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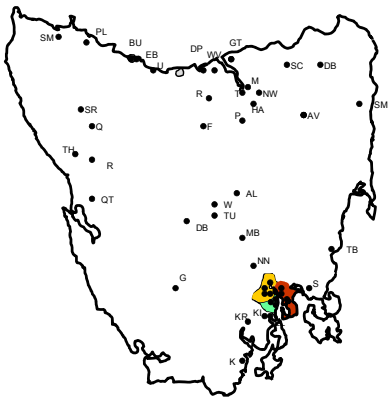

HOBART EAST

DEVELOPMENT PLAN

REV NO.	DATE	REVISION DESCRIPTION	APPROVALS	
0		Working Draft	Prepared by	
			Reviewed by	
			Approved by	

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1 EXECUTIVE SUMMARY

The Hobart-East (HE) planning area consists of the region east of the Derwent River including South Arm in the south, Tranmere, Otago Bay and Tea Tree Rd in the east, Colebrook in the north and as far west as the Coal River and Seven Mile Beach. HE is considered a medium growth area, recording a growth rate of 2-3% pa in 2009. The area contains a mixture of commercial, industrial and residential load.

There is significant rural-residential load in the Eastern and Southern regions of the planning area, with the commercial, industrial and urban-residential concentrated along the East bank of the Derwent River.

To facilitate the current and forecast load, the HE planning area maintains both a subtransmission network at 33 kV and distribution network at 11kV, incorporating a growing number of local distributing zone substations. HE is one of only two planning areas to accommodate such a network including 24,052 connected customers supplied by 5 11 kV substations and 852 km of OH and UG circuit.[1]

The identified or known large constraints are as follows:

- Bellerive Zone is exceeding firm capacity during the winter months.
- From Bellerive Zone there are two feeders 27175 and 27178 that are exceeding the planning rating. These feeders supply Howrah and Rosny areas. Further, there are two additional feeders, which will exceed the planning rating in 10 years based upon projected growths.
- Geilston Bay Zone is exceeding firm capacity during the winter months.
- From Geilston Bay Zone there is one feeder, 26167 that is exceeding the planning rating. This feeder supplies the Lindisfarne and Risdon Vale area including the Risdon Gaol. Further, there are two additional feeders, which will exceed the planning rating in 10 years based upon projected growths.
- From Rokeby Substation there are two feeders 28221, and 28230 that are exceeding the planning rating. These feeders supply Tranmere, and Howrah areas.
- Both Bellerive Zone 33 kV subtransmission cables are derated due to one oil-filled cable section on each subtransmission cable being installed in long under road crossings.
- Oil tests have shown that both Richmond Zone power transformers are in poor condition.
- A mixture of 22 kV and 11 kV distribution networks within the Richmond area limits distribution transfer capacity during planned outages and fault management.

[1] Data available in NW-#30146137-Feeder Data for Development Plans.

- In 2018 and 2020 the Geilston Bay and Bellerive Zone transformers will reach their nominated end of life respectively.
- Localised overloading is having moderate impact on the fleet of distribution substations and low voltage networks in this planning area.

To address the above constraints the following is being proposed:

- Following a final report submitted to AEMO covering a joint Aurora and Transend study, a significantly reinforced Eastern Shore 33 kV and substation and zone arrangement is proposed.
- Howrah and Rosny Zones are to be established before winter 2011 and 2012 respectively. Howrah and Rosny are to be established at a budget cost of $9.8M and $12.9M respectively and will manage the load on Lindisfarne, Rokeby, Bellerive Zone and Geilston Bay Zone transformers and 11 kV feeders.
- One transformer is to be upgraded at Richmond Zone in 2013. System security will be managed from the 11 kV network. The transformer will be wound at 33,22 & 11 kV to facilitate the upgrade from 22 kV to 33 kV in 2017.
- In 2017 Richmond Zone is to be upgraded from a 22/11 kV to a 33/11 kV zone substation supplied from Lindisfarne 33 kV substation.
- In 2018 and 2020 the Geilston Bay and Bellerive Zone transformers will reach their nominated end of life respectively. From these dates onwards it is possible that these transformers will be upgraded due to deterioration in their condition. The conceptual cost for this is $4M per zone substation.
- Geilston Bay Zone has one overloaded feeder heading north. Minor interconnections will be constructed between this and adjacent feeders to facilitate load transfers. Conceptual costs for these interconnections are $50 k.
- Progressive work will be undertaken from 2011 to 2018 to re-voltage both from 11 kV and 22kV circuits in the Richmond area to facilitate interconnection and standardising of supply voltages at a preliminary cost of $950 k.
- Demand side options have been identified in the Sandford and Lauderdale areas to defer the establishment of an additional zone substation required in 2017, identified as part of the Eastern Shore Upgrade study.
- Temperature sensing equipment will be installed on the Cambridge and Bellerive subtransmission cables on their major de-rated sections for dynamic rating purposes.

TABLE OF CONTENTS

2 STRATEGIC PLAN

HE will continue the development of a radial 33 kV subtransmission network and a highly interconnected 11 kV distribution network. Only 33 kV Major Injection Points will be encouraged with bulk load distributed at Aurora owned 33/11 kV zone substations.

The existing distribution arrangement of both an 11 kV Major Injection Point and Aurora owned 33/11 kV zone substations will co-exist for the foreseeable future.

Highly interconnected Low Voltage reticulation will continue to develop at 433V.

Embedded Generation options will be encouraged at the 11 kV and 433V connection points.

Demand Side Management solutions will be encouraged to reduce system peaks and defer large system upgrades where possible. Technologies to be implemented to limit the growth in demand to include:

- Communications infrastructure to customer installations to facilitate;
    - Hot water load control;
    - Load moderation utilising smart domestic appliances;
    - Load curtailment in commercial installations;
- Embedded/distributed generation and energy storage;
    - Close liaison with Tas Gas for generation opportunities;
    - Standby peak shaving generation;
    - Combined heat and power generation options; and
    - Modern network connected battery storage.
- Smart grid development;
    - Auto-reconfiguration and short-term dynamic ratings;

3 EXISTING SYSTEM

3.1 Substations

The HE planning area has a growing number of Major Injections Points and Aurora owned substations as follows:

Note: hyperlinks in the section below will display the power circuit one line diagram from Transend Networks Pty Ltd (Transend) Operational Diagram System. The Username and Password to view these files can be obtained from Aurora's Network Planning group.

Major Injection Points (Transend owned substations)

- Lindisfarne 110/33 kV – (click to see the 110/33kV single line diagram)
- Mornington 110/33 kV - (proposed in 2011)
- Rokeby 110/11 kV – (click to see the 110/11kV single line diagram)

Aurora owned substations

Details of drawings including single line diagrams of Aurora owned substations are available in NW-#284367-Aurora Zone and Terminal Sub Drawing Register from QDMS.

- Bellerive 33/11 kV 22.5 MVA Zone (single line diagram drawing file: C9095-RG.pdf)
- Cambridge 33/11 kV 20 MVA Zone (click here to see the 33/11kV single line diagram)
- Geilston Bay Zone 33/11 kV 22.5 MVA
- Richmond 22/11 kV 2.5 MVA Rural Zone
- Howrah 33/11 kV 25 MVA Zone (2011)
- Rosny 33/11 kV 25 MVA Zone (2012)
- Sandford 33/11 kV Zone (2017)

Lindisfarne 110/33 kV supplies Bellerive, Cambridge and Geilston Bay 33/11 kV Zones.

Mornington 110/33 kV, scheduled for completion in 2011, will supply Howrah, Rosny and Sandford 33/11 kV Zones as they are commissioned.

Richmond 22/11 kV Rural Zone is currently supplied by Sorell 22kV Feeders 41512 and 41516. Although Richmond 22/11 kV Rural Zone is incorporated in the HE planning area, Feeders 41512 41516 are included in the Sorell – Peninsula Development Plan (Sorell-Peninsula Development Plan.).

3.2 Supply Network

The supply network in the HE planning area incorporates two HV levels:

- 33 kV Subtransmission; and
- 11 kV Distribution.

Some 22 kV distribution feeders from the Sorell-Peninsulla planning area encroach into the Grasstree Hill and Risdon Vale regions of the HE planning area.

Although the 33 kV subtransmission network in HE is limited to radial, transformer-ended feeders with no interconnectivity, there are strong 11 kV interconnections and transfer capability between the 110/11 kV and 33/11 kV substations.

Richmond 22/11 kV Rural Zone however has limited interconnectivity and transfer capability with the surrounding 11 kV network. In addition Richmond Zone's 11 kV network is also a different vector group.

3.3 Network Statistics

Table 1 – Hobart East Planning Area – Network Statistics[2]

11kV circuit length	810	km
Connected customers	24,052	
Connected transformer capacity	251,408	kVA
Customer density	30	per 11kV circuit km
Transformer capacity density	310	kVA per 11kV circuit km

3.4 Geographic Area

The map in Figure 1 below shows the geographic area referred to as Hobart East.

Figure 1 – Hobart East Planning Area – Geographic Area

4 LOCAL PLANNING ISSUES

4.1 Local Government Authorities

For planning purposes, Aurora consults closely with the following local government authorities in the HE planning area:

- Clarence City Council.

The Clarence Planning Scheme 2007 came into operation on 2 April 2008. The Planning Scheme identifies planning policies and controls affecting the use, development and subdivision of all land within Clarence. Assessment of applications under this scheme is governed by the Land Use Planning and Approvals Act 1993.

A copy of the Clarence Planning Scheme is available from the following link.

Clarence City Council Planning Scheme

Other relevant authorities include:

- Department of Infrastructure, Energy and Resources (DIER); and
- Southern Water Tasmania.

4.2 Existing Critical Loads

HE planning area has a large number of existing critical loads requiring a higher level of supply security or a limit to operational flexibility. Table 2 below details critical loads in the HE planning area:

Table 2 - Hobart East Critical Loads

Load Type	Description	Substation(s)	Feeder(s)	Asset Connection Point(s) - if applicable
Commercial / Major Retail	Hobart International Airport	Cambridge Zone	29485 29492	C010905
	Rosny Park (inc Eastland's Shopping Centre)	Bellerive Zone	27172 27175 27176	-
	Cambridge Park	Cambridge Zone	29486 29491	-
	Bellerive Oval	Bellerive Zone	27171 27178	T262902 T262647
Medical	Clarence Community Health Centre	Bellerive Zone	27175	T261325
Rehabilitation Services	Risdon Gaol	Geilston Bay Zone	26167	T240642 T241374 T242737
Industrial	Cambridge Rd Industrial	Cambridge Zone	29488	-
	Mornington Rd Industrial	Bellerive Zone	27174	-
	Kennedy Dr Industrial	Cambridge Zone	29489	T282810
	Aurora Depot - Data Centre	Cambridge Zone	29486	T282829
Sewerage Treatment Plants	Droughty Pt Rd Waste Water Plant	Rokeby Substation	28221	T282557
	Clarence Waste Water Treatment Plant	East Hobart Zone	14061	T262702
	Hobart Airport Waste Water Treatment Plant	Cambridge Zone	29485	T282787
Education	Tasmanian Polytechnic Clarence Campus	Geilston Bay Zone	26165	T250891
	Rosny College	Geilston Bay Zone	26169	T251202 T251479

Improvements to supply security for the above connections and supply areas are encouraged.

4.3 Future Developments and Restrictions

Council planning schemes

- The Clarence City Council has indicated that the majority of future settlement in this region will be infill in existing urban areas, or growth on the fringes of the existing urban areas. As such, the primary source of future settlement is expected to be in and around the suburbs of Lauderdale, Howrah, Tranmere, Rokeby and Clarendon Vale.

4.4 Proposed Plans and Developments

Zone/Terminal	Feeder	Project No.	Conceptual Plan	CPA	Scope	TX No.	Street	Note
Howrah Zone		00001	NW-#30076814		NW-#30088212		Rokeby Rd Pass Rd	Applicable to Mornington
		00002						
	22320 22322 22323 22326 223XX	00003	NW-#30076836		NW-#30088180 NW-#30088181 NW-#30088179		South Arm Hwy Rokeby Rd Pass Rd Meehan Rd Tollard Dr	
		00004	NW-#30081483		NW-#30088177 NW-#30088178		Glebe Hill Rd Merindah St Pass Rd	
Rokeby Terminal	28221	00201	NW-#233894				Oceana Dr Tranmere Rd Droughty Point Rd	
	28222	00006	NW-#30081586		NW-#30088171	T262791 T260614	Talbani St	Applicable to Howrah Deferred until required
	28227	00008	NW-#30090724		NW-#30090789	T260739 T270608 T260828 T270316 T272400 T271691 T272369 T272859 T270315 T270024 T270318 T270319	Norma St Pass Rd Meehan Rd Rokeby Rd Diosma St Tranmere Rd	Applicable to Howrah
	28228	00065	NW-#30077976	NW-#30173100	NW-#30093096	T281537	South Arm Rd	

							Dorans Rd	
		00201	NW-#233894				Oceana Dr Tranmere Rd Droughty Point Rd	
	28229	00006	NW-#30081586		NW-#30088171	T262791 T260614	Talbani St	Applicable to Howrah Deferred until required
		00008	NW-#30090724		NW-#30090789	T260739 T270608 T260828 T270316 T272400 T271691 T272369 T272859 T270315 T270024 T270318 T270319	Norma St Pass Rd Meehan Rd Rokeby Rd Diosma St Tranmere Rd	Applicable to Howrah
		00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927 T260262 T260878 T260490	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St Waverley St Wentworth St	Applicable to Rosny

						T260236		
	28230	00005	NW-#30081496		NW-#30088174 NW-#30088175 NW-#30088176	T261434 T260614 T261633 T261145	Norma St Sirius St Skyline Dr Minno St	Applicable to Howrah
		00006	NW-#30081586		NW-#30088171	T262791 T260614	Talbani St	Applicable to Howrah Deferred until required
		00008	NW-#30090724		NW-#30090789	T260739 T270608 T260828 T270316 T272400 T271691 T272369 T272859 T270315 T270024 T270318 T270319	Norma St Pass Rd Meehan Rd Rokeby Rd Diosma St Tranmere Rd	Applicable to Howrah
	28231	00007	NW-#30082250		NW-#30088170 NW-#30088172 NW-#30088173	T271350 T271223 T270842	Jungira St Tranmere Rd Carella St	Applicable to Howrah
		00008	NW-#30090724		NW-#30090789	T260739 T270608 T260828 T270316 T272400 T271691 T272369 T272859 T270315 T270024	Norma St Pass Rd Meehan Rd Rokeby Rd Diosma St Tranmere Rd	Applicable to Howrah

						T270318 T270319		
Geilston Bay	26165	00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927 T260262 T260878 T260490 T260236	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St Waverley St Wentworth St	Applicable to Rosny
	26166	00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927 T260262 T260878 T260490 T260236	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St Waverley St Wentworth St	Applicable to Rosny

		00074	NW-#30078167		NW-#30105262 NW-#30090852		Gordons Hill Rd Marril St	Applicable to Risdon Vale
	26169	00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927 T260262 T260878 T260490 T260236	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St Waverley St Wentworth St	Applicable to Rosny
	26161	00023	NW-#30082267		NW-#30092928	T580672	Grasstree Hill Rd Sugarloaf Rd	Applicable to Risdon Vale
	26167	00023	NW-#30082267		NW-#30092928	T580672	Grasstree Hill Rd Sugarloaf Rd	Applicable to Risdon Vale
Bellerive	27171	00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St	Applicable to Rosny

						T260262 T260878 T260490 T260236	Waverley St Wentworth St	
	27175	00013	NW-#30090835		NW-#30090840	T250345 T251033 T250256 T252629 T250670 T252118 T250292 T252599 T260261 T262936 T260927 T260262 T260878 T260490 T260236	Ballawinne Rd Loatta Rd Gordons Hill Rd Flagstaff Gully Rd Montagu Bay Rd Bastick St View St Abbot St Church St Beach St High St Waverley St Wentworth St	Applicable to Rosny
		00073	NW-#30078163		NW-#30105261 NW-#30090851	T261618	Bayfield St Cambridge Rd	Applicable to Rosny
		00075	NW-#30078168		NW-#30105263 NW-#30090853	T261162	Gordons Hill Rd Lanena St	Applicable to Rosny
	27174	00297						
	-	00014			NW-#30088216			Removed Indefinitely
		00015			NW-#30088753			Applicable to Mornington
		00016			NW-#30088791			Applicable to Mornington
		00018			NW-#30090850			To be deleted
Cambrige	29482	00021	NW-#30082298		NW-#30093100		Backhouse Lane Kennedy Drive	
	29484	00020	NW-#30082262		NW-#30088807	T282917	Hollyman Ave	

	29492	00020	NW-#30082262		NW-#30088807	T282917	Hollyman Ave	
Lindisfarne	25305	00017	NW-#30082304		NW-#30090854 NW-#30090855			Applicable to Bellerive Removed Indefinitely
	25306	00019	NW-#30093108		NW-#30093104			
	25309	00019	NW-#30093108		NW-#30093104			
	25310	00017	NW-#30082304		NW-#30090854 NW-#30090855			Applicable to Bellerive Removed Indefinitely
		00019	NW-#30093108		NW-#30093104			
Rosny	-	00009	NW-#30076815		NW-#30088182 NW-#30161797		Cambridge Rd Tasman Hwy	
		00010	NW-#30076815		NW-#30088739		Cambridge Rd Tasman Hwy	
		00011	NW-#30076816		NW-#30088751		Cambridge Rd Tasman Hwy	
	22352 23346 23347 23348 23349 23350 23353 23354 23355 23356	00012	NW-#30082080			T26168	Gordons Hill Rdd Tasman Hwy Cambridge Rd Quarry Rd Waverley St Balamara St Bligh St Bayfield St	
Richmond & Sorell	40002, 40003, & 41512	00056	NW-#30077812		NW-#30077840			
		00057	NW-#30077812		NW-#30077843			
		00058	NW-#30077812		NW-#30077845			
		00059	NW-#30077812		NW-#30077846			
		00134	NW-#30077812					
	-	00135						
		00136						

South Arm	-	00137	NW-#30079819				South Arm Rd	
		00138	NW-#30079819				South Arm Rd	
		00139	NW-#30079819				South Arm Rd	
		00140	NW-#30079819				South Arm Rd	
		00141					South Arm Rd	
		00142					South Arm Rd	
		00143					South Arm Rd	
		00144					South Arm Rd	

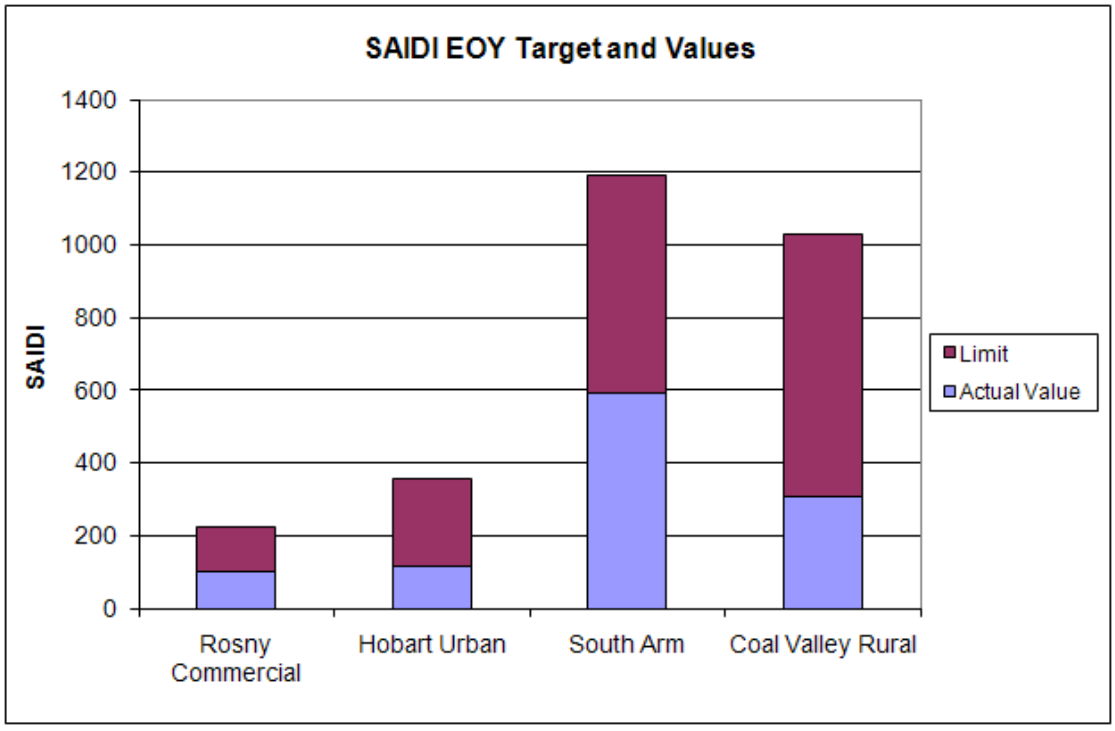
4.5 Reliability for the area

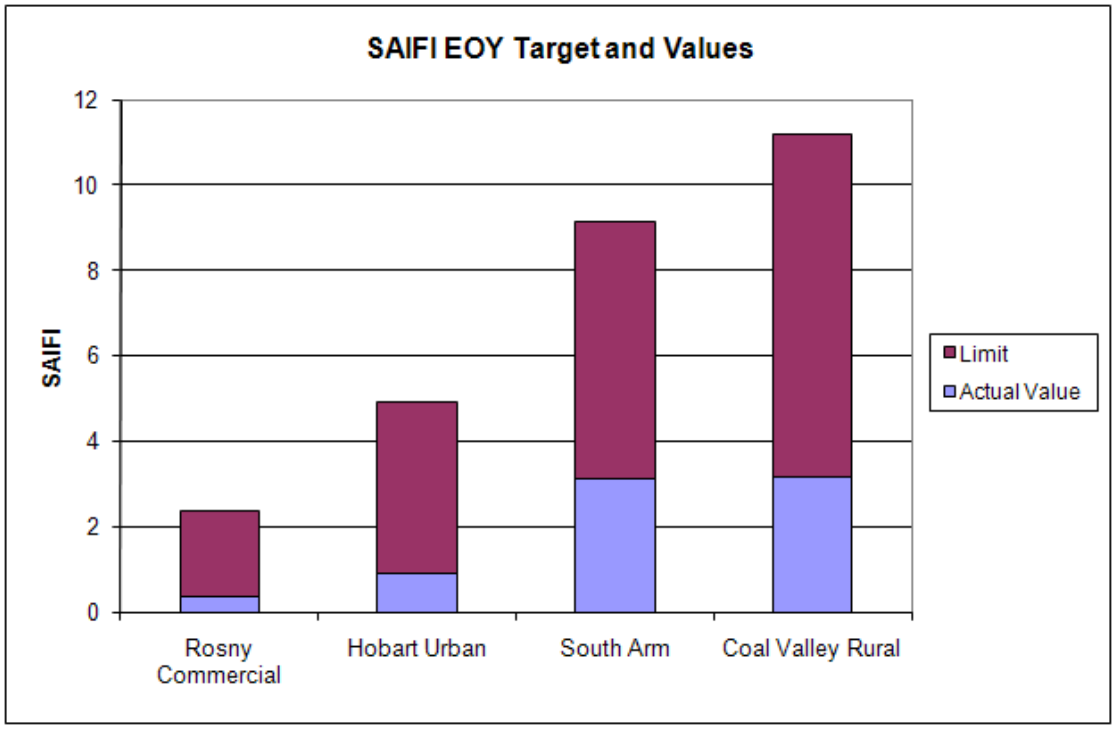
The HE planning area includes the following Reliability communities:

- High Density Commercial – Rosny Commercial
- Urban - Hobart Urban
- High Density Rural - South Arm, Coal River Valley
- Low Density Rural - Coal Valley Rural

Details of actual reliability performance in the 09/10 financial year are available in the link below (note: will need to be updated yearly).

NW-#30061377-Area Reliability Reporting 09_10





(DM ref# 30061377)

On figures for the 9 months to the end of March 2010 all the communities in Hobart East appear likely to have reliability performance better than target in 2010.

4.6 Asset issues

There are a number of major asset issues throughout the HE planning area.

- Richmond Zone 2.5 MVA power transformers are at or beyond their nominal end of life and in poor condition.
- Bellerive Zone 22.5 MVA power transformers are approaching their nominal end of life (2020)
- Geilston Bay Zone 22.5 MVA power transformers are approaching their nominal end of life (2018)
- Large amounts of 11 kV underground cable t-joints have resulted in operational limitations
- Large populations of oil-insulated JKSS 11 kV switchgear have resulted in operational limitations

Further information is detailed in the following Asset Management Plans relevant to the HE planning area:

The Ground Mounted Substation Management Plan outlines issues associated with these substations. Such issues include:

- Aging substations;
- Fire protection (conversion from CO_2 to Stat-X suppression systems);
- Asbestos management;
- Ferroresonance;
- Switchgear failure;
- PCB contamination;
- Earthing safety;
- and corrosion.

This document also outlines the plans put in place to deal with these issues. Any planned work involving ground mounted substations should align with the management plan in order to help fix these issues and mitigate against any risks involved.

NW-#30160765-Management Plan 2011: Ground Mounted Substations

The High Voltage Regulators Management Plan identifies issues associated with these regulators including:

- Rusting of regulator tanks;
- Corrosion and water ingress on the tap change indicators;
- Tap changer motor drive capacitor replacement; and
- Oil containment.

Currently the tap changer motor drive capacitor is located within the voltage regulator tank and thus the replacement of this requires the unit to be removed from the site and detanked. It is recommended that the capacitors be placed inside the control cubicle outside the tank for easier access. This plan also states that only approximately 30 % of ground mounted regulator sites have adequate oil containment as per applicable standard at the time of installations. All of the three phase regulators contain greater than 500 L of oil in the device and therefore, according to the Australian Standards, bunding is necessary. Any planned work involving high voltage regulators should align with the management plan in order to help fix these issues and mitigate against any risks involved.

NW-#30161495-Management Plan 2011: High Voltage Regulators

Specific issues associated with such equipment are outlined in the Overhead Systems and Structures Management Plan. One of these includes fire mitigation which will be accomplished by replacing EDO fuse tubes at transformer sites in high and very high fire danger areas with fire safe

alternatives and undertaking bush fire mitigation works on HV and LV overhead conductor in high and very high bushfire areas.

Endangered species can come under threat from electrocution and thus measures are implemented to ensure fewer deaths to animals and less supply interruptions caused by such an event. These measures include possum guards, bird perches and insulators on stay wires.

Any planned work involving overhead systems and structures should align with the management plan in order to help fix these issues and mitigate against any risks involved.

NW-#30161322-Management Plan 2011: Overhead System and Structures

The Underground System Management Plan identifies several specific asset issues. One of these includes CONSAC cable failures which cause 70% of LV cable outages when only 17% of LV cables are CONSAC type and are therefore in the process of being replaced. Cast Iron Potheads are now also being replaced due to the cracking of the iron casing allowing water ingress and on occasion resulting in the casing being blown apart. UGLBS are scheduled for replacement due to multiple incidents where melting of the compound insulating the terminations occurred resulting in catastrophic failure and flashover.

Lightning arrestors are now being installed on critical HV termination poles and according to the new design standards every new HV feeder pole will have a lightning arrestor installed on it due to the increase in occurrences of lightning and associated outages.

Any planned work involving underground systems should align with the management plan in order to help fix these issues and mitigate against any risks involved.

NW30043361 - Management Plan 2010: Underground System

The Zone Substation Management Plan has identified issues associated with various zone substations including excessive noise, high moisture levels and aging transformers. Approximately 40% of the urban zone substation transformers are over 40 years old, with several approaching 50 years old. Any planned work involving zone substations should align with the management plan in order to help fix these issues and mitigate against any risks involved.

NW-#30161548-Management Plan 2011: Zone Substations

4.7 Links

LAM Area Management Plans relevant to the HE planning area are:

- Hobart NW-#183926-10/11 Area Management Plan Hobart Urban and CBD
- Midlands South NW-#164938-Area Management Plan Midlands South

In addition Transend's Annual Planning Report contains relevant information. It can be found on their website www.transend.com.au.

5 LOAD FORECAST

The HE planning area has experienced growth from 2-3% per year for the past two years and sustained growth in this area is expected. HE is considered one of the growth hotspots in the state.

The long term medium growth rate from the Aurora forecast is approximately 2.7% for the HE planning area. Blanket load growth above this rate is considered unlikely, however higher growth is likely in certain areas.

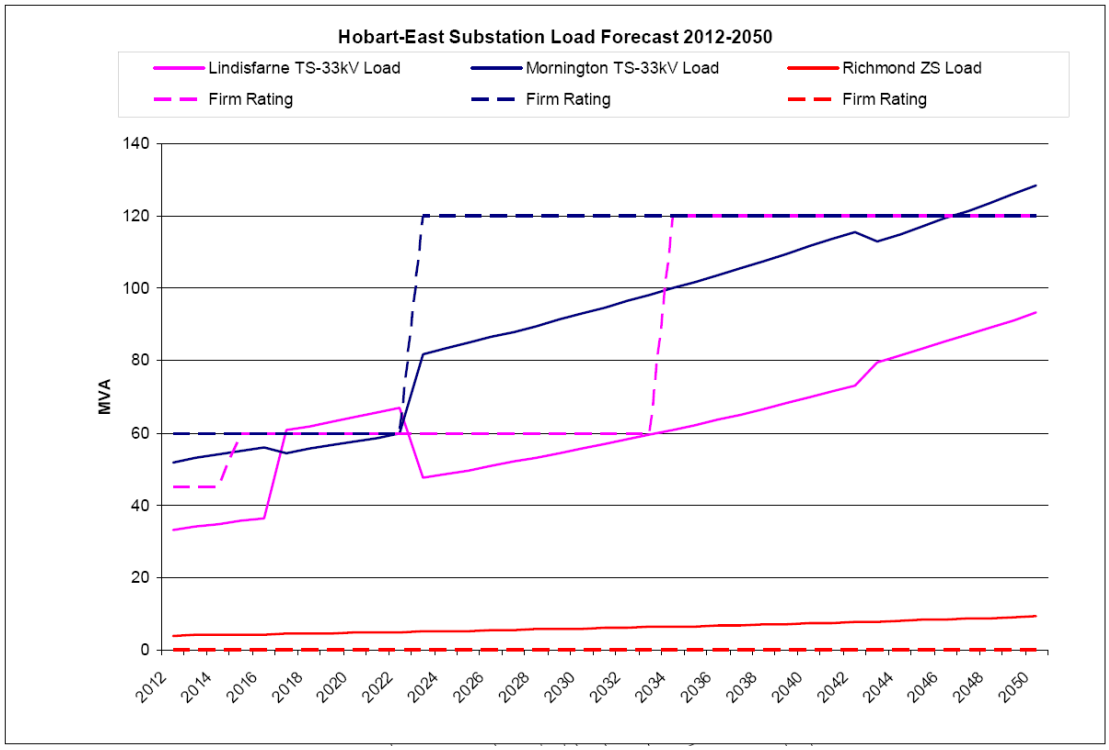
The following regions are considered to have potential for particularly high growth:

- The area to the west of Hobart International Airport and east of Mt Rumney is considered a likely area for future significant commercial growth, with Cambridge a potential future commercial centre of the Eastern Shore. There is also the potential for long term residential subdivision in the surrounding area, with a significant amount of undeveloped land, flat terrain and access to the Tasman Highway.
- Subdivisions in the Lauderdale and Tranmere areas are expected to increase, with this area having the potential for reticulated water supply from the Rokeby treatment plant, and land corridors have been set aside by the Clarence council for development.

As a result, to produce a conservative load forecast high growth has been applied to these areas, with medium growth applied to the remainder of the planning area.

For the purposes of this study the planning area has been combined into a group of substations, with members of the group having significant transfer capacity amongst each other. The substations within the group are Cambridge, Geilston Bay, Bellerive, Howrah, Rosny and Rokeby. It is assumed that a capacity limitation occurs when the group load exceeds the sum of the firm capacities. Richmond substation has been considered separately, since it has limited load transfer capacity to adjacent substations.

The resulting load forecast up to 2050, and firm ratings for substations of the Hobart-East planning area are provided below.


Hobart-East Substation Load Forecast 2012-2050
Lindisfarne TS-33kV Load
Mornington TS-33kV Load
Richmond ZS Load
Firm Rating
Firm Rating
Firm Rating
MVA
0
20
40
60
80
100
120
140
2012
2014
2016
2018
2020
2022
2024
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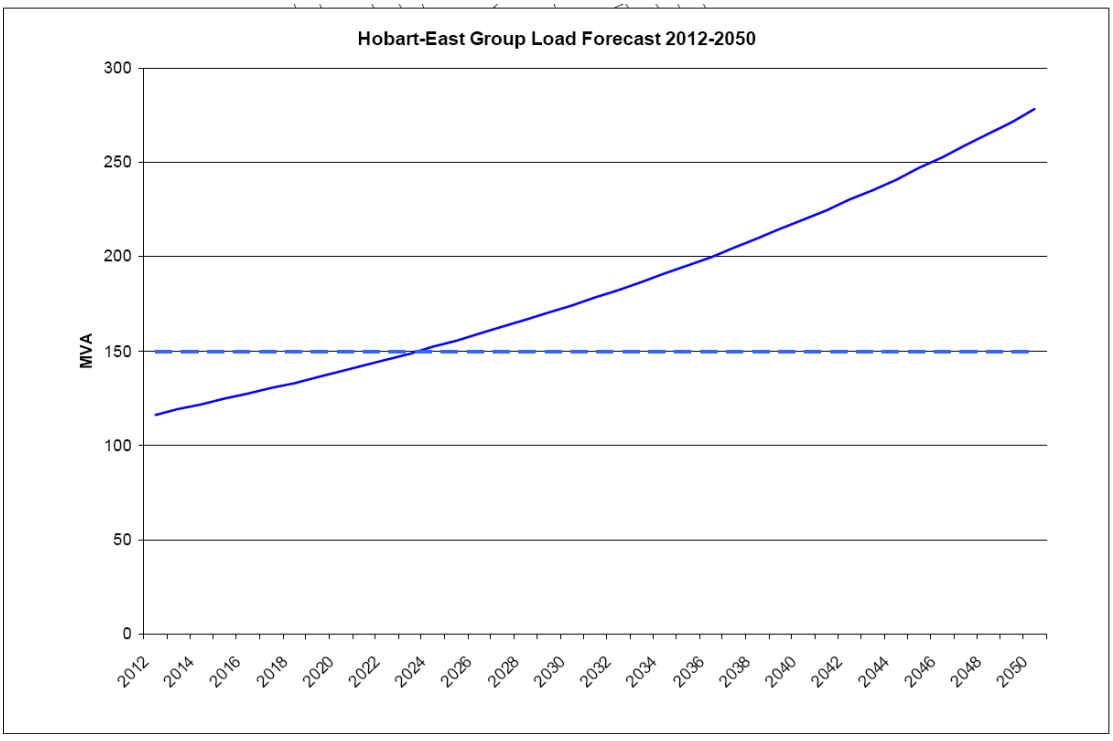
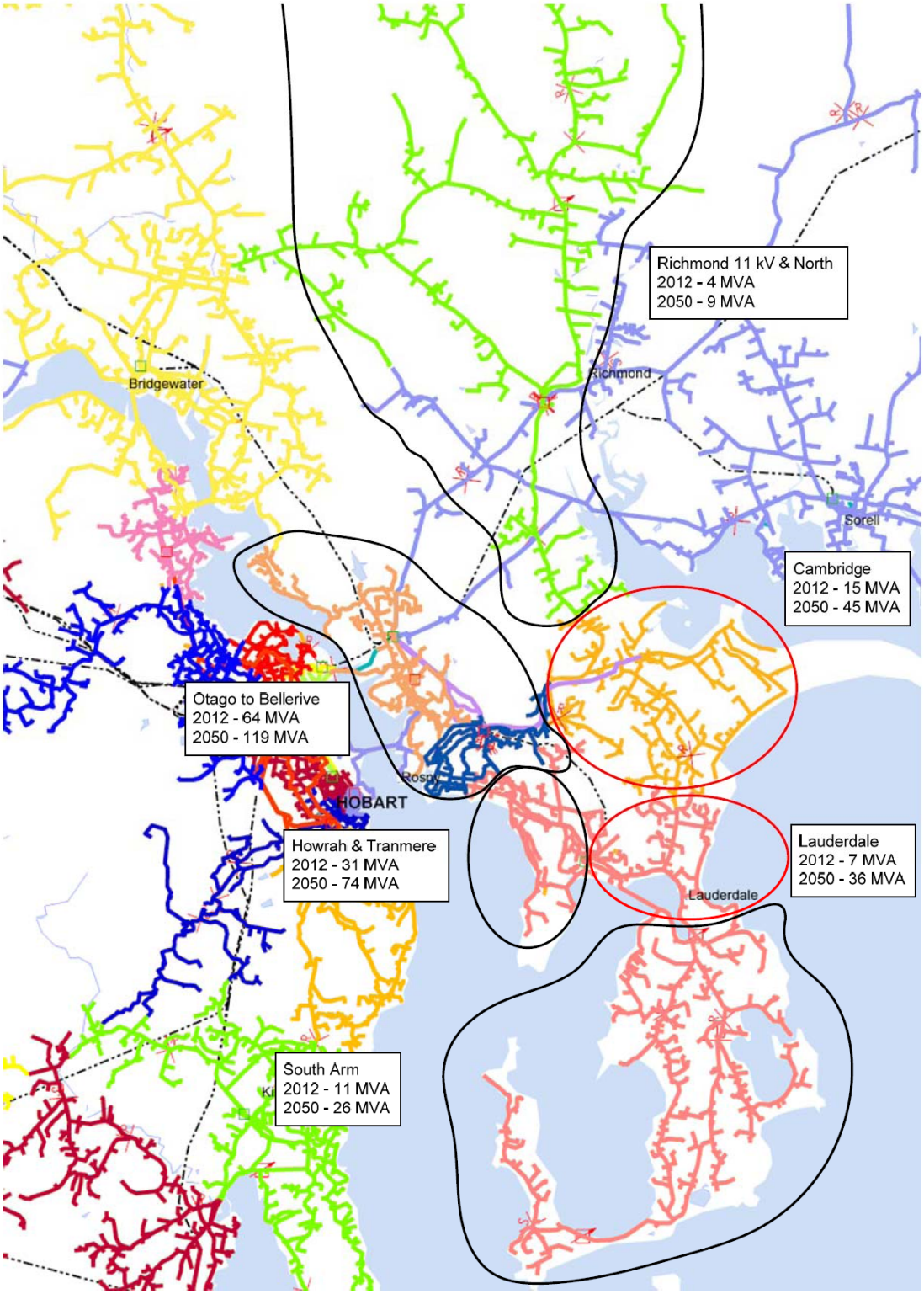
2048
2050


Hobart-East Group Load Forecast 2012-2050
MVA
0
50
100
150
200
250
300
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050

The following figure provides a geographic view of the resulting load distribution in 2012 and 2050.



The 2009 10 year load forecast report by UES is used as the basis for this plan. NW30089965 - Aurora 2009 Maximum Demand & Consumption 10 year Forecast Report

Forecast load growth tables are stored in the spreadsheet NW-#30040697-Zone and Area MD and consumption tables 2009

	Planning Area	Connection Point Substation	Forecast Growth pa
	Hobart East	Lindisfarne	2.5%
	Hobart East	Rokeby	1.4%

The latest load model spreadsheet is NW-#30069006-Hobart East area load model (2009)

Copy of load profile

5.1 Future committed point loads (> 1 MVA)

- Skettring (HV connection), Cambridge, 3 MW
- Eastlands Shopping Centre
- Hanson Quarry, Flagstaff Gully, 1.2 MW & 164 kW generation
- Carrowdore Pty Ltd Poultry Farm, Cambridge 1.2 MVA
- Hobart Airport, Cambridge 7.953 MVA
- Department of Health and Human Services, Rosny Park
- Derwent Park Developments, Cambridge

5.2 Possible point loads (> 1 MVA)

- Major Subdivisions (>200 lots)
  - Glebe
  - Tranmere
  - Oakdowns

5.3 Possible point loads to be removed (> 1 MVA)

- None identified

5.4 Possible future embedded generation (> 1 MVA)

- Hanson Quarry, Flagstaff Gully, 1.2 MW & 164 kW generation

Project Data from NW-#30012319-Customer_Connection_Status_Listing

5.5 Analysis of Load Forecast

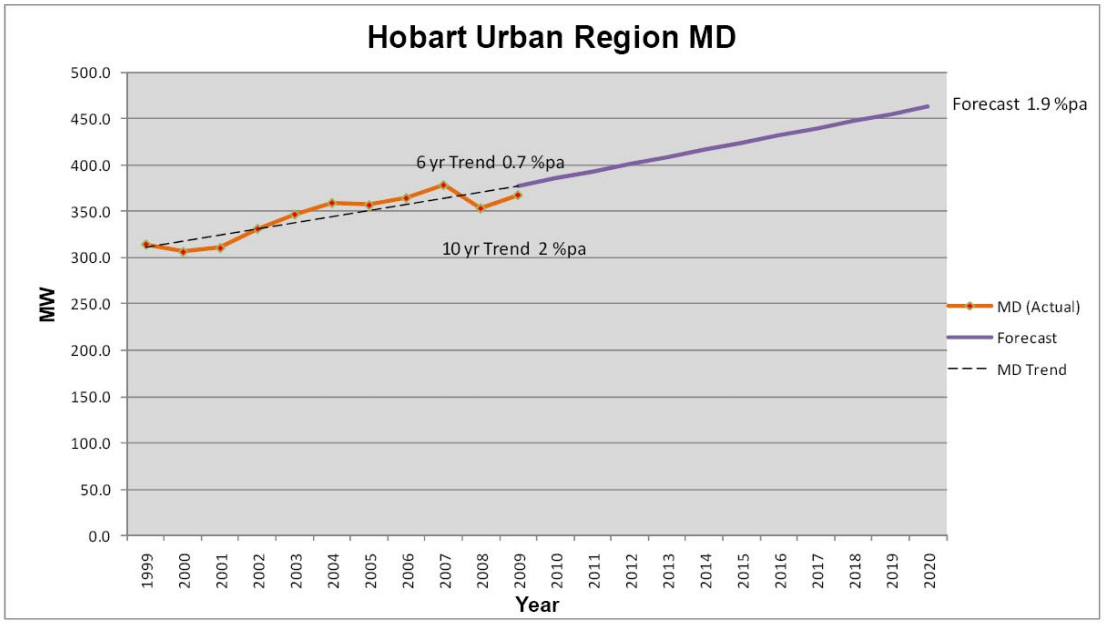
Detailed load forecast data is available in the following documents:

- Load model reference NW-#30069006-Hobart East area load model (2009)

The UES 10 year load forecast document can be found at

NW30089965 - Aurora 2009 Maximum Demand & Consumption 10 year Forecast Report

The most recent forecast combines Hobart East and Hobart West into an area called Hobart Urban. The forecast growth in maximum demand extracted from the UES document for this area is shown below.



6 PLANNING CRITERIA

Planning criteria for the HE planning area are detailed in Aurora's Distribution Planning Manual and is consistent for the all planning areas:

NW102505705 - Distribution Network Planning Manual May 1999

More up to date information is included in this document in Appendix E on page 38.

7 CONSTRAINTS (LIMITATIONS)

Constraints in the HE planning area are classified under the following management groups:

Constraint	Description	Definition
Capacity	Substation Firm Capacity	Substation Maximum Demand > Substation Firm Capacity (N-1)
	Feeder Tail Capacity	Feeder Maximum Demand > 5 MVA for 11 kV OR 10 MVA for 22 kV
	Feeder Section Capacity	Load through conductor >conductor continuous rating
	Feeder Tie Capacity	Transfer Capacity limited due to undersized conductor/equipment
Fault Level	Substation Bus Fault Level	Maximum 3-phase fault level > 13.1 kA OR Maximum 1-phase > kA
	Equipment Rating Fault Level	Maximum 3-phase OR 1-phase fault level > equipment rating
Voltage	Normal load Voltage Drop	Voltage drop exceeds ± 6%
	Emergency load Voltage Drop	Voltage drop exceeds ± 10%
Reliability	SAIDI	Reliability community SAIDI performance has or is likely to exceed target
	SAIFI	Reliability community SAIFI performance has or is likely to exceed target

Table 3 - Constraint Definitions

Constraints are managed at the following levels

- Zone Substation
- Subtransmission Feeder
- Distribution Feeder
- Distribution Substation
- LV Systems

This document details constraints at the Zone Substation (inc Rural Zone Substations), Subtransmission Feeder and Distribution Feeder levels only. Refer to XXXXXXXXX for State wide management plans for the Distribution Substation and LV System planning levels

7.1 Summary of Constraints

7.1.1 Substation Constraints

Capacity Constraints				
Substation	**Firm Capacity (MVA)**	**Current Load (MVA)**	**Forecast to exceed (year)**	**Comments**
Lindisfarne Terminal	45		Already Exceeded	Lindisfarne is currently loaded well in excess of its firm capacity. The establishment of Mornington 33kV injection point in 2011 will reduce loading at Lindisfarne. Load, post Mornington, is forecast to exceed firm capacity in 2026.
Cambridge Zone	20		2023	
Geilston Bay Zone	22.5		Already Exceeded	Geilston Bay is currently loaded well in excess of its firm capacity. Load transfers to Rosny zone in 2012 will reduce loading at Geilston Bay. Load, is forecast to again exceed firm capacity in 2025.
Bellerive Zone	22.5		Already Exceeded	Aged transformers expected to require replacement in 2020/21
Mornington Terminal	60	0	2020	Load forecast to exceed emergency capacity in 2030.
Howrah Zone	25	0	2025.	
Rosny Zone	25	0	2040.	

Fault Level Constraints			
Substation	**Fault Level Description**	**Forecast replacement (year)**	**Comments**
			None identified

7.1.2 Subtransmission Constraints

Capacity Constraints				
Substation	**Feeder**	**Capacity constraint type**	**Forecast to exceed (year)**	**Comments**
Lindisfarne	25305	Feeder Section	Already Exceeding	Long underground section of oil-insulated 33 kV cable installed in bore conduit. Subtransmission feeder de-rated below Bellerive Zone Firm Capacity rating.
Lindisfarne	25310	Feeder Section	Already Exceeding	Long underground section of oil-insulated 33 kV cable installed in bore conduit. Subtransmission feeder de-rated below Bellerive Zone Firm Capacity rating.

Voltage Constraints			
Substation	**Feeder**	**Forecast to exceed (year)**	**Comments**
			None identified

Reliability Constraints			
Substation	**Feeder**	**Forecast to exceed (year)**	**Comments**
			None identified

7.1.3 Distribution Feeder Constraints

Capacity Constraints				
Substation	**Feeder**	**Capacity constraint type**	**Forecast to exceed (year)**	**Comments**
		Feeder Section	Already Exceeding	
		Feeder Section	Already Exceeding	

Voltage Constraints			
Substation	**Feeder**	**Forecast to exceed (year)**	**Comments**
			None identified

Reliability Constraints			
Substation	**Feeder**	**Forecast to exceed (year)**	**Comments**
			None identified

7.2 Security

Aurora's zone substations are typically run in N-1 secure mode. This means that in the event of any single outage of a network element all load can still be supplied.

In some cases this level of security is not possible, and a 'switched firm' strategy is in place. In this case a single outage at a zone substation may cause an interruption to customers' supply, but it will be possible to restore supply by switching load to an adjacent substation. The Regulatory Investment Test carried out for the Hobart Eastern Shore development includes discussion of security of supply issues in the area.

7.3 Transfer and Operational Capability

The table below shows the rating, peak load and transfer capacity. The peak load figures are those forecast for winter 2010. Since Aurora's substations are subject to winter peaks, these are the most onerous.

	MVA				
Substation	**Rating**	**N-1 Rating**	**Peak Load**	**Transfer Capacity**	**Transfer Substation**
Bellerive	45	22.5		5.7	Geilston Bay
				2.8	Cambridge
				6.9	Rokeby
Cambridge	40	20		6.8	Bellerive
				2.8	Rokeby
Geilston Bay	45	22.5		8.4	Bellerive
				2.6	Newtown
Rokeby				13.0	Bellerive
				4.3	Cambridge
Richmond				1.2	Cambridge

The table shows that…

Details of the analysis carried out on load transfers in the HE area are available in NW-#30087826-Hobart East area load transfer (2009).

7.4 Power Factor

- Customer power factor correction
- Network power factor correction

7.5 LV issues

There are no locations in the Hobart East Planning area where widespread LV network issues have been identified.

The table below shows the count of transformers in the planning area and the count of those that are at risk of overloading. This is determined by the count of connected customers indicated a load greater than 130% of nameplate rating. It should be noted that the actual load on a transformer may be much different to its value calculated in this way.

	Total		**>130% of rating[3]**	
Tx size	**Count**	**Customer Count**	**Count**	**Customer Count**
< 50 kVA	779	1,272	7	34
>= 50 kVA	932	19,742	27	2,587

8 SHORT TERM PLAN (<5YR)

The Hobart East Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103834-Hobart East strategic plan Rev_3.

A summary of the proposed works from 2010 to 2015 in the Hobart-East planning area is outlined in the following table.

Year	**Proposed Project**	**Proposed Outcomes**
2012	Convert Richmond zone substation to 33/11 kV	Convert sections of 22kV encroaching on Hobart-East to 11kV and establish a 33kV feeder from Lindisfarne
2014	Upgrade Geilston Bay zone substation	Replace ageing 33/11 kV transformers and increase firm capacity at Geilston Bay
2015	Upgrade Lindisfarne terminal substation	Replace ageing 110/33 kV transformers and increase firm capacity at Lindisfarne

Details of the constraints, options and possible solutions analysed to arrive at these proposed projects are included in Appendix A on page 21.

[3] Data sourced from NW-#30075639-Statewide Distribution Transformers Customer Count Nov 09. Transformer data extracted from Gtech in November 2009.

9 MEDIUM TERM PLAN (5 TO 10YR)

The Hobart East Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103834-Hobart East strategic plan Rev_3.

A summary of the proposed works from 2016 to 2020 in the Hobart-East planning area is outlined in the following table.

Year	Proposed Project	Proposed Outcomes
2017	Establish Sandford zone substation	Deload Rokeby and relieve Lauderdale and South Arm 11 kV feeders
2020	Upgrade Bellerive zone substation	Upgrade Replace ageing 33/11 kV transformers and increase firm capacity at Bellerive
2020	Extend 22kV feeder 41512 to Oatlands and convert Colebrook to 22 kV	Address power quality issues on the Richmond northern 11 kV network and reliability issues in the Oatlands area

Details of the constraints, options and possible solutions analysed to arrive at these proposed projects are included in Appendix B on page 25.

10 LONG TERM PLAN (10YR+)

The Hobart East Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103834-Hobart East strategic plan Rev_3.

A summary of the proposed works from 2021 to 2050 in the Hobart-East planning area is outlined in the following table.

Year	Proposed Project	Proposed Outcomes
2023	Upgrade Mornington terminal substation	Increase firm capacity at Mornington
2032	Upgrade Rokeby terminal substation	Replace ageing 110/11 kV transformers and increase firm capacity at Rokeby
2034	Upgrade Lindisfarne terminal substation	Increase firm capacity at Lindisfarne
2039	Upgrade Cambridge zone substation	Increase firm capacity at Cambridge and address group firm capacity limitation
2045	Establish Risdon Vale	Address group firm capacity limitation

	zone substation	
2049	Upgrade Howrah/Rosny zone substation	Address group firm capacity limitation

Further details of these and other potential long term projects in the HE area are discussed in Appendix C below.

11 PROGRAM OF WORK DRAFT

Project	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Install UG HV - 6 feeder tails New Norfolk Zone		$ 173,000				
(Project BW 006] Install 0.2 km HV UG Huntingtier Rd PID 221007 to Hardwicks Rd Bagdad PID 390836	$ 80,000					
Augment OH HV - 14 Mile Rd, Tarraleah					$ 210,000	
Augment OH HV - Fdr 37002 stage 1 Gretna Zone associated with Zone replacement					$ 411,000	
Augment OH HV - Fdr 37002 stage 2 Gretna Zone associated with Zone replacement					$ 411,000	
Augment OH HV - Fdr 37002 stage 3 Gretna Zone associated with Zone replacement					$ 206,000	
Derwent Bridge - Install 3rd wire Lyell Hwy (generator stability) 2 kms	$ 40,000					
Derwent Bridge - Install permanent connection point generator	$ 25,000					
Install 1 x 6.6/ 22 kV step up stations at todds corner						$ -
Install 19/3.25 AA OH link Hamilton - F45003 2 kms	$ 130,000					
Install OH HV - Auburn Rd to Macquarie Rd						
Install OH HV - Derwent Bridge to Bronte Link					$ 630,000	
Install OH HV - link Meadowbank 45003 to Wayatinah 49412 to Tunagtinah 49305						$ 420,000
Install OH HV - link to Lake Cresent 3 ph (to assist in removal of SWER)				$ 630,000		
Install OH HV - link Victoria Valley SWER to Tungatinah fdr 49303, Dee Lagoon					$ 124,000	
Install OH HV - new Feeder, Elderside						$ -
Install OH HV - Upgrade SWER, Dee Lagoon Link, Victoria Valley Rd				$ 294,000		
Project BW 004 Reinsulate7.6 k & 8 tx Bridgewater F48 190 to 22 kV and supply from Meadowbank TS	$ 300,000					
Project BW 005 Reinsulate 10.0 k &11 tx Bridgewater F 48 190 to 22 kV and supply from Meadowbank TS		$ 352,000				
Project MB 001 - Westerway 38002 OH conversion to 22 kV (10 km OH and 15 txs)		$ 400,000				
Project MB 002 - Westerway 38002 OH conversion to 22 kV (12 km OH and 22 txs)			$ 460,000			
Project MB 003 - Westerway 38002 OH conversion to 22 kV (11 km OH and 15 txs)					$ 360,000	
Tods corner - Convert 6.6 kv line to 22 kv						$ -
Augment pole sub 300 kVA First Avenue New Norfolk	$ 40,000					
Augment pole sub Fairfax Terrace New Norfolk	$ 40,000					
Install new pole sub George Street New Norfolk	$ 40,000					
Install Substation - new or augment pole type 300 kVA				$ 30,000	$ 30,000	$ 30,000
Augment OH LV - overloaded LV ccts Highlands stage 2		$ 14,000				
Augment OH LV - overloaded LV ccts Midlands South stage 2		$ 14,000				
Augment OH LV - overloaded LV ccts Midlands South stage 3		$ 14,000				
Augment OH LV - overloaded LV ccts Midlands South stage 4				$ 14,000		
	$ 695,000	$ 967,000	$ 460,000	$ 968,000	$ 2,382,000	$ 450,000

12 OPERATIONAL PLANS

- Contingency plans (not at operational level)

Operations Group have developed a number of contingency plans to define operational actions to be taken in the event of substation, busbar and feeder outages. The document NW-#30126392-Contingency Plan Register provides links to contingency plan documents as they are produced.

13 REFERENCE DOCUMENTS

Self explanatory but listed documents for system studies, council plans etc

- Listing of DINIS personal files
- Links to other work documents

14 NOTES

- System development plans identified for the area should link to other plans. Consultation with other work groups, in particular System Performance, Distribution Operations, Area Managers and key external stakeholders e.g. Councils and Government Departments, is essential to ensure optimum outcomes.

Appendix A. Short Term Plan (<5 years) - Constraints Options and Solutions

A.1 Convert Richmond zone substation to 33/11 kV

A.1.1. Constraints

Richmond zone substation is currently equipped with 2 x 2.5 MVA transformers, providing a firm capacity of 2.5 MVA. The transformers at Richmond have been recommended for replacement and Aurora has indicated that they will likely be replaced in 2012 with a 10 MVA 33/11kV unit; with an offload tap changer installed to provide a 22 kV tap. Richmond would initially retain its supply from Sorell 22 kV feeder 41512.

The star-star connection of the new transformer would remove the phase shift that currently exists between Richmond and the adjacent 11 kV networks.

The 11 kV network to the south of Richmond overlaps with the 22 kV network from Sorell, resulting in an undesirable mix of voltage levels and limiting the transfer capacity between Richmond and the surrounding 11 kV network.

A.1.2. Options considered

1. Convert Richmond zone substation to 33/11 kV
2. Install second 33/22/11 kV transformer at Richmond

Option 1 (recommended option) – Convert Richmond zone substation to 33/11 kV

This option involves the conversion of the existing 22 kV network to the south and west of Richmond to 11 kV and the establishment of a new 33 kV feeder from Lindisfarne to Richmond. All of Sorell feeder 41512 to the west of the Coal River running through Richmond would be re-energised at 11 kV, with distribution transformers replaced with new 11/0.415 kV units (approximately 80).

A 9 km section of the southern-most section of 22 kV line would be reinsulated to 33 kV and underbuilt with 11 kV line. A new 33 kV overhead line would then be established for the remaining 4 km run to Richmond zone substation.

Richmond would thus be supplied from Lindisfarne at 33 kV, and the newly converted 11 kV network would be supplied from Richmond and Geilston Bay substations.

Aurora has indicated that revenue and resources would be available to complete these works in 2017.

As the estimated cost of works is less than $5M a Regulatory Investment Test (RIT) is not required for this project.

This project deloads Sorell feeder 41512 by approximately 4.5 MVA in 2017, which allows load to be transferred from 41516 to 41512, thus addressing reliability issues on feeder 41516. This is a benefit of option 1 that is not addressed by the other options.

Option 2 – Install second 33/22/11 kV transformer at Richmond

This option involves the installation of a second 33/22/11 kV transformer at Richmond, supplied from Sorell feeder 41512. This would address the lack of firm capacity at Richmond; however additional works would be required to address the reliability issues on 22kV feeder 41516.

This option would ultimately require conversion of the 22 kV network to the South and west of Richmond to 11 kV as per option 1, since load growth in the area will eventually drive the requirement for transfer capacity, however it is assumed this may be delayed by 5 years

Technical comparison

Option	Description	Advantages	Disadvantages
1	Convert Richmond zone substation to 33/11 kV	• Reliability improvement since Richmond has a dedicated source of supply • Decreases load on Sorell substation and Sorell 22 kV feeder 41512 • Increases transfer capacity between Richmond and surrounding substations • Removes non-standard 22/11 kV zone substation from network • Deloads 41512, allowing it to be used to support 41516	• Increases load on Lindisfarne

Option	Description	Advantages	Disadvantages
2	Install second 33/22/11 kV transformer at Richmond	• Provides firm capacity at Richmond substation	• Non-standard 22/11 kV zone substation remains in network • No transfer capacity between Sorell feeder 41512 and adjacent 11 kV feeders

The above technical comparison of options indicates that option 1 provides the best technical solution.

Cost comparison

Option	Initial Capital Cost ($M)	Total Capital Cost ($M)	Net Present Value ($M)
1	4.0	4.1	2.6
2	1.0	5.5	2.7

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 of NW-#30103834-Hobart East strategic plan Rev_3

A.1.3. Possible Solution

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

It is therefore proposed that Richmond 22/11 kV substation be converted to 33/11 kV in 2017, with the 22 kV network to the south and west of Richmond re-energised at 11 kV and distribution transformers replaced with 11/0.433 kV units. Richmond would be supplied by re-insulating sections of 22kV feeder to 33 kV and terminating on a new CB at Lindisfarne substation, resulting in a dedicated 33 kV feeder between Lindisfarne and Richmond.

A.2 Upgrade Geilston Bay zone substation

A.2.1. Constraints

The Geilston Bay 2 x 22.5 MVA 33/11 kV transformers have been deemed to be end of life by 2014.

A.2.2. Options considered

1. Upgrade Geilston bay zone substation
2. Risdon Vale
3. Load transfers
4. Non-network option
5. Do nothing option

Option 1 (recommended option) – Upgrade Geilston Bay zone substation

To address the above limitations, it is proposed that the existing 33/11 kV transformers be replaced with new 25 MVA units in 2014.

As this project is justified on condition grounds and proposes a like-for-like replacement, for regulatory purposes it is considered a refurbishment project rather than an augmentation project. As such, a Regulatory Investment Test (RIT) is not required for this project.

Option 2 – Risdon Vale

Option 3 – Load transfers

Option 4 – Non-network option

No non-network alternatives have been considered.

Option 5 – Do nothing option

The do nothing option is not considered a feasible option as the Geilston Bay transformers have been deemed to be end of life by 2014, and therefore must be removed from service by this time.

A.2.3. Possible Solution

It is proposed that the 2 x 22.5 MVA transformers be replaced by 25 MVA units in 2014. The estimated cost for the upgrade is $4 million.

A.3 Upgrade Lindisfarne terminal substation

14.1.1 Constraints

The Lindisfarne 2 x 45 MVA 110/11 kV transformers have been recommended for replacement by Transend by 2015.

14.1.2 Options considered

1. Upgrade Lindisfarne Terminal substation
2. Non-network option
3. Do nothing option

Option 1 (Preferred Network option) – Upgrade Lindisfarne zone substation

To address the above limitations, it is proposed that the existing 110/33 kV transformers be replaced with new 60 MVA units in 2015.

As this project is justified on condition grounds and proposes a like-for-like replacement, for regulatory purposes it is considered a refurbishment project rather than an augmentation project. As such, a Regulatory Investment Test (RIT) is not required for this project.

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 Lindisfarne transformers have been deemed to be end of life by 2015, and therefore must be removed from service by this time.

14.1.3 Possible Solution

It is proposed that the 2 x 45 MVA transformers be replaced by 60 MVA units in 2015. The estimated cost for the upgrade is $7 million.

Appendix B. Medium Term Plan (5 to 10 years) - Constraints Options and Solutions

B.1 Establish Sandford zone substation

B.1.1. Constraints

Rokeby terminal substation is equipped with 2 x 35 MVA 110/11 kV transformers providing a firm capacity of 35 MVA. Rokeby terminal substation is forecast to exceed firm capacity from 2017.

11kV feeders 28223 and 28228, which run south from Rokeby, are greater than 15 km long. The combined load on these feeders is forecast to exceed their combined planning rating of 10 MVA in 2015, increasing to 12 MVA in 2022. Feeder 28224, running east from Rokeby, is also forecast to be heavily loaded, increasing from 3.7 MVA to 4.7 MVA between 2012 and 2022.

The load on Mornington terminal substation is forecast to exceed firm capacity in 2020.

B.1.2. Options considered

1. Establish Sandford zone substation
2. Establish Lauderdale zone substation
3. Upgrade Rokeby terminal substation

Option 1 (recommended option) – Establish Sandford zone substation

This option involves the establishment of a new zone substation in the Sandford area supplied by 2 x 33 kV cables from Mornington terminal substation in 2017.

Sandford zone substation will consist of 2 x 25 MVA 33/11 kV transformers and two sections of 11kV switchgear. The substation will be supplied transformer-ended from 33 kV cables from Mornington (approximately 14 km).

The 11 kV network would be reconfigured with minimal augmentation such that the existing three 11 kV feeders to the peninsula would be used to support the Lauderdale and Rokeby areas from Sandford. The two long feeders to the south would be split into five feeders initially, with future feeders established as required.

To defer the firm capacity limitation at Mornington, it is also proposed that Bellerive zone substation be normally supplied from Lindisfarne following the establishment of Sandford zone substation.

Option 2 – Establish Lauderdale zone substation

This option is identical to option 1, except that the zone substation is established in the Lauderdale area rather than on the peninsula.

This option would require a shorter 33 kV feeder run initially, but would require significantly more 11 kV reinforcement both initially and ultimately. The forecast 2050 load on the peninsula is approximately 26 MVA, so the entire Lauderdale substation would be dedicated to supplying to the south and many additional 11 kV feeders would ultimately be required across the narrow isthmus to the peninsula.

Option 3 – Upgrade Rokeby terminal substation

This option involves the replacement of the existing 2 x 35 MVA 110/11 kV transformers at Rokeby with 60 MVA units.

This option would require significant 11kV reinforcement to the peninsula and Lauderdale areas to address feeder capacity and reliability issues. Feeder routes along South Arm Rd between Rokeby and Lauderdale are difficult to obtain. Thus it is assumed that the second round of feeder reinforcement from Rokeby to the peninsula would need to be via sub-marine cables.

Technical comparison

Option	Description	Advantages	Disadvantages
1	Establish Sandford zone substation	• Increases group firm capacity by 25 MVA • Results in shortest 11kV feeders and hence best reliability of all options • Optimally utilises existing assets	• Requires a longer 33 kV cable run than option 2 • Increases load on Mornington substation and advances firm capacity limitation • Requires purchase and establishment of a new site
2	Establish Lauderdale zone substation	• Increases group firm capacity by 25 MVA • Requires a shorter 33kV cable run than option 1	• Requires significant 11kV reinforcement to the peninsula • Increases load on Mornington substation and advances firm capacity limitation • Substation location not ideal to supply ultimate load • Requires purchase and establishment of a new site

Option	Description	Advantages	Disadvantages
3	Upgrade Rokeby terminal substation	• Increases group firm capacity by 25 MVA • Defers the Mornington firm capacity limitation • Utilises existing site	• Fails to fully utilise existing Rokeby transformers (15 years life remaining) • Requires significant 11kV reinforcement to the peninsula • Difficulty getting additional 11 kV feeders out of Rokeby and onto the peninsula due to congestion

The above technical comparison of options indicates that option 1 provides the best technical solution.

Cost comparison

Option	Initial Capital Cost ($M)	Total Capital Cost ($M)	Net Present Value ($M)
1	14.2	27.2	13.5
2	15.5	28.5	14.4
3	15.5	30.8	13.7

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 of NW-#30103834-Hobart East strategic plan Rev_3.

B.1.3. Possible Solution

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

Therefore it is proposed that a new zone substation with 2 x 25 MVA transformers be established in Sandford in 2017. The zone substation will be supplied from Mornington terminal substation via 2 x 33 kV underground feeders (approximately 10 km), and supply to the Lauderdale, Sandford and South Arm areas.

B.2 Upgrade Bellerive zone substation

B.2.1. Constraints

The Bellerive zone substation transformers have been deemed to be end of life by 2020.

B.2.2. Options considered

1. Upgrade Claremont zone substation
2. Non-network option
3. Do nothing option

Option 1 (recommended option) – Upgrade Bellerive zone substation

To address the above limitations, it is proposed that the existing transformers be replaced with new 25 MVA units in 2020.

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 Bellerive transformers have been deemed to be end of life by 2020, and therefore must be removed from service by this time.

B.2.3. Possible Solution

It is proposed that the 2 x 22.5 MVA transformers be replaced by 25 MVA units in 2020. The estimated cost for the upgrade is $4 million.

B.3 Extend 22 kV feeder 41512 to Oatlands and convert Colebrook to 22 kV

B.3.1. Constraints

Sorell 22 kV feeder 41516 currently supplies into the Oatlands (2.3 MVA), Richmond (1.2 MVA) and Sorell (0.7 MVA) areas. The Oatlands area is currently experiencing reliability issues, with the current round of reliability works in the area expected to relieve these limitations until approximately 2020. There are 22 kV feeders from Meadowbank and Avoca which have ties to 41512, however each of these feeders is over 80 km in length to Oatlands and both are experiencing reliability issues themselves.

Sorell 22 kV feeder 41512 currently supplies Richmond 22/11 kV substation as well as some 22 kV distribution load in Sorell, Midway point and between Richmond and Lindisfarne. This feeder is expected to be deloaded significantly in 2017, when Richmond is converted to 33/11 kV and much of the 22 kV network between Richmond and Lindisfarne is converted to 11 kV.

Aurora have indicated that the 11 kV network in the Colebrook area, to the South of Oatlands, is currently experiencing power quality issues such as voltage drop during the starting of electric irrigation pumps. This area is currently supplied from the Richmond zone substation via 30 km 11 kV feeder 40002.

B.3.2. Options considered

1. Extend 22kV feeder 41512 to Oatlands and convert Colebrook 11kV network to 22kV
2. Establish Bothwell terminal substation and convert Colebrook 11kV network to 22kV

Option 1 (recommended option) – Extend Sorell feeder 41512 and convert Colebrook 11kV network to 22kV

This option involves the conversion of the 11 kV network in the Colebrook area to 22 kV in 2020, as well as the extension of Sorell feeder 41512 north from Richmond to supply the Colebrook area and part of Oatlands. The resulting feeder would be limited by 7/3.00 Cu for much of its length, providing a feeder winter day rating of 7.8 MVA.

Option 2 – Establish Bothwell terminal substation and convert Colebrook 11kV network to 22kV

This option also proposes the conversion of the Colebrook 11 kV network to 22 kV in 2020; however it is proposed that the reliability limitations be addressed by the establishment of a new single transformer 110/22 kV substation at Bothwell.

Technical comparison

Option	Description	Advantages	Disadvantages
1	Extend Sorell feeder 41512 and convert Colebrook 11 kV network to 22 kV	• Utilises spare capacity at Sorell substation and on feeder 41512	• Broadens boundary of 22 and 11 kV in Richmond
2	Establish Bothwell terminal substation and convert Colebrook 11 kV network to 22KV	• Provides shorter 22 kV feeder than option 1	• Substation site is not ideal location to supply future load

The above technical comparison of options indicates that option 1 provides the best technical solution.

Cost comparison

Option	Initial Capital Cost ($M)	Total Capital Cost ($M)	Net Present Value ($M)
1	1.8	28.6	3.8
2	9.0	35.8	6.2

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 of NW-#30103834-Hobart East strategic plan Rev_3.

B.3.3. Possible Solution

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

Therefore it is proposed to convert the Colebrook area 11kV network to 22kV in 2020 and extend the 22kV Sorell feeder 41512 north from Richmond to supply this Colebrook area and part of Oatlands.

Appendix C. Long Term Plan (>10 years) - Constraints Options and Solutions

C.1 Upgrade Mornington terminal substation

The Mornington terminal substation is planned to be established in 2011. The load at Mornington terminal substation is forecast to exceed firm capacity in 2023 and the load at Lindisfarne terminal substation is forecast to exceed firm capacity in 2034 (after the transfer of Bellerive zone substation to Mornington during contingencies).

Therefore it is proposed that a third 60MVA transformer be installed at Mornington substation in 2023, with the associated 33 and 110kV switchgear. It is also proposed that Bellerive zone substation be normally supplied from Mornington at this time in order to deload Lindisfarne below firm capacity.

C.2 Upgrade Rokeby terminal substation

The transformers at Rokeby substation reach end of life in 2032. The substation group load forecast also exceeds firm capacity in 2033.

Therefore it is recommended that the existing Rokeby transformers be replaced with 60 MVA units in 2032.

C.3 Upgrade Lindisfarne terminal substation

The load at Lindisfarne terminal substation is forecast to exceed firm capacity in 2034.

Therefore it is proposed that a third 60MVA transformer be installed at Lindisfarne substation in 2034, with the associated 33 and 110kV switchgear.

An alternative option at this stage would be to establish a zone substation to the south of Geilston Bay, utilising the existing Lindisfarne to Bellerive 33 kV circuits. This would actually increase the load at Lindisfarne substation depending on how much load is transferred from Bellerive and Rosny zone substations; however it would also provide transfer capacity away from Lindisfarne for a transformer contingency. This would defer the third

transformer at Lindisfarne by 5-10 years while potentially superseding one of the zone substation projects discussed below.

A third option at this stage would be to run a short 33 kV double circuit from Mornington substation to cut into the existing Lindisfarne to Cambridge 33 kV circuits, thus supplying Cambridge from Mornington. The Lindisfarne end of the circuits could then be used to supply a new zone substation at an appropriate location.

The option chosen at this point is highly dependent on load growth. If the growth is in the Cambridge or Risdon Vale areas, then the Lindisfarne substation upgrade is probably the superior option. However if a zone substation is justified between Geilston Bay and Bellerive it is better to defer the Lindisfarne upgrade by establishing new 11kV injection and taking advantage of the existing 33kV feeder capacity and 110/33 kV transformer capacity at Mornington.

C.4 Upgrade Cambridge zone substation

The group firm capacity of the Hobart-East substations is exceeded again in 2039, with the Cambridge area having a forecast load of 31 MVA at this time according to the high growth forecast. Being relatively remote from the remainder of the Hobart-East substations, it is unlikely that a significant amount of load can be transferred to adjacent substations.

Therefore it is recommended that a third transformer be installed at Cambridge substation at this time, supplied from a third 33 kV feeder from Mornington.

It should be noted that this project is heavily dependent on the load growth in the Cambridge area. It may be that the project can be deferred, or interchanged with the Ridson Vale or Howrah/Rosny projects, or the upgrade of a more suitable zone substation, depending on the location and magnitude of load growth. Another option would be the establishment of a new zone substation in the vicinity of Acton Park, should the load in the Lauderdale area require additional support from the north.

C.5 Establish Risdon Vale zone substation

The group firm capacity of the Hobart-East substations is exceeded again in 2045. To address this limitation it is proposed that a new zone substation be established in the Risdon Vale area in 2045.

The substation will be 2 x 25 MVA transformers, supplied from 2 x 33 kV underground feeders from Lindisfarne (approximately 2 km).

It should be noted that the location of the new zone substation is highly dependent on load development, and it may be that a better development at this stage would be to install a third transformer at Bellerive, or establish a new zone substation between Geilston Bay and Bellerive utilising the existing

Lindisfarne to Bellerive 33 kV circuits. This should be evaluated closer to the date.

C.6 Upgrade Howrah/Rosny zone substation

The group firm capacity of the Hobart-East substations is exceeded again in 2049. In particular, Howrah and Rosny zone substations are forecast to be well above firm capacity. The lowest cost way to address this limitation would be to install a third 33/11 kV transformer be installed at Howrah or Rosny, supplied from a new 33 kV feeder from Mornington (approximately 3 km). However should the 11kV feeder network between the two substations also require significant augmentation, a new zone substation between the two may be the better solution. This should be evaluated closer to the date.

Appendix D. Technical Data

D.1 Substation loading

Bellerive			Capacity with all elements in service (N)		Capacity with one element out of service (N-1)		Maxium Demand 2008		Maxium Demand predicted summer 2009		Maximum Demand predicted for winter 2009	
Elements	No	Emergency Rating MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	N-1 Load at Risk	Winter MVA	N-1 Load at Risk
Transfomers	2	22.5	45	45	22.5	22.5	17.4	28.0	17.8	0	28.8	6.3
Subtransmission Feeder 25305	1		13.4	13.4	0	0	10	10.4	10.3	10	10.7	10.7
Subtransmission Feeder 25310	1		13.4	13.4	0	0	10	17.8	10.3	10	18.3	18.3

Cambridge			Capacity with all elements in service (N)		Capacity with one element out of service (N-1)		Maxium Demand 2008		Maxium Demand predicted summer 2009		Maximum Demand predicted for winter 2009	
Elements	No	Emergency Rating MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	N-1 Load at Risk	Summer MVA	N-1 Load at Risk
Transfomers 2 x 20 MVA	2	20	40	40	20	20				x	x	x
Subtransmission Feeder 25306	1	19.8	19.8	19.8	0	0				0	0	0
Subtransmission Feeder 25309	1	19.8	19.8	19.8	0	0				0	0	0

Geilston Bay			Capacity with all elements in service (N)		Capacity with one element out of service (N-1)		Maxium Demand 2008		Maxium Demand predicted summer 2009		Maximum Demand predicted for winter 2009	
Elements	No	Emergency Rating MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	N-1 Load at Risk	Summer MVA	N-1 Load at Risk
Transfomers	2	22.5	45	45	22.5	22.5		27.8	0	0	0	0
Subtransmission Feeder 25307			0	0	0	0		14	0	0	0	0
Subtransmission Feeder 25308			0	0	0	0		13.8	0	0	0	0

Richmond			Capacity with all elements in service (N)		Capacity with one element out of service (N-1)		Maxium Demand 2008		Maxium Demand predicted summer 2009		Maximum Demand predicted for winter 2009	
Elements	No	Emergency Rating MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	Winter MVA	Summer MVA	N-1 Load at Risk	Summer MVA	N-1 Load at Risk
Transfomers	2	3	45	45	22.5	22.5			14.6	0	30	7.5
Distributed Subtransmission Feeder 41512			0	0	0	0			14.6	0	0	0

Reference master document # 30006462

D.2 Aurora Zone Substation data sheet

Planning Area	Zone Substation	Type	Primary Voltage (kV)	Secondary Voltage	No of Feeders In Service
Hobart - East	Bellerive	Urban - major	33	11	8
Hobart - East	Cambridge	Urban - major	33	11	9
Hobart - East	Geilston Bay	Urban - major	33	11	9
Hobart - East	Richmond	Rural - minor	22	11	3

Reference master document #30040697

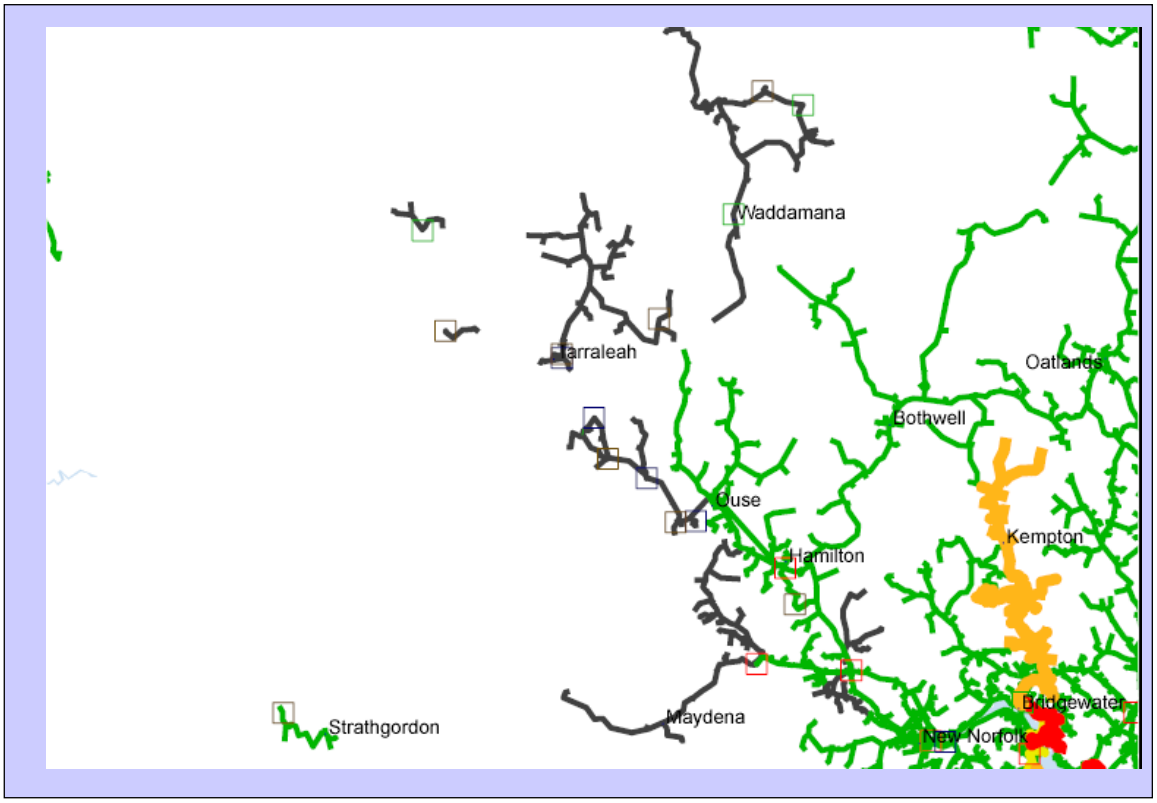
D.3 Transend Station data sheet

Planning Area	Connect Point Substation	Connection Company	Connection Voltage kV	No. Of Connection Points	Type
Hobart East	Lindisfarne	Transend Networks	33	6	Distribution
Hobart East	Risdon	Transend Networks	33	7	Subtransmission
Hobart East	Rokeby	Transend Networks	11	11	Distribution

Reference master document #30040697

D.4 High Voltage feeder loading

2008



Planning Area	Station	Feeder Number	Voltage	Sum of MD (MVA)	Planning Std (MVA)	Load in 5 years (MVA)
Central	Fisher	3 (C252)	11	0.9	5	1.0
		4 (D252)	11	0.0	5	0.1
	Meadowbank	45001	22	1.6	10	1.9
		45002	22	2.1	10	2.4
		45003	22	3.2	10	3.6
	New Norfolk (Terminal)	39563	22	7.5	10	8.3
		39565	22	6.2	10	6.9
		39568	22	2.3	10	2.6
		39569	22	0.1	10	0.2
		39570	22	6.1	10	6.8
		39571	22	3.6	10	4.0
	New Norfolk (Zone)	35010	11	2.9	5	3.2
		35011	11	2.3	5	2.7
		35012	11	2.3	5	2.6
	Tungatinah	T8&T9	22	1.4	10	1.6
	Waddamana	202	22	0.6	10	0.7
	Wayatinah	1	0	0.0	0	0.1
		2	0	0.0	0	0.1
		3	0	0.0	0	0.1

Reference master document #30040697

D.5 Transfer Capacity

- MD transfer capacity with other stations (order of)

-
-
- Brief outline of subtransmission feeder arrangements, ratings and capabilities

Note it would be useful to include any details of reference documents and schematic diagrams

- HV feeder ratings, current summer and winter loads. MD's
- Provide high and low load forecasts i.e. +/- 10% of base load as above for each HV feeder for the next 10 years

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Appendix E. Planning Criteria and Guidelines

E.1 Transmission Planning Criteria

Transend's planning criteria are fundamentally based on:

- the National Electricity Rules (NER);
- the Electricity Supply Industry (Network Performance Requirements) Regulations 2007; and
- good electricity industry practice

The following criteria are used when planning for the transmission system.

Transmission and transformer loading

- Transmission lines and autotransformer loadings for an intact system or for a contingency (N–1) should not exceed their continuous ratings in planning studies. For supply transformers four-hour emergency ratings can be used to defer augmentations depending on the peak duration of the load duration curve.
- Transmission line loading on circuits covered by NCSPS should not exceed 95 per cent of their rating for an intact system when Basslink is exporting. When Basslink is not in service or importing, standard N–1 criteria applies.

Load interruptions

For an intact system, i.e. where no elements are out of service for maintenance the following should apply as per Network Performance Requirements:

- no credible single contingency event will interrupt more than 25 MW load;
- no single asset failure will interrupt more than 850 MW or, in any event cause a system black;
- the unserved energy to loads interrupted as a result of damage to a network element related to a credible contingency event must not exceed 300 MWh; and
- the unserved energy to loads interrupted as a result of a single asset failure must not exceed 3,000 MWh

Single asset failure that would cause large load interruptions is the loss of a double circuit line, a bus section fault or a bus coupler fault. In calculating unserved energy, the ability to transfer load and the time required for load restoration should be taken into account.

Exposure due to maintenance outage

- Where a network element has been withdrawn from service for maintenance, replacement or repair, the energy exposed to interruption by a credible contingency event must not exceed 18,000 MWh.

In calculating unserved energy, the ability to transfer load should be taken into account.

Maximum repair / replacement time

Minimum Performance Requirements state that for the purpose of calculating unserved energy, any replacements or repairs undertaken, should not exceed the following:

- Transmission line repair – 48 hours
- Transformer replacement – 8 days
- Auto transformer replacement – 18 days

E.2 Distribution Planning Criteria

Key planning standards include: -

System Performance

- Voltage regulation range of + 6% and – 6% of the nominal HV voltage and a LV voltage range of 230/400 V +10% and –2%;
- Power quality standards are recognised in accordance with the TEC, NER and applicable Australian Standards; and
- Tasmanian Reliability Performance Standards

Table Appendix E -1 Tasmanian Reliability Performance Standards

Community category	Frequency standard (Maximum average number of supply interruptions per year)		Duration standard (Maximum total time without electricity in a year measured in minutes)	
	For the category	For each community	For the category	For each community
Critical infrastructure	0.2	0.2	30	30
High density commercial	1	2	60	120
Urban and regional centres	2	4	120	240
Higher density rural	4	6	480	600
Lower density rural	6	8	600	720

Source: Tasmanian Electricity Code

Capacity

Maximum average loading considerations for distribution feeders facilitating HV feeder interconnectivity;

- 22 kV – 10 MVA continuous and 15 MVA (typically one hour) emergency;
- 11 kV - 5 MVA continuous and 7.5 MVA (typically one hour) emergency.

Security of supply

Group firm philosophy or a deterministic planning standard, e.g. “N-1”, dependent on elements of security, load and exposure to risk

Schedule 5.1.2.2 (a) of the NER states:

> *“In the satisfactory operating state, the power system must be capable of providing the highest reasonably expected requirement for power transfer (with appropriate recognition of diversity between individual peak requirements and the necessity to withstand credible contingency events) at any time.”*