



FINAL REPORT

DEVELOPMENT OF

RATHMINES 132/11kV ZONE SUBSTATION

23rd December 2008

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EXECUTIVE SUMMARY

This paper has been prepared to report on upgrade work that is proposed to develop the electricity supply network in the West Lake Macquarie network area in accordance with Clause 5.6.2 (h) of the National Electricity Rules. The work proposed by this report is classified as a new large distribution asset.

A Consultation Paper on the projected limitation and options for corrective action was published on 19th May 2008. This Consultation Paper included a preliminary application of the Regulatory Test to options that had been identified to address the projected limitations. No submission was received in response to the Consultation Paper.

There are capacity and aged asset issues in the West Lake Macquarie network area. To ensure a safe and reliable electricity supply for existing customers, EnergyAustralia is providing additional capacity to meet forecast load demands and facility to retire or refurbish aging infrastructure.

The provision of additional capacity is required to meet network performance requirements set by EnergyAustralia in accordance with Schedule 5.1 of the Rules.

This report covers the following issues:

Section 1 provides a background of the West Lake Macquarie network area and the need for augmentation.

Section 2 describes the capacity and aged asset issues in the West Lake Macquarie network area. The concept of service standard, as implemented by EnergyAustralia, is discussed.

Section 3 describes the proposed augmentation in relation to the National Electricity Rules (the Rules). The proposed development of new Rathmines 132/11kV ZS is classified as a distribution system asset by the Rules, and the proposed development is classified as a large network asset as it involves expenditure of greater than \$10 million.

Section 4 describes the strategy options that were considered, including Demand Management as well as:

- Strategy 1 – Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS,
- Strategy 2 – Awaba 132/11kV ZS,
- Strategy 3 – Myuna 33/11kV ZS and future Woodrising 33/11kV ZS.

Section 5 presents the results of economic analysis of the options considered, sensitivity analysis and the ranking of the options and identification of the least cost option.

Section 6 concludes that the preferred option is Strategy 1 – Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS.

EnergyAustralia's recommended action is the development of a new Rathmines 132/11kV ZS and its associated feeder works, and the decommissioning of the existing Rathmines temporary ZS. The estimated capital cost for these works is \$27.5M. The estimated capital cost for the entire Strategy 1 is \$53.7M. The proposed new Rathmines ZS is planned to be commissioned in late 2012.

1. BACKGROUND

1.1. Introduction

This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out in the West Lake Macquarie network area. The information provided in this Final Report includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have lead to the necessity for augmentation of the zone substation;
- A discussion of the service standard that has been adopted for planning purposes;
- Descriptions of options for development of the electricity supply in the area; and
- Details of the outcomes of the cost-effectiveness analysis of the options considered.

The West Lake Macquarie area is bounded by Boolaroo to the north, Wye to the south and is situated between Lake Macquarie and the F3 freeway. There are a number of existing and future supply issues in the northern part of the West Lake Macquarie area including:

- Toronto zone substation firm capacity constraints and aged assets,
- Boolaroo zone substation aged assets,
- Wangi 11kV distribution issues,
- Awaba STS aged assets.

In order to address these various capacity and asset condition issues, the long term strategy is to construct a permanent 132/11kV zone substation at Rathmines. However, the previously planned development of the Rathmines ZS was delayed due to potential future mine subsidence issues at the previously selected site. A temporary 132/11kV single-transformer zone substation has recently been commissioned at Rathmines as a short-term solution to address the immediate supply issues at the Toronto zone substation.

A recent investigation has recommended an alternative site for the development of the proposed permanent Rathmines ZS. The proposed development of permanent Rathmines 132/11kV zone substation is part of the preferred long term strategy for the West Lake Macquarie area.

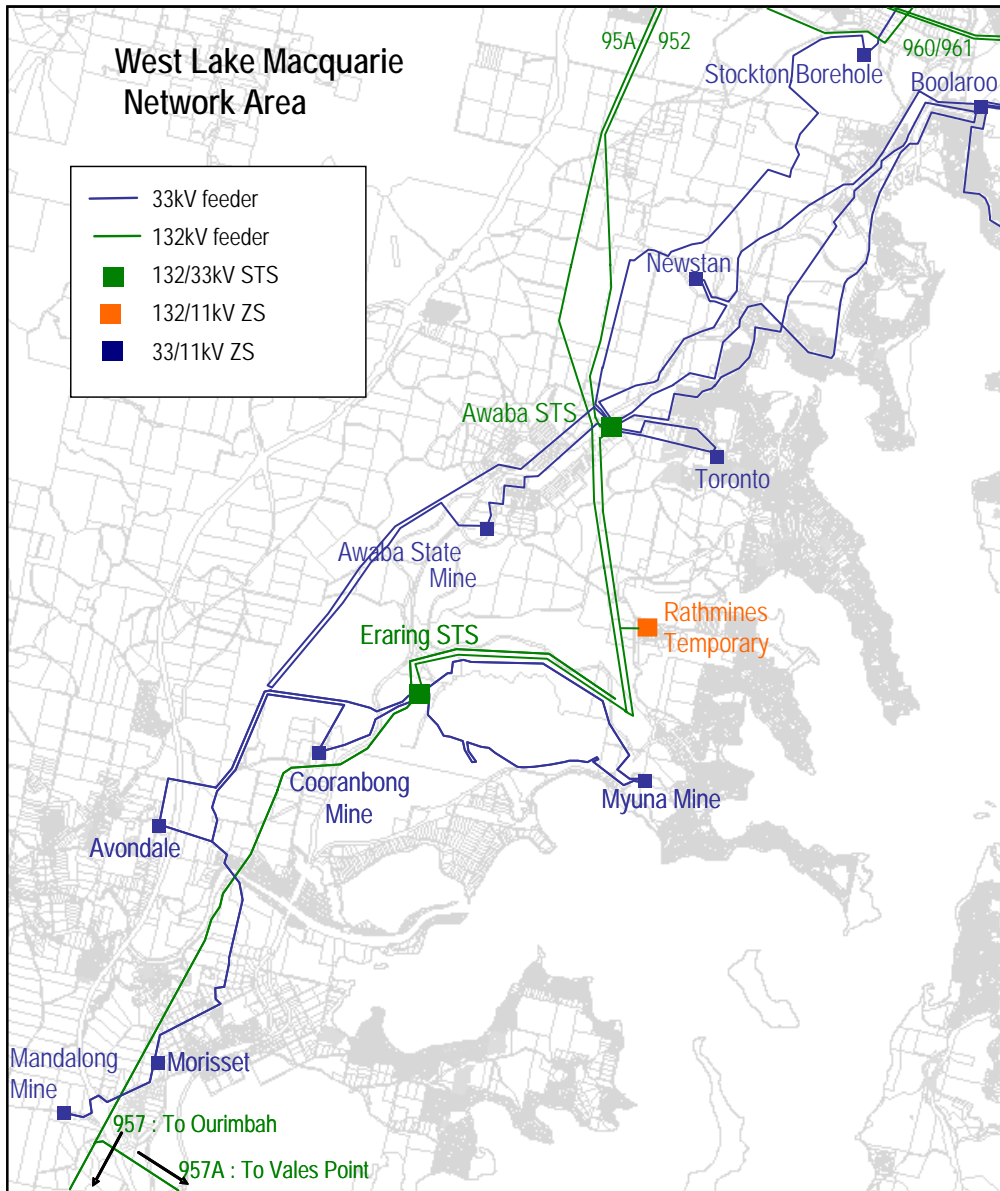


Figure 1.0 – Geographic overview of West Lake Macquarie area

1.1.1. Supply Arrangements

Current supply arrangement to the northern part of the West Lake Macquarie area is as follows:

Awaba Subtransmission Substation

Awaba 132/33kV Sub-transmission Substation (STS) supplies Boolaroo and Toronto 33/11kV zone substations as well as Newstan Colliery and Awaba State Mine 33/11kV zone substations. The Awaba STS is supplied from TransGrid’s Newcastle Bulk Supply Point (BSP) via two 132kV overhead feeders 95A and 952.

Eraring Subtransmission Substation

Eraring 132/33kV STS supplies Avondale and Morisset 33/11kV zone substations as well as Cooranbong, Mandalong and Myuna mines at 33kV. The Eraring STS is supplied from TransGrid’s Newcastle BSP via a 132kV overhead feeder 952, and also has 132kV connections with Ourimbah STS and Delta Electricity’s Vales Point Power Station via feeder 957.

2. ISSUES

2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the West Lake Macquarie area are summarised below:

Applicable to all Network Elements

The minimum requirement for any network element is that, with all elements in service, the thermal capacity is required to meet at least 115% of forecast demand. The requirements described in the following sections are additional to this requirement.

Subtransmission Substations

For a failure of a single critical element (i.e. N-1 conditions) within a subtransmission substation, the forecast demand is not to exceed the thermal capacity. Recovery of load should be within one minute.

Zone Substations and Overhead Subtransmission Feeders

For a failure of a single critical element (i.e. N-1 conditions) within zone substations supplying greater than 10MVA of load and for overhead subtransmission network, the forecast demand is not to exceed the thermal capacity for more than 1% of the time i.e. a total aggregate time of 88 hours per annum; up to a maximum of 20% above the thermal capacity. Recovery of load should be within one minute.

For load less than 10MVA, a non-firm supply (ie, N security standard) is appropriate provided that the thermal capacity provided is greater than 115% of forecast demand.

Underground Subtransmission Feeders

For an underground subtransmission feeder, any overhead section should be designed as if it was a subtransmission overhead feeder, providing the forecast demand does not exceed the thermal capacity of the underground section at any time under N-1 conditions.

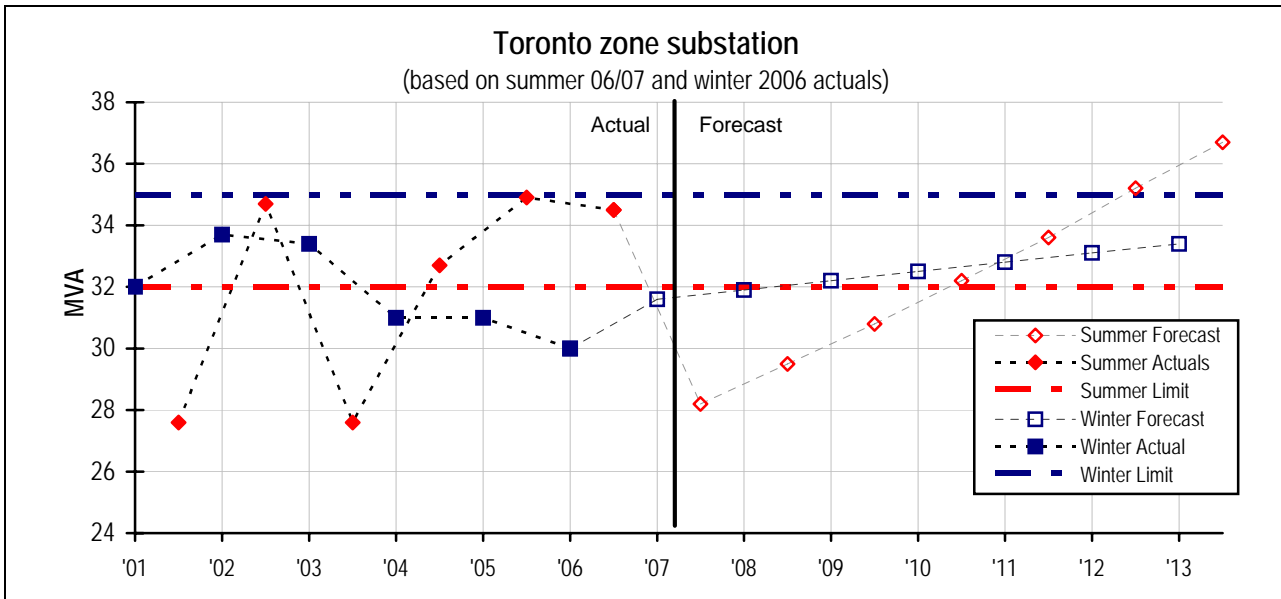
2.2. Network Issues

2.2.1. Capacity Issues

Toronto Zone Substation

Toronto ZS is equipped with two 25MVA transformers and has a firm capacity of 26.9MVA in summer and 29.0MVA in winter. The area of Toronto has limited distribution capacity on all the feeders and has very limited interconnection capacity to surrounding zones.

Toronto zone substation peak load exceeded 120% of the zone firm capacity in summer 2006/2007. Loads have been recently transferred to Rathmines Temporary zone substation in order to maintain the Toronto ZS load within the 120% utilisation level. Toronto ZS summer peak load is forecast to exceed the 120% of the firm capacity level in summer 2011/2012.



	Actual						Forecast						
SUMMER	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Load [MVA]	27.6	34.7	27.6	32.7	34.9	34.5	28.2	29.5	30.8	32.2	33.6	35.2	36.7
Firm Capacity (FC) [MVA]	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9
Limit (120% of FC) [MVA]	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
Utilisation (Load/FC)	103%	129%	102%	122%	130%	128%	105%	110%	115%	120%	125%	131%	137%
WINTER (See Note 1)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Load [MVA]	32.0	33.7	33.4	31.1	31.0	30.0	31.6	31.9	32.2	32.5	32.8	33.1	33.4
Firm Capacity (FC) [MVA]	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Limit (120% of FC) [MVA]	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Utilisation (Load/FC)	110%	116%	115%	107%	107%	103%	109%	110%	111%	112%	113%	114%	115%

Note 1: The load transfer from Toronto ZS to Rathmines temporary ZS has not been included in the Toronto winter load forecast data. Approximately 8MVA of winter peak load would be transferred to Rathmines temporary ZS from 2007.

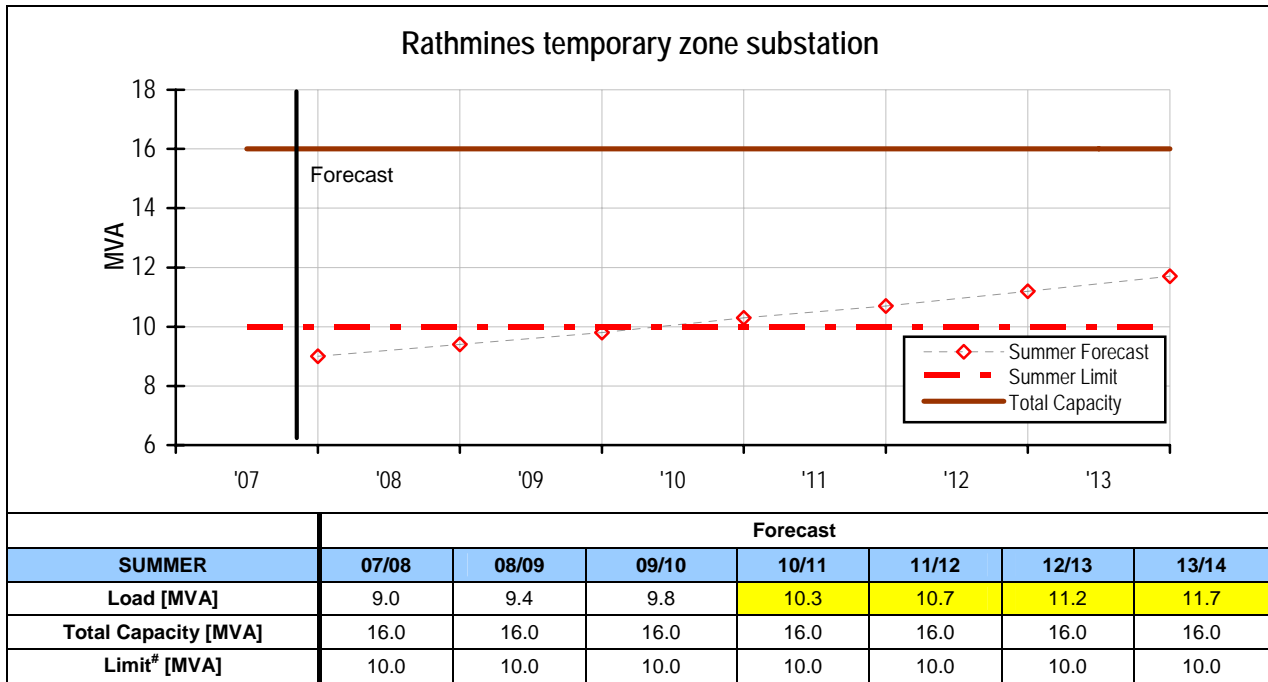
Rathmines Temporary Zone Substation

The Rathmines temporary ZS is equipped with one 25/37.5MVA transformer and hence has the 'N' network security standard. The Rathmines temporary ZS was recently installed as a short-term solution to address the capacity issues at Toronto ZS and the delay of the permanent Rathmines ZS.

Under the Licence condition, the zone substations supplying loads greater than or equal to 10MVA are required to provide 'N-1' security standard. The Rathmines temporary zone substation peak load is forecast to exceed 10MVA in summer 2010/2011.

Furthermore, the Wangi peninsula area load was previously supplied from Toronto ZS but is now supplied from the Rathmines temporary ZS. Previously, the 11kV feeders from Toronto ZS to the Wangi area are up to 13km long and had voltage regulation issues.

The Toronto ZS is geographically the closest zone substation from Rathmines temporary ZS, however it is not feasible to transfer load from Rathmines temporary ZS to Toronto ZS due to the various capacity and aged asset issues at the Toronto ZS. Load transfers to other adjacent zone substations, Avondale and Boolaroo, are not feasible or cost-effective due to various capacity and aged asset issues as well as significant distances between Rathmines temporary ZS and those zone substations.



: 10MVA limit for 'N' network security standard under the Licence conditions.

Note: Approximately 8MVA of winter peak load would be transferred from Toronto ZS to Rathmines temporary ZS.

2.2.2. Asset Issues

Toronto Zone Substation

Toronto ZS is approximately 47 years old and no significant refurbishment work has been undertaken since commissioning. Majority of the assets at Toronto zone are reaching the end of their serviceable life and require replacement within five years.

Recently the 11kV switchroom at the substation suffered from land subsidence related damage, requiring the installation of temporary strung bus and decommissioning of part of the 11kV switchboard. The zone substation is located within an established residential area and has very limited available room to accommodate any significant expansion or redevelopment. The two 25MVA Tyree transformers presently installed at Toronto zone were commissioned in 1974 and no issues have been identified with the transformers. However, the capacity benefits of replacing the transformers with larger units are very limited given the other asset and capacity limitations that exist at the site.

Boolaroo Zone Substation

Boolaroo ZS is approximately 50 years old. The site is located next to the recently closed Pasmenco smelter. Prior to the closure of Pasmenco this area was regarded as a high pollution area due to the smelter emissions. This has caused increased degradation of the substation equipment, particularly the circuit breaker bushings.

It is envisaged that Boolaroo zone substation will be decommissioned in 2009/10 after the commissioning of Argenton 132/33/11kV substation (to the north) anticipated in early 2009. All of Boolaroo 11kV feeders are planned to be transferred to Argenton.

Awaba STS

Awaba STS is approximately 48 years old. The substation utilises an outdoor 132kV bus, outdoor transformers and outdoor 33kV switchgear. The 33kV circuit breakers are Westinghouse 345GCN type requiring ongoing monitoring of the bushing condition. These units will require replacement in the near future.

A majority of the original equipment is still in service. The 132kV and 33kV isolators are old and deteriorating, and now require increased level of maintenance.

Commissioning of proposed Argenton 132/33/11kV substation in the area will provide an opportunity to retire a majority of substation equipment at Awaba STS.

3. TYPE OF AUGMENTATION

Toronto, Rathmines temporary and the proposed Rathmines permanent ZS are classified as distribution system assets by the National Electricity Rules (the Rules).

The Rules require that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, that the Distribution Network Service Provider must notify any affected Registered Participants of these limitations and the expected time for corrective action and consult with affected Registered Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system. A Network Service Provider does not need to consult on a network option that would be a small network asset, or for options that do not augment the system.

The proposed development strategy for the West Lake Macquarie area involves expenditure in excess of \$10 million and is regarded by the Rules as a new large network asset. Accordingly, a Consultation Paper on the projected limitation and options for corrective action was published on 19th May 2008. This Consultation Paper included a preliminary application of the Regulatory test to options that had been identified to address the projected limitations. No submission was received in response to the Consultation Paper.

The new capacity provided by the proposed augmentation has been necessitated by both the need to address aged asset issues and to provide increased system capacity to meet EnergyAustralia's licence conditions described in Section 2 and would thus be regarded as a reliability driven augmentation for the purposes of the Regulatory Test. Consequently, EnergyAustralia has used a least cost test to examine the options identified to address projected system limitations.

4. OPTIONS CONSIDERED

The development strategy for the West Lake Macquarie network area is driven by the need to address both capacity and asset issues. The following section describes Demand Management and three supply side strategy options to address these issues.

Note: The cost estimates indicated in this section are for the projects that relate to the issues discussed above and those that are within the West Lake Macquarie network area strategies that are not common across the strategies.

4.1. Demand Management

Investigation into Demand Management and Local Generation opportunities in the West Lake Macquarie area was carried out in May 2008. In order to defer the proposed supply side solution by one year, the required demand reduction is 10.3MVA from Toronto and Rathmines temporary ZS summer 2010/2011 peak load. This represents approximately 24% of the total demand on Toronto and Rathmines temporary ZS. The cost saving from the one year deferral is \$167/kVA which is moderate. The demand reduction required is very high particularly in the predominantly residential area.

Considering the relatively large amount of demand reduction required, the type of load in the area and moderate cost savings, it is not considered reasonable to expect that it would be cost-effective to postpone the proposed supply side option by implementing demand management strategies.

4.2. Strategy 1: Permanent Rathmines 132/11kV ZS and Future Woodrising 33/11kV ZS

This strategy involves the development of permanent Rathmines 132/11kV zone substation as well as Woodrising 33/11kV zone substation in the future to address various issues in the West Lake Macquarie area.

Major components of this strategy include the following projects:

Project	Commission Date
Rathmines 132/11kV ZS	2012/2013
Decommission Rathmines Temporary ZS	2012/2013
Woodrising 33/11kV ZS	2012/2013
Decommission Toronto ZS	2013/2014
Decommission Awaba STS 33kV bus and Transformers	2014/2015

The development of the proposed permanent Rathmines 132/11kV zone substation in the vicinity of the existing Rathmines temporary zone substation is the first stage of this strategy. The proposed Rathmines 132/11kV zone substation and associated feeder works will:

- Provide the required load relief for Toronto ZS;
- Enable the retirement of Rathmines temporary ZS;
- Address 11kV distribution network issues in the Wangi peninsula and surrounding areas;
- Provide an opportunity (along with the future development of Woodrising ZS) to retire Toronto ZS and Awaba STS to address their aged asset issues; and
- Enable the reconfiguration of the 132kV network which will significantly reduce load flow through Eraring STS transformers.

The proposed connection of the Rathmines ZS is shown in Figure 3.

The estimated capital cost for this entire strategy is \$53.7M.

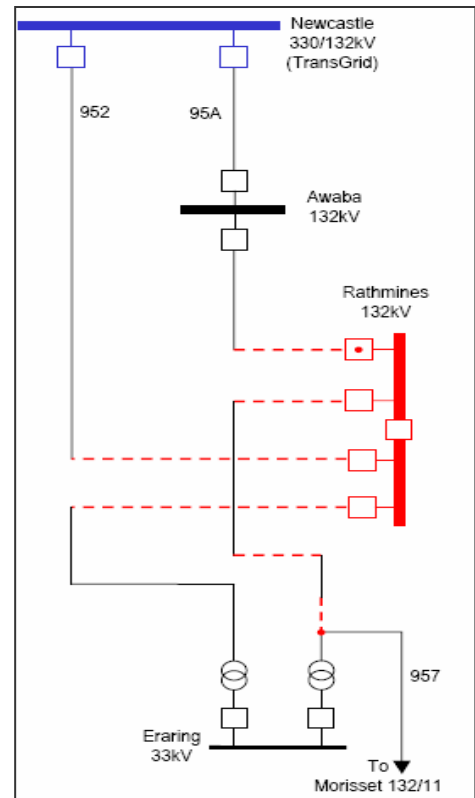


Figure 3: Proposed connection of Rathmines 132/11kV ZS

4.3. Strategy 2: Awaba 132/11kV ZS

This strategy involves the development of Awaba 132/11kV zone substation instead of the Rathmines and Woodrising zone substations. Although this has the effect of reducing the expenditure on zone substations and sub-transmission feeders, it requires substantial additional expenditure on the 11kV system compared to the Strategy 1.

Major components of this strategy include the following projects:

Project	Commission Date
Awaba 132/11kV ZS	2012/2013
Decommission Rathmines Temporary ZS	2013/2014
Decommission Toronto ZS	2013/2014
Awaba ZS additional 11kV switchgear	2014/2015
Decommission Awaba STS 33kV bus and Transformers	2014/2015

This strategy provides similar benefits as those of the Strategy 1.

The estimated capital cost for this entire strategy is \$58.0M.

4.4. Strategy 3: Myuna 33/11kV ZS and Future Woodrising 33/11kV ZS

This strategy involves the development of two 33/11kV zone substations: Myuna and Woodrising. The 33/11kV ZS at Myuna will enable the retirement of the Rathmines temporary ZS and will also address the capacity issues at the Toronto ZS. The proposed Myuna ZS will be supplied from Eraring STS and this will result in the need for augmentation of Eraring STS in the future.

Major components of this strategy include the following projects:

Project	Commission Date
Myuna 33/11kV ZS	2012/2013
Decommission Rathmines Temporary ZS	2012/2013
Woodrising 33/11kV ZS	2012/2013
Decommission Toronto ZS	2013/2014
Decommission Awaba STS 33kV bus and Transformers	2014/2015
Eraring STS transformer uprating	2018/2019
Myuna ZS 33kV feeder uprating	2022/2023

This strategy provides similar benefits as those of the Strategy 1.

The estimated capital cost for this entire strategy is \$63.5M.

5. APPLICATION OF THE REGULATORY TEST

A preliminary economic analysis has been carried out. It involves the comparison of options on an economic basis by carrying out Net Present Cost (NPC) analysis for each of the three options.

The economic analysis incorporates:

- Capital costs.
- Operation and Maintenance (O&M) costs.
- Sensitivities to changing:
 - Substation construction costs.
 - Transmission mains costs.
 - Distribution mains costs.
 - Growth rates.
 - Discount Factor.

5.1. Base Case Analysis

The results of the base case economic analysis using a discount factor of 8.5% are summarised in Table 1 below.

Table 1 - Comparison of Options – Base Case

Options	Description	Capital Cost (\$M)	NPC ¹ of Costs (\$M)
Strategy 1	Permanent Rathmines 132/11kV ZS and future Woodrising 33/11kV ZS	53.7	46.4
Strategy 2	Awaba 132/11kV ZS	58.0	47.2
Strategy 3	Myuna 33/11kV ZS and future Woodrising 33/11kV ZS	63.5	48.6

The analysis above indicates that Options 1 has the least Net Present Cost.

5.2. Sensitivity Analysis

The base case and the range over which sensitivity checks were conducted are shown in Table 2.

Table 2 - Base Case Values and Range of Values Used in Sensitivity Checks

Parameter	Base Case Value	Sensitivity Checks at
Substation Costs	100%	75% and 125%
Transmission Mains Costs	100%	75% and 125%
Distribution Mains Costs	100%	75% and 125%
Discount Factor	8.5%	7.0% and 10.0%
Growth Rate	100%	75% and 125% ²

The results of sensitivity analysis are displayed in Table 3 below.

Table 3 - Sensitivity Analysis: Comparison of Options

Scenario	Net Present Cost (\$M)		
	Strategy 1	Strategy 2	Strategy 3
25% reduction in substation costs	38.8	41.8	41.3
25% increase in substation costs	54.1	52.7	55.9
25% reduction in transmission mains costs	44.1	45.3	45.9
25% increase in transmission mains costs	48.7	49.1	51.3
25% reduction in distribution mains costs	45.7	42.9	47.1
25% increase in distribution mains costs	47.1	51.5	50.1
7% discount factor	48.3	49.6	51.4
10% discount factor	44.7	45.0	46.1
25% reduction in anticipated load	46.4	47.2	48.6
25% increase in anticipated load	46.4	47.2	48.6

¹ NPC also includes operation and maintenance costs.

² Variation in annual load growth rate from the base rate.

The results from the sensitivity analysis indicate that Strategy 1 remains the least cost option under majority of the sensitivity checks.

6. CONCLUSION

Strategy 1 has the lowest NPC under the base case and majority of the sensitivity scenarios. Therefore, the Strategy 1 is the preferred option.

The first stage of this strategy is the development of Rathmines permanent 132/11kV zone substation and associated 132kV feeder works as well as 11kV works to transfer all loads from Rathmines temporary ZS and a proportion of load from Toronto ZS.

The estimated capital cost for the development of Rathmines permanent zone substation and its associated 132kV and 11kV feeder works, and the decommissioning of Rathmines temporary zone substation is \$27.5M. The estimated capital cost for the entire Strategy 1 is \$53.7M.

The establishment of the proposed new Rathmines ZS is forecast to be completed by late 2012. This service availability date may change if the project is affected by circumstances beyond EnergyAustralia's control, such as changes in the timing of customer load increases or other issues such as: delays in the approval process, equipment supply difficulties, unforeseen technical constraints, acts of God and industrial action.

7. CONTACT DETAILS FOR ENQUIRIES

This report recommends the construction of a new large distribution network asset. Registered Participants may dispute the recommendations of the report under Clause 5.6.2(i) of the Rules. Registered Participants who intend to dispute the recommendations of this report must do so within 40 business days of the report being published and made available on EnergyAustralia's website.

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8. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

WACC = 8.5% p.a.

Strategy 1 – Permanent Rathmines 132/11kV ZS and Future Woodrising 33/11kV ZS

Actions	NPC* [\$K]	CAPEX [\$K]	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Rathmines 132/11kV ZS	22,325	26,375	4,282	1,988	8,834	9,362	1,908	-	-	-	-	-	-	-	-	-	-
Substation works			897	829	7,786	8,270	1,410	-	-	-	-	-	-	-	-	-	-
132kV fdr works			220	197	269	337	59	-	-	-	-	-	-	-	-	-	-
11kV fdr works			165	962	778	756	440	-	-	-	-	-	-	-	-	-	-
Land			3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O&M	1,386		-	-	-	-	-	252	299	299	299	299	299	299	299	299	299
Decommission Rathmines Temp ZS	832	1,153	-	-	-	-	1,153	-	-	-	-	-	-	-	-	-	-
Woodrising 33/11kV 33kV Connections and transfers to Woodrising from Argenton & Toronto	5,570	7,547	-	-	37	1,938	5,573	-	-	-	-	-	-	-	-	-	-
O&M	170		-	-	-	-	-	2	42	42	42	42	42	42	42	42	42
Woodrising ZS	12,460	15,082	-	2,096	5,805	6,784	396	-	-	-	-	-	-	-	-	-	-
O&M	928		-	-	-	-	-	187	198	198	198	198	198	198	198	198	198
Decommission Toronto 33kV Zone	-105	-215	-	-	5	43	31	3	-	-296	-	-	-	-	-	-	-
Awaba STS 33kV feeder network augmentation	2,443	3,197	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
O&M	72		-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
Decommission Awaba STS 33kV Busbar , Tx's	114	178	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-
Woodrising 33kV ZS - Cap bank	210	409	-	-	-	-	-	-	-	-	344	65	-	-	-	-	-
O&M	10		-	-	-	-	-	-	-	-	-	-	5	5	5	5	5
TOTAL	46,415	53,726															

All values are in 2008/2009 real dollars [\$K].

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

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Strategy 2 – Awaba 132/11kV ZS

Actions	NPC* [\$K]	CAPEX [\$K]	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Awaba 132/11kV zone	23,913	29,622		1,257	10,546	15,296	2,524	-	-	-	-	-	-	-	-	-	-
Substation works		23,275		1,257	10,403	10,924	691	-	-	-	-	-	-	-	-	-	-
132kV fdr works		6,347		-	142	4,372	1,833	-	-	-	-	-	-	-	-	-	-
O&M	1,595		-	-	-	-	-	293	344	344	344	344	344	344	344	344	344
Load transfer from Toronto to Awaba 132	8,675	11,534	-	-	-	5,756	5,778	-	-	-	-	-	-	-	-	-	-
O&M	589		-	-	-	-	-	39	138	138	138	138	138	138	138	138	138
Load Transfer from Argenton & Rathmines temp to Awaba 132	7,413	10,693	-	-	-	-	5,335	5,358	-	-	-	-	-	-	-	-	-
O&M	466		-	-	-	-	-	-	36	128	128	128	128	128	128	128	128
Decommission Rathmines Temp ZS	767	1,153	-	-	-	-	-	1,153	-	-	-	-	-	-	-	-	-
Decommission Toronto 33kV ZS	-105	-215	-	-	5	43	31	3	-	-296	-	-	-	-	-	-	-
Awaba STS 33kV feeder network augmentation	2,443	3,197	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
O&M	72		-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
Decommission Awaba STS 33kV Busbar , Tx's	114	178	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-
Awaba 132/11 additional 11x11kV SG panels	1,191	1,809	-	-	-	-	-	1,581	228	-	-	-	-	-	-	-	-
O&M	81		-	-	-	-	-	-	-	22	24	24	24	24	24	24	24
TOTAL	47,214	57,971															

All values are in 2008/2009 real dollars [\$K].

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

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Strategy 3 – Myuna 33/11kV ZS and Future Woodrising 33/11kV ZS

Actions	NPC* [\$K]	CAPEX [\$K]	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Myuna 33/11kV ZS	14,099	17,142	-	2,068	6,283	8,351	440	-	-	-	-	-	-	-	-	-	-
Substation works		13,647	-	232	6,283	6,819	314	-	-	-	-	-	-	-	-	-	-
132kV fdr works		1,659	-	-	-	1,532	127	-	-	-	-	-	-	-	-	-	-
Land		1,836	-	1,836	-	-	-	-	-	-	-	-	-	-	-	-	-
O&M	877		-	-	-	-	-	170	188	188	188	188	188	188	188	188	188
Load Transfer from Toronto & Rathmines Temp to Myuna ZS	6,660	7,226	-	-	-	3,754	3,768	-	-	-	-	-	-	-	-	-	-
O&M	562		-	-	-	-	-	26	90	90	90	90	90	90	90	90	90
Decommission Rathmines Temp	832	1,153	-	-	-	-	1,153	-	-	-	-	-	-	-	-	-	-
Woodrising 33/11kV 33kV Connections and transfers to Woodrising from Argenton & Toronto	5,570	7,547	-	-	37	1,938	5,573	-	-	-	-	-	-	-	-	-	-
O&M	170		-	-	-	-	-	2	42	42	42	42	42	42	42	42	42
Woodrising ZS	12,460	15,082	-	2,096	5,805	6,784	396	-	-	-	-	-	-	-	-	-	-
O&M	928		-	-	-	-	-	187	198	198	198	198	198	198	198	198	198
Decommission Toronto 33kV Zone	-105	-215	-	-	5	43	31	3	-	-296	-	-	-	-	-	-	-
Awaba STS 33kV feeder network augmentation	2,443	3,197	-	-	43	2,138	1,016	-	-	-	-	-	-	-	-	-	-
O&M	72		-	-	-	-	-	1	18	18	18	18	18	18	18	18	18
Decommission Awaba STS 33kV Busbar , Tx's	114	178	-	-	-	-	-	89	89	-	-	-	-	-	-	-	-
Woodrising 33kV ZS - Cap bank	210	409	-	-	-	-	-	-	-	-	344	65	-	-	-	-	-
O&M	10		-	-	-	-	-	-	-	-	-	-	5	5	5	5	5
Eraring STS Tx uprating	3,008	6,523	-	-	-	-	-	-	-	-	-	3,257	3,266	-	-	-	-
O&M	122		-	-	-	-	-	-	-	-	-	-	-	81	85	85	85
Myuna 1x6MVar capacitors	182	418	-	-	-	-	-	-	-	-	-	-	351	67	-	-	-

* Including future works covering the long term strategy for the area. The NPC also includes operation & maintenance costs.

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Actions	NPC* [\$K]	CAPEX [\$K]	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
O&M	6		-	-	-	-	-	-	-	-	-	-	-	-	5	5	5
Myuna 33/11kV feeder upgrade	1,359	3,948	-	-	-	-	-	-	-	-	-	-	-	-	-	3,647	300
O&M	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eraring STS 33kV CB uprating	204	597	-	-	-	-	-	-	-	-	-	-	-	-	-	502	95
O&M	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	48,604	63,502															

All values are in 2008/2009 real dollars [\$K].