Capital Expenditure: Expenditure Justification Cover Sheet

Project name	Molonglo District Supply Solution
Expenditure type	Capital Expenditure
Business Group	Asset Strategy & Planning
Period	1 July 2014 to 30 June 2019
Five year total spend (2014/15 $s)	$22.7M
CAPEX category & Primary Drivers	• Augmentation CAPEX • Compliance with reliability and security of supply obligations 1. National Electricity Law Chapter 7 *The objective of this Law is to promote **efficient investment** in, and efficient operation and use of, electricity services for the **long term interests** of consumers of electricity with respect to—* *(a) price, quality, safety, reliability and security of supply of electricity; and* *(b) the reliability, safety and security of the national electricity system* 2. Compliance with Utilities (Management of Electricity Network Assets Code) Determination 2013 *This Code requires electricity distributors to protect integrity and reliability of the electricity network and to ensure the safe management of the electricity network without injury to any person or damage to property and the environment.*

Version control

Date	Version	Description	Reviewed	Author
16/11/13	0.3	Internal draft for review	F Gotla	R Goggin
20/05/14	1.0	First issue for Regulatory Submission	G Pallesen	R Goggin
30/11/14	1.4	Internal update for response to AER draft decision	M Schulzer	G Pallesen
05/12/14	2.0	Preliminary DRAFT for internal review. Major update of options including update with 2014 demand forecast	D Stanley	G Pallesen
12/12/14	2.2	Change from RIT-D format to Project Justification Report Format	G Pallesen	S Turki
13/12/14	2.4	Complete review / revision to substantiate economic analysis and recommended option justification	D Stanley	G Pallesen
16/12/14	2.8	Minor amendments and update of NPV	D Stanley	G Pallesen
08/01/15	2.9	Update with independent (Jacobs) Molonglo Zone Sub Estimate	S Turki	G Pallesen
12/01/15	2.10	Inclusion of Demand Side Management information to compare with initial supply solution	D Stanley	G Pallesen

Referenced documents

Document	Version
National Electricity Rules	Version 66
Molonglo District Long-Term Load Forecast (Land Development Agency)	Nov 2014
Zone Development Report Woden Zone	Version 1.0
ActewAGL Peak Demand Forecast 2014	2014
National Electricity Law Chapter 7A “Revenue and Pricing Principals”	19.12.2013
National Electricity Rules Chapter 6.5.7 Forecast capital expenditure	V66
Utilities Act (ACT)	2000
Utilities (Management of Electricity Network Assets Code) Determination	2013

Approval

Manager Primary Systems Strategy	Signature	Date
Branch Manager Asset Strategy and Planning	Signature	Date
General Manager Asset Management	Signature	Date

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Executive Summary

The Molonglo District has a forecast demand growth from 2014/15 to 2042/43 of approximately 1.5MVA to 2MVA per annum. The final electricity load for the Molonglo District is forecast to be 53 MVA[1] in 2042/43.

ActewAGL Distribution (AAD) are developing and executing a long term strategy to provide a secure, safe and reliable supply to the residents of the Molonglo District. Three (3) feeder augmentation projects are planned to provide the first 8.6 MVA of load from existing zone substations before a longer term solution is required. The current demand forecast indicates this initial 8.6 MVA will supply the Molonglo District until 2018/19. The timing of these projects is provided in **Table 1**.

Table 1: Available Network Capacity in the immediate area (planned projects)

Zone Substation (ZS)	Project	Year commissioned	MVA
Woden ZS	Hilder feeder extension	2015	2.7
Woden ZS	Streeton feeder extension	2015	2.7
Civic ZS	Black Mountain upgrade	2017	3.2
Total			**8.6**

Four (4) long term supply options have been assessed in detail. A Demand Side Management (DSM) option was considered to defer the initial network supply solution and discounted based on large disparity in cost. In recognition of the likelihood of DSM being an integral part of the Molonglo District demand requirements a lower 2.5 kVA per household After Diversity Maximum Demand (ADMD) value has been used for developing the long term demand forecast for the Molonglo District. This figure could nominally be in the range of 2.5 kVA to 3.0 kVA.

The four (4) network augmentation options that have been assessed to provide a long term supply solution from 2014/15 to 2042/43 to the Molonglo District include:

1. Do Nothing
2. Molonglo Zone Substation
3. Feeder Augmentations from existing zone substations
4. Woden Zone Substation Extension

AAD's recommendation is to implement Option 2 the new Molonglo Zone Substation, which includes the continuation of the initial 8.6 MVA feeder supply solution from existing zone substations and building the long term secure and reliable supply solution of Molonglo Zone Substation and associated feeders to be commissioned by 2018/19. This timing is a deferral of 12 months from the 2014 subsequent regulatory proposal submission.

Option 2 promotes economic efficiency with respect to direct control network services in reference to the National Electricity Rules Chapter 6.5.7 and provides a solution in the long term interests of the consumer as required by the National Electricity Law Chapter 7.

All financial information in this report is in 2014/15 $s unless otherwise stated. A capital cost of $22.7M is requested for the 2014-19 regulatory period for the construction of a new zone substation to service the long term needs of the Molonglo District. This $22.7M is less than that submitted in the subsequent regulatory proposal as a result of an updated capital cost estimate prepared by Jacobs in January 2015. A 30 year NPV analysis has been completed on the three (3) viable options and includes Energy at Risk and 11 kV feeder losses. The proposed Molonglo Zone Substation is the lowest cost NPV solution at $21.8M[2] to service the forecast demand requirements of the Molonglo District to 2043.

This project is subject to the National Electricity Rules Regulatory Investment Test – Distribution (RIT-D). This and other related regulatory obligations are provided on the following page.

[1] Residential only. Commercial loads are not included in this forecast.
[2] NPV Model includes zone substation, access road and all associated 11 kV feeders

5.17 Regulatory investment test for distribution

5.17.1 Principles

(a) The *AER* must develop and *publish* the *regulatory investment test for distribution* in accordance with the *distribution consultation procedures* and this clause 5.17.1.

(b) The purpose of the *regulatory investment test for distribution* is to identify the credible option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the *National Electricity Market* (the preferred option). For the avoidance of doubt, a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action.

National Electricity Law Chapter 7 —National electricity objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for **the long term interests of consumers** of electricity with respect to

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system. "

6.5.7 Forecast capital expenditure

(a) A *building block proposal* must include the total forecast capital expenditure for the relevant *regulatory control period* which the *Distribution Network Service Provider* considers is required in order to achieve each of the following (the *capital expenditure objectives*):

(1) meet or manage the expected demand for *standard control services* over that period;

(2**) comply with all applicable *regulatory obligations*** *or requirements* associated with the provision of *standard control services*;

(3) to the extent that there is no applicable *regulatory obligation or requirement* in relation to:

(i) the quality, reliability or security of supply of *standard control services*; or

(ii) the reliability or security of the *distribution system* through the supply of *standard control services*,

to the relevant extent:

(iii) **maintain the quality, reliability and security of supply** of *standard control services*; and

(iv) **maintain the reliability and security of the *distribution system*** through the supply of *standard control services*; and

(4) **maintain the safety** of the *distribution system* through the supply of *standard control services*.

The methodology and estimated costs are developed through the application of industry knowledge and Good Engineering Operating Practices based on historical similar projects. This approach complies with paragraphs 6 & 7 of National Electricity Law (NEL).

NATIONAL ELECTRICITY (NSW) LAW - SECT 7A

Revenue and pricing principles

When providing an estimate for a project, state that the estimate is commensurate with the economic costs and risks of the potential for under and over investment by a regulated network service in reference to Section 7A of the National Electricity Law, paragraph 6 & 7.

AAD has an obligation to comply with the Utilities Act 2000 (ACT) which imposes specific technical, safety and reliability obligations on AAD.

Utilities (Management of Electricity Network Assets Code) Determination 2013
The Management of Electricity Network Assets Code is a technical code under Part 5 of the *Utilities Act 2000* (the Act).

5.3 Safe Design, Construction, Operation and Maintenance
(1) An electricity distributor must design, construct, operate and maintain its aerial lines, underground lines, substations, equipment and metering with reasonable care to avoid injury to any persons or damage to property or the environment and to provide a reliable and efficient power supply.

1. Strategic Context & Expenditure Need

1.1 Existing Supply Arrangements

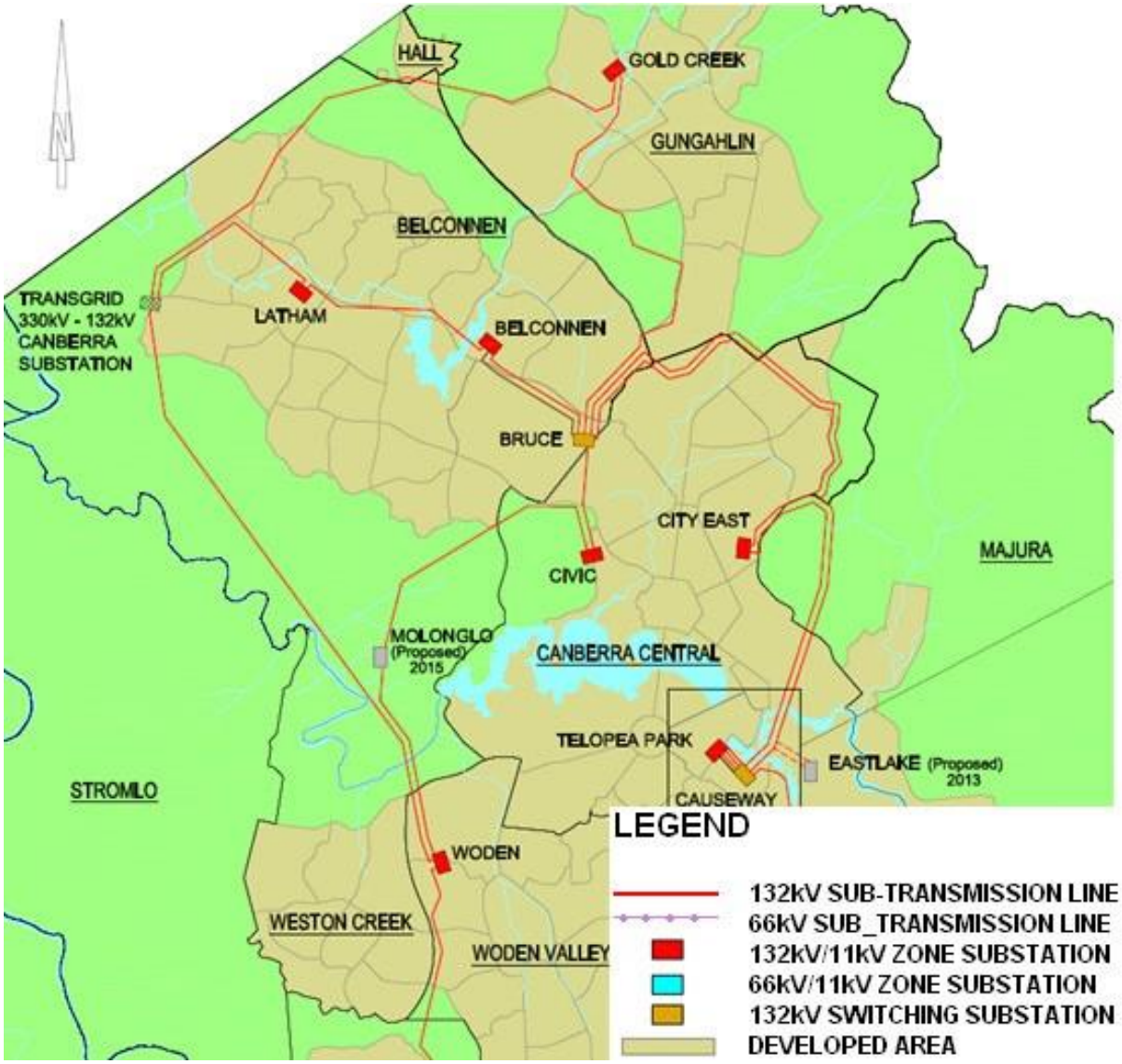
The Molonglo District is situated in Canberra's west, approximately 10 km from the Canberra Central Business District (CBD). It lies to the north of the urban areas of Weston Creek and south of Belconnen. Land servicing has commenced for the initial developments and when fully developed (by 2042/43), the Molonglo District will support an estimated 55,000 people. Future land uses for the Molonglo District include residential, shopping centres, schools and community facilities.

There are four (4) existing zone substation facilities within 10 km of the proposed Molonglo Zone Substation. These are Latham (8.5 km), Belconnen (7.2 km), Civic (5.3 km) and Woden (5 km). Figure 1 shows the geographical overview of the ActewAGL 132 kV network and zone substations surrounding the Molonglo District.

Woden zone substation is presently servicing the Molonglo District and will continue to do so by extending nearby 11 kV feeders with available capacity. Feeder augmentation works are planned in 2015 – 2017. The demand growth in the Molonglo District is forecast to exceed the augmented feeder capacity by 2018/19[3].

[3] Refer Table 2, which includes a feeder augmentation project from Civic Zone Substation

Figure 1: Geographical map of AAD's 132 kV network and zone substations



There are three (3) augmentation projects planned to supply the initial load to the Molonglo Valley before a longer term solution is required. These three (3) projects are summarised in **Table 2**. These feeder augmentations are included as the 'baseline initial supply solution' for each of the options assessed in this report.

Table 2: Initial Molonglo District Supply Solution – Feeder augmentation planned projects

Zone Substation	Project	Commissioned Year	MVA
Woden ZS	Hilder feeder extension	2015	2.7
Woden ZS	Streeton feeder extension	2015	2.7
Civic ZS	Black Mountain upgrade	2017	3.2
Total			**8.6**

1.2 Need for Augmentation

AAD's 2014 demand forecasting[4] has forecast a requirement to provide a long term electricity supply solution to the Molonglo District from 2014/15 to 2042/43. This consists of the provision of an initial supply from existing zone substations and a longer term solution being commissioned by 2018/19 when a supply constraint has been identified.

1.3 Strategic Issues

The Molonglo District is located approximately 10 km from the Canberra Central Business District (CBD) with supply from an existing 11 kV feeder - "Cotter" from the Woden zone substation. The site for the proposed Molonglo Zone Substation was purchased in 2012 and Development Application (DA) approval was granted for the construction of a new substation in Oct 2014. Long term access to the proposed zone substation site has been secured via an upgrade to a road that traverses the Arboretum. The costs for these road works are included in the Molonglo Zone Substation option. The planning of the Molonglo Zone Substation has been completed in close consultation with the ACT Government's Land Development Agency (LDA).

Feeder augmentation projects from Woden and Civic Zone Substations (Streeton, Hilder and Black Mountain 11 kV feeders) are planned to meet the initial Molonglo District electricity supply requirements, however the 2014 demand forecast indicates a supply constraint during 2018/19 at which time AAD has assessed it is prudent to ensure that the long term Molonglo Valley electricity supply solution is available to meet the needs of the planned 55,000 consumer base in the Molonglo District in providing a reliable and secure electricity supply.

To meet the forecast demand beyond 2018/19, a new single transformer 132/11 kV substation is the preferred option (Option 2) to supply the Molonglo District for the provision of power to new suburbs in Molonglo and North Weston. The new zone substation will also have the capability to supply a portion of load in Weston Creek currently supplied from the Woden Zone Substation, thereby deferring the need for capacity augmentation at the Woden Zone Substation for approximately ten (10) years.

In addition to the proposed Molonglo Zone Substation, this report also considers other alternative long term solutions i.e. feeder supply option from existing zone substations and electricity supply from an existing zone substation expansion option.

AAD has reviewed its existing distribution network configuration in the vicinity of the Molonglo District. Four (4) existing zone substation facilities are within 10 km of the proposed Molonglo Zone Substation and are considered as potential locations from which to establish feeder connections or potentially augment capacity to provide as the primary supply source for the Molonglo District. The consideration of these options cover the prudency test in that, 'reasonable' solutions available have been considered. Note that DSM options have not been assessed in detail and are not considered as viable long term electricity supply solutions on their own, however it is assumed that DSM will play a core role in minimising the demand requirements in the Molonglo District and a lower 2.5 kVA per residence ADMD has been used in demand forecasts. This is at the lower end of a 2.5 kVA to 3.0 kVA range for residential loads.

Consideration of all feasible options resulted in the evaluation of following four (4) options, each of which was treated as mutually exclusive in the evaluation process for the purpose of meeting the core objective of promoting efficient investment in the long term interests of the electricity consumers:

1. Do Nothing
2. Molonglo Zone Substation
3. Feeder Augmentations from existing zone substations
4. Woden Zone Substation extension

[4] This demand forecast Includes Nov 2014 ACT Land Development Agency residential occupancy forecasts for the Molonglo District, but excludes commercial occupancy forecasts, which are envisaged to be realised in around 2024/25.The forecast is based on dwelling occupation forecasts and considers the timing delay between the purchase of the land and dwelling occupation

1.4 Molonglo District Demand growth

The forecast demand growth is based on the details of dwelling occupations which were provided by the ACT Government (Treasury and Economic Development Directorate), with a reference date of November 2014. **Table 3** shows the forecast dwelling occupations and demand growth to February 2043.

Table 3: Forecast dwelling occupations and demand growth to February 2043[5]

	Molonglo Total Dwelling Occupations Forecast Nov 2014 – estimated 2.5kVA per dwelling										
	Feb-13	**Feb-14**	**Feb-15**	**Feb-16**	**Feb-17**	**Feb-18**	**Feb-19**	**Feb-20**	**Feb-21**	**Feb-22**	**Feb-23**
Dwelling Occupations	35	285	855	1,538	2,228	2,878	3,478	4,078	4,678	5,328	6,028
Total (MVA)	0.09	0.713	2.137	3.845	5.57	7.2	8.7	10.2	11.7	13.32	15.07
	Feb-24	**Feb-25**	**Feb-26**	**Feb-27**	**Feb-28**	**Feb-29**	**Feb-30**	**Feb-31**	**Feb-32**	**Feb-33**	
Dwelling Occupations	6,678	7,328	7980	8632	9284	9984	10684	11384	12084	12784	
Total (MVA)	16.7	18.32	19.9	21.6	23.3	25.1	26.8	28.6	30.3	32.1	
	Feb-34	**Feb-35**	**Feb-36**	**Feb-37**	**Feb-38**	**Feb-39**	**Feb-40**	**Feb-41**	**Feb-42**	**Feb-43**	
Dwelling Occupations	13484	14236	14988	15740	16540	17340	18140	18992	19944	20896	
Total (MVA)	33.9	35.8	37.7	39.7	41.7	43.7	45.8	48.2	50.6	52.9	

Table 4 indicates that as a result of new dwelling occupations, the demand growth in the Molonglo District will increase from 2.1 MVA in February 2015 to 8.7 MVA in February 2019 - in the current 2014 – 19 regulatory period. With the three (3) planned feeder extensions, AAD are able to supply 8.6 MVA from the Woden and Civic Zone Substations which will provide electricity supply for the forecast demand until 2018/19. Table 3 shows the utilisation of the available network capacity to provide the initial supply to the Molonglo District with these three (3) planned feeder augmentation projects. The load from the Molonglo District is forecast to increase by 1.5 MVA to 2.0 MVA per annum to 52.9 MVA in FY 2042/43.

Table 4: Available network capacity with planned feeder extensions (2014/15 $s)

Zone Substation	Project	Year	MVA	Cost
Woden ZS	Hilder feeder extension	2015	2.7	0.4M
Woden ZS	Streeton feeder extension	2015	2.7	0.35M
Civic ZS	Black Mountain upgrade	2017	3.2	0.85M
Total			**8.6**	**1.6M**

1.5 Key drivers

The key business and regulatory compliance drivers for this expenditure are:

- compliance with the national electricity rules and regulatory obligations;
- maintain security of supply and system reliability;
- promote efficient investment for the longer term benefit of consumers;
- efficient asset management; and
- manage risk (financial, operational, health and safety, environmental and legal).

[5] This demand forecast includes Nov 2014 ACT Land Development Agency residential occupancy forecasts for the Molonglo District, but excludes commercial occupancy forecasts, which are envisaged to be realised in around 2024/25. The forecast is based on dwelling occupation forecasts and considers the timing delay between the purchase of the land and dwelling occupation.

2. Regulatory Compliance

Based on dwelling occupations, the demand growth in Molonglo District is forecast to reach 52.9 MVA in FY 2042/43. Land sales started in 2012/13 with dwelling occupations occurring around 12 months later. AAD has three (3) planned feeder extension projects to meet the initial forecast demand requirements until FY 2018/19 at which time a supply shortfall has been identified, driving the need to establish a long term electricity supply solution for the planned 55,000 consumers in the Molonglo District. It is a legal and regulatory obligation under the NEL, NER and Utility Act (ACT) for AAD to maintain security of supply and system reliability whilst proactively promoting the national electricity objective of making efficient investments in the longer term interests of the consumers.

2.1 Reliability and security of supply:

The Do Nothing Option places AAD in breach of its obligation to provide a reliable and secure supply to the Molonglo District. The recommended option to establish the Molonglo Zone Substation in 2018/19 is required to meet AADs NEL, NER and Utility Act (ACT) obligations. The recommended option considers it basis of the preferred option as being the best option to be delivered in the long term interests of the planned 55,000 consumers which will establish in the Molonglo District between 2014/15 and 2042/43.

National Electricity Law Chapter 7 —National electricity objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for **the long term interests of consumers** of electricity with respect to

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system. “

6.5.7 Forecast capital expenditure

(a) A *building block proposal* must include the total forecast capital expenditure for the relevant *regulatory control period* which the *Distribution Network Service Provider* considers is required in order to achieve each of the following (the *capital expenditure objectives*):
(1) meet or manage the expected demand for *standard control services* over that period;
(2**) comply with all applicable *regulatory obligations** or requirements* associated with the provision of *standard control services*;
(3) to the extent that there is no applicable *regulatory obligation or requirement* in relation to:
(i) the quality, reliability or security of supply of *standard control services*; or
(ii) the reliability or security of the *distribution system* through the supply of *standard control services*,
to the relevant extent:
(iii) **maintain the quality, reliability and security of supply** of *standard control services*; and
(iv) **maintain the reliability and security of the *distribution system*** through the supply of *standard control services*; and

(4) **maintain the safety** of the *distribution system* through the supply of *standard control services*.

AAD has an obligation to comply with the Utilities Act 2000 (ACT) which imposes specific technical, safety and reliability obligations on AAD.

Utilities (Management of Electricity Network Assets Code) Determination 2013
The Management of Electricity Network Assets Code is a technical code under Part 5 of the *Utilities Act 2000* (the Act).

5.3 Safe Design, Construction, Operation and Maintenance
(1) An electricity distributor must design, construct, operate and maintain its aerial lines, underground lines, substations, equipment and metering with reasonable care to avoid injury to any persons or damage to property or the environment and to provide a reliable and efficient power supply.

2.2 Cost compliance:

Cost compliance is achieved by proactively pursuing the philosophy of compliance with the national electricity objective by fully exploring and evaluating all alternatives technically and commercially so as to seek approval for a solution which provides sound grounds for an efficient investment while meeting the long term interests of the consumers.

The investment value has been determined using the 2014/15 market prices.

The methodology and estimated costs used for the Molonglo District supply solution are developed through the application of industry knowledge and Good Engineering Operating Practices based on historical similar projects. This approach complies with paragraphs 6 & 7 of National Electricity Law (NEL).

NATIONAL ELECTRICITY (NSW) LAW - SECT 7A

Revenue and pricing principles
When providing an estimate for a project, state that the estimate is commensurate with the economic costs and risks of the potential for under and over investment by a regulated network service in reference to Section 7A of the National Electricity Law, paragraph 6 & 7.

3. Options assessment

The following four (4) network augmentation options were evaluated to meet the 2014/15 to 2042/43 forecast demand growth of the Molonglo District. The evaluation was completed both from a technical and commercial feasibility for comparison purposes.

1. Do Nothing
2. Molonglo Zone Substation
3. Feeder Augmentations from existing zone substations
4. Woden Zone Substation Extension

AAD also considered the ability to increase the capacity at Woden Zone Substation by upgrading transformer tails and discounted this as a cost effective long term solution. The upgrading of transformer tails at the Woden Zone Substation would result in approximately: a summer "firm / 2 h emergency" rating increase of 5 MVA / 0 MVA and a winter "firm / 2 h emergency" rating increase of 15 MVA / 7 MVA. A similar scenario to this potential 5 MVA increase as a source of supply is considered in Option 3, with 5.5 MVA being supplied from Woden Zone Substation and then the next 5.5 MVA being supplied from Civic Zone Substation – without the need for the additional expense of upgrading transformer tails at Woden Zone Substation and including an additional unnecessary expense for a long term supply solution for the 55,000 consumers in the Molonglo District.

AAD investigated the use of a DSM solution to offset the initial network supply solutions. The cost of providing a DSM solution was based on Diesel Rotary Uninterruptable Power Supply (DRUP) and the comparison shown in Table 5. The DSM solution was not considered further as the investigation clearly shows it is not a viable solution when compared with the alternate network supply options. Table 6 provides details of the DRUP cost basis.

Table 5: Comparison of DSM and Network Solutions for initial Molonglo District Supply

	2015	2016	2017	2018	2019	Total
Demand Forecast - MVA	2.1	3.8	5.6	7.2	8.7	
Network Initial Supply Option (capex)						
Hilder feeder extension	$400,000					**$400,000**
Streeton feeder extension	$350,000					**$350,000**
Black Mountain upgrade			$850,000			**$850,000**
Total	**$750,000**	**$0**	**$850,000**	**$0**	**$0**	**$1,600,000**
DSM Initial Supply Option (opex)						
DRUPS	$1,903,020	$2,854,530	$4,570,670	$5,709,060	$6,660,570	**$21,697,850**

Table 6: Basis of DRUP Generation Costs

Description	Itemised Cost	1MVA	2.5MVA	3.75MVA
1000 KVA generator (per day)	$2,250	$821,250	0	0
2 X 1250 KVA generators (per day)	$5,000	0	$1,825,000	$2,737,500
Cost of network connection cubicle	$10,000 each	$10,000	$20,000	$30,000
AAD Labour for connection	$200	$400	$400	$600
Fence panels	$13.50 each	$270	$270	$405
Delivery for panels	$150	$150	$150	$225
Diesel	$1.60/litre	$26,000	$57,200	$85,800
	Total	***$858,070***	***$1,903,020***	***$2,854,530***

Qualifications, assumptions & exceptions

The following assumptions have been made in assessing the options:

- The cost estimates are based on FY2014/15 prices.
- Consistent with the AER's approval of the Jemena Gas Network's 2014 regulatory proposal[6]:
    - This Molonglo Supply solution Project Justification Report is a Stage 1 project. A Stage 1 project targets a 50% confidence level and recommends a preferred option to address a particular project driver.
    - The cost estimates include a "scope allowance"[7] of 10% to 20%.
- The cost estimates include a 10% - 15% allowance for internal costs[8]. Typical items included in these costs includes:
    - Project management, commissioning management
    - Training & inductions
    - Safety compliance audits
    - Design and standards reviews and approvals
    - Safety, environmental, constructability, operability, quality reviews
    - Legal / commercial reviews
    - Permits
    - Approvals management
- Installation of underground cable and conduit base cost $400/m
- Installation of additional conduit (excluding cable) $50/m
- Installation of cable only in existing conduit estimated at $200/m
- Allowance made for 50% rock, additional cost of rock excavation and/ or drilling estimated at $300/m (extra to base conduit & cable installation cost)
- Feeder length used will reach Molonglo Valley boundary plus an additional 2 km to enter suburbs.
- Zone substation load forecasts based on AAD 2014 demand forecast and long term growth of 0.5 MVA per annum
- Estimates exclude any abnormal site conditions and environmental impacts
- Molonglo load forecast is based on Dwelling occupations
- The economic modeling covers the period 2014/15 to 2042/43
- At Risk Energy Analysis has been included by way of incorporating "Value of Customer reliability" (VCR) in the economic analysis:
    - Length of feeders / Number of Feeders = VCR Length of Feeders
    - Overhead feeders = 10 Outages per annum per 100 km at 2 hours each
    - Underground feeders = 3.5 Outages per annum per 100 km at 2 hours each
    - Cost of VCR = $67.258 per kWh[9]
- 11 kV feeder loss calculations for each option are based on $0.08 kWh average load at 75% of peak demand

[6] Ref: "Appendix 06 09 Project estimation methodology review" of the 2014 approved regulatory pricing proposal - Jemena Gas Networks (NSW) Ltd
[7] ActewAGL - B16.2_Molonglo zone substation 7519206_Project Brief – 2014 "Risk Management Contingency on Estimate Accuracy"
[8] ActewAGL - B16.2_Molonglo zone substation 7519206_Project Brief – 2014 "ActewAGL Internal Costs"

[9] STPIS reliability incentive rates 2015-2019. 30 May 2014

Option 1: Do nothing

The Do Nothing option assumes that no investment is made towards network supply augmentation in the Molonglo District to meet the forecast demand growth of new urban development in this area. This option is in breach of AAD's regulatory compliance obligations to provide a reliable source of secure supply in the long term interests of consumers.

Adoption of 'Do Nothing' option places AAD in breach of fulfilling its regulatory obligations with respect to the system reliability and security of supply.

Option 2: Establish a new zone substation in the Molonglo District (preferred)

Option 2 proposes to establish a new 132kV/11 kV zone substation in the Molonglo District by the end of 2018/19. AAD (in consultation with the ACT Government) has identified and agreed a suitable site for the location of this new zone substation in the Molonglo District. This site has been purchased and has been granted the necessary ACT government approvals. Long term access to the proposed zone substation site has been secured via an upgrade to a road that traverses the Arboretum. Funding for the road upgrade has been included in the cost estimate for this option.

The new Molonglo Zone Substation would initially be equipped with 1 x 55 MVA power transformer with flexibility to add additional transformers in the future to improve security of supply and substation installed capacity. The selection of a 55 MVA transformer is commensurate with AAD's transformer fleet in its distribution network and complies with best practice asset management for which AAD is obligated under the Utilities Act (ACT) "Management of Electricity Network Assets Code" to comply with PAS55 "Optimisation of Physical Assets" and ISO 55001 "Asset Management System".

Utilities (Management of Electricity Network Assets Code) Determination 2013

5.3 Safe Design, Construction, Operation and Maintenance

(1) An electricity distributor must design, construct, operate and maintain its aerial lines, underground lines, substations, equipment and metering with reasonable care to avoid injury to any persons or damage to property or the environment and to provide a reliable and efficient power supply.

(2) The electricity distributor shall maintain a database of all installed network assets including their manufacturer and model number, manufacture date, installation/construction date, attributes, operational parameters, maintenance history and defects, and other relevant details to enable the network to be effectively and efficiently designed, operated and maintained.

(3) The electricity distributor must have an up to date asset management system consistent with PAS 55 Asset Management and ISO 55000 Asset Management.

The Molonglo Zone Substation would be supplied via two 132 kV overhead feeders with provision for a future third underground 132 kV feeder connection. The two 132 kV feeders would connect the substation with the AAD transmission network by cutting into the existing 132 kV line between Civic and Woden Zone Substations.

This approach is commensurate with AAD meeting its NEL obligation for considering the long term consumer needs by making provisions in the initial design for future expansion:

National Electricity Law Chapter 7 —National electricity objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for **the long term interests of consumers** of electricity with respect to

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system. "

As described in section 1.4 of this report, the demand growth of 8.7 MVA until February 2019 in the Molonglo District will be met by planned augmentation works to three (3) existing underground feeders from Woden & Civic Zone Substations.

In summary this option consists of the following program of works:

- Augmentation works to three (3) existing 11 kV feeders from Woden and Civic Zone Substations supplying the Molonglo District - 2014/15 to 2017/18.
- Design, build & commission the Molonglo Zone Substation - 2016/17 to 2018/19
- Design and build new 11 kV feeders from the Molonglo zone substation 2017/18 - 2018/19
- Design and build a new 11kV feeder from the Molonglo zone substation as demand growth continues to increase.

This option targets the commissioning of the Molonglo Zone Substation by June 2019 prior to the 2019/20 summer peak. It is noted the February 2019 forecast constraint is only a minimal exceedence and it is assumed the February 2019 forecast constraint will be mitigated by the existing feeder arrangements exceeding their firm capacity but remaining under their thermal capacity. As part of establishing the initial load for the proposed Molonglo zone substation, loads servicing the Molonglo District will be transferred from Woden and Civic zone substations (approximately 5.4 MVA and 3.2 MVA respectively).

The Net Present Value (NPV) of this option over a 30 year period is $21.8 Million[10].

Implementation of this option optimises security of supply and network reliability whilst also complying with the requirements of the national electricity objective of promoting a cost efficient investment for the longer term benefit of the consumers. Therefore, establishment of a new zone substation in the Molonglo district by FY 2018/19 is the recommended option.

Table 7 provides details extracted from the NPV model showing the $25.3M funding requested for the 2014-19 regulatory period for the recommended Molonglo Zone Substation option.

Table 7: 2014-19 Regulatory Period Capex Requirement for Recommended Option

	2014/15	2015/16	2016/17	2017/18	2018/19	Total 2014-2019 Reg Period
Molonglo ZS			4,146,372	10,365,930	6,219,558	$20,731,860
Substation Access Road			527,046			
11kV Feeder					$1,442,000	$1,442,000
Hilder Ext	$400,000					$400,000
Streeton Ext	$350,000					$350,000
Blk Mtn Upg			$850,000			$850,000
Total	$750,000	$0	$5,523,418	$10,365,930	$7,661,558	$24,300,906
Total exc planned feeder upgrades (funding included in other augmentation capex)	$0	$0	$4,673,418	$10,365,930	$7,661,558	$22,700,906

The cost basis for this option is provided in:

Appendix A – Cost & Scope Basis for Option 2 Molonglo Zone Substation.

[10] Refer Options Analysis section of this report

Option 3: Feeder augmentations from existing zone substations

This option investigates the feasibility to meet the 2042/43 demand forecast of 52.9 MVA by using feeder augmentations from the existing zone substations with deferred power transformer capacity expansion identified as being required in the distribution network in 2026. The three (3) nearest zone substations are at Woden (6 km), Civic (9 km) and Latham (10 km). **Table 8** shows details of the planned works at the three zone substations at Woden, Civic and Latham including their available zone substation capacities and associated feeder augmentation costs.

Voltage regulation support is required for feeders from Civic and Latham Zone Substation due to their length (typically 11kV feeder distances above 8 km require consideration for voltage regulation support). It should be noted that the inclusion of voltage regulation support does not affect the NPV outcome.

Table 8: Feeder augmentation works from existing zone substations

Zone substation	Continuous rating MVA	Two hour emergency rating MVA	Available capacity MVA	Spare 11 kV feeder circuit breakers	Proposed works with year of completion	Cost $M
Woden	95	100	11.8	None	Install 6 km feeder, double up with existing 11 kV breaker to provide 5.5 MVA (conduit exists along John Gorton Drive) – planned completion 2020	2.3
Civic	110	110	48.3	Seven (7)	Install 9 km feeder and three spare conduits to provide 5.5MVA – planned completion 2024. Install 9 km feeder in existing conduit to provide 5.5 MVA – planned completion 2027 Install 9 km feeder in existing conduit to provide 5.5 MVA – planned completion 2030 Install 9 km feeder in existing conduit to provide 5.5 MVA – planned completion 2034	5.4 2.7 2.7 2.7
Latham	95	100	37.4	Three (3)	install 10 km feeder and two spare conduits to provide 5.5 MVA – planned completion 2036 Install 10 km feeder in existing conduit, provide 5.5 MVA – planned completion 2039 Install 10 km feeder in existing conduit, provide 5.5 MVA – planned completion 2041	5.5 3.0 3.0
Capacity expansion[11]	55	TBA	N/A	TBD	Installation of a new 132/11 kV power Tx – planned completion 2026	15.0

[11] This option considers a long term planning horizon to 2042/43. With this option drawing on the available capacity of existing zone substations, it is recognised, from a long term planning perspective and holistically considering the broader distribution network and long term demand growth in areas other than the Molonglo District, that additional capacity will be required by the installation of a 55 MVA power transformer somewhere in the distribution network as a direct result of this option scope.

The planned works program for the feeder augmentation option including estimated costs are shown in **Table 9** below.

Table 9: Planned works program for the feeder augmentation option

Financial Year	Load (MVA)	Cumulative Load (MVA)	Project Capacity (MVA)	Cumulative Capacity (MVA)	Project	Cost ($M)	Woden ZS Load (MVA)	Civic ZS Load (MVA)	Latham ZS Load (MVA)
2013/14	0.625	0.71					83.20	61.70	57.60
2014/15	1.425	2.14	5.4	5.4	Hilder Ext,[12] Streeton Ext	0.75	84.63	61.70	58.60
2015/16	1.7075	3.85		5.4			86.33	61.70	59.60
2016/17	1.725	5.57	3.2	8.6	Blk Mtn Upg[13]	0.85	88.06	61.70	60.60
2017/18	1.625	7.20		8.6			88.06	63.33	61.60
2018/19	1.5	8.70		8.6	Woden Feeder[14]	2.3	89.56	64.83	62.60
2019/20	1.5	10.20	5.5	14.1			91.06	70.33	63.60
2020/21	1.5	11.70		14.1			92.56	70.33	64.60
2021/22	1.625	13.32		14.1	Civic Feeder	8.84	93.06	71.95	65.60
2022/23	1.75	15.07	5.5	19.6			93.56	73.70	66.60
2023/24	1.625	16.70		19.6			94.06	75.33	67.60
2024/25	1.625	18.32		19.6			94.56	76.95	68.60
2025/26	1.625	19.95		19.6	Network Power TX Civic Feeder	15 1.93	95.06	78.58	69.60
2026/27	1.625	21.57	5.5	25.1			95.06	80.20	70.60
2027/28	1.75	23.32		25.1			95.06	81.95	71.60
2028/29	1.75	25.07		25.1	Civic Feeder	1.93	95.06	83.70	72.60
2029/30	1.75	26.82	5.5	30.6			95.06	85.45	73.60
2030/31	1.75	28.57		30.6			95.06	87.20	74.60
2031/32	1.75	30.32		30.6	Civic Feeder	1.93	95.06	88.95	75.60
2032/33	1.75	32.07	5.5	36.1			95.06	90.70	76.60
2033/34	1.875	33.95		36.1			95.06	92.58	77.60
2034/35	1.875	35.82		36.1	Latham Feeder	9.05	95.06	94.45	78.60
2035/36	1.875	37.70	5.5	41.6			95.06	95.45	80.48
2036/37	2	39.70		41.6			95.06	95.95	82.48
2037/38	2	41.70		41.6	Latham Feeder	2.13	95.06	96.45	84.48
2038/39	2	43.70	5.5	47.1			95.06	96.95	86.48
2039/40	2.125	45.82		47.1	Latham Feeder	2.13	95.06	96.45	88.60
2040/41	2.375	48.20	5.5	52.6			95.06	97.95	90.98
2041/42	2.375	50.57		52.6			95.06	97.45	93.35
2042/43	2.375	52.95		52.6			95.06	98.95	95.73

[12] One of the three (3) feeder augmentation projects supplying the initial load
[13] One of the three (3) feeder augmentation projects supplying the initial load
[14] One of the three (3) feeder augmentation projects supplying the initial load

Each feeder augmentation is to be executed one year prior to the identified constraint to ensure there is no shortfall in supplying the forecast demand. All of the planned feeders which are part of this option will be operating at 75% of their thermal rating which will allow for N-1 redundancy when connected to three other feeders. The remaining 25% on each feeder is reserved for contingency conditions which is standard AAD practice across the entire network. This network arrangement will provide a backup supply in the case of a feeder outage due to planned or unplanned works.

The feeder augmentation option includes the installation of eight (8) feeders from various nearby zone substations over the course of twenty-six (26) years to supply the Molonglo District forecast demand. As a result of the feeder installations, network capacity of the supplying zone substations will decrease as the Molonglo District demand increases. This will result in the supplying zone substations to reach their firm capacity earlier than forecast, which will trigger capacity augmentation work within the network to maintain supply to consumers. It is expected that the augmentation work will consist of installation of a new power transformer to increase the network capacity. The location of the installed capacity would be assessed when appropriate demand forecast information is known, which would occur as part of AAD's annual demand forecast process. The cost of the additional power transformer is estimated at $15 Million and forecast to occur in 2026. The timing is based on the forecast demand for the Molonglo District in addition to an estimate of general demand growth (0.5 MVA/year) that will also be supplied from the zone substations in this region (Woden, Civic, Latham). The cost has been estimated from recent projects where a new power transformer has been installed or there is one planned for installation in near future.

The major risks associated with the implementation of this option include:

- Noting that this is a long term (to 2042/43) planning option, there is a risk of zone substation capacity not being available in the future. This will require other augmentation solutions to provide required supply to Molonglo Valley. In essence there is uncertainty around the long term viability of the scope of this option due to external influencing factors outside of the control of this long term supply option.
- The quality, reliability and security of supply may be reduced as this option requires long feeders with multiple joints to be installed in close proximity to each other which has the propensity to increase feeder failure. A 10 km feeder will require 18 joints along the entire feeder. The long distance also has a propensity for voltage regulation issues.
- Obtaining Development Application Approvals is an unknown risk. If approvals are not granted, AAD will be placed in a position of implementing supply solutions that are not in the long term interests of the consumers.

A risk assessment for this preferred option is included in:

Appendix B – Risk Assessment – Option 2 Molonglo Zone Substation

In summary this option requires eight (8) new feeders (from various zone substations), two (2) feeder extensions, one (1) feeder upgrade and capacity expansion over the course of twenty six (26) years to supply the forecast demand of 52.9 MVA in the Molonglo District. Each feeder augmentation is planned to be executed according to the actual demand growth of the area which is monitored on an annual basis. The benefit of this option is that the risk of unserved energy (VCR) will always remain a minimum as projects are executed as required. This option will be competing against other major projects planned for the future such as City to the Lake Redevelopment and West Belconnen Precinct which will affect actual loads at the zone substation level. A system transformer to add capacity to the surrounding area needs to be included in this option to overcome possible load shortfall as a result of the removal of capacity from the zone substations used in this feeder supply solution option.

Option 4: Woden Zone Substation Extension

This option seeks to increase the capacity at Woden Zone Substation to be able to provide for the forecast demand growth of the Molonglo District to 2042/43. Woden Zone substation currently has three 132/11 kV power transformers installed with a combined summer firm rating of 95 MVA. The installation of a fourth 132/11 kV, 55 MVA transformer (and associated infrastructure) will increase the zone firm rating to approximately 145 MVA. The extension of Woden Zone Substation would require the following works:

- Civil works for the extension of earth grid, yard, fencing and substation pad
- Installation and integration of 132 kV gantry, conductors/cables and transformer
- Installation of 11 kV Tx Cables, switch room and switchgear
- All associated protection, SCADA, testing and commissioning
- Eight outgoing 11 kV Feeders to provide supply to Molonglo Valley

The basis of the cost estimate for this option is provided in Appendix C – Option 4 Cost Estimate Basis and is based on a high level project cost estimate developed by AAD's Principal Engineer – Substations. Woden Zone Substation extension is estimated to cost $17.7M and is within the range of other similar projects. Civic Zone Substation extension was completed in 2012 at approximately $22M, while Belconnen Zone Substation extension is planned at an estimated cost of $16.7M.

Planned works program including estimated costs for the Woden Zone Substation extension works is shown in **Table 10** below.

Table 10: Planned works program for the Woden zone substation extension works

Financial Year	Load (MVA)	Cumulative Load (MVA)	Project Capacity (MVA)	Cumulative Capacity (MVA)	Project	Cost ($M)	Woden ZS Load (MVA)
2013/14	0.625	0.71					83.2
2014/15	1.425	2.14	5.4	5.4	Hilder Ext, Streeton Ext[15]	0.75	84.625
2015/16	1.7075	3.85		5.4			86.3325
2016/17	1.725	5.57	3.2	8.6	Blk Mtn Upg[16]	0.85	88.0575
2017/18	1.625	7.20		8.6			88.0575
2018/19	1.5	8.70		8.6	Woden Feeder[17]	3.6	88.0575
2019/20	1.5	10.20	5.5	14.1			89.5575
2020/21	1.5	11.70		14.1			91.0575
2021/22	1.625	13.32		14.1	Woden Feeder	1.2	92.6825
2022/23	1.75	15.07		14.1			94.4325
2023/24	1.625	16.70	5.5	19.6			96.0575
2024/25	1.625	18.32		19.6			97.6825
2025/26	1.625	19.95		19.6	Woden Feeder	1.2	99.3075
2026/27	1.625	21.57	5.5	25.1			100.9325
2027/28	1.75	23.32		25.1			102.6825
2028/29	1.75	25.07		25.1	Woden Feeder	1.2	104.4325
2029/30	1.75	26.82	5.5	30.6			106.1825
2030/31	1.75	28.57		30.6			107.9325
2031/32	1.75	30.32		30.6	Woden Feeder	5	109.6825
2032/33	1.75	32.07		30.6			111.4325
2033/34	1.875	33.95	5.5	36.1			113.3075
2034/35	1.875	35.82		36.1	Woden Feeder	1.2	115.1825
2035/36	1.875	37.70	5.5	41.6			117.0575
2036/37	2	39.70		41.6			119.0575
2037/38	2	41.70		41.6	Woden Feeder	1.2	121.0575
2038/39	2	43.70	5.5	47.1			123.0575
2039/40	2.125	45.82		47.1	Woden Feeder	1.2	125.1825
2040/41	2.375	48.20	5.5	52.6			127.5575
2041/42	2.375	50.57		52.6			129.9325
2042/43	2.375	52.95		52.6			132.3075

Each feeder augmentation is to be executed one year prior to the identified constraint to ensure there is no shortfall in supplying the forecast demand. The total route for the feeders supplying the Molonglo District from Woden Zone Substation is approximately 6 km. There are four (4) existing usable conduits for approximately 3 km along the main road through the Molonglo District which have been taken into account.

The major risks associated with the implementation of this option include:

1. Woden Zone Substation was never designed as a four (4) transformer substation, there are additional integration and connectivity issues associated with expanding a brown field site, which results in a higher project design cost and delivery risk profile. This often also contributes towards increased actual costs and schedule slippage.
2. The majority of the Molonglo District will be supplied by one zone substation with limited connections to other zone substations. This limits network connectivity and flexibility and is not commensurate with AAD meeting its security and reliability of supply regulatory obligations when compared to the recommended option.

This option is for the extension of Woden Zone Substation to increase its firm rating to approximately 145 MVA by installing a new power transformer which can then support the forecast demand of 52.9 MVA for the Molonglo District from 2014/15 to 2042/43. 11 kV Feeders would be installed from Woden Zone Substation into the Molonglo District as required to cater for the forecast demand growth. The zone substation extension is required to be completed in FY18/19 along with the first feeder installation to ensure supply is provided to meet the requirements of the forecast demand for the Molonglo District.

[15] One of the three (3) feeder augmentation projects supplying the initial load
[16] One of the three (3) feeder augmentation projects supplying the initial load
[17] One of the three (3) feeder augmentation projects supplying the initial load

4. Options Assessment

AAD has carried out a technical and economic evaluation of the considered options for the period from 2014/15 – 2042/43 on options 2, 3 and 4.

4.1 Assessment Criteria

The major criterion used for evaluating the options are:

1. NPV Analysis of capital cost, Value of Customer Reliability (VCR) and 11 kV feeder losses;
2. Risk Reduction (minimise any incidence and scope of load-at-risk);
3. Maintaining reliability and security of supply;
4. Optimise asset management;
5. Compliance with the Utilities Act (ACT), National Electricity Rules and regulatory obligations.

4.2 Options Comparison

The summary of the options is included in the **Table 11** below

Table 11: NPV Option Summary

SUMMARY FINANCIAL ANALYSIS RESULTS FOR	***Molonglo Zone Sub***					Menu	
SCENARIO:	***Options Analysis***				**Option**	**Desc**	
Determine least net present cost of options analysed					One	Do Nothing	
					Two	Molonglo Zone Substation	
Project Purpose:					Three	Feeder Augmentations	
To meet reliability and capacity requirements of customers in Molonglo							
					Four	Woden Zone Substation Extension	
					Five	Demand Management	
RESULTS:	***One***	***Two***	***Three***	***Four***	***Five***	***Six***	
Capital Outlay (Real 2014/15 $)	$0	$33,346,682	$59,916,145	$44,771,568	$0	$0	
Nominal Capital & Cash Flows - 50 years	$0	$29,119,817	$68,942,993	$44,162,671	$0	$0	
NPV - 30 years	$0	($21,816,516)	($27,692,581)	($24,925,942)	$0	$0	
Financial Conclusion							
Option 2 provides the lowest NPV outcome over a 30 year period. This analysis includes Energy at Risk (Value of Customer Reliability), 11kV Feeder Losses. Option 2 includes the access road and initial civil works (benching) for the zone substation site.							

The Molonglo Zone Substation (Option 2) has the lowest NPV over 30 years and is the recommended option.

Table 12 shows the budgetary requirement for each option in the 2014 – 19 regulatory period.

Table 12: 2014 -19 Regulatory Period Capex comparison for each option

Option[18]	14/15	15/16	16/17	17/18	18/19	2014-19
1 Do nothing	$0.00M	$0.00M	$0.00M	$0.00M	$0.00M	**$0.00M**
2 Molonglo Zone Substation	$0.00M	$0.00M	$4.67M	$10.37M	$7.66M	**$22.70M**
3 Feeder augmentations from existing zone substations	$0.00M	$0.00M	$0.00M	$0.00M	$2.30M	**$2.30M**
4 Woden Zone Substation Extension	$0.00M	$0.00M	$2.7M	$10.00M	$8.60M	**$21.30M**

4.3 Preferred solution

The recommended option (Option 2 – "Molonglo Zone Substation") is the lowest NPV option and meets the criteria of providing a long term, reliable supply to the planned 55,000 consumers in the Molonglo District by 2042/43. This enables AAD to meet its compliance obligations of the Utilities Act (ACT) and the National Electricity Rules as outlined in the Compliance section of this report.

The detailed economic analysis indicates that establishment of a new zone substation at Molonglo (option 2) is prudent and efficient. A Regulatory Investment Test – Distribution (RIT-D) will be undertaken in accordance with the National Electricity Rules.

5. Recommendations

The forecast demand growth in the Molonglo District of 52.9 MVA in 2042/43 requires establishment of a long term supply solution. To meet this requirement the establishment of a new zone substation at Molonglo is recommended. The Molonglo Zone Substation is planned for commissioning in 2018/19.

Table 13 shows the capital budget required during the 2014-19 regulatory period is $22.7M.

Table 13: 2014-19 Funding Request for Recommended Option

	2014/15	2015/16	2016/17	2017/18	2018/19	Total 2014-2019 Reg Period
Molonglo ZS			4,146,372	10,365,930	6,219,558	$20,731,860
Substation Access Road			527,046			
11kV Feeder					$1,442,000	$1,442,000
Hilder Ext	$400,000					$400,000
Streeton Ext	$350,000					$350,000
Blk Mtn Upg			$850,000			$850,000
Total	$750,000	$0	$5,523,418	$10,365,930	$7,661,558	$24,300,906
Total exc planned feeder upgrades (funding included in other augmentation capex)	$0	$0	$4,673,418	$10,365,930	$7,661,558	$22,700,906

[18] All options include the three (3) planned feeder augmentation projects to supply the initial forecast demand requirements of the Molonglo District. The funding for these projects is included in other Distribution Augmentation Capex.

Appendix A – Cost & Scope Basis for Option 2 Molonglo Zone Substation

Table 14: Cost basis for funding required in the 2014-19 regulatory period for the Molonglo Zone Substation[19]

	Project Delivery Area		2014/15 $s	Comment
1	**Molonglo Zone Substation**			
1.1	Substation Design and Construct		$ 14,900,000	Jacobs Jan 2015 estimate was 2012/13 $s but they advised and included a comment in their reoprt that due to market forces escaltion increases to 2014/15 $s are neglible
1.2	AAD Internal Costs	15%	$ 2,302,050	These cost include Project Management costs of approx 8% and 7% for technical reviews, approvals, commissioning costs, safety in design reviews etc.
1.3	Scope Allowance	20%	$ 3,529,810	A "Scope Allowance" is included in recognition of the limited engineering at the concept stage and that the estimate has an accuracy of +/- 50%. A moderate increase of 20% is included to adjust the delivery costs to a more likely cost of delivery probability. This was previously labelled "Risk management contingency" and is consistent with the AER's approval of the Jemena Gas Network's 2014 regulatory proposal Ref: "Appendix 06 09 Project estimation methodology review" of the 2014 approved regulatory pricing proposal - Jemena Gas Networks (NSW) Ltd
	SubTotal		**$ 20,731,860**	
2	**Substation Access Road**			
2.1	Design and Construct		$ 1,135,575	Mott McDondalds concept design estimate. Upper limit is $1,469,082
	Removal of benching cost (inc in Zone sub scope)		-$ 700,000	The cost estimate completed by Jacobs included approx $700k for benching works.
2.2	ActewAGL internal costs	10%	$ 43,557.50	These cost include Project Management costs of approx 7% and 3% for technical reviews, approvals.
2.3	Scope Allowance	10%	$ 47,913	A "Scope Allowance" is included in recognition of the limited engineering at the concept stage and that the estimate has an accuracy of +/- 30%. A moderate increase of 10% is included to adjust the delivery costs to a more likely cost of delivery probability. This was previously labelled "Risk management contingency" and is consistent with the AER's approval of the Jemena Gas Network's 2014 regulatory proposal Ref: "Appendix 06 09 Project estimation methodology review" of the 2014 approved regulatory pricing proposal - Jemena Gas Networks (NSW) Ltd
	SubTotal		**$ 527,046**	
	11kv Feeders		$ 1,442,000	Further feeder works of $2M is required in 2019/20 which is the next regulatory period
	SubTotal		**$ 1,442,000**	
	Grand Total		**$ 22,700,906**	

[19] Consistent with the AER's approval of the Jemena Gas Network's 2014 regulatory proposal Ref: "Appendix 06 09 Project estimation methodology review" of the 2014 approved regulatory pricing proposal - Jemena Gas Networks (NSW) Ltd The cost estimates include a "scope allowance" of 10% to 20%.

Table 15: Scope Basis for Molonglo Zone Substation

1. 5 x 132 kV switchgear bays
2. 1 x 132/11 kV, 30/35/55 MVA (ONAN/ODAN/ODAF), YNd1 power transformer with air bushing connections on primary side and cable box connections on secondary side
3. 1 x Neutral Earthing Transformer
4. 1 x 11/0.433 kV, Dyn1 auxiliary transformer of adequate kVA rating to suit
5. 1 x 11 kV switchboard with ten circuit breakers – double bus-bars
6. Back up diesel genset
7. Earth grid and lightning protection for the sub
8. Substation earth works, buildings and civil works for all equipment (provision for future substation expansion)
9. Substation weld-mesh security fence and electronic security
10. Substation control, protection and SCADA system
11. Substation auxiliaries
12. The substation connects to the existing 132 kV sub-transmission network via a ‘turn in’ / ‘turn out’ arrangement on the Bruce to Woden overhead line

Appendix B – Risk Assessment – Option 2 Molonglo Zone Substation

Ref #	Risk description	Present Risk			Mitigated Risk			
		Likelihood	Conseq.	Rating	Proposed Controls	Likelihood	Conseq.	Rating
1	Molonglo District forecast demand will exceed local capacity resulting in a supply shortfall	Almost Certain	Major	Very High	Assess and select preferred long term supply solution to meet the forecast demand for the 55,000 consumers.	Rare	Minor	Low
2	Molonglo District forecast demand is overestimated resulting in under utilised assets	Possible	Minor	Medium	Include a non-conservative approach in determining the timing for network constraints and need for long term solution.	Unlikely	Minor	Low
3	Molonglo District forecast demand is underestimated resulting in shortfall of supply capacity.	Unlikely	Moderate	Medium	Ongoing communication with Land Development Agency and revision of augmentation timing based on actual and forecast data.	Rare	Moderate	Low
4	Recommended long term supply solution is unreliable resulting in high SAIDI and SAIFI figures.	Possible	Minor	Medium	Options analysis to include Energy at Risk (Value of Customer Reliability) and technical assessment to meet AAD's reliability planning criteria.	Unlikely	Minor	Low
5	Security of supply is compromised due to lack of network conectivity resulting in longer outages	Possible	Minor	Medium	Recommended solution design tointegrate existing network conectivity and ensure minimum security of supply planning criteria are met.	Unlikely	Minor	Low
6	Demand increase external to the Molonglo District may be higher than forecast, restricting the available supply to the Molonglo District resulting in additional unforseen capital works	Possible	Moderate	Medium	Recommended solution to be independed/not reliant on available capacity on the network which may be at risk due to supply requirements of other competing projects	Unlikely	Minor	Low
7	Inadequate project specifications resulting in cost escalations and time delays to the project completion	Possible	Major	High	Review technical specifications, assess / engage industry recognised suppliers / contractors. Utilise external experts to develop specification or review specifications. Consider appointing an Owners Engineer.	Unlikely	Major	Medium
8	Delay in project implementation	Possible	Major	High	Appoint compentent PM with recent similar sucessful project delivery experience. Follow Prince 2 project delivery principles and maintain proactive approach through escalation of issues with the relevant stakeholders through consultative process	Unlikely	Major	Medium
9	Poor work practices / inadequate design of installation leads to collateral damage to third party assets	Possible	Minor	Medium	Use reputable contractor and review and audit designs and installation during construction phase	Unlikely	Minor	Low
10	Delay in development approval or development approval conditions, which results in delays in meeting project objectives	Possible	Moderate	Medium	Seek early completion of development approvals	Unlikely	Minor	Low
11	Poor planning leads to an inability to access the project site, resulting in delays in meeting project objectives.	Likely	Minor	Medium	Adequate forward planning	Unlikely	Minor	Low
12	Safety, Quality, Constructibility, Operability issues	Likely	Moderate	High	Embedded and planned reviews inc: Safety in Design, Operaobility, Constructability, Operability. Subsequent monitoring through project delivery and commissioning / handover. Ensure as-built documentation matches design intent. Include in Tender Schedules and Evaluation.	Possible	Minor	Medium
13	An unacceptable environmental impact leads to delays in meeting project objectives	Possible	Moderate	Medium	Adequate forward planning. Monitoring of contractor. Contractor has Environment Management Sytstem certification.	Possible	Minor	Medium

Appendix C – Option 4 Cost Estimate Basis

Addition of 4th power Tx at Woden ZS	
Civic Zone Asset Description	Cost $M 2014/15
Civil Works - Switchyard	1.7
Conduits and Cable ducts	0.3
Fence	0.7
Drainage	0.1
Footings	0.4
Transformer Blast Walls	0.1
Fire Main & Hydrants	0.03
Civil Works - Building	0.5
Control Building	0.8
Steel Structures - Switchyard	0.5
Light Poles	0.0
11kV Switch Boards (10 panel)	2.0
132kV Equipment	
Surge Diverters	0.015
Circuit Breakers	0.6
Isolators	0.2
Isolator earth switches	0.1
Voltage transformers	0.2
Current Transformers - Line	0.2
Current Transformers - Bus	0.2
Overhead conductors	0.1
132/11kV, 55MVA Tx	1.8
11kV Earthing Transformer	0.2
Cabling	2.0
Over Head Busbars	0.1
Primary Equipment Earthing	0.3
Control & Protection Panels	1.5
Communications Panel	0.5
Light & Power Panel	0.05
Battery Charger Panel & Batteries	0.3
Scada system	2.25
Total	**17.75**