PR724: MT GILEAD ZONE SUBSTATION
MAJOR PROJECT BUSINESS CASE

Project	Description
Primary Driver	Network Connection
Project Category	Greenfield Residential
Publish Date	

Approvals	Name	Designation	Date
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Approved			

Revision	Amendment	Date

1.0 Background

The precinct of Mount Gilead is part of the NSW Government's Greater Macarthur Priority Growth Area. Mount Gilead is the subject of a gateway determination process that will open a new development frontier within this priority growth area.

The rezoning of the first stages of development has already occurred with rezoning for the remainder of the precinct imminent. The Mount Gilead precinct will contain up to 17,550 dwellings and 67 hectares of employment lands.

Error! Reference source not found. presents an overview of the Greater Macarthur Priority Growth Area and highlights existing and future investments required. Figure 2 provides a view from the Housing Industry Association in relation to dwelling forecasts for the region showing a recent acceleration of construction starts and a forecast that supports a sustained level of activity that is higher than average.

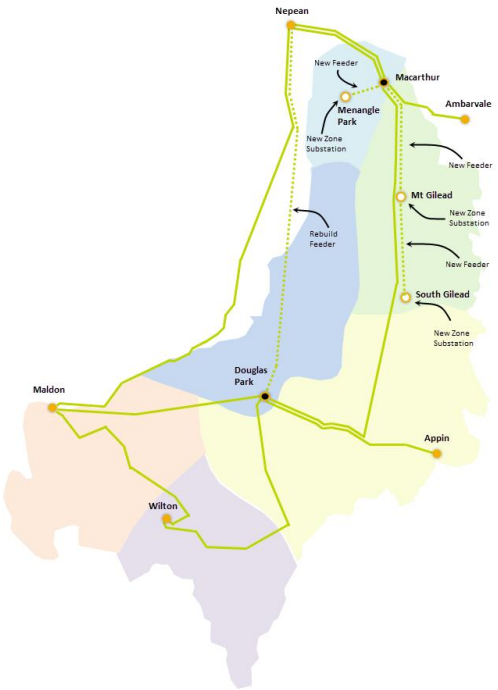


Figure 1 - Overview

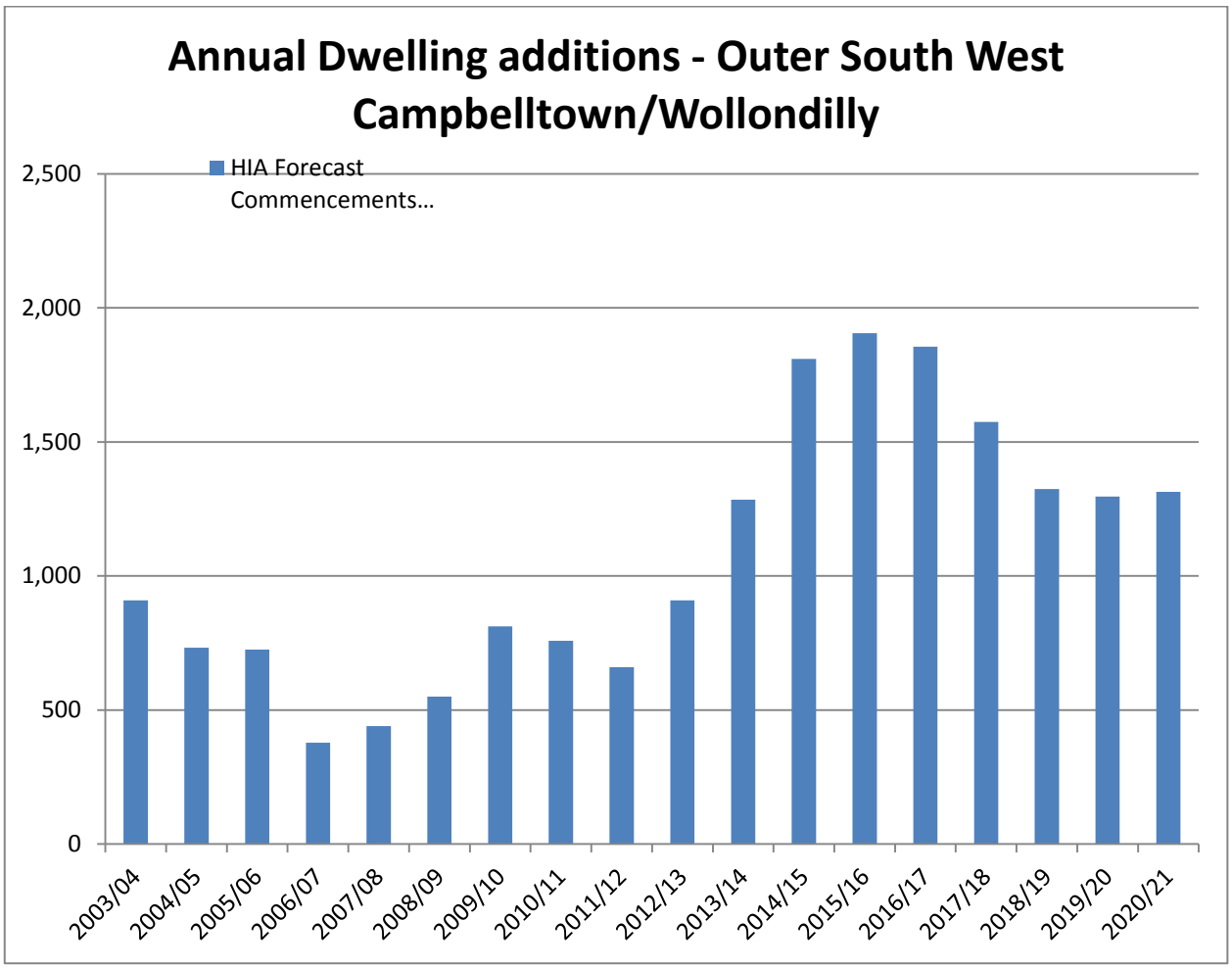


Figure 2 - Trends in residential dwelling commencements and completions. (Source: HIA)

2.0 Need/Opportunity

The NSW Government has begun to release and rezone identified precincts as part of the Greater Macarthur Priority Growth Area. The precinct of Mount Gilead is one of the first precincts to be released since the announcement of the priority growth areas. Furthermore, there has been recent interest in developing areas south of Mt Gilead.

The final total load for up to 17,550 dwellings and 67 hectares of employment land in the Mount Gilead area has an upper bound of 74.2 MVA. This estimate was calculated using average demand per residential dwelling and average demand per square kilometre of undeveloped employment lands. The closest adjacent zone substation is Ambarvale. The distribution feeder in the area is a rural feeder supplying a sparsely distributed, handful of loads. This feeder does not have sufficient capacity to supply a densely populated urban area.

An initial development of 1700 lots in the north eastern part of Mt Gilead closest to Ambarvale ZS can be supplied by establishing a new 11kV feeder. However, due to the distances involved and the limited capacity at Ambarvale the timely construction of an appropriately situated zone substation will be required to meet the growing demand in the area.

2.1 Forecast Demand

Forecast demand for the new precinct Mount Gilead is indicated in **Error! Reference source not found.**Figure 3. Limited initial development in these precincts will be supplied from the existing Ambarvale Zone Substation through the existing distribution network in the area. Connections activity in this region has grown exponentially over the past 5 years (Figure 2) and the Mount Gilead development is part of this market.

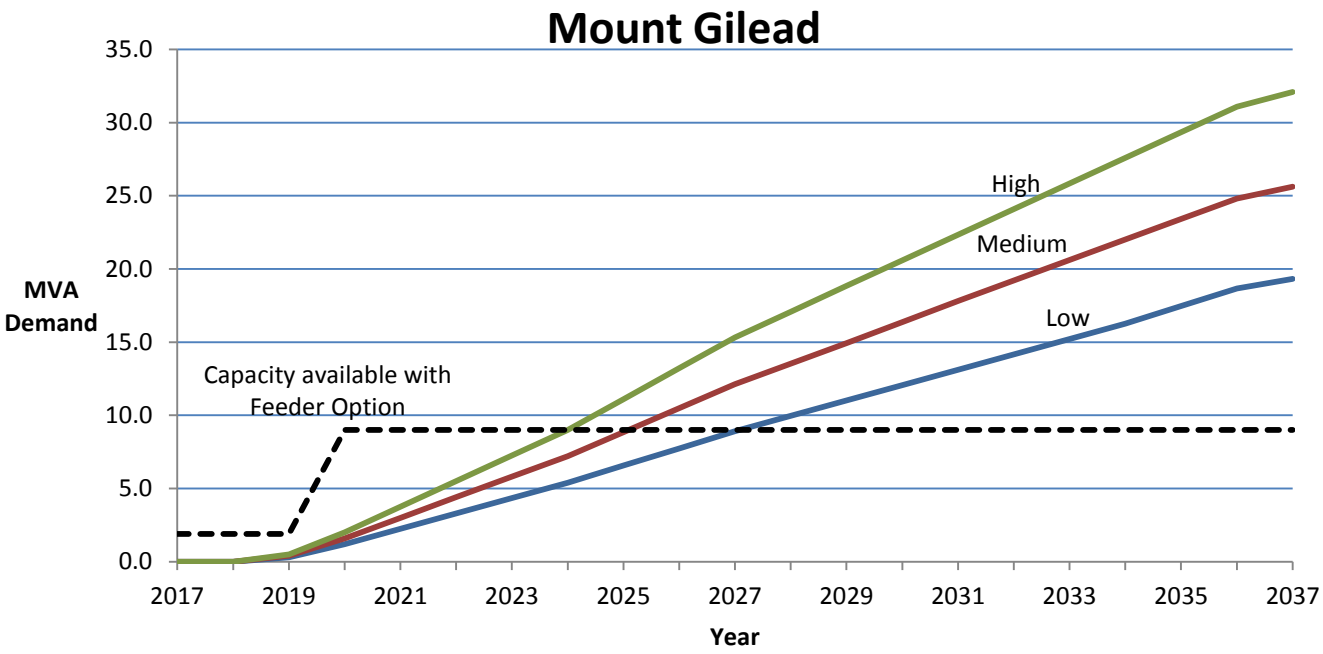


Figure 3 – Mount Gilead Precinct - Forecast residential load

2.2 Existing Supply

The closest supply point to the new precinct of Mount Gilead is Ambarvale Zone Substation which is approximately 4.5 km to the north. The next closest supply is Nepean Zone Substation which is approximately 8km to the North West. However, any connections to Nepean would require river crossings. The Mount Gilead area can be supplied by feeders T866 and T868. Feeder T866 runs adjacent to the north-eastern portion of the precinct and is in close proximity to the site of the first 1700 lots to be developed. T868 runs along the eastern border of the precinct. The feeders have 1.28MVA and 0.61MVA of spare capacity respectively for a total of 1.89MVA. The remaining spare capacity at Ambarvale can be utilised for the north-eastern portions of Mount Gilead by establishing new 11kV feeders.

The existing feeder in the area has enough capacity for approximately 375 dwellings, which is well short of the ultimate dwelling yield of 17,550. For the remaining available capacity at Ambarvale to be utilised additional 11kV feeders would need to be built. However, the available capacity is at best 6.8MVA. Additional feeders built to supply the area in the interim could become redundant if a new zone substation were built. Furthermore, the southern parts of the Mount Gilead area will be beyond the practical urban “catchment area” of Ambarvale ZS and only the northern most areas will be within the 2.5 to 3.5km radius.

2.3 Load at Risk

Available distribution capacity from Ambarvale ZS is only 9MVA. Continued connection of new dwellings development will lead to load at risk on the distribution network, leading quickly to an inability to supply the development. The following table shows the load at risk when considering the available 1.89MVA of capacity from Ambarvale feeders T866 and T868. The remaining available capacity is not considered as it would require additional feeders being constructed.

Table 1 - Load at risk (MW)

Network	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Distribution Capacity LAR (Ambarvale ZS)	-	-	1.0	2.4	3.8	5.2	6.6	8.2	9.9	11.5

2.4 Energy at Risk

The following table shows the energy at risk when considering the available capacity from Ambarvale feeders T866 and T868. The remaining available capacity is not considered as it would require additional feeders being constructed. Based on supply to initial developments within the new precincts, energy at risk over the forecast period is estimated as follows:

Table 2 - Energy at Risk (MWh)

Network	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Energy at Risk	-	-	450	3484	6806	9042	10262	10735	10869	10908
Energy unable to be supplied (no capacity)	-	-	0	99	775	2518	5403	9509	14090	19007
Sum	-	-	450	3583	7582	11560	15665	20244	24960	29915

3.0 Project Value

Continued connection of new customers to the small capacity available within the local distribution network will result in unacceptably high values for expected unserved energy and consequently VCR risk costs.

The precinct requires connections for 17,550 new customers who will be entering the electricity market and generating business for market participants. In greenfield projects the VCR costs are strictly only applicable if supply is available. In this instance, capacity for new connections is only available for the first 473 of these customers, resulting in 17,077 new customers remaining unconnected unless further investment in the network is made. Application of the VCR to these unconnected customers is arguably not appropriate. Hence for the purpose of economic evaluation, an indicative value for the cost of energy has been applied to the energy that is not able to be served. This represents the value that market participants will be deprived of if these unconnected customers remained unconnected. This is considered extremely conservative as the economic costs of customers remaining unconnected are arguably not as high as the connected cost customers would be willing to pay in the event of an outage.

Hence, by establishing additional subtransmission or distribution capacity to facilitate these connections, the following risk of non-supply costs would be addressed and available as benefits to the project proposal.

3.1 Modelled Project Benefits (VCR Risk Costs + Risk of Non-Supply)

Table 3 - VCR Risk Costs

Network	PV of VCR Risk + Non supply Risk Costs
Distribution Capacity from Ambarvale ZS	$182m

The VCR benefits are high for this project as connection capacity will be exceeded in 2020 and if no action is taken development will not be able to proceed.

3.2 Use of Existing Network

The initial development of 1700 lots is expected to commence within the next two years. The capacity required for this initial development is 6.8MVA. The two feeders close to the initial development site only have 1.89MVA of spare total capacity.

The whole development cannot be serviced entirely with distribution feeders from Ambarvale Zone Substation as the substation does not have the capacity and 11kV feeder CBs to meet the ultimate 74.2 MVA demand from the precinct. This level of demand will require more than 17 fully loaded feeders and could cost more than $50 million. Furthermore, Distribution feeders from the Ambarvale ZS will have to traverse distances in excess of 7.5 km in order to service the entire precinct. Increasing density and the long distances traversed will eventually make voltage drop an issue for the feeders. A zone substation would ultimately be required, but there is scope to defer immediate requirements through the establishment of two distribution feeders initially to service the initial 1700 lots.

4.0 Options

4.1 Option 1 – Establishment of Distribution Feeders followed by a zone Substation

The establishment of initial distribution feeders from adjacent substations in such greenfield areas may be considered as credible options subject to several factors including:

- Available transformer capacity at adjacent zone substations
- Available circuit-breakers and switchboard capacity at zone substations
- the availability of suitable routes and established road layouts to establish feeders.

In this case, there is some capacity available within the area from two existing distribution feeders to provide for initial seed development of approximately 375 dwellings. This capacity could easily be exhausted within the first 12 to 18 months of development commencing. Investment in additional capacity is required once this capacity is exhausted.

Analysis indicates that the extension of two 11kV distribution feeders from Ambarvale Zone Substation is feasible and will defer the requirement for a zone substation by four years based on the “medium” forecast. This will allow 1700 lots to be developed before a zone substation is required. Beyond these two new feeders, there will be no more available 11kV circuit breakers at Ambarvale to facilitate connection of additional 11kV feeders.

The 2x 11kV feeders is estimated to cost $4.5million and involves trenching of a major road (Appin). The road is proposed to upgraded in the near future and the 11kV conduits can be installed at the time of road upgrade. Endeavour Energy has already received the application from the developer to subdivide the first 1700 lots.

A zone substation will still be required to be commissioned by FY24, which means work will need to commence in FY22 to ensure connection capacity remains available for development.

The estimated Net Market Benefits from this option has been evaluated to be $195.2 Million and allows for the deferral of the zone substation by four years.

4.2 Option 2 – Establishment of a 66/11kV Zone Substation upfront

The establishment of a 66/11kV Zone substation upfront will have to be closely timed with commencement of development as the lead times offered by the available capacity are not sufficient to allow for construction of a zone substation without interruptions in customer connections.

Mount Gilead Zone Substation is estimated to cost $19.3m in real terms inclusive of associated transmission and distribution works.

The estimated net market benefits from this option has been evaluated to be $194.8 Million.

4.3 Option 3 – Non-Network Options

The principal contributors to the peak demand in this area are the existing rural area along with growth in demand from the new residential development. For demand management to be successful, peak demand on the existing feeders will need to be reduced as well as managing the demand growth in the development areas. However, given that surrounding areas are also developing and connections to these feeders are likely to increase, the available capacity to supply the developing areas reduces and obtaining sufficient demand reduction becomes more challenging. A demand reduction or energy efficiency program is unlikely to achieve the required levels of demand reduction from an existing customer base for this greenfield development area.

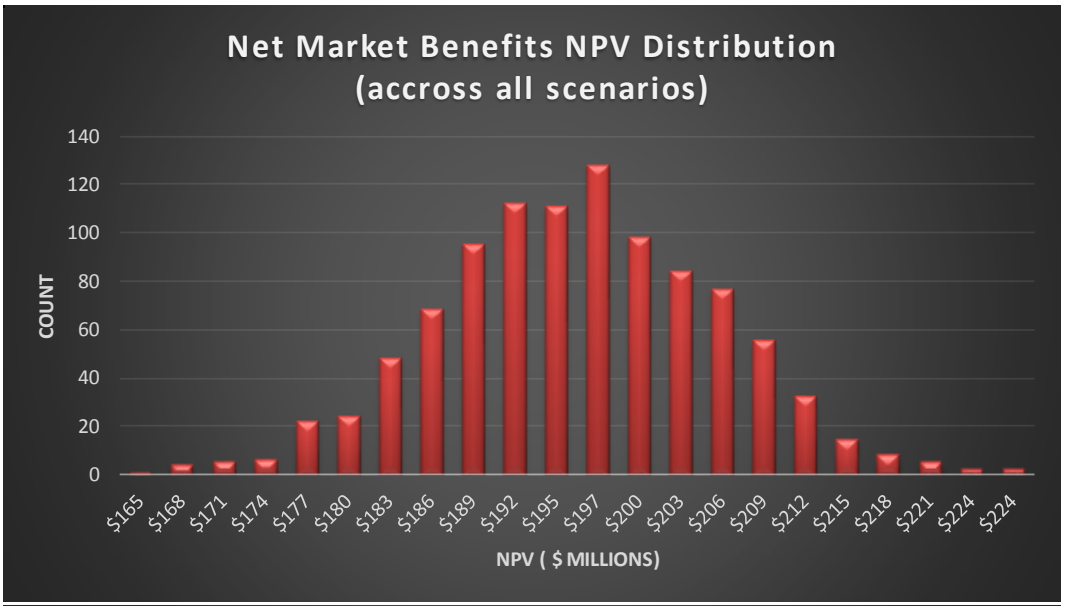
Non-network solutions may be feasible for the new planned developments in conjunction with the developer where sufficient demand reduction exists within the existing customer base in conjunction with the initiatives within the development areas such as distributed energy resources. Newly constructed dwellings within the development areas are built to high energy efficiency standards. The associated demand reduction has been built into the demand forecast for these areas. Non-network solutions may also be feasible in managing the risks of unserviced load thus allowing further connections to be made. These opportunities will be further assessed during the RIT-D phase of the project.

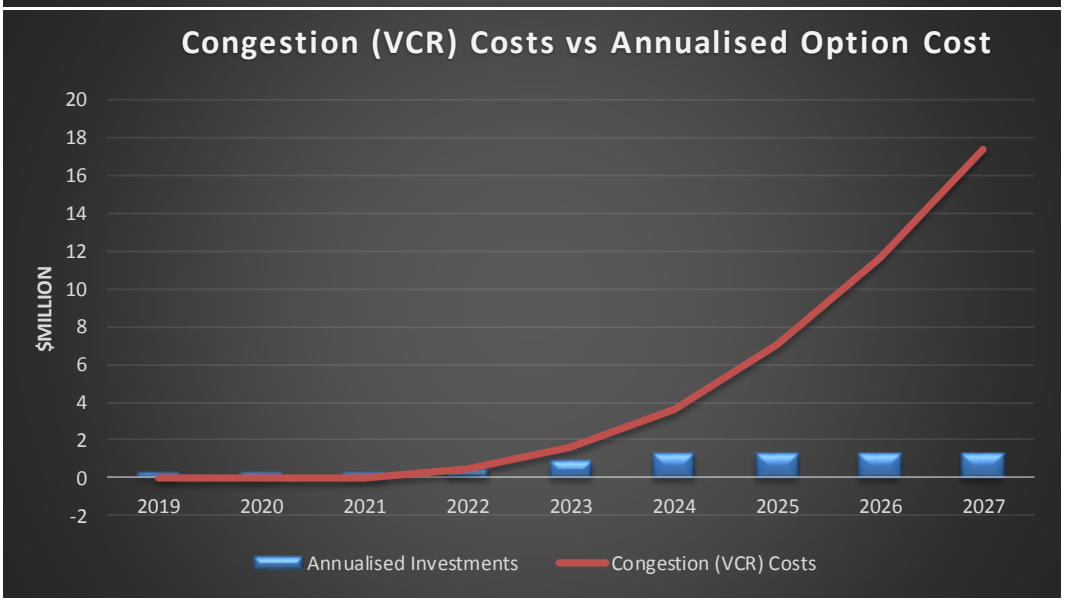
5.0 Conclusion

Based on the rates of growth and limited existing capacity, a zone substation of appropriate capacity needs to be established within the Mount Gilead precinct. The establishment of two distribution feeders from Ambarvale ZS is feasible, delivers marginally better net market benefits and will defer the requirement for a zone substation by four years. However, connection requirements for the subdivision are imminent, with a deferral of four years, investment in the zone substation will still be required within the 2018/19-2023/24 regulatory period.

6.0 Appendix

Probabilistic VCR Template v3 Mt Gilead - ZS + Feeders Option.xlsm			
	PV investments ($m)	PV Market Benefits ($m)	NPV ($m)
Deterministic Assessment	$ 16.5	$ 212.7	$ 196.2
Proabablistic Assessment	**$ 17.7**	**$ 212.3**	**$ 195.2**
PV of Risk Costs (Potential Market Benefits)		**$ 212.5**	
	% Risk		
Risk of Negative Market Benefits	**0%**		





Probabilistic VCR Template v3 Mt Gilead - ZS Upfront Option.xlsm			
	PV investments ($m)	PV Market Benefits ($m)	NPV ($m)
Deterministic Assessment	$ 16.7	$ 212.6	$ 195.9
Proabablistic Assessment	**$ 17.9**	**$ 212.1**	**$ 194.8**
PV of Risk Costs (Potential Market Benefits)		**$ 212.5**	
	% Risk		
Risk of Negative Market Benefits	**0%**