

PR713: BOX HILL ZONE SUBSTATION

MAJOR PROJECT NEED/OPPORTUNITY BUSINESS CASE STATEMENT

Project	Description
Primary Driver	Network Connection
Project Category	GREENFIELD AUGEX
Publish Date	

Approvals	Name	Designation	Date
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Revision	Amendment	Date

1.0 Background

The precincts of Box Hill and Box Hill Industrial is part of the NSW Government's Greater North West Growth Centre. Box Hill was previously had a rural zoning, with large landholdings, making it a greenfield site in terms of urban development.

Box Hill was subject of an approved rezoning to urban development in April 2013. At a similar time a large developer had a large parcel of land at Box Hill North approved for urban development adjacent to but outside the boundaries of the North West Growth Centre. Both these locations will open up a new development frontier within this priority growth area.

The Box Hill and Box Hill Industrial precincts will deliver approximately 10,000 new homes with employment lands and a new town centre with 3 village centres.

The Box Hill North landowning will deliver approximately 4000 new homes with a new town centre.

The entire Box Hill combined areas will deliver 14,000 new homes and two town centres. Development has already begun in both locations with new home owners now starting to occupy the new residential subdivisions.

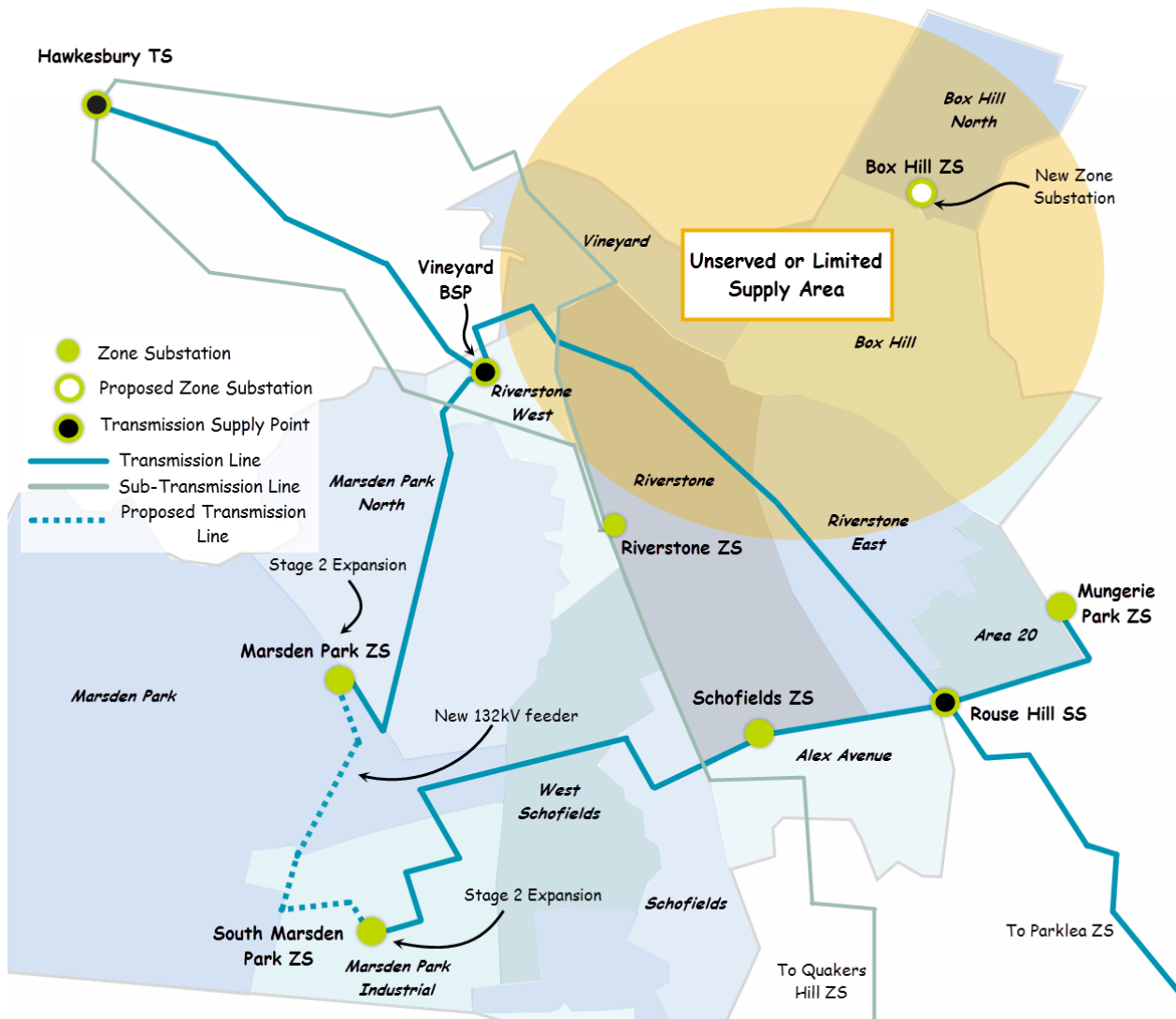


Figure 1 - Overview

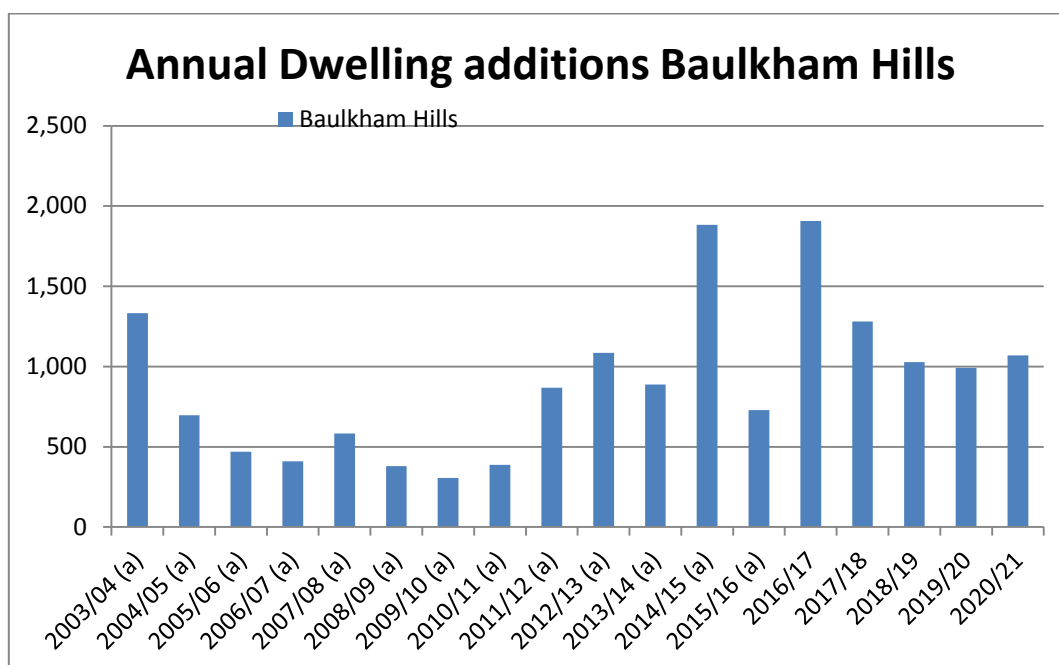


Figure 2 - Trends in residential dwelling commencements and completions. (Source: HIA)

2.0 Need/Opportunity

The NSW Government has rezoned and released the Box Hill and Box Hill Industrial precincts identified as part of the North West Sector Priority Growth Area. The precincts of Box Hill and Box Hill Industrial are now underway since the announcement of the priority growth areas. These two precincts will deliver up to 10,000 new dwellings and with a new Town Centre and a component of industrial zoned land on previously rural lands.

Simultaneously, a large developer has begun delivering new dwellings in the Box Hill North precinct. The Box Hill North precinct will deliver over 4000 dwellings and a Town Centre on previously rural lands. Given supply capacity in the area was restricted significant investment in two additional distribution 22kV feeders was undertaken for initial supplies. This investment included a project to convert the existing rural standard 11kV network to 22kV. The 22kV conversion works allowed previous plans for two zone substations in the area (Box Hill and Box Hill North) to be combined into a single future zone substation project due to the additional reach of the 22kV feeders. These 22kV feeders were commissioned in March 2017 and allowed a deferral of the proposed Box Hill Zone Substation

To provide electrical capacity for the ultimate residential development of 14,000 dwellings at Box Hill, timely construction of an appropriately situated zone substation is now required at Box Hill. This will also minimise investments in what would become redundant distribution assets from other locations.

2.1 Forecast Demand

Demand for the Box Hill and Box Hill North Precincts is expected to ultimately reach 70-80MVA. Of this approximately 63MVA is expected to be new residential load. Demand associated with the existing Box Hill and the Box Hill North precincts will be transferred to the Box Hill ZS solution from the Mungerie Park ZS. The remaining load is expected for some years following the continuing residential development and possible expansion to include parts of the Vineyard Release area fronting the Boundary Rd area

Forecast demand for the new residential component of the Box Hill and Box Hill North precincts is indicated in Figure 3. In Limited initial development in these precincts will be supplied from the Mungerie Park Zone Substation through the existing 22kV distribution network in the area. Connections activity in this region has grown over the past 5 years and the Box Hill catchment is part of this market.

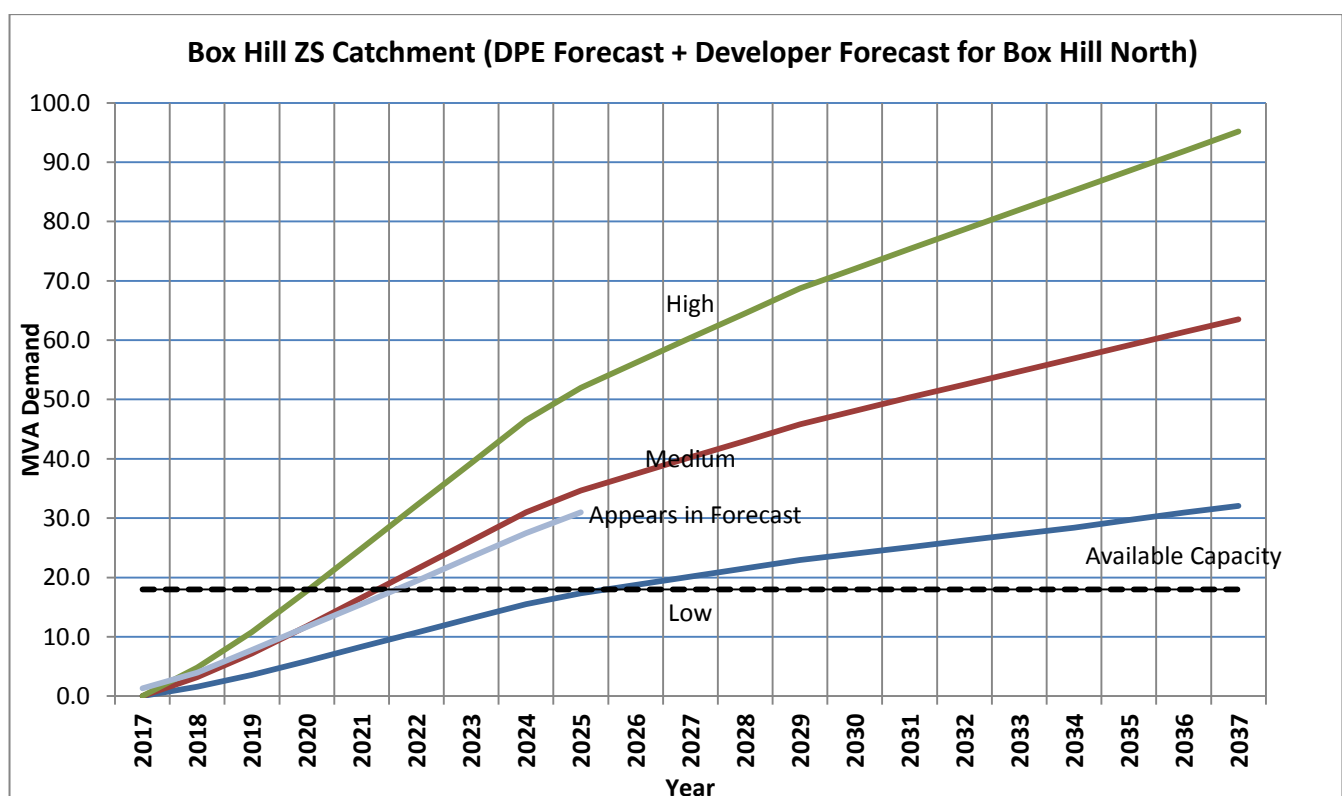


Figure 3 – Box Hill and Box Hill North Precinct - Forecast residential load

2.2 Existing Supply at 22kV

The closest supply point to the new precinct of Box Hill and Box Hill North is Mungerie Park Zone Substation approximately 8 km by road to the south east. Riverstone Zone Substation is a similar distance to the south-west but this zone substation is capacity constrained and is operating at 11kV.

Supply strategy for development in emerging precincts within Endeavour Energy's franchise area is developed based on and assessment of the following general principles:

- magnitude of the load ultimately appearing on the network to assess the impacts on zone substations in adjacent areas to determine if these substations have sufficient sub-transmission capacity available
- available distribution capacity within the developing precinct and the feasibility and practicality of extending further distribution feeders into the area from adjacent regions, including an assessment of what distribution capacity is available at suitable points in the adjacent regions
- distances involved and the availability of developed/final street patterns en-route to the new precinct.
- availability and proximity of suitable transmission lines in the area.
- assets likely to be stranded if a zone substation were to be eventually built to service the new precinct.

Subject to geographical, distance and technical constraints, the extension of one or two distribution feeders from adjacent zone substations to supply new residential developments is often considered feasible and is explored initially if the existing network in the area is inadequate to support some initial development within a new precinct. As the feeder(s) can be later used as inter-zone ties when a new substation asset is eventually built, the risk of stranded assets is mitigated. However, if a zone substation is ultimately required for the development, the extension of further feeders from adjacent zone substations often puts this investment at risk of stranding.

The subject area is presently supplied from 22kV Feeders MR2218 and MR2272 from Mungerie Park ZS. These 22kV feeders were commissioned in April 2017 under "Project PR184 Box Hill 22kV Conversion" to allow existing and ongoing customer connections to proceed and thereby defer the immediate establishment of a Box Hill ZS. Each 22kV feeder is capable of 9 MVA each, allowing a total allowable "n" connection of 18 MVA load. Planning estimates are that a further 22kV cross feeder tie would be required at a demand level of 13 MVA to allow a load of 18 MVA to be supplied at n-1 security.

Based on an ultimate dwelling yield of 14,000 homes, approximately 63 MVA of load is required to service this area excluding existing loads, and two proposed town centres. The precinct would ultimately require about 8 x 22kV distribution feeders to service the area. The existing rural network to the north of this area will be supplied by a 3 MVA 22/11kV Auto transformer to maintain existing 11kV supplies until future 22kV conversion works with Box Hill ZS commissioning are undertaken.

2.3 Load at Risk

Available 22kV distribution connection capacity in the area is 18 MVA. Continued connection of new dwellings will lead to load at risk on the distribution network, resulting in an inability to supply the development.

Table 1 - Load at risk (MW)

Network	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Distribution Capacity LAR 22kV Feeders	-	-	-	2.8	7.6	12.4	17.2	22.0	25.6	28.4

Available capacity from Mungerie Park ZS will also approach its firm capacity of 90 MVA in 2023. Mungerie Park ZS is also supporting load from the Parklea 22kV ZS as well the Kellyville ZS 22kV area. Mungerie Park ZS is supplying its own high growth catchment with 4000 additional homes underway at North Kellyville, supply to the Area 20 precinct and a proposed doubling in the size of the Rouse Hill Town Centre.

This operating condition means that any further 22kV feeders from Mungerie Park ZS to Box Hill will exceed firm capacity at Mungerie Park ZS and start to introduce additional expected unserved energy. A business case to support the establishment of Box Hill ZS will allow the bulk transfer of 18 MVA from Mungerie Park to Box Hill ZS as well as supporting the new residential subdivisions of Box Hill.

2.4 Energy at Risk

On the basis of supply to initial developments within the new precincts, energy at risk over the forecast period is estimated as follows:

Table 3 - Energy at Risk (MWh)

Network	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Energy at Risk	0	0	0	141	1124	3966	9220	16829	23588	29374
Energy unable to be supplied (no capacity)	0	0	0	0	7	124	552	1545	2847	4382
Sum	0	0	0	141	1132	4090	9772	18374	26434	33757

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 up to 14000 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 4500 of these customers, resulting in 9500 new customers remaining unconnected unless further investment in the network is made. The application of the VCR to these unconnected customers is debatable. Hence for economic evaluation, an indicative retail 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 far greater and different from what connected customers would be willing to pay in the event of an outage.

Hence, by establishing additional sub-transmission 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 2 - VCR Risk Costs

Network	PV of VCR Risk + Non supply Risk Costs
Available Distribution Capacity from ZS	\$89.8m

The VCR benefits are high for this project as connection capacity will be exceeded in 2021 and if no action is taken development will not be able to proceed.

4.0 Indicative Options

This section outlines initial indicative options considered as part of the preliminary business case to establish the case for capital investment. A more thorough options evaluation exercise is to be carried out as part of the RIT-D evaluation process prior to actual commitment of funds.

4.1 Option 1 – Establishment of 22kV Distribution Feeders

Endeavour Energy has already invested (\$7m) in establishing conversion to 22kV and 2x22kV feeders from Mungerie Park into the Box Hill area. This was completed in April 2017 to allow the initial Box Hill and Box Hill North residential area to proceed and defer the Box Hill ZS.

The two existing 22kV feeders from Mungerie Park ZS to the Box Hill area are forecast to exceed 18 MVA by 2023. Installed distribution capacity of the two 22kV feeders is 18MVA.

The establishment of further 22kV distribution feeders from Mungerie Park ZS into the Box Hill area will be significantly more expensive than the initial two feeders installed. The first two feeders were established using existing spare conduits in a major road (the most direct route) for a significant portion of the route. An additional 22kV feeder will require major civil works on to install new conduits on a different route and will be a much higher cost per km than the original two feeders. With a total route 8km and sections of unformed rural road it is not considered practical or cost effective. It will impose unnecessary costs on the community for future relocation of the feeders once some of these roads are upgraded. The additional feeder will only defer the zone substation commissioning by 12-18 months, have to be constructed in parallel with the zone substation and is likely to become mostly redundant once the zone substation is built.

The loading on Mungerie Park ZS is forecast to exceed firm capacity in 2023 and hence expected unserved energy will start to accrue if a third feeder is established. Another important consideration is that the Vineyard precinct north of Box Hill has been rezoned on 29/1/2018 for a further 2300 homes and a village centre. This has not yet been factored into demand forecasts.

Based on all of the above reasons a third 22kV feeder is not considered to be a practical option.

4.2 Option 2 – Establishment of a 132/22KV Zone Substation

Endeavour Energy does not own a 132/22kV mobile substation due to the limited number of locations where it could be deployed in the network which is mostly 11kV.

The establishment of a 132/22kV Zone Substation at Box Hill is estimated to cost \$34m (FY19) real allowing for one new 132kV feeder to Vineyard BSP.

This option requires Transgrid to install a new 132kV feeder bay at Vineyard. In the recent draft determination for Transgrid the AER deemed that the need for the Vineyard feeder bay was prudent and efficient based on the timing of the planned Box Hill Zone Substation.

The estimated net market benefits from this option has been evaluated to be \$61.7 Million.

4.3 Option 3 – Non-Network Options*

A Screening for Non Network Options at Box Hill was completed prior to the commencement of construction of the 2 x 22kV feeders built in 2017. The investigation into the demand reduction potential found that a 238kVA demand reduction was feasible. That was based on the 11kV network at that time supplying the new Box Hill release area. However this fell short of the required 1.9 MVA reduction to achieve a one year deferral.

Endeavour Energy received no submissions or proposals from non-network providers in response to the screening report. The load increase of approximately 3 MVA per annum is driven by the development in newly released residential and industrial areas. The non network option would also not sufficiently address the voltage regulation constraints as a result of the rezoning and resultant demand increase.

Endeavour Energy will conduct a further assessment of potential for non-network solutions and consult with interested parties as part of the RIT-D process at an appropriate time to test for economic alternatives to defer network investment.

5.0 Conclusion

Based on the rates of growth and limited existing capacity, the preferred option is the establishment of a zone substation of appropriate capacity within the Box Hill area within the 2018/19-2023/24 regulatory period. Based on current development indicators, to avoid delays in customer connections, the zone substation is required to be commissioned by 2022/23.

6.0 Appendix

Probabilistic VCR Template v4 - Box Hill Full ZS Option.xlsm			
	PV investme nts (\$m)	PV Market Benefits (\$m)	NPV (\$m)
Deterministic Assessment	\$ 26.4	\$ 51.0	\$ 24.6
Proabablistic Assessment	\$ 28.1	\$ 89.5	\$ 61.6
PV of Risk Costs (Potential Market Benefits)		\$ 89.8	
	% Risk		
Risk of Negative Market Benefits	0	%	

