

PR657: CALDERWOOD ZONE SUBSTATION

MAJOR PROJECT BUSINESS CASE

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

| Approvals | Name | Designation | Date |
|-----------|---------------|-------------------------------------|------|
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| Revision | Amendment | Date |
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1.0 Background

The precinct of Calderwood is an emerging residential development in the greater West Lake Illawarra greenfield growth area. The precinct of Calderwood has already been rezoned from rural to urban and will provide up to 6,555 new dwellings across the two local government areas of Shellharbour City Council and Wollongong City Council. Initially, only the Shellharbour City Council portion will be developed with 4,800 dwellings planned as well as providing a mix of commercial/retail space in the town centre. Growth in Calderwood is presently addressed by capacity available at the existing Albion Park Zone Substation which services the existing Albion Park residential and commercial/retail area. Endeavour Energy has committed to supply firm applications already received from Calderwood stages 1, 2 & 3 totalling 1140 lots from the distribution network from Albion Park ZS.

The NSW Government through the Wollongong office co-ordinates the Illawarra Shoalhaven Development Program. It aims to manage continued land and housing supply in the Illawarra and Shoalhaven through implementation of regional strategies.

Figure 1 presents an overview of the West Lake Illawarra growth area and highlights existing and future investments required to service the growing number of businesses and dwellings requiring connection to grid services.

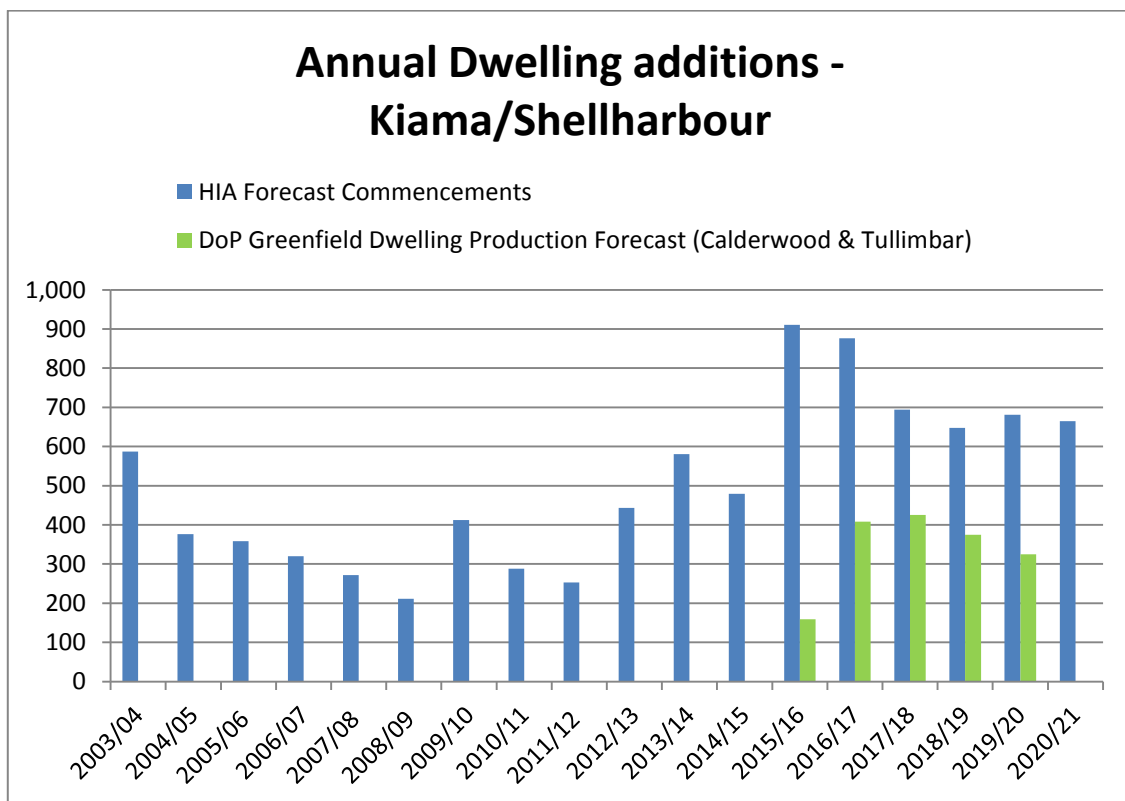


Figure 2 provides alternative views from the Housing Industry Association and the Department of Planning in relation to dwelling forecasts for the region. The HIA data indicates the trend in dwelling commencements whereas the Department of Planning data displays the trend in dwelling production specifically for the precincts of Calderwood and Tullimbar.

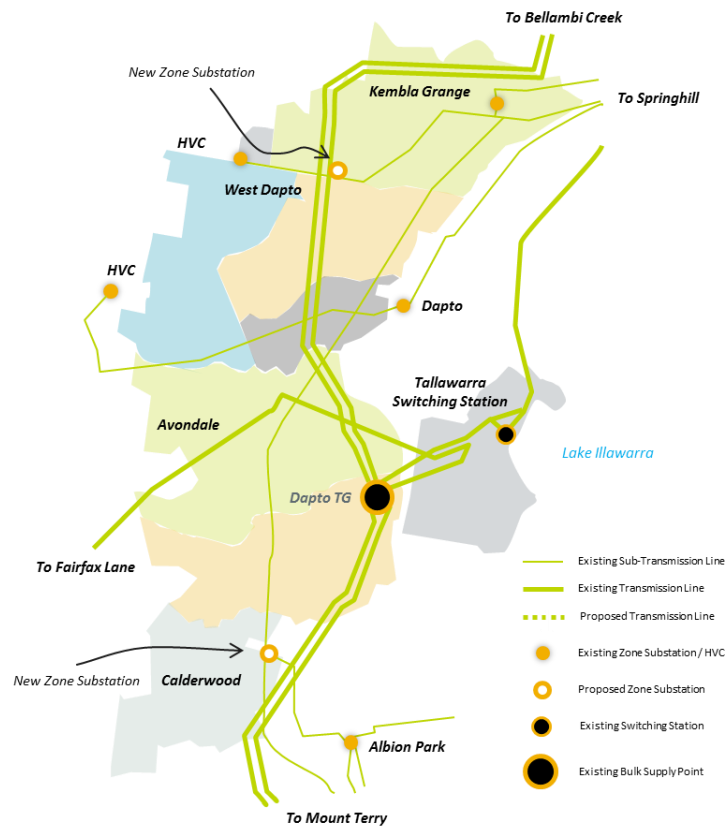


Figure 1 - Overview

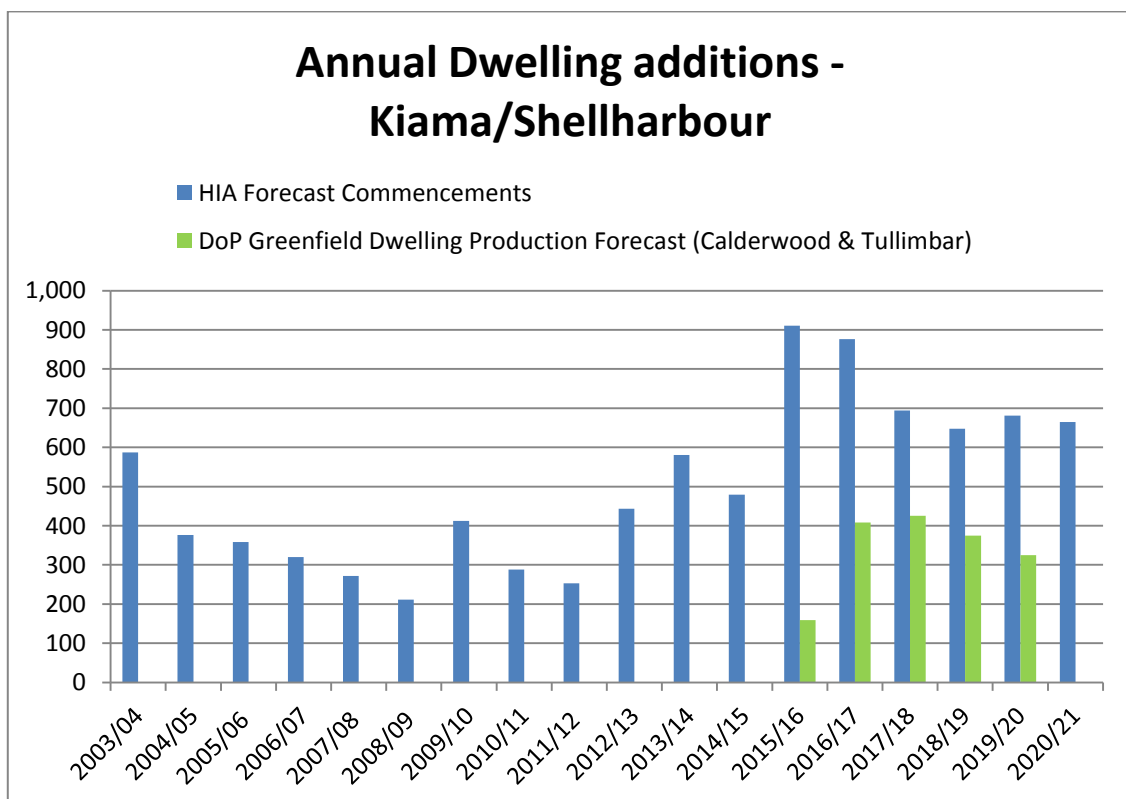


Figure 2 - Trends in residential dwelling commencements and completions. (Source: HIA, Department of Planning)

2.0 Need/Opportunity

Supply to the initial stages of the Calderwood precinct has been managed through capacity being made available from Albion Park Zone Substation. There is an adjacent Tullimbar precinct where additional distribution capacity is being fast tracked to provide sufficient initial capacity for both precincts. Tullimbar will add an additional 660 dwellings. Given the projected dwelling numbers, significant investment in additional distribution feeder capacity is comparable to establishing a zone substation closer to the load within the precinct of Calderwood. Whilst short term supply issues are able to be managed using existing assets, in order to cater for the ultimate development, timely construction of an appropriately situated zone substation will minimise investments in what would become redundant distribution assets.

2.1 Forecast Demand

Forecast demand for the new precinct Calderwood is indicated in Figure 3. Limited initial development in this precinct will be supplied from the existing Albion Park Zone Substation through the existing distribution network in the area. Connections activity in this region has grown consistently over the past 12-months.

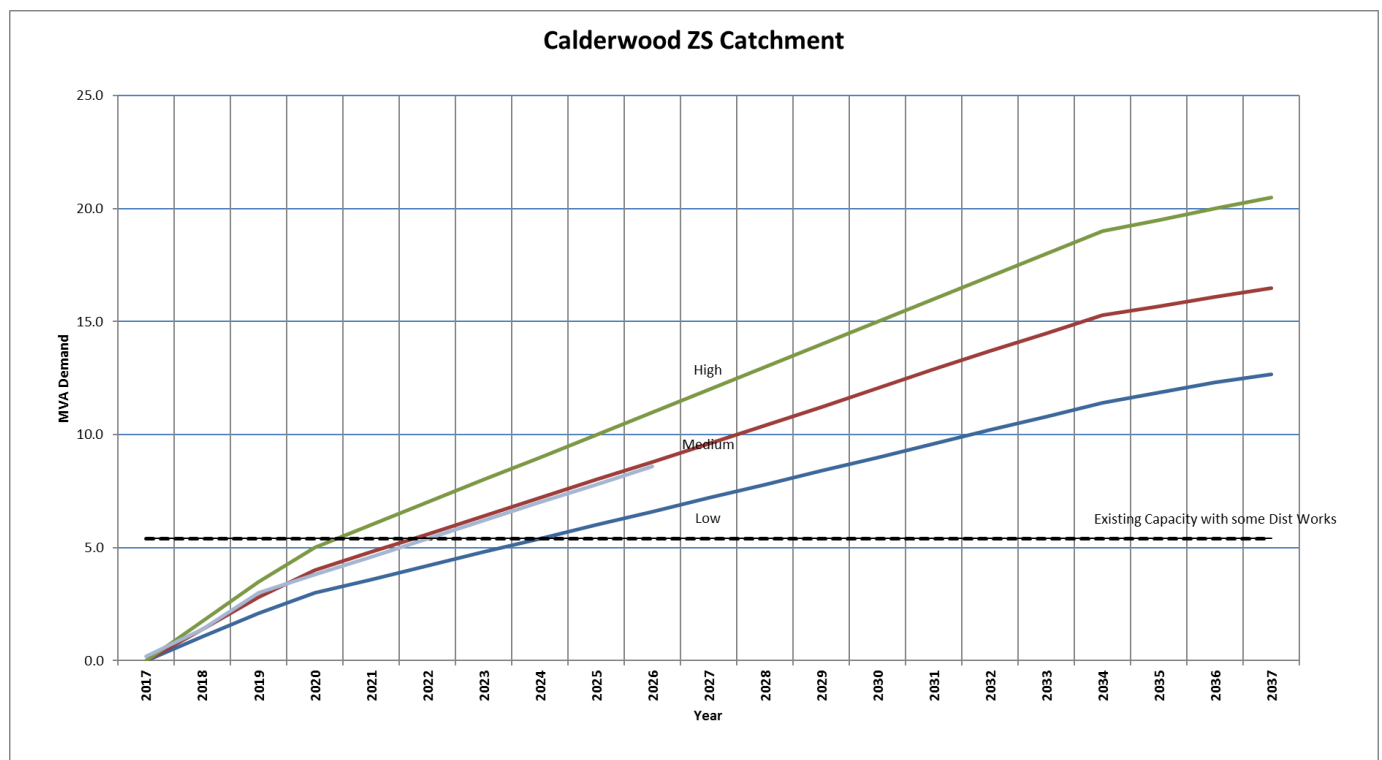


Figure 3 – Calderwood Precinct - Forecast residential load

2.2 Existing Supply

The closest supply point to the new precinct of Calderwood is Albion Park Zone Substation approximately 3.5km to the northwest across the Macquarie Rivulet via a new bridge to gain all weather access to the main precinct area. The existing Calderwood Valley rural properties are supplied from two rural standard 11kV feeders from Albion Park Zone Substation. Dapto Zone Substation is located approximately 8.0km north and has no distribution network within the precinct area.

Based on a dwelling yield of 4,800 approximately 19MVA of load is required to service this area excluding a proposed shopping centre and other community facilities (e.g. school). The precinct would require six 11kV distribution feeders to service the area. As part of a staged strategy to service growth the existing rural network has previously been augmented to a capacity of 5400kVA and is only able to support 1350 dwellings, supplied from Albion Park ZS.

2.3 Load at Risk

Available distribution capacity in the area is 5400kVA. Continued connection of new dwellings following 2018 of the development will lead to load at risk on the distribution network, leading quickly to 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 (Albion Park ZS) | - | 0.2 | 1.0 | 1.8 | 2.6 | 3.4 | 4.2 | 5.0 | 5.8 | 6.6 |

2.4 Energy at Risk

On the basis of supply to initial developments within the new precinct, 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 | 2833 | 6585 | 9242 | 12306 | 14735 | 17529 | 20214 | 22646 | 25027 | 2833 |
| Energy unable to be supplied (no capacity) | 0 | 0 | 4 | 23 | 68 | 170 | 382 | 722 | 1214 | 0 |
| Sum | 2833 | 6585 | 9246 | 12330 | 14803 | 17699 | 20596 | 23368 | 26241 | 2833 |

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 4,800 customers initially who will be entering the electricity market and generating business for market participants. In this instance, capacity for new connections is only available for the first 1350 of these customers, resulting in 3,450 new customers remaining unconnected unless further investment in the network is made. Application of the AEMO VCR to these unconnected customers produces extremely high values for unserved energy. Hence for the purpose of economic evaluation, an indicative retail value for the cost of energy (\$0.23 per kWh) 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 than but 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 Albion Park ZS | \$85.2m |

The VCR benefits are high for this project as connection capacity will be exceeded in 2019 and if no action is taken development will not be able to proceed.

3.2 Project Costs

Distribution feeders from existing zone substations will have to traverse distances in excess of 3.5km & 8.0km for respective existing Albion Park & Dapto Zone Substations in order to service the precinct. Increasing density around existing zone substations will make voltage drop an issue for long feeders. Assuming voltage drop remains within acceptable limits, a minimum of five distribution feeders will be required to service these precincts and will cost in excess of \$20million, however the closest zone substation at Albion Park has 11kV switchboard constraints. It will preclude the opening up of further development frontiers in adjacent future precincts.

A new zone substation an interim form at Calderwood is estimated to cost \$15.9 million inclusive of sub-transmission feeder and 11kV distribution costs (\$15.7m within the next RCP). An interim substation is earmarked as the preferred option here as the 33/11kV mobile substation has been earmarked for another location where there is more potential for capital deferral.

4.0 Indicative Options

4.1 Option 1 – Establishment of Distribution Feeders

As stated previously Endeavour Energy has already taken a staged approach and has invested in augmenting the 11kV network to provide 5MVA of capacity to service growth.

The establishment of initial distribution feeders from adjacent substations in such greenfield areas may be considered as credible options subject to a number of 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, the establishment of additional distribution feeders from Albion Park Zone Substation is not feasible due to lack of available circuit-breakers Albion Park Zone Substation. Being a space constrained brownfield site, it is difficult and costly to expand the 11kV switchboard. Additionally, available firm capacity at this substation is forecast to be exceeded by 2019 based on initial capacity being supplied to the precinct of Calderwood and connections within its own catchment area.

Furthermore, additional feeders from Dapto Zone Substation are not feasible due to lack of available circuit-breakers and spare capacity at Dapto Zone Substation and long distances with limited connecting roads. Available capacity at Dapto Zone Substation is forecast to be exhausted by 2021 based on initial capacity being supplied to the precinct of West Dapto (North) and connections within its own catchment area.

Both Albion Park and Dapto Zone Substation's do not provide suitable feeder routes to establish additional feeders which would have the necessary capacity and voltage regulation to support the required load.

4.2 Option 2 – Establishment of a 33/11kV Zone Substation

The establishment of a 33/11kV Zone substation is ultimately the preferred option on the basis of greater net market benefits over option 1 and given the size and extent of the development precinct. This option also removes forecast load at risk at Albion Park Zone Substation.

The estimated net market benefits from this option have been evaluated to be \$44.3 Million. The results of the VCR analysis are attached.

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.

The market will be consulted in future for non-network solutions may also be feasible in managing the risks of unserved 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 Calderwood Precinct within the 2018/19-2023/24 regulatory period.

6.0 Appendix

| Probabilistic VCR Template v3 - Calderwood v2.xlsm | | | |
|--|-----------------------------|--------------------------------|----------------|
| | PV investmen ts (\$m) | PV Market Benefits (\$m) | NPV (\$m) |
| Deterministic Assessment | \$ 13.5 | \$ 41.7 | \$ 28.2 |
| Proabablistic Assessment | \$ 14.4 | \$ 82.8 | \$ 68.6 |
| PV of Risk Costs (Potential Market Benefits) | | \$ 85.2 | |
| | % Risk | | |
| Risk of Negative Market Benefits | 0% | | |

