Options Paper

Capacity expansion project:

Proposed Baldivis zone substation

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Revision Details

Revision No.	Date	Summary of change	Section
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Contents

Consultation Options Paper Summary

Introduction

Western Power is planning for the future electricity needs of the Baldivis area, which is growing quickly. The current electricity infrastructure is reaching its limits, and action is needed to ensure reliable power for homes and businesses as the community expands.

What's being proposed?

We are proposing to build a new electricity zone substation in Baldivis. This would:

- relieve pressure on the existing Waikiki substation, which is becoming overloaded
- ensure there's enough capacity to meet future demand as more people move into the area
- improve the reliability of electricity supply for everyone in Baldivis and nearby suburbs.

Several options are under consideration, upgrading the existing zone substation at Waikiki, or using temporary solutions like batteries. After careful analysis, building a new substation at Baldivis is recommended as the most cost-effective and reliable long-term solution.

Why is this needed?

Population Growth: Baldivis is one of the fastest-growing areas in Western Australia. More people mean more demand for electricity.
Network Limits: The current system can't keep up with this growth much longer. Without action, there's a risk of power outages and reduced reliability.
Strategic Planning: Investing now prevents larger problems and higher costs in the future.

How are investment decisions made? (Regulatory Test & NFIT)

All major capital investments by Western Power pass through two important checks:

1. **Regulatory Test (major augmentations exceeding specified cost thresholds):**
   This is a "best-choice" check, required before any money is spent. It asks:
   - is this proposal the most beneficial option for the network, the market, the community and for electricity users?
   - have all reasonable alternatives been considered?
   - will this investment deliver the greatest value for money?
   - is it shown these projects will also meet an NFIT assessment (see below)?

   The Regulatory Test is determined by the Economic Regulation Authority (ERA) and helps to ensure that only the most efficient option is selected to before a commitment is made to the acquisition or development of the proposed augmentation.

2. **New Facilities Investment Test (NFIT)**
   When a project is initiated, the NFIT acts as a "value-for-money" check and determines whether investments in network assets are both justified and efficient and can therefore costs be recovered through regulated network tariffs. It provides a routine investment structure to ensure money is being spent prudently and efficiently.
   - Was the investment justified, and was the most efficient solution applied?
   - Were costs reasonable and well-managed?

In essence, the Regulatory Test looks to ensure the right option is selected to guide high-cost network augmentations, while the NFIT validates the prudency and efficiency of capital investments.

Why is the document so technical?

This document is written in technical language because:

- it must provide sufficient evidence and analysis to ensure stakeholders can assess whether all credible options have been considered.
- it needs to demonstrate that the included options have been rigorously assessed, and that the recommended solution is justified on technical, economic, and strategic grounds
- as well as the public and our customers, the audience includes technical experts, regulators, and decision-makers who require precise information to make informed choices.

However, Western Power recognises the importance of making the key messages accessible to the broader community, which is why clear English summaries and consultation materials are also provided.

In summary

Western Power is planning to build a new substation in Baldivis to keep up with rapid growth and ensure reliable electricity for the future. The proposal must pass strict regulatory assessments to ensure it is the best and most efficient option. Public feedback is not just welcomed, it is a required and valued part of the process, shaping the final decision and any future actions.

A full technical explanation of the options assessed follows in the paper, with a summary of the options shown below, in Table 1

Table 1 Options summary

Option	Description	Cost (NPC[1])	Type of solution
1	Do nothing	-	Operational
2	Additional transformer at WAI zone substation	$110.60 million	Network
3	Build a new substation at Baldivis (BVS) in 2030	$81.69 million	Network
4	Contract network support services cost for deferral of BVS by 3 years, [includes the 2033 cost to construct BVS]	$102.68 million	Non-network hybrid
5	Contract network support services cost for deferral of BVS by 5 years, [includes the 2035 cost to construct BVS]	$127.08 million	Non-network hybrid

[1] Net present cost (NPC) can be broadly defined as the present value of all the costs of installing and operating the Option.

How is community feedback used?

Public consultation and community feedback is a vital part of this major augmentation process:

- **Consultation:** This Options Paper is published to invite feedback from all interested parties, for example, the public, local stakeholders, and anyone affected by the proposal.
- **Incorporation:** Comments and suggestions are reviewed and, where appropriate, used to explore, discuss and consider alternative solutions.
- **Regulatory submission:** All feedback is summarised and included in our submission to the ERA to commence the formal regulatory test assessment.
- **Future stages:** when the formal submission goes ahead, further engagement will occur during the ERA assessment of the proposal; and upon commencement of the proposed works.

How you can have your say:

Western Power invites submissions from all interested parties on the major network upgrade described in this paper.

You can provide feedback in several ways:

- **Online**:
  Please go to Home | Let's Talk Power for more information
  Noting that you can register to participate in the online Baldivis stakeholder forum from that link, and find the details of our in-person community engagement sessions

- **Post:**
  Submission – Capacity expansion project: Proposed Baldivis zone substation
  Janica Lukas, Transmission System Planning Manager
  Western Power GPO Box L921
  Perth WA 6842

- **Email**:
  Please use the subject heading "Capacity expansion project: Proposed Baldivis zone substation" and send to: communityenquiries@westernpower.com.au

Deadline:

All feedback, suggestions, and submissions must be received by 19 December 2025.

1. Background

1.1 Introduction

This Options Paper focuses on the Western Power electricity network (WPN) in the Mandurah load area – especially the rebalancing of network supply configurations at Waikiki and Baldivis. As such, it is directly concerned with alleviating supply constraints that are imminent in the Baldivis area, while also considering wider network constraints emerging along the north-south corridor between Mandurah and Rockingham.

At the heart of the discussion is the need to efficiently mitigate the risks associated with the load area's growing demand forecasts and the escalating network constraints. It is noted that this is not a detailed technical or design document. Rather, the objective of this paper is to provide an analysis of credible options (including non-network and alternative options) for efficiently addressing the capacity constraints and long-term supply needs in these areas. The options are presented in a way that allows for determining whether the option maximises the net benefit, as is required by the Access Code. By doing this, the engagement discussions and feedback received can be assessed and included in our upcoming regulatory test submission.

Figure 1 The locality of Baldivis

The greater Baldivis area is often considered as Northern and Southern parts, as shown in Figure 1, with more Baldivis supply details shown below in Figure 3 (a) and (b). Growth in these regions, with a direct link to diminished nearby distribution network capacity, are primary drivers for the augmentation proposed here.

1.2 Rockingham area growth

To provide background to the increasing demand forecasts driving the proposed work, it is helpful to note the relevant high population growth rates. For instance, between 2015 and 2025, Western Australia's

population experienced significant growth[2], with a notable increase from 2.6 million in 2015 to an estimated 3.0 million in 2025[3]. Part of that increase can be attributed to Baldivis, which is in one of the state's top growth corridors.

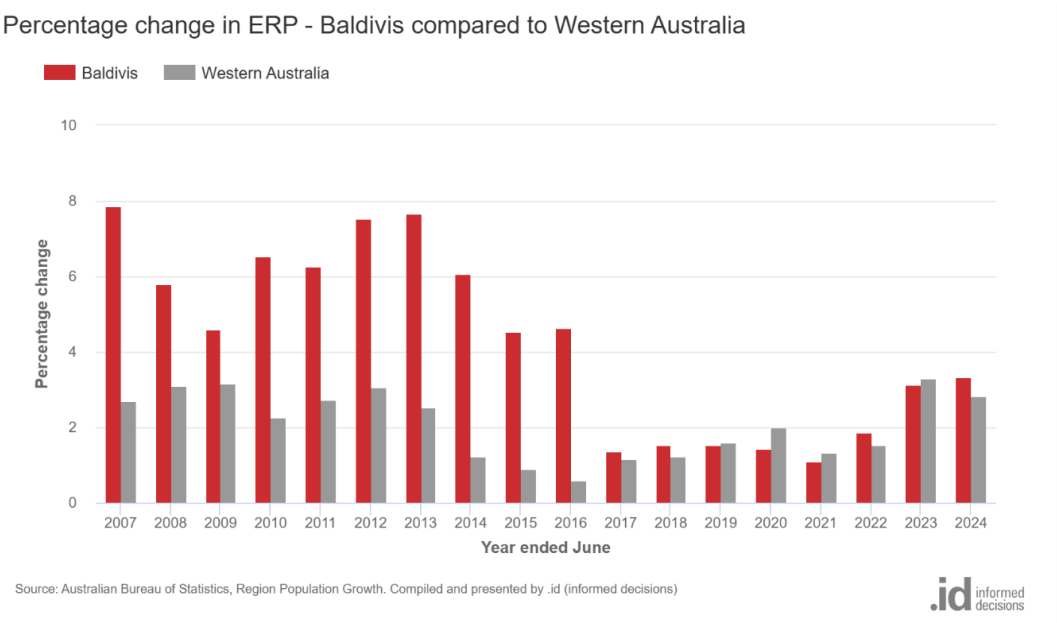


Figure 2 Historical recent population growth in Baldivis versus Western Australia[4]

Comparative WA versus Baldivis population growth is shown in Figure 2, (aggregating North and South Baldivis). This amplifies the concerns driving this proposed augmentation, because the previous rapid growth in Baldivis (esp. for the decade between 2007 and 2016) shows well above average growth. In addition to those numbers, the areas between Rockingham and Mandurah are also forecasted to continue to experience strong population growth in parallel with Baldivis (this is detailed later in Figure 5).

It is noted that the COVID-19 pandemic affected growth during the 2020 to 2023 period, as can be seen in Figure 2, and thus, charts and trends in this discussion should be interpreted accordingly.

1.3 Context of the reconfiguration of Baldivis supply

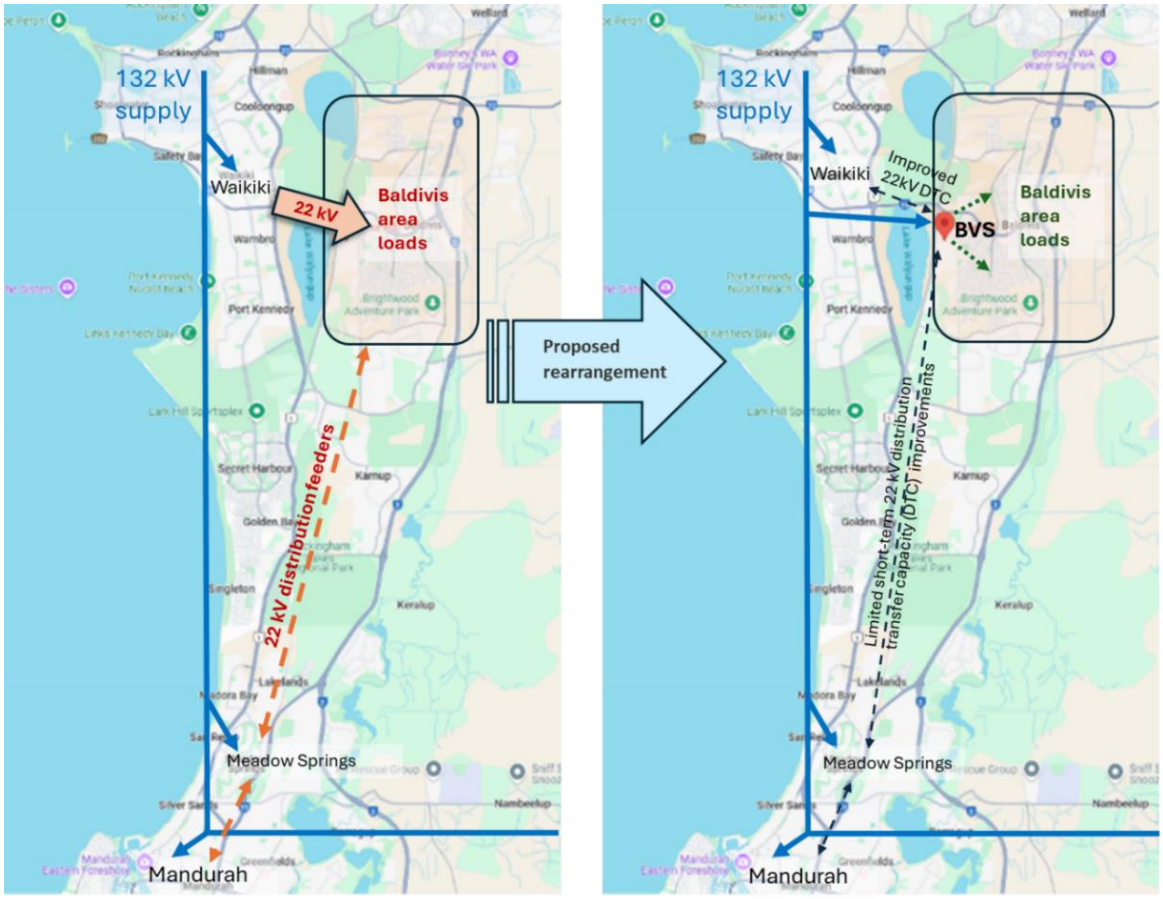
Higher level details for WPN South Metropolitan region (which includes the Mandurah load area) are regularly reviewed under Western Power's short, medium, and longer-term planning work in accordance with its responsibilities under applicable regulatory obligations[5].

WPN planning analyses are published in the annual Transmission System Plan (TSP), with the most recent version being TSP 2024. In an iterative way, planning assessments build on previous understandings – and these are extrapolated annually, 5 yearly, and into longer-term outlooks to derive scopes of work to be implemented in specific projects. Each project and program of work is subject to governance, regulatory and risk frameworks, as we formulate them into prioritised 'prudent and efficient' network investments.

Although the key considerations for the present augmentation focus on Waikiki zone substation and its Baldivis loads configurations (as per Figure 3 (a) and (b) below), a complete assessment of potential long term development options will have to deal with growth related impacts within the wider Mandurah load

2 Western Australia Tomorrow 12 Population Forecasts
3 About the forecast areas | Australia | Population forecast
4 Estimated Resident Population (ERP) | Western Australia Parliamentary Library | Community profile
5 for example, see the Transmission System Plan, and the Network Opportunity Map.

area more broadly. For example, high growth will likely drive treatments for depleted capacity at the other zone substations within the load area, and this proposal recognises the short-term positive distribution transfer capacity (DTC) improvements that the new BVS zone substation will bring to the existing Meadow Springs (MSS) and Mandurah (MH) substations. Permanent capacity mitigation solutions for MSS and MH will be looked at as in separate investments.



(3a) Current arrangement **(3b) Proposed augmentation**

Figure 3 Conceptual rearrangement for a sustainable Baldivis distribution network supply.

The present configuration is shown in Figure 3 (a), with Baldivis loads connected as distribution network loads connected to WAI zone substation, with smaller areas to the south of Baldivis fed from MSS. Due to local growth close to the existing zone substations (e.g. WAI, MSS), as well as escalating demand forecasts in the Baldivis area expected to rapidly diminish the remaining WAI capacity levels – this arrangement cannot be sustained.

As is shown in later charts, e.g. Figure 7 and 8, and in Figure 17, there is now a critical need for meaningful change in Baldivis supply arrangements. That is, a move to transmission system level supply – as is proposed here (see Figure 3 (b)). A 132/22 kV zone substation at BVS will remove the present distribution network congestion and, thus, ensure supply for Baldivis into the future. A further key benefit is that WAI/MSS gain strategic localised capacity which is freed up through the proposed rearrangement. In addition, Baldivis customers will benefit in the medium and longer terms from the inherently more reliable transmission supply source achieved by adopting this approach.

Transferring WAI's Baldivis loads will effectively defer expansion works elsewhere (for example, Option 3), and the proposed augmentation works captures the necessary upgrades to relevant Baldivis distribution feeders. This approach efficiently restores capacity to WAI and indirectly adds support to network capacity

in the corridor between Mandurah and Rockingham to the west and south of Baldivis. This work is timely, as the load area is increasingly facing significant overloading and compliance issues.

With a new zone substation in Baldivis, as per the draft proposal presented here(see Option 3 in Table 2, below), there would be an immediate operational and maintenance benefit – because planned and unplanned outages can be better managed with the improved distribution transfer capacity (DTC) between zone substations across this part of the network (as is illustrated in Figure 3 (b)).

1.4 Present arrangements

The present capacity constraints apply for both load (increases), and for maintaining sufficient distribution transfer capacity (DTC). DTC enables the sharing of load between zone substations for operational, fault response, and maintenance reasons from time to time in accordance with Technical Rules requirements. Demand has grown at higher rates than previously forecast, not only impacting WAI supply to Baldivis, but across the wider Mandurah load area.

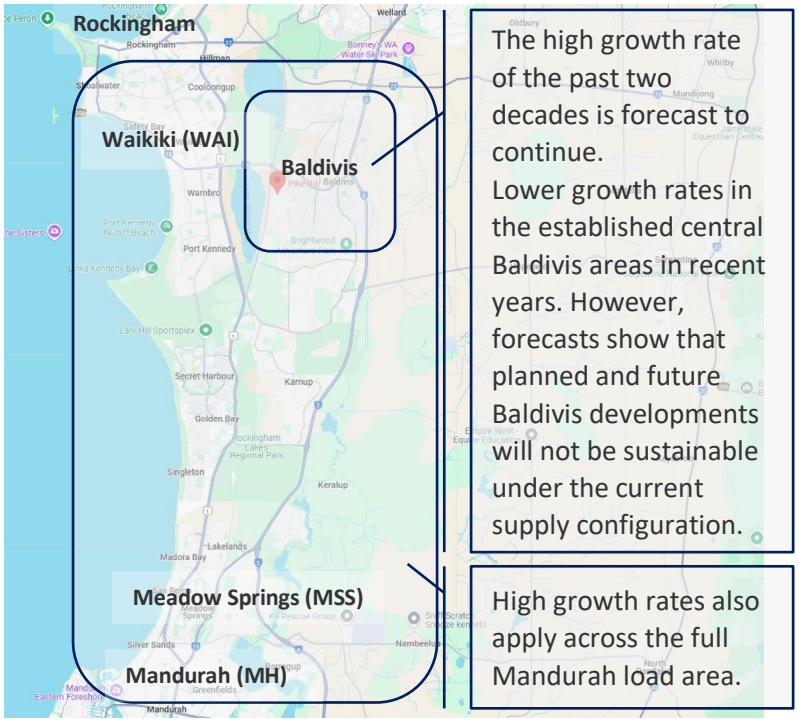


Figure 4 Baldivis area growth overview (c. 2025)

Trends and forecasts show that the current higher than average rates of growth experienced in Baldivis (as highlighted in Figure 4), and across the Mandurah load area will continue (e.g. with emerging new residential areas like Karnup[6]). Current forecasts show that the Karnup-Keralup area population will grow sharply from the present low thousands to upwards of 30,000 by 2046[7]. Electrical supply – like other services and utilities – will also start to experience high growth in demand for services once mainstream occupation of these areas commences.

1.5 Background to the rearrangement of supply for Baldivis

The present distribution-based Baldivis supply, e.g. see earlier Figure 3 (a) and (b), has evolved as the area has continued to develop, over recent decades. WAI is currently providing a high proportion of supply to the Baldivis area via the lengthy intervening 22 kV distribution feeders in use, with Meadow Springs (MSS)

6 Karnup District Structure Plan - City of Rockingham

7 About the forecast areas | City of Rockingham | Population forecast

also providing supply, to a lesser extent, to the south of Baldivis. However, those existing substations are also experiencing elevated levels of growth in demand, close by, in their local supply areas. This means that, at this time, there is a strong need to implement a sustainable solution that will effectively meet long-term supply and coverage requirements, while also ensuring current and imminent demand are met.

Due to the ideal location of the proposed BVS substation site in terms of distance to nearby load centres, BVS will enable deferral of imminent zone substation capital expansion works otherwise needed at WAI (however, such works are shown to be very inefficient, as demonstrated in Option 3 analysis, in section 4). The proposed BVS augmentation will relieve WAI of its 'highly loaded' Baldivis feeders and loads; and frees up the associated portions of WAI transformer capacity. To a similar, but lesser extent, MSS will also benefit in the short term by transferring its southern Baldivis loads across to the new BVS substation.

The draft recommendation is for BVS to have three Western Power standard 33 MVA transformers and to access the transmission network by cut-in cut-out of the existing MH-WAI/MSS 81 line. By taking this approach with the line interconnection, future work to de-mesh the Mason Road load area from MH and MSS load area is enabled. HV backbone de-meshing work will benefit zone substation transmission supplies by providing better future balancing in transmission (132 kV) sub-networks serving the WPN Metro South region (that is, improving power flows in the north-south corridor between the cities of Rockingham and Mandurah).

1.6 City of Rockingham growth

The City of Rockingham (which includes Waikiki and Baldivis) is experiencing high and persistent population growth. The increasing WAI demand forecast must be understood in the context of decoupling the BVS augmentation proposal. The critically escalating WAI load forecasts are increasing due to the high expected growth in Baldivis, while the other areas around WAI are expected to grow, but at a slower pace.

City of Rockingham

Between 2021 and 2046, the population for the City of Rockingham is forecast to increase by 90,960 persons (64% growth), as shown in Figure 5, at an average annual change of 2.0%.

The City of Rockingham's Local Planning Strategy[8] identifies and progresses land development in the Baldivis area as per the Metropolitan Region Scheme (MRS[9]), and the relevant requirements and processes are administered by the Western Australian Planning Commission (WAPC). Various local planning scheme amendment proposals and application are in progress, having been made to gain local structural planning and subdivision approval.

Baldivis area growth

As can be seen in Figure 5, Baldivis is experiencing significant population growth in line with or exceeding broader Western Australia growth rates[10]. Baldivis – referenced by the City of Rockingham as a North, and a South area – is experiencing significant population growth compared to broader Western Australia growth rates. In particular, the average annual % growth for Rockingham city (2.0%) compares to the North Baldivis rate of (5.6%) and South Baldivis (1.8%)[11]. These population growth rates reflect a higher demand for services, and see larger supply demands made, and forecast, to be made on the nearby Western Power electricity network.

8 Local Planning Strategy - City of Rockingham
9 Metropolitan Region Scheme
10 WA Tomorrow 12 Population Forecast – Data Tables
11 https://forecast.id.com.au/rockingham/population-summary (between 2021 and 2046).

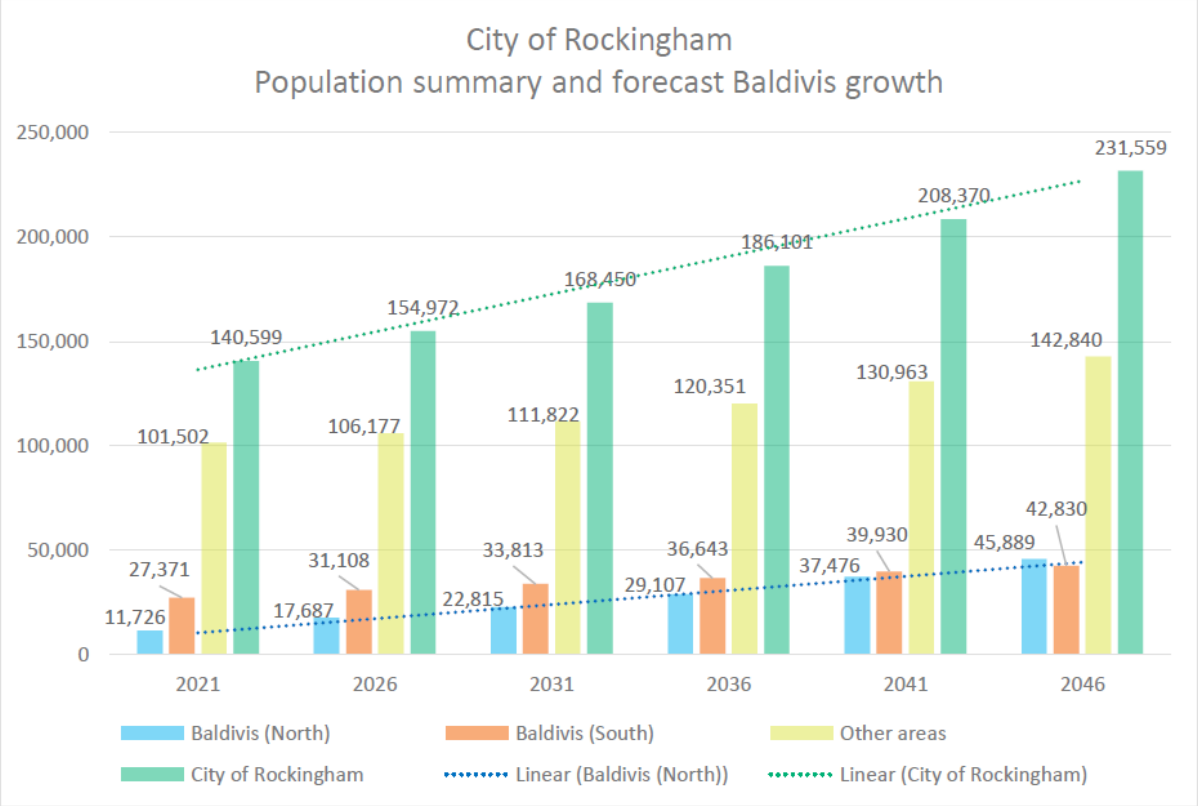


Figure 5 Estimated population growth trends in Rockingham and Baldivis[12]

North Baldivis is subject to new subdivisions in progress through the Western Australian Planning Commission (WAPC), with the aim of increasing the availability of new residential estates (along with the services to support them) – and this is being reflected in high expected growth rates in North Baldivis.

Increasing growth rates are also being experienced in South Baldivis, with high growth rates also expected to extend further south (for example, into the Karnup and Keralup areas).

Key factors are identified by the City of Rockingham as indicating continued growth – these include:

- **Greenfield Development -** significant greenfield development in the Kwinana, Rockingham and Mandurah regions are contributing to high rates of growth in Baldivis.
- **New Residential Estates -** new residential estates, such as Karnup, Parkland Heights and Baldivis Parks, as well as proposed developments in the pipeline, are attracting new residents and driving demand (e.g. services and utilities; and with the take-up of new commercial and industrial opportunities).
- **Infrastructure Upgrades -** improvements to infrastructure, including the Kwinana Freeway, community services, utilities, and public transport options, which are enhancing connectivity and further fuelling growth[13].

12 Population summary | City of Rockingham | Population forecast
13 Local Development Plans - City of Rockingham

2. Electricity supply and demand

2.1 Existing Supply Arrangements

The WPN's Metro South Region covers a large area, including the urban Perth metropolitan networks south of the Swan River, from the Cannington Terminal in the east to the Southern and South Fremantle Terminal towards the west. The region also covers the southern metropolitan coastal strip from Kwinana through to Rockingham and Mandurah and extends east to encompass the Pinjarra Substation. The Transmission System Plan[14] provides a good summary of the emerging issues and drivers for the southern portion of the South Metro region (which is shown in Figure 6).

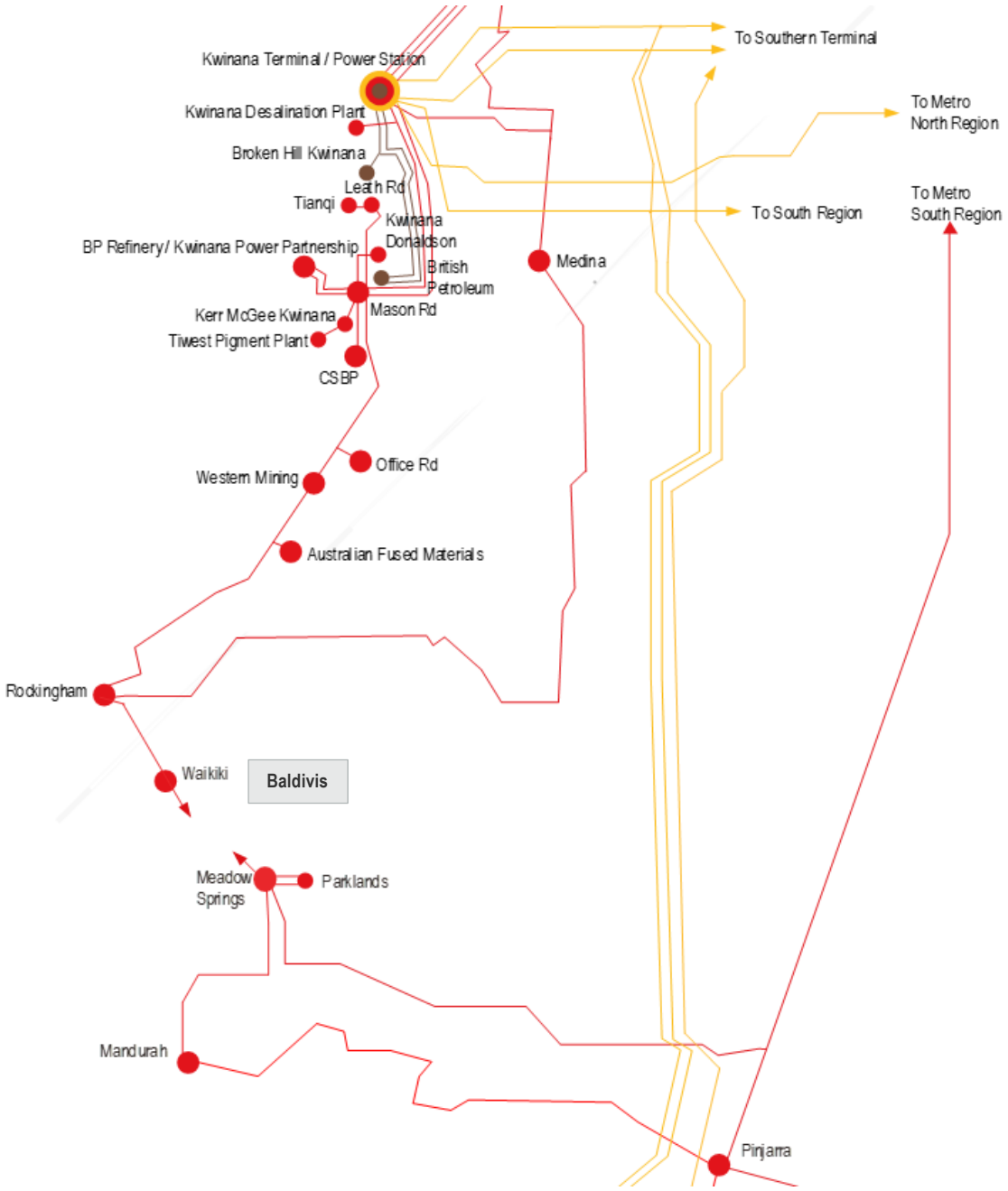


Figure 6 Mandurah load area is in the lower south of the South Metro region

[14] Transmission System Plan - 2024, (see p. 72).

2.2 Load area assumptions

The Mandurah load area is located the southernmost part of the WPN South Metro region (per Figure 6). It contains mostly residential, commercial, and light industrial loads. Covering a large area, it includes zones which are mature and well-established, as well as zones which are being established and growing quickly. The load forecasts (medium term forecast (MTF 25)) for each zone substation site (and the associated forecast demand levels) discussed here use 10% Probability of Exceedance (PoE) level – and this is consistent with standard Western Power transmission planning practices.

Load, or network demand, forecast is a guide to the triggers and staging of developments described within the options considered. It is noted that these triggers will vary year on year as more refined forecasts (for example, more precisely reflecting changing technological 'norms' and recorded 'actual' power usage levels) are established. However, despite variability around forecasts, it is assumed that comparative assessments to reach a preferred solution will not be materially impacted.

2.3 Peak demand and network loading

Waikiki zone substation and feeder peak capacities are forecast to continue trending upwards into full loading and/or overloading of limits to the extent that resolutions can no longer be avoided by operational measures. Operational actions, such as off-loading, rerouting, and reconfiguration, are required for the short-term management of affected assets at times of peak demand. However, similar full to over-loading peaks are expected to be simultaneously impacting most zone substations in the Mandurah load area. Thus, every substation will be increasingly unable to gain alternative configurations – given the current widespread escalating shortage of available distribution transfer capacity (DTC).

In residential situations, direct management of demand is relatively immature, although there may be scope to pursue that approach in the future, it might only bring short term relief to the underlying problems driving the reconfiguration and new substation proposed for Baldivis.

2.4 Load locations and spread for WAI

WAI has been used historically to provide the bulk of Baldivis area supply via distribution feeders, as illustrated earlier in Figure 3 (a) and (b). It has three transformers with an installed capacity of 36, 39.7, 39.9 MVA, for a total of 115.6 MVA, and substation planning capacity of 86.7 MVA (as shown in Figure 7).

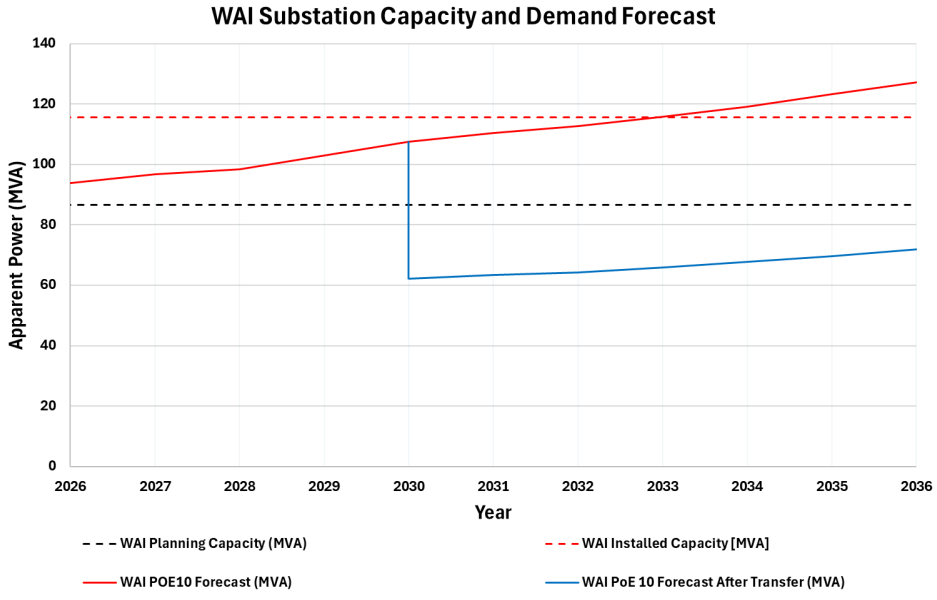


Figure 7 WAI substation forecast load relative to current planning capacity.

Figure 7 also illustrates the impact of current WAI demand growth forecasts for the expanding Baldivis areas and illustrates how offloading four of highly loaded Baldivis feeders will reduce WAI peak load demand significantly.

The timing of 'actual peaks' in demand tend to occur across the entire network, with climatic variations (like days experiencing extremities in seasonal temperatures) making the extent and timing of overloading increasingly difficult to predict and treat with short-term and stop gap measures.

2.4.1 Waikiki distribution feeders

A sizeable portion of Waikiki substation load (see Figure 9) is distributed on the east side of the Lake Walyungup in Baldivis suburb, consisting of feeders WAI 527, WAI 507, WAI 539, and WAI 540. WAI feeder demand forecasts are shown in Figure 8, and this show that these are nearing, or will soon exceed their rated capacity.

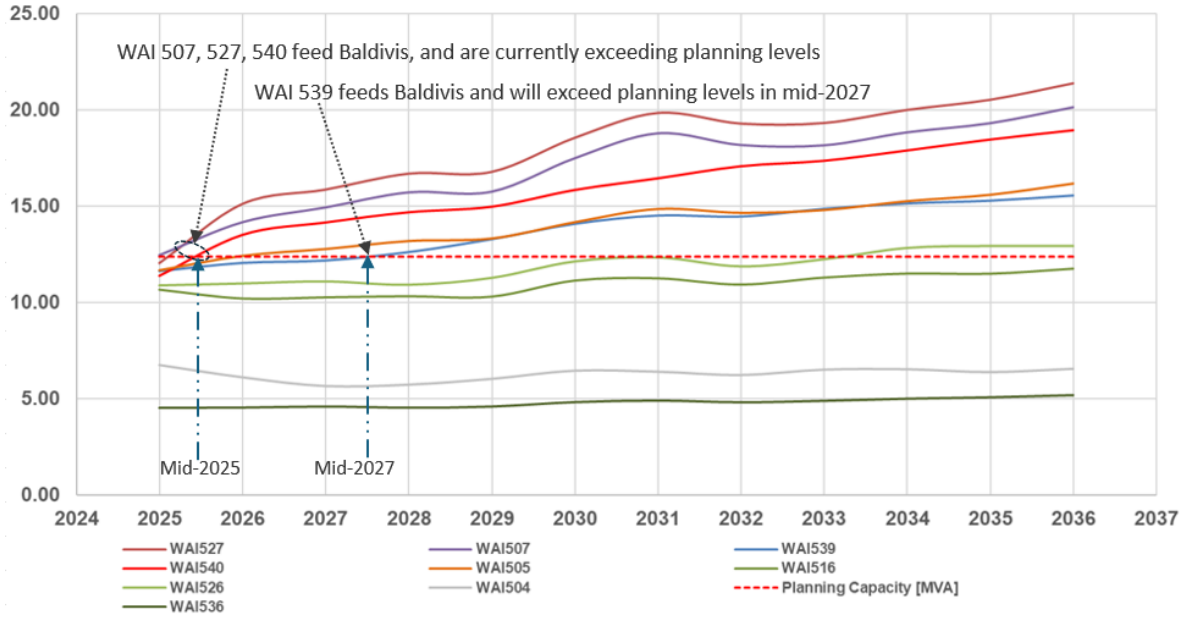


Figure 8 WAI feeders demand forecast against planning capacity.

Figure 9 shows comparative loading proportions (at 2025 peak, i.e. fully loaded levels) for clusters of feeders exiting WAI. The Baldivis portion of feeders (to the east of WAI, shown in orange) is subject to higher – above average – growth rates into the near future, while the blue and green (west and south of WAI) are presently subject to more stable growth rates.

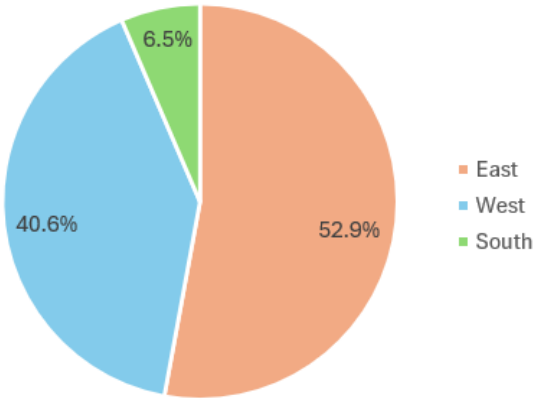


Figure 9 Typical peak WAI feeder clusters' utilisation (Baldivis loads are to the east, shown in orange)

Operational procedures (e.g. switching across alternate routes to spread high demand flows) are in place to avoid asset failures, but there is a scarcity (and diminishing amount) of DTC to enable WAI to continue to avoid overloads into the future.

Proportions of WAI loading, by clusters of feeders (noting that loads will vary dynamically), are approximated in Figure 9. Relieving WAI of the Baldivis portion (blue wedge) enables WAI capacity to achieve adequate levels. After BVS commissioning and under forecast growth conditions, WAI can be expected to align with technical and regulatory limits into the foreseeable future – as shown later in Figure 17.

Figure 10 andFigure 11, below, also show that because WAI (and to a currently lesser extent MSS) are supplying various areas in Baldivis, they are deprived of capacity increasingly needed within each of those existing substation's immediate surrounding areas.

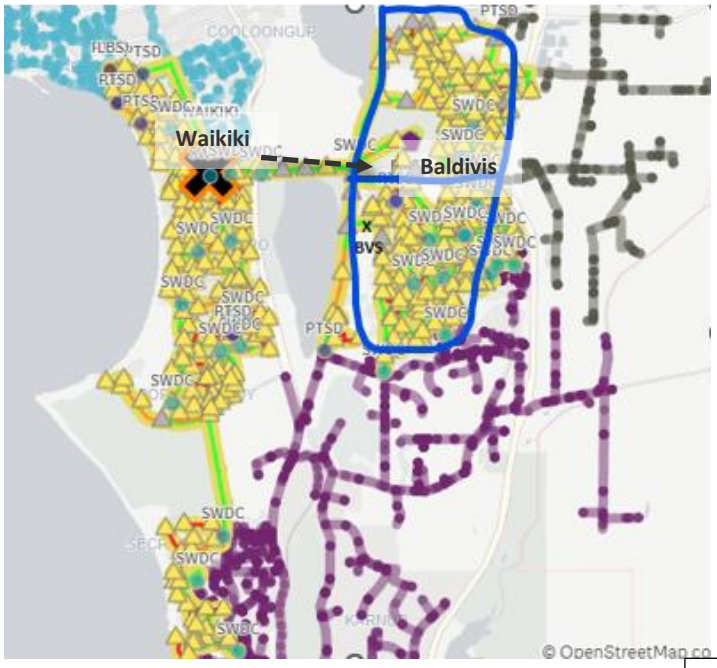
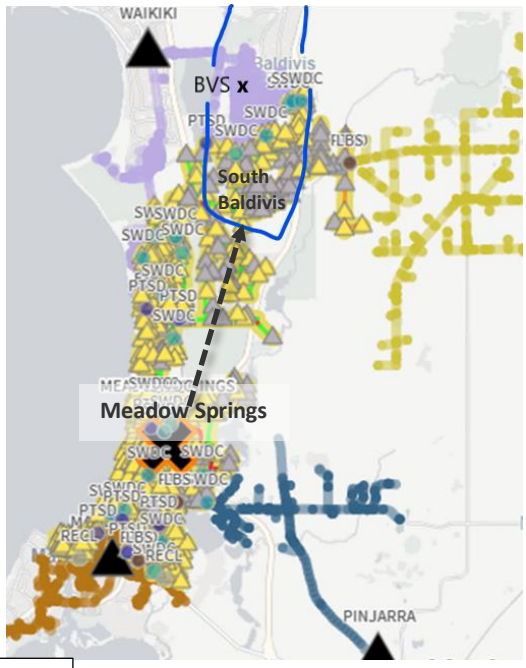


Figure 10 Waikiki (WAI) loads



Not to scale

Figure 11 Meadow Springs (MSS) loads

2.5 Other resolution considerations

Currently, there is a convergence of drivers which support a pressing need for investment in the proposed new zone substation at Baldivis. The proposed transition from the present configuration to a new arrangement is shown in Figure 3. Due to the investment level forecast for establishing the new BVS substation, this project is subject to the Access Code Regulatory Test approval. The proposed project will:

a. construct and commission the most cost-efficient solution which is the best long-term solution to meet Baldivis area growing supply demand and meet Community needs;

b. provide the most effective way to restore spare capacity to existing substations (especially for WAI, and can provide a degree of short-term DTC support for MSS and MH);

c. reduce and or eliminate excessive network losses by a combination of transferring to (transmission network) supply voltage and reducing conductor lengths for local supply feeders (distribution network); and,

d. alleviate the customer and network compliance issues present (when supply sources become overloaded). For example, complaints may result if network Users begin to experience unreliable power supply.

By reconfiguring Baldivis loads away from WAI, an equivalent amount of additional growth is accommodated in its local vicinity. As such, an increase in distribution transfer capacity, and lower feeder losses due to loads being in closer proximity to their points of zone substation supply, will also relieve present loading constraints and congestion for nearby substations.

The main element of this draft network augmentation proposal is to establish a new Baldivis (BVS) 132 kV to 22 kV zone substation at 60 Pike Rd, Baldivis. This reconfiguration proposes a substation with two 132 kV line circuits initially (via cut-in and cut-out of existing line MH-WAI/MSS 81) and three 132/22 kV standard 33 MVA transformers which provides a planning capacity of approximately 66 MVA.

2.5.1 Transmission network growth

The 132 kV transmission network in the Metro South Region is highly meshed, which results in an over-utilised 132 kV network and under-utilised 330 kV network. Western Power is investigating options to de-mesh parts of the 132 kV network to improve efficiency and simplify power flows within and out of the region. With the expected level of forecast network capacity constraint and impacts from asset aging and replacement over the medium and longer-terms, there is a significant opportunity approaching to reconfigure (or re-mesh) the Metropolitan South transmission system with positive impacts across the wider region, the Mandurah load area, and for the Baldivis locality. Those improvements will better balance load sharing and asset utilisation across the bulk transfer 330 kV network elements and the 132 kV circuits feeding zone substations.

Western Power is working with industry to better understand future impacts of the proliferation of electric vehicles (EV) the network in the Metro South Region. Increased EV usage may trigger the need to further increase capacity needs on the network and will be considered in future planning. Wide EV uptake may create challenges with service congestion, scarcity of available land, construction of new transmission lines and substations.

2.5.2 Peak loads

Peak load diversity is not material to this discussion, as our zone substations face aggregate peak loads at similar times. This is a fair assumption due to the load in the Mandurah load area being a mix of commercial, industrial, and residential connections – with similar load peaks and timing occurring across the region. For example, widespread peaks in demand at times of above average ambient temperatures will diminish diversity options available to/between the zone substations in the Mandurah load area.

Upon the recommended BVS substation going into service, there would be flexibility to offload areas in Baldivis from the existing arrangements. With the use of suitable network open points on the pre-existing feeders, loads can also be re-distributed amongst these substations with a degree of flexibility to better respond to faults, and or for operational and maintenance purposes.

2.6 Proposed location for BVS substation

Western Power currently owns land suitable for Zone substation construction, at 60 Pike Road[15], Baldivis. Further, it is reserved for "Public Purposes – SEC[16]" under the Metropolitan Region Scheme (MRS). As such, development of the substation on the site is deemed permitted development pursuant to Clause

[15] Please note that 60 Pike Rd, is used in this paper, is as per the Title, (noting that Nos 38, 44, and 48 Pike Road appear in some maps).
[16] SEC is an old reference to a previous state-owned utility like Western Power, i.e. the State Electricity Commission (SEC).

29(1)(f)(viii) of the MRS and does not require (further) development approval from the Western Australian Planning Commission.

In addition, Western Power is exempt from local development approval, pursuant to Section 60 of the Electricity Corporation Act 2005 and therefore a development application is not required to be submitted to the City of Rockingham under its Local Planning Scheme No. 2. This exemption is on the premise that Western Power undertake the following (direct from s.60 of the EC Act):

> *.."carry out the works, so far as is reasonably practicable — (i) in keeping with the design and intent of; and (ii) so as not to destroy the amenity of, any relevant scheme or order referred to in subsection (3); and (b) is to consult with the responsible authority at the time when a proposal for any works referred to in subsection (2) is being formulated to ensure that paragraph (a) will be complied with."*

2.6.1 Substation site

The Pike Rd., Baldivis site (proposed for BVS) is identified with a red pin in Figure 12. It lies to the west of a corridor of current and emerging Baldivis developments. Western Power routinely consults with stakeholders (e.g. public, the Local Government Authority (LGA) and WAPC) during scoping and planning project phases, so that will serve to suitably preserve the amenity of the location, as well as ensuring that the site will efficiently perform its longer-term required functions.

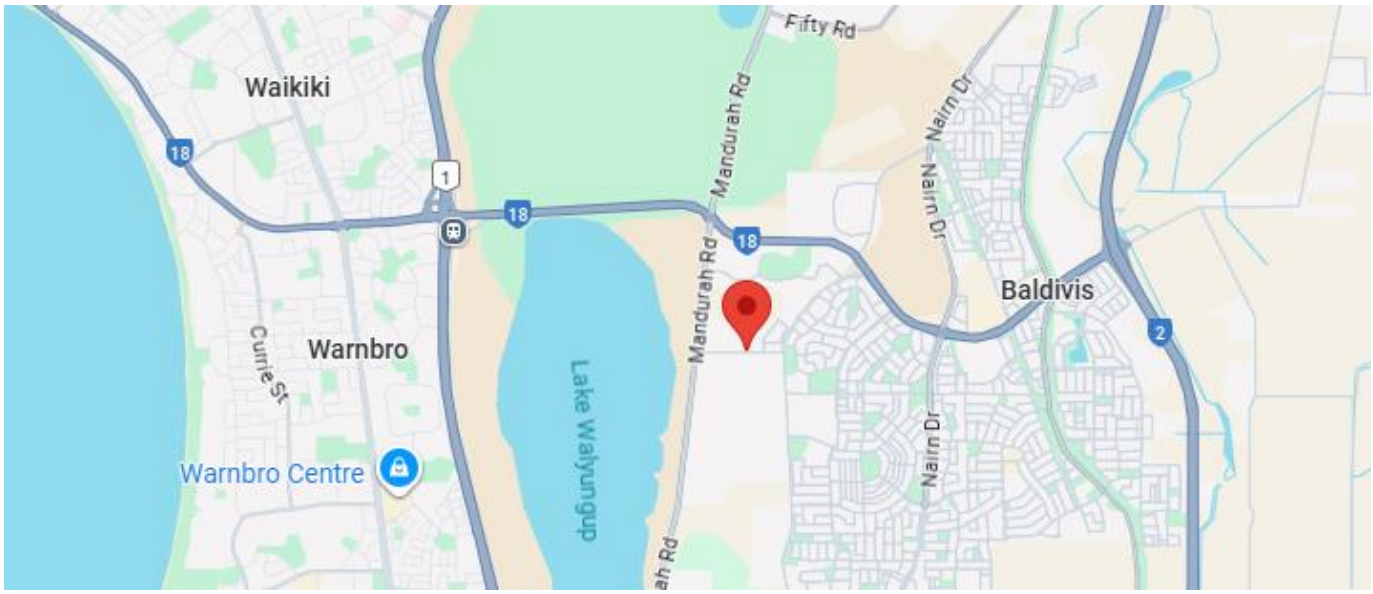


Figure 12 Pike Road zone substation site relative to Waikiki and the Baldivis area

The existing WPN feeders to the west of Baldivis (ultimately interconnecting with WAI) follow routes traversing challenging, swampy land. Alternative routes nearby are likely to face difficulties due to the terrain and meeting the relevant bio-diversity protections applying to sites in the area. For sites located in other directions to be served by the proposed BVS substation, access will be subject to appropriate checks and balances but appear to be less challenging.

Figure 13 October 2024 view of the proposed BVS site

From the network point of view, this site (see the map in Figure 12, and the photographs in Figure 13 and 14) is preferred because it is ideally located to become the central supply point for the Baldivis load area in the coming decades.

Figure 14 An aerial view of Lot 3001, 60 Pike Road, Baldivis

3. Network supply and demand forecasts

3.1 Planning criteria for network development

Western Power has security, reliability, and quality of supply obligations, e.g. as defined in the relevant Technical Rules[17], and under the Networks Quality and Reliability of Supply (NQRS) Code. Western Power applies good industry practice[18] so that the WPN will be able to meet forecast electricity demand during faults, such as the outage of critical network elements.

3.2 New facilities investment test (NFIT)

Western Power continuously assesses the current and future capability of its network and takes action to ensure that it will continue to meet the required performance standards. As part of these planning processes Western Power has identified that action is required to ensure the network supplying Waikiki and Baldivis, within the Mandurah load area, will be able to meet these obligations for forecast demand.

The increasing load growth and summer demand peaks being experienced in this load area makes this compliance aspect especially relevant for the proposed BVS augmentation. Thus, solutions to address the forecast requirements are classified under 'safety or reliability' as referenced in the new facilities test, 6.52 (b) iii of the Electricity Networks Access Code 2004.

3.3 Supply and demand assumptions

In its assessment of the network capability, Western Power has made the following assumptions - and remains consistent with the TSP 2024, and more generally aligns with Access Arrangement and Technical Rules obligations, in this regard.

Specifics about the medium-term forecast (MTF) approach, and probability of exceedance (PoE) term, are explained in more detail in section 7 of this paper.

Generation

There is no local transmission connected generation in the Mandurah Load area (although Kwinana is a nearby source). The generation pattern modelling used on the WPN is based on the highest probability generation scenario.

The impact of embedded photovoltaic (PV) generation is included in the load area forecasts and applies at local feeders, and when aggregated, on a South West Interconnected System (SWIS) wide basis.

Demand

The electricity demand forecast is based on the latest Western Power MTF2025 load forecast and this is applied accounting for extremities of weather conditions (i.e. at 10% PoE). The Western Power forecast contains the under-lying load growth, and (any foreseeable) load increases which have a high level of confidence of materialising. For the transmission network, reliability targets require that there should be no load lost if there is a loss of one network element (e.g. zone substation transformer).

Transformer ratings

The zone substation transformer ratings in this document refer to either:

- Western Power's standard planning ratings (e.g. BVS nominally has three 33 MVA transformers); or,
- the (actual) nameplate transformer capacity rating[19]. For example, WAI zone substation installation has three transformers (rated at 36 MVA, 40 MVA, and 40 MVA, giving an installed capacity of 115.6 MVA), which provide a combined NCR[20] planning capacity of 86.7 MVA.

17 as published under Chapter 12 the Electricity Networks Access Code

18 For example, see Electricity Industry Act 2004.pdf, p. 177, regarding generic concepts like 'efficient cost of supply'.

19 This applies to new zone substations established with our standard 33MVA transformers

20 NCR definition can be found in c. 2.5.4 of the 2016 Technical Rules

4. Options considered

4.1 Options summary

Consistent with Western Power's standardised options investigation and development, both network and hybrid non-network solutions are considered to address the capacity issues of WAI, with five feasible options listed and compared in Table 2.

Table 2 Options to reinforce capacity in the Waikiki and Baldivis areas.

Option	Description	Estimated Cost[21] (Total NPC)	Remarks
Network options			
1	Do nothing	-	- Unacceptable risk levels in the coming years and inability to support future load growth.
2	Increase capacity at WAI	$110.60 million	- capacity gained (at high cost) is constrained almost immediately. This option will not cope with new Baldivis loads and or future developments. - BVS construction can only be delayed in the short-term. - this is a challenging substation fourth transformer expansion, as WAI substation is designed for a maximum of three transformers.
3	Build a new substation at Baldivis in 2030	$81.69 million	- cut-in/out and reconductor nearby transmission line. - reuses and upgrades distribution feeders. - Western Power owns suitably zoned land in Baldivis. - BVS brings significantly higher reliability and better shares load across substations; uses shorter, less lossy feeders.
Non-network (hybrid) options			
4	Contract network support services to achieve 3-year deferral of BVS	$102.68 million	- use of distribution Network Support Services (NSS) to flatten the demand profile to defer BVS construction by three years, until 2033.
5	Contract network support services to achieve 5-year deferral of BVS	$127.08 million	- use of distribution NSS to flatten the demand profile to defer BVS construction by five years until 2035.

[21] The forecasts and project cost estimating approach used are explained in s. 6.3

4.2 Network options considered

The network options have been developed, with the following considerations:

- short, medium, and long-term technical feasibility;
- risk profile and mitigation;
- meeting Western Power obligations and standards;
- financial feasibility (NFIT, NPC and lowest capital cost); and,
- alignment with the relevant Codes, rules, and regulations.

Western Power has completed detailed planning studies in considering feasible options to mitigate all of the identified network limitations to address the capacity issues of WAI over the medium to long term, as discussed in section 3. These studies include steady state and dynamic load flow analysis as well as other technical assessments to determine the capacity of various options to adequately reduce the identified network risks. The relevant network studies and data also apply when considering non-network solution integration into the network at system and market levels.

4.3 Non-network options considered

Non-network approaches diverge from traditional investment paths to meet project drivers. Western Power has explored distribution NSS[31] in the region to determine the feasibility of that approach. NSS generation sources involves contracting supply facilities (such as a generator, DER, or battery storage technologies) to provide dispatchable support services in an area where such support is operationally feasible. Procuring NSS involves a competitive commercial tendering process and would be required to respond to maintain network compliance levels and mitigate capacity shortfall.

Non-network options (as hybrid solutions) are discussed below in the context of Option 3 deferral substation establishment works. However, the non-network options are shown to be less cost effective than long-term network options. That is, given that an NSP was acting efficiently, the less efficient and non-cost-effective options would not be adopted. Specific to this case, (see s. 4.5, below) the non-network options section includes discussion of seeking efficiencies by deferring Option 3 (see Options 4 and 5).

4.4 Network options

4.4.1 Option 1: Do-nothing

The ‘Do nothing’ option has been discounted as this option would defer addressing the existing issues and exacerbate the risks associated with sustaining the present arrangements. The network risks will continue to increase over time as the demand in the area grows.

Given that operational measures will be used if and where possible to maintain service levels, but only up to points of exceeding network asset, and/or non-compliance, limits. In this case (where limits become very thin), the risks for justifying or seeking rules exemptions likely outweigh the benefits.

Basis of the estimate

- capital cost estimate does not apply.
- ongoing operational expenditure will result from faults or outages due to overloads.
- other impacts such as not meeting reliability or other SSBs, may apply, but are not quantified here.

Advantages

- no (or minimal) upfront capital network expenditure.

Disadvantages

- increasing reliability, operational and reputational risks.
- inability to support load growth.
- not aligned with long term strategy for the Mandurah load area.

Recommendation

Leaving these problems without satisfactory resolution will not see Western Power meeting the applicable network and market laws, codes, and rules (e.g. network safety, performance, constraints, reliability, and supply quality – and similar legislative and regulatory targets).

Option 1 represents potential network reliability risk and community impact. It is not recommended since it does not address the immediate capacity shortfall issue, increases risk to the network, and will not adequately meet supply security and reliability obligations.

4.4.2 Option 2: Expand WAI with an additional transformer

This option proposes to increase the substation capacity at WAI by installing a new transformer. WAI substation is originally designed for three transformers, so the site requires extension for adding a fourth transformer, and new feeders – as well as maintaining adequate clearances and site access.

Such practical design complexities increase the project costs. In addition to the high cost and complexity of the option, in terms of substation development, the significant cost of the required new feeders to offload highly loaded feeders leaving WAI and servicing Baldivis loads makes this option unfavourable.

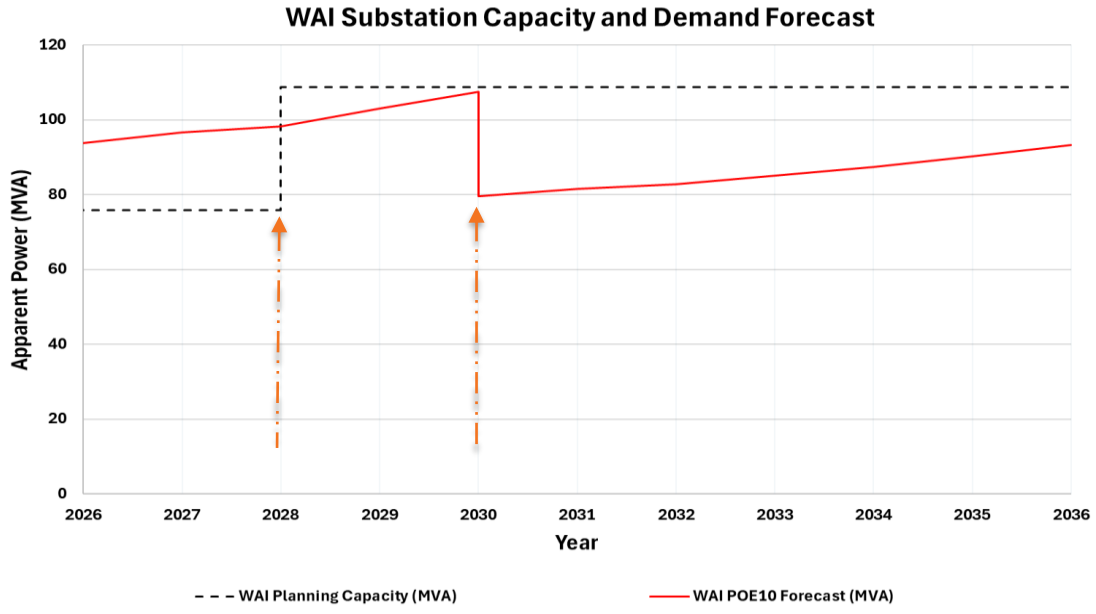


Figure 15 WAI substation forecast, with 4th transformer in 2028, (BVS required by the end of 2030)

Figure 15 illustrates the short-term gain which results from an additional transformer at WAI, shown at the end of 2028. In a short timeframe it is expected that further intervention will be required (e.g. BVS required by end of 2030, as is currently planned). Thus, in the present circumstances at WAI, this option (2) does not resolve the fundamental issues associated with the present Baldivis load driven constraints at WAI. That is,

increasing the capacity at WAI does not resolve the growing distribution network constraints which have accumulated in recent times.

There are highly loaded feeders from WAI supplying the areas to the east of Lake Walyungup (i.e. the Baldivis area) include: WAI 527, WAI 507, WAI 539, and WAI 540 (shown earlier in Figure 8). The feeders' loads are centred at a point approximately 10 km from the substation. Based on the amount of demand above capacity for these feeders, three new feeders will be required to offload them (in addition to the extra transformer at WAI). Each feeder would be around 10 km, based on the load centres distance from the substation.

The short-term relief provided by this option (Option 2 may serve to delay BVS construction with at least two standard 33 MVA transformers) by as little as 12 or 18 months, assuming that BVS was otherwise planned to go into service by the end of 2030), which means, given these inefficiencies, that it is not attractive.

In a similar way to the WAI feeders described above, lengthy Meadow Springs zone substation feeders currently supply areas to the south of Baldivis (e.g. MSS529, MSS536, and MSS505). Those areas are subject to the rapid Baldivis growth rates already noted, hence transferring those loads to BVS will offer short-term improvements to the available capacity at MSS. However, (and to avoid potentially costly duplication) works to address accelerating contraction in available capacity at MSS: will form part of a separate investment to also consider: Mandurah area and MH zone substation; and, expected growth to the east of Mandurah. Other than reconfiguring the Baldivis extremities of affected MSS distribution feeders, works at MSS are not included here.

Basis of the estimate

- an additional standard 33 MVA transformer installed at WAI with requisite site works and rearrangements.
- estimate allows for initial BVS construction providing two standard 33 MVA transformers, allowing for a delay provisioning a third transformer at BVS until late the 2030s, or early the 2040s.
- reworking and augmenting distribution feeders and interconnections, rerouting feeders, and lines, and installing express feeders.

Estimated cost (Total NPC) is $110.90 million.

Advantages

- one to one and half years deferral of BVS construction likely, with further deferral of BVS third transformer possible.

Disadvantages

- the expected cost is high (due to short delay to the need for BVS), particularly the distribution cost due to the lengthy distances between the load centres and the zone substations.
- high cost and design complexity of adding the fourth transformers – as WAI requires expansion beyond its full capacity, which brings land, access and spacing concerns.
- most assets installed under Option 2 will be lightly loaded (into the foreseeable future) after BVS is commissioned, (although WAI and BVS could exchange DTC via the otherwise redundant Option 2 express feeders).
- this option (alone) will not scale well, since the added capacity is constrained to the additional capacity of the fourth transformer, in areas experiencing high growth rates.

- this option (alone) does not provide sufficient uplift for Baldivis (for existing, and forecast load increases, such as with new developments), or acceptably cater for growth centred around WAI.

Recommendation

Option 2 brings only short-term relief to current constraints, at high costs, by expanding WAI and suitably reinforcing Baldivis feeders. It is not preferred nor recommended due to the high cost, lack of adequate scalability to meet expected growth, and design complexity of its implementation.

4.4.3 Option 3: New substation at Baldivis

Establish a new zone substation at 60 Pike Road, Baldivis – this option addresses the previous significant growth in the area, and the increasing future demand forecasts – while relieving key capacity issues at WAI. Due to the ideal location of the substation in terms of distance to the load centres of the area, there will be significant saving in the cost of distribution, estimated 4.5 km of cable to offload highly loaded feeders of WAI to (new) BVS.

This option employs three transformers to yield 66 MVA planning capacity and to meet current and forecasted WAI, Baldivis area demand. BVS will initially have capacity to assist with other nearby Mandurah load area capacity demand challenges.

BVS overhead (OH) lines design will cut-in and cut-out of MH-WAI/MSS 81 feeder using new steel poles. To support the proposed new mid-line configuration, suitable poles, conductor, and overhead earth wire (OHEW) is required for 500 m from the new substation line circuit gantry structures. This necessitates 1 km of overhead line reconductoring.

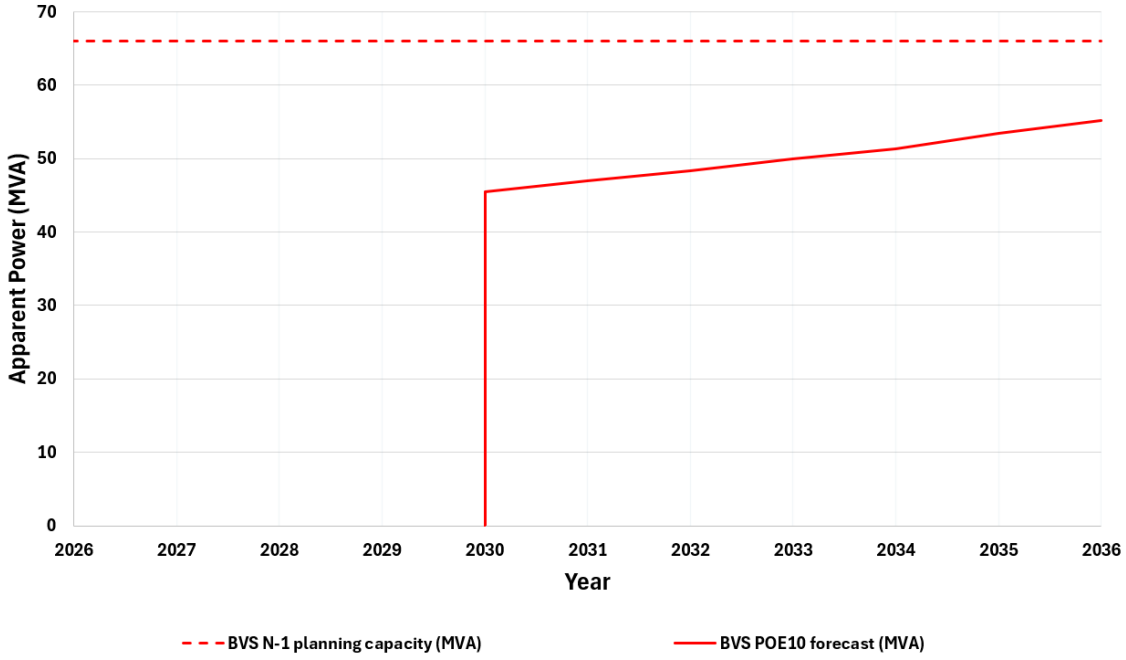


Figure 16 BVS substation capacity (with 3 x standard 33 MVA transformers) against forecast demand

We considered an alternative option to address potential questions regarding undergrounding a small portion of the 132 kV transmission lines supplying the proposed BVS. This was a reasonable consideration, as it is being proposed that the overhead lines be strengthened and reconductored as part of establishing the proposed BVS substation (i.e. Option 3, above). To test the undergrounding approach, we assessed the use of two 500 m sections of underground transmission feeder cable, in place of Option 3's direct cut-in-

cut-out of the overhead lines. However, no direct network benefits were identified for undergrounding these sections and it is noted that transmission undergrounding routinely attract relatively high costs.

Estimated cost of the work is (Total NPC): $84.35 million. The elevated cost, however, does not add to the network and supply benefits, which remain the same as for Option 3. As such, the cost and lack of flexibility achieved with this option are not attractive at the expected high level of investment.

Basis of the estimate

- new zone substation (scope details are provided in the executive summary, see p. 8).
- cut in cut out transmission lines.
- providing new distribution feeders and interconnections, rerouting lines to accommodate new substation.

Estimated cost (Total NPC): $81.69 million.

Advantages

- this option addresses expected future load growth (as is shown in Figure 16).
- Western Power owns land at 60 Pike Road, Baldivis, which has been earmarked for establishment of a future zone substation.
- lower cost of distribution due to the vicinity of the load centres to the new substation location.
- better network interconnectivity and reliability.

Disadvantages

- this option brings complexity in dealing with dedicated land usage within roadway easements to ensure optimal alignment of new lines and feeders.

Recommendation

Western Power has anticipated the situation at Baldivis and has been conceptually planning for the eventual provision of a 132 / 22kV zone substation at the Pike Road site. The proposed network augmentation transitions from the present long distribution feeders to a transmission fed zone substation.

The primary network planning objectives of the proposed Option 3 are to:

- resolve the capacity issues at WAI by establishing new Baldivis 132kV zone substation (BVS);
- off load Baldivis loads from existing 22 kV distribution feeders, redistribute 22 kV loads, and restore DTC between WAI and (new) BVS zone substations;
- address the high demand and cater for significant long-term growth in the Baldivis areas;
- provide as much short-term relief to MSS by connecting to BVS where that is possible; and,
- provide indirect relief to MH substation with an increase in short-term DTC to MSS, and North to WAI and/or BVS.

Option 3 forms the draft recommendation for this Options Paper, since it alleviates the risks associated with the full range of impending constraints. That is, it meets: expected demand; maintains short- and long-term network compliance; and does so at lower net present cost than the feasible alternatives.

4.5 Non-network options

Recognising the extent of the high utilisation of the distribution network assets which have historically served to provide Baldivis supply, non-network options which might provide point sources to offset demand and help to resolve constraints will add additional cost to the delivery of the project; and they offer limited relief for the transfer limitations, given the near term need and which are relevant to this discussion, as discussed further in Section 6.1.

Transmission network emergency services (e.g. transmission NCESS generation) is omitted as it is presently not possible to use this approach. The required distribution power flows through existing highly loaded substation transformers, and or distribution network feeders cannot be sustained. The earlier explanation for an additional transformer at WAI further explains why the approaches here have focussed on distribution non-network options which might offset the overloaded feeders (especially the lengthy Baldivis feeders to the east of WAI which are facing impending overloads).

The distribution feeder non-network hybrid supply options consider deferral of BVS construction for 3 years, and 5 years, respectively. Options 4 and 5 have been considered to investigate if these approaches might be cost-effective, and this is explained in the following section.

In the event, that short term peak capacity risk mitigation is needed prior to establishment of a new Baldivis substation, then distribution feeder NSS options may be considered by Western Power.

4.5.1 Options 4 and 5: Hybrid non-network solution(s).

These options consider opportunities for installing contract distribution network support services(NSS) (like DER, battery energy storage systems and or other local supply provision services) to understand and frame the economic parameters associated with the deferral of BVS construction. That is, a non-network solution to achieve deferral, followed by the network solution proposed in Option 3, which would then commence as described, but would target the nominated in-service dates. These estimates follow the cost estimating methods used in the earlier options and consider both capital costs and operational expenditure.

The distribution NSS approach involves procuring and interconnecting supply support systems at optimal points on the distribution network feeders to counteract the peaks in demand. Although the preliminary costs given are indicative[22], current market values suggest that the cost estimates for hybrid options with battery as a deferral solution (i.e. to delay the BVS augmentation, as detailed in Table 3), are not efficient.

Table 3 Contract supply systems options costs

Option 4 – battery or hybrid systems	Estimated NPC
3-year deferral of BVS – (sufficient) BESS or hybrid support to resolve WAI and Baldivis capacity issues until 2033 construction of BVS	$102.68 million
Option 5– battery or hybrid systems	**Estimated NPC**
5-year deferral of BVS – (sufficient) BESS or hybrid support to resolve WAI and Baldivis capacity issues until 2035 construction of BVS	$127.08 million

[22] Western Power has relied on our most recent NSS expression of interest (EOI) costs to make this economic assessment

Basis of the estimate(s)

- contracted NSS services dispatchable capacity required to effectively meet the forecast overall capacity shortfalls for the nominated target years (and thus defer the BVS augmentation project).
- the estimated cost includes the relevant future cost for building the BVS zone substation.

Advantages

- if feasible, the contract support services approaches may be able to improve (existing) network asset utilisation by flattening the demand profile in a short-term view.
- if feasible, local network control or contract supply approaches may be able to defer major investments.

Disadvantages

- potentially expensive (inefficient and resource intensive) to address demand growth as the operating costs grow steeply over time, as assets experience exposure to growing levels of overloading.
- the cost to achieve deferral savings in capital investment expenditure (BVS) comes at a high and increasing Opex cost for the NSS contract.
- can be expected to require identification and acquisition of suitable sites for contractors facilities; with a corresponding potential need for additional planning and/or regulatory approvals; community consultation; and resolving these things will likely lead to additional project risk in terms of potential for timing delays.
- unlikely to add support to address the capacity shortages across the Mandurah load area.
- not capable of efficiently providing additional assets' capacity for potential future growth, and or enabling the deployment of future non-network solutions.

Recommendation

The deferral approach lacks technical, timing and investment feasibility – Options 4 and 5 are unlikely to adequately address the forecast long-term capacity issue within a reasonable cost and thus, would provide an inefficient approach due the projected high cost and short-term deferral of Option 3 until either of the target years, namely 2033 or 2035.

These Options 4 and 5 are not recommended - since they do not resolve the expected medium-, or long-term capacity constraints at Waikiki, Baldivis, or offer support across the Mandurah load area. In summary, the overall levels of investment (and the capex and opex cost components required) for these approaches, to achieve the required network capacity and reliability, are excessive when compared to the network zone substation option.

Option 3 provides a better set of outcomes than Options 4 and 5 when assessed for

a. the Regulatory Test's net benefit criteria;
b. meeting NFIT; and,
c. providing the best long-term Users' network, and market outcomes.

5. Draft recommendation

A range of technical options have been assessed to address the supply constraints being experienced and which are emerging in the areas of Waikiki and Baldivis. A significant portion of the WAI power flows supplying Baldivis loads connect via lengthy 22 kV distribution feeders, as shown earlier in Figure 9. By removing that source of loading (with escalating growth) at WAI, the resulting levels of load remaining at WAI (subject to lower demand growth) become acceptable into the future.

5.1 Recommended option

Key parts of the project work to establish the new BVS zone substation at 60 Pike Rd, Baldivis[23], includes:

a. install 2 x 132kV line circuits (for cut-in and cut-out of existing line MH-WAI/MSS 81);

b. install 3 x 132/22 kV, Western Power standard 33 MVA transformers;

c. install 132 kV busbars to accommodate BVS transformers and line circuits and make provisions for future expansion as per Standard layout;

d. install 22 kV single bus switchboards, capacitor banks, reactor banks and earthing compensators;

e. install new relay room;

f. provide new steel structures and wooden poles for the cut-in and cut-out of existing line;

g. replace overhead conductor as required to meet substation fault ratings;

h. site preparation and development works for the substation site; and,

i. providing new BVS interconnections and re-configuring existing Baldivis distribution feeders.

The draft Option 3 is shown in this paper to have the lowest Net Present Cost and to meet the Regulatory Test net-benefit test after considering the feasible alternative options.

The provision of a new zone substation at Baldivis is a good strategic investment that:

- establishes a long-term transmission voltage supply arrangement for Baldivis;
- brings an inbuilt improvement in supply reliability; and,
- provides a degree of relief to the nearby zone substations, which are also facing high demand and experiencing population growth.

5.1.1 Benefits

Key benefits of the proposed BVS network augmentation investment are:

- **Resolves imminent WAI capacity issues:** efficiently ensures long-term 'substation planning capacity' is available to adequately cater for growth near WAI. This has increasingly been taken up supplying growing Baldivis loads (which would be transferred to the proposed new substation, BVS). This will ensure that the WAI substation, and the associated distribution feeders, do not exceed functional and/or regulatory limits, in line with long-term forecast demand growth.
- **Resolves present Baldivis growth constraints:** provides an optimal and efficient pathway to ensure long-term capacity is available to meet the forecast supply demand at Baldivis (i.e. via the proposed BVS zone substation).

[23] Proposed site owned is by Western Power

- **Future Housing Development:** supports the future development plan in the Karnup area[24] [25]. This was not included in Western Power demand forecast because the timeframe for Karnup development is not available at this stage. However, having additional capacity in the area will support early developments.
- **Improved reliability of supply:** a new zone substation (BVS) provides reliable and efficient transmission network supplies for the Baldivis community. In addition, improved DTC provided by rebalancing of loads across WAI and BVS will bring improved short-term load sharing opportunities for MSS and MH zone substations (which are forecast to be in deficit at times of peak demand, by FY 2028/29).

5.1.2 Implementation Considerations

The draft recommendation, Option 3, is to establish a new Baldivis zone substation. This option will deliver the highest net benefit to covered network electricity users and electricity market participants over the long term. The preferred option provides a robust and future-ready solution that:

a. adapts the WAI distribution supply for Baldivis via a change to inherently more reliable transmission supply flows to meet forecast demand growth;

b. relieves WAI overloads and enhances network resilience and redundancy;

c. provides a better WPN configuration for the integration of future renewable generation and DER;

d. minimises lifecycle costs through the proposed durable infrastructure augmentation investment;

e. aligns with the relevant rules and Access Code objectives; and,

f. presents a balanced risk profile, with a clear implementation pathway and minimal environmental or land-use constraints.

5.2 Proposed in service date

The proposed commissioning date for the draft recommendation to construct the BVS zone substation is December-2030, with preparatory and associated project works to be scheduled, managed and completed in line with that targeted commissioning date.

5.3 Evaluation of Alternatives

Alternative options, including overhead versus underground supply to the new zone substation, and two non-network possibilities were assessed – but these were found to be less favourable due to: higher costs; investment inefficiencies; reduced supply and reliability benefits; and/or greater long-term network and implementation risks.

Due to the scale of the issues being explained and addressed here – and the applicable resolution timeframes – combinations of non-network approaches and network options (e.g. as staging or deferral approaches) have proven to be costly.

5.4 Gains achieved at WAI

The project is technically mature and ready for implementation. Key delivery milestones have been identified, and risk mitigation strategies are in place to manage cost, schedule, and environmental factors.

24 Major land release announced for Perth's fringe
25 Karnup District Structure Plan - City of Rockingham

Implementation of the proposed scope of works will commence post receiving approval from the ERA with an expected in-service date of 2030.

A review of forecast demand correction expected for WAI, post-BVS is shown in Figure 17.

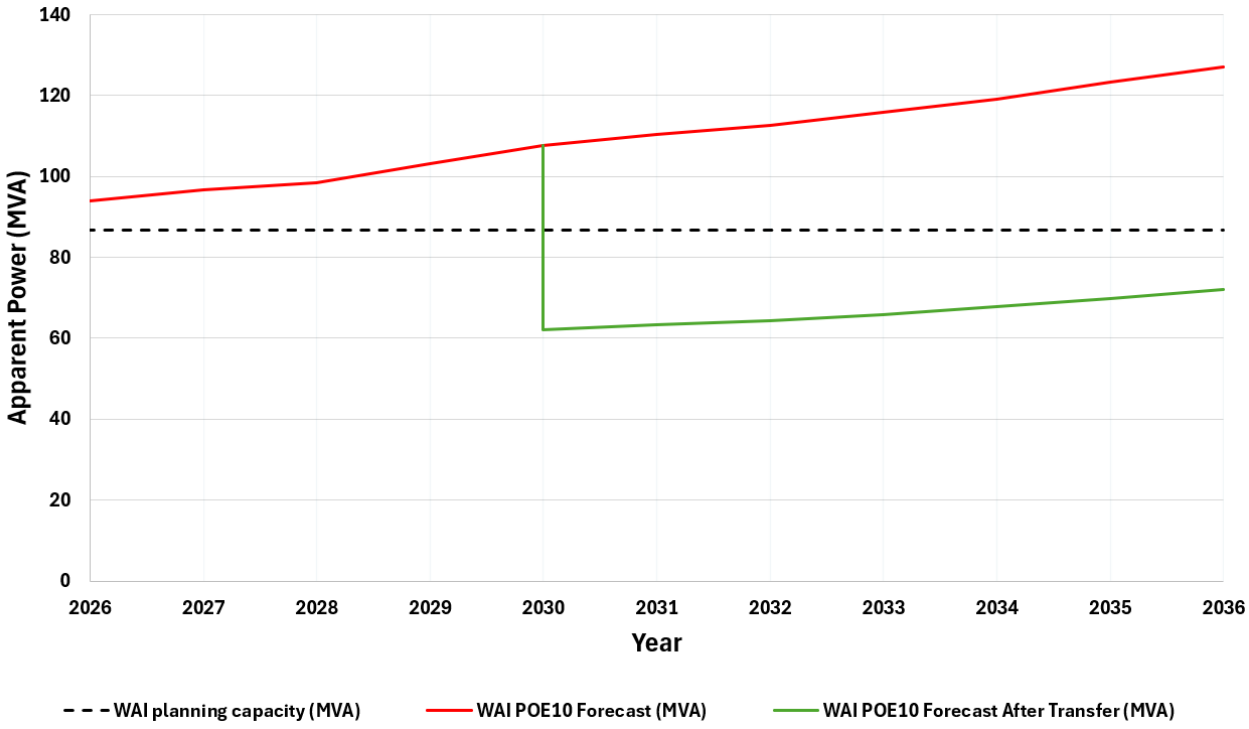


Figure 17 Aggregate improvements sought for WAI loads (pre and post BVS)

This proposal will make a vital contribution to Waikiki, Baldivis, and ongoing Mandurah Load Area reinforcement works. It also recognises that other projects in this load area will be taken forward in due course (and may be subject to future Regulatory Tests).

5.5 Net benefits summary

This options paper discusses the proposed augmentation on the basis that:

a. the augmentation is the most efficient way to maintain supply reliability in a growing region;

b. there is clear demand growth;

c. there is a lack of viable non-network alternatives; and

d. there is strong cost-benefit justification.

For Regulatory Test purposes, this paper shows the net benefit test[26] is met – as per the required three categories listed below.

The draft recommended solution from Option 3 best addresses imminent Waikiki, Baldivis and limited wider Mandurah load area supply constraints.

[26] 20080222 Guideline for Application of the Regulatory Test.pdf, e.g. see p. 4. and 5.

The draft proposal provides optimal benefits for:

Generators

- enables efficient and timely organic SWIS growth, within technical rules and limits, aggregating up to electricity system and market rules (i.e. ESMR) levels, integrating higher WPN Users' demand as increasing commercial opportunities for generators as wholesale electricity market (WEM) participants.
- proposed BVS substation will meet forecast aggregate demand – ensuring that network power flows will keep pace with the fast-growing load centre locations of the consumers providing additional demand.

Transporters

- to meet increased demand without abrogating regulatory service standards, the WPN must maintain reliable supply flows for the existing consumers, as well as enabling new connections.
- (proposed) BVS relieves capacity constraints within the northern sector in the Mandurah load area to a reasonable level, and additional reinforcements across the load area are expected to proceed in a timely fashion across the AA6 period (these are noted here as they will likely imply subsequent Regulatory Test(s) where there will be large investment in substations and new circuits/lines).
- the proposed augmentation (per Option 3) will maintain WPN aligning with the relevant rules' limits into the future, as well meeting network and end-user supply reliability expectations. That is, ensuring that the applicable SWIS system requirements (such as relevant Technical and ESM Rules, NQRS Code, Access Code, connection agreements, and the like) can be met.

Consumers

- benefit from minimising impacts (and/or related costs) of energy price pressure and unserved energy by maintaining the network reliability to meet the required limits, both in current demand scenarios, and for those expected into the future. In practical terms, there are tangible impacts of preventable losses of supply, for example, should load-shedding be required due to unmanageable overloading, and or if protection trips occur at times of peak loading.
- given the applicable power supply and quality obligations, consumers may reasonably expect that the network will maintain required levels of power supply, and power quality. In this case, there is a balance – maintaining the benefits that adequate supply brings – and simultaneously (cost effectively) respecting the finite technical limits, and ratings, of the network components.
- generally improves supply reliability into these areas (directly at Baldivis by draft provision of BVS supply via direct transmission network interconnection in place of the current distribution arrangements, and indirectly at Waikiki by improving the maintainability of WAI substation and feeder assets).
- benefit from minimising losses over lengthy highly loaded distribution feeders (i.e. wasted cost of generation, reduced emissions which brings an associated decarbonisation benefit).
- A greenfield zone substation (BVS) adds to the localised hosting capacity for (future) domestic photo-voltaic (DPV); community or network batteries; and distributed energy resource (DER) systems in the Baldivis area.

6. Forecasting and financial details

6.1 Capital expenditure

The draft recommended Option 3 for this augmentation will require investment estimated to be $77 million (base costs, FY 2025). The required expenditure will be classified as capital expenditure (Capex) and the amount noted here includes a risk allowance, and this level of investment triggers a Regulatory Test.

6.2 Net present value

The net present cost (NPC) of the recommended investment is $81.69 million, based on the assumption that the recommended expenditure satisfies the New Facilities Investment Test (for Capex) and thus will be subject to a regulatory return. This estimate uses an Internal Rate of Return (IRR) of 7.62% (pre-tax nominal weighted average cost of capital (WACC) in use across the AA5[27] period). This assessment includes all capital and operating financial inputs applicable to the recommended option over the investment's useful life associated regulatory revenue applicable to the recommended expenditure.

6.3 Forecasts and project cost estimating

6.3.1 Cost estimates

The MTF 25 forecasts and cost estimating methods used here are like the TSP 2024[28] and the AA5 methods and approaches. Refinements have been made which consider connections being sought and negotiated, and allowances made for non-network sourced energy. Standardised approaches apply, so that there will be minimal net cost differences between the options which are due to forecasting methods.

A conceptual design is used to establish an option's scope of works and a bill of materials, which are then used to derive building blocks of required work. Average estimated cost building blocks are then used to build cost estimates to collate and compare relative costs for each of the feasible options.

When estimating costs in the initial stages of this project, Western Power has followed the relevant ERA Regulatory Test Guidelines[29], namely:

> *…generally include the capital, operating and maintenance costs of ensuring that the option complies with all existing and anticipated laws, regulations, and administrative determinations such as those dealing with health and safety, land management and environment pollution and the abatement of pollution (including greenhouse gas abatement).*

6.3.2 Demand forecasting methodology

In the context of the full WPN, Western Power develops forecast models that can be classified as short-term load (one week), medium-term (up to 10 years) and long-term forecasting (up to 50 years). These forecasts may be segmented by customer type, tariff, and different network levels. Development of Western Power's forecast models is guided by three primary principles: accuracy, transparency, and evidence-based decision-making.

A range of statistical and analytical models are used to forecast customer connections, energy usage, climatic variations, and network demand across all customer segments (e.g. residential and small to large commercial connections). These forecasts are generated and applied at various levels, including system-wide at tariff levels – as well as at substation and feeder levels. Actual and projected demand will also consider the likely impacts of external variables such as: network users' demographics, locality and

27 Access Arrangement number 5, applies for the period July 2022 to June 2027.
28 See TSP 2024 - noting that 2025 updates will be published in TSP 2025, due towards the end of the 2025 calendar year.
29 20080222 Guideline for Application of the Regulatory Test.pdf, e.g. see p. 4.

urbanisation, daily and seasonal temperature, any applicable demonstrated statistical relevance, and/or substitution of network electricity (i.e. to capture influence of alternatives to network delivered electricity).

The aggregate demand forecasts appropriate for planning capacity expansion on the WPN are known as Western Power's medium-term forecasts (MTF). The MTF encompasses timeframes from one day up to 10 years, and these forecasts reflect the most likely scenarios and inform network planning, development strategies, and tariff setting under the Access Arrangements framework.

To adapt and take account of various dynamic inputs, the MTF incorporates sources such as:

a. Department of Planning, Land and Heritage (DPLH WA) "DPLH Tomorrow" population forecast forms the basis for customer connection growth at the localised level for feeders and zone substation catchments. This ensures consistency with the projections from the department and state land release timing (population growth is discussed earlier in this paper);
b. effect of photo-voltaic (PV) systems in demand forecasts – the MTF uses a time domain forecasting approach which involves developing daily and longer-term profiles of solar PV analytics data to determine granular daily and seasonal views;
c. PV forecasts include Australian Bureau of Statistic (ABS) data on home ownership and rental data per suburb to understand the socio economic and likelihood of PV adoption; and,
d. EV forecast is based on Australian Energy Market Operator (AEMO) ESOO[30] projections, and on CSIRO suburb level EV projection. The EV charging impact to the networks are modelled based on the collaborative work with EPWA when WP was working on the EV Action Plans.

The ultimate MTF demand forecast is iterative and complex – it is based on traditional statistical models and daily machine learning models where the best performing models are promoted (as the most representative) to develop and formulate the annual 10 years demand forecast.

The MTF has a new version released every year, identified by adding the applicable year of the forecast (for example, MTF 25 currently applies for 2025).

Probability of exceedance

Electricity demand is dynamic – and understanding its patterns are one of the critical factors determining the size, timing and location of investments and other operational and strategic network decisions made by Western Power. The validity of forecasts is checked and categorised by running statistical tests to ensure consistency at distinct levels of aggregation. For any given season or year, probability of exceedance (PoE) values - PoE10, PoE50 and PoE90 – are defined as:

- PoE10 where there is a 10% probability of demand exceeding the PoE10 value.
- PoE50 where there is a 50% probability of demand exceeding the PoE50 value.
- PoE90 where there is a 90% probability of demand exceeding the PoE90 value.

6.3.3 Asset lifecycle

While the detailed comparisons of the full asset lifecycle costings are not described in detail in NPC comparisons used here, it is noted that the asset life of the Option 3 facility can be expected to be 50 years, and that Option 3 investment will form a regulatory capital investment, which attracts returns on investment over the assets' service lives. Different conditions apply for supply sourced by third party contract NSS – those costs are Opex and they form sunk costs over the life time of those support services contracts.

[30] AEMO | WEM Electricity Statement of Opportunities

7. Conclusions and recommendations

7.1 Summary

The proposed Option 3 efficiently alleviates the present constraints being experienced across the fast-growing coastal corridor between Rockingham and Mandurah (i.e. the WPM Mandurah load area) and best enables meeting all key objectives of this work – which are summarised as follows:

a. provides timely additional capacity into the Baldivis area, via the long-term and more desirable, more electrically efficient means, that is, to a 132 kV transmission network supply. The proposed new supply will be subject to better reliability standards than normally apply to the present distribution supply arrangement;

b. rebalance the new capacity which will become available across the new (BVS) and existing zone substations to achieve critical, broad, and sufficient "Mandurah load area reinforcement";

c. reduce the impacts (cost, lost capacity through wasteful and potentially harmful emissions, etc.) such as I^2R losses (or *copper losses*) across the lengthy 22 kV distribution feeders which have evolved to supply the Baldivis area loads; and,

d. capacity restored in the distribution network for localised feeder functions (i.e. removes the 'losses' component from the present physical limits due to using overloaded, lengthy circuits).

7.2 Conclusion and draft recommendation

In conclusion, the draft proposal for the recommended BVS substation will:

a. provide timely relief to the imminent constraints at WAI zone substation;

b. make a vital contribution to ongoing Baldivis supply needs;

c. provide timely distribution network rebalancing and reinforcement capacity within the northern sector of the Mandurah Load Area; and,

d. ensure that the WPN, and the SWIS:

   (i) adequately adapt to expected network load increases;

   (ii) integrate expected increased loads into the electricity supply market and mechanisms; and,

   (iii) maintain current reliability, system security, and power quality compliance levels.

Accordingly, the draft recommendation is that the proposed augmentation "Option 3: Build a new substation at Baldivis (via overhead line reconductor)", commences in a timely manner immediately after Regulatory Test approval is gained.

In accordance with the Regulatory Test processes in the Electricity Networks Access Code 2004, Western Power invites submission from all interested parties on the major network augmentation which is described in this Options Paper.

7.3 How you can have your say

We have provided points of contact to gain your feedback earlier in the paper (see p. 7). Following consideration of submissions received by that date, Western Power expects to analyse and publish our responses early in 2026. After that, the intention is to proceed with a Regulatory Test submission for the ERA's net-benefit assessment of the Waikiki and Baldivis major augmentation in January 2026.

Appendix A –Access Code and Regulatory Test requirements

The Regulatory Test (Reg. Test) is an assessment under Chapter 9 of the Electricity Networks Access Code 2004 (Access Code) [31].

A.1 What is a regulatory test?

In simple terms, the Regulatory Test is an assessment (determined by the ERA[32]) of whether a proposed Major Augmentation to a covered network maximises the Net Benefit (measured in present value terms to the extent that it is possible to do so) to those who generate, transport or consume electricity (see the Access Code), and the ERA's (the Authority's) Regulatory Test guidelines[33]).

A.1.1 Net-benefit

The Reg. Test is defined in the Access Code (in Ch. 9) and applies to major augmentations (defined in Access Code s. 1.3). The Reg. Test process is well defined but applies infrequently, and thus, there is variability about its practical application and scope. For example, there are Reg. Test objectives, in s. 9.1, especially 9.1(c), which may be interpreted and can vary on a case-by-case basis.

A.1.2 Consumer Price Index Adjustments

The *Electricity Networks Access Code 2004* refers CPI adjusted limits for the Regulatory Test and the following 2025 adjusted figures[34] have been published by the ERA:

Table 4 Consumer price index adjusted Regulatory Test limits

Year	Section 1.3	
	Distribution	Transmission
2025	$15.6 million	$46.8 million

31 Electricity Networks Access Code - Unofficial Consolidated Version
32 Regulatory Tests - Economic Regulation Authority Western Australia
33 Regulatory Test Guidelines - Economic Regulation Authority Western Australia
34 Consumer Price Index Adjustments - Economic Regulation Authority Western Australia

Appendix B – Glossary

The list of abbreviations and acronyms used throughout this document is shown below.

Acronym / Abbreviation	Definition
AA	Access Arrangement
Access Code	Electricity Networks Access Code
AEMO	Australian Energy Market Operator
AUD	Australian dollars
BESS	Battery Energy Storage Systems
BVS	Baldivis Zone Substation
Capex	Capital Expenditure
CPI	Consumer Price Index
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DER	Distribution Energy Resource
DPLH	Department of Planning, Lands and Heritage
DPV	Domestic Photovoltaic system
DSM	Demand-Side Management
DSR	Demand-Side Response
DTC	Distribution Transfer Capacity
EPWA	Energy Policy Western Australia
ERA	Economic Regulation Authority
ESMR	Energy System and Market Rules
ESOO	Electricity Statement of Opportunities
ESS	Essential System Services
EV	Electric Vehicle
FY	Financial Year
HV	High Voltage
I^2R	Square of current multiplied by resistance (i.e. copper losses)
IRR	Internal Rate of Return
kV	kilo Volt
LGA	Local Government Authority
MH	Mandurah Zone Substation
MRS	Metropolitan Region Scheme
MSS	Meadow Springs Zone Substation
MTF	Medium Term Forecast

Acronym / Abbreviation	Definition
MVA	Mega Volt Ampere
MWh	Mega Watt-Hour
N-1	System maintains an operational state with one transmission element out of service
NCESS	Non-Co-Optimised Essential System Services
NCR	Normal Cyclic Rating
NFIT	New Facilities Investment Test
NNS	Non-Network Solution
NPC	Net Present Cost
NQRS	Electricity Industry (Networks Quality and Reliability of Supply) Code 2005
NSS	Network Support Services
OHEW	Overhead Earth Wire
Opex	Operational Expenditure
PoE	Probability of Exceedance
PV	Photovoltaic
SCC	Social Cost of Carbon
SEC	Old term referring to “State Energy Commission/Corporation”
SWIS	South-West Interconnected System
TSP	Transmission System Plan
VPP	Virtual Power Plant
WACC	Weighted Average Cost of Capital
WAI	Waikiki Zone Substation
WAPC	Western Australian Planning Commission
WEM	Wholesale Electricity Market
WPN	Western Power Network