ASSET MANAGEMENT DISTRIBUTION ANNUAL PLANNING REPORT 2020

December 2020

essential energy

Table of Contents

List of Figures

List of Tables

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EXECUTIVE SUMMARY

Since 1 January 2013, the National Electricity Rules (NER) have stated that all Distribution Network Service Providers (DNSPs) operating in the National Electricity Market (NEM) are required to:

- Conduct an annual planning review and publish a Distribution Annual Planning Report (DAPR)
- Conduct economic assessments of potential project options under a new Regulatory Investment Test for Distribution (RIT-D)
- Implement a Demand Side Engagement Strategy to consult with and engage non-network providers in the development and evaluation of potential solutions to identified network needs.

The annual planning review includes the planning for all assets and activities carried out by Essential Energy that would materially affect the performance of its network. This includes planning activities associated with the replacement and refurbishment of assets and negotiated services. The objective of the annual planning review is to enable DNSPs to plan for and adequately address possible future issues in a timely manner. The outcome of the annual planning review is the DAPR.

Essential Energy is required to prepare and publish a DAPR that is compliant with the requirements of the NER (Section 5.13.2 and Schedule 5.8) to:

- Provide transparency to Essential Energy's decision making processes and provide a level playing field for all regions in the NEM in terms of attracting investment and promoting efficient decisions
- Set out the results of Essential Energy's annual planning review, including joint planning, covering a minimum five year forward planning period for distribution assets
- Inform registered participants and interested parties on the annual planning review outcomes - report on capacity and load forecasts for sub-transmission lines, zone substations and transmission-distribution connection points, plus, where they have been identified, any primary distribution feeders which were overloaded or forecast to be overloaded within the next two years
- Provide information on Essential Energy's demand management activities and actions taken to promote non-network initiatives each year, and plans for demand management and embedded generation over the forward planning period
- Assist non-network providers, Transmission Network Service Providers (TNSPs), DNSPs and connection applicants to make efficient investment decisions.

The DAPR covers a minimum five year forward planning period for distribution network assets.

1. INTRODUCTION

1.1 About Essential Energy

Essential Energy's purpose is '*enabling energy solutions that improve life'*, with a vision to be '*empowering communities to share and use energy for a better tomorrow'.*

The organisation operates and maintains one of Australia's largest electricity networks, across 95 per cent of New South Wales (NSW) and parts of southern Queensland. Serving more than 865,000 customers – including homes, hospitals, schools, businesses and community services – Essential Energy is an economic enabler for regional, rural and remote communities.

Essential Energy aims to continuously improve safety performance for employees, contractors and the community, along with the reliability, security and cost efficiency of the network, while striving to maintain downward pressure on the network component of customers' electricity bills and deliver an acceptable return on capital employed.

Essential Energy's business objectives are:

- Continuous improvements in safety culture and performance
- Operate at industry best practice for efficiency, delivering best value for customers
- Deliver real reductions in customers' distribution network charges
- Deliver a satisfactory Return on Capital Employed
- Reduce the environmental impact of Essential Energy where it is efficient to do so.

These will be achieved through enhanced customer engagement; investing in best practice systems, processes and technology; improving commercial capabilities to enable the business to operate safely and efficiently; improving the understanding of Essential Energy's environmental footprint, and making decisions to improve the sustainability of the business's operations.

Essential Energy's network area is divided into ten operations areas encompassing a wide range of geographical, climatic and environmental conditions.

In the Far West of NSW, an operating division, Essential Water, services a population of approximately 18,000 people. A secure water supply is delivered to around 10,500 customers in Broken Hill, Sunset Strip, Menindee and Silverton, as well as rural customers. Reliable sewerage services are provided to around 9,700 customers in Broken Hill. Essential Water operates a network of dams, water treatment plants, sewage treatment plants, reservoirs, water and sewage pumping stations, mains, and other related infrastructure.

1.1.1 Operating Environment

Essential Energy is a NSW Statutory State Owned Corporation and Energy Services Corporation, regulated by state and national statutory and legislative requirements. In addition to being subject to specific electricity distribution laws and rules, Essential Energy is subject to most of the statutory and other legal requirements that other businesses are subject to; including workplace health and safety (WHS), environmental, competition, industrial, consumer protection and information laws. Essential Energy is also required to follow government and regulatory direction.

At a national level, Essential Energy is subject to the National Electricity Law (NEL) and the National Electricity Rules (NER) which regulate the National Electricity Market (NEM). Essential Energy operates in the NEM as a Distribution Network Service Provider (DNSP). The Australian Energy Regulator (AER) regulates the transmission and distribution sectors of the NEM under the NEL and NER.

At a state level, Essential Energy's activities are governed by the NSW Electricity Supply Act 1995, the Energy Services Corporations Act 1995 and a NSW Distribution Network Service Provider licence. The NSW Department of Planning, Industry and Environment develops and administers Essential Energy's Network Design, Reliability and Performance Licence Conditions, and the Independent Pricing and Regulatory Tribunal (IPART - Electricity) is responsible for monitoring compliance with licence requirements.

Essential Energy ensures compliance with these laws and regulations through its internal codes and policies and a common control framework, which comprises plans, policies, procedures, delegations, instruction and training, audits of compliance and risk management. Operations are guided by policies and codes, including Health, Safety and Environmental Policy, Statement of Business Ethics, and Code of Conduct.

1.1.2 Essential Energy Statistics

Table 1 – Essential Energy Statistics for FY2019/20

Category	Number at 30/6/2020
Distribution Customer Numbers (Total)	866,351
Customer Numbers (Coastal)	116,725
Customer Numbers (Ranges)	58,280
Customer Numbers (Mid North Coast)	172,444
Customer Numbers (Northern Tablelands)	80,630
Customer Numbers (North Western)	28,723
Customer Numbers (Macquarie)	99,576
Customer Numbers (Riverina Slopes)	76,423
Customer Numbers (South Eastern)	118,418
Customer Numbers (Murray)	67,028
Customer Numbers (Central)	48,104
Maximum Demand (MW)	2,402
Feeder Number CBD	0
Feeder Number Urban	302
Feeder Number Short Rural	922
Feeder Numbers Long Rural	244
Energy Received by Distribution Network to Year End GWh	13,128
Energy Distributed (Residential) GWh	4,595
Energy Distributed (Non-Residential including un-metered supplies) GWh	7,855
Energy Distributed (Coastal) GWh	838
Energy Distributed (Ranges) GWh	720
Energy Distributed (Mid North Coast) GWh	1,442
Energy Distributed (Northern Tablelands) GWh	1,145
Energy Distributed (North Western) GWh	338
Energy Distributed (Macquarie) GWh	3,402
Energy Distributed (Riverina Slopes) GWh	1,277
Energy Distributed (South Eastern) GWh	1,185
Energy Distributed (Murray) GWh	925
Energy Distributed (Central) GWh	1,178

Category (Continued)	Number at 30/6/20
System Loss Factor (%)	5.17
Substation - Zone (Number)[1]	339
Substation - Distribution (Number)	139,070
High Voltage Overhead (km)	157,721
High Voltage Underground (km)	2,835
Low Voltage Overhead (km)[2]	25,479
Low Voltage Underground (km)	6,650
Pole (Number)[3]	1,328,202
Streetlights (Number)	161,247

Notes: Distances for overhead and underground lines are circuit km.

[1] The number of zone substations reported include only those sites where the forecast is published within this document.

[2] LV Services and Streetlight circuits excluded, LV Services classification only includes the last span from the pole to the Point of Attachment, and no longer includes the road crossing section.

[3] This number is the sum of urban, short rural and long rural poles published in the annual RIN.

1.2 Essential Energy's Network

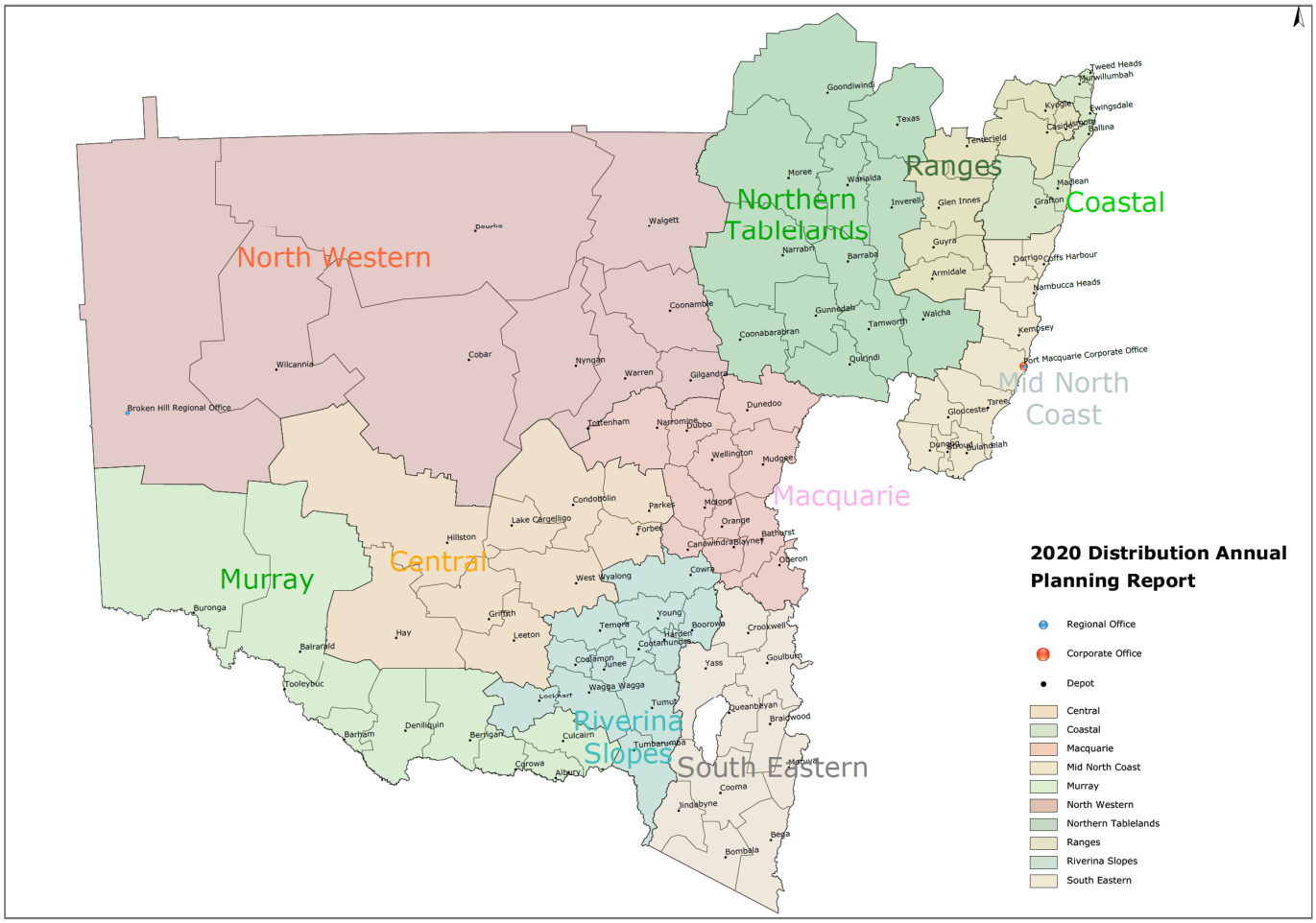


Figure 1 – Essential Energy's Network Area

Essential Energy's network includes 183,200km of overhead powerlines traversing 737,000 square kilometres of landmass. The network has a large number of asset types across different voltage levels. Customers can be connected at any voltage level from 220,000 volts down to low voltage (400/230 volts), depending on their power needs. Figure 2 illustrates the variety of network components owned by Essential Energy, with shaded portions showing examples of connected customers and bulk supply points not owned by Essential Energy – the distribution network is one component of an integrated system by which electricity is generated, transmitted and distributed to customers.

The majority of costs associated with electricity distribution are not driven by the number of customers or their demand on the network. Rather, network costs are driven by the number of assets required to deliver electricity to each customer. Whether there are 50 customers connected to one pole or 50 poles connecting one customer, each asset needs to be inspected, safely maintained and replaced at the end of its life.

1.2.1 Number and Types of Distribution Assets

Essential Energy's network consists of 183,200 kilometres of sub-transmission, high voltage distribution and low voltage distribution power lines, and over 1.3 million poles. Approximately 95 per cent of the network is of an overhead construction type and 95 per cent of distribution substations are pole-mounted due to the predominately rural nature of the network.

The majority of the distribution network is radial, with most parts supplied from one source, providing little opportunity for interconnection with other circuits for security and continuation of supply when performing maintenance activities or in the event of unplanned outages. This is equally true of the radial 132,000 volt and 66,000 volt sub-transmission networks.

Essential Energy reviews the level of reliability received by our customers against the nationally defined Value of Customer Reliability (VCR) and ensures that the level of network investment is in line with this measure of customer expectation. This approach does limit the level of reliability able to be delivered to our remote customers, primarily due to the level of investment required. Essential Energy is, however, committed to continually reviewing the reliability of its network in all parts of its supply area, with a view to utilising available technologies and appropriate practices to provide the maximum reliability and security of supply possible within these constraints.

Table 2 – Network Assets at 30 June 2020

ASSETS	Circuit kilometres		Transformers	
	Overhead lines	Underground cables	Number	Nominal capacity (MVA)
220kV	3.0	0	0	0
132kV	2,170	12	77	2,948.50
110kV	21	0	3	300
66kV	7,561	38	417	5,943.73
33kV	5,425	51	1,583	1,752.75
22kV	42,545	359	34,999	2,580.64
11kV and below	70,331	2,334	93,950	7,588.10
SWER (all voltages)	29,665	41	8,688	147.33
Low voltages	25,479	6,650	0	0
Total network	**183,200**	**9,485**	**139,717**	**21,261.04**

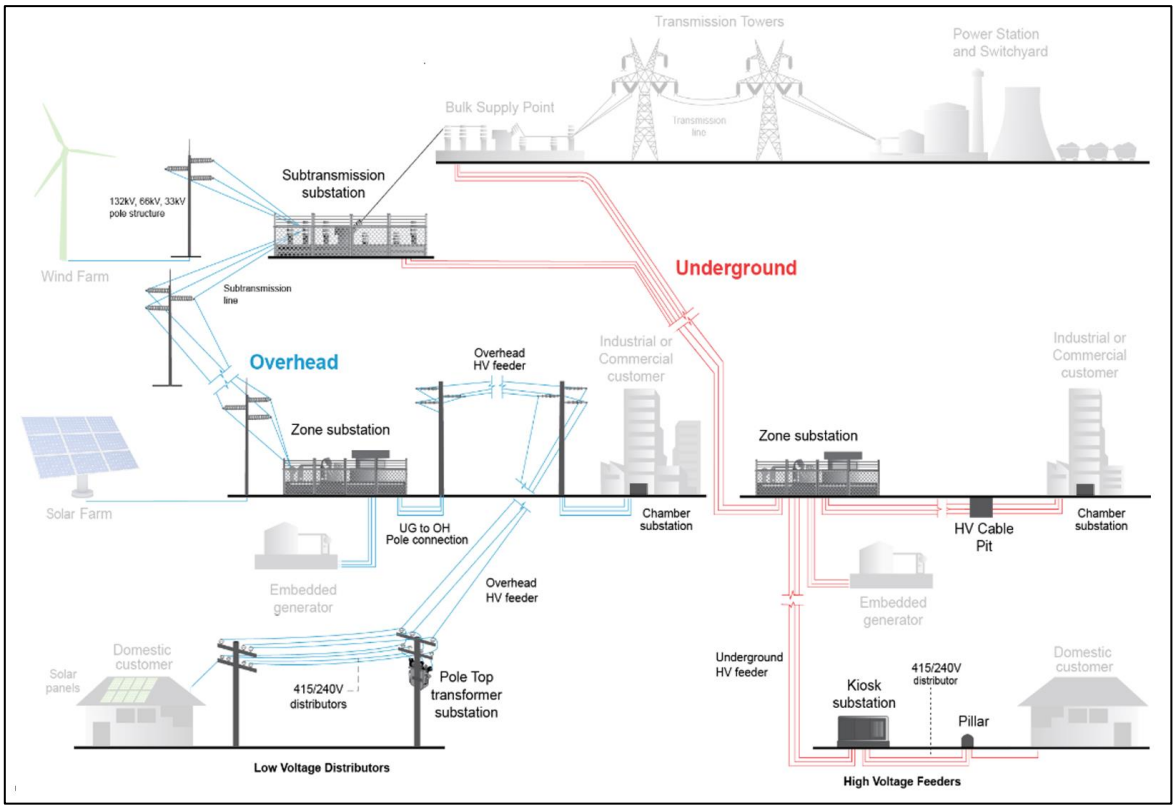


Figure 2 – Typical components of Essential Energy's electricity network

1.3 Annual Planning Review

The NER require that the Annual Planning Review includes the planning for all assets and activities carried out by Essential Energy that would materially affect the performance of its network. This includes planning activities associated with the replacement and refurbishment of assets and negotiated services. The objective of the Annual Planning Review is to identify possible future issues that could adversely impact the performance of the distribution network to enable DNSPs to plan for and adequately address such issues in a timely manner. The outcome of the Annual Planning Review is the DAPR.

This DAPR provides information to Registered Participants and interested parties on the nature and location of emerging constraints on Essential Energy's sub-transmission and high voltage distribution network assets, commonly referred to as the Distribution Network. The timely identification and publication of emerging network constraints allows the market to identify potential non-network solutions and Essential Energy to develop and implement appropriate and timely solutions to them.

Essential Energy has worked closely with the Institute of Sustainable Futures (ISF) to publish network opportunity maps. These maps use the Australian Renewable Energy Mapping Infrastructure (AREMI) platform to provide a visualisation of emerging constraints over the next 10 years. These maps can be accessed through the AREMI website https://nationalmap.gov.au/renewables/, under Electricity Infrastructure, Network Opportunities.

The 2020 DAPR can be visualised through the website https://dapr.essentialenergy.com.au/. This site contains an interactive map of the network, including forecasts, limitations and planned investments.

1.3.1 Network Planning Process

The planning and development process for the distribution network is carried out in accordance with the NER Chapter 5 Part D Planning and Expansion.

Essential Energy carries out network planning at both a strategic and project level. The processes used for each of these levels of network planning are set out in the Essential Energy procedural guideline "*Sub-transmission and Distribution Network Planning Criteria and Guidelines*", housed and administered through Essential Energy's Business Management System.

The Essential Energy investment governance process ensures continuous review and assurance that capital prudence and efficiency are being achieved, as well as being consistently aligned with longer term strategic planning as set out within the Essential Energy Corporate Objectives, Strategic Business Plans and Strategic Asset Management Plan (SAMP).

The Essential Energy network planning process uses a quantified approach to monetise the value of risk for Network Constraints and a value-based approach to identify the most effective ways to minimise risk, while delivering benefit to network users.

The first stage of the network planning process involves researching the data required to assess all constraints and assemble a whole-of-network view. This includes historical and existing peak demands, the preparation of a range of seasonal demand forecasts, examining network capacity limits, assessing asset condition and risk of failure, forecasting new customer connections (including new or augmented 'spot' loads and/or embedded generators) and taking into account duty of care and regulatory obligations.

The forecast adequacy of the network is assessed against key criteria, including:

- Meeting modern infrastructure standards, including safety and security of the network and environmental compliance
- Addressing any 'demand – capacity' imbalance
- Risk, reliability and power quality performance
- Asset condition and re-investment considerations
- Customer connection requirements (loads and embedded generation).

When emerging network limitations are identified and quantified according to Essential Energy Asset Risk Management and Appraisal Value Frameworks, a range of feasible options, including both network and non-network solutions, are developed to address the network need and to ensure continuing compliance.

All relevant potential credible options, including non-network and operational alternatives are considered in determining how to best meet network performance obligations and the objectives of the NEL.

There is a robust selection process based on analysis of the Net Present Value of options and a range of sensitivity analyses that explicitly trade off alternative investment options. These options use quantified estimates for credible option costs and market benefits against business performance targets to identify the optimum portfolio of projects that minimises the risk and cost of achieving the desired performance.

In accordance with NER obligations and statutory requirements, network augmentation and demand management options are assessed impartially using a consistent value-based review process. Demand management and non-network options are evaluated on the extent to which they can avoid or defer the need for traditional network augmentation.

This DAPR seeks to inform stakeholders and provides advice on emerging network limitations and network adequacy. It also provides details of the expected time required to allow appropriate corrective network augmentation, non-network alternatives or modifications to connection facilities.

The Essential Energy network planning approach is outlined in its Network Management Plan and is consistent with the principles of the NSW Government Total Asset Management framework.

Essential Energy is required to comply with mandatory service standards in accordance with the *Reliability and Performance Licence Conditions for Electricity Distributors (July 2014*) and subsequent variations.

This document provides information for locations where investment is required to address network limitations due to forecast demand and other prudent considerations.

1.4 Significant Changes from previous DAPR

The 2020 DAPR follows the same format as previous years, with many of the changes being related to network configuration and forecasting methodology improvements. The content has been improved based on feedback from various stakeholders including the AER.

1.4.1 Analysis and explanation of forecast changes

The spike in measured total network demand seen in the summer of 2018/19 has reduced this year, with summer still the peak season overall. Individual site forecasts are generally indicating low steady growth, though some sites have seen measurable impacts from drought, bushfires and population movements during the current pandemic, and it is unclear what the long term effects of these events will be.

As site data and the forecasting process is improved, the quality of each forecast is also improving. At all levels from Transmission-Distribution Connection Points to the sub-transmission and zone substation level, forecasts have been adjusted to account for expected load transfers for new and decommissioned sites.

There have been several changes to Essential Energy's network including the commissioning and decommissioning of zone substations and sub-transmission lines. These may affect the recorded loads on the existing system based on various load transfers.

The forecasting process is constantly evolving, with new improvements this year including the application of solar irradiance in the weather correction calculation. The forecast starting point methodology has been enhanced, with the most suitable methodology chosen for each site. There were further improvements to the process used to reconcile forecasts against interconnected areas of the network. The forecasting changes are described in further detail in Section 2.2.

1.4.2 Analysis and explanation of changes in other information

The main focus for this document was data quality improvements and adjustments to the forecasting methodology, so the majority of sections within the document contain only minor changes.

A project has been included in the Urgent and Unforeseen Investments section, relating to bushfire damage to the network supplying Cabramurra zone substation.

2. FORECASTS FOR THE FORWARD PLANNING PERIOD

This section provides a detailed assessment of the current peak demand forecast process.

Peak demand forecasts provide Essential Energy with the basis for identifying network limitations, evaluating the credible network and non-network options to address those limitations and (if applicable) commencing the RIT-D process. It also feeds into the SAMP and identification of the capital and operating investment expected to be required for the forward planning period.

Essential Energy's Network System peak demand for the Summer 2019/20 and Winter 2020 periods peaked in Summer at 2,402 megawatts (MW) at 6:30pm (AEST) on Thursday, 30 January 2020.

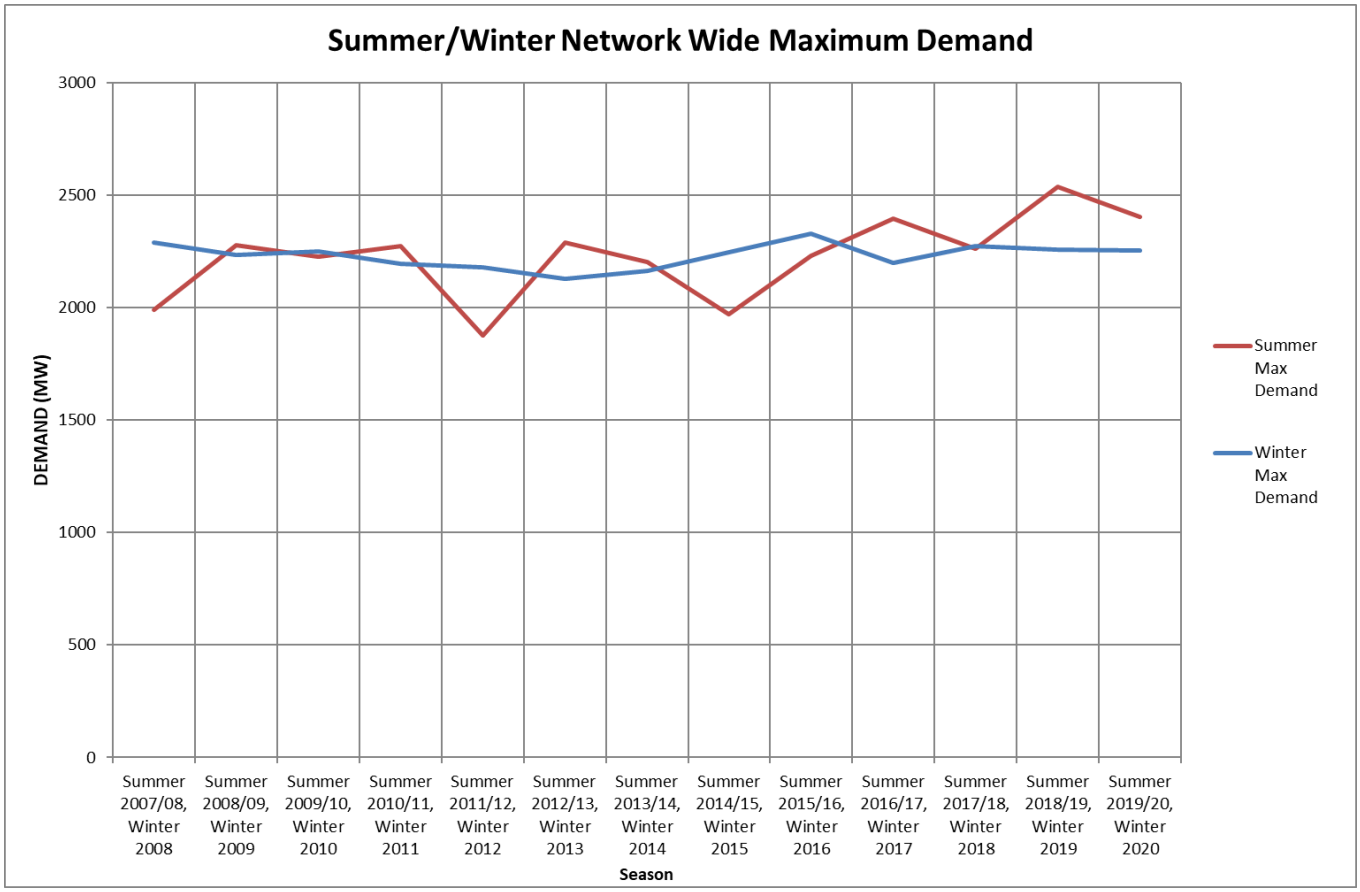


Figure 3 – Essential Energy's recorded maximum demands

2.1 Load Forecasting Strategy

A primary driver in network development and the identification of specific investments is the forecast of electricity demand and energy. The spatial demand forecast is a critical process that supports planning, development of the capital program and the regulatory submission.

Given the importance of the demand forecast on the required capital expenditure and the SAMP, Essential Energy's main objectives are:

- Efficient, closed-loop development and refinement of the forecasting process, data and documentation
- Engagement of the wider audience to appropriately inform the impacts and building blocks of demand.

In the process of moving towards achieving these objectives, Essential Energy has seen a substantial transition in the network forecasting methodology and process from a relatively simplistic process (such as minimal weather correction and reconciliation between top-down and bottom up forecasts) which required a high level of subjectivity to a more complex, repeatable process using concepts from the AEMO connection point forecasting methodology.

2.2 Load Forecasting Methodology and Process

The forecasting methodology has been developed and refined using two main vision items as the driving force, these items are:

- That the demand forecasting process undertaken is commensurate with the benefits the forecast provides
- That all demand forecasts are auditable and repeatable.

Essential Energy has developed a methodology which provides for the establishment of the building blocks required to achieve this vision. This methodology is summarised in Figure 4.

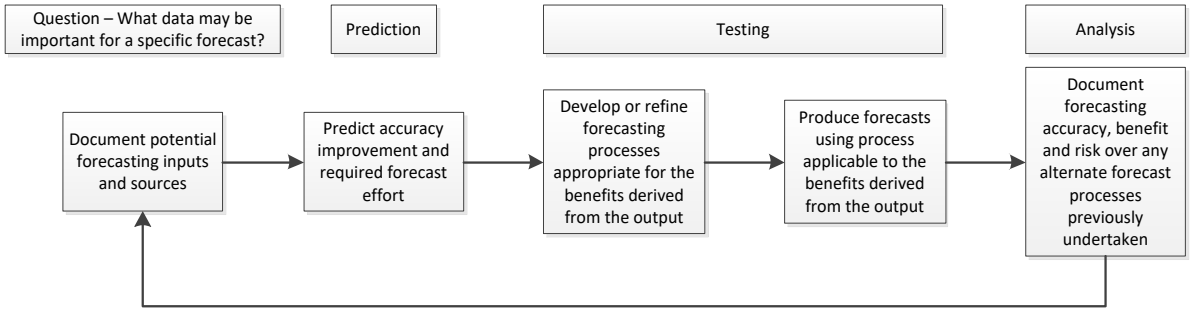


Figure 4 – Forecasting Methodology

As shown in Figure 4, Essential Energy's methodology calls for continuous improvement in the forecasting process specific to the site in question and dependent on the predicted cost/benefit. As an example some sites may have poor input data and hence poor forecasting accuracy, however if no benefits can be identified from improving the forecast, the cost to improve the process cannot be justified and the forecast inaccuracy specific to the site in question will remain. Alternatively, high benefits (such as capital deferral) would justify substantial forecasting effort and the appropriate level of expense and rigour.

To assist in the network planning process and to identify regional growth patterns, several levels of forecast are used by Essential Energy:

- Overall Essential Energy network forecast
- Regional TransGrid and other TNSP connection point forecasts
- Sub-transmission feeder forecast
- Zone substation forecasts
- Local distribution feeder forecasts as necessary.

The forecasting process used by Essential Energy is heavily influenced by the Australian Energy Market Operators' (AEMOs) published Connection Point Forecasting Methodology[4].

[4] Australian Energy Market Operator – AEMO Connection Point Forecasting Methodology – Forecasting Maximum Electricity Demand in the National Electricity Market 29 July 2016

At a high level, the process consists of:

- **Data collection and collation**

  To cater for regional and local needs, a forecast of the demand at each zone substation is developed based on historical demands and information provided by major customers. Account is taken of load diversity between connection points. Embedded generation is recognised and included in the forecast where it offers firm capacity at the time of demand.

- **Outlier removal / Data preparation**

  In order to ensure only system normal conditions are evaluated, short-term network switching and abnormal metering outputs are removed.

- **Weather correction (or normalisation)**

  Historical demand is weather-corrected in order to provide a reference set of conditions from which each year can be compared (with a probability of exceedance of 50 per cent). Daily temperatures and solar irradiance from relevant weather stations are used in the correction to account for various forms of demand behaviour.

- **Repeat for each season over the time periods available**

  The forecast covers both summer and winter demands and uses data going back up to ten years. Where the load is very consistent the historical data is not analysed in separate seasons. This variation improves the accuracy of some forecasts, especially when step changes in total load occurs.

- **Determine the most applicable growth rate based on known variables**

  A series of short and long-term trends in the ten years of temperature-corrected historical demand are analysed and growth rate selected based on the median of such trends. Where the median does not accurately reflect a sites' growth (e.g. significant changes in historical configuration, customer mix, etc) an alternative growth rate is selected to reflect the current status of the site. In some cases, it may be necessary to remove certain time periods from the analysis where configuration changes have been deemed to impact the trend analysis.

- **Determine starting point of forecasts**

  Forecasts generated from trending weather-corrected history and raw history are compared and the most suitable model is chosen as the starting point of each sites' forecast. Where both models generate poor results (e.g. small dataset, major configuration changes, etc) then the starting point is taken to be the value of the most recent historical seasonal maximum demand.

- **Calculate forecast load**

  The forecast extends over a planning horizon of ten years, with the first five years published in this report. The forecast power factor used is the median of the power factor distribution based on the top 1% of half-hourly demands over the last three years.

- **Apply any post model adjustments**

  Where there is known potential for the connection of major spot load developments, such as mining loads and major subdivisions, the forecast takes into account any reasonably firm step load increases in the medium term.

- **Reconciliation of forecasts**

  Calculation to ensure the forecast aligns with upstream and downstream network components, and identification of changes to previously developed forecasts.

2.2.1 Sources of load forecast input information

Potential inputs to an individual forecast and the applicable source data may include:

Table 3 – Potential sources of load forecast input information

Potential Inputs	Potential Source Data
Historic demands	Interval meter data, supervisory control and data acquisition (SCADA) data, recloser data, derived loads, assumed factors
Seasonal indicators	Seasonal trends
Future step loads (large customer or residential subdivision)	Information from large customers and developers
Residential growth rates	Department of Planning
Economic conditions	Australian Bureau of Statistics
Weather patterns	Bureau of Meteorology
Generation	Interval meter data, Bureau of Meteorology, customer information
Individual customer demands	Interval meter data
Regulatory variation	AER documentation, Minimum Energy Performance Standards (MEPS) reports, other government initiatives
Distribution changes	Network information (planning, operations, load control)
Distribution programs	Network program information (planning, load control)
Tariff changes	Network Tariff information
Residential Solar Generation	Solcast estimates from measured solar irradiance
Electric Vehicle Charging	Interval meter data, forecasts of new car sales, connection applications

2.2.2 Assumptions applied to load forecasts

Numerous assumptions are required in order to streamline the forecasting process. Some of these assumptions are that:

- All large customers and embedded generators are recorded appropriately
- Historic demand data used for summer forecasts comprise the high temperature days from months November to March inclusive while winter forecasts consider the low temperature days from months May to September
- All load information is actual (i.e. no erroneous readings, metering drift, etc)
- All switching events are recorded or easily detected in analysis
- All weather related data is actual
- The selected weather sites are the best currently available to Essential Energy for representation of the conditions at the load sites
- All historic network changes have been accounted for
- Information provided by large load customers and developers will come to fruition
- Sub-transmission feeder forecasts are a special case, using a proportion of the Bulk Supply point forecast rather than an actual forecast. Hence, sub-transmission forecasts may not reconcile to zone substation forecasts
- Site forecasts are performed individually. Deviations to combined upstream forecasts can easily occur due to individual peak demands occurring at different times.

2.3 Supply Area Forecasts

2.3.1 Terranora Supply Area

Description of Terranora area

All zone substations in the Terranora area are in the Coastal region.

The Terranora sub-transmission substation is owned by Essential Energy and is supplied from the Queensland transmission system via 2 x 110kV lines that are jointly owned by Essential Energy and Powerlink.

A high voltage direct current transmission network is connected between Mullumbimby and Terranora (via Bungalora) which allows supply to be either injected into the Lismore area from Terranora or injected into the Terranora area from Lismore.

TERRANORA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – CUD3B3 Duranbah	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
757	110	Powerlink Mudgeeraba 275/110kV STS	Terranora 110/66kV STS	106	100.0	100.0	100.0	100.0	100.0	119	100.0	100.0	100.0	100.0	100.0
758	110	Powerlink Mudgeeraba 275/110kV STS	Terranora 110/66kV STS	106	101.0	101.0	101.0	101.0	101.0	119	101.0	101.0	101.0	101.0	101.0
9501	66	Terranora 110/66kV STS	Cudgen ZS	59	23.0	23.7	28.6	28.9	29.2	66	22.8	23.4	28.1	28.3	28.4
9502	66	Terranora 110/66kV STS	Murwillumbah ZS	61	10.1	10.3	10.4	10.5	10.7	68	10.3	10.4	10.6	10.7	10.9
9503	66	Terranora 110/66kV STS	Banora Pt ZS	59	30.9	31.0	31.2	31.3	31.4	66	24.4	24.7	25.0	25.3	25.6
9504	66	Terranora 110/66kV STS	Condong Sw Stn	61	9.1	9.2	9.4	9.5	9.6	68	9.3	9.5	9.6	9.8	9.9
9505	66	Cudgen ZS	Banora Point ZS	53	1.2	1.2	1.2	1.3	1.3	59	1.0	1.1	1.1	1.1	1.1
9508	66	Terranora 110/66kV STS	Tweed Heads ZS	41	16.2	16.2	16.2	16.2	16.2	46	12.7	12.7	12.7	12.7	12.8
9510	66	Banora Point ZS	Tweed Heads South ZS	43	15.6	15.7	15.9	16.0	16.2	50	14.4	14.7	15.1	15.5	15.8
9514	66	Condong Sw Stn	Murwillumbah ZS	61	17.2	17.5	17.7	17.9	18.1	68	16.8	17.1	17.3	17.6	17.8
9516	66	Tweed Head South ZS	Tweed Heads ZS	43	3.9	3.9	3.9	3.9	3.9	50	3.0	3.0	3.0	3.0	3.0
9406	33	Cudgen ZS	Casuarina Sw Stn	17	11.3	11.7	12.0	12.3	12.7	19	11.3	11.5	11.7	11.9	12.0
9407	33	Casuarina Sw Stn	Hastings Pt ZS	20	0.0	0.0	0.0	0.0	0.0	20	0.0	0.0	0.0	0.0	0.0
9409	33	Casuarina Sw Stn	Hastings Pt ZS	20	11.3	11.7	12.0	12.3	12.7	20	11.3	11.5	11.7	11.9	12.0

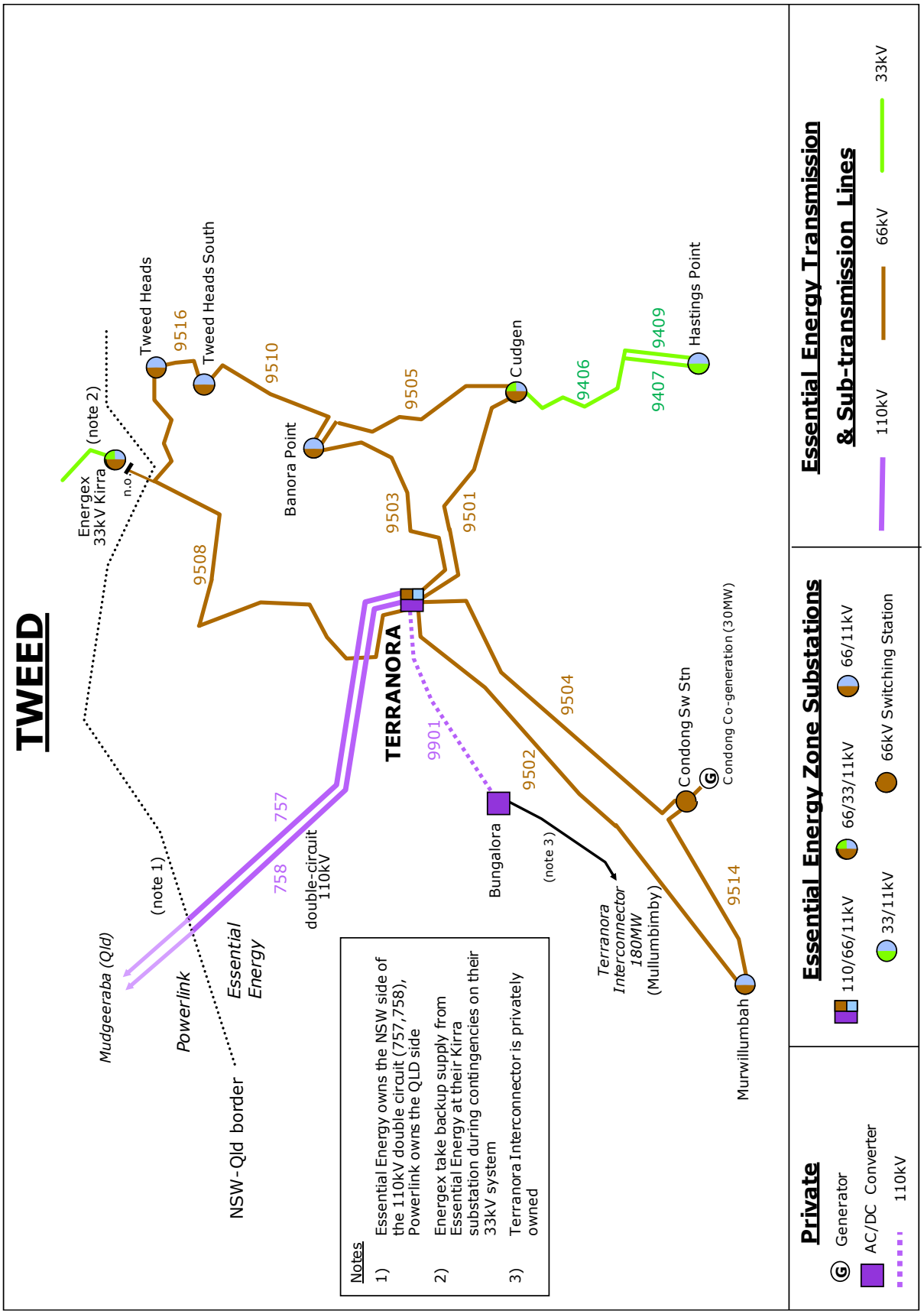
A 30MW biomass generator is located at Condong and is connected to the Terranora 110/66kV sub-transmission substation at 66kV via feeders 9504, 9514 and 9502.

STS and ZS load forecast

SUMMER	Terranora Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Banora Point	66/11	24/30	24/30		33	1.00	13.8	13.9	14.0	14.0	14.1	9.60	1
Cudgen 11kV	66/33/11	70/40/30	70/40/30		33	1.00	14.0	14.6	19.8	19.9	20.1	8.72	1.5
Cudgen 33kV	66/33/11	70/40/30	70/40/30		44	1.00	11.6	11.8	11.9	12.2	12.4	0.00	2.5
Hastings Point	33/11	15	15		16.5	1.00	11.3	11.7	12.0	12.3	12.7	9.71	2.5
Murwillumbah	66/11	15/20/25	15/20/25		27.5	0.98	20.3	20.5	20.8	21.1	21.3	13.98	2.5
Terranora 110/66kV	110/66	70/100	70/100	70/100	220	1.00	86.8	87.1	87.7	88.0	88.2	0.00	5.5
Terranora 11kV	66/11	24/30	24/30		33	1.00	5.9	6.0	6.0	6.0	6.1	5.29	2.5
Tweed Heads	66/11	25	25		27.5	0.97	15.4	15.4	15.4	15.4	15.4	2.72	5.5
Tweed Heads South	66/11	20/30	20/30		33	0.99	14.9	15.0	15.1	15.3	15.4	9.02	1.5

WINTER	Terranora Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Banora Point	66/11	24/30	24/30		36	1.00	11.9	11.9	12.0	12.1	12.2	9.60	4
Cudgen 11kV	66/33/11	70/40/30	70/40/30		36	1.00	13.6	14.3	19.3	19.4	19.5	8.72	3.5
Cudgen 33kV	66/33/11	70/40/30	70/40/30		48	1.00	11.7	11.8	11.9	12.0	12.1	0.00	5.5
Hastings Point	33/11	15	15		18	1.00	11.3	11.5	11.7	11.9	12.0	9.71	6
Murwillumbah	66/11	15/20/25	15/20/25		30	1.00	18.7	19.0	19.2	19.5	19.8	13.98	6
Terranora 110/66kV	110/66	70/100	70/100	70/100	240	1.00	84.1	84.1	83.8	83.7	83.5	0.00	2
Terranora 11kV	66/11	24/30	24/30		36	1.00	6.1	6.1	6.2	6.3	6.3	5.29	4
Tweed Heads	66/11	25	25		30	1.00	12.0	12.1	12.1	12.1	12.2	2.72	4.5
Tweed Heads South	66/11	20/30	20/30		36	1.00	13.7	14.0	14.4	14.7	15.1	9.02	6.5

Sub-transmission Single Line Diagram of Terranora area



2.3.2 Lismore Supply Area

Description of Lismore area

Zone substations in the Lismore area are spread across both the Coastal and Ranges regions.

The Lismore 132/66kV sub-transmission substation is owned by Essential Energy. It receives its supply via three Essential Energy 132kV lines from the TransGrid 330/132kV sub-transmission substation at Lismore.

A high voltage direct current transmission network is connected between Mullumbimby and Terranora (via Bungalora) which allows supply to be either injected into the Lismore area from Terranora or injected into the Terranora area from Lismore.

LISMORE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – DUN3B4 Mt Nardi	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
9U8	132	TransGrid Lismore 330/132 STS	Lismore 132/66kV STS	183	53.5	54.3	55.1	56.0	56.7	214	48.1	48.6	49.0	49.5	49.9
9U9	132	TransGrid Lismore 330/132 STS	Lismore 132/66kV STS	128	49.5	50.2	50.9	51.7	52.4	143	44.5	45.0	45.4	45.8	46.2
9W1	132	TransGrid Lismore 330/132 STS	Lismore 132/66kV STS	128	45.8	46.5	47.1	47.9	48.5	143	41.2	41.7	42.0	42.4	42.8
9G2	132	Ballina ZS	Lennox Head ZS	124	11.8	11.9	12.1	12.3	12.5	139	9.6	9.7	9.8	9.9	10.0
9G3	132	Lennox Head ZS	Suffolk Park ZS	124	15.8	16.0	16.3	16.5	16.7	139	14.0	14.2	14.3	14.4	14.6
9G4	132	Suffolk Park ZS	Ewingsdale ZS	124	22.0	22.4	22.7	23.1	23.4	139	20.2	20.4	20.6	20.8	21.0
9G5	132	Ewingsdale ZS	Mullumbimby ZS	122	38.4	39.0	39.5	40.2	40.7	137	38.4	38.8	39.1	39.5	39.9
9U6	132	Lismore 132/66kV STS	Mullumbimby ZS	107	24.2	24.5	24.9	25.3	25.6	123	24.6	24.8	25.0	25.3	25.5
9U7	132	Lismore 132/66kV STS	Dunoon ZS	107	27.3	27.7	28.1	28.6	28.9	123	27.4	27.7	27.9	28.2	28.4
9U7/1	132	Dunoon ZS	Mullumbimby ZS	107	21.0	21.4	21.7	22.0	22.3	123	21.6	21.9	22.1	22.3	22.5
892	66	Lismore 132/66kV STS	Woodburn ZS	11	7.3	7.4	7.4	7.5	7.6	19	6.9	7.0	7.1	7.2	7.3
893	66	Lismore 132/66kV STS	Casino ZS	34	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0
894:LME	66	Lismore 132/66kV STS	Kyogle ZS	11	9.2	9.4	9.5	9.7	9.8	19	6.5	6.5	6.4	6.4	6.4
0897:LME	66	Lismore 132/66kV STS	Alstonville ZS	62	18.8	19.1	19.4	19.7	19.9	69	18.0	18.2	18.3	18.5	18.7
8502	66	Lismore East ZS	Alstonville ZS	62	10.0	10.1	10.3	10.4	10.6	69	10.1	10.2	10.3	10.4	10.5
8503	66	Ballina ZS	Alstonville ZS	62	8.7	8.9	9.0	9.1	9.3	69	8.0	8.1	8.2	8.2	8.3
8507	66	Alstonville ZS	Ballina ZS	61	10.1	10.2	10.4	10.5	10.7	68	9.3	9.4	9.5	9.6	9.7
8510	66	Lismore Sw Stn	East Lismore ZS	61	22.6	23.0	23.3	23.6	24.0	68	21.5	21.7	21.9	22.1	22.3
8511	66	Lismore 132/66kV STS	Lismore Sw Stn	62	19.8	20.1	20.4	20.7	21.0	69	17.8	18.0	18.1	18.3	18.5
8512	66	Lismore Sw Stn	Lismore University ZS	54	9.2	9.2	9.1	9.1	9.1	54	6.5	6.5	6.4	6.4	6.3
8513	66	Lismore Sw Stn	Lismore University ZS	54	9.2	9.2	9.1	9.1	9.1	54	6.5	6.5	6.4	6.4	6.3
8514	66	Lismore 132/66kV STS	South Lismore ZS	68	10.2	10.2	10.2	10.2	10.1	68	8.3	8.3	8.2	8.2	8.2
8515	66	Lismore 132/66kV STS	South Lismore ZS	68	10.1	10.1	10.1	10.1	10.0	68	8.2	8.2	8.1	8.1	8.1
8516	66	Lismore 132/66kV STS	Lismore Sw Stn	62	19.7	20.0	20.3	20.6	20.9	69	17.7	17.9	18.0	18.2	18.4

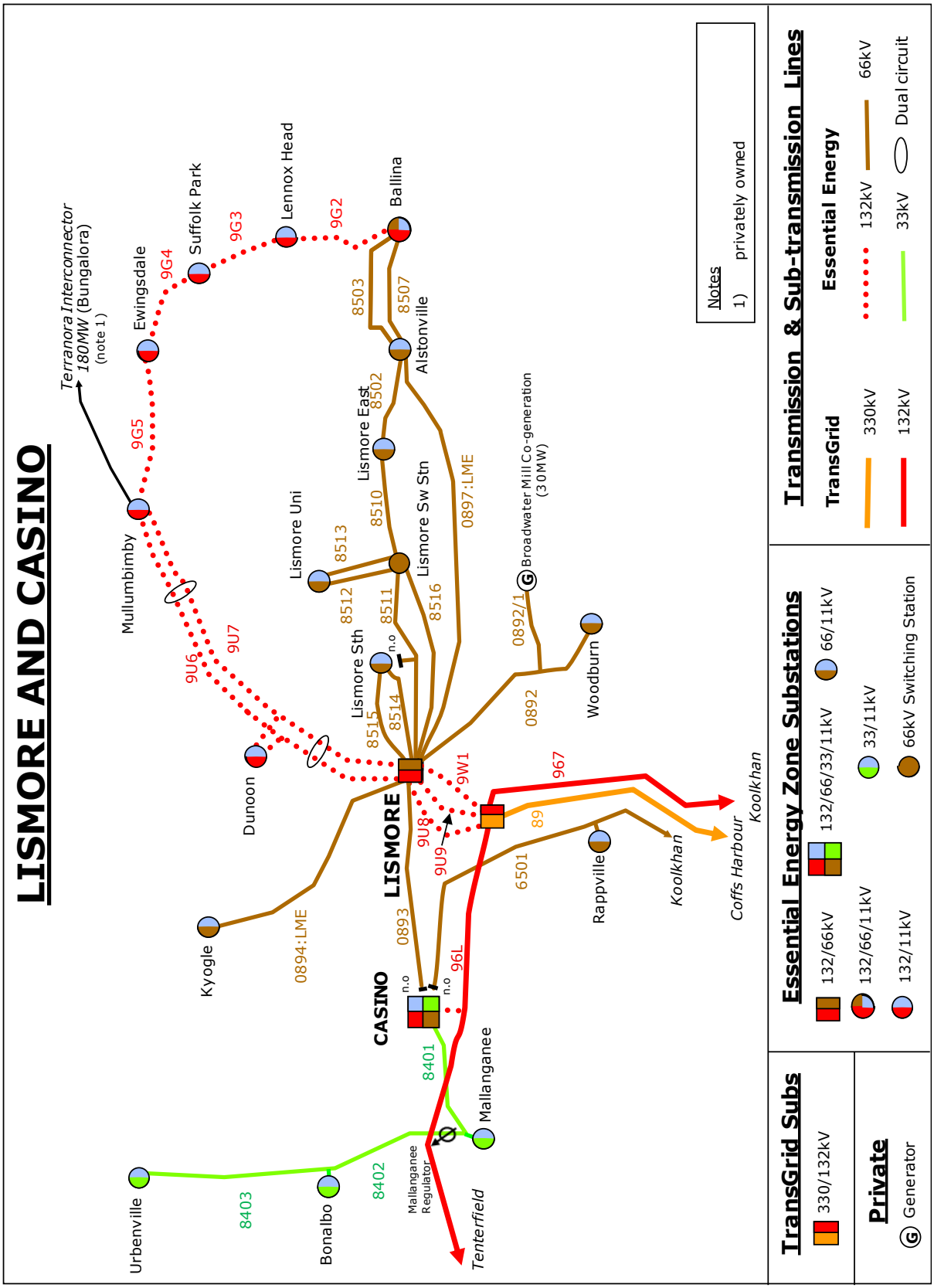
A 30MW biomass generator is located at Broadwater and is connected to the Lismore 132/66kV sub-transmission substation at 66kV via feeder 0892.

STS and ZS load forecast

SUMMER	Lismore Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Alstonville	66/11	20	16/20		22	1.00	12.4	12.5	12.5	12.6	12.7	8.95	1
Ballina	66/11	30	30		33	1.00	25.5	25.5	25.7	25.8	25.9	15.73	3.5
Ballina 132kV	132/66	35/45/60			0	1.00	18.7	18.7	18.6	18.6	18.5	0.00	4.5
Dunoon	132/11	10	10		11	1.00	6.7	6.9	7.1	7.3	7.5	4.52	0.5
Ewingsdale	132/11	30/45	30/45		49.5	1.00	16.4	16.4	16.4	16.3	16.3	10.42	3
Kyogle	66/11	8/10	8/10		11	0.96	9.2	9.4	9.5	9.7	9.8	4.34	1
Lennox Head	132/11	16	16		17.6	1.00	5.0	5.0	5.1	5.1	5.2	4.56	5
Lismore 132/66kV	132/66	80/120	80/120	80/120	264	0.99	87.8	88.0	88.0	87.8	87.9	0.00	2.5
Lismore East	66/11	15/19/23	15/20/25		25.3	0.98	14.8	14.9	15.0	15.0	15.1	9.21	0.5
Lismore South	66/11	25	23	20/25	52.8	1.00	20.5	20.5	20.4	20.4	20.3	7.11	8.5
Lismore Uni	66/11	20/30	20/30		33	0.99	18.3	18.3	18.3	18.2	18.2	6.59	1
Mullumbimby	132/11	16	10		11	1.00	7.3	7.4	7.4	7.5	7.5	6.39	3
Suffolk Park	132/11	30			0	1.00	9.4	9.6	9.7	9.9	10.1	6.98	2.5
Woodburn	66/11	8/10	8/10		11	0.98	7.3	7.4	7.4	7.5	7.6	4.30	2

WINTER	Lismore Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Alstonville	66/11	20	16/20		24	1.00	11.8	11.9	11.9	12.0	12.1	8.95	4
Ballina	66/11	30	30		36	1.00	24.2	24.4	24.6	24.8	25.0	15.73	5
Ballina 132kV	132/66	35/45/60			0	1.00	16.7	16.7	16.6	16.6	16.6	0.00	2.5
Dunoon	132/11	10	10		12	1.00	6.9	7.0	7.2	7.3	7.5	4.52	3.5
Ewingsdale	132/11	30/45	30/45		54	1.00	18.7	19.2	19.7	20.3	20.9	10.42	5
Kyogle	66/11	8/10	8/10		12	0.99	6.5	6.5	6.4	6.4	6.4	4.34	4
Lennox Head	132/11	16	16		19.2	1.00	6.6	6.7	6.8	6.9	7.0	4.56	6
Lismore 132/66kV	132/66	80/120	80/120	80/120	288	1.00	70.1	70.1	70.1	70.1	70.1	0.00	2
Lismore East	66/11	15/19/23	15/20/25		27.6	1.00	12.5	12.6	12.7	12.8	12.9	9.21	3
Lismore South	66/11	25	23	20/25	57.6	1.00	16.6	16.5	16.5	16.4	16.3	7.11	3
Lismore Uni	66/11	20/30	20/30		36	1.00	12.9	12.9	12.8	12.7	12.7	6.59	4
Mullumbimby	132/11	16	10		12	1.00	8.2	8.3	8.3	8.4	8.5	6.39	3
Suffolk Park	132/11	30			0	1.00	12.8	13.0	13.2	13.4	13.6	6.98	8.5
Woodburn	66/11	8/10	8/10		12	1.00	6.9	7.0	7.1	7.2	7.3	4.30	2.5

Sub-transmission Single Line Diagram of Lismore area



2.3.3 Casino Supply Area

Description of Casino area

All zone substations in the Casino area are in the Ranges region.

The Casino area sub-transmission system is supplied from the Essential Energy 132/66kV sub-transmission substation at Casino which is teed off the TransGrid 132kV Tenterfield to Lismore line. On loss of the single 132/66kV transformer, 66kV supply reverts to Lismore 132/66kV substation via the Lismore – Casino 66kV line (0893).

CASINO – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – CSO3B2 Kyogle Rd	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
96L	132	Transgrid Casino 132kV 96L Tee	Casino ZS	140	30.1	30.2	30.5	30.7	30.9	157	21.8	21.9	22.0	22.1	22.2
6501	66	Casino ZS	Rappville Tee	16	1.2	1.2	1.2	1.2	1.2	25	0.9	0.9	0.9	0.9	0.9
8401	33	Casino ZS	Mallanganee ZS	4	3.8	3.8	3.9	3.9	3.9	6	2.9	3.0	3.0	3.0	3.0
8402	33	Mallanganee ZS	Bonalbo ZS	4	2.3	2.3	2.3	2.3	2.4	6	1.7	1.8	1.8	1.8	1.8
8403	33	Bonalbo ZS	Urbenville ZS	4	1.2	1.2	1.2	1.2	1.2	7	1.1	1.1	1.1	1.1	1.1

STS and ZS load forecast

SUMMER	Casino Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bonalbo	33/11	3	2.5		2.75	0.90	1.0	1.0	1.0	1.0	1.1	0.48	3
Casino 132/66kV	132/66	35/45/60			0	0.98	31.1	31.3	31.4	31.5	31.6	0.00	0.5
Casino 66/11kV	66/11	20/30	20/30		33	0.99	28.2	28.3	28.3	28.5	28.6	10.30	0.5
Casino 66/33kV	66/33	8	3.5		3.85	0.98	3.6	3.6	3.7	3.7	3.7	0.00	3.5
Mallanganee	33/11	5/8	2.5		2.75	0.99	1.4	1.4	1.4	1.3	1.3	0.50	3.5
Rappville	66/11	5/6.25	5		5.5	0.97	0.9	0.9	0.9	0.9	0.9	0.37	1.5
Urbenville	33/11	5/8	2.5		2.75	0.98	0.9	0.9	1.0	1.0	1.0	0.36	4

WINTER	Casino Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bonalbo	33/11	3	2.5		3	0.90	0.8	0.8	0.9	0.9	0.9	0.48	3
Casino 132/66kV	132/66	35/45/60			0	1.00	21.4	21.5	21.6	21.7	21.8	0.00	2.5
Casino 66/11kV	66/11	20/30	20/30		36	1.00	17.9	17.8	17.8	17.8	17.8	10.30	2
Casino 66/33kV	66/33	8	3.5		4.2	1.00	3.1	3.1	3.0	3.0	3.0	0.00	3.5
Mallanganee	33/11	5/8	2.5		3	1.00	1.1	1.1	1.1	1.1	1.1	0.50	14
Rappville	66/11	5/6.25	5		6	0.97	0.9	0.9	0.9	0.9	0.9	0.37	0.5
Urbenville	33/11	5/8	2.5		3	1.00	0.9	0.9	0.9	0.9	0.9	0.36	4

Sub-transmission Single Line Diagram of Casino area

Please refer to the Sub-transmission Single Line Diagram of Lismore area on Page 26.

2.3.4 Grafton Supply Area

Description of Grafton area

All zone substations in the Grafton area are in the Coastal region.

The Grafton area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Koolkhan.

GRAFTON – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – SGN3B7 Grafton South Town	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
825	66	TransGrid Koolkhan 132/66kV STS	Koolkhan ZS	62	22.7	22.7	22.8	22.9	23.0	69	17.0	17.0	17.1	17.2	17.3
826	66	TransGrid Koolkhan 132/66kV STS	Grafton North ZS	61	18.5	18.6	18.6	18.7	18.8	68	13.5	13.5	13.6	13.7	13.7
6503	66	Grafton North ZS	South Grafton ZS	24	12.1	12.1	12.2	12.2	12.3	25	7.9	7.9	8.0	8.0	8.0
6504	66	Five Mile Sw Stn	South Grafton ZS	61	5.2	5.2	5.3	5.3	5.3	68	3.4	3.4	3.4	3.4	3.5
6505	66	Koolkhan SS	Grafton ZS	52	20.1	20.2	20.3	20.4	20.5	58	14.6	14.6	14.7	14.8	14.9
6506	66	Shannon Creek ZS	Nymboida ZS	14	0.3	0.3	0.3	0.3	0.3	21	0.4	0.4	0.4	0.4	0.4
6508	66	Maclean ZS	Yamba ZS	28	10.1	10.1	10.1	10.2	10.2	32	12.4	12.6	12.9	13.1	13.4
6509	66	Shannon Creek ZS	Five Mile Sw Stn	14	1.4	1.4	1.4	1.4	1.4	21	1.1	1.1	1.1	1.1	1.1
6510	66	Grafton North ZS	Five Mile Sw Stn	28	6.5	6.5	6.6	6.6	6.6	34	4.2	4.2	4.3	4.3	4.3
896:MLN	66	TransGrid Koolkhan 132/66kV STS	Maclean ZS	21	10.8	10.8	10.8	10.9	10.9	25	8.2	8.2	8.2	8.3	8.3
8G1	66	TransGrid Koolkhan 132/66kV STS	Maclean ZS	68	13.8	13.8	13.9	14.0	14.0	68	10.4	10.4	10.5	10.5	10.6
6402	33	Maclean ZS	Yamba Tee	8	0.5	0.5	0.5	0.6	0.6	9	0.3	0.3	0.3	0.3	0.3
6403	33	Yamba Tee	Redcliff ZS	3	0.5	0.5	0.5	0.6	0.6	5	0.4	0.4	0.4	0.4	0.4
6404	33	Yamba Tee	Yamba ZS	10	0.0	0.0	0.0	0.0	0.0	12	0.0	0.0	0.0	0.0	0.0

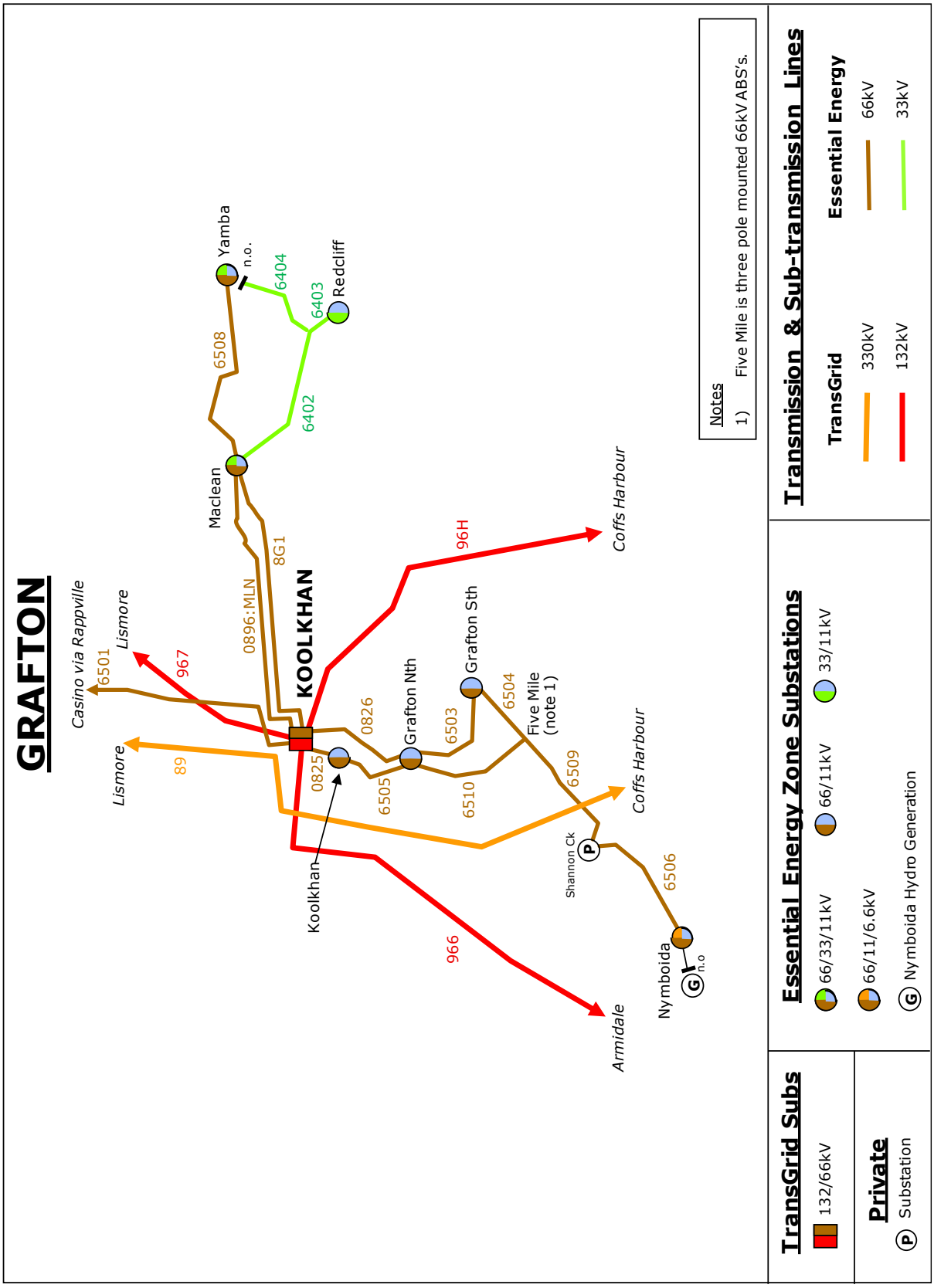
STS and ZS load forecast

SUMMER	Grafton Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Grafton North	66/11	24/30	15/20/25		27.5	0.99	17.5	17.6	17.6	17.6	17.7	6.81	4
Grafton South	66/11	15/19/25	15/19/24.5		26.95	0.97	19.6	19.6	19.6	19.5	19.5	8.22	0.5
Koolkhan 11kV	66/11	7.5/10			0	0.97	2.3	2.3	2.3	2.3	2.3	1.37	2
Maclean 66/11kV	66/11	16	16		17.6	0.99	10.0	10.1	10.1	10.1	10.2	6.61	1.5
Maclean 66/33kV	66/33	8/10			0	0.96	0.4	0.3	0.3	0.3	0.3	0.00	1.5
Nymboida	66/11	0.6	0.6		0.66	0.95	0.4	0.4	0.4	0.4	0.4	0.22	1
Redcliff	33/11	0.5	0.5		0.55	0.96	0.3	0.3	0.3	0.3	0.3	0.16	1.5
Shannon Creek	66/11	8			0	0.99	0.8	0.9	0.9	0.9	1.0	0.52	170.5
Yamba	66/11	20/30	15/19/23		25.3	1.00	10.1	10.1	10.1	10.2	10.2	6.28	11.5

WINTER	Grafton Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Grafton North	66/11	24/30	15/20/25		30	1.00	12.4	12.4	12.3	12.3	12.3	6.81	2
Grafton South	66/11	15/19/25	15/19/24.5		29.4	0.99	13.0	13.0	13.1	13.1	13.2	8.22	2.5
Koolkhan 11kV	66/11	7.5/10			0	0.99	2.2	2.2	2.2	2.2	2.2	1.37	0.5
Maclean 66/11kV	66/11	16	16		19.2	0.95	7.3	7.3	7.3	7.3	7.3	6.61	2
Maclean 66/33kV	66/33	8/10			0	0.99	0.3	0.3	0.3	0.3	0.3	0.00	1.5
Nymboida	66/11	0.6	0.6		0.72	0.95	0.3	0.3	0.3	0.3	0.3	0.22	3.5
Redcliff	33/11	0.5	0.5		0.6	0.99	0.3	0.4	0.4	0.4	0.4	0.16	1.5
Shannon Creek	66/11	8			0	1.00	0.9	0.9	0.9	1.0	1.0	0.52	5
Yamba	66/11	20/30	15/19/23		27.6	0.98	12.4	12.6	12.9	13.1	13.4	6.28	1.5

The Nymboida hydro generation has reached end of life so has been decommissioned.

Sub-transmission Single Line Diagram of Grafton area



2.3.5 Coffs Harbour Supply Area

Description of Coffs Harbour area

All zone substations in the Coffs Harbour area are in the Mid North Coast region.

The Coffs Harbour area sub-transmission system is supplied from the TransGrid 330/132/66kV sub-transmission substation at Coffs Harbour (Karangi). The Dorrigo substation is normally connected via the Essential Energy 132kV tee line from the TransGrid 132kV transmission line between Armidale and Coffs Harbour with back up from the 66kV system. Boambee South is an Essential Energy 132/66/11kV zone substation that is supplied by the TransGrid 132kV transmission network between Kempsey and Coffs Harbour.

COFFS HARBOUR – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

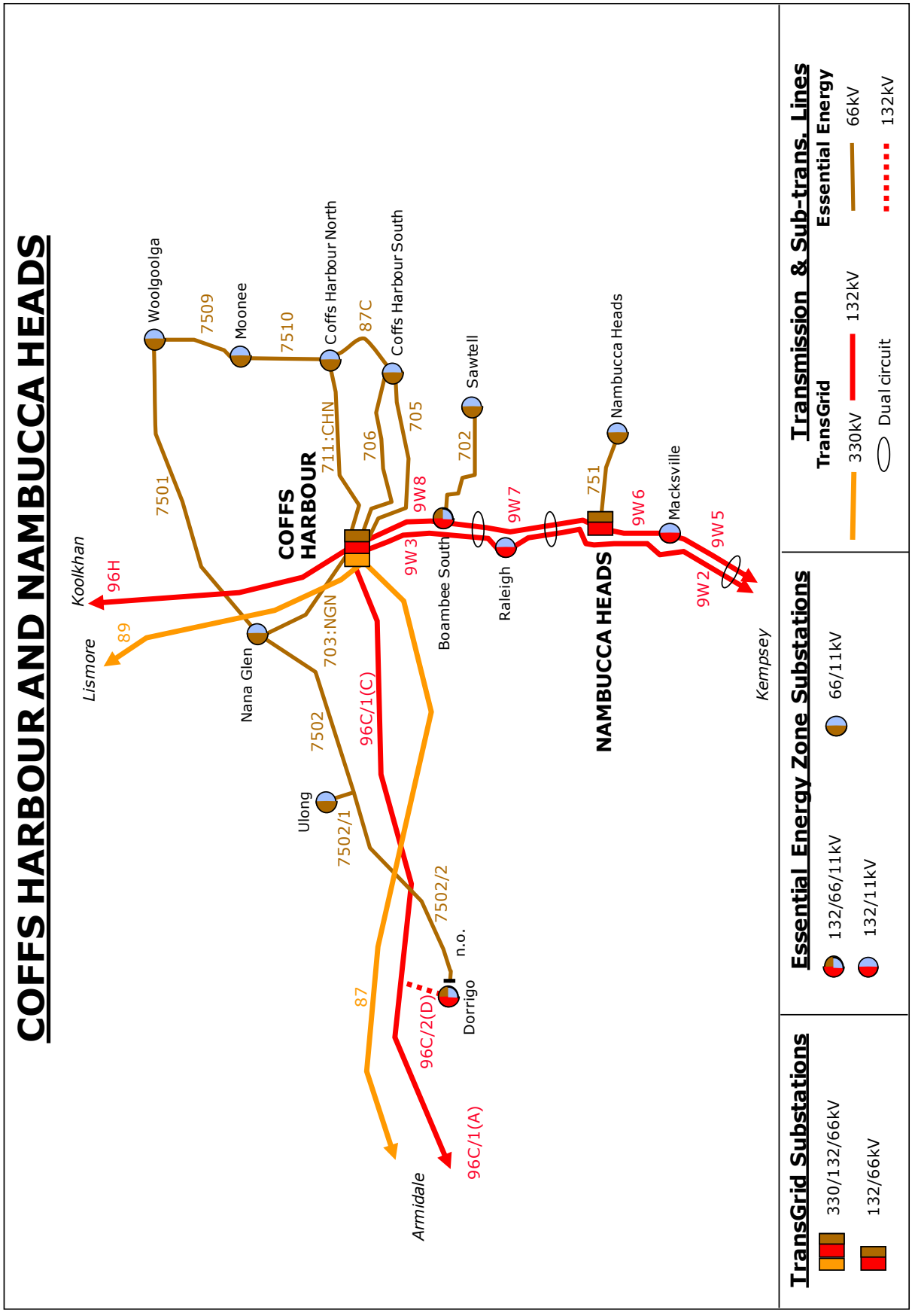
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
96C/2(D)	132	TransGrid 96C Armidale Coffs Harbour Dorrigo Tee	Dorrigo ZS	122	2.9	3.0	3.0	3.0	3.0	137	2.7	2.7	2.7	2.7	2.7
702	66	Boambee South 132/66kV STS	Sawtell ZS	61	9.0	9.4	9.9	10.3	10.8	68	10.2	10.3	10.5	10.6	10.8
705	66	TransGrid Coffs Harbour 132/66 kV STS	South Coffs ZS	52	15.4	15.4	15.4	15.5	15.5	58	14.9	14.9	15.0	15.0	15.1
706	66	TransGrid Coffs Harbour 132/66 kV STS	South Coffs ZS	52	17.4	17.5	17.5	17.6	17.6	58	16.9	17.0	17.0	17.1	17.1
7501	66	Nana Glen ZS	Woolgoolga ZS	29	5.7	5.8	5.8	5.8	5.8	33	5.6	5.6	5.6	5.6	5.6
7502	66	Nana Glen ZS	Ulong Tee	9	0.3	0.3	0.3	0.4	0.4	15	0.4	0.4	0.4	0.4	0.4
7502/1	66	Ulong Tee	Ulong ZS	9	0.3	0.3	0.3	0.4	0.4	15	0.4	0.4	0.4	0.4	0.4
7502/2	66	Ulong Tee	Dorrigo ZS	9	0.0	0.0	0.0	0.0	0.0	15	0.0	0.0	0.0	0.0	0.0
7509	66	Moonee ZS	Woolgoolga ZS	30	9.9	10.0	10.0	10.1	10.1	36	12.3	12.6	12.9	13.1	13.4
7510	66	North Coffs ZS	Moonee ZS	61	7.4	7.5	7.5	7.5	7.5	68	7.2	7.2	7.3	7.3	7.3
703:NGN	66	TransGrid Coffs Harbour 132/66 kV STS	Nana Glen ZS	62	9.4	9.4	9.4	9.5	9.5	69	9.1	9.1	9.2	9.2	9.2
711:CHN	66	TransGrid Coffs Harbour 132/66 kV STS	North Coffs ZS	62	18.9	18.9	19.0	19.0	19.1	69	18.2	18.3	18.4	18.5	18.5
87C	66	North Coffs ZS	South Coffs ZS	68	11.8	11.8	11.8	11.9	11.9	68	11.4	11.4	11.5	11.5	11.6

STS and ZS load forecast

SUMMER	Coffs Harbour Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Boambee South 11kV	132/66/11	60/30/30			33	1.00	8.6	8.5	8.4	8.2	8.1	5.27	2
Boambee South 66kV	132/66/11		60/30/30		33	1.00	9.1	9.3	9.5	9.7	9.8	0.00	4.5
Coffs Harbour North	66/11	15/19/23	15/20/25	15/19/23	50.6	1.00	23.4	23.4	23.4	23.3	23.3	8.79	5
Coffs Harbour South	66/11	20/30	20/30		33	0.98	23.5	23.5	23.5	23.5	23.5	5.78	1
Dorrigo	66/11, 132/11	7.5/10	10		11	0.98	2.9	3.0	3.0	3.0	3.0	1.49	3.5
Moonee	66/11	10/16	10/16		17.6	1.00	5.8	5.8	5.9	5.9	5.9	4.14	2
Nana Glen	66/11	5/6.25	8		6.875	0.95	3.1	3.1	3.2	3.2	3.3	1.89	1.5
Sawtell	66/11	15/19/24.5	15/19/25		26.95	1.00	9.0	9.4	9.9	10.3	10.8	4.07	3.5
Ulong	66/11	2.5			0	0.97	0.3	0.3	0.3	0.4	0.4	0.22	5
Woolgoolga	66/11	20/30	20/30		33	1.00	9.9	10.0	10.0	10.1	10.1	7.55	2

WINTER	Coffs Harbour Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Boambee South 11kV	132/66/11	60/30/30			36	1.00	8.4	8.3	8.3	8.3	8.3	5.27	3
Boambee South 66kV	132/66/11		60/30/30		36	1.00	9.3	9.5	9.7	9.9	10.1	0.00	3
Coffs Harbour North	66/11	15/19/23	15/20/25	15/19/23	55.2	1.00	20.3	20.1	19.8	19.5	19.3	8.79	10
Coffs Harbour South	66/11	20/30	20/30		36	1.00	20.7	21.0	21.4	21.8	22.2	5.78	1.5
Dorrigo	66/11, 132/11	7.5/10	10		12	0.99	2.7	2.7	2.7	2.7	2.7	1.49	2
Moonee	66/11	10/16	10/16		19.2	1.00	6.0	6.0	6.1	6.2	6.2	4.14	1
Nana Glen	66/11	5/6.25	8		7.5	0.95	2.4	2.4	2.4	2.4	2.4	1.89	1
Sawtell	66/11	15/19/24.5	15/19/25		29.4	0.96	10.2	10.3	10.5	10.6	10.8	4.07	4
Ulong	66/11	2.5			0	0.97	0.4	0.4	0.4	0.4	0.4	0.22	3.5
Woolgoolga	66/11	20/30	20/30		36	1.00	12.3	12.6	12.9	13.1	13.4	7.55	6

Sub-transmission Single Line Diagram of Coffs Harbour area



2.3.6 Nambucca Heads Supply Area

Description of Nambucca Heads area

All zone substations in the Nambucca Heads area are in the Mid North Coast region.

The Nambucca Heads area sub-transmission system is supplied from the TransGrid 132kV transmission network. Nambucca Heads is a 66/11kV zone substation supplied via a 66kV line from TransGrid's Nambucca 132/66kV substation, while Raleigh and Macksville are 132/11kV zone substations supplied from the TransGrid 132kV transmission network between Kempsey and Coffs Harbour.

NAMBUCCA HEADS – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
751	66	TransGrid Nambucca 132/66 kV STS	Nambucca ZS	15	7.1	7.2	7.3	7.3	7.4	25	8.8	8.8	8.8	8.9	8.9

STS and ZS load forecast

SUMMER	Nambucca Heads Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Macksville	132/11	24/30	24/30		33	0.99	9.2	9.2	9.3	9.2	9.2	5.42	7
Nambucca Heads	66/11	15/19/23	17/22/24.5		25.3	1.00	7.1	7.2	7.3	7.3	7.4	4.60	2
Raleigh	132/11	30	30		33	0.98	10.3	10.5	10.6	10.8	10.9	6.52	4

WINTER	Nambucca Heads Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Macksville	132/11	24/30	24/30		36	1.00	10.1	10.2	10.2	10.3	10.4	5.42	1.5
Nambucca Heads	66/11	15/19/23	17/22/24.5		27.6	1.00	8.8	8.8	8.8	8.9	8.9	4.60	2.5
Raleigh	132/11	30	30		36	1.00	10.7	10.8	11.0	11.1	11.3	6.52	4.5

Sub-transmission Single Line Diagram of Nambucca Heads area

Please refer to the Sub-transmission Single Line Diagram of Coffs Harbour area on Page 34.

2.3.7 Kempsey Supply Area

Description of Kempsey area

All zone substations in the Kempsey area are in the Mid North Coast region.

The Kempsey area sub-transmission system is supplied from the TransGrid 132/33kV sub-transmission substation at Kempsey.

KEMPSEY – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

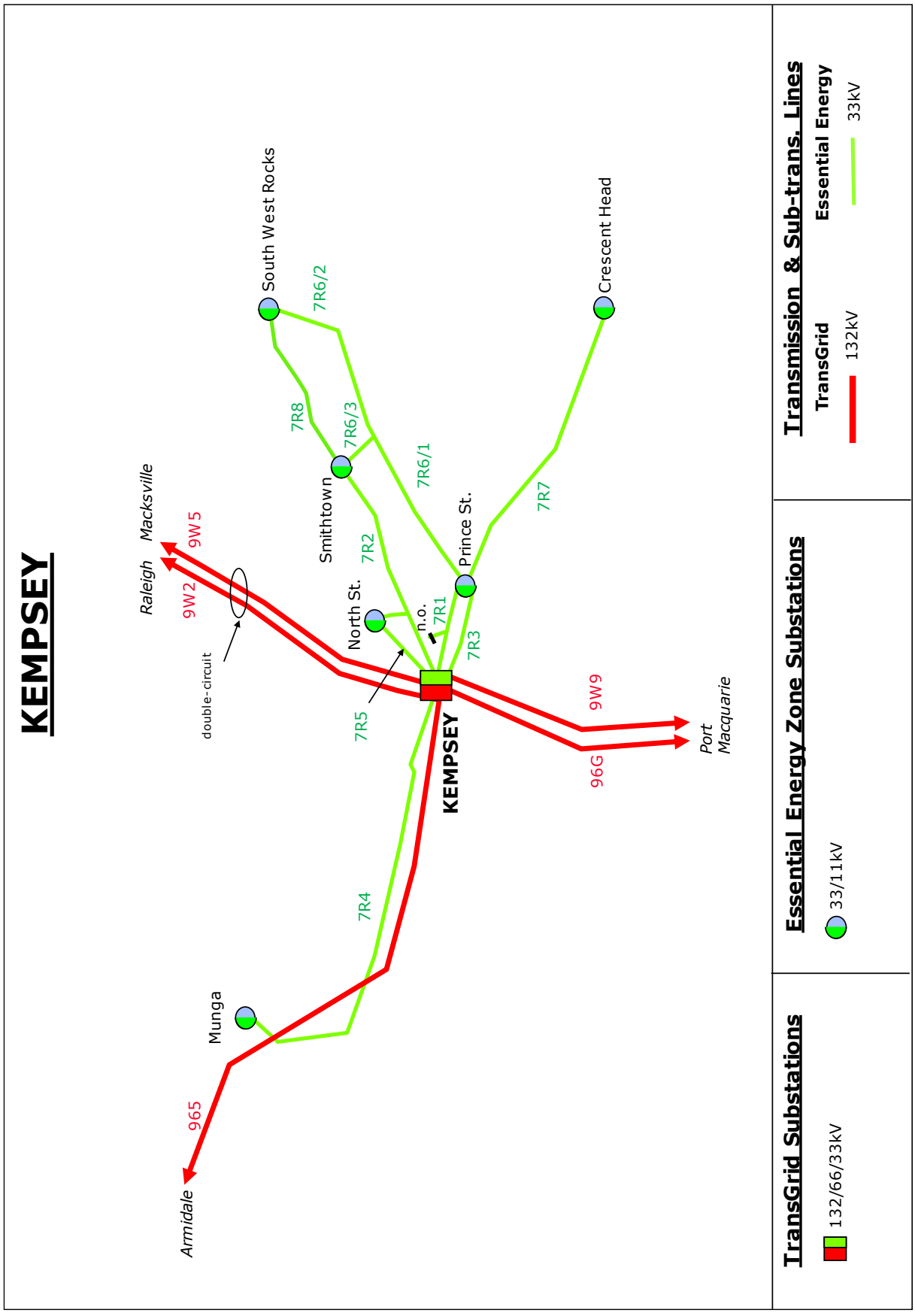
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
7R1	33	TransGrid Kempsey 132/33kV STS	Prince St ZS	30	7.1	7.1	7.2	7.2	7.3	34	8.1	8.3	8.4	8.6	8.8
7R2/1	33	TransGrid Kempsey 132/33kV STS	North St Tee	26	8.2	8.3	8.3	8.4	8.5	29	9.0	9.2	9.4	9.6	9.8
7R2/2	33	North St Tee	Smithtow n ZS	19	4.1	4.1	4.2	4.2	4.2	21	5.3	5.4	5.5	5.6	5.7
7R2/3	33	North St Tee	North St ZS	10	4.0	4.1	4.1	4.1	4.2	19	3.7	3.7	3.8	3.9	4.0
7R3	33	TransGrid Kempsey 132/33kV STS	Prince St ZS	26	7.1	7.2	7.2	7.3	7.3	29	8.2	8.3	8.5	8.7	8.9
7R4	33	TransGrid Kempsey 132/33kV STS	Munga ZS	3	1.7	1.8	1.8	1.9	1.9	4	1.2	1.3	1.3	1.3	1.3
7R5	33	TransGrid Kempsey 132/33kV STS	North St ZS	19	6.2	6.3	6.3	6.3	6.4	21	6.8	7.0	7.1	7.3	7.4
7R6/1	33	Prince St ZS	South West Rocks Tee	15	5.2	5.2	5.3	5.3	5.3	18	6.4	6.5	6.7	6.8	7.0
7R6/2	33	South West Rocks Tee	South West Rocks ZS	19	2.6	2.6	2.7	2.7	2.7	21	3.3	3.4	3.4	3.5	3.6
7R6/3	33	South West Rocks Tee	Smithtow n ZS	19	2.4	2.4	2.5	2.5	2.5	21	2.9	3.0	3.0	3.1	3.2
7R7	33	Prince St ZS	Crescent Head ZS	5	1.6	1.6	1.6	1.6	1.6	8	2.2	2.3	2.3	2.4	2.5
7R8	33	Smithtow n ZS	South West Rocks ZS	30	3.1	3.1	3.1	3.2	3.2	34	3.9	4.0	4.0	4.1	4.2

STS and ZS load forecast

SUMMER	Kempsey Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Crescent Head	33/11	3/4	5		4.4	0.97	1.6	1.6	1.6	1.6	1.6	0.79	3
Munga	33/11	2.5/3.25	3		3.3	0.99	1.7	1.8	1.8	1.9	1.9	0.83	3
North St	33/11	10	10		11	1.00	11.1	11.3	11.5	11.7	12.0	4.41	4.5
Prince St	33/11	10/15	10/15		16.5	0.94	8.3	8.4	8.5	8.6	8.7	3.33	3
Smithtown	33/11	5/6.5	5		5.5	0.97	3.9	3.9	4.0	4.1	4.2	1.43	7
South West Rocks	33/11	10/12.5	16		13.75	0.99	6.1	6.1	6.1	6.1	6.1	3.38	4

WINTER	Kempsey Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Crescent Head	33/11	3/4	5		4.8	0.99	2.2	2.3	2.3	2.4	2.5	0.79	1.5
Munga	33/11	2.5/3.25	3		3.6	1.00	1.2	1.3	1.3	1.3	1.3	0.83	5
North St	33/11	10	10		12	0.99	10.9	11.3	11.8	12.1	12.5	4.41	1.5
Prince St	33/11	10/15	10/15		18	0.99	9.8	10.1	10.5	10.8	11.1	3.33	1.5
Smithtown	33/11	5/6.5	5		6	0.98	4.2	4.2	4.3	4.4	4.4	1.43	6.5
South West Rocks	33/11	10/12.5	16		15	0.98	7.9	8.1	8.4	8.6	8.9	3.38	2

Sub-transmission Single Line Diagram of Kempsey area



2.3.8 Port Macquarie Supply Area

Description of Port Macquarie area

All zone substations in the Port Macquarie area are in the Mid North Coast region.

The Port Macquarie area sub-transmission system is supplied from the TransGrid 132/33kV sub-transmission substation at Port Macquarie.

PORT MACQUARIE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – OPM3B1 Granite St	3.3

Sub-transmission feeder load forecast

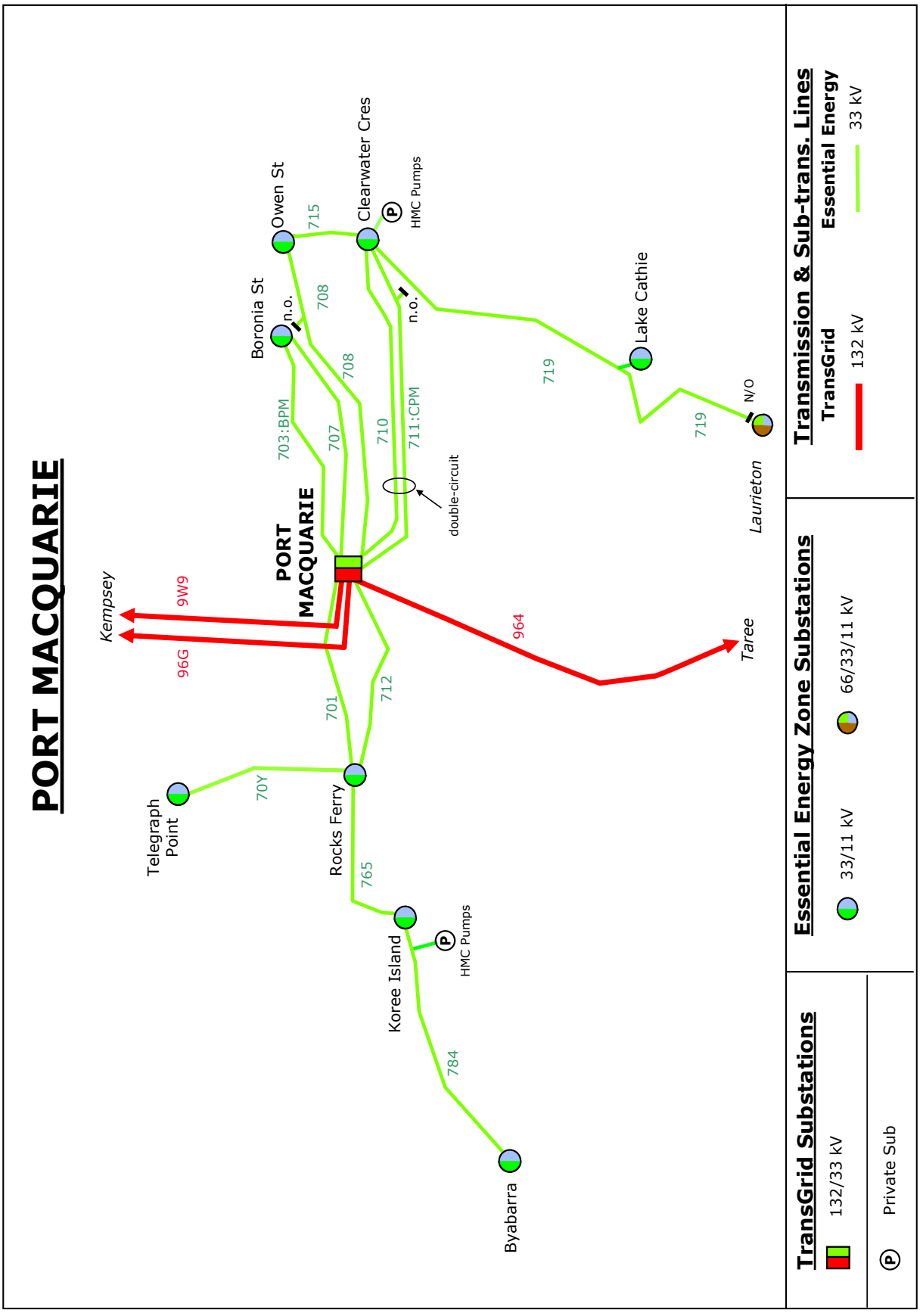
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
70Y	33	Rocks Ferry ZS	Telegraph Point ZS	8	2.1	2.1	2.2	2.2	2.3	12	1.7	1.7	1.7	1.7	1.7
701	33	TransGrid Port Macquarie 132/33kV STS	Rocks Ferry ZS	22	10.7	10.9	11.1	11.3	11.5	26	11.0	11.2	11.4	11.6	11.8
703:BPM	33	TransGrid Port Macquarie 132/33kV STS	Boronia Street ZS	26	8.8	9.0	9.2	9.4	9.5	29	9.3	9.5	9.7	9.8	10.0
707	33	TransGrid Port Macquarie 132/33kV STS	Boronia Street ZS	26	10.0	10.2	10.4	10.6	10.8	29	10.6	10.8	11.0	11.1	11.3
708	33	TransGrid Port Macquarie 132/33kV STS	Owen Street ZS	26	11.6	11.8	12.1	12.3	12.5	29	13.7	14.0	14.2	14.4	14.7
710	33	TransGrid Port Macquarie 132/33kV STS	Clearwater ZS	31	12.7	12.9	13.1	13.4	13.6	34	15.8	16.1	16.4	16.6	16.9
711:CPM	33	TransGrid Port Macquarie 132/33kV STS	Clearwater ZS	20	12.6	12.8	13.1	13.3	13.5	20	15.8	16.0	16.3	16.5	16.9
712	33	TransGrid Port Macquarie 132/33kV STS	Rocks Ferry ZS	12	7.1	7.2	7.3	7.5	7.6	14	7.2	7.4	7.5	7.6	7.7
715	33	Clearwater ZS	Owen Street ZS	31	5.3	5.4	5.5	5.6	5.7	34	4.3	4.4	4.5	4.6	4.6
719/1	33	Clearwater ZS	Lake Cathie ZS	20	5.4	5.7	5.9	6.2	6.5	20	6.5	6.7	6.9	7.0	7.2
719/2	33	Lake Cathie ZS	Laurieton ZS	12	0.0	0.0	0.0	0.0	0.0	14	0.0	0.0	0.0	0.0	0.0
765	33	Rocks Ferry ZS	Koree ZS	9	4.8	4.8	4.9	5.0	5.1	11	5.4	5.5	5.6	5.7	5.8
784	33	Koree ZS	Byabarra ZS	9	1.3	1.3	1.3	1.3	1.4	11	1.3	1.3	1.3	1.4	1.4

STS and ZS load forecast

SUMMER	Port Macquarie Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Boronia St	33/11	20/30	20/30		33	1.00	19.4	19.5	19.5	19.7	19.8	7.97	2.5
Byabarra	33/11	2.5/3.25	3		3.3	0.94	1.4	1.5	1.5	1.5	1.5	0.80	3
Clearwater Cr	33/11	20/30	20/30		33	1.00	19.1	19.6	20.0	20.5	20.9	11.84	2
Koree Island	33/11	5/8	3.5		3.85	0.99	2.0	2.1	2.2	2.3	2.4	1.41	1
Lake Cathie	33/11	5	10/16		5.5	0.99	5.4	5.7	5.9	6.2	6.5	3.98	3
Owen St	33/11	15/20	15/20		22	0.99	14.6	14.5	14.5	14.5	14.5	3.52	15.5
Rocks Ferry	33/11	10/16	10/15		16.5	0.98	12.9	13.3	13.8	14.2	14.6	6.48	1
Telegraph Point	33/11	3/4	3/4		4.4	0.99	2.1	2.1	2.2	2.2	2.3	1.01	2

WINTER	Port Macquarie Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Boronia St	33/11	20/30	20/30		36	1.00	19.7	20.1	20.5	20.9	21.3	7.97	1
Byabarra	33/11	2.5/3.25	3		3.6	0.98	1.3	1.3	1.3	1.3	1.3	0.80	3.5
Clearwater Cr	33/11	20/30	20/30		36	1.00	23.6	24.2	24.9	25.6	26.4	11.84	1
Koree Island	33/11	5/8	3.5		4.2	1.00	1.7	1.7	1.7	1.8	1.8	1.41	5
Lake Cathie	33/11	5	10/16		6	1.00	6.5	6.7	6.9	7.0	7.2	3.98	2
Owen St	33/11	15/20	15/20		24	0.98	16.4	16.5	16.7	16.9	16.9	3.52	6
Rocks Ferry	33/11	10/16	10/15		18	1.00	11.1	11.4	11.7	11.9	12.2	6.48	3.5
Telegraph Point	33/11	3/4	3/4		4.8	1.00	1.7	1.7	1.7	1.7	1.7	1.01	1.5

Sub-transmission Single Line Diagram of Port Macquarie area



2.3.9 Herons Creek Supply Area

Description of Herons Creek area

All zone substations in the Herons Creek area are in the Mid North Coast region.

The Herons Creek 132/66kV substation is owned by Essential Energy. It receives supply via a tee off TransGrid's Taree – Port Macquarie 132kV line (#964). Johns River, Kew and Laurieton 66/11kV zone substations take normal 66kV supply from Herons Creek, and backup 66kV supply from TransGrid's Taree 132/66/33kV substation via the Essential Energy 66kV line (#862).

HERONS CREEK – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
866:KEW	66	Herons Creek 132/66kV STS	Kew ZS	16	11.9	12.2	12.6	12.9	13.4	25	11.6	11.9	12.2	12.5	12.8
871	66	Kew ZS	Laurieton ZS	36	8.1	8.2	8.4	8.5	8.7	42	10.2	10.6	10.9	11.3	11.7
862/1	66	Kew ZS	Johns River ZS	16	1.0	1.0	1.0	1.0	1.0	25	1.0	1.0	1.0	1.1	1.1
862/2	66	TransGrid Taree 132/66/33kV STS	Johns River ZS	16	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Herons Creek Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Herons Creek	132/66	60			0	0.99	11.6	12.0	12.3	12.6	12.9	0.00	3.5
Johns River	66/11	3			0	0.93	1.0	1.0	1.0	1.0	1.0	0.66	2.5
Kew	66/11	3	8		3.3	0.98	3.4	3.4	3.4	3.4	3.4	1.70	0.5
Laurieton	33/11, 66/11	15/20	15/20		22	0.99	8.1	8.2	8.4	8.5	8.7	5.51	5.5

WINTER	Herons Creek Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Herons Creek	132/66	60			0	0.99	11.6	12.1	12.5	12.9	13.3	0.00	2
Johns River	66/11	3			0	0.94	1.0	1.0	1.0	1.1	1.1	0.66	4
Kew	66/11	3	8		3.6	0.99	3.0	3.0	3.0	3.0	3.0	1.70	3
Laurieton	33/11, 66/11	15/20	15/20		24	1.00	10.2	10.6	10.9	11.3	11.7	5.51	2

Sub-transmission Single Line Diagram of Herons Creek area

Please refer to the Sub-transmission Single Line Diagram of Taree area on Page 45.

2.3.10 Taree Supply Area

Description of Taree area

All zone substations in the Taree area are in the Mid North Coast region.

The Taree area sub-transmission system is supplied from the TransGrid 132/66/33kV sub-transmission substation at Taree.

TAREE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – FOR17262 Wells St	3.3

Sub-transmission feeder load forecast

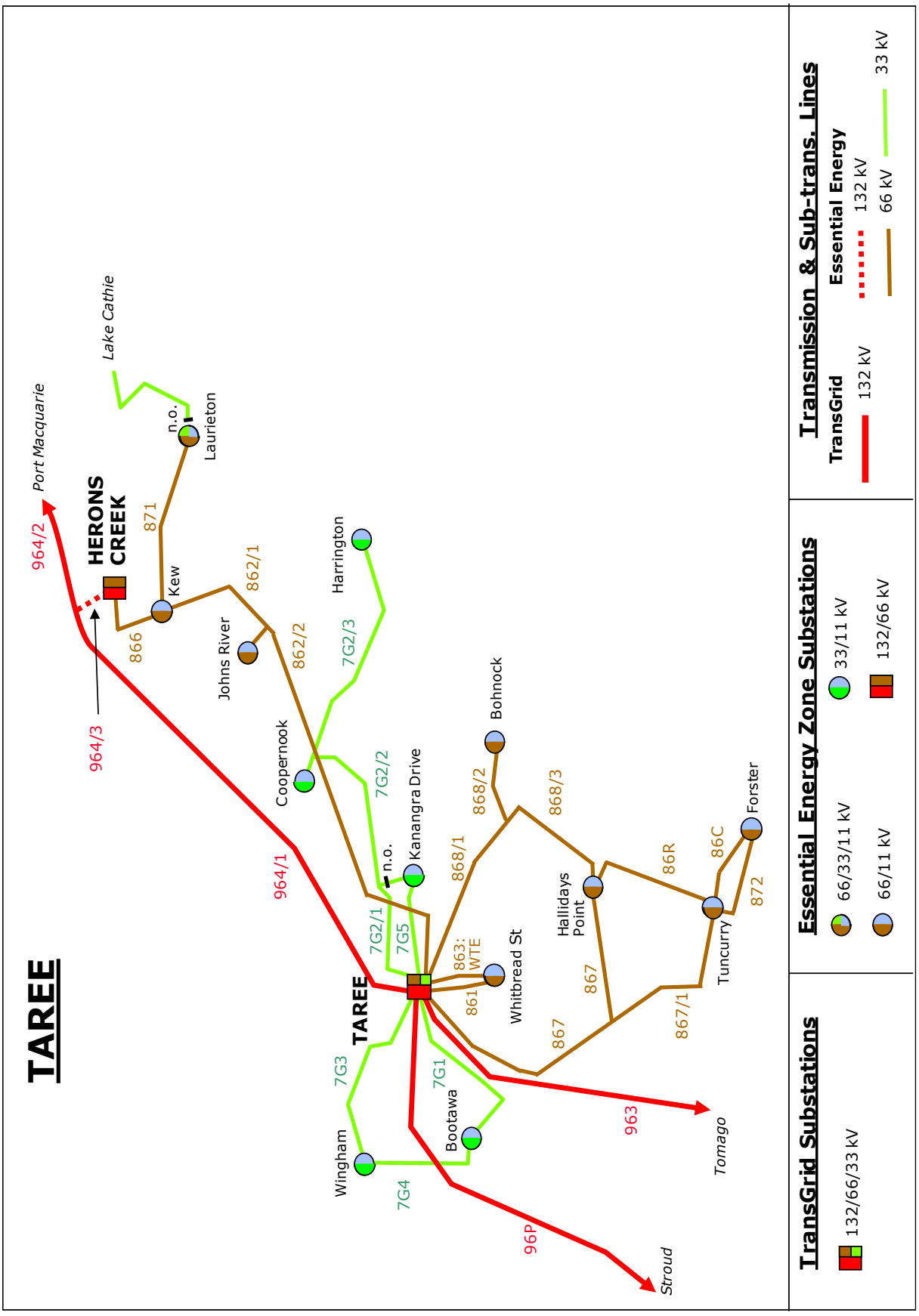
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
861	66	TransGrid Taree 132/66/33kV STS	Whitbread ZS	62	10.0	10.0	10.0	10.0	10.1	69	8.2	8.2	8.2	8.2	8.2
863:WTE	66	TransGrid Taree 132/66/33kV STS	Whitbread ZS	62	10.3	10.3	10.3	10.4	10.4	69	8.4	8.4	8.4	8.4	8.4
867	66	TransGrid Taree 132/66/33kV STS	Hallidays Point ZS	34	14.0	14.0	14.0	14.1	14.1	39	17.1	17.1	17.1	17.2	17.2
867/1	66	Hallidays Point Tee	Tuncurry ZS	39	8.4	8.4	14.0	14.1	14.1	43	11.3	11.3	17.1	17.2	17.2
868/1	66	TransGrid Taree 132/66/33kV STS	Bohnock Tee	36	16.4	16.4	16.5	16.5	16.6	41	20.7	20.7	20.7	20.8	20.8
868/2	66	Bohnock Tee	Bohnock ZS	16	6.8	7.1	7.2	7.5	7.7	26	6.6	6.7	6.9	7.0	7.1
868/3	66	Bohnock Tee	Hallidays Point ZS	38	12.0	12.0	12.0	12.1	12.1	43	14.3	14.3	14.3	14.4	14.4
872	66	Tuncurry ZS	Forster ZS	30	7.0	7.1	7.1	7.1	7.1	37	9.0	9.0	9.0	9.1	9.1
86C	66	Tuncurry ZS	Forster ZS	42	6.2	6.2	6.2	6.2	6.3	46	8.1	8.1	8.1	8.1	8.1
86R	66	Hallidays Point ZS	Tuncurry ZS	38	11.8	11.8	11.8	11.8	11.9	43	15.0	15.0	15.0	15.0	15.0
7G2/1	33	TransGrid Taree 132/66/33kV STS	Kanangra Tee	22	7.2	7.4	7.5	7.7	7.8	27	5.7	5.8	5.9	5.9	6.0
7G2/2	33	Kanangra Tee	Coopernook ZS	7	6.2	6.3	6.4	6.6	6.7	12	5.2	5.2	5.3	5.3	5.4
7G2/3	33	Coopernook ZS	Harrington ZS	8	3.6	3.6	3.6	3.6	3.6	13	3.8	3.9	4.0	4.2	4.3
7G4	33	Bootaw a ZS	Wingham ZS	18	2.9	2.9	3.0	3.1	3.1	21	2.5	2.5	2.5	2.6	2.6
7G5	33	TransGrid Taree 132/66/33kV STS	Kanangra Dr ZS	17	10.6	10.8	11.0	11.3	11.5	17	8.5	8.6	8.7	8.8	8.8
7G1	33	TransGrid Taree 132/66/33kV STS	Bootaw a ZS	17	7.7	7.9	8.1	8.3	8.4	19	5.7	5.8	5.8	5.9	5.9
7G3	33	TransGrid Taree 132/66/33kV STS	Wingham ZS	18	8.1	8.3	8.5	8.7	8.8	20	6.2	6.3	6.3	6.4	6.4

STS and ZS load forecast

SUMMER	Taree Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bohnock	66/11	5/7	5/7		7.7	0.98	6.8	7.1	7.2	7.5	7.7	3.61	2
Bootawa	33/11	8/11	5		5.5	0.97	4.4	4.5	4.5	4.6	4.6	0.99	2
Coopernook	33/11	5/8	5/6.5		7.15	0.98	2.9	3.0	3.1	3.1	3.2	1.58	3.5
Forster	66/11	15/20/25	15/20/25		27.5	1.00	14.5	14.7	15.0	15.2	15.5	5.85	3
Hallidays Point 11kV	66/11	12.5/16	10/16		17.6	1.00	7.7	8.0	8.3	8.7	9.0	4.51	2
Harrington	33/11	5/8	5/6.25		6.875	0.99	3.6	3.6	3.6	3.6	3.6	2.42	2
Kanangra Dr	33/11	20/30	20/25		27.5	1.00	12.2	12.3	12.4	12.6	12.7	4.57	5
Tuncurry	66/11	10/16	12.5/16		17.6	1.00	6.1	6.1	6.1	6.1	6.1	2.37	1.5
Whitbread St	66/11	20	20/30		22	0.95	21.3	21.1	20.8	20.6	20.3	5.27	1
Wingham	33/11	10/16	7.5/10		11	0.95	11.3	11.4	11.4	11.5	11.6	4.01	8

WINTER	Taree Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bohnock	66/11	5/7	5/7		8.4	0.99	6.6	6.7	6.9	7.0	7.1	3.61	3
Bootawa	33/11	8/11	5		6	0.98	3.8	3.8	3.8	3.8	3.8	0.99	2.5
Coopernook	33/11	5/8	5/6.5		7.8	1.00	2.3	2.3	2.3	2.3	2.3	1.58	2.5
Forster	66/11	15/20/25	15/20/25		30	1.00	15.6	15.7	15.7	15.7	15.8	5.85	3
Hallidays Point 11kV	66/11	12.5/16	10/16		19.2	1.00	8.3	8.6	9.0	9.3	9.6	4.51	3.5
Harrington	33/11	5/8	5/6.25		7.5	1.00	3.8	3.9	4.0	4.2	4.3	2.42	2.5
Kanangra Dr	33/11	20/30	20/25		30	1.00	10.2	10.2	10.2	10.3	10.3	4.57	4.5
Tuncurry	66/11	10/16	12.5/16		19.2	1.00	7.0	7.0	7.0	7.0	7.0	2.37	3
Whitbread St	66/11	20	20/30		24	0.99	14.9	15.0	15.2	15.3	15.5	5.27	3.5
Wingham	33/11	10/16	7.5/10		12	0.98	8.4	8.5	8.5	8.6	8.6	4.01	1

Sub-transmission Single Line Diagram of Taree area



2.3.11 Stroud Supply Area

Description of Stroud area

All zone substations in the Stroud area are in the Mid North Coast region.

The Stroud 132/33kV sub-transmission substation is owned by Essential Energy. It receives supply via two TransGrid 132kV lines. sub-transmission supply to Martins Creek and Gresford is taken from Stroud, with a secondary supply that emanates from Ausgrid's Network. The 33kV sub-transmission line is partly owned by Essential Energy.

STROUD – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – GLS3B7 City Central	3.3

Sub-transmission feeder load forecast

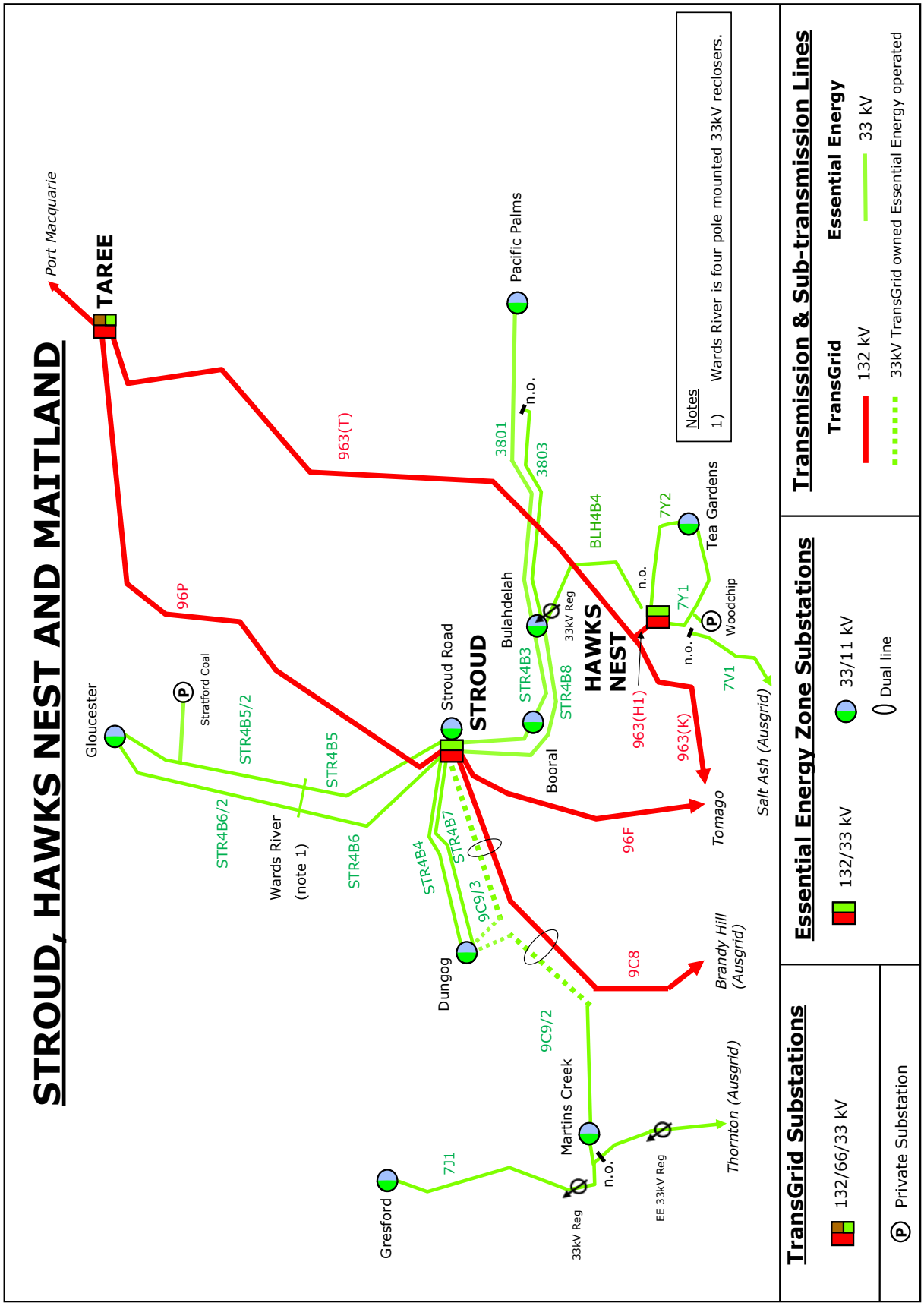
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
9C9/3	33	Stroud 132/33kV STS	Dungog ZS	27	8.7	8.8	8.9	9.0	9.1	27	5.4	5.5	5.5	5.6	5.6
9C9/2	33	Dungog ZS	Martins Creek ZS	21	6.7	6.8	6.9	7.0	7.1	27	4.2	4.2	4.2	4.2	4.2
STR4B3/1	33	Stroud 132/33kV STS	Booral ZS	7	5.2	5.3	5.5	5.6	5.7	12	5.8	5.9	5.9	6.0	6.1
STR4B3/2	33	Booral ZS	Bulahdelah ZS	7	3.7	3.8	3.9	4.0	4.1	12	4.2	4.2	4.3	4.3	4.4
STR4B4	33	Stroud 132/33kV STS	Dungog ZS	4	3.0	3.0	3.0	3.1	3.1	6	1.8	1.8	1.8	1.9	1.9
STR4B5/1	33	Stroud 132/33kV STS	Wards River Sw Stn	17	7.4	7.6	7.8	8.0	8.1	19	6.4	6.5	6.5	6.6	6.7
STR4B5/2	33	Wards River Sw Stn	Stratford Tee	19	8.4	8.7	9.0	9.2	9.6	21	7.6	7.6	7.6	7.7	7.7
STR4B5/2a	33	Stratford Tee	Stratford Coal ZS	7	4.9	5.2	5.5	5.7	6.0	12	5.0	5.0	5.0	5.0	5.1
STR4B5/3	33	Stratford Tee	Gloucester ZS	19	3.2	3.2	3.3	3.3	3.4	21	2.3	2.4	2.4	2.4	2.4
STR4B6/1	33	Stroud 132/33kV STS	Wards River Sw Stn	17	8.6	8.8	9.0	9.2	9.4	19	7.4	7.5	7.5	7.6	7.7
STR4B6/2	33	Wards River Sw Stn	Gloucester ZS	17	6.2	6.3	6.4	6.4	6.5	19	4.6	4.6	4.6	4.7	4.7
STR4B7	33	Stroud 132/33kV STS	Dungog ZS	7	4.5	4.6	4.6	4.7	4.7	12	3.3	3.3	3.3	3.4	3.4
STR4B8	33	Stroud 132/33kV STS	Bulahdelah ZS	7	4.7	4.9	5.0	5.1	5.2	12	4.9	5.0	5.1	5.1	5.2
3801	33	Bulahdelah ZS	Pacific Palms ZS	7	3.7	3.6	3.6	3.6	3.5	12	5.3	5.4	5.4	5.5	5.6
3803	33	Bulahdelah ZS	Bungwahl Sw Stn	7	0.0	0.0	0.0	0.0	0.0	12	0.0	0.0	0.0	0.0	0.0
BLH4B4	33	Bulahdelah ZS	Hawks Nest 132/33kV STS	7	0.3	0.3	0.3	0.3	0.3	12	0.3	0.3	0.3	0.3	0.3
7J1	33	Ausgrid Recloser 33175 (Patterson)	Martins Creek Tee	8	0.0	0.0	0.0	0.0	0.0	10	0.0	0.0	0.0	0.0	0.0
7J1/2	33	Martins Creek Tee	Martins Creek ZS	4	2.8	2.9	2.9	2.9	2.9	7	1.8	1.8	1.8	1.8	1.8
7J1/3	33	Martins Creek Tee	Gresford ZS	4	2.8	2.9	2.9	2.9	2.9	7	1.8	1.8	1.8	1.8	1.8

STS and ZS load forecast

SUMMER	Stroud Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Booral	33/11	3	2.5		2.75	0.95	1.7	1.7	1.7	1.7	1.7	0.78	4
Bulahdelah	33/11	5/8	5/6.5		7.15	0.98	4.5	4.6	4.6	4.7	4.8	1.77	2
Dungog	33/11	10/16	10/16		17.6	0.99	9.5	9.6	9.7	9.8	9.8	2.97	5.5
Gloucester	33/11	10/16	10/16		17.6	1.00	9.4	9.6	9.7	9.7	9.9	3.35	5
Gresford	33/11	5/8	5/6.5		7.15	1.00	2.8	2.9	2.9	2.9	2.9	0.95	3
Martins Creek	33/11	5/8	5/8		8.8	0.98	3.8	3.9	4.0	4.1	4.2	1.63	4.5
Pacific Palms	33/11	5/8	5/8		8.8	0.99	3.7	3.6	3.6	3.6	3.5	1.89	4.5
Stroud 132/33kV	132/33	50/60	50/60		66	1.00	36.8	37.6	38.3	39.0	39.7	0.00	4.5
Stroud 33/11kV	33/11	5	5/8		5.5	1.00	3.0	3.0	3.0	3.0	3.0	1.23	1

WINTER	Stroud Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Booral	33/11	3	2.5		3	0.95	1.3	1.3	1.3	1.3	1.3	0.78	0.5
Bulahdelah	33/11	5/8	5/6.5		7.8	0.97	3.3	3.3	3.3	3.3	3.3	1.77	2.5
Dungog	33/11	10/16	10/16		19.2	1.00	6.2	6.4	6.4	6.5	6.6	2.97	2.5
Gloucester	33/11	10/16	10/16		19.2	0.99	6.9	7.0	7.0	7.1	7.1	3.35	4.5
Gresford	33/11	5/8	5/6.5		7.8	0.96	1.8	1.8	1.8	1.8	1.8	0.95	6.5
Martins Creek	33/11	5/8	5/8		9.6	0.97	2.4	2.4	2.4	2.4	2.4	1.63	6.5
Pacific Palms	33/11	5/8	5/8		9.6	1.00	5.3	5.4	5.4	5.5	5.6	1.89	4.5
Stroud 132/33kV	132/33	50/60	50/60		72	0.98	31.0	31.8	32.4	33.2	34.0	0.00	3.5
Stroud 33/11kV	33/11	5	5/8		6	0.98	2.2	2.2	2.2	2.2	2.3	1.23	4

Sub-transmission Single Line Diagram of Stroud area



2.3.12 Hawks Nest Supply Area

Description of Hawks Nest area

All zone substations in the Hawks Nest area are in the Mid North Coast region.

The Hawks Nest 132/33kV sub-transmission substation is owned by Essential Energy. It receives supply via a tee off the TransGrid Tomago to Taree 132kV line (#963). Tea Gardens zone substation takes normal supply from the Hawks Nest 132/33kV substation. Tea Gardens zone substation takes backup supply from a 33kV sub-transmission line that emanates from Ausgrid's Tomago network. A partial backup supply for Tea Gardens is via the 33kV network emanating from the Stroud substation via Bulahdelah.

HAWKS NEST – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
7Y1	33	Hawks Nest 132/33kV STS	Tea Gardens ZS	7	5.4	5.4	5.5	5.6	5.6	12	4.8	4.8	4.9	4.9	4.9
7Y2	33	Hawks Nest 132/33kV STS	Tea Gardens ZS	7	4.9	5.0	5.0	5.1	5.1	12	4.4	4.4	4.5	4.5	4.5
7V1	33	Ausgrid Salt Ash ZS	Tee with 7Y1	7	0.0	0.0	0.0	0.0	0.0	12	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Hawks Nest Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Hawks Nest 132/33kV	132/33	50			0	1.00	10.3	10.4	10.6	10.7	10.8	0.00	3
Tea Gardens	33/11	10/16	10/16		17.6	1.00	10.3	10.5	10.7	10.9	11.1	4.08	3

WINTER	Hawks Nest Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Hawks Nest 132/33kV	132/33	50			0	0.99	9.2	9.3	9.4	9.4	9.5	0.00	3
Tea Gardens	33/11	10/16	10/16		19.2	1.00	8.8	8.8	8.9	8.9	9.0	4.08	5

Sub-transmission Single Line Diagram of Hawks Nest area

Please refer to the Sub-transmission Single Line Diagram of Stroud area on Page 48.

2.3.13 Tenterfield Supply Area

Description of Tenterfield area

All zone substations in the Tenterfield area are in the Ranges region.

The Tenterfield area is supplied at 22kV and 11kV from the TransGrid 132/22/11kV sub-transmission substation at Tenterfield. Essential Energy is responsible for the 22/11kV substation area.

TENTERFIELD – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

There are no sub-transmission feeders in the Tenterfield area.

STS and ZS load forecast

SUMMER	Tenterfield Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
TransGrid 132/22kV Total Tenterfield 22kV Supply						0.99	3.8	3.8	3.8	3.8	3.8	1.67	8
Tenterfield 11kV	22/11	2.5	4		2.75	0.98	1.7	1.7	1.7	1.7	1.7	1.05	9

WINTER	Tenterfield Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
TransGrid 132/22kV Total Tenterfield 22kV Supply						1.00	5.3	5.3	5.3	5.3	5.3	1.67	4.5
Tenterfield 11kV	22/11	2.5	4		3	0.99	2.3	2.3	2.4	2.4	2.5	1.05	3

Sub-transmission Single Line Diagram of Tenterfield area

Please refer to the Sub-transmission Single Line Diagram of Glen Innes area on Page 55.

2.3.14 Armidale Supply Area

Description of Armidale area

Zone substations in the Armidale area are spread across both the Ranges and Northern Tablelands regions.

The Armidale area sub-transmission system is supplied from the TransGrid 330/132/66kV sub-transmission substation at Armidale.

ARMIDALE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – WLS8B5 Uralla/Walcha Rd/Wollun	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
661/1	66	TransGrid Armidale 330/132/66kV STS	Hillgrove Tee	20	0.8	0.9	0.9	0.9	0.9	24	1.0	1.0	1.0	1.0	1.0
661/2	66	Hillgrove Tee	Hillgrove ZS	16	0.3	0.3	0.3	0.3	0.3	20	0.4	0.4	0.4	0.4	0.4
661/3	66	Hillgrove Tee	Oaky ZS	20	0.5	0.5	0.5	0.5	0.5	24	0.6	0.6	0.6	0.6	0.6
662/1	66	TransGrid Armidale 330/132/66kV STS	Uralla Tee	12	5.2	5.2	5.2	5.2	5.2	17	7.2	7.3	7.3	7.3	7.3
662/2	66	Uralla Tee	Uralla ZS	9	2.7	2.7	2.7	2.7	2.7	15	3.6	3.6	3.6	3.6	3.6
662/4	66	Uralla Tee	Walcha South ZS	9	2.6	2.6	2.6	2.6	2.6	15	3.7	3.7	3.7	3.8	3.8
664	66	TransGrid Armidale 330/132/66kV STS	Gallow ay St ZS	28	13.9	13.9	13.9	13.9	13.9	34	22.3	22.4	22.4	22.5	22.6
665	66	TransGrid Armidale 330/132/66kV STS	Madgw ick Dr ZS	21	8.9	8.9	8.9	8.9	9.0	39	12.5	12.5	12.6	12.6	12.6
66C	66	Miller St ZS	Madgw ick Dr ZS	21	1.8	1.8	1.8	1.8	1.8	39	3.4	3.4	3.4	3.5	3.5
66F	66	Gallow ay St ZS	Miller St ZS	15	6.4	6.4	6.4	6.4	6.4	25	8.8	8.8	8.8	8.8	8.9

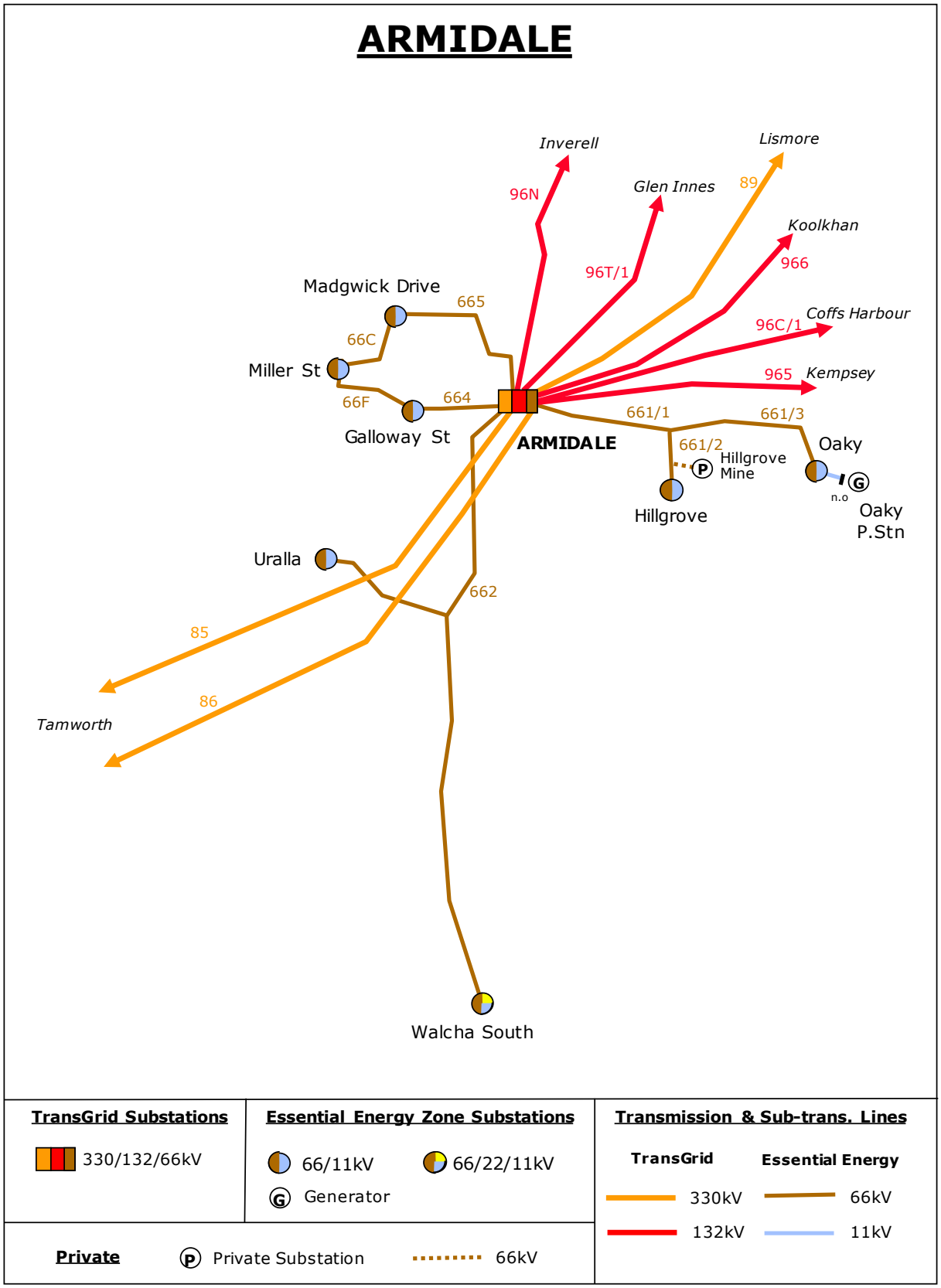
The 5MW hydro generation at Oaky is presently decommissioned after failure of the dam wall.

STS and ZS load forecast

SUMMER	Armidale Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Galloway St	66/11	12.5/16	10/12.5		13.75	1.00	8.0	7.9	7.9	7.8	7.8	4.71	6
Hillgrove	66/11	5/6.25			0	0.87	0.3	0.3	0.3	0.3	0.3	0.14	2
Madgwick Dr	66/11	10/12.5	10/16		13.75	0.98	9.5	9.4	9.3	9.3	9.2	3.22	12
Miller St	66/11	12.5/16	10/16		17.6	0.96	8.1	8.2	8.3	8.4	8.5	3.21	8
Oaky	66/11	3.5	3.5		3.85	0.95	0.4	0.4	0.4	0.4	0.4	0.13	2
Uralla	66/11	8	5		5.5	0.95	2.7	2.7	2.7	2.7	2.7	1.81	2.5
Walcha South 66/22kV	66/22	8	3		3.3	0.78	1.4	1.4	1.4	1.4	1.4	0.68	5
Walcha South 22/11kV	22/11	3	3		3.3	0.98	1.1	1.1	1.1	1.1	1.1	0.70	9

WINTER	Armidale Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Galloway St	66/11	12.5/16	10/12.5		15	1.00	12.7	12.8	13.0	13.2	13.4	4.71	7
Hillgrove	66/11	5/6.25			0	0.98	0.4	0.4	0.4	0.4	0.4	0.14	4
Madgwick Dr	66/11	10/12.5	10/16		15	0.99	13.7	13.7	13.7	13.6	13.6	3.22	7
Miller St	66/11	12.5/16	10/16		19.2	0.99	11.4	11.4	11.4	11.4	11.5	3.21	1
Oaky	66/11	3.5	3.5		4.2	0.95	0.4	0.4	0.4	0.4	0.4	0.13	5
Uralla	66/11	8	5		6	0.95	3.6	3.6	3.6	3.6	3.6	1.81	14
Walcha South 66/22kV	66/22	8	3		3.6	0.75	2.0	2.0	2.0	2.0	2.0	0.68	6.5
Walcha South 22/11kV	22/11	3	3		3.6	0.99	1.7	1.7	1.7	1.7	1.8	0.70	7

Sub-transmission Single Line Diagram of Armidale area



2.3.15 Glen Innes Supply Area

Description of Glen Innes area

Zone substations in the Glen Innes area are spread across both the Ranges and Northern Tablelands regions.

The Glen Innes area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Glen Innes.

GLEN INNES – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – GNI3B3 Red Range/Kookabookra	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
886	66	TransGrid Glen Innes 132/66kV STS	Glen Innes ZS	70	4.3	4.3	4.3	4.3	4.3	78	6.2	6.2	6.2	6.2	6.2
887	66	TransGrid Glen Innes 132/66kV STS	Glen Innes ZS	19	5.1	5.1	5.1	5.1	5.1	33	7.4	7.4	7.4	7.4	7.4
6NY	66	Glen Innes ZS	Guyra ZS	11	3.0	3.0	3.0	3.0	3.0	19	4.2	4.2	4.2	4.2	4.2
6NE	66	Glen Innes ZS	Emmaville ZS	17	0.9	0.9	0.9	0.9	0.9	30	1.2	1.2	1.2	1.1	1.1
6AE/A	66	Pindari ZS	Ashford ZS	17	0.0	0.0	0.0	0.0	0.0	30	0.0	0.0	0.0	0.0	0.0
6AE/E	66	Emmaville ZS	Pindari ZS	17	0.3	0.3	0.3	0.3	0.3	30	0.4	0.4	0.4	0.4	0.4

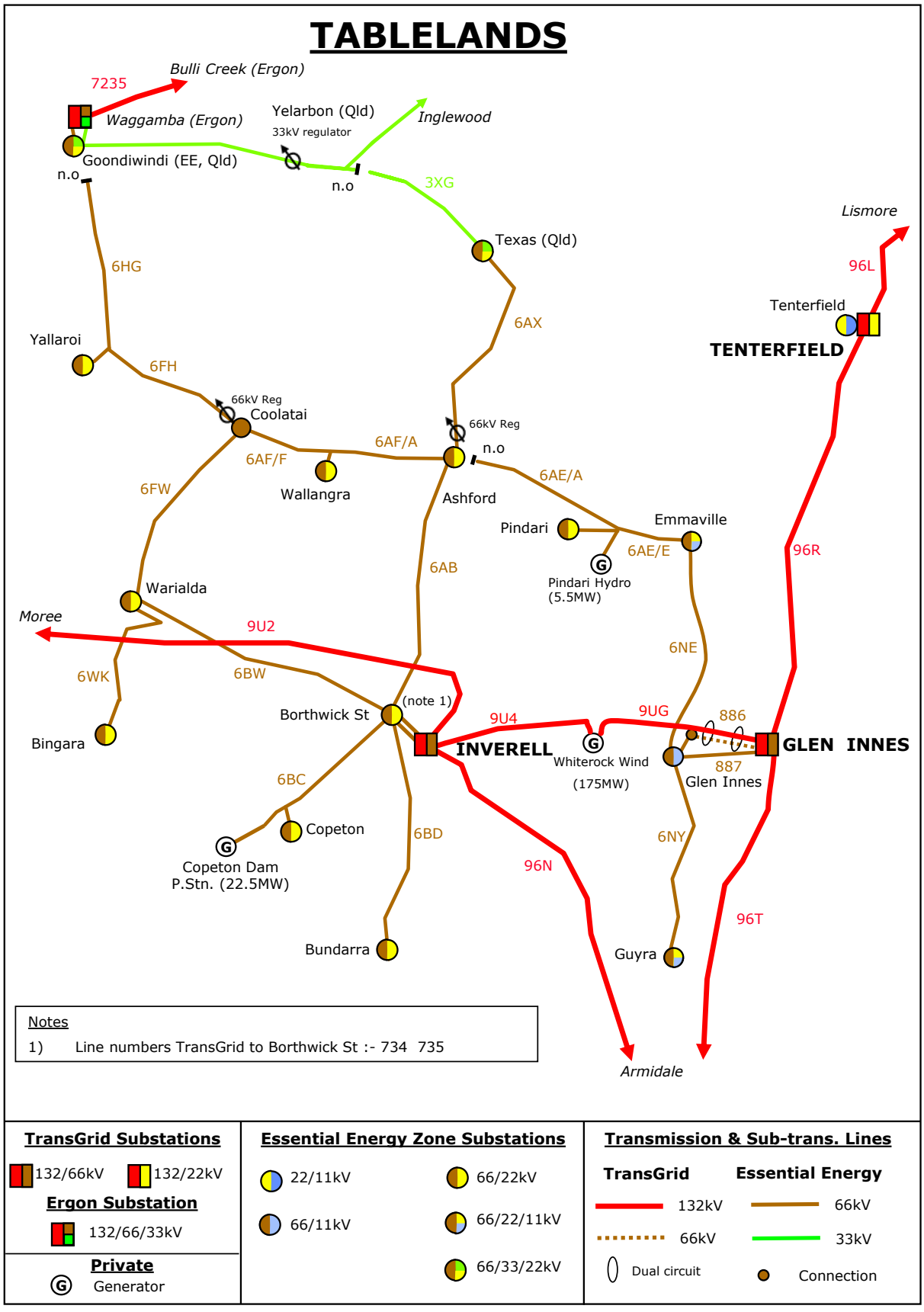
A 5.5MW hydro generator is located at Pindari Dam and is connected to the TransGrid Glen Innes 132/66kV sub-transmission substation at 66kV via feeders 6AE, 6NE, 886 and 887.

STS and ZS load forecast

SUMMER	Glen Innes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Emmaville 66/11kV	66/11	3			0	0.95	0.7	0.7	0.7	0.7	0.7	0.73	3.5
Emmaville 66/22kV	66/22	2.5			0	0.95	0.1	0.1	0.1	0.1	0.1	0.10	7
Glen Innes	66/11	15/20	15/20		22	0.99	5.8	5.8	5.8	5.8	5.8	4.00	5
Guyra	66/11/22	5	5		5.5	0.99	3.0	3.0	3.0	3.0	3.0	1.99	17.5
Pindari	66/22	0.3			0	0.98	0.1	0.1	0.1	0.1	0.1	0.01	0

WINTER	Glen Innes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Emmaville 66/11kV	66/11	3			0	0.95	0.9	0.9	0.9	0.9	0.9	0.73	6.5
Emmaville 66/22kV	66/22	2.5			0	0.95	0.2	0.2	0.2	0.2	0.2	0.10	2
Glen Innes	66/11	15/20	15/20		24	1.00	8.4	8.4	8.4	8.4	8.5	4.00	3.5
Guyra	66/11/22	5	5		6	1.00	4.2	4.2	4.2	4.2	4.2	1.99	7.5
Pindari	66/22	0.3			0	0.98	0.1	0.1	0.1	0.1	0.1	0.01	0

Sub-transmission Single Line Diagram of Glen Innes area



2.3.16 Inverell Supply Area

Description of Inverell area

All zone substations in the Inverell area are in the Northern Tablelands region.

The Inverell area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Inverell.

INVERELL – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – WRA2W08 Northern	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
734	66	TransGrid Inverell 132/66kV STS	Borthwick St ZS	64	17.2	17.4	17.6	17.8	18.0	71	16.8	16.9	17.0	17.0	17.1
735	66	TransGrid Inverell 132/66kV STS	Borthwick St ZS	64	17.4	17.7	17.9	18.1	18.3	71	17.1	17.2	17.3	17.3	17.4
6AB	66	Borthwick St ZS	Ashford ZS	17	6.3	6.4	6.4	6.5	6.6	30	5.0	5.0	5.0	5.0	5.0
6AF/A	66	Ashford ZS	Wallangra ZS	11	0.9	0.9	0.9	0.9	0.9	19	0.9	0.9	0.9	0.9	0.9
6AF/F	66	Wallangra ZS	Coolatai Sw Stn	11	0.7	0.7	0.7	0.7	0.7	19	0.8	0.8	0.8	0.8	0.8
6AX	66	Ashford ZS	Texas ZS	9	5.2	5.3	5.4	5.4	5.5	15	3.4	3.4	3.4	3.4	3.4
6BC	66	Borthwick St ZS	Copeton ZS	21	0.8	0.8	0.8	0.8	0.8	41	0.8	0.9	0.9	0.9	0.9
6BD	66	Borthwick St ZS	Bundarra ZS	14	0.9	0.9	0.9	0.9	0.9	21	1.1	1.1	1.1	1.1	1.1
6BW	66	Borthwick St ZS	Warialda ZS	15	6.9	7.0	7.1	7.1	7.2	25	5.9	5.9	5.9	6.0	6.0
6FH	66	Coolatai Sw Stn	Yallaroi ZS	20	2.2	2.2	2.2	2.3	2.3	39	1.9	1.9	1.9	1.9	2.0
6FW	66	Warialda ZS	Coolatai Sw Stn	11	1.7	1.7	1.7	1.7	1.7	19	1.2	1.2	1.2	1.2	1.2
6HG	66	Yallaroi ZS	Goondiwindi ZS	20	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0
6WK	66	Warialda ZS	Bingara ZS	11	2.7	2.7	2.7	2.8	2.8	19	2.5	2.5	2.5	2.5	2.5

A 23MW hydro generator is located at Copeton Dam and is connected to the TransGrid Inverell 132/66kV sub-transmission substation at 66kV via feeders 6BC, 734 and 735.

STS and ZS load forecast

SUMMER	Inverell Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Ashford	66/22	3			0	0.95	0.9	0.9	0.9	0.9	0.9	0.53	1.5
Bingara	66/22	3	7.5		3.3	0.95	2.6	2.6	2.6	2.7	2.7	1.22	10
Borthwick St	66/22	20/30	15/30		33	0.99	21.0	21.2	21.5	21.8	22.1	8.99	4
Bundarra	66/22	3			0	0.66	1.3	1.2	1.2	1.3	1.2	0.47	4
Copeton	66/22	3	1.5		1.65	0.95	1.1	1.2	1.2	1.2	1.3	0.00	2
Texas 66/22kV	66/22	5	5		5.5	0.95	3.4	3.5	3.5	3.5	3.6	0.98	9.5
Texas 66/33kV	66/33	7.5	5		5.5	0.95	1.8	1.9	1.9	1.9	1.9	0.34	3.5
Wallangra	66/22	1			0	0.89	0.2	0.2	0.2	0.2	0.2	0.10	1.5
Warialda	66/22	4	8		4.4	1.00	3.2	3.2	3.2	3.2	3.2	1.58	2
Yallaroi	66/22	5			0	0.95	1.8	1.8	1.8	1.8	1.7	0.76	8

WINTER	Inverell Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Ashford	66/22	3			0	0.95	0.6	0.6	0.6	0.6	0.6	0.53	12
Bingara	66/22	3	7.5		3.6	0.95	2.1	2.1	2.1	2.1	2.1	1.22	2
Borthwick St	66/22	20/30	15/30		36	1.00	20.3	20.5	20.7	20.9	21.0	8.99	6.5
Bundarra	66/22	3			0	0.62	1.3	1.3	1.3	1.3	1.3	0.47	12
Copeton	66/22	3	1.5		1.8	0.95	1.0	1.0	1.0	1.0	1.0	0.00	7.5
Texas 66/22kV	66/22	5	5		6	0.95	2.3	2.4	2.4	2.4	2.5	0.98	2.5
Texas 66/33kV	66/33	7.5	5		6	0.95	1.4	1.4	1.4	1.4	1.4	0.34	2.5
Wallangra	66/22	1			0	0.82	0.2	0.2	0.2	0.2	0.2	0.10	3.5
Warialda	66/22	4	8		4.8	0.98	2.7	2.7	2.7	2.7	2.7	1.58	1
Yallaroi	66/22	5			0	0.95	1.8	1.8	1.8	1.8	1.8	0.76	10.5

Sub-transmission Single Line Diagram of Inverell area

Please refer to the Sub-transmission Single Line Diagram of Glen Innes area on Page 55.

2.3.17 Waggamba (Ergon) Supply Area

Description of Waggamba area

All zone substations in the Waggamba area are in the Northern Tablelands region.

The Waggamba area sub-transmission system is supplied from the Ergon 132/66/33kV sub-transmission substation at Goondiwindi. The 132/66/33kV substation is supplied by a 132kV network from Powerlink's Bulli Creek substation.

Backup supply to Goondiwindi is limited to a maximum of 20MVA via 66kV from Inverell.

WAGGAMBA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

There are no sub-transmission feeders in the Waggamba area.

STS and ZS load forecast

SUMMER	Waggamba Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Goondiwindi 22kV	66/22	20	20/30		22	1.00	13.9	13.8	13.7	13.7	13.6	4.14	2.5
Goondiwindi 33kV	66/33	5			0	1.00	5.7	5.7	5.7	5.7	5.7	2.03	11.5

WINTER	Waggamba Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Goondiwindi 22kV	66/22	20	20/30		24	0.99	12.7	12.7	12.7	12.7	12.7	4.14	3
Goondiwindi 33kV	66/33	5			0	0.98	4.9	4.9	5.0	5.1	5.2	2.03	3.5

Sub-transmission Single Line Diagram of Waggamba area

Please refer to the Sub-transmission Single Line Diagram of Glen Innes area on Page 55.

2.3.18 Moree Supply Area

Description of Moree area

All zone substations in the Moree area are in the Northern Tablelands region.

The Moree area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Moree.

MOREE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
876	66	TransGrid Moree 132/66kV STS	Moree Solar Farm	70	56.4	56.4	56.4	56.5	56.5	78	56.6	56.6	56.6	56.7	56.8
87J	66	Moree Solar Farm	Bellata ZS	25	1.0	1.0	1.0	0.9	0.9	27	0.8	0.8	0.8	0.7	0.7
721	66	TransGrid Moree 132/66kV STS	Moree ZS	64	9.1	9.1	9.1	9.1	9.1	71	7.2	7.2	7.2	7.2	7.3
722	66	TransGrid Moree 132/66kV STS	Moree ZS	64	9.6	9.6	9.6	9.6	9.6	71	7.6	7.6	7.6	7.6	7.6
881/1	66	TransGrid Moree 132/66kV STS	Ashley Tee	15	3.5	3.4	3.4	3.4	3.4	25	10.2	10.2	10.2	10.2	10.1
881/2	66	Ashley Tee	Ashley ZS	10	1.2	1.2	1.2	1.2	1.2	16	5.7	5.7	5.7	5.7	5.7
6PU	66	Ashley Tee	Mungindi ZS	10	2.1	2.1	2.0	2.0	2.0	16	4.3	4.3	4.3	4.3	4.3
723:WTR/1	66	TransGrid Moree 132/66kV STS	Wathagar ZS	12	5.5	5.5	5.5	5.5	5.5	19	5.5	5.5	5.5	5.5	5.5
723:WTR/2	66	Wathagar ZS	Wenna ZS	15	5.5	5.5	5.5	5.5	5.5	25	5.5	5.5	5.5	5.5	5.5

A 56MW solar generator is located at Moree Solar Farm and is connected to TransGrid's Moree 132/66kV sub-transmission substation at 66kV via feeder 876.

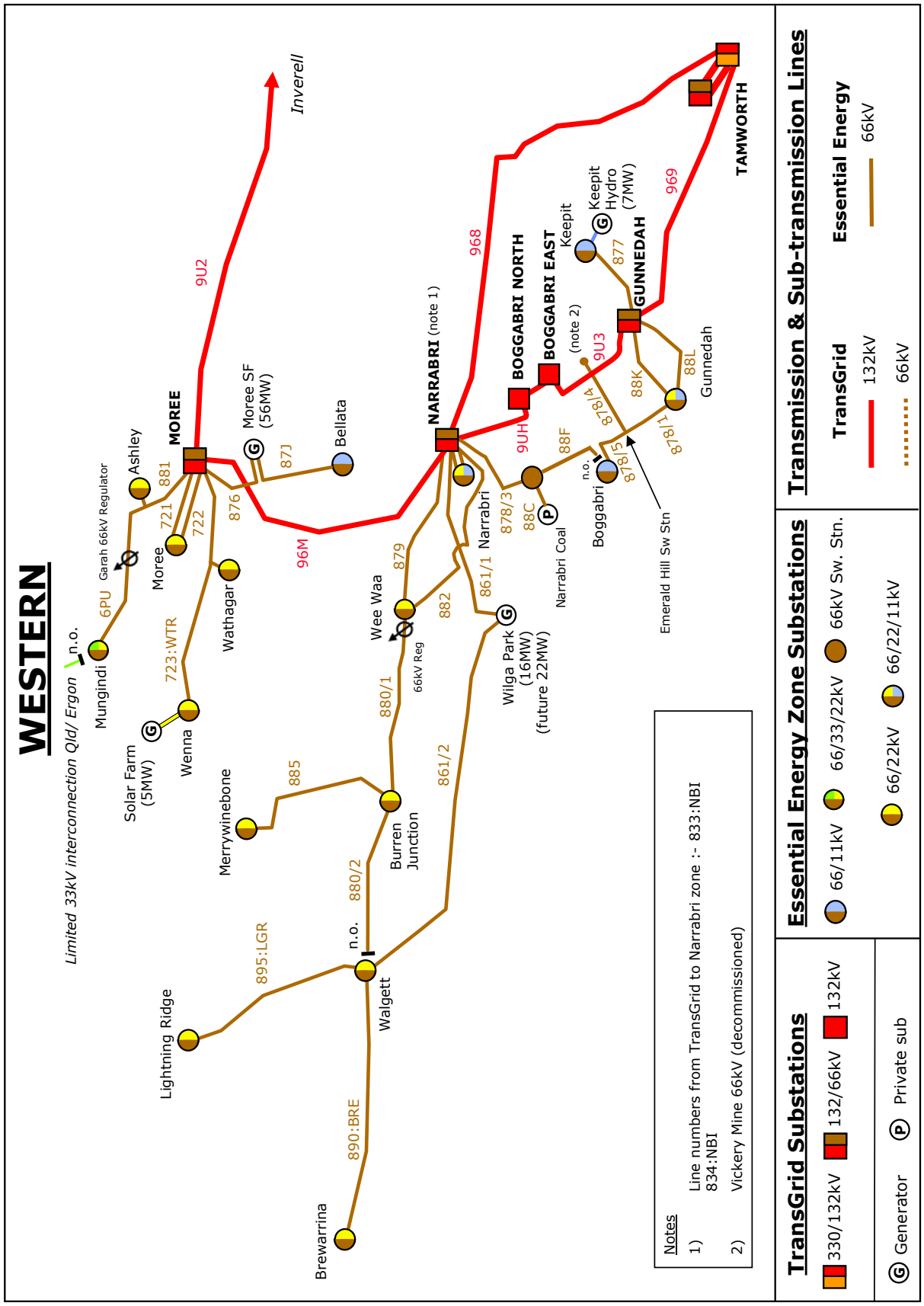
STS and ZS load forecast

SUMMER	Moree Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Ashley	66/22	8			0	0.99	1.2	1.2	1.2	1.2	1.2	0.36	1
Bellata	66/11	2.8	2.5		2.75	0.98	1.0	1.0	1.0	0.9	0.9	0.43	6.5
Moree	66/22	15/30	24/30		33	0.99	19.3	19.3	19.2	19.1	19.1	9.93	5
Mungindi	66/22/33	8			0	0.95	2.1	2.1	2.0	2.0	2.0	0.80	5.5
Wathagar	66/22	5			0	0.95	2.8	2.8	2.8	2.8	2.8	0.21	0.5
Wenna	66/22	7.5			0	0.80	0.7	0.7	0.7	0.7	0.7	0.04	2

WINTER	Moree Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Ashley	66/22	8			0	0.98	5.7	5.7	5.7	5.7	5.7	0.36	4.5
Bellata	66/11	2.8	2.5		3	1.00	0.8	0.8	0.8	0.7	0.7	0.43	8.5
Moree	66/22	15/30	24/30		36	1.00	20.1	20.1	20.2	20.2	20.3	9.93	4.5
Mungindi	66/22/33	8			0	0.95	4.3	4.3	4.3	4.3	4.3	0.80	10.5
Wathagar	66/22	5			0	0.95	5.3	5.3	5.4	5.4	5.5	0.21	21
Wenna	66/22	7.5			0	0.71	0.3	0.3	0.3	0.3	0.3	0.04	3

A 5MW solar generator is located at Wenna on the 22kV network.

Sub-transmission Single Line Diagram of Moree area



2.3.19 Narrabri Supply Area

Description of Narrabri area

Zone substations in the Narrabri area are spread across both the Northern Tablelands and North Western regions.

The Narrabri area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Narrabri.

NARRABRI – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – NBI8B7 M6 Wee Waa	3.3
Feeder – NBI8B10 M16 Mount Dowe	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
879	66	TransGrid Narrabri 132/66kV STS	Wee Waa ZS	18	4.5	4.5	4.5	4.5	4.6	22	4.4	4.4	4.4	4.4	4.4
882	66	TransGrid Narrabri 132/66kV STS	Wee Waa ZS	64	8.7	8.8	8.8	8.8	8.9	71	8.6	8.6	8.6	8.6	8.6
885	66	Burren Junction ZS	Merryw inebone ZS	15	1.5	1.5	1.5	1.5	1.5	25	2.6	2.6	2.6	2.6	2.6
833:NBI	66	TransGrid Narrabri 132/66kV STS	Narrabri ZS	38	9.0	9.0	9.0	9.0	9.0	43	7.8	7.8	7.8	7.8	7.8
834:NBI	66	TransGrid Narrabri 132/66kV STS	Narrabri ZS	38	9.0	9.0	9.0	9.0	9.0	43	7.8	7.8	7.8	7.8	7.8
861/1	66	TransGrid Narrabri 132/66kV STS	Wilga Park ZS	64	14.5	14.5	14.4	14.5	38.5	71	14.2	14.1	14.1	37.9	37.9
861/2	66	Wilga Park ZS	Walgett ZS	64	11.3	11.3	11.2	11.2	11.2	71	9.4	9.4	9.4	9.4	9.3
88F	66	Narrabri Coal Tee	Boggabri ZS	24	0.0	0.0	0.0	0.0	0.0	29	0.0	0.0	0.0	0.0	0.0
878/3	66	TransGrid Narrabri 132/66kV STS	Narrabri Coal Tee	61	18.5	18.5	18.5	18.5	18.5	68	18.5	18.5	18.5	18.5	18.5
880/1	66	Wee Waa ZS	Burren Junction ZS	13	3.5	3.5	3.5	3.5	5.4	18	3.8	3.7	3.7	5.9	5.9
880/2	66	Burren Junction ZS	Walgett ZS	13	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0
890:BRE	66	Walgett ZS	Brew arrina ZS	15	2.8	2.8	2.8	2.8	2.8	25	2.2	2.2	2.2	2.2	2.2
895:LGR	66	Walgett ZS	Lightning Ridge ZS	15	3.1	3.1	3.1	3.1	3.1	25	2.7	2.7	2.6	2.6	2.6

A 10MW and 6MW gas generator located at Wilga Park is connected to the TransGrid Narrabri 132/66kV sub-transmission substation at 66kV via feeder 861.

STS and ZS load forecast

SUMMER	Narrabri Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Brewarrina	66/22	6.5/8			0	0.98	2.8	2.8	2.8	2.8	2.8	0.79	12
Burren Junction	66/22	5	5		5.5	1.00	2.2	2.2	2.2	2.2	2.3	0.50	2.5
Lightning Ridge	66/22	8	5		5.5	1.00	3.1	3.1	3.1	3.1	3.1	1.25	9.5
Merrywinebone	66/22	5			0	0.81	1.5	1.5	1.5	1.5	1.5	0.43	6
Narrabri	66/22/11	18/30	18/30		33	0.97	17.9	17.9	17.9	17.9	17.9	6.41	0.5
Walgett	66/22	10/16	10		11	0.99	4.9	4.9	4.8	4.8	4.8	1.65	15
Wee Waa	66/22	10	10		11	0.92	8.8	8.8	8.8	8.9	8.9	1.99	9

WINTER	Narrabri Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Brewarrina	66/22	6.5/8			0	0.92	2.2	2.2	2.2	2.2	2.2	0.79	6.5
Burren Junction	66/22	5	5		6	0.98	1.6	1.6	1.6	1.5	1.5	0.50	3.5
Lightning Ridge	66/22	8	5		6	1.00	2.7	2.7	2.6	2.6	2.6	1.25	1.5
Merrywinebone	66/22	5			0	1.00	2.6	2.6	2.6	2.6	2.6	0.43	16.5
Narrabri	66/22/11	18/30	18/30		36	0.98	15.7	15.7	15.7	15.7	15.7	6.41	11
Walgett	66/22	10/16	10		12	0.94	4.2	4.2	4.2	4.2	4.1	1.65	10.5
Wee Waa	66/22	10	10		12	0.97	8.1	8.1	8.1	8.1	8.1	1.99	2.5

Sub-transmission Single Line Diagram of Narrabri area

Please refer to the Sub-transmission Single Line Diagram of Moree area on Page 61.

2.3.20 Gunnedah Supply Area

Description of Gunnedah area

All zone substations in the Gunnedah area are in the Northern Tablelands region.

The Gunnedah area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Gunnedah.

GUNNEDAH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – GDH6501 M65 Wandobah	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
877	66	TransGrid Gunnedah 132/66kV STS	Keepit Dam ZS	10	0.2	0.2	0.2	0.2	0.2	16	0.2	0.2	0.2	0.2	0.2
878/1	66	Gunnedah ZS	Emerald Hill Sw Stn	24	16.0	16.0	16.0	16.0	16.0	29	4.5	16.4	16.3	16.3	16.2
878/5	66	Emerald Hill Sw Stn	Boggabri ZS	24	4.0	4.0	4.0	4.0	4.0	29	4.5	4.4	4.3	4.3	4.2
88K	66	TransGrid Gunnedah 132/66kV STS	Gunnedah ZS	61	19.7	19.8	19.8	19.8	19.9	68	12.0	18.1	18.3	18.4	18.6
88L	66	TransGrid Gunnedah 132/66kV STS	Gunnedah ZS	61	19.7	19.8	19.8	19.8	19.9	68	12.0	18.1	18.3	18.4	18.6

A 7MW hydro generator is located at Lake Keepit and is connected to the TransGrid Gunnedah 132/66kV sub-transmission substation at 66kV via feeder 877.

STS and ZS load forecast

SUMMER	Gunnedah Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Boggabri	66/11	5/6.5	10		7.15	0.96	4.0	4.0	4.0	4.0	4.0	1.06	9.5
Gunnedah 22kV	66/22/11	18/30	18/30		33	0.98	23.4	23.5	23.6	23.6	23.7	6.32	29.5
Keepit Dam	66/11	1			0	0.94	0.2	0.2	0.2	0.2	0.2	0.03	4.5

WINTER	Gunnedah Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Boggabri	66/11	5/6.5	10		7.8	0.97	4.5	4.4	4.3	4.3	4.2	1.06	2.5
Gunnedah 22kV	66/22/11	18/30	18/30		36	1.00	19.5	19.9	20.2	20.6	20.9	6.32	7
Keepit Dam	66/11	1			0	0.98	0.1	0.1	0.1	0.1	0.1	0.03	1.5

Sub-transmission Single Line Diagram of Gunnedah area

Please refer to the Sub-transmission Single Line Diagram of Moree area on Page 61.

2.3.21 Tamworth Supply Area

Description of Tamworth area

All zone substations in the Tamworth area are in the Northern Tablelands region.

The Tamworth area sub-transmission system is supplied from the TransGrid 132/66kV sub-transmission substation at Tamworth.

TAMWORTH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

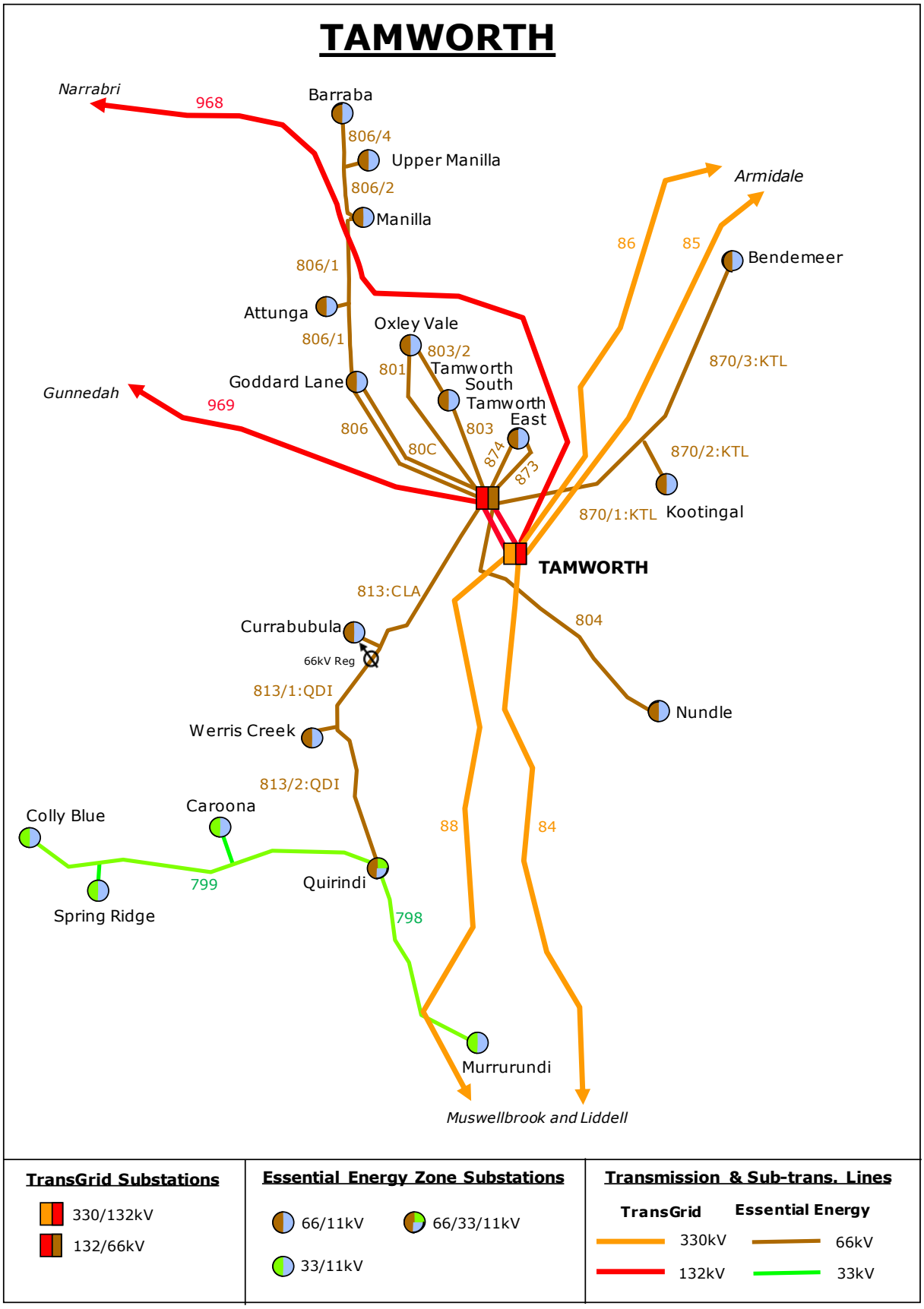
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
801	66	Transgrid Tamworth 132/66kV STS	Oxley Vale ZS	63	13.5	13.5	13.5	13.5	13.5	70	11.4	11.5	11.7	11.8	11.9
803	66	Transgrid Tamworth 132/66kV STS	South Tamworth ZS	70	27.7	27.8	27.8	27.9	27.9	78	25.1	25.4	25.6	25.8	26.0
804	66	Transgrid Tamworth 132/66kV STS	Nundle ZS	8	1.7	1.7	1.7	1.7	1.7	13	1.7	1.8	1.8	1.9	1.9
806	66	Transgrid Tamworth 132/66kV STS	Goddard Lane ZS	38	11.9	12.0	12.0	12.0	12.0	47	9.7	9.8	9.8	9.9	10.0
873	66	Transgrid Tamworth 132/66kV STS	East Tamworth ZS	53	17.4	17.5	17.5	17.5	17.5	61	13.1	13.2	13.3	13.4	13.6
874	66	Transgrid Tamworth 132/66kV STS	East Tamworth ZS	53	16.6	16.7	16.7	16.7	16.7	61	12.4	12.6	12.6	12.8	12.9
803/2	66	South Tamworth ZS	Oxley Vale ZS	63	5.0	5.1	5.1	5.1	5.1	70	4.8	4.9	4.9	5.0	5.0
806/1	66	Goddard Lane ZS	Attunga ZS	18	12.9	13.0	13.0	13.0	13.0	33	8.0	8.1	8.1	8.2	8.3
806/1	66	Attunga ZS	Manilla ZS	18	9.1	9.1	9.1	9.1	9.1	33	5.8	5.8	5.9	5.9	6.0
806/2	66	Manilla ZS	Upper Manilla ZS	18	3.3	3.3	3.3	3.3	3.3	33	2.6	2.6	2.6	2.7	2.7
806/4	66	Upper Manilla ZS	Barraba ZS	15	2.5	2.5	2.6	2.6	2.6	25	2.2	2.2	2.2	2.2	2.2
80C	66	Transgrid Tamworth 132/66kV STS	Goddard Lane ZS	61	10.7	10.7	10.7	10.8	10.8	68	8.1	8.2	8.2	8.3	8.4
813:CLA	66	Transgrid Tamworth 132/66kV STS	Currububula ZS	28	18.1	18.2	18.2	18.2	18.2	34	13.8	13.9	14.0	14.1	14.3
813/1:QDI	66	Currububula ZS	Werris Creek ZS	28	15.1	15.2	15.2	15.2	15.2	34	11.6	11.7	11.8	11.9	12.0
813/2:QDI	66	Werris Creek ZS	Quirindi ZS	28	13.5	13.6	13.8	13.8	14.0	34	9.3	9.4	9.4	9.5	9.6
870/1:KTL	66	Transgrid Tamworth 132/66kV STS	Kootingal Tee	14	6.9	7.0	7.0	7.0	7.0	21	5.0	5.1	5.1	5.1	5.2
870/2:KTL	66	Kootingal Tee	Kootingal ZS	12	6.2	6.2	6.1	6.0	6.0	20	5.1	5.2	5.3	5.4	5.4
870/3:KTL	66	Kootingal Tee	Bendemeer ZS	13	0.8	0.8	0.9	0.9	0.9	21	0.7	0.8	0.8	0.8	0.8
798	33	Quirindi ZS	Murrurundi ZS	4	2.8	2.9	2.9	2.9	2.9	6	2.4	2.4	2.5	2.5	2.5
799/1	33	Quirindi ZS	Caroona Tee	6	3.3	3.3	3.3	3.3	3.3	10	2.3	2.3	2.4	2.4	2.4
799/2	33	Caroona Tee	Caroona ZS	4	0.9	0.9	0.9	0.9	0.8	6	0.6	0.7	0.7	0.7	0.7
799/3	33	Caroona Tee	Spring Ridge ZS	3	0.7	0.7	0.7	0.7	0.7	5	0.6	0.6	0.6	0.6	0.6
799/4	33	Spring Ridge ZS	Colly Blue ZS	3	1.3	1.3	1.3	1.3	1.3	5	1.0	1.0	1.0	1.0	1.1

STS and ZS load forecast

SUMMER	Tamworth Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Attunga	66/11	5	8		5.5	0.95	3.6	3.6	3.6	3.6	3.7	1.05	6.5
Barraba	66/11	5	5		5.5	0.98	2.5	2.5	2.6	2.6	2.6	1.04	4
Bendemeer	66/11	3	1		1.1	1.00	0.8	0.8	0.9	0.9	0.9	0.35	2
Caroona	33/11	2	3		2.2	0.88	0.9	0.9	0.9	0.9	0.8	0.06	6
Colly Blue	33/11	1.5	3		1.65	0.95	1.3	1.3	1.3	1.3	1.3	0.21	14.5
Currabubula	66/11	3			0	0.95	1.6	1.6	1.6	1.6	1.6	0.38	8
Goddard Lane	66/11	20/30	20/30		33	1.00	13.0	13.0	13.1	13.1	13.1	1.66	12
Kootingal	66/11	10/16	10/16		17.6	0.98	6.2	6.2	6.1	6.0	6.0	2.63	6
Manilla	66/11	5/6.25	5/6.25		6.875	0.90	4.8	4.8	4.8	4.8	4.8	1.47	16
Murrurundi	33/11	5/8	5/8		8.8	0.98	3.1	3.1	3.2	3.2	3.2	1.03	4
Nundle	66/11	2.5	2.5		2.75	0.93	1.7	1.7	1.7	1.7	1.7	0.83	9
Oxley Vale	66/11	20/30	20/30		33	1.00	19.3	19.4	19.3	19.4	19.3	5.71	3.5
Quirindi 66/11kV	66/33/11	10/13.3	10/13.3		14.63	0.99	7.5	7.6	7.7	7.7	7.8	1.89	3
Quirindi 66/33kV	66/33/11	8/10	8/10		11	0.98	6.0	6.1	6.1	6.1	6.1	0.00	6
Spring Ridge	33/11	1			0	0.96	0.7	0.7	0.7	0.7	0.7	0.14	3
Tamworth East	66/11	20/30	18/23	18/23	50.6	1.00	30.7	30.7	30.4	30.5	30.3	6.19	9
Tamworth South	66/11	20/30	20/30		33	0.97	24.6	24.6	24.5	24.5	24.3	7.34	7.5
Upper Manilla	66/11	1.5			0	0.93	0.8	0.8	0.8	0.9	0.9	0.08	1.5
Werris Creek	66/11	8	5/6.25		6.875	0.95	2.7	2.7	2.7	2.7	2.6	0.79	2

WINTER	Tamworth Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Attunga	66/11	5	8		6	0.95	2.3	2.3	2.3	2.3	2.3	1.05	7
Barraba	66/11	5	5		6	1.00	2.2	2.2	2.2	2.2	2.2	1.04	7
Bendemeer	66/11	3	1		1.2	1.00	0.7	0.8	0.8	0.8	0.8	0.35	4
Caroona	33/11	2	3		2.4	0.91	0.6	0.7	0.7	0.7	0.7	0.06	1
Colly Blue	33/11	1.5	3		1.8	0.98	1.0	1.0	1.0	1.0	1.1	0.21	3
Currabubula	66/11	3			0	0.95	1.0	1.0	1.0	1.0	1.0	0.38	7.5
Goddard Lane	66/11	20/30	20/30		36	0.99	10.4	10.5	10.6	10.7	10.9	1.66	11
Kootingal	66/11	10/16	10/16		19.2	1.00	5.1	5.2	5.3	5.4	5.4	2.63	7
Manilla	66/11	5/6.25	5/6.25		7.5	0.90	3.5	3.5	3.5	3.5	3.5	1.47	1.5
Murrurundi	33/11	5/8	5/8		9.6	1.00	2.3	2.4	2.4	2.4	2.4	1.03	5.5
Nundle	66/11	2.5	2.5		3	0.98	1.7	1.8	1.8	1.9	1.9	0.83	0.5
Oxley Vale	66/11	20/30	20/30		36	0.99	16.3	16.5	16.7	16.9	17.1	5.71	1.5
Quirindi 66/11kV	66/33/11	10/13.3	10/13.3		15.96	1.00	5.3	5.4	5.4	5.5	5.5	1.89	2
Quirindi 66/33kV	66/33/11	8/10	8/10		12	1.00	4.0	4.0	4.0	4.0	4.0	0.00	12.5
Spring Ridge	33/11	1			0	0.97	0.6	0.6	0.6	0.6	0.6	0.14	7
Tamworth East	66/11	20/30	18/23	18/23	55.2	1.00	24.0	24.0	24.1	24.2	24.3	6.19	8
Tamworth South	66/11	20/30	20/30		36	0.99	20.7	20.7	20.8	20.9	21.0	7.34	6.5
Upper Manilla	66/11	1.5			0	0.94	0.6	0.6	0.6	0.6	0.7	0.08	7.5
Werris Creek	66/11	8	5/6.25		7.5	0.95	2.4	2.4	2.4	2.4	2.4	0.79	1.5

Sub-transmission Single Line Diagram of Tamworth area



2.3.22 Beryl Supply Area

Description of Beryl area

Zone substations in the Beryl area are spread across both the Northern Tablelands and Macquarie regions.

The Beryl area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation. The Mudgee substation is normally connected to the Essential Energy 132kV teed line from the TransGrid Mt Piper to Beryl 132kV transmission line with back up from the Beryl 66kV system via Gulgong.

BERYL – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

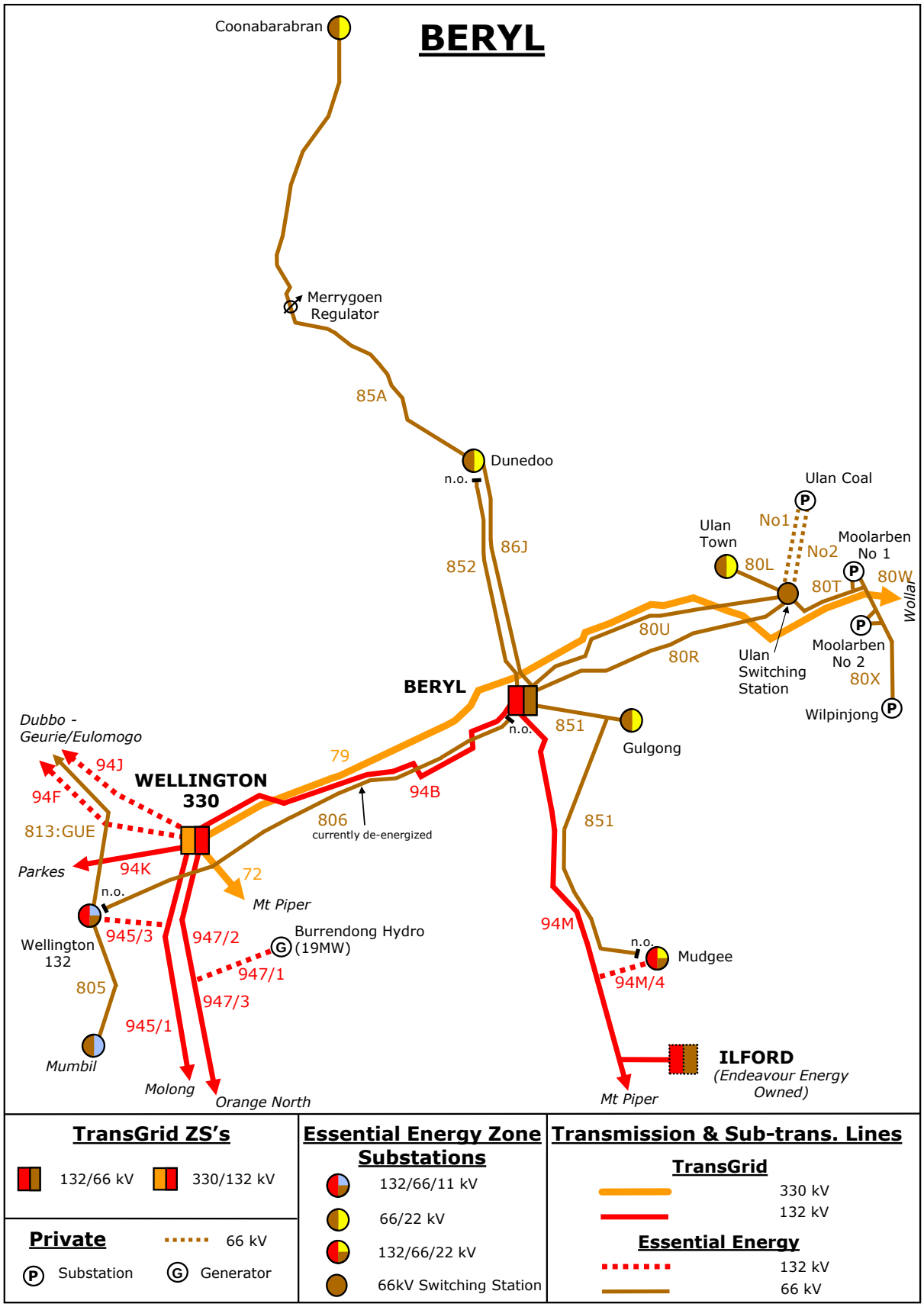
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
94W4	132	TransGrid 94M Mudgee Tee	Mudgee ZS	128	27.4	27.5	27.4	27.4	27.4	143	24.7	25.2	25.7	26.3	26.8
851	66	TransGrid Beryl 132/66kV STS	Gulgong ZS	28	4.0	4.0	4.0	4.0	4.1	32	3.4	3.4	3.4	3.4	3.4
851	66	Gulgong ZS	Mudgee ZS	28	0.0	0.0	0.0	0.0	0.0	32	0.0	0.0	0.0	0.0	0.0
852	66	TransGrid Beryl 132/66kV STS	Dunedoo ZS	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
86J	66	TransGrid Beryl 132/66kV STS	Dunedoo ZS	61	14.5	14.6	14.7	14.8	14.9	68	13.4	13.5	13.5	13.6	13.7
85A	66	Dunedoo ZS	Coonabarabran ZS	11	9.7	9.7	9.7	9.8	9.8	19	9.0	9.0	9.0	9.0	9.1
80L	66	Ulan Sw Stn	Ulan Tow n ZS	15	2.6	2.6	2.8	2.8	3.0	25	2.3	2.4	2.5	2.5	2.6
80R	66	TransGrid Beryl 132/66kV STS	Ulan Sw Stn	64	41.0	41.4	41.6	41.9	42.1	71	41.5	41.6	41.9	42.1	42.2
80U	66	TransGrid Beryl 132/66kV STS	Ulan Sw Stn	61	34.4	34.5	34.4	34.4	34.4	68	30.7	30.7	30.7	30.7	30.8
80T	66	Ulan Sw Stn	Moolarben No1 Mine ZS	43	28.4	28.4	28.4	28.4	28.4	54	30.1	30.0	30.1	30.1	30.1
80W	66	Moolarben No1 Mine ZS	Moolarben No2 Mine ZS	43	13.8	13.8	13.8	13.8	13.8	54	14.5	14.5	14.5	14.5	14.5
80X	66	Moolarben No2 Mine ZS	Wilpinjong Mine ZS	61	5.7	5.7	5.7	5.7	5.7	68	5.9	5.9	5.9	5.9	5.9

STS and ZS load forecast

SUMMER	Beryl Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Coonabarabran	66/22	10/13	10/13		14.3	1.00	8.9	8.9	8.9	9.0	9.0	4.24	6
Dunedoo	66/22	7.5/10	7.5/10		11	1.00	5.6	5.7	5.8	5.8	5.9	2.61	6.5
Gulgong	66/22	5			0	0.99	4.0	4.0	4.0	4.0	4.1	1.08	4
Mudgee	66/22, 132/22	30	30		33	1.00	27.0	27.0	26.9	26.8	26.8	8.95	6.5
Ulan Town	66/22	3	2.5		2.75	0.95	2.6	2.6	2.8	2.8	3.0	1.03	5.5

WINTER	Beryl Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Coonabarabran	66/22	10/13	10/13		15.6	1.00	8.2	8.2	8.2	8.2	8.3	4.24	4.5
Dunedoo	66/22	7.5/10	7.5/10		12	1.00	5.2	5.3	5.3	5.4	5.4	2.61	2.5
Gulgong	66/22	5			0	1.00	3.4	3.4	3.4	3.4	3.4	1.08	2.5
Mudgee	66/22, 132/22	30	30		36	1.00	25.2	25.5	25.9	26.2	26.6	8.95	4.5
Ulan Town	66/22	3	2.5		3	0.95	2.3	2.4	2.5	2.5	2.6	1.03	2

Sub-transmission Single Line Diagram of Beryl area



2.3.23 Wellington Supply Area

Description of Wellington area

All zone substations in the Wellington area are in the Macquarie region.

The Essential Energy Wellington 132/66/11kV zone substation is normally connected to the Essential Energy 132kV tee line #945/3 from TransGrid's Wellington to Molong 132kV transmission line #945. The 66kV supply for Mumbil is obtained from the Wellington 11kV busbar via a step up 66/11kV transformer. The backup supply for Wellington and Mumbil is via the 66kV powerline #813 from Eulomogo.

WELLINGTON – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
945/3	132	TransGrid Line 945 Wellington 132kV Tee	Wellington 132kV ZS	124	11.0	11.0	11.0	11.0	11.0	139	8.3	8.3	8.3	8.3	8.3
947/1	132	TransGrid Line 947 Burrendong Tee	Burrendong Hydro	36	2.6	2.7	2.6	2.6	2.6	64	1.9	1.9	1.9	1.9	1.9
94F	132	TransGrid Wellington 330/132kV STS	Dubbo 132/66kV STS	173	94.5	94.3	94.2	94.1	94.3	194	81.6	81.6	81.8	82.0	82.2
94J	132	TransGrid Wellington 330/132kV STS	Dubbo 132/66kV STS	173	87.5	87.3	87.3	87.2	87.4	194	76.4	76.5	76.7	76.8	77.0
805	66	Wellington 132kV ZS	Mumbil ZS	11	1.4	1.4	1.4	1.4	1.4	19	1.1	1.1	1.2	1.2	1.2
813:WGN	66	Wellington 132kV ZS	Geurie Tee	12	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Wellington Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Mumbil	66/11	2.5	2.8		2.75	0.95	1.4	1.4	1.4	1.4	1.4	0.32	8.5
Wellington 11kV	132/11, 66/11	10	15		11	0.97	11.0	11.0	11.0	11.0	11.0	2.84	9

WINTER	Wellington Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Mumbil	66/11	2.5	2.8		3	0.95	1.1	1.1	1.2	1.2	1.2	0.32	3.5
Wellington 11kV	132/11, 66/11	10	15		12	0.99	8.3	8.3	8.3	8.3	8.3	2.84	9

Sub-transmission Single Line Diagram of Wellington area

Please refer to the Sub-transmission Single Line Diagram of Beryl area on Page 71.

2.3.24 Dubbo Supply Area

Description of Dubbo area

Zone substations in the Dubbo area are spread across both the Macquarie and North Western regions.

Essential Energy owns two 132kV powerlines emanating from the TransGrid owned Wellington 330/132kV sub-transmission substation that support the Dubbo 132/66kV sub-transmission substation and Nyngan 132/66kV sub-transmission substation supply areas.

The Narromine zone substation is supplied from the Narromine South Switching station connected between Dubbo South and Nyngan 132kV.

The Nevertire zone substation is normally supplied from the 132kV network via a tee, off the 94W Dubbo to Nyngan 132kV line, with back up supply available from Nyngan 66kV system via Nyngan Town.

DUBBO – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – GID12 Gilgandra Town No.1	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
943/1	132	94F Tee	Dubbo South ZS	106	41.5	41.4	41.4	41.3	41.4	119	36.5	36.5	36.6	36.7	36.8
943/2	132	Dubbo South ZS	Narromine South Sw Stn	106	26.5	26.4	26.4	26.4	26.4	119	23.5	23.5	23.5	23.6	23.6
94W/1	132	Dubbo 132/66kV STS	Nevertire Tee	128	91.3	91.1	91.1	91.0	91.1	143	88.5	88.5	88.8	88.9	89.1
94W/2	132	Nevertire Tee	Nevertire ZS	124	5.9	5.8	5.8	5.7	5.7	139	7.2	7.1	7.0	6.9	6.8
94W/3	132	Nevertire Tee	Nevertire Sw Stn	128	25.9	25.9	25.9	25.9	25.9	143	24.8	24.8	24.9	24.9	25.0
9GX	132	Nevertire Sw Stn	Nyngan 132/66kV STS	128	32.5	32.5	32.4	32.5	32.4	143	58.5	58.5	58.7	58.9	58.8
9GP	132	Narromine South Sw Stn	Narromine ZS	124	11.8	11.9	11.9	12.0	12.0	139	13.0	13.0	13.0	13.0	13.0
9GR	132	Narromine South Sw Stn	Narromine ZS	124	0.0	0.0	0.0	0.0	0.0	139	0.0	0.0	0.0	0.0	0.0
9GT	132	Dubbo West ZS	Narromine South Sw Stn	140	42.7	42.8	42.9	43.1	43.2	157	42.6	42.7	42.8	42.9	43.0
9GU	132	Narromine South Sw Stn	Nyngan 132/66kV STS	106	67.9	68.0	68.2	68.5	68.6	119	65.2	65.4	65.6	66.0	66.0
9GW	132	Dubbo 132/66kV STS	Dubbo West ZS	140	36.1	36.0	36.0	35.9	36.0	157	32.2	32.2	32.3	32.4	32.4
812	66	Yarrandale ZS	Gilgandra ZS	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
815	66	Dubbo 132/66kV STS	Phillip St ZS	24	12.0	11.9	11.8	11.6	11.5	28	9.3	9.2	9.1	9.0	8.9
816	66	Dubbo 132/66kV STS	Phillip St ZS	24	12.0	11.9	11.8	11.6	11.5	28	9.3	9.2	9.1	9.0	8.9
813:EUL	66	Eulomogo ZS	Geurie Tee	12	1.7	1.8	1.8	1.8	1.8	18	1.1	1.2	1.2	1.2	1.2
813/1:GUE	66	Geurie Tee	Geurie ZS	16	1.7	1.8	1.8	1.8	1.8	27	1.1	1.2	1.2	1.2	1.2
814/1	66	Gilgandra ZS	Gulargambone ZS	11	7.9	7.9	7.9	7.9	7.9	19	6.3	6.3	6.2	6.2	6.2
814/2	66	Gulargambone ZS	Coonamble ZS	11	6.1	6.1	6.1	6.2	6.1	19	4.7	4.7	4.7	4.7	4.6
81M	66	Dubbo 132/66kV STS	Eulomogo ZS	20	9.9	9.8	9.8	9.8	9.8	39	9.1	9.1	9.1	9.2	9.2
81P	66	Dubbo 132/66kV STS	Yarrandale ZS	61	10.5	10.5	10.5	10.5	10.5	68	10.2	10.2	10.2	10.2	10.2
81R	66	Dubbo 132/66kV STS	Eulomogo ZS	20	10.3	10.3	10.3	10.3	10.3	39	9.5	9.5	9.5	9.5	9.5
81X	66	Dubbo 132/66kV STS	Yarrandale ZS	28	11.5	11.5	11.5	11.5	11.5	34	11.0	11.0	11.1	11.1	11.1
81T	66	Yarrandale ZS	Gilgandra ZS	43	15.6	15.6	15.7	15.7	15.6	54	12.8	12.8	12.8	12.9	12.9

STS and ZS load forecast

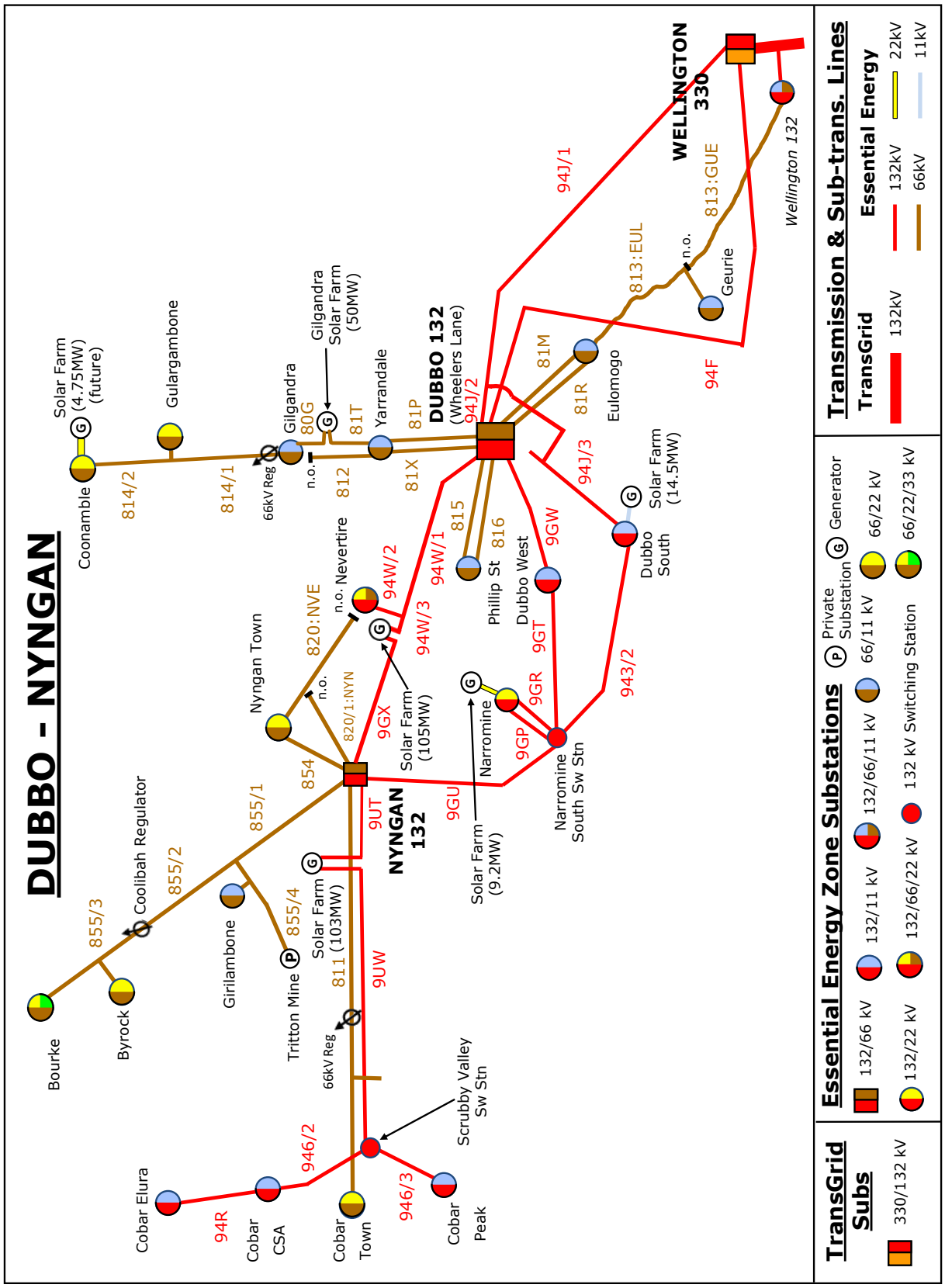
SUMMER	Dubbo Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Coonamble	66/22	10	10		11	1.00	6.1	6.1	6.1	6.2	6.1	2.17	18
Dubbo 132/66kV	132/66	30/45	30/45	30/45	99	0.97	61.0	60.6	60.2	59.9	59.5	0.00	12
Dubbo Phillip St	66/11	20/30	20/30		33	0.94	24.0	23.8	23.5	23.3	23.0	3.52	3.5
Dubbo South	132/11	30	30		33	0.98	20.3	20.7	20.9	21.2	21.5	7.48	3.5
Dubbo West	132/11	15/23	15/23		25.3	0.97	17.7	17.9	18.1	18.4	18.6	6.59	6.5
Eulomogo	66/11	15/30	20/30		33	0.97	20.7	20.7	20.7	20.8	20.8	8.91	5.5
Geurie	66/11	5			0	0.97	1.7	1.8	1.8	1.8	1.8	0.61	4
Gilgandra	66/11	8/12	8/12		13.2	0.98	7.7	7.7	7.7	7.7	7.7	2.85	5.5
Gulargambone	66/22	3			0	0.95	1.6	1.6	1.6	1.6	1.6	0.62	4
Narromine	132/22	17/24	24		26.4	1.00	11.8	11.9	11.9	12.0	12.0	5.21	4.5
Nevertire	132/22, 66/22	17/24	10		11	0.99	5.9	5.8	5.8	5.7	5.7	2.35	4.5
Yarrandale	66/11	18/25	30		27.5	0.94	7.4	7.3	7.2	7.2	7.1	1.31	22.5

WINTER	Dubbo Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Coonamble	66/22	10	10		12	0.99	4.7	4.7	4.7	4.7	4.6	2.17	4.5
Dubbo 132/66kV	132/66	30/45	30/45	30/45	108	1.00	50.7	51.2	51.7	52.2	52.7	0.00	5
Dubbo Phillip St	66/11	20/30	20/30		36	0.96	18.6	18.4	18.2	18.0	17.8	3.52	5
Dubbo South	132/11	30	30		36	1.00	17.2	17.5	17.8	18.2	18.4	7.48	2.5
Dubbo West	132/11	15/23	15/23		27.6	0.99	13.5	13.7	13.9	14.2	14.4	6.59	4.5
Eulomogo	66/11	15/30	20/30		36	1.00	18.3	18.5	18.7	18.9	19.1	8.91	3
Geurie	66/11	5			0	0.99	1.1	1.2	1.2	1.2	1.2	0.61	4
Gilgandra	66/11	8/12	8/12		14.4	1.00	6.4	6.4	6.5	6.5	6.6	2.85	2
Gulargambone	66/22	3			0	0.95	1.5	1.5	1.5	1.5	1.5	0.62	0.5
Narromine	132/22	17/24	24		28.8	1.00	13.0	13.0	13.0	13.0	13.0	5.21	6.5
Nevertire	132/22, 66/22	17/24	10		12	0.99	7.2	7.1	7.0	6.9	6.8	2.35	1.5
Yarrandale	66/11	18/25	30		30	0.92	6.9	6.9	6.8	6.8	6.8	1.31	5.5

A 9.2MW solar generator is located at Narromine on the 22kV network, and a 14.5MW solar generator is connected at Dubbo South on the 11kV network.

A 105MW solar generator is located at Nevertire and is connected to the Dubbo 132/66kV sub-transmission substation at 132kV via the feeder 94W.

Sub-transmission Single Line Diagram of Dubbo area



2.3.25 Nyngan Supply Area

Description of Nyngan area

All zone substations in the Nyngan area are in the North Western region.

Essential Energy's Nyngan 132/66kV substation is supplied from our Dubbo 132/66kV sub-transmission substation via two Essential Energy 132kV transmission lines. The 94W Dubbo to Nyngan 132kV line has a tee connection into Nevertire, with back up supply available from Nyngan 66kV system via Nyngan Town and the 94J-9GU Dubbo to Nyngan 132kV line via Narromine South switching station.

NYNGAN – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
9UT	132	Nyngan 132/66kV STS	Nyngan Solar Farm	106	66.2	66.3	66.3	66.3	66.5	119	67.5	66.9	66.5	66.2	65.7
9UW	132	Nyngan Solar Farm	Scrubby Valley Sw Stn	106	45.7	45.6	45.6	45.5	45.4	119	44.9	45.3	45.8	46.3	46.8
946/2	132	Scrubby Valley Sw Stn	Cobar CSA ZS	106	26.2	26.1	26.1	26.0	26.0	119	25.4	25.6	25.8	26.0	26.3
946/3	132	Scrubby Valley Sw Stn	Cobar Peak ZS	102	11.9	11.9	11.9	11.8	11.8	114	11.8	12.1	12.4	12.7	12.9
94R	132	Cobar CSA ZS	Cobar Elura ZS	128	7.9	7.9	7.8	7.8	7.7	143	8.8	8.8	8.8	8.8	8.8
811	66	Nyngan 132/66kV STS	Cobar Town ZS	10	8.1	8.1	8.2	8.2	8.2	16	6.5	6.4	6.4	6.4	6.3
854	66	Nyngan 132/66kV STS	Nyngan Town ZS	15	8.1	8.2	8.3	8.4	8.4	25	6.3	6.3	6.3	6.3	6.3
820/1:NYN	66	Nyngan Town ZS	Nevertire Tee	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
820:NVE	66	Nyngan 132/66kV STS	Nevertire ZS	11	0.0	0.0	0.0	0.0	0.0	19	0.0	0.0	0.0	0.0	0.0
855/1	66	Nyngan 132/66kV STS	Girilambone Tee	28	15.0	15.1	15.1	15.2	15.3	34	15.6	15.8	15.9	16.1	16.2
855/1a	66	Girilambone Tee	Girilambone ZS	24	10.4	10.5	10.5	10.6	10.6	29	10.0	10.0	10.1	10.1	10.2
855/2	66	Girilambone Tee	Byrock Tee	28	8.3	8.4	8.4	8.5	8.5	34	9.6	9.7	9.8	9.9	10.1
855/3	66	Byrock Tee	Bourke ZS	28	7.9	8.0	8.0	8.1	8.1	34	9.2	9.3	9.4	9.5	9.6
855/3a	66	Byrock Tee	Byrock ZS	15	0.1	0.1	0.1	0.1	0.1	25	0.1	0.1	0.1	0.1	0.1
855/4	66	Girilambone ZS	Tritton Mine ZS	24	9.2	9.2	9.2	9.2	9.2	29	8.7	8.7	8.7	8.7	8.7

A 102MW solar generator is located at Nyngan Solar Farm and is connected to the Nyngan 132/66kV sub-transmission substation at 132kV via the feeder 9UT.

STS and ZS load forecast

SUMMER	Nyngan Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bourke 22kV	66/22	10	10		11	0.98	5.9	5.9	6.0	6.0	6.0	1.78	8
Bourke 33kV	66/33	5/8			0	0.69	2.9	2.9	3.0	3.0	3.0	0.57	3
Byrock	66/22	1	1		1.1	0.88	0.1	0.1	0.1	0.1	0.1	0.03	2.5
Cobar CSA	132/11	15/18	15/18		19.8	1.00	20.5	20.5	20.5	20.6	20.5	0.00	67.5
Cobar Elura	132/11	15	15		16.5	0.98	7.9	7.9	7.8	7.8	7.7	0.00	34.5
Cobar Peak	132/11	15/22	15/22		24.2	0.94	11.9	11.9	11.9	11.8	11.8	0.00	137
Cobar Town	66/22	8/11	10/13		12.1	0.95	7.1	7.1	7.2	7.2	7.2	2.87	6.5
Girilambone	66/11	10/12.5			0	0.94	2.5	2.6	2.7	2.8	2.9	0.00	2.5
Nyngan 132kV	132/66	18/30	30/45		33	1.00	30.9	30.9	31.0	31.1	31.2	0.00	12
Nyngan Town	66/22	10	10		11	1.00	8.1	8.2	8.3	8.4	8.4	1.74	5.5

WINTER	Nyngan Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bourke 22kV	66/22	10	10		12	0.98	7.0	7.1	7.2	7.4	7.5	1.78	2
Bourke 33kV	66/33	5/8			0	0.48	3.2	3.2	3.2	3.2	3.2	0.57	1.5
Byrock	66/22	1	1		1.2	0.85	0.1	0.1	0.1	0.1	0.1	0.03	0.5
Cobar CSA	132/11	15/18	15/18		21.6	0.99	18.8	19.0	19.3	19.5	19.8	0.00	4
Cobar Elura	132/11	15	15		18	0.99	8.8	8.8	8.8	8.8	8.8	0.00	0.5
Cobar Peak	132/11	15/22	15/22		26.4	0.95	11.8	12.1	12.4	12.7	12.9	0.00	62.5
Cobar Town	66/22	8/11	10/13		13.2	0.95	5.5	5.4	5.4	5.4	5.3	2.87	2.5
Girilambone	66/11	10/12.5			0	0.93	2.5	2.6	2.7	2.8	2.9	0.00	29.5
Nyngan 132kV	132/66	18/30	30/45		36	1.00	29.6	29.7	29.8	30.0	30.0	0.00	5.5
Nyngan Town	66/22	10	10		12	0.98	6.3	6.3	6.3	6.3	6.3	1.74	6

Sub-transmission Single Line Diagram of Nyngan area

Please refer to the Sub-transmission Single Line Diagram of Dubbo area on Page 76.

2.3.26 Broken Hill Supply Area

Description of Broken Hill area

All zone substations in the Broken Hill area are in the North Western region.

The Broken Hill area is supplied from TransGrid's 220/22kV substation. Essential Energy utilises two 22kV lines and steps them up to 66kV for supply to Mt Gipps and Sunset Strip from which 33kV and other voltage levels are derived for specific purposes.

BROKEN HILL – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
X4	220	TransGrid Broken Hill 220/22kV STS	Perilya Mine	213	23.7	23.8	23.9	23.9	24.0	238	24.6	24.7	24.7	24.8	24.8
5B1:PPL	66	Pinnacles Place ZS	Mt Gipps ZS	19	10.2	10.2	10.2	10.2	10.2	33	8.1	8.1	8.1	8.1	8.1
5B1:MTG	66	Mt Gipps ZS	Sunset Strip ZS	19	8.3	8.3	8.3	8.3	8.3	33	6.6	6.6	6.6	6.6	6.6
5B1:SUN	66	Sunset Strip ZS	Menindee ZS	6	0.9	0.9	0.9	0.9	0.9	9	0.8	0.8	0.8	0.8	0.8

A 53MW solar generator is located at Broken Hill and is connected to the TransGrid Broken Hill 220/22kV sub-transmission substation at 22kV.

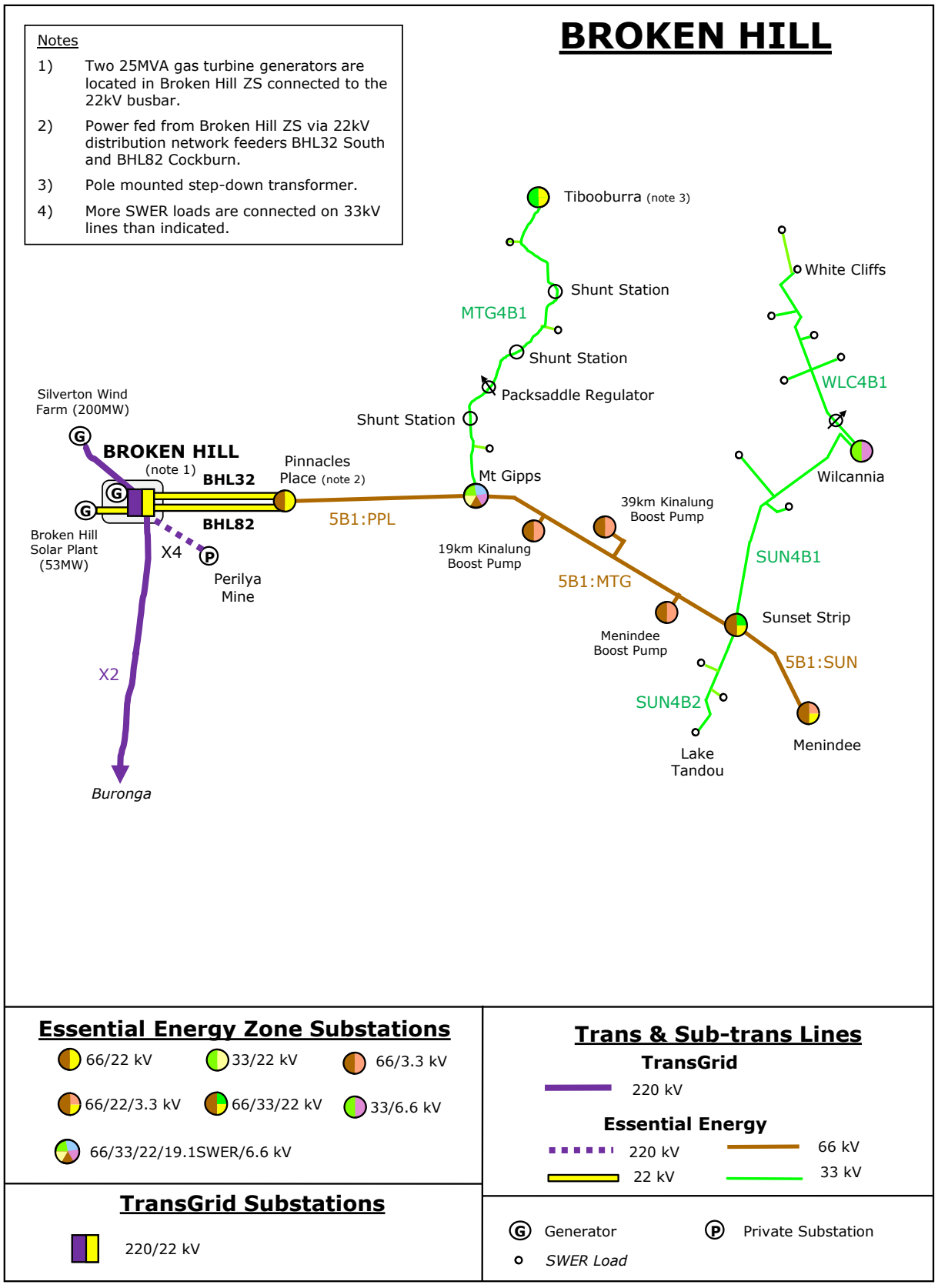
STS and ZS load forecast

SUMMER	Broken Hill Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
TransGrid 220/22kV Total Broken Hill 22kV Supply						0.97	41.2	41.2	41.2	41.2	41.3	12.81	9
Wilcannia 33kV						0.87	0.6	0.6	0.6	0.6	0.6	0.27	4
Menindee	66/22	5	5		5.5	0.96	0.9	0.9	0.9	0.9	0.9	0.57	6.5
Mt Gipps 33kV	66/33	1.5	1.5		1.65	0.95	1.1	1.1	1.1	1.1	1.1	0.51	7
Mt Gipps 6.6kV	66/6.6	1.5	1.5/2		1.65	0.99	0.8	0.8	0.8	0.8	0.8	0.06	4.5
Pinnacles Place	22/66	15	15		16.5	1.00	10.2	10.2	10.2	10.2	10.2	0.00	7.5
Sunset Strip 22kV	66/22	5			0	0.94	0.4	0.4	0.4	0.4	0.4	0.06	5.5
Sunset Strip 33kV	66/33	4	4		4.4	0.92	2.7	2.7	2.7	2.7	2.7	0.17	9.5
Wilcannia 6.6kV	33/6.6	3.5	3.5		3.85	0.94	0.9	0.9	0.9	0.9	0.9	0.25	1.5

WINTER	Broken Hill Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
TransGrid 220/22kV Total Broken Hill 22kV Supply						1.00	38.6	38.6	38.6	38.6	38.6	12.81	10.5
Wilcannia 33kV						0.77	0.6	0.6	0.6	0.6	0.6	0.27	4
Menindee	66/22	5	5		6	1.00	0.8	0.8	0.8	0.8	0.8	0.57	1
Mt Gipps 33kV	66/33	1.5	1.5		1.8	0.82	1.0	1.0	1.0	1.0	1.0	0.51	2.5
Mt Gipps 6.6kV	66/6.6	1.5	1.5/2		1.8	0.99	0.5	0.5	0.5	0.5	0.5	0.06	1.5
Pinnacles Place	22/66	15	15		18	0.93	8.1	8.1	8.1	8.1	8.1	0.00	7
Sunset Strip 22kV	66/22	5			0	0.99	0.4	0.4	0.4	0.4	0.4	0.06	1
Sunset Strip 33kV	66/33	4	4		4.8	0.87	2.6	2.6	2.6	2.6	2.6	0.17	12.5
Wilcannia 6.6kV	33/6.6	3.5	3.5		4.2	0.99	0.9	0.9	0.9	0.9	1.0	0.25	3.5

There have been changes to the water pump network with a new water supply now coming from Wentworth. It is unclear what the long-term configuration will be for the existing water pump infrastructure and whether it will affect peak loads.

Sub-transmission Single Line Diagram of Broken Hill area



2.3.27 Orange Supply Area

Description of Orange area

All zone substations in the Orange area are in the Macquarie region.

The Orange area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation, with the Orange town substations (Industrial, North, South and West) being supplied via a 66kV ring network. The Orange area provides a back-up 66kV supply to Molong via Orange West which supplies Cumnock and Molong via a 66/11kV transformer.

ORANGE – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

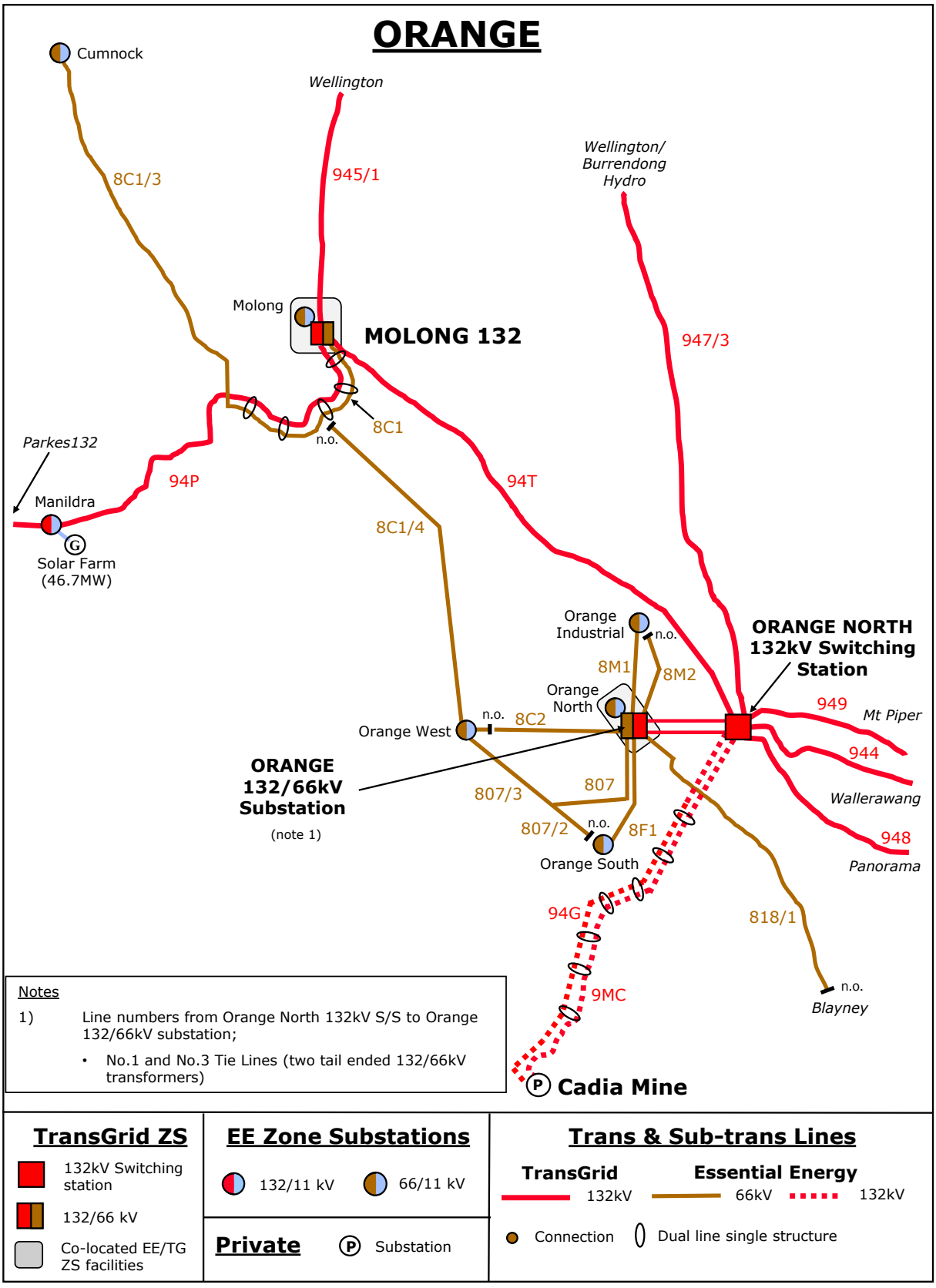
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
94G	132	TransGrid Orange North 132kV Sw Stn	Cadia ZS	142	83.1	91.5	90.1	89.7	90.3	142	84.1	92.5	91.4	91.2	91.3
9MC	132	TransGrid Orange North 132kV Sw Stn	Cadia ZS	142	83.1	91.5	90.1	89.7	90.3	142	84.1	92.5	91.4	91.2	91.3
807	66	TransGrid Orange 132/66kV STS	Orange West & South Tee	61	15.2	15.3	15.4	15.5	15.7	68	16.9	17.1	17.3	17.5	17.7
807/2	66	Orange West & South Tee	Orange South ZS	63	0.0	0.0	0.0	0.0	0.0	70	0.0	0.0	0.0	0.0	0.0
807/3	66	Orange West & South Tee	Orange West ZS	62	15.2	15.3	15.4	15.5	15.7	69	16.9	17.1	17.3	17.5	17.7
818/1	66	TransGrid Orange 132/66kV STS	Blayney ZS	11	0.0	0.0	0.0	0.0	0.0	19	0.0	0.0	0.0	0.0	0.0
8C2	66	TransGrid Orange 132/66kV STS	Orange West ZS	9	0.0	0.0	0.0	0.0	0.0	15	0.0	0.0	0.0	0.0	0.0
8F1	66	TransGrid Orange 132/66kV STS	Orange South ZS	63	19.9	19.8	19.8	19.8	19.8	70	23.4	23.5	23.5	23.5	23.5
8M1	66	TransGrid Orange 132/66kV STS	Orange Industrial ZS	11	11.7	11.9	12.1	12.2	12.4	19	12.8	12.9	13.0	13.1	13.2
8M2	66	TransGrid Orange 132/66kV STS	Orange Industrial ZS	21	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Orange Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Orange Industrial	66/11	15	10		11	0.99	11.7	11.9	12.1	12.2	12.4	5.39	2.5
Orange North	66/11	20/30			0	0.96	14.7	14.7	14.8	14.8	14.9	3.65	2.5
Orange South	66/11	20/30	20/30		33	0.97	18.9	18.9	18.9	18.9	18.9	5.66	4.5
Orange West	66/11	30	30		33	0.99	15.2	15.3	15.4	15.5	15.7	5.72	0.5

WINTER	Orange Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Orange Industrial	66/11	15	10		12	1.00	12.8	12.9	13.0	13.1	13.2	5.39	1.5
Orange North	66/11	20/30			0	0.98	16.4	16.6	16.8	17.0	17.3	3.65	5
Orange South	66/11	20/30	20/30		36	0.99	22.3	22.4	22.4	22.4	22.4	5.66	4.5
Orange West	66/11	30	30		36	1.00	16.9	17.1	17.3	17.5	17.7	5.72	4

Sub-transmission Single Line Diagram of Orange area



2.3.28 Molong Supply Area

Description of Molong area

All zone substations in the Molong area are in the Macquarie region.

The Molong 132/66/11kV substation is a shared asset with TransGrid, whereby Essential Energy takes supply at 66kV which supplies Cumnock and Molong via a 66/11kV transformer, with back up supply from the Orange 66kV network via Orange West. Manildra zone substation is also a shared asset with TransGrid and is supplied from TransGrid's Molong substation at 132kV.

MOLONG – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – MDA3B6 Monument	3.3
Feeder – MLO22 East	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
8C1	66	TransGrid Molong 132/66kV STS	Cumnock / Orange West Tee	61	2.0	2.0	2.1	2.1	2.1	68	1.7	1.7	1.8	1.8	1.8
8C1/3	66	Cumnock / Orange West Tee	Cumnock ZS	9	2.0	2.0	2.1	2.1	2.1	15	1.7	1.7	1.8	1.8	1.8
8C1/4	66	Cumnock / Orange West Tee	Orange West ZS	9	0.0	0.0	0.0	0.0	0.0	15	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Molong Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Cumnock	66/11	2.5	2.5		2.75	0.98	2.0	2.0	2.1	2.1	2.1	0.92	2
Manildra	132/11	18/24	18/24		26.4	0.96	10.7	10.8	10.9	11.0	11.2	1.39	6
Molong 11kV	66/11	5/7.5	3/4		4.4	1.00	4.3	4.3	4.4	4.5	4.5	1.41	1

WINTER	Molong Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Cumnock	66/11	2.5	2.5		3	0.98	1.7	1.7	1.8	1.8	1.8	0.92	5
Manildra	132/11	18/24	18/24		28.8	0.98	10.2	10.4	10.6	10.7	10.9	1.39	45
Molong 11kV	66/11	5/7.5	3/4		4.8	1.00	3.6	3.6	3.7	3.7	3.8	1.41	5

A 46.7MW solar generator is located at Manildra on the 11kV network.

Sub-transmission Single Line Diagram of Molong area

Please refer to the Sub-transmission Single Line Diagram of Orange area on Page 84.

2.3.29 Bathurst Supply Area

Description of Bathurst area

All zone substations in the Bathurst area are in the Macquarie region.

The Bathurst area sub-transmission system is supplied from TransGrid's Panorama 132/66kV sub-transmission substation with the Bathurst town substations (Russell St, Raglan and Stewart) being supplied via 66kV ring network.

The Blayney and Mandurama substations are supplied by a radial 66kV line from Panorama with a 66kV back up supply from Orange if required.

BATHURST – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – RAG3B5 O'Connell	3.3
Feeder – BNY3B4 Millthorpe	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
81H	66	TransGrid Panorama 132/66kV STS	Stewart ZS	62	11.0	11.1	11.3	11.5	11.7	69	9.2	9.2	9.2	9.2	9.2
81G	66	TransGrid Panorama 132/66kV STS	Stewart ZS	64	15.7	15.9	16.1	16.5	16.7	71	13.2	13.2	13.2	13.2	13.2
81F	66	TransGrid Panorama 132/66kV STS	Russell St ZS	64	28.9	28.7	28.4	28.2	28.0	71	28.3	28.2	28.1	28.0	27.9
81J	66	Raglan ZS	Russell St ZS	64	5.5	5.5	5.4	5.4	5.4	71	5.4	5.4	5.4	5.3	5.3
81L	66	TransGrid Panorama 132/66kV STS	Raglan ZS	64	17.9	17.7	17.6	17.4	17.3	71	17.5	17.4	17.3	17.3	17.2
81C	66	TransGrid Panorama 132/66kV STS	Blayney ZS	19	12.4	12.3	12.3	12.3	12.3	22	14.7	14.7	14.8	14.8	14.9
66:MAN	66	Blayney ZS	Mandurama ZS	9	2.6	2.5	2.5	2.5	2.5	15	2.7	2.7	2.7	2.8	2.8

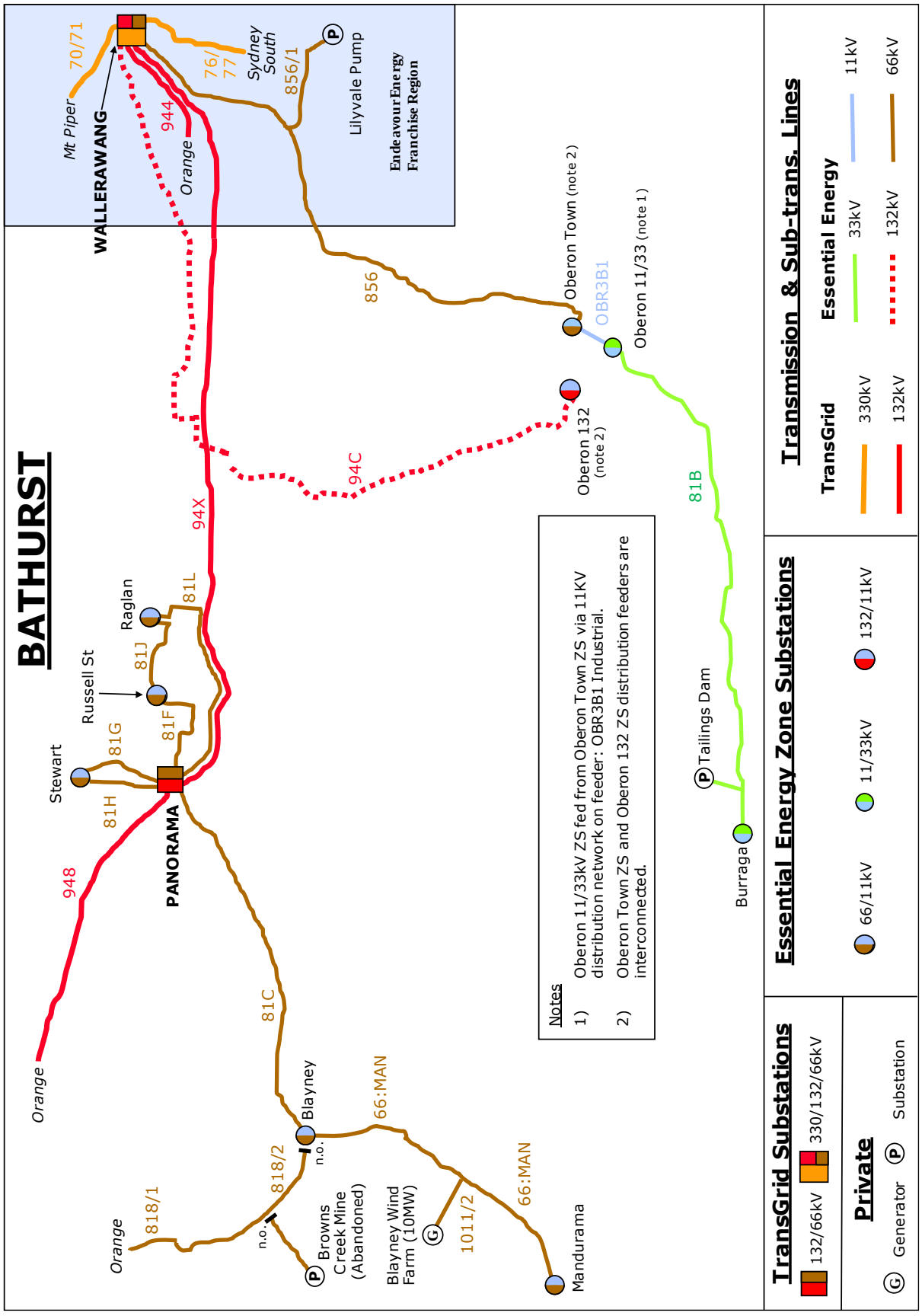
A 10MW wind generator is located at Blayney wind farm and is connected to the TransGrid Panorama 132/66kV sub-transmission substation at 66kV via feeders 66:MAN and 81C.

STS and ZS load forecast

SUMMER	Bathurst Supply Area POE50 Indicative Demand Forecast												
Substation	**kV**	**Transformer Rating (MVA)**			Firm Normal Cyclic Rating (MVA)	Forecast PF	**Forecast (MVA)**					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	**Tx.2**	**Tx.3**			20/21	21/22	22/23	23/24	24/25		
Blayney	66/11	14/20	14/20		22	0.98	9.2	9.2	9.2	9.2	9.2	2.48	7.5
Mandurama	66/11	2.5	3/4		2.75	0.98	2.6	2.5	2.5	2.5	2.5	1.06	0.5
Raglan	66/11	18/30	18/30		33	1.00	23.8	23.8	23.8	23.9	24.0	6.87	2.5
Russell Street	66/11	20/30	15/30	20/30	66	0.95	18.8	18.4	18.0	17.6	17.2	4.32	4.5
Stewart	66/11	15/18/25	15/18/25		27.5	1.00	26.1	26.5	26.9	27.4	27.9	6.81	3

WINTER	Bathurst Supply Area POE50 Indicative Demand Forecast												
Substation	**kV**	**Transformer Rating (MVA)**			Firm Normal Cyclic Rating (MVA)	Forecast PF	**Forecast (MVA)**					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	**Tx.2**	**Tx.3**			2021	2022	2023	2024	2025		
Blayney	66/11	14/20	14/20		24	0.99	11.4	11.4	11.4	11.4	11.4	2.48	3
Mandurama	66/11	2.5	3/4		3	1.00	2.7	2.7	2.7	2.8	2.8	1.06	2
Raglan	66/11	18/30	18/30		36	1.00	19.6	19.5	19.4	19.2	19.1	6.87	6
Russell Street	66/11	20/30	15/30	20/30	72	0.98	22.0	22.0	21.9	21.9	21.8	4.32	14
Stewart	66/11	15/18/25	15/18/25		30	1.00	21.9	21.9	21.9	21.9	21.9	6.81	1.5

Sub-transmission Single Line Diagram of Bathurst area



2.3.30 Oberon Supply Area

Description of Oberon area

All zone substations in the Oberon area are in the Macquarie region.

The zone substations at Oberon are supplied directly from Wallerawang via Essential Energy's 66kV and 132kV sub-transmission lines respectively.

OBERON – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
94C	132	TransGrid Wallerawang 330/132/66kV STS	Oberon 132 ZS	128	27.1	27.4	27.7	27.9	28.2	143	28.1	28.1	28.0	28.0	27.9
856	66	TransGrid Wallerawang 330/132/66kV STS	Oberon Town ZS	28	4.8	4.8	4.8	4.8	4.9	32	7.0	7.1	7.2	7.2	7.3
81B	33	Oberon Town ZS	Burraga ZS	8	0.4	0.4	0.4	0.4	0.4	13	0.5	0.5	0.5	0.5	0.5

STS and ZS load forecast

SUMMER	Oberon Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Burraga	33/11	2.5			0	0.85	0.4	0.4	0.4	0.4	0.4	0.00	3
Oberon 132kV	132/11	25/45	25/45		49.5	0.88	27.1	27.4	27.7	27.9	28.2	0.00	9.5
Oberon Town	66/11	10/15	10/15		16.5	0.98	4.3	4.3	4.3	4.3	4.4	2.13	5

WINTER	Oberon Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Burraga	33/11	2.5			0	0.88	0.5	0.5	0.5	0.5	0.5	0.00	1
Oberon 132kV	132/11	25/45	25/45		54	0.88	28.1	28.1	28.0	28.0	27.9	0.00	11
Oberon Town	66/11	10/15	10/15		18	0.99	6.4	6.5	6.6	6.6	6.7	2.13	1.5

Sub-transmission Single Line Diagram of Oberon area

Please refer to the Sub-transmission Single Line Diagram of Bathurst area on Page 88.

2.3.31 Parkes Supply Area

Description of Parkes area

All zone substations in the Parkes area are in the Central region.

The Parkes area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation via a 66kV 89L/89G ring to the Parkes Town zone substation with a feed to Peak Hill and Tomingley Mine Substations.

PARKES – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

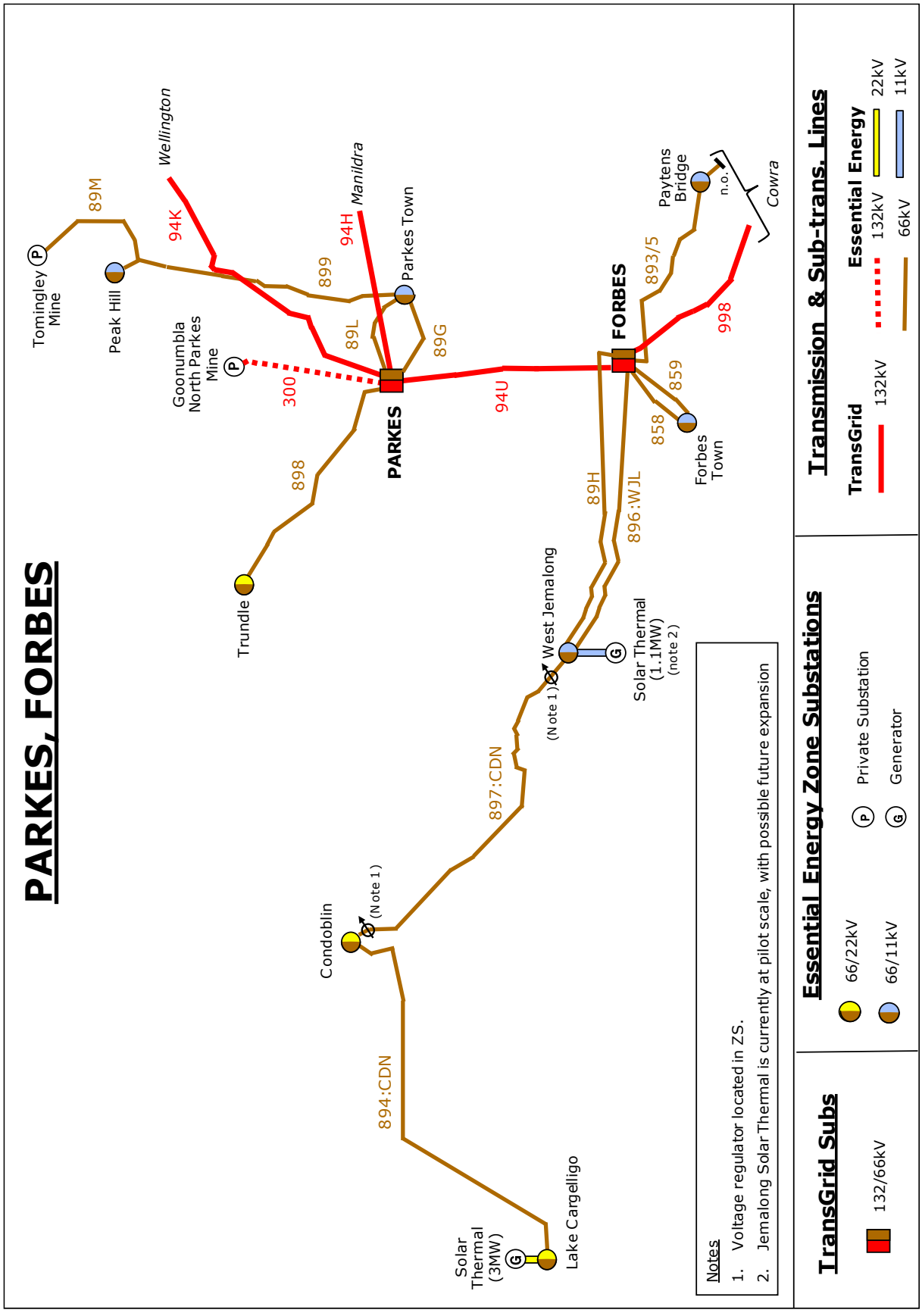
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
300	132	TransGrid Parkes 132/66kV STS	North Parkes Mine ZS	87	53.1	53.1	53.1	53.2	53.2	108	54.2	54.8	55.2	55.8	56.3
898	66	TransGrid Parkes 132/66kV STS	Trundle ZS	11	3.5	3.5	3.5	3.5	3.5	17	2.5	2.5	2.5	2.6	2.6
899	66	Parkes Town ZS	Peak Hill ZS	13	9.1	9.1	9.1	9.1	9.1	20	9.0	9.0	9.0	9.0	9.0
89G	66	TransGrid Parkes 132/66kV STS	Parkes Town ZS	68	17.3	17.4	17.5	17.7	17.8	76	14.3	14.4	14.4	14.5	14.6
89L	66	TransGrid Parkes 132/66kV STS	Parkes Town ZS	38	13.0	13.1	13.2	13.3	13.4	43	10.8	10.8	10.9	11.0	11.0
89M	66	Peak Hill ZS	Tomingley Mine ZS	17	7.5	7.5	7.5	7.5	7.5	28	7.7	7.7	7.7	7.7	7.7

STS and ZS load forecast

SUMMER	Parkes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Parkes Town	66/11	30	30		33	0.97	20.9	21.1	21.3	21.5	21.8	7.50	7
Peak Hill	66/11	5	5		5.5	0.98	1.9	1.9	1.9	1.9	1.9	1.06	9
Trundle	66/22	5	5		5.5	0.99	3.5	3.5	3.5	3.5	3.5	1.52	4

WINTER	Parkes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Parkes Town	66/11	30	30		36	1.00	15.7	15.8	16.0	16.2	16.3	7.50	7
Peak Hill	66/11	5	5		6	1.00	1.7	1.7	1.7	1.6	1.6	1.06	3.5
Trundle	66/22	5	5		6	0.99	2.5	2.5	2.5	2.6	2.6	1.52	8

Sub-transmission Single Line Diagram of Parkes area



2.3.32 Forbes Supply Area

Description of Forbes area

Zone substations in the Forbes area are spread across both the Riverina Slopes and Central regions.

The Forbes area sub-transmission system is supplied from TransGrid's Forbes 132/66kV sub-transmission substation.

FORBES – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – PYB3B1 Eugowra	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
858	66	TransGrid Forbes 132/66kV STS	Forbes Town ZS	28	15.1	15.0	15.0	15.0	14.9	34	11.3	11.3	11.4	11.4	11.4
859	66	TransGrid Forbes 132/66kV STS	Forbes Town ZS	28	0.0	0.0	0.0	0.0	0.0	34	0.0	0.0	0.0	0.0	0.0
893/5	66	TransGrid Forbes 132/66kV STS	Payten's Bridge ZS	12	4.9	4.9	4.9	4.9	5.0	18	3.0	3.0	3.0	3.0	3.0
894:CDN	66	Condobolin ZS	Lake Cargelligo ZS	15	4.1	4.1	4.1	4.1	4.1	25	3.5	3.5	3.5	3.5	3.5
896:WJL	66	TransGrid Forbes 132/66kV STS	West Jemalong ZS	20	5.7	5.7	5.7	5.7	5.7	24	4.8	4.8	4.8	4.8	4.8
897:CDN	66	West Jemalong ZS	Condobolin ZS	20	13.0	13.0	13.0	13.1	13.0	24	11.8	11.7	11.7	11.7	11.7
89H	66	TransGrid Forbes 132/66kV STS	West Jemalong ZS	43	10.4	10.4	10.4	10.4	10.4	54	8.7	8.7	8.6	8.6	8.6

STS and ZS load forecast

SUMMER	Forbes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Condobolin	66/22	16	10		11	1.00	7.8	7.8	7.8	7.8	7.7	3.09	6.5
Forbes Town	66/11	18/30	15/30		33	0.98	15.1	15.0	15.0	15.0	14.9	4.69	6.5
Lake Cargelligo	66/22	8	5		5.5	0.98	4.1	4.1	4.1	4.1	4.1	1.99	4
Paytens Bridge	66/11	5	5/6.25		5.5	0.94	4.9	4.9	4.9	4.9	5.0	0.78	3.5
West Jemalong	66/11	3/4	3/4		4.4	0.95	2.7	2.7	2.8	2.9	2.9	0.28	21

WINTER	Forbes Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Condobolin	66/22	16	10		12	0.99	6.2	6.2	6.2	6.2	6.2	3.09	2
Forbes Town	66/11	18/30	15/30		36	0.99	11.3	11.3	11.4	11.4	11.4	4.69	2.5
Lake Cargelligo	66/22	8	5		6	0.88	3.5	3.5	3.5	3.5	3.5	1.99	4
Paytens Bridge	66/11	5	5/6.25		6	0.94	3.0	3.0	3.0	3.0	3.0	0.78	1
West Jemalong	66/11	3/4	3/4		4.8	0.97	1.8	1.9	1.9	1.9	2.0	0.28	2.5

A 3MW solar thermal generator is located at Lake Cargelligo on the 22kV network, and a 1.1MW solar thermal generator is located at West Jemalong on the 11kV network.

Sub-transmission Single Line Diagram of Forbes area

Please refer to the Sub-transmission Single Line Diagram of Parkes area on Page 91.

2.3.33 Moruya North Supply Area

Description of Moruya North area

All zone substations in the Moruya North area are in the South Eastern region.

Essential Energy's Moruya North sub-transmission substation is supplied via 2 x 132kV transmission lines from Endeavour Energy's 132kV transmission system that emanate from the Evans Lane switching station near Ulladulla. Essential Energy partly owns with Endeavour Energy both 132kV transmission lines from Evans Lane switching station.

MORUYA NORTH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

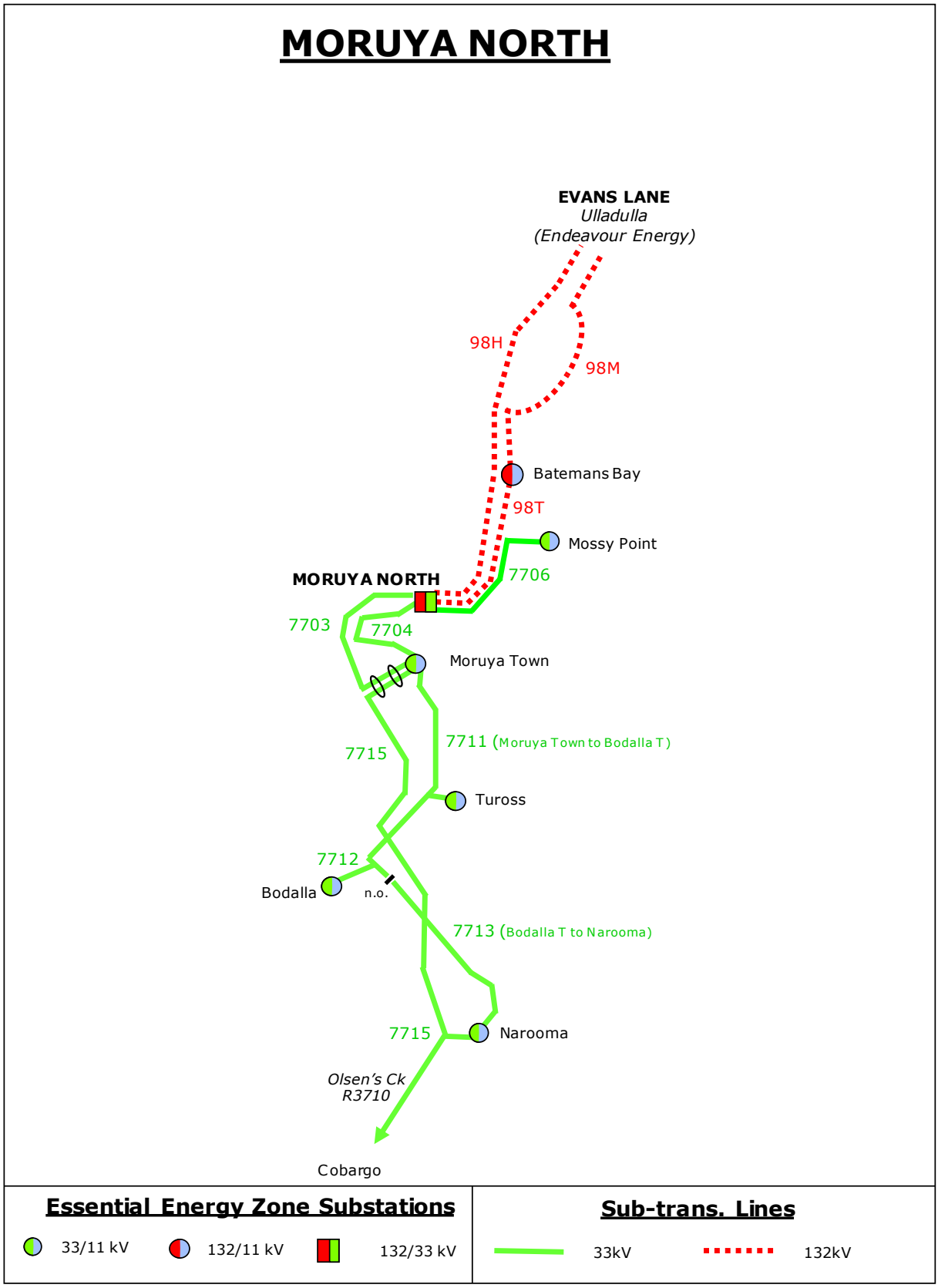
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
98H	132	Endeavour Energy Evans Lane Sw Stn	Moruya North 132/33kV STS	180	17.1	17.1	17.2	17.2	17.3	202	26.4	26.9	27.4	27.9	28.3
98M	132	Endeavour Energy Evans Lane Sw Stn	Batemans Bay ZS	50	21.5	21.5	21.6	21.7	21.8	62	33.0	33.7	34.3	34.8	35.4
98T	132	Batemans Bay ZS	Moruya North 132/33kV STS	61	3.9	3.9	3.9	3.9	3.9	70	6.6	6.7	6.8	6.9	7.0
7703	33	Moruya North 132/33kV STS	Moruya Town ZS	30	6.5	6.5	6.5	6.5	6.5	34	10.2	10.4	10.6	10.7	10.9
7704	33	Moruya North 132/33kV STS	Moruya Town ZS	26	8.2	8.2	8.3	8.3	8.3	30	12.9	13.2	13.4	13.6	13.9
7706	33	Moruya North 132/33kV STS	Mossy Point ZS	25	5.6	5.6	5.6	5.6	5.7	28	8.8	8.9	9.1	9.3	9.4
7712	33	Bodalla Tee	Bodalla ZS	10	1.1	1.1	1.2	1.2	1.2	19	1.7	1.8	1.8	1.8	1.9
7713	33	Bodalla Tee	Narooma ZS	21	0.0	0.0	0.0	0.0	0.0	27	0.0	0.0	0.0	0.0	0.0
7817	33	Narooma Tee	Cobargo ZS	10	0.0	0.0	0.0	0.0	0.0	19	0.0	0.0	0.0	0.0	0.0
7711/1	33	Moruya Town ZS	Tuross Tee	17	2.8	2.8	2.8	2.8	2.8	19	5.0	5.1	5.2	5.3	5.4
7711/2	33	Tuross Tee	Tuross ZS	7	1.7	1.7	1.7	1.7	1.7	12	3.2	3.3	3.4	3.4	3.5
7711/3	33	Tuross Tee	Bodalla Tee	21	1.1	1.1	1.1	1.1	1.1	27	1.7	1.7	1.8	1.8	1.8
7715/1	33	Moruya Town ZS	Narooma Tee	30	5.5	5.5	5.5	5.6	5.6	34	9.3	9.5	9.6	9.8	10.0
7715/2	33	Narooma Tee	Narooma ZS	10	5.2	5.2	5.2	5.3	5.3	19	8.8	8.9	9.1	9.2	9.4

STS and ZS load forecast

SUMMER	Moruya North Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Batemans Bay	132/11	30/45	30/45		49.5	1.00	19.7	19.6	19.5	19.5	19.4	6.88	3
Bodalla	33/11	3/4	3		3.3	0.97	1.2	1.2	1.2	1.2	1.2	0.72	0.5
Moruya North	132/33	40	30/45		44	0.98	19.7	19.6	19.5	19.5	19.5	0.00	3
Moruya Town	33/11	16	16		17.6	0.97	6.1	6.1	6.1	6.2	6.2	3.20	1.5
Mossy Point	33/11	12.5	12.5		13.75	0.99	5.7	5.8	5.8	5.9	5.9	3.13	1
Narooma	33/11	10/16	10/12.5		13.75	0.98	5.2	5.2	5.2	5.2	5.2	2.99	3
Tuross	33/11	5/8			0	0.98	2.1	2.1	2.1	2.1	2.1	1.34	2

WINTER	Moruya North Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Batemans Bay	132/11	30/45	30/45		54	1.00	20.9	21.3	21.6	21.9	22.2	6.88	8
Bodalla	33/11	3/4	3		3.6	0.99	1.4	1.4	1.4	1.4	1.4	0.72	1
Moruya North	132/33	40	30/45		48	1.00	31.0	31.7	32.4	33.0	33.7	0.00	2.5
Moruya Town	33/11	16	16		19.2	1.00	7.1	7.2	7.2	7.3	7.3	3.20	16
Mossy Point	33/11	12.5	12.5		15	1.00	9.5	9.8	10.1	10.4	10.7	3.13	2.5
Narooma	33/11	10/16	10/12.5		15	1.00	7.8	7.9	8.1	8.2	8.3	2.99	1.5
Tuross	33/11	5/8			0	1.00	2.8	2.9	2.9	3.0	3.1	1.34	3.5

Sub-transmission Single Line Diagram of Moruya North area



2.3.34 Cooma Supply Area

Description of Cooma area

All zone substations in the Cooma area are in the South Eastern region.

The Cooma area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation at Cooma.

COOMA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
974	132	TransGrid Cooma 132/66kV STS	Bega 132/66kV STS	128	15.6	15.5	15.5	15.5	15.5	143	23.2	23.6	24.0	24.4	24.6
97R	132	TransGrid Cooma 132/66kV STS	Steeple Flat 132/66kV STS	140	81.5	81.8	81.5	81.7	81.9	157	70.8	70.3	69.9	69.1	69.2
82D	66	TransGrid Cooma 132/66kV STS	Jindabyne East ZS	20	9.8	9.8	9.8	9.8	9.8	39	20.5	20.6	20.6	20.5	20.6
84J	66	TransGrid Cooma 132/66kV STS	Cooma 66/11kV ZS	70	5.4	5.4	5.5	5.5	5.5	78	6.6	6.6	6.6	6.7	6.7
84L	66	TransGrid Cooma 132/66kV STS	Cooma 66/11kV ZS	64	5.4	5.4	5.5	5.5	5.5	71	6.6	6.6	6.6	6.7	6.7
82J/1	66	Snowy Adit 132/66/11kV ZS	Snowy Lookout Sw Stn	12	0.0	0.0	0.0	0.0	0.0	20	0.0	0.0	0.0	0.0	0.0
82J/2	66	Jindabyne ZS	Snowy Lookout Sw Stn	12	0.0	0.0	0.0	0.0	0.0	19	0.0	0.0	0.0	0.0	0.0
82R	66	Jindabyne East ZS	Jindabyne ZS	20	4.5	4.5	4.5	4.4	4.4	39	15.0	15.0	15.0	15.0	15.0
888/1	66	TransGrid Cooma 132/66kV STS	Rhine Falls Sw Stn	16	3.9	3.9	3.9	3.9	3.9	25	4.6	4.6	4.6	4.6	4.6
888/3	66	Rhine Falls Sw Stn	Adaminaby ZS	16	3.6	3.6	3.6	3.6	3.6	25	4.4	4.4	4.4	4.4	4.4
888/4	66	Rhine Falls Sw Stn	Eucumbene Tee	15	0.5	0.5	0.5	0.5	0.5	25	0.4	0.4	0.4	0.4	0.4
888/6	66	Eucumbene Tee	Eucumbene ZS	15	0.3	0.3	0.3	0.3	0.3	25	0.3	0.3	0.3	0.3	0.3
888/7	66	Eucumbene Tee	Snowy Adit 132/66/11kV ZS	20	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0
849/1	33	Adaminaby ZS	Providence Portal ZS	7	1.8	1.8	1.8	1.8	1.8	12	2.7	2.7	2.7	2.7	2.7
849/2	33	Providence Portal ZS	Mt Selwyn Tee	7	1.1	1.1	1.1	1.1	1.1	12	1.9	1.9	1.9	1.9	1.9
849/3	33	Mt Selwyn Tee	Cabramurra ZS	8	1.1	1.1	1.1	1.1	1.1	12	1.7	1.7	1.7	1.7	1.7

A 5MW hydro generator is located at Brown Mountain Hydro and is connected to Steeple Flat 132/66kV sub-transmission substation at 66kV via feeder 810.

A 114MW wind generator is located at Boco Rock wind farm and is connected to the Steeple Flat 132/66kV sub-transmission substation which is connected to TransGrid's Cooma 132/66kV sub-transmission substation at 132kV via the feeder 97R.

A 1MW hydro generator is located at Jindabyne Dam and is connected to the Jindabyne zone substation 11kV busbar via feeder JIN22.

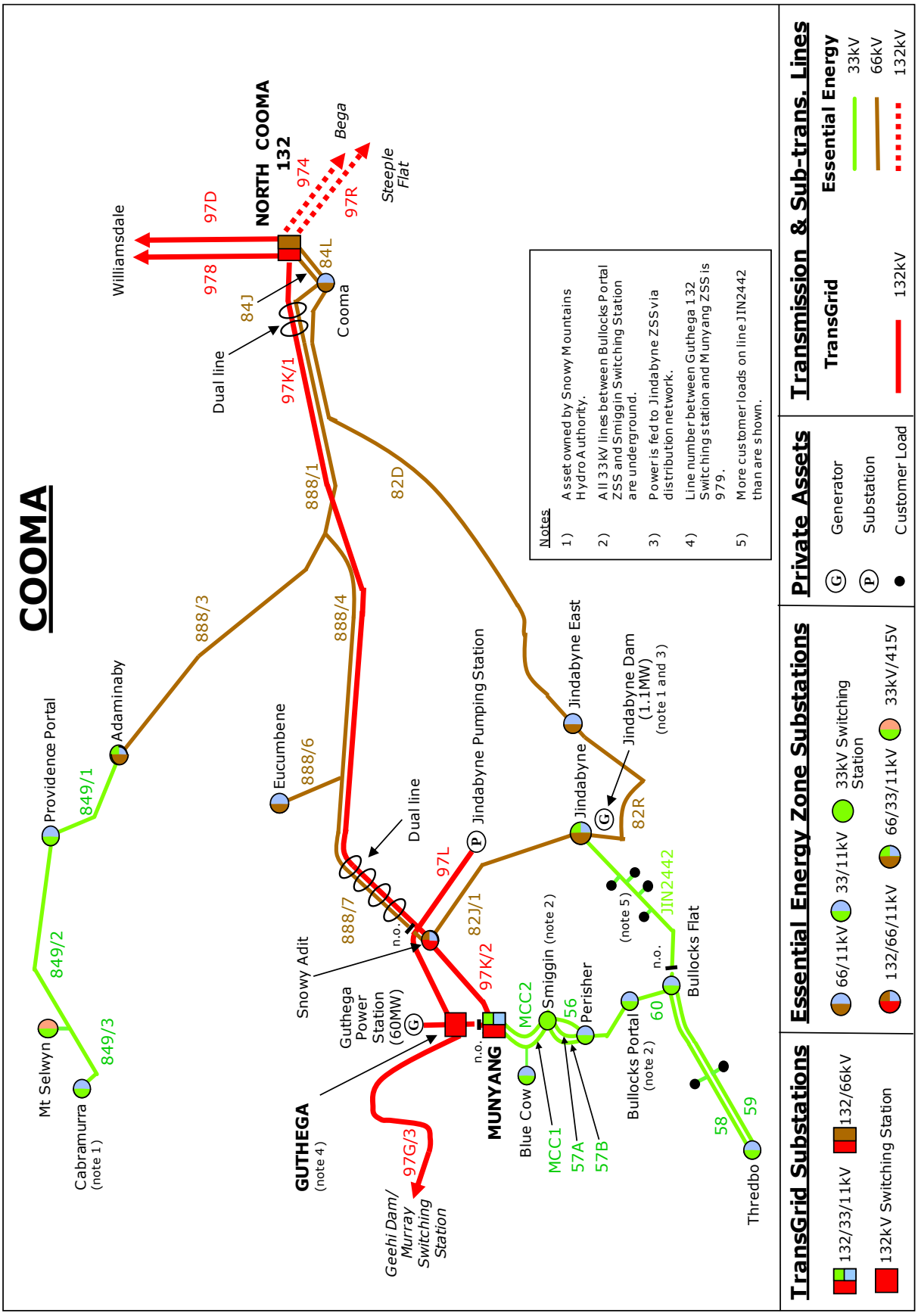
STS and ZS load forecast

SUMMER	Cooma Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Adaminaby 11kV	66/33/11	8/10		5	5.5	0.98	0.7	0.7	0.7	0.7	0.7	0.35	6
Adaminaby 33kV	66/33/11		5		5.5	1.00	1.5	1.5	1.6	1.6	1.7	0.00	2.5
Cooma 66/11kV	66/11	15/20	15/20		22	0.96	10.8	10.9	10.9	11.0	11.1	4.15	2.5
Eucumbene	66/11	0.6			0	0.95	0.1	0.1	0.1	0.1	0.1	0.05	1
Jindabyne 11kV	66/33/11	15/30	15/30		33	0.98	4.0	4.1	4.1	4.1	4.2	1.69	6
Jindabyne 33kV	66/33/11	15			0	0.92	0.3	0.3	0.3	0.3	0.3	0.09	0.5
Jindabyne East	66/11	8/10	8/10		11	0.99	1.9	1.9	2.0	2.0	2.0	1.09	1.5
Providence Portal	33/11	0.5			0	0.82	0.2	0.2	0.2	0.2	0.2	0.00	1

WINTER	Cooma Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Adaminaby 11kV	66/33/11	8/10		5	6	0.99	1.2	1.2	1.2	1.2	1.1	0.35	1.5
Adaminaby 33kV	66/33/11		5		6	1.00	2.3	2.3	2.3	2.3	2.3	0.00	14.5
Cooma 66/11kV	66/11	15/20	15/20		24	0.99	13.2	13.2	13.3	13.3	13.3	4.15	6
Eucumbene	66/11	0.6			0	0.95	0.2	0.2	0.2	0.2	0.2	0.05	0.5
Jindabyne 11kV	66/33/11	15/30	15/30		36	0.99	10.4	10.3	10.3	10.3	10.2	1.69	5.5
Jindabyne 33kV	66/33/11	15			0	1.00	0.7	0.7	0.7	0.7	0.7	0.09	2
Jindabyne East	66/11	8/10	8/10		12	0.99	4.2	4.3	4.3	4.3	4.3	1.09	2
Providence Portal	33/11	0.5			0	0.88	0.1	0.1	0.1	0.1	0.1	0.00	2.5

The recent bushfires affected the supply of Cabramurra and Selwyn from Adaminaby 33kV. The forecasts have been calculated with this supply restored, but this will be dependent on the restoration option selected, outlined in 4.3 Urgent and Unforeseen Investments.

Sub-transmission Single Line Diagram of Cooma area



2.3.35 Munyang Supply Area

Description of Munyang area

All zone substations in the Munyang area are in the South Eastern region.

The Munyang area sub-transmission system is supplied from TransGrid's sub-transmission substation at Munyang. The majority of the Snowy Mountains winter ski resorts are supplied from the Munyang sub-transmission substation.

Essential Energy takes supply at 11kV from Snowy Mountains Hydro at the Murray transmission substation to supply the Khancoban township.

MUNYANG – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
56	33	Smiggin Sw Stn	Perisher ZS	20	2.2	2.2	2.2	2.2	2.2	23	18.0	18.0	18.0	18.0	18.1
57A	33	Smiggin Sw Stn	Perisher ZS	20	0.8	0.8	0.8	0.8	0.8	23	8.0	8.1	8.0	8.2	8.2
57B	33	Smiggin Sw Stn	Perisher ZS	20	0.5	0.5	0.5	0.5	0.5	23	5.4	5.4	5.4	5.5	5.5
No.1 Perisher	33	TransGrid Munyang 132/33kV STS	Smiggin Sw Stn	38	2.2	2.2	2.2	2.2	2.2	41	18.0	18.0	18.0	18.0	18.1
No.2 Perisher	33	TransGrid Munyang 132/33kV STS	Blue Cow Tee	38	1.5	1.5	1.5	1.5	1.5	49	18.8	18.8	18.8	19.1	19.1
No.2 Perisher	33	Blue Cow Tee	Smiggin Sw Stn	38	1.3	1.3	1.3	1.3	1.3	49	13.4	13.4	13.4	13.7	13.7
60/2	33	Bullocks Portal ZS	Bullocks Flat ZS	19	1.9	1.9	2.0	2.0	2.0	23	18.0	18.0	18.0	18.0	18.1
58	33	Bullocks Flat ZS	Thredbo ZS	6	0.5	0.5	0.5	0.5	0.5	14	10.0	10.0	10.0	10.0	10.0
59	33	Bullocks Flat ZS	Thredbo ZS	6	1.4	1.4	1.4	1.4	1.4	14	8.2	8.2	8.2	8.2	8.2
Bullocks Portal Line	33	Perisher ZS	Bullocks Portal ZS	20	2.2	2.2	2.2	2.2	2.2	23	18.0	18.0	18.0	18.0	18.1

STS and ZS load forecast

SUMMER	Munyang Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Blue Cow	33/11	5/8			0	0.83	0.2	0.2	0.2	0.2	0.2	0.00	889.5
Bullocks Flat	33/11	5/6.25			0	1.00	0.3	0.3	0.3	0.3	0.3	0.05	3
Bullocks Portal	33/11	5/6.25			0	1.00	0.5	0.5	0.5	0.5	0.5	0.00	0.5
Perisher	33/11	8/10	8/10		11	0.95	1.3	1.3	1.3	1.3	1.3	0.05	2
Snowy Adit 11kV	132/66/11		10		0	0.90	0.0	0.0	0.0	0.0	0.0	0.00	83
Snowy Adit 66kV	132/66/11	30			0	0.99	3.2	3.2	3.2	3.2	3.2	0.00	7.5
Thredbo	33/11	10/16	10/16		17.6	0.99	2.0	2.0	2.0	2.0	2.0	0.02	2.5

WINTER	Munyang Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Blue Cow	33/11	5/8			0	0.86	5.4	5.4	5.4	5.4	5.4	0.00	1
Bullocks Flat	33/11	5/6.25			0	1.00	1.0	1.0	1.0	1.1	1.1	0.05	10
Bullocks Portal	33/11	5/6.25			0	1.00	0.6	0.6	0.6	0.6	0.6	0.00	0.5
Perisher	33/11	8/10	8/10		12	0.95	13.4	13.4	13.4	13.7	13.7	0.05	3
Snowy Adit 11kV	132/66/11		10		0	0.89	0.0	0.0	0.0	0.0	0.0	0.00	0.5
Snowy Adit 66kV	132/66/11	30			0	0.99	6.9	6.9	6.9	6.9	6.9	0.00	5
Thredbo	33/11	10/16	10/16		19.2	0.97	16.4	16.3	16.4	16.3	16.4	0.02	19.5

Sub-transmission Single Line Diagram of Munyang area

Please refer to the Sub-transmission Single Line Diagram of Cooma area on Page 99.

2.3.36 Bega Supply Area

Description of Bega area

All zone substations in the Bega area are in the South Eastern region.

Essential Energy's Bega sub-transmission substation is supplied from TransGrid's Cooma 132/66kV sub-transmission substation via two Essential Energy 132kV transmission lines.

BEGA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

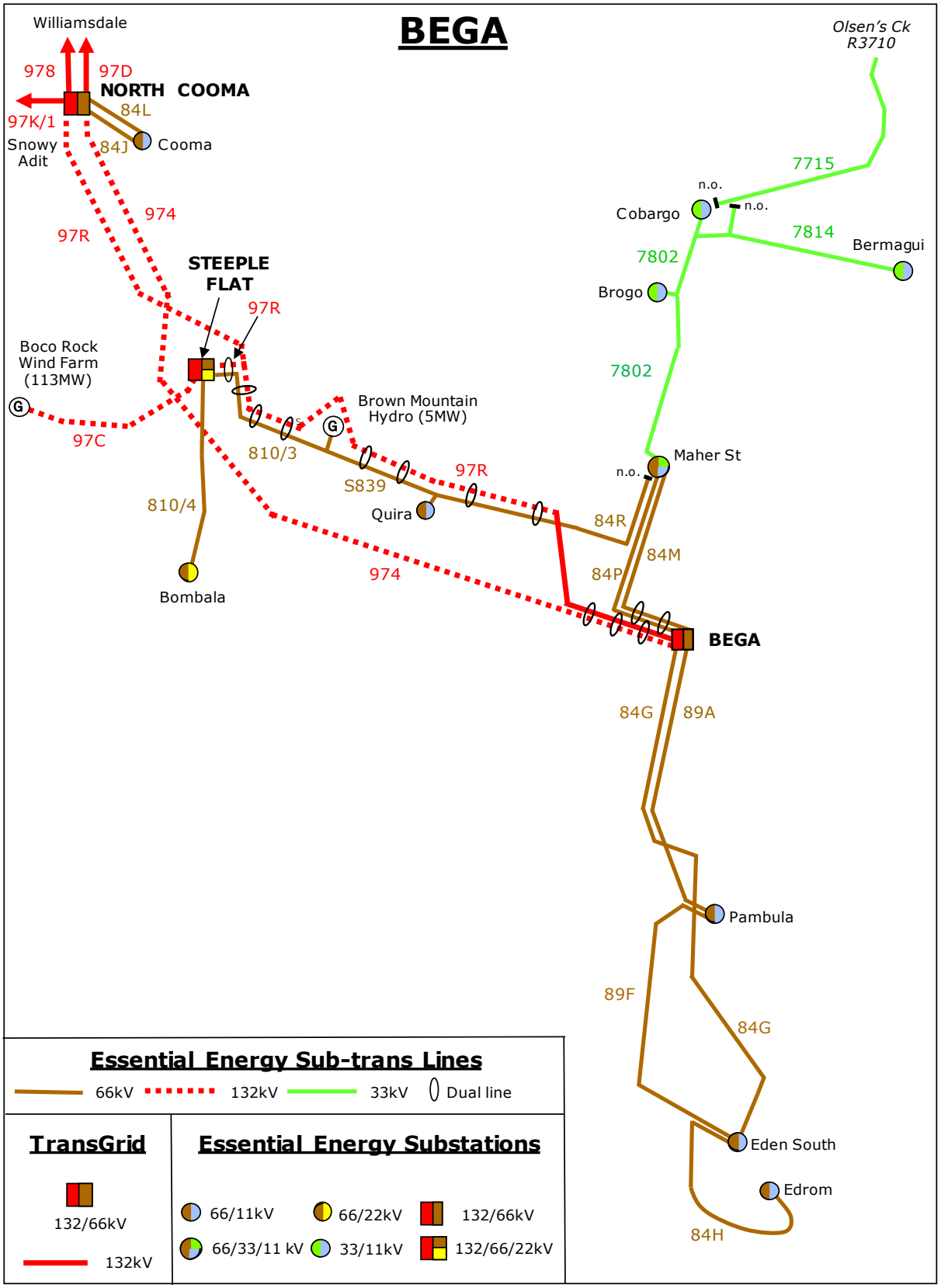
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
84G	66	Bega 132/66kV STS	Eden South ZS	61	6.0	5.9	5.9	5.9	5.9	68	9.7	9.9	10.1	10.2	10.3
84H	66	Eden South ZS	Edrom ZS	38	2.4	2.5	2.5	2.5	2.6	43	2.0	2.0	2.1	2.1	2.1
84M	66	Bega 132/66kV STS	Maher St ZS	61	9.2	9.2	9.3	9.3	9.3	68	11.0	11.1	11.3	11.4	11.5
89A	66	Bega 132/66	Pambula ZS	38	9.1	9.1	9.1	9.1	9.1	43	15.2	15.4	15.7	16.0	16.1
84P	66	Bega 132/66kV STS	Maher St ZS	38	9.2	9.2	9.3	9.3	9.3	43	11.0	11.1	11.3	11.4	11.5
89F	66	Pambula ZS	Eden South ZS	16	1.0	1.0	1.0	1.0	1.0	26	1.9	1.9	1.9	2.0	2.0
7802/1	33	Maher St ZS	Brogo ZS	12	3.5	3.5	3.5	3.5	3.5	24	5.6	5.7	5.8	5.9	6.0
7802/2	33	Brogo ZS	Cobargo ZS	10	3.0	3.0	3.0	3.0	3.0	19	4.6	4.7	4.8	4.9	4.9
84R	33	Maher St ZS	Quira ZS	6	0.0	0.0	0.0	0.0	0.0	9	0.0	0.0	0.0	0.0	0.0
7814	33	Cobargo ZS	Bermagui ZS	5	2.6	2.6	2.6	2.6	2.6	9	3.5	3.5	3.6	3.7	3.7

STS and ZS load forecast

SUMMER	Bega Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bega 132kV	132/66	35/60	35/60		66	1.00	32.6	32.6	32.6	32.6	32.6	0.00	2.5
Bermagui	33/11	5	5		5.5	0.99	2.6	2.6	2.6	2.6	2.6	1.54	1.5
Brogo	33/11	3			0	0.96	0.8	0.8	0.8	0.8	0.9	0.31	5
Cobargo	33/11	3	2.5		2.75	0.97	1.2	1.2	1.2	1.2	1.2	1.10	0.5
Eden South	66/11	10/16	10/16		17.6	0.97	4.1	4.1	4.1	4.1	4.1	1.77	1.5
Edrom	66/11	5	5		5.5	0.86	2.4	2.5	2.5	2.5	2.6	0.00	2.5
Maher Street 66/33kV	66/33	8			0	0.96	4.6	4.7	4.7	4.7	4.8	0.00	2
Maher Street 66/11kV	66/11	24/30	24/30		33	1.00	13.3	13.3	13.3	13.3	13.3	5.17	2.5
Pambula	66/11	10/13/16	10/13/16		17.6	0.99	11.2	11.2	11.2	11.2	11.1	6.08	2
Quira	66/11	5			0	0.96	1.3	1.3	1.3	1.2	1.2	0.51	4

WINTER	Bega Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bega 132kV	132/66	35/60	35/60		72	0.99	42.9	43.2	43.5	43.8	44.1	0.00	3.5
Bermagui	33/11	5	5		6	1.00	3.5	3.5	3.6	3.7	3.7	1.54	1
Brogo	33/11	3			0	0.99	0.9	1.0	1.0	1.1	1.1	0.31	0.5
Cobargo	33/11	3	2.5		3	0.99	1.5	1.5	1.5	1.5	1.5	1.10	5
Eden South	66/11	10/16	10/16		19.2	0.99	5.1	5.1	5.2	5.2	5.3	1.77	6.5
Edrom	66/11	5	5		6	0.87	2.0	2.0	2.1	2.1	2.1	0.00	1.5
Maher Street 66/33kV	66/33	8			0	1.00	5.9	6.0	6.1	6.2	6.4	0.00	7.5
Maher Street 66/11kV	66/11	24/30	24/30		36	0.97	15.7	15.8	15.9	16.0	16.1	5.17	3
Pambula	66/11	10/13/16	10/13/16		19.2	1.00	16.3	16.3	16.4	16.6	16.6	6.08	11
Quira	66/11	5			0	0.97	1.6	1.6	1.7	1.7	1.7	0.51	1.5

Sub-transmission Single Line Diagram of Bega area



2.3.37 Steeple Flat Supply Area

Description of Steeple Flat area

All zone substations in the Steeple Flat area are in the South Eastern region.

The Steeple Flat 132/66/22kV substation is owned by Essential Energy. It receives supply via a tee off the Essential Energy 97R Cooma to Bega 132kV line. The 132/66/11kV transformer provides supply for the 66kV network to Bombala 66/22kV zone substation and connection for the Brown Mountain Generation. An 11/22kV transformer at Steeple Flat provides 22kV supply for local distribution load. Steeple Flat also provides connection for the Boco Rock wind farm to the 132kV network.

STEEPLE FLAT – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
97C	132	Steeple Flat 132/66kV STS	Boco Rock Wind Farm	140	111.3	111.6	111.3	111.4	111.7	157	110.3	110.3	110.5	110.2	110.5
97R	132	Steeple Flat 132/66kV STS	Bega 132/66kV STS	140	16.0	16.0	16.0	16.0	16.0	157	24.1	24.5	25.0	25.4	25.6
810/3	66	Steeple Flat 132/66kV STS	Brown Mountain Hydro	70	4.3	4.3	4.3	4.2	4.2	78	4.1	4.1	4.1	4.1	4.1
810/4	66	Steeple Flat 132/66kV STS	Bombala ZS	21	4.0	4.1	4.1	4.2	4.2	25	4.9	4.9	5.0	5.0	5.0
S839	66	Brown Mountain Hydro	Quira ZS	70	1.3	1.3	1.3	1.2	1.2	78	1.6	1.6	1.7	1.7	1.7

STS and ZS load forecast

SUMMER	Steeple Flat Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bombala	66/22	10/16	10/13		14.3	1.00	4.0	4.1	4.1	4.2	4.2	0.76	4.5
Steeple Flat 132/66kV	132/66	30			0	0.98	4.8	4.8	4.8	4.8	4.8	0.00	6
Steeple Flat 22kV	11/22	5			0	0.94	0.6	0.6	0.7	0.7	0.7	0.29	3

WINTER	Steeple Flat Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bombala	66/22	10/16	10/13		15.6	1.00	4.9	4.9	5.0	5.0	5.0	0.76	15.5
Steeple Flat 132/66kV	132/66	30			0	0.98	5.7	5.7	5.7	5.7	5.7	0.00	8.5
Steeple Flat 22kV	11/22	5			0	0.98	0.8	0.8	0.8	0.8	0.9	0.29	6.5

Sub-transmission Single Line Diagram of Steeple Flat area

Please refer to the Sub-transmission Single Line Diagram of Bega area on Page 104.

2.3.38 Tumut Supply Area

Description of Tumut area

All zone substations in the Tumut area are in the Riverina Slopes region.

The Tumut area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation.

TUMUT – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
827	66	TransGrid Tumut 132/66kV STS	Tumut ZS	28	16.0	16.0	16.1	16.0	16.0	34	16.5	16.5	16.6	16.5	16.5
828	66	TransGrid Tumut 132/66kV STS	Gundagai South ZS	11	6.9	6.9	6.9	6.9	6.9	19	6.1	6.1	6.1	6.1	6.1
829	66	TransGrid Tumut 132/66kV STS	Tumut ZS	28	0.0	0.0	0.0	0.0	0.0	34	0.0	0.0	0.0	0.0	0.0
831	66	Gundagai South ZS	Nangus ZS	11	1.2	1.2	1.2	1.2	1.2	19	0.6	0.6	0.6	0.6	0.6
848	66	Adelong Tee	Adelong ZS	12	1.5	1.5	1.6	1.5	1.5	19	1.5	1.5	1.5	1.5	1.5
830/2:GUN	66	Gundagai South ZS	Parsons Creek ZS	11	0.3	0.3	0.3	0.3	0.3	19	0.3	0.3	0.3	0.3	0.3
848/1	66	Adelong Tee	Batlow ZS	21	9.3	9.3	9.3	9.3	9.3	25	11.2	11.2	11.2	11.2	11.2
848/2	66	Batlow ZS	Tumbarumba ZS	22	7.4	7.4	7.4	7.4	7.4	26	8.8	8.8	8.8	8.8	8.8
848/3	66	TransGrid Tumut 132/66kV STS	Adelong Tee	21	10.8	10.8	10.8	10.8	10.8	25	12.7	12.7	12.7	12.7	12.7
850:TAL	66	TransGrid Tumut 132/66kV STS	Talbingo ZS	18	1.3	1.3	1.3	1.3	1.3	22	1.5	1.5	1.5	1.5	1.5

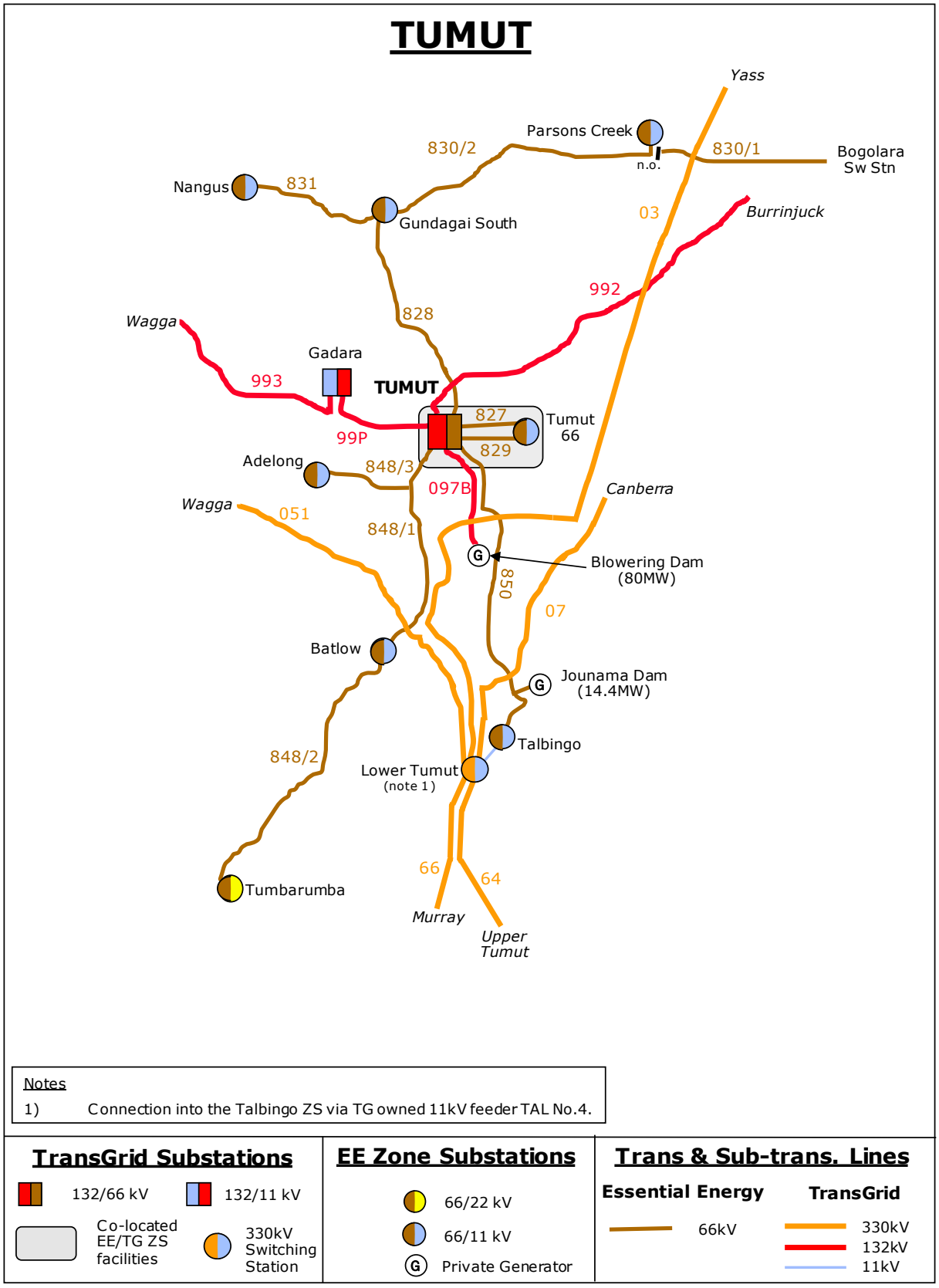
A 15MW hydro generator is located at Jounama Dam and is connected to the TransGrid Tumut 132/66kV sub-transmission substation at 66kV via feeder 850:TAL.

STS and ZS load forecast

SUMMER	Tumut Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Adelong	66/11	3	2.5		2.75	0.99	1.8	1.8	1.8	1.8	1.7	0.87	4.5
Batlow	66/11	5	5		5.5	0.96	1.7	1.8	1.8	1.8	1.8	0.82	6
Gundagai South	66/11	8	8		8.8	0.98	6.4	6.4	6.4	6.4	6.4	2.28	10
Nangus	66/11	1	2.8		1.1	0.93	1.2	1.2	1.2	1.2	1.2	0.35	10.5
Parsons Creek	66/11	3			0	1.00	0.1	0.1	0.1	0.1	0.1	0.05	2
Talbingo	66/11	3.5			0	1.00	0.4	0.5	0.5	0.5	0.5	0.23	3.5
Tumbarumba	66/22	10/12.5	10/12.5		13.75	1.00	7.6	7.6	7.6	7.6	7.6	2.12	9
Tumut	66/11	30	18/30		33	0.94	16.9	16.9	16.9	16.9	16.9	3.86	3

WINTER	Tumut Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Adelong	66/11	3	2.5		3	1.00	1.6	1.6	1.6	1.6	1.7	0.87	1.5
Batlow	66/11	5	5		6	0.98	2.1	2.1	2.1	2.1	2.1	0.82	1.5
Gundagai South	66/11	8	8		9.6	1.00	5.5	5.5	5.6	5.6	5.6	2.28	1.5
Nangus	66/11	1	2.8		1.2	0.98	0.6	0.6	0.6	0.6	0.6	0.35	4.5
Parsons Creek	66/11	3			0	1.00	0.1	0.1	0.1	0.1	0.1	0.05	3
Talbingo	66/11	3.5			0	1.00	0.4	0.5	0.5	0.5	0.5	0.23	2
Tumbarumba	66/22	10/12.5	10/12.5		15	1.00	8.9	8.9	8.9	9.0	9.0	2.12	17.5
Tumut	66/11	30	18/30		36	0.96	14.4	14.4	14.4	14.4	14.4	3.86	9

Sub-transmission Single Line Diagram of Tumut area



2.3.39 Queanbeyan Supply Area

Description of Queanbeyan area

All zone substations in the Queanbeyan area are in the South Eastern region.

The Queanbeyan area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation.

QUEANBEYAN – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Single transformer supply with high forecast growth at Googong Town	3.2

Sub-transmission feeder load forecast

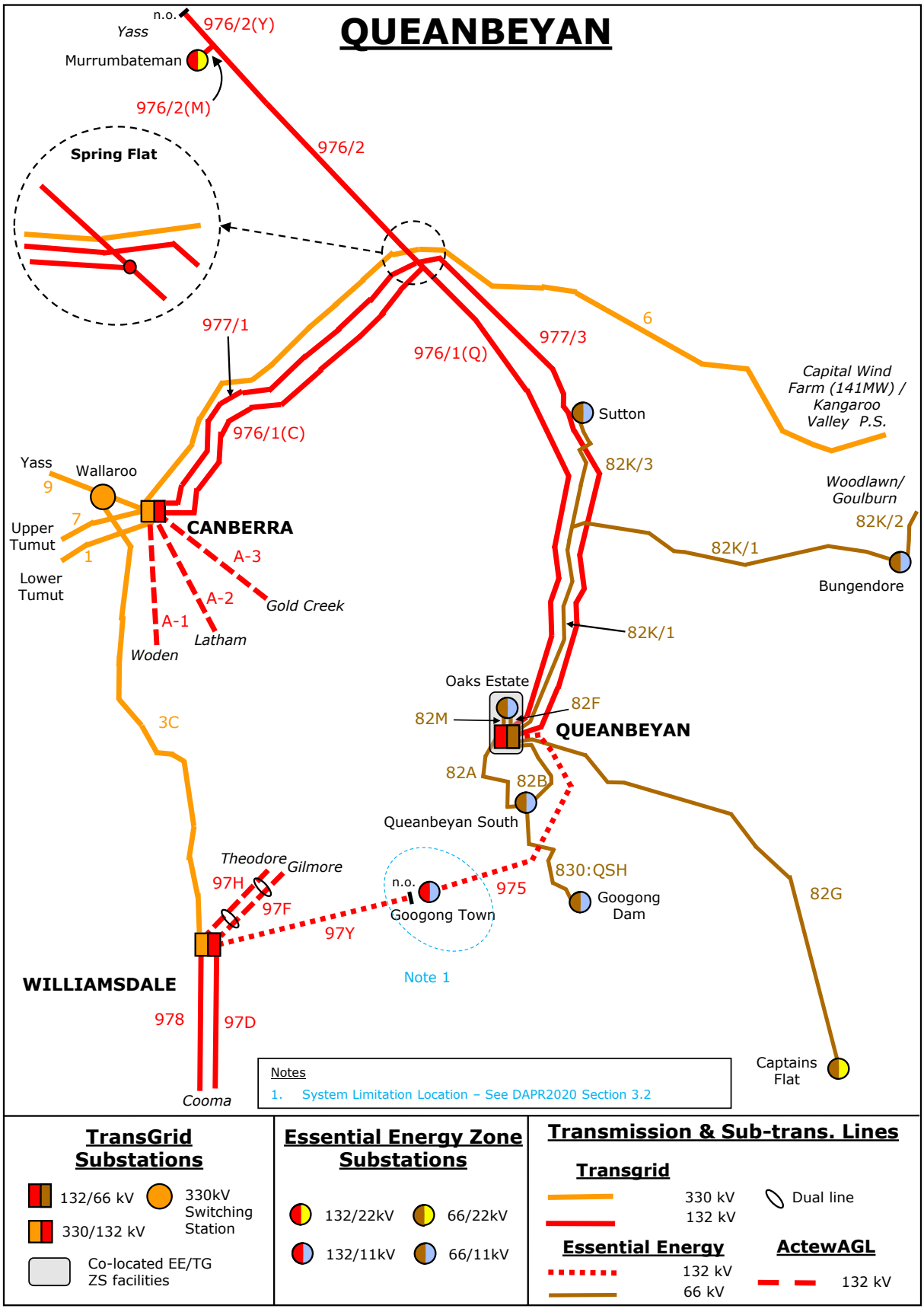
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
97Y	132	TransGrid Williamsdale 330/132kV STS	Googong Town ZS	91	0.0	0.0	0.0	0.0	0.0	112	0.0	0.0	0.0	0.0	0.0
975	132	TransGrid Queanbeyan 132/66kV STS	Googong Town ZS	41	9.7	10.5	11.2	11.9	19.6	79	12.0	13.4	15.0	16.4	24.9
82A	66	TransGrid Queanbeyan 132/66kV STS	Queanbeyan South ZS	30	13.5	14.8	15.8	16.8	15.5	37	13.3	14.7	15.8	16.9	15.8
82B	66	TransGrid Queanbeyan 132/66kV STS	Queanbeyan South ZS	30	10.1	11.1	11.8	12.6	11.7	37	9.9	11.0	11.9	12.7	11.9
82F	66	TransGrid Queanbeyan 132/66kV STS	Oaks Estate ZS	49	19.7	21.5	22.1	22.5	19.4	49	25.8	27.7	28.3	28.8	25.6
82G	66	TransGrid Queanbeyan 132/66kV STS	Captains Flat ZS	12	6.1	6.2	6.3	6.3	6.4	19	8.7	8.9	9.1	9.3	9.5
82K/1	66	TransGrid Queanbeyan 132/66kV STS	Sutton / Bungendore Tee	28	14.1	14.2	14.3	14.4	14.6	34	14.5	14.9	15.3	15.7	16.1
82K/1	66	Sutton / Bungendore Tee	Bungendore ZS	28	9.5	9.6	9.7	9.8	9.9	34	9.4	9.6	9.7	9.9	10.1
82K/3	66	Sutton / Bungendore Tee	Sutton ZS	28	4.5	4.6	4.6	4.6	4.7	34	5.1	5.3	5.5	5.8	6.0
82M	66	TransGrid Queanbeyan 132/66kV STS	Oaks Estate ZS	20	0.0	0.0	0.0	0.0	0.0	20	0.0	0.0	0.0	0.0	0.0
830:QSH	66	Queanbeyan South ZS	Googong Dam ZS	15	2.8	2.9	2.9	3.0	3.0	25	0.6	0.6	0.6	0.6	0.6

STS and ZS load forecast

SUMMER	Queanbeyan Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bungendore	66/11	7.5/10	7.5/10		11	1.00	9.2	9.3	9.4	9.5	9.6	4.48	2.5
Captains Flat	66/22	8/11	5		5.5	1.00	5.8	5.9	6.0	6.0	6.1	1.65	3
Googong Dam	66/11	8/10	7.5/10		11	0.99	2.6	2.7	2.7	2.8	2.8	0.00	18
Googong Town	132/11	30			0	1.00	9.7	10.5	11.2	11.9	19.6	4.16	3.5
Oaks Estate	66/11	30	20/30		33	0.97	19.7	21.5	22.1	22.5	19.4	4.07	10
Queanbeyan South	66/11	20/25/30	20/25/30		33	0.99	22.6	24.7	26.3	27.9	25.9	7.99	5.5
Sutton	66/11	8	6.5/8		8.8	0.99	4.4	4.5	4.5	4.5	4.6	2.59	2.5

WINTER	Queanbeyan Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bungendore	66/11	7.5/10	7.5/10		12	1.00	9.1	9.3	9.4	9.6	9.8	4.48	12
Captains Flat	66/22	8/11	5		6	0.99	8.4	8.6	8.8	9.0	9.2	1.65	11.5
Googong Dam	66/11	8/10	7.5/10		12	1.00	0.4	0.4	0.4	0.4	0.4	0.00	11
Googong Town	132/11	30			0	1.00	12.0	13.4	15.0	16.4	24.9	4.16	1
Oaks Estate	66/11	30	20/30		36	0.99	25.8	27.7	28.3	28.8	25.6	4.07	1.5
Queanbeyan South	66/11	20/25/30	20/25/30		36	1.00	22.1	24.6	26.4	28.2	26.4	7.99	6.5
Sutton	66/11	8	6.5/8		9.6	0.99	5.0	5.2	5.4	5.7	5.9	2.59	7

Sub-transmission Single Line Diagram of Queanbeyan area



2.3.40 Goulburn Supply Area

Description of Goulburn area

All zone substations in the Goulburn area are in the South Eastern region.

Essential Energy's Goulburn (Rocky Hill) 132/66/33kV substation is supplied via Essential Energy's 132kV transmission lines from TransGrid's sub-transmission substations at Marulan and Yass respectively.

GOULBURN – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
972	132	TransGrid Marulan 330/132kV STS	Goulburn 132/66/33kV STS	180	44.1	43.2	42.6	42.0	41.6	202	50.6	50.6	50.2	50.7	50.2
9UR	132	TransGrid Marulan 330/132kV STS	Taralga Wind Farm	140	104.5	105.0	105.7	106.5	107.5	157	104.5	105.0	105.1	106.1	106.1
843	66	Clinton St ZS	Goulburn North ZS	46	5.5	5.5	5.5	5.4	5.4	52	5.1	5.1	5.1	5.2	5.2
82K/2	66	Woodlaw n ZS	Bungendore ZS	28	0.0	0.0	0.0	0.0	0.0	34	0.0	0.0	0.0	0.0	0.0
840:GOU	66	Goulburn 132/66/33kV STS	Goulburn North ZS	61	9.6	9.8	10.0	10.1	10.3	68	8.5	8.8	9.1	9.4	9.7
841:GBN	66	Goulburn North ZS	Crookw ell ZS	9	4.8	4.9	5.0	5.1	5.2	13	3.8	3.8	3.7	3.7	3.6
850:GOU	66	Goulburn 132/66/33kV STS	Woodlaw n ZS	28	5.6	5.9	6.3	6.6	7.0	34	6.6	6.9	7.1	7.4	7.7
86M/1	66	Goulburn 132/66/33kV STS	Marulan North Tee	25	11.5	11.7	11.9	12.1	12.4	29	12.5	12.9	13.4	13.8	14.2
86M/2	66	Marulan North Tee	Marulan South ZS	25	7.3	7.3	7.4	7.4	7.5	29	7.4	7.5	7.6	7.7	7.9
86L	66	Marulan North Tee	Marulan North ZS	12	5.5	5.7	5.9	6.1	6.3	19	6.5	6.9	7.2	7.6	8.0
870:GOU	66	Goulburn 132/66/33kV STS	Clinton St ZS	34	23.5	23.7	23.9	23.9	24.1	41	21.3	21.7	22.1	22.5	23.0
GOU12	33	Goulburn 132/66/33kV STS	Brisbane Grove ZS	7	3.0	3.1	3.1	3.2	3.3	12	2.5	2.5	2.5	2.6	2.6

A 7MW biomass generator is located at Woodlawn Bioreactor and is connected to the Woodlawn 66/11kV zone substation at 11kV via feeder WOO8642.

A 5MW wind generator is located at Crookwell wind farm and is connected to the Goulburn 132/66kV sub-transmission substation at 66kV via feeders 841:GBN and 840:GOU.

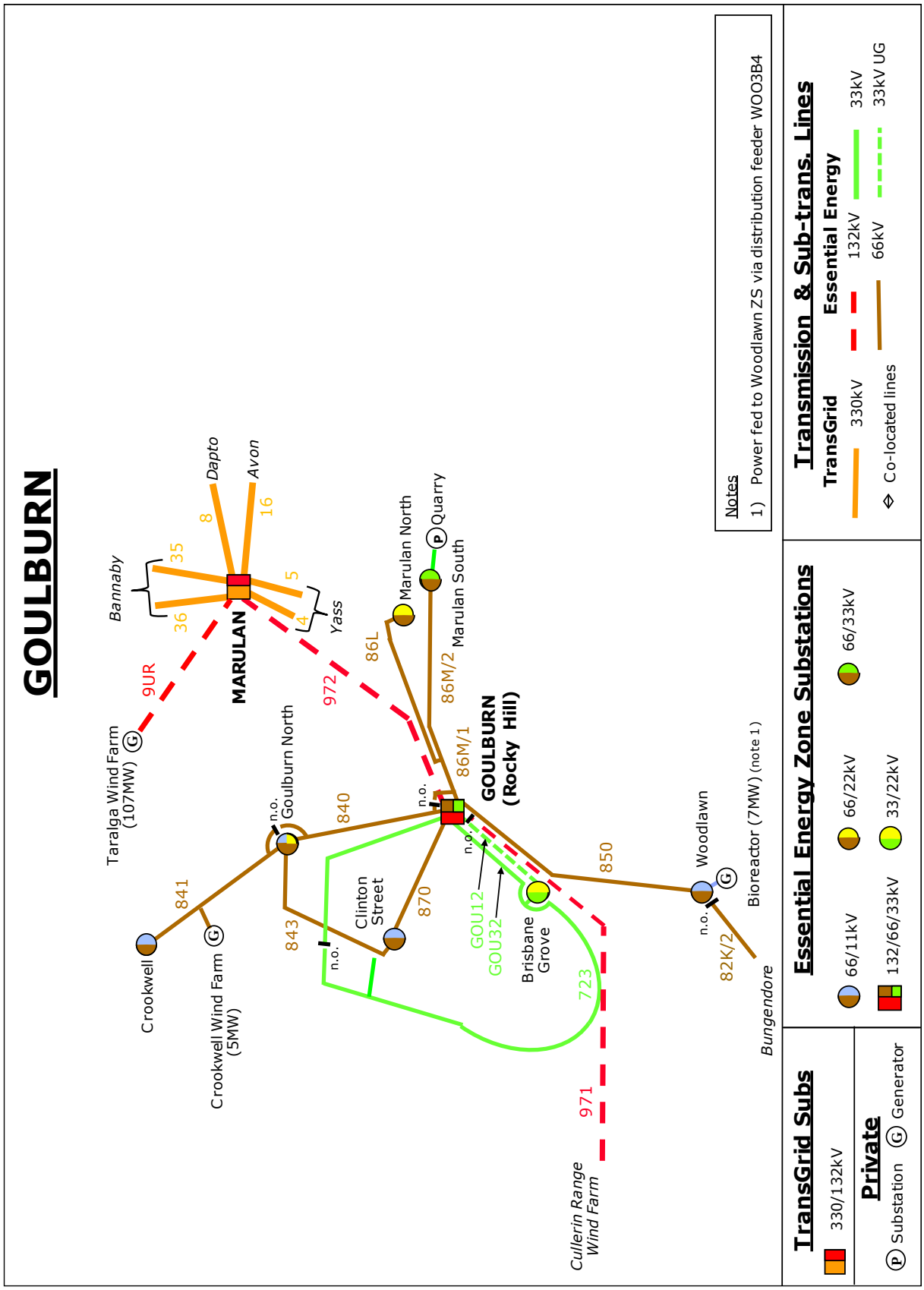
A 107MW wind generator is located at Taralga wind farm and is connected to the TransGrid Marulan 330/132kV sub-transmission substation at 132kV via feeder 9UR.

STS and ZS load forecast

SUMMER	Goulburn Supply Area POE50 Indicative Demand Forecast												
Substation	**kV**	**Transformer Rating (MVA)**			Firm Normal Cyclic Rating (MVA)	Forecast PF	**Forecast (MVA)**					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	**Tx.2**	**Tx.3**			20/21	21/22	22/23	23/24	24/25		
Brisbane Grove	33/22	2.5	2.5		2.75	0.98	3.0	3.1	3.1	3.2	3.3	1.33	2
Clinton Street	66/11	15/19	20/23/30		20.9	0.97	16.2	16.1	16.1	16.0	16.0	3.96	9
Crookwell	66/11	7.5/10	7.5/10		11	0.99	4.8	4.9	5.0	5.1	5.2	2.59	4
Goulburn 132/33kV	132/33	15/22.5/30	30/36		33	1.00	13.6	13.6	13.7	13.7	13.7	2.12	5
Goulburn 132/66kV	132/66	35/60	35/60		66	0.97	44.1	45.4	46.6	47.7	48.9	0.00	5
Goulburn North	66/11	15	12.5/16		16.5	1.00	10.1	10.3	10.5	10.6	10.8	3.37	4.5
Marulan North	66/22	12.5/15	12.5/15		16.5	1.00	5.5	5.7	5.9	6.1	6.3	1.54	5.5
Marulan South	66/33	10/16			0	0.96	7.3	7.3	7.4	7.4	7.5	0.00	3.5
Woodlawn	66/11	10/14	24/30		15.4	1.00	5.6	5.9	6.3	6.6	7.0	0.72	8

WINTER	Goulburn Supply Area POE50 Indicative Demand Forecast												
Substation	**kV**	**Transformer Rating (MVA)**			Firm Normal Cyclic Rating (MVA)	Forecast PF	**Forecast (MVA)**					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	**Tx.2**	**Tx.3**			2021	2022	2023	2024	2025		
Brisbane Grove	33/22	2.5	2.5		3	0.97	2.5	2.5	2.5	2.6	2.6	1.33	4.5
Clinton Street	66/11	15/19	20/23/30		22.8	0.99	14.9	15.0	15.1	15.2	15.4	3.96	8
Crookwell	66/11	7.5/10	7.5/10		12	1.00	3.8	3.8	3.7	3.7	3.6	2.59	1.5
Goulburn 132/33kV	132/33	15/22.5/30	30/36		36	1.00	13.2	13.3	13.4	13.4	13.5	2.12	12.5
Goulburn 132/66kV	132/66	35/60	35/60		72	0.99	37.9	39.2	40.5	41.7	43.0	0.00	3.5
Goulburn North	66/11	15	12.5/16		18	1.00	8.9	9.3	9.6	9.9	10.2	3.37	11.5
Marulan North	66/22	12.5/15	12.5/15		18	1.00	6.5	6.9	7.2	7.6	8.0	1.54	3.5
Marulan South	66/33	10/16			0	0.96	7.4	7.5	7.6	7.7	7.9	0.00	3.5
Woodlawn	66/11	10/14	24/30		16.8	1.00	6.6	6.9	7.1	7.4	7.7	0.72	23

Sub-transmission Single Line Diagram of Goulburn area



2.3.41 Cowra Supply Area

Description of Cowra area

Zone substations in the Cowra area are spread across both the Macquarie and Riverina Slopes regions.

The Cowra area sub-transmission system is supplied from TransGrid's Cowra 132/66kV sub-transmission substation. Normal 66kV system operation supplies from Cowra to Young open point and includes Bendick Murrell, Monteagle and connection to Wyangala Power Station.

COWRA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Feeder – CWD33 Eugowra	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
865	66	TransGrid Cowra 132/66kV STS	Cowra Town ZS	15	10.6	10.7	10.8	10.9	11.0	25	7.6	7.6	7.7	7.7	7.8
863:CWD	66	TransGrid Cowra 132/66kV STS	Canowindra ZS	9	6.9	6.9	7.0	7.1	7.2	15	4.7	4.8	4.8	4.9	4.9
866:COW	66	TransGrid Cowra 132/66kV STS	Cowra Town ZS	15	10.6	10.7	10.8	10.9	11.0	25	7.6	7.6	7.7	7.7	7.8
891/1	66	TransGrid Cowra 132/66kV STS	Wyangala Dam Tee	20	2.4	2.4	2.4	2.4	2.4	24	2.7	2.7	2.7	2.8	2.8
891/2	66	Wyangala Dam Tee	Wyangala Dam	19	0.0	0.0	0.0	0.0	0.0	33	0.0	0.0	0.0	0.0	0.0
891/5	66	Monteagle Tee	Monteagle ZS	13	1.0	1.0	1.0	1.0	1.0	22	1.1	1.1	1.1	1.2	1.2
891/6	66	Monteagle Tee	Young ZS	19	0.0	0.0	0.0	0.0	0.0	33	0.0	0.0	0.0	0.0	0.0
891/7	66	Bendick Murrell Tee	Bendick Murrell ZS	19	2.0	2.0	2.0	2.0	2.0	33	1.7	1.7	1.7	1.8	1.8
891:BMU	66	Wyangala Dam Tee	Bendick Murrell Tee	19	2.7	2.7	2.7	2.8	2.8	33	2.6	2.7	2.7	2.7	2.8
891:BMU	66	Bendick Murrell Tee	Monteagle Tee	19	0.9	0.9	0.9	0.9	0.9	33	1.0	1.0	1.0	1.1	1.1
893/1	66	TransGrid Cowra 132/66kV STS	Grenfell Tee	12	5.0	5.0	5.0	5.0	5.1	18	5.7	5.8	5.8	5.9	6.0
893/4	66	Grenfell Tee	Payten's Bridge ZS	12	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0
893/6	66	Grenfell Tee	Grenfell ZS	12	5.1	5.1	5.1	5.2	5.2	18	5.9	6.0	6.0	6.1	6.2

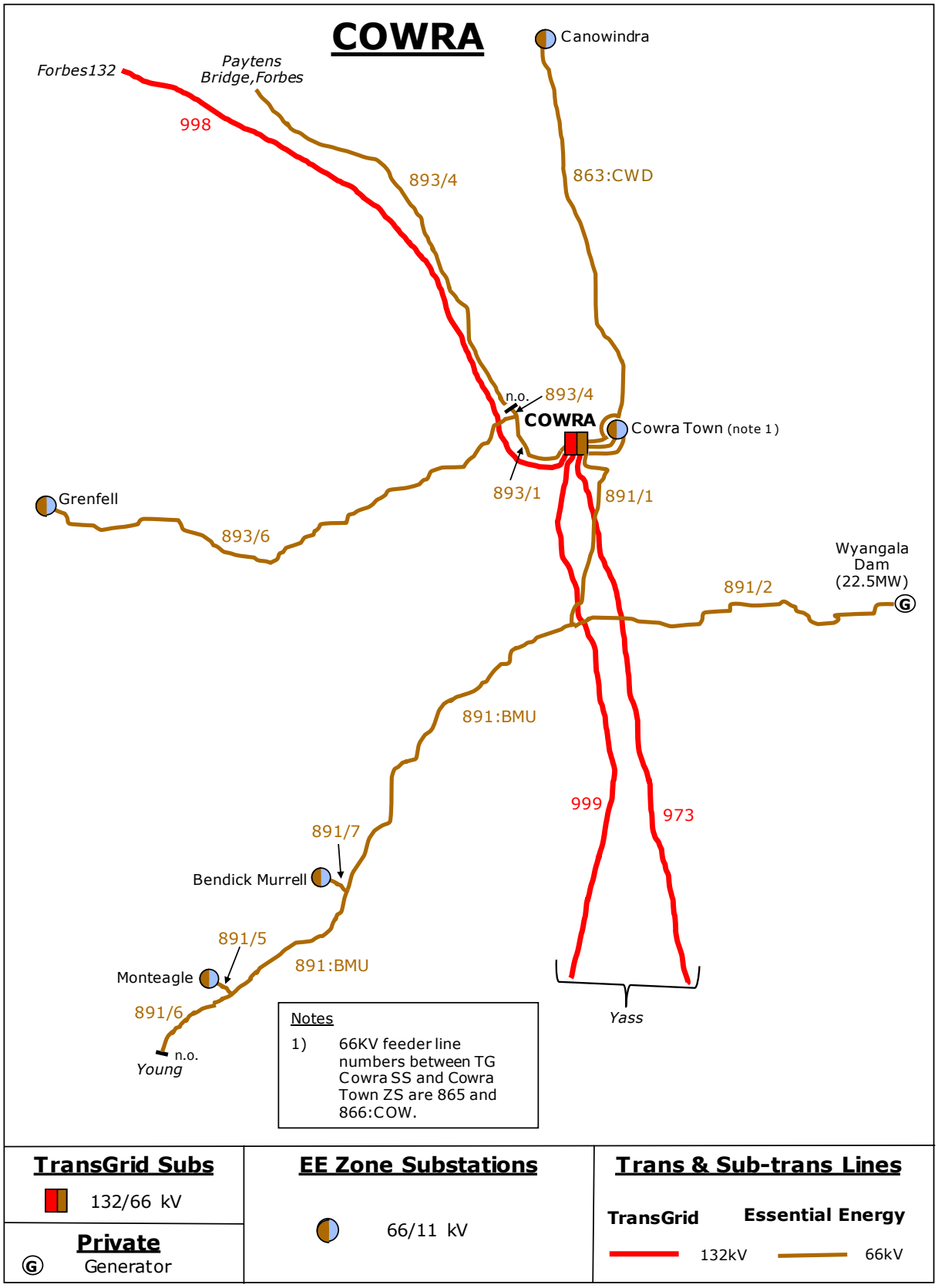
A 22.5MW hydro generator is located at Wyangala Dam and is connected to the TransGrid Cowra 132/66kV sub-transmission substation at 66kV via feeder 891.

STS and ZS load forecast

SUMMER	Cowra Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bendick Murrell	66/11	2.8			0	0.93	1.7	1.7	1.7	1.7	1.7	0.73	4
Canowindra	66/11	5	8		5.5	0.96	6.9	6.9	7.0	7.1	7.2	2.09	8
Cowra	66/11	15/30	15/30		33	1.00	21.1	21.4	21.6	21.8	22.0	6.09	7
Grenfell	66/11	8	5		5.5	0.95	5.4	5.4	5.4	5.4	5.4	2.24	6
Monteagle	66/11	1			0	0.96	1.0	1.0	1.0	1.0	1.0	0.45	5

WINTER	Cowra Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bendick Murrell	66/11	2.8			0	1.00	1.2	1.2	1.3	1.3	1.3	0.73	4.5
Canowindra	66/11	5	8		6	0.99	4.7	4.8	4.8	4.9	4.9	2.09	1
Cowra	66/11	15/30	15/30		36	1.00	15.2	15.3	15.4	15.5	15.6	6.09	9
Grenfell	66/11	8	5		6	0.95	4.4	4.3	4.3	4.3	4.3	2.24	6
Monteagle	66/11	1			0	0.96	0.9	0.9	0.9	0.9	0.9	0.45	14.5

Sub-transmission Single Line Diagram of Cowra area



2.3.42 Murrumburrah Supply Area

Description of Murrumburrah area

All zone substations in the Murrumburrah area are in the Riverina Slopes region.

The Harden-Murrumburrah area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation at Murrumburrah.

MURRUMBURRAH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Separation of Bethungra subtransmission from Cootamundra ZS	3.1

Sub-transmission feeder load forecast

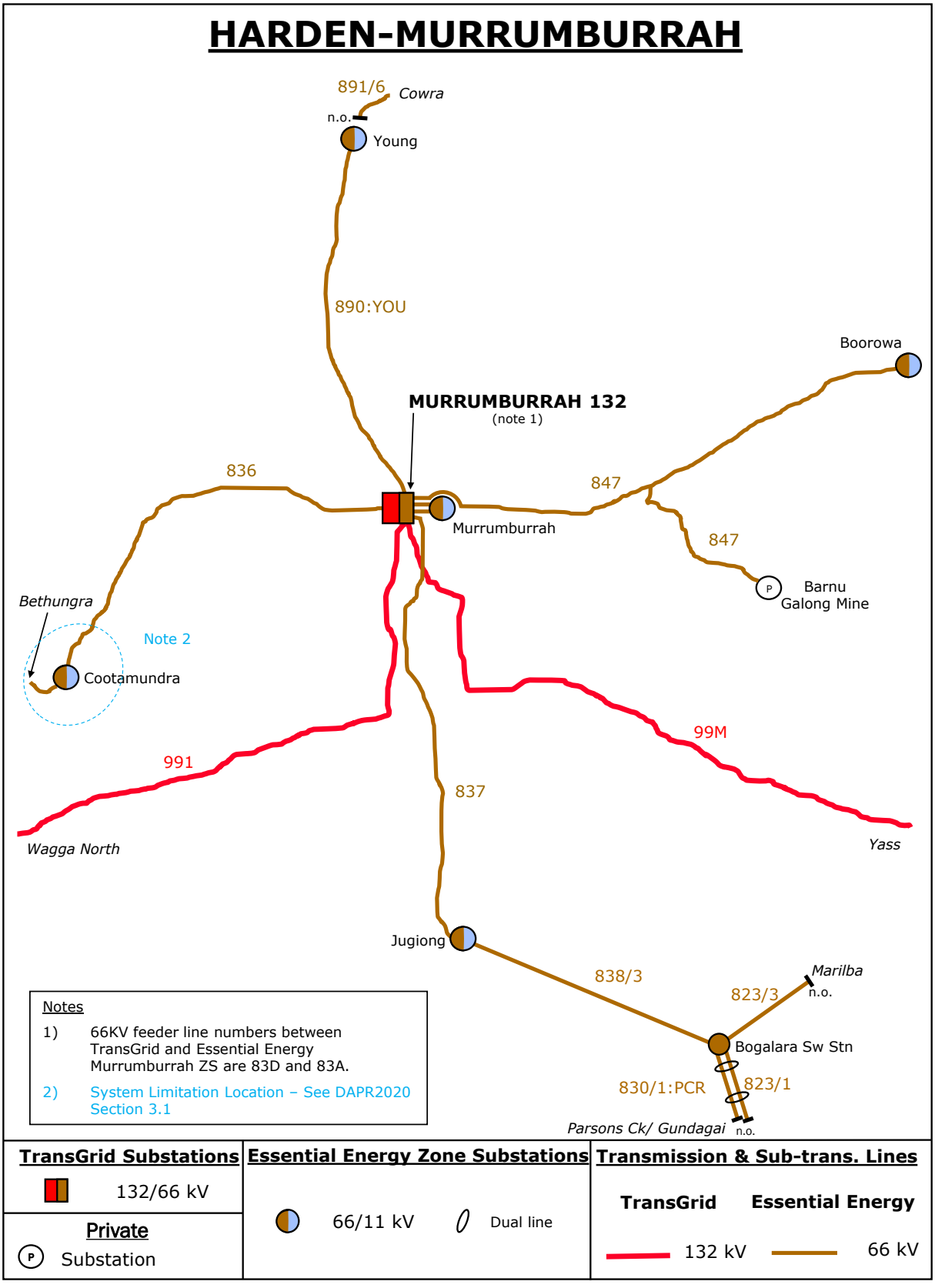
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
836	66	TransGrid Murrumburrah 132/66kV STS	Cootamundra ZS	12	12.0	12.3	12.8	13.2	13.5	18	8.1	8.2	8.2	8.3	8.4
837	66	TransGrid Murrumburrah 132/66kV STS	Jugiong ZS	12	1.9	1.9	1.9	1.9	1.9	18	1.7	1.7	1.7	1.7	1.7
847	66	TransGrid Murrumburrah 132/66kV STS	Boorowa ZS	10	5.2	5.2	5.2	5.2	5.2	16	4.4	4.4	4.5	4.5	4.5
823/3	66	Bogalara Sw Stn	Marilba ZS	12	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0
830/1:PCR	66	Bogalara Sw Stn	Parsons Creek ZS	11	0.0	0.0	0.0	0.0	0.0	19	0.0	0.0	0.0	0.0	0.0
838/3	66	Jugiong ZS	Bogalara Sw Stn	12	0.0	0.0	0.0	0.0	0.0	20	0.0	0.0	0.0	0.0	0.0
83A	66	TransGrid Murrumburrah 132/66kV STS	Murrumburrah ZS	15	5.5	5.6	5.6	5.7	5.7	25	4.6	4.7	4.7	4.8	4.8
83D	66	TransGrid Murrumburrah 132/66kV STS	Murrumburrah ZS	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
890:YOU	66	TransGrid Murrumburrah 132/66kV STS	Young ZS	24	18.5	18.4	18.4	18.4	18.4	28	15.9	16.0	16.2	16.3	16.5

STS and ZS load forecast

SUMMER	Harden - Murrumburrah Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Boorowa	66/11	8	5		5.5	0.97	4.1	4.1	4.1	4.1	4.1	1.81	4.5
Cootamundra	66/11	15/19	15/19		20.9	1.00	12.0	12.3	12.8	13.2	13.5	3.93	2.5
Jugiong	66/11	5.9/6.5	5.9/6.5		7.15	0.92	1.9	1.9	1.9	1.9	1.9	0.27	6.5
Murrumburrah	66/11	8/10	8/10		11	0.96	5.5	5.6	5.6	5.7	5.7	2.15	5
Young	66/11	24/30	18/30		33	0.98	18.5	18.4	18.4	18.4	18.4	5.74	7.5

WINTER	Harden - Murrumburrah Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Boorowa	66/11	8	5		6	0.98	3.6	3.7	3.8	3.9	3.9	1.81	9.5
Cootamundra	66/11	15/19	15/19		22.8	1.00	8.1	8.2	8.2	8.3	8.4	3.93	2
Jugiong	66/11	5.9/6.5	5.9/6.5		7.8	0.93	1.7	1.7	1.7	1.7	1.7	0.27	2.5
Murrumburrah	66/11	8/10	8/10		12	0.99	4.6	4.7	4.7	4.8	4.8	2.15	10.5
Young	66/11	24/30	18/30		36	1.00	15.9	16.0	16.2	16.3	16.5	5.74	10

Sub-transmission Single Line Diagram of Murrumburrah area



2.3.43 Yass Supply Area

Description of Yass area

All zone substations in the Yass area are in the South Eastern region.

The Yass area sub-transmission system is supplied from TransGrid's 330/132/66kV sub-transmission substation.

YASS – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Separation of Marilba subtransmission from Yass ZS	3.1

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating MVA	Line Forecast MVA					Line Rating MVA	Line Forecast MVA				
					20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025
971(1)	132	TransGrid Yass 330/132/66kV STS	Cullerin Range Wind Farm	106	78.0	78.0	78.1	78.1	78.2	119	75.3	75.4	75.4	75.5	75.5
971(2)	132	Cullerin Range Wind Farm	Gunning Wind Farm	140	48.0	48.0	47.9	48.0	48.0	157	47.6	47.7	47.6	47.7	47.8
971(3)	132	Cullerin Range Wind Farm	Goulburn 132/66/33kV STS	106	0.0	0.0	0.0	0.0	0.0	119	0.0	0.0	0.0	0.0	0.0
976/2 (M)	132	TransGrid 132kV Line 976/2(Y) / Murrumbateman Tee	Murrumbateman ZS	42	7.4	7.5	7.6	7.7	7.8	82	7.3	7.5	7.7	7.9	8.1
824	66	TransGrid Yass 330/132/66kV STS	Yass ZS	12	15.8	15.9	15.9	15.9	16.0	18	14.6	14.8	15.0	15.3	15.5
823/5	66	Yass ZS	Marilba ZS	12	1.6	1.6	1.6	1.6	1.6	18	1.6	1.7	1.7	1.7	1.7

A 30MW wind generator is located at Cullerin Range wind farm and is connected to the TransGrid Yass 330/132/66kV sub-transmission substation at 132kV via feeder 971.

A 47MW wind generator is located at Gunning wind farm and is also connected to the TransGrid Yass 330/132/66kV sub-transmission substation at 132kV via feeder 971.

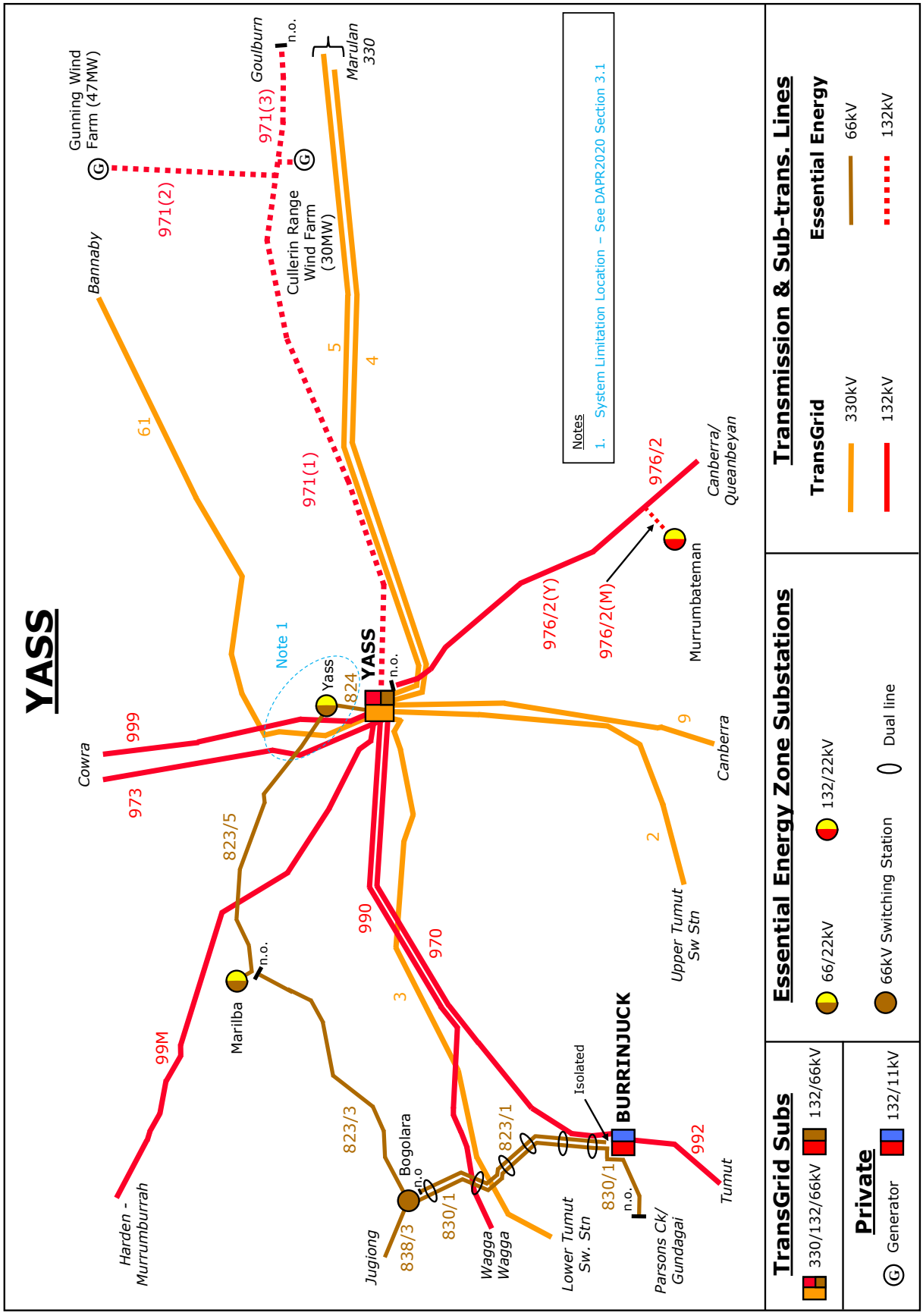
STS and ZS load forecast

SUMMER	Yass Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Gunning	22/11	2.5	2.5		2.75	0.99	1.2	1.3	1.3	1.3	1.4	0.75	3.5
Marilba	66/11	3	1		1.1	0.99	1.5	1.5	1.5	1.5	1.5	0.73	3.5
Murrumbateman	132/22	10/12.5			0	1.00	7.4	7.5	7.6	7.7	7.9	4.23	3
Yass	66/22	10/12	10/12		13.2	0.96	14.5	14.5	14.5	14.5	14.5	4.81	5

WINTER	Yass Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Gunning	22/11	2.5	2.5		3	1.00	1.2	1.3	1.3	1.4	1.4	0.75	2
Marilba	66/11	3	1		1.2	1.00	1.5	1.5	1.6	1.6	1.6	0.73	5
Murrumbateman	132/22	10/12.5			0	1.00	7.3	7.5	7.7	7.9	8.0	4.23	6.5
Yass	66/22	10/12	10/12		14.4	0.95	13.2	13.3	13.5	13.6	13.7	4.81	9.5

There are multiple load transfer points in the Yass area to other zone substations that can be utilised with the loss of a single Yass transformer.

Sub-transmission Single Line Diagram of Yass area



2.3.44 Temora Supply Area

Description of Temora area

Zone substations in the Temora area are spread across both the Riverina Slopes and Central regions.

Essential Energy's Temora 132/66kV sub-transmission substation is supplied from TransGrid's Wagga Wagga North 132/66kV sub-transmission substation via two Essential Energy 132kV transmission lines.

TEMORA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

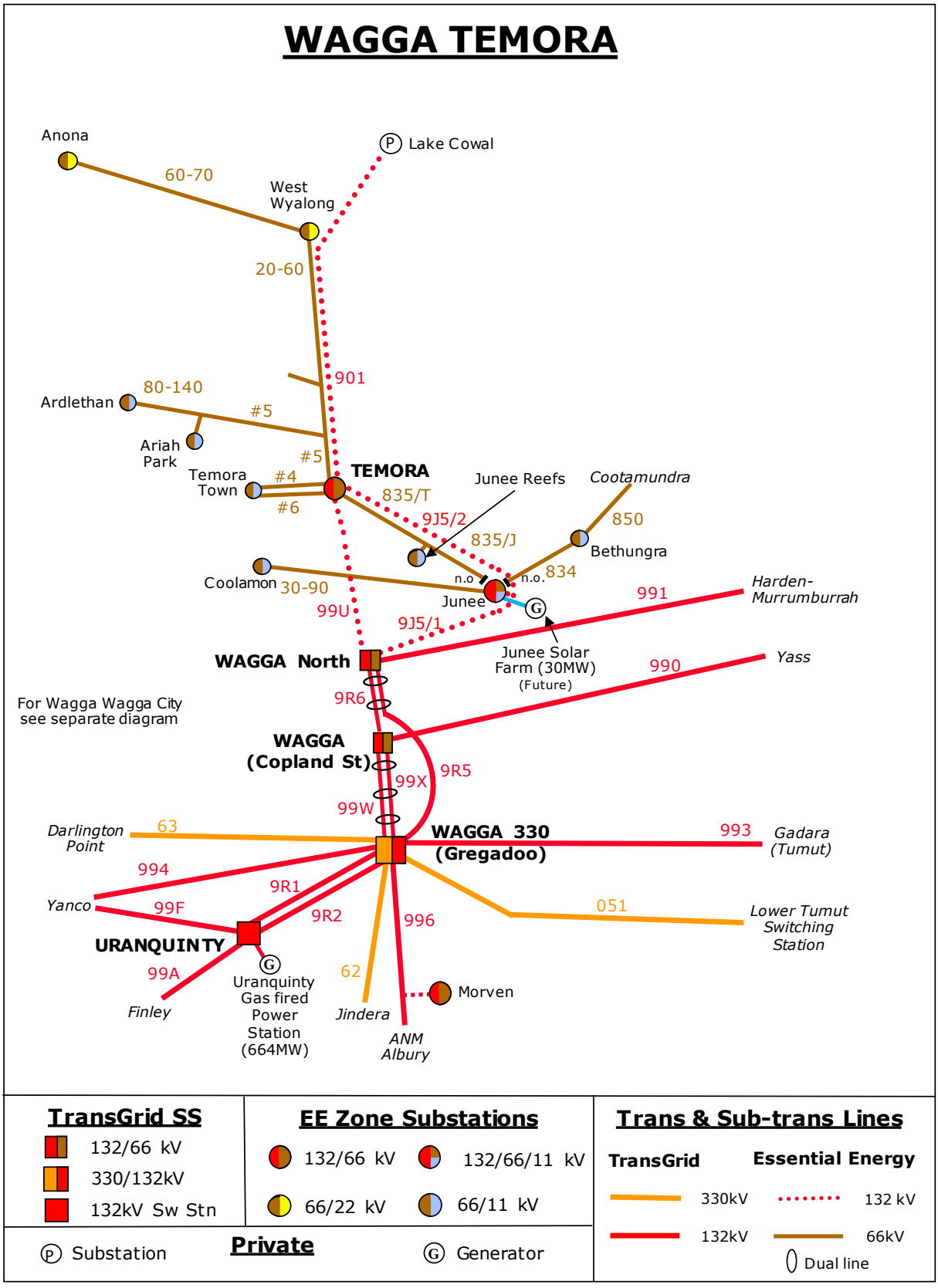
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
901	132	Temora 132/66 STS	Lake Cowal	108	33.0	33.2	33.2	33.3	33.4	135	33.5	33.8	34.2	34.5	34.8
4	66	Temora 132/66 STS	Temora Town ZS	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
5	66	Temora 132/66 STS	Ariah Park Tee	21	13.0	13.1	13.2	13.4	13.5	25	9.6	9.4	9.2	9.1	9.0
6	66	Temora 132/66 STS	Temora Town ZS	15	8.2	8.2	8.2	8.1	8.1	25	6.2	6.3	6.3	6.3	6.4
20-60	66	Ariah Park Tee	West Wyalong ZS	21	10.8	10.9	11.0	11.2	11.3	25	8.0	7.8	7.7	7.6	7.5
60-70	66	West Wyalong ZS	Anona ZS	7	1.5	1.5	1.5	1.4	1.4	12	1.1	1.1	1.1	1.1	1.1
80-140	66	Ariah Park Tee	Ariah Park ZS	15	2.2	2.2	2.2	2.2	2.3	25	1.6	1.6	1.5	1.5	1.5
80-140	66	Ariah Park ZS	Ardlethan ZS	11	0.8	0.8	0.8	0.9	0.9	19	0.6	0.6	0.6	0.6	0.6
835/J	66	Junee Reefs ZS	Junee ZS	12	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0
835/T	66	Temora 132/66 STS	Junee Reefs ZS	12	0.2	0.2	0.2	0.2	0.2	18	0.2	0.2	0.2	0.2	0.2

STS and ZS load forecast

SUMMER	Temora Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Anona	66/22	3	2.5		2.75	1.00	1.5	1.5	1.5	1.4	1.4	0.60	5.5
Ardlethan	66/11	2.5	3		2.75	0.98	0.8	0.8	0.8	0.9	0.9	0.30	5.5
Ariah Park	66/11	3	3		3.3	0.99	1.1	1.2	1.2	1.2	1.2	0.41	6.5
Junee Reefs	66/11	3			0	0.95	0.2	0.2	0.2	0.2	0.2	0.17	1.5
Temora 132/66kV	132/66	35/60	35/60		66	1.00	22.0	22.0	22.0	22.0	22.0	0.00	6
Temora 66/11kV	66/11	6.75/10	10/12.5		11	0.97	8.2	8.2	8.2	8.1	8.1	3.20	6
West Wyalong	66/22	8	10/12.5		8.8	0.97	9.8	9.8	9.8	9.8	9.8	3.05	7

WINTER	Temora Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Anona	66/22	3	2.5		3	0.94	1.1	1.1	1.1	1.1	1.1	0.60	11.5
Ardlethan	66/11	2.5	3		3	1.00	0.6	0.6	0.6	0.6	0.6	0.30	4
Ariah Park	66/11	3	3		3.6	1.00	0.8	0.8	0.8	0.8	0.8	0.41	5.5
Junee Reefs	66/11	3			0	0.98	0.2	0.2	0.2	0.2	0.2	0.17	4.5
Temora 132/66kV	132/66	35/60	35/60		72	0.99	15.4	15.4	15.4	15.4	15.3	0.00	15.5
Temora 66/11kV	66/11	6.75/10	10/12.5		12	1.00	6.2	6.3	6.3	6.3	6.4	3.20	13.5
West Wyalong	66/22	8	10/12.5		9.6	0.98	6.6	6.7	6.8	6.8	6.9	3.05	8

Sub-transmission Single Line Diagram of Temora area



2.3.45 Wagga North Supply Area

Description of Wagga North area

All zone substations in the Wagga North area are in the Riverina Slopes region.

The Wagga Wagga area sub-transmission system is supplied from two separate TransGrid 132/66kV sub-transmission substations at Wagga Wagga (Copland St) and Wagga North.

The transmission system emanating from Wagga North supplies many smaller outlying areas.

WAGGA NORTH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

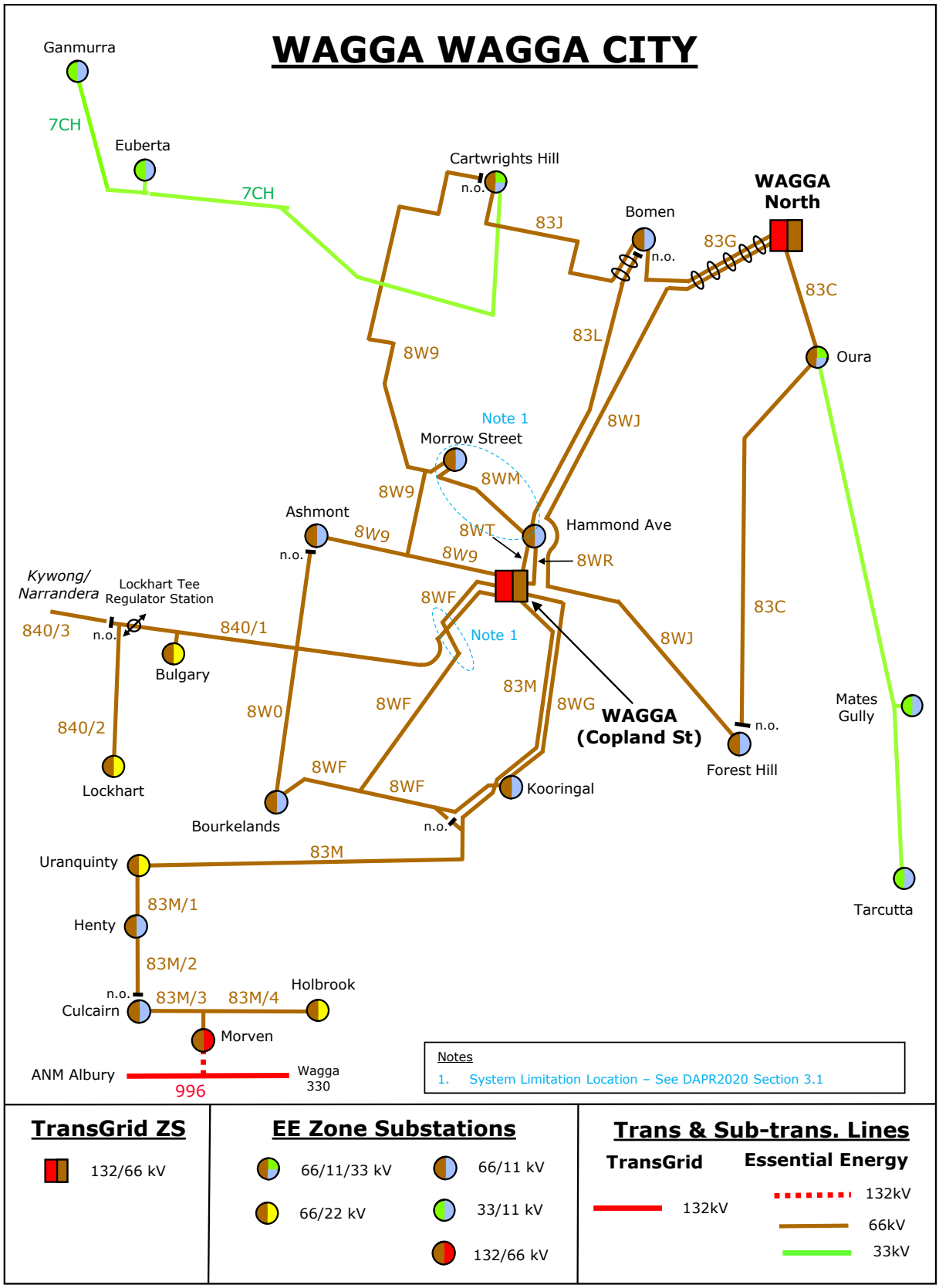
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
99U	132	TransGrid Wagga North 132/66kV STS	Temora 132/66 STS	128	30.4	30.6	30.8	31.1	31.2	143	25.9	25.8	25.7	25.7	25.7
9J5/1	132	TransGrid Wagga North 132/66kV STS	Junee 132/66/11kV ZS	140	38.7	39.0	39.2	39.6	39.7	157	34.3	34.2	34.1	34.1	34.0
9J5/2	132	Junee 132/66/11kV ZS	Temora 132/66 STS	140	28.1	28.3	28.5	28.7	28.9	157	22.9	22.7	22.5	22.4	22.2
30-90	66	Junee ZS	Coolamon ZS	6	5.4	5.4	5.5	5.5	5.5	9	4.2	4.2	4.2	4.2	4.2
834:JUN	66	Junee ZS	Bethungra ZS	11	1.1	1.2	1.2	1.2	1.2	19	1.0	1.0	1.0	1.0	1.0
83C	66	TransGrid Wagga North 132/66kV STS	Oura ZS	24	4.5	4.5	7.6	7.6	7.6	28	2.9	2.9	6.1	6.1	6.1
83C	66	Oura ZS	Forest Hill ZS	34	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0
83G	66	TransGrid Wagga North 132/66kV STS	Bomen ZS	34	18.1	18.1	18.2	18.2	18.3	39	15.0	15.1	15.2	15.3	15.4
83J	66	Bomen ZS	Cartw rights Hill ZS	34	8.9	9.0	9.0	9.1	9.2	39	6.7	6.9	7.0	7.1	7.2
850:BET	66	Bethungra ZS	Cootamundra ZS	12	0.0	0.0	0.0	0.0	0.0	18	0.0	0.0	0.0	0.0	0.0
CHI2527	33	Cartw rights Hill ZS	Euberta ZS	4	2.0	2.0	2.0	2.1	2.1	6	1.6	1.6	1.6	1.7	1.7
CHI2527	33	Euberta ZS	Ganmurra ZS	4	0.6	0.6	0.6	0.6	0.6	6	0.5	0.5	0.5	0.5	0.6
Mates Gully	33	Oura ZS	Mates Gully ZS	3	1.9	1.9	1.9	1.9	1.9	6	1.5	1.5	1.5	1.5	1.5
Mates Gully	33	Mates Gully ZS	Tarcutta ZS	4	1.2	1.2	1.2	1.2	1.2	7	1.0	1.0	1.0	1.0	1.0
8WJ	66	TransGrid Wagga North 132/66kV STS	Forest Hill ZS	34	6.2	6.2	6.2	6.2	6.2	39	5.8	5.8	5.8	5.8	5.8

STS and ZS load forecast

SUMMER	Wagga North Supply Area POE50 Indicative Demand Forecast													
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Bethungra	66/11	3	3		3.3	0.96	0.8	0.9	0.9	0.9	0.9	0.19	15.5
Bomen	66/11	20/30	20/30		33	0.99	11.4	11.4	11.4	11.3	11.3	0.24	9.5
Cartwrights Hill 11kV	66/11	6.75/10	6.75/10		11	0.98	8.7	8.8	8.8	8.9	9.0	1.92	6.5
Cartwrights Hill 33kV	11/33	5	4		4.4	0.96	1.9	1.9	1.9	1.9	1.9	0.00	4.5
Coolamon	66/11	8	8		8.8	0.98	5.1	5.1	5.2	5.2	5.2	2.27	4.5
Euberta	33/11	4	3		3.3	0.94	1.4	1.4	1.4	1.4	1.4	0.45	3.5
Forest Hill	66/11	12.5/16	10/14		15.4	0.95	6.0	6.0	6.0	6.0	6.0	1.25	1
Ganmurra	33/11	2.5			0	0.96	0.6	0.6	0.6	0.6	0.6	0.15	3
Junee 11kV	66/11	10/18	15		16.5	0.99	7.6	7.7	7.8	7.9	8.0	2.39	2
Junee 66kV	132/66	30			0	0.98	12.9	13.0	13.1	13.2	13.2	0.00	5
Mates Gully	33/11	2			0	0.96	0.6	0.6	0.6	0.6	0.6	0.20	4
Oura 11/33kV	11/33	4	2		2.2	0.98	1.9	1.9	2.0	2.0	2.0	0.00	3
Oura 66/11kV	66/11	5/6.9	5/6.9		7.59	0.95	4.4	4.4	7.5	7.5	7.5	0.31	8.5
Tarcutta	33/11	1	3		1.1	0.90	1.2	1.2	1.2	1.2	1.2	0.47	5.5

WINTER	Wagga North Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Bethungra	66/11	3	3		3.6	1.00	0.7	0.7	0.7	0.7	0.7	0.19	16.5
Bomen	66/11	20/30	20/30		36	0.99	10.1	10.1	10.1	10.1	10.1	0.24	135
Cartwrights Hill 11kV	66/11	6.75/10	6.75/10		12	1.00	6.5	6.7	6.8	6.9	7.0	1.92	9
Cartwrights Hill 33kV	11/33	5	4		4.8	0.99	1.3	1.3	1.3	1.3	1.3	0.00	4
Coolamon	66/11	8	8		9.6	1.00	3.9	3.9	3.9	3.9	3.9	2.27	1.5
Euberta	33/11	4	3		3.6	0.95	1.1	1.1	1.1	1.1	1.1	0.45	0.5
Forest Hill	66/11	12.5/16	10/14		16.8	0.96	5.6	5.6	5.6	5.6	5.6	1.25	3
Ganmurra	33/11	2.5			0	0.98	0.5	0.5	0.5	0.5	0.5	0.15	3.5
Junee 11kV	66/11	10/18	15		18	0.99	6.5	6.6	6.7	6.9	7.0	2.39	10.5
Junee 66kV	132/66	30			0	1.00	10.5	10.7	11.0	11.2	11.5	0.00	9.5
Mates Gully	33/11	2			0	0.98	0.4	0.4	0.4	0.4	0.4	0.20	4
Oura 11/33kV	11/33	4	2		2.4	1.00	1.3	1.3	1.3	1.3	1.3	0.00	7.5
Oura 66/11kV	66/11	5/6.9	5/6.9		8.28	0.98	2.8	2.8	6.0	6.0	6.0	0.31	2.5
Tarcutta	33/11	1	3		1.2	0.90	1.0	1.0	1.0	1.0	1.0	0.47	3.5

Sub-transmission Single Line Diagram of Wagga North area



2.3.46 Wagga Wagga (Copland St) Supply Area

Description of Wagga Wagga area

Zone substations in the Wagga Wagga area are spread across both the Riverina Slopes and Murray regions.

The Wagga Wagga area sub-transmission system is supplied from two separate TransGrid 132/66kV sub-transmission substations at Wagga Wagga (Copland St) and Wagga North.

The transmission system emanating from Wagga Wagga (Copland St) supplies the majority of the Wagga Wagga city load as well as supplying the areas as far south as Holbrook and as far west as Lockhart.

WAGGA WAGGA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Network limitations associated with tee connection on feeder 8WF	3.1
Total loss of supply at Morrow ZS for loss of feeder 8WM	3.1
Feeder – KOO3B6 Lake Albert	3.3
Feeder – UQT8B2 Uranquinty Nth	3.3

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
83L	66	Hammond Ave ZS	Bomen ZS	54	0.0	0.0	0.0	0.0	0.0	62	0.0	0.0	0.0	0.0	0.0
83M	66	TransGrid Wagga 132/66kV STS (Copland St)	Uranquinty ZS	28	6.9	6.9	6.8	6.8	6.8	34	5.7	5.6	5.6	5.5	5.5
840/1	66	TransGrid Wagga 132/66kV STS (Copland St)	Bulgary ZS	15	3.9	3.9	3.8	3.8	3.8	25	3.0	3.0	3.0	2.9	2.9
840/2	66	Bulgary ZS	Lockhart ZS	15	3.8	3.8	3.8	3.8	3.7	24	2.9	2.8	2.8	2.8	2.8
840/3	66	Lockhart Tee	Kywong ZS	16	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
83M/1	66	Uranquinty ZS	Henty ZS	15	2.5	2.5	2.4	2.4	2.4	25	2.2	2.2	2.2	2.2	2.1
83M/2	66	Henty ZS	Culcairn ZS	15	0.0	0.0	0.0	0.0	0.0	25	0.0	0.0	0.0	0.0	0.0
8W9	66	TransGrid Wagga 132/66kV STS (Copland St)	Ashmont ZS	34	19.0	18.9	18.8	18.7	18.5	39	13.9	13.8	13.7	13.6	13.5
8WF/1	66	TransGrid Wagga 132/66kV STS (Copland St)	Bourkelands ZS	34	12.9	12.9	13.0	13.0	13.0	39	10.3	10.5	10.7	10.9	11.1
8WM	66	Hammond Ave ZS	Morrow St ZS	34	12.3	12.3	12.2	12.1	12.0	39	8.8	8.8	8.7	8.6	8.6
8WO	66	Ashmont ZS	Bourkelands ZS	34	0.5	0.5	0.5	0.5	0.5	39	0.7	0.7	0.7	0.7	0.7
8WP	66	Morrow St ZS	Cartwrights Hill ZS	34	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0
8WR	66	TransGrid Wagga 132/66kV STS (Copland St)	Hammond Ave ZS	52	14.2	14.2	14.0	14.0	13.9	60	10.7	10.6	10.5	10.5	10.4
8WT	66	TransGrid Wagga 132/66kV STS (Copland St)	Hammond Ave ZS	52	14.1	14.0	13.9	13.8	13.7	60	10.6	10.5	10.4	10.4	10.3
8WG	66	TransGrid Wagga 132/66kV STS (Copland St)	Kooringal ZS	34	19.8	20.2	20.4	20.8	21.0	39	15.4	15.4	15.5	15.5	15.5
8WF/2	66	Bourkelands ZS	Kooringal ZS	34	0.0	0.0	0.0	0.0	0.0	39	0.0	0.0	0.0	0.0	0.0

STS and ZS load forecast

SUMMER	Wagga (Copland St) Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Ashmont	66/11	20/30	20/30		33	0.97	20.5	20.5	20.6	20.6	20.6	4.35	10
Bourkelands	66/11	10/13.333	10/13		14.3	0.98	12.9	12.9	13.0	13.0	13.0	4.73	5.5
Bulgary	66/22	2.5			0	0.99	0.2	0.2	0.2	0.2	0.2	0.00	5
Hammond Ave	66/11	24/30	24/30		33	0.97	16.6	16.6	16.6	16.5	16.5	2.73	4.5
Henty	66/11	5	5		5.5	0.98	2.8	2.8	2.8	2.8	2.8	1.35	4
Kooringal	66/11	18/25	18/25		27.5	0.99	19.8	20.2	20.4	20.8	21.0	5.89	5
Lockhart	66/22	8	5		5.5	1.00	3.5	3.5	3.5	3.5	3.5	1.62	5
Morrow St	66/11	20	20		22	0.95	13.1	13.1	13.0	12.9	12.9	1.26	4.5
Uranquinty	66/22	10/16	10/16		17.6	0.99	5.7	5.7	5.7	5.7	5.7	1.95	6.5

WINTER	Wagga (Copland St) Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Ashmont	66/11	20/30	20/30		36	0.99	16.0	16.3	16.6	16.9	17.2	4.35	14.5
Bourkelands	66/11	10/13.333	10/13		15.6	1.00	10.3	10.5	10.7	10.9	11.1	4.73	4.5
Bulgary	66/22	2.5			0	1.00	0.1	0.1	0.1	0.1	0.1	0.00	2.5
Hammond Ave	66/11	24/30	24/30		36	1.00	13.4	13.4	13.4	13.4	13.4	2.73	5
Henty	66/11	5	5		6	1.00	2.2	2.2	2.2	2.2	2.2	1.35	6.5
Kooringal	66/11	18/25	18/25		30	0.99	15.4	15.4	15.5	15.5	15.5	5.89	6
Lockhart	66/22	8	5		6	0.96	3.0	3.0	3.0	3.0	3.0	1.62	3
Morrow St	66/11	20	20		24	0.98	9.0	9.1	9.2	9.3	9.4	1.26	13
Uranquinty	66/22	10/16	10/16		19.2	1.00	4.7	4.7	4.7	4.8	4.8	1.95	9.5

Sub-transmission Single Line Diagram of Wagga Wagga area

Please refer to the Sub-transmission Single Line Diagram of Wagga North area on Page 129.

2.3.47 Morven Supply Area

Description of Morven area

All zone substations in the Morven area are in the Murray region.

The Morven 132/66kV substation is owned by Essential Energy. It receives supply via a tee off the TransGrid Wagga Wagga 330kV (Gregadoo) – Albury (ANM) 132kV line 996. Culcairn 66/11kV and Holbrook 66/22kV zone substations take normal 66kV supply from Morven and backup 66kV supply from TransGrid's Wagga Wagga 132/66kV substation (Copland St) on the Essential Energy 66kV line 83M via Uranquinty and Holbrook.

MORVEN – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
996/1	132	TransGrid 132kV Line 996 Tee	Morven 132/66kV STS	45	9.3	9.4	9.5	9.7	9.8	86	6.6	6.6	6.6	6.6	6.6
83M/3	66	Morven 132/66kV STS	Culcairn ZS	15	4.6	4.6	4.6	4.6	4.6	25	4.1	4.1	4.2	4.2	4.3
83M/4	66	Morven 132/66kV STS	Holbrook ZS	15	3.6	3.6	3.6	3.6	3.6	25	3.3	3.3	3.3	3.3	3.3

STS and ZS load forecast

SUMMER	Morven Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Culcairn	66/11	5/7	8		7.7	0.96	4.6	4.6	4.6	4.6	4.6	2.29	4.5
Holbrook	66/22	5/7	5/7		7.7	0.99	3.6	3.6	3.6	3.6	3.6	1.75	4
Morven	132/66	30			0	0.98	9.3	9.4	9.5	9.7	9.8	0.00	4

WINTER	Morven Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Culcairn	66/11	5/7	8		8.4	0.99	4.1	4.1	4.2	4.2	4.3	2.29	4
Holbrook	66/22	5/7	5/7		8.4	1.00	3.3	3.3	3.3	3.3	3.3	1.75	2.5
Morven	132/66	30			0	1.00	6.6	6.6	6.6	6.6	6.6	0.00	10.5

Sub-transmission Single Line Diagram of Morven area

Please refer to the Sub-transmission Single Line Diagram of Wagga North area on Page 129.

2.3.48 Albury Supply Area

Description of Albury area

All zone substations in the Albury area are in the Murray region.

The Albury area 132kV sub-transmission system is supplied from TransGrid's Jindera 330/132kV sub-transmission substation with backup via TransGrid's 132kV line from ANM substation Ettamogah.

The Essential Energy substation of Corowa and Mulwala are supplied at 132kV from the Essential Energy 132kV powerlines connecting the Union Road substation to TransGrid's Finley 132/66kV sub-transmission substation.

ALBURY – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

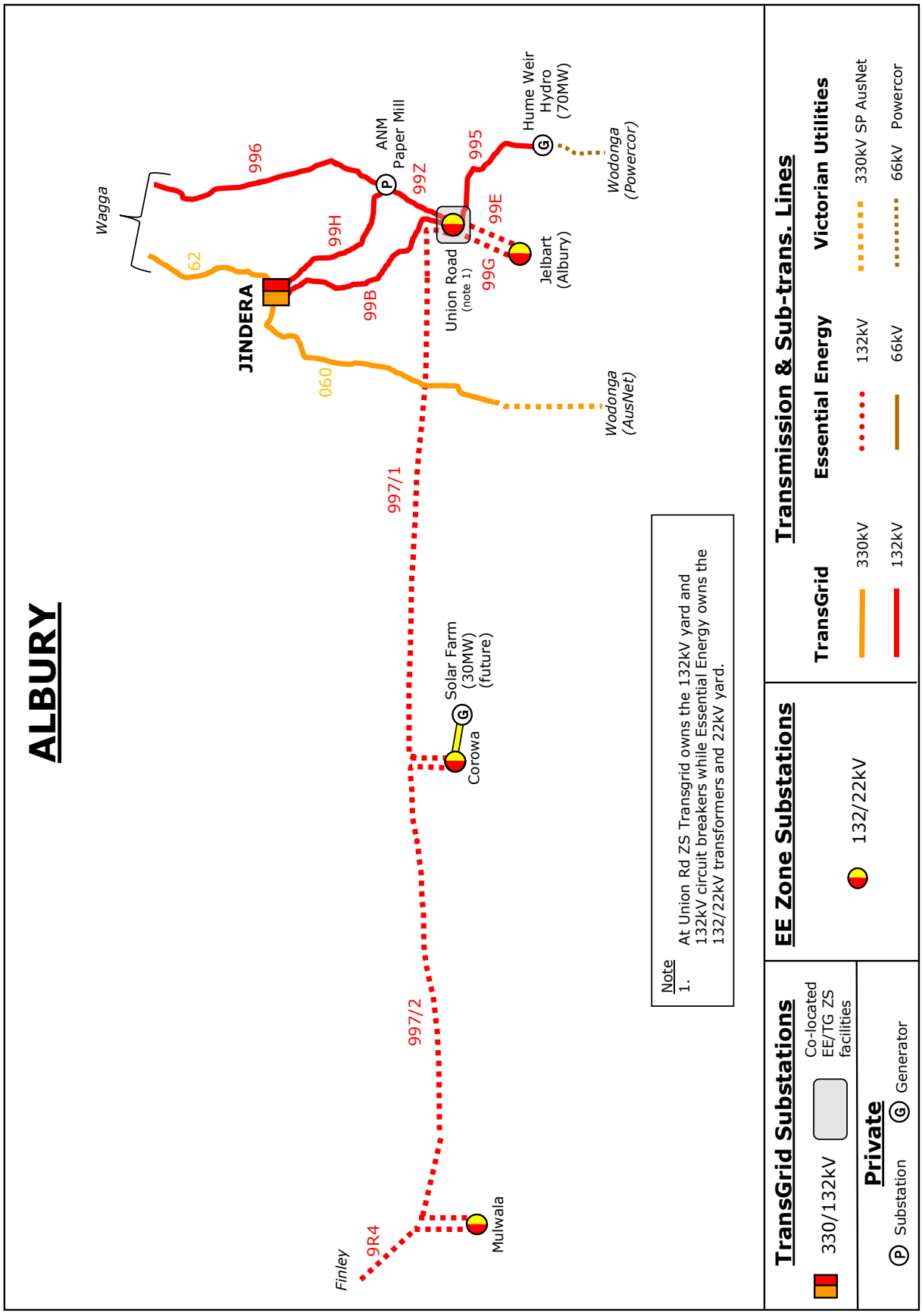
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
997/1	132	Union Rd ZS	Corowa ZS	128	33.1	33.3	33.4	33.5	33.6	143	23.5	23.6	23.8	24.0	24.1
997/2	132	Corowa ZS	Mulwala ZS	128	13.8	13.8	13.8	13.8	13.8	143	10.0	10.0	10.1	10.2	10.2
99E	132	Union Rd ZS	Jelbart ZS	148	21.5	21.3	21.2	21.1	20.9	164	16.7	16.6	16.6	16.6	16.5
99G	132	Union Rd ZS	Jelbart ZS	148	21.5	21.3	21.2	21.1	20.9	164	16.7	16.6	16.6	16.6	16.5

STS and ZS load forecast

SUMMER	Albury Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Corowa	132/22	30	27/30		33	0.97	19.3	19.5	19.6	19.7	19.8	7.93	2.5
Jelbart	132/22	30/44	30/44		48.4	0.99	43.0	42.7	42.4	42.1	41.8	8.15	4.5
Mulwala	132/22	30	30		33	0.98	13.8	13.8	13.8	13.8	13.8	3.96	5
Union Rd	132/22	15/35	30/44	30/44	86.9	0.98	54.1	54.0	53.9	54.0	54.0	20.39	3.5

WINTER	Albury Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Corowa	132/22	30	27/30		36	0.99	13.5	13.6	13.7	13.8	13.9	7.93	11.5
Jelbart	132/22	30/44	30/44		52.8	1.00	33.4	33.3	33.2	33.2	33.1	8.15	3
Mulwala	132/22	30	30		36	0.99	10.0	10.0	10.1	10.2	10.2	3.96	7.5
Union Rd	132/22	15/35	30/44	30/44	94.8	1.00	38.7	39.0	39.2	39.4	39.7	20.39	14.5

Sub-transmission Single Line Diagram of Albury area



2.3.49 Finley Supply Area

Description of Finley area

All zone substations in the Finley area are in the Murray region.

The Finley area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation.

FINLEY – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
9R4	132	TransGrid Finley 132/66kV STS	Mulwala ZS	140	13.5	13.5	13.5	13.6	13.5	157	10.9	10.9	10.9	10.9	10.9
84A	66	TransGrid Finley 132/66kV STS	Jerilderie ZS	15	3.5	3.5	3.5	3.5	3.5	25	3.8	3.8	3.8	3.8	3.8
84B	66	TransGrid Finley 132/66kV STS	Finley ZS	61	8.0	8.0	8.0	8.0	8.0	70	5.1	5.1	5.1	5.1	5.1
84C	66	TransGrid Finley 132/66kV STS	Finley ZS	61	5.9	5.9	5.9	5.9	5.9	70	3.7	3.7	3.7	3.7	3.7

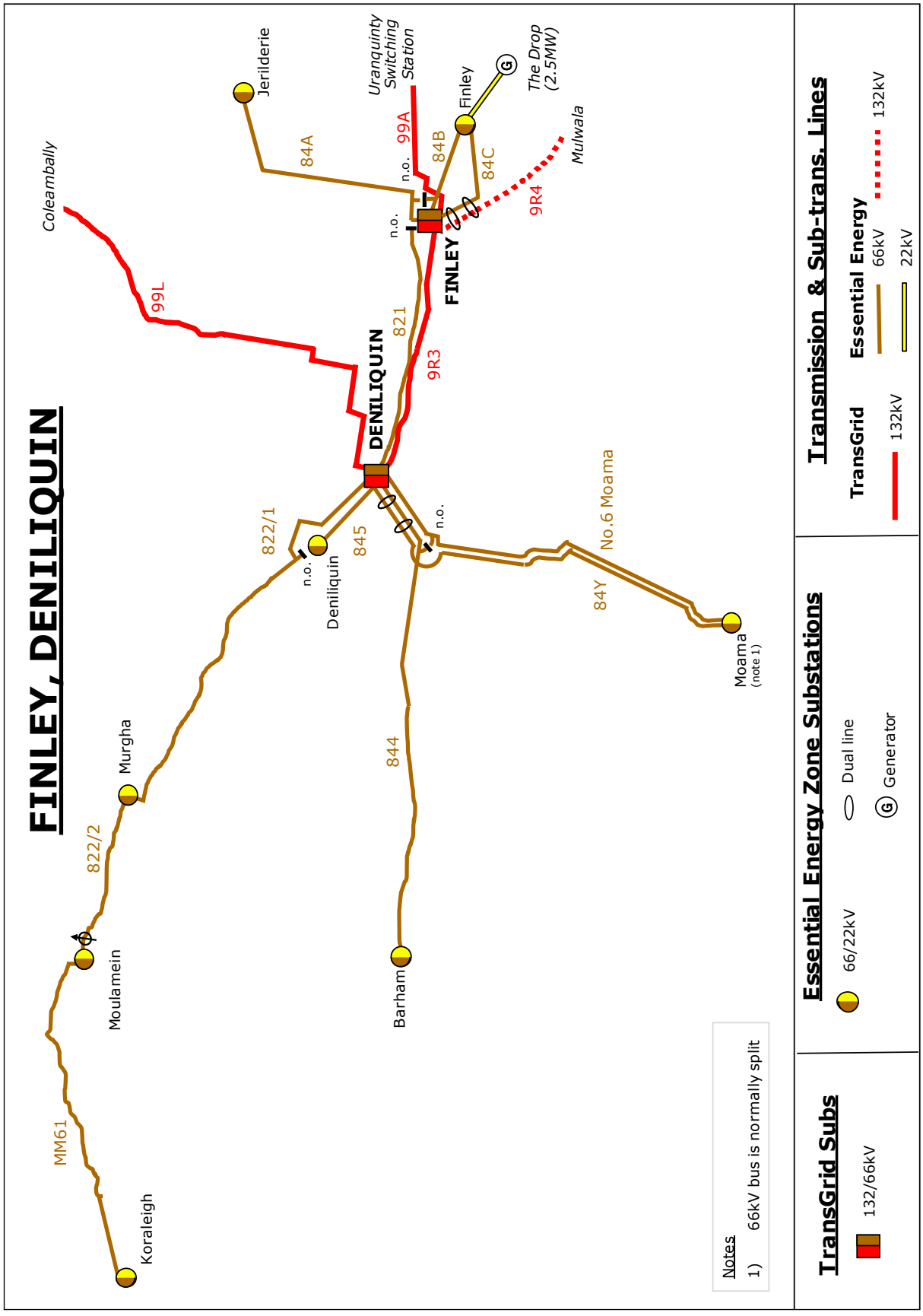
STS and ZS load forecast

SUMMER	Finley Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Finley Town	66/22	24/30	24/30		33	0.99	13.7	13.7	13.7	13.7	13.7	5.94	4.5
Jerilderie	66/22	8.8/10	8.8/10		11	1.00	3.2	3.2	3.2	3.2	3.2	1.43	5.5

WINTER	Finley Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Finley Town	66/22	24/30	24/30		36	1.00	10.3	10.3	10.3	10.3	10.3	5.94	8
Jerilderie	66/22	8.8/10	8.8/10		12	0.99	2.8	2.7	2.8	2.8	2.8	1.43	4.5

A 2.5MW hydro generator is located at The Drop and is connected to the Finley 66/22kV zone substation at 22kV via feeder FIN42.

Sub-transmission Single Line Diagram of Finley area



2.3.50 Deniliquin Supply Area

Description of Deniliquin area

All zone substations in the Deniliquin area are in the Murray region.

The Deniliquin area sub-transmission system is supplied from TransGrid's 132/66kV sub-transmission substation.

DENILIQUIN – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
844	66	TransGrid Deniliquin 132/66kV STS	Barham ZS	11	5.7	5.7	5.7	5.7	5.7	19	4.0	4.0	4.0	3.9	3.9
845	66	TransGrid Deniliquin 132/66kV STS	Deniliquin ZS	38	21.7	21.7	21.7	21.7	21.7	43	15.3	15.1	15.0	14.9	14.8
822/1	66	TransGrid Deniliquin 132/66kV STS	Murgha ZS	11	7.4	7.4	7.4	7.4	7.4	19	5.7	5.7	5.6	5.6	5.5
822/2	66	Murgha ZS	Moulamein ZS	11	6.3	6.3	6.3	6.2	6.3	19	4.9	4.9	4.8	4.8	4.7
84Y	66	TransGrid Deniliquin 132/66kV STS	Moama ZS	66	8.4	8.4	8.4	8.4	8.4	66	3.9	3.8	3.8	3.8	3.7
MM61	66	Moulamein ZS	Koraleigh ZS	15	4.1	4.1	4.1	4.1	4.1	25	2.3	2.3	2.3	2.2	2.2
No.6 Moama	66	TransGrid Deniliquin 132/66kV STS	Moama ZS	34	5.9	5.9	5.9	5.9	5.9	39	2.7	2.7	2.7	2.7	2.6

STS and ZS load forecast

SUMMER	Deniliquin Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Barham	66/22	10/16	10		11	0.98	5.5	5.6	5.5	5.6	5.5	2.73	6.5
Deniliquin	66/22	18/30	18/30		33	0.97	20.7	20.6	20.7	20.7	20.7	6.79	4
Koraleigh	66/22	8/11	5		5.5	0.98	4.4	4.4	4.4	4.4	4.4	1.80	4
Moama	66/22	24/30	24/30		33	0.99	16.4	16.6	16.9	17.1	17.3	4.53	3.5
Moulamein	66/22	8/11	5		5.5	1.00	1.9	1.9	1.9	1.9	1.9	0.74	6.5
Murgha	66/22	1			0	0.87	0.6	0.6	0.6	0.6	0.6	0.00	1

WINTER	Deniliquin Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Barham	66/22	10/16	10		12	1.00	4.3	4.3	4.3	4.3	4.3	2.73	1
Deniliquin	66/22	18/30	18/30		36	1.00	14.5	14.5	14.5	14.5	14.5	6.79	23.5
Koraleigh	66/22	8/11	5		6	1.00	2.9	2.9	2.9	3.0	3.0	1.80	4
Moama	66/22	24/30	24/30		36	1.00	10.3	10.5	10.6	10.8	10.9	4.53	6.5
Moulamein	66/22	8/11	5		6	0.99	1.4	1.4	1.4	1.4	1.4	0.74	10.5
Murgha	66/22	1			0	0.90	0.6	0.6	0.6	0.6	0.5	0.00	2.5

Sub-transmission Single Line Diagram of Deniliquin area

Please refer to the Sub-transmission Single Line Diagram of Finley area on Page 136.

2.3.51 Coleambally Supply Area

Description of Coleambally area

All zone substations in the Coleambally area are in the Central region.

Essential Energy's Coleambally 132/33kV sub-transmission substation is supplied from TransGrid's 132kV transmission powerlines 99L from Deniliquin and 99T from Darlington Point system.

COLEAMBALLY – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

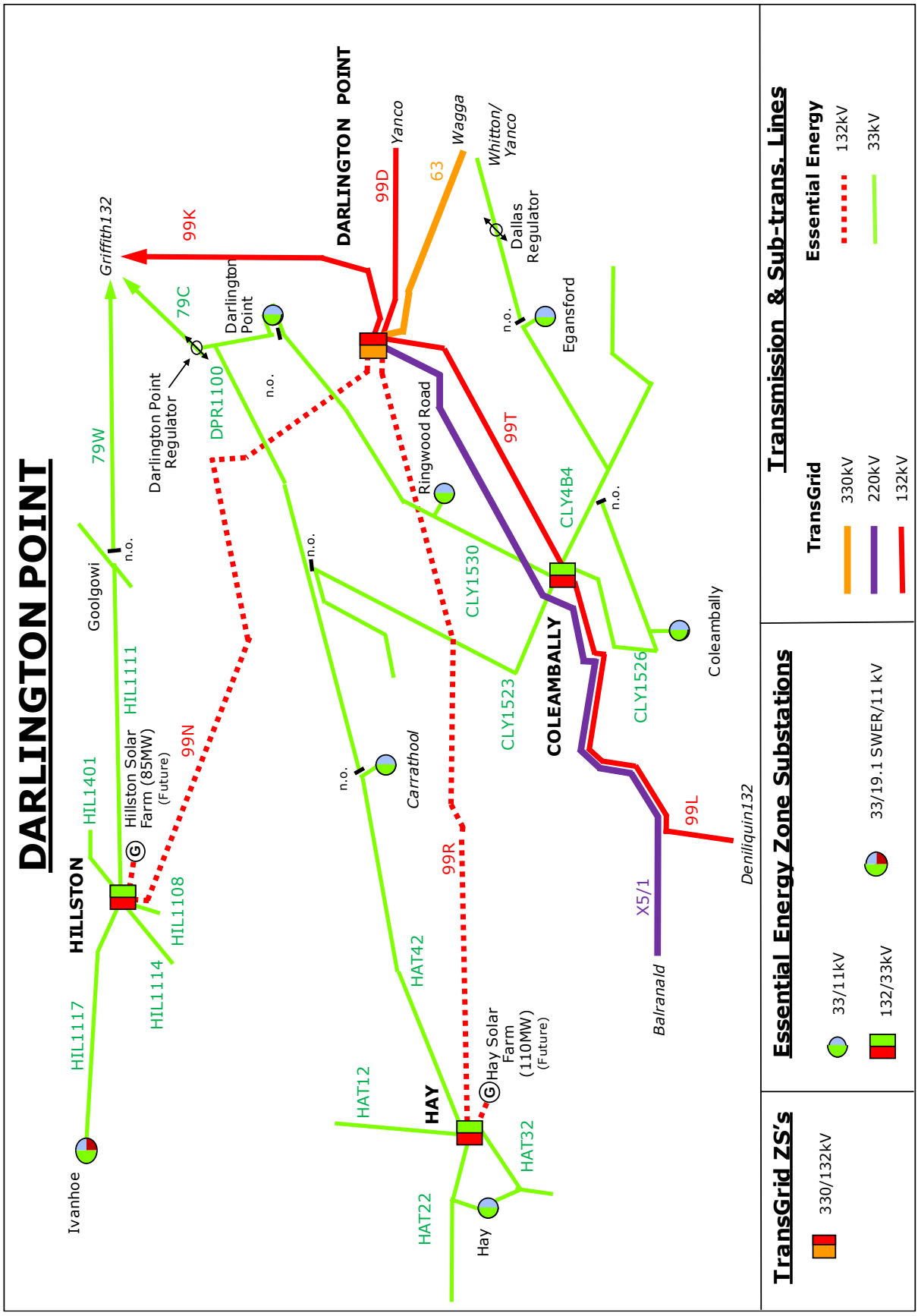
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
CLY1526	33	Coleambally 132/33kV STS	Coleambally Tee	10	9.5	9.5	9.5	9.5	9.4	19	8.9	8.9	8.9	8.9	8.9
CLY1526	33	Coleambally Tee	Coleambally ZS	10	8.7	8.6	8.6	8.6	8.6	19	8.1	8.1	8.1	8.1	8.1
CLY1526	33	Coleambally Tee	Egansford ZS	8	1.5	1.5	1.5	1.5	1.5	13	1.1	1.2	1.2	1.2	1.2
CLY1530	33	Coleambally 132/33kV STS	Ringw ood Rd ZS	8	6.1	6.2	6.1	6.1	6.1	13	4.0	3.9	3.8	3.7	3.6
CLY1530	33	Ringw ood Rd ZS	Darlington Point ZS	8	4.0	4.0	3.9	3.9	3.8	13	2.6	2.6	2.6	2.6	2.6

STS and ZS load forecast

SUMMER	Coleambally Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Coleambally 132kV	132/33	17.5/25	25		27.5	0.93	14.6	14.6	14.6	14.6	14.6	0.64	13.5
Coleambally 33/11kV	33/11	7.5	7.5		8.25	0.91	8.7	8.6	8.6	8.6	8.6	0.57	4.5
Darlington Point	33/11	10/12.5	10/14		13.75	0.81	4.0	4.0	3.9	3.9	3.8	0.68	3
Egansford	33/11	2.5	5		2.75	0.88	1.3	1.3	1.3	1.3	1.3	0.07	6
Ringwood Road	33/11	5			0	0.75	2.7	2.7	2.8	2.8	2.8	0.51	16

WINTER	Coleambally Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Coleambally 132kV	132/33	17.5/25	25		30	0.96	9.1	9.2	9.4	9.6	9.8	0.64	2.5
Coleambally 33/11kV	33/11	7.5	7.5		9	0.94	8.1	8.1	8.1	8.1	8.1	0.57	5.5
Darlington Point	33/11	10/12.5	10/14		15	0.88	2.6	2.6	2.6	2.6	2.6	0.68	4.5
Egansford	33/11	2.5	5		3	0.88	1.0	1.0	1.1	1.1	1.1	0.07	2
Ringwood Road	33/11	5			0	0.77	1.7	1.6	1.5	1.4	1.4	0.51	4.5

Sub-transmission Single Line Diagram of Coleambally area



2.3.52 Darlington Point Supply Area

Description of Darlington Point area

All zone substations in the Darlington Point area are in the Central region.

The Darlington Point area 132kV sub-transmission system is supplied from TransGrid's 330/132kV sub-transmission substation. Essential Energy owns the 132kV transmission lines supplying Hay and Hillston substations. The 33kV sub-transmission originates from these substations.

DARLINGTON POINT – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
99N	132	TransGrid Darlington Point 330/132kV STS	Hillston ZS	128	14.3	14.4	14.5	14.6	14.7	143	14.3	14.2	14.2	14.1	14.1
99R	132	TransGrid Darlington Point 330/132kV STS	Hay 132 ZS	128	8.4	8.4	8.4	8.3	8.3	143	13.6	13.6	13.5	13.4	13.4
HAT 22	33	Hay 132 ZS	Hay ZS	8	7.5	7.5	7.6	7.6	7.7	14	7.3	7.2	7.2	7.2	7.2
HAT 32	33	Hay 132 ZS	Hay ZS	8	1.3	1.3	1.3	1.3	1.4	14	1.4	1.4	1.4	1.4	1.4
HAT 42	33	Hay 132 ZS	Carrathool ZS	7	2.4	2.4	2.4	2.5	2.5	12	2.1	2.0	2.0	2.0	2.0
HIL1117	33	Hillston ZS	Ivanhoe ZS	8	4.0	4.0	4.0	4.0	4.1	14	4.7	4.7	4.7	4.7	4.7

STS and ZS load forecast

SUMMER	Darlington Point Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Carrathool	33/11	1.5	1.5		1.65	0.91	0.6	0.6	0.6	0.6	0.6	0.13	2.5
Hay 132kV	132/33	24/30	30/36		33	0.98	7.3	7.3	7.3	7.2	7.2	0.86	9.5
Hay Town	33/11	8/11	8/10		11	0.96	4.8	4.8	4.8	4.7	4.7	1.82	6.5
Hillston	132/33	30	12/16		17.6	1.00	12.9	13.1	13.3	13.4	13.6	2.25	6
Ivanhoe	33/11	1	1		1.1	0.98	1.0	1.0	1.0	1.1	1.1	0.16	9

WINTER	Darlington Point Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Carrathool	33/11	1.5	1.5		1.8	0.94	0.5	0.5	0.5	0.5	0.5	0.13	2.5
Hay 132kV	132/33	24/30	30/36		36	0.99	13.1	13.1	13.0	12.9	12.9	0.86	7
Hay Town	33/11	8/11	8/10		12	0.99	5.9	6.0	6.0	6.1	6.2	1.82	11
Hillston	132/33	30	12/16		19.2	0.99	7.1	7.1	7.1	7.1	7.2	2.25	4.5
Ivanhoe	33/11	1	1		1.2	0.98	0.7	0.7	0.7	0.7	0.7	0.16	7.5

Sub-transmission Single Line Diagram of Darlington Point area

Please refer to the Sub-transmission Single Line Diagram of Coleambally area on Page 140.

2.3.53 Griffith Supply Area

Description of Griffith area

All zone substations in the Griffith area are in the Central region.

The Griffith area sub-transmission system is supplied from TransGrid's 132/33kV sub-transmission substation.

GRIFFITH – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Voltage and thermal limitations under contingent conditions on Feeder 79W	3.1
Feeder – GFH3B6 Illilliwa	3.3

Sub-transmission feeder load forecast

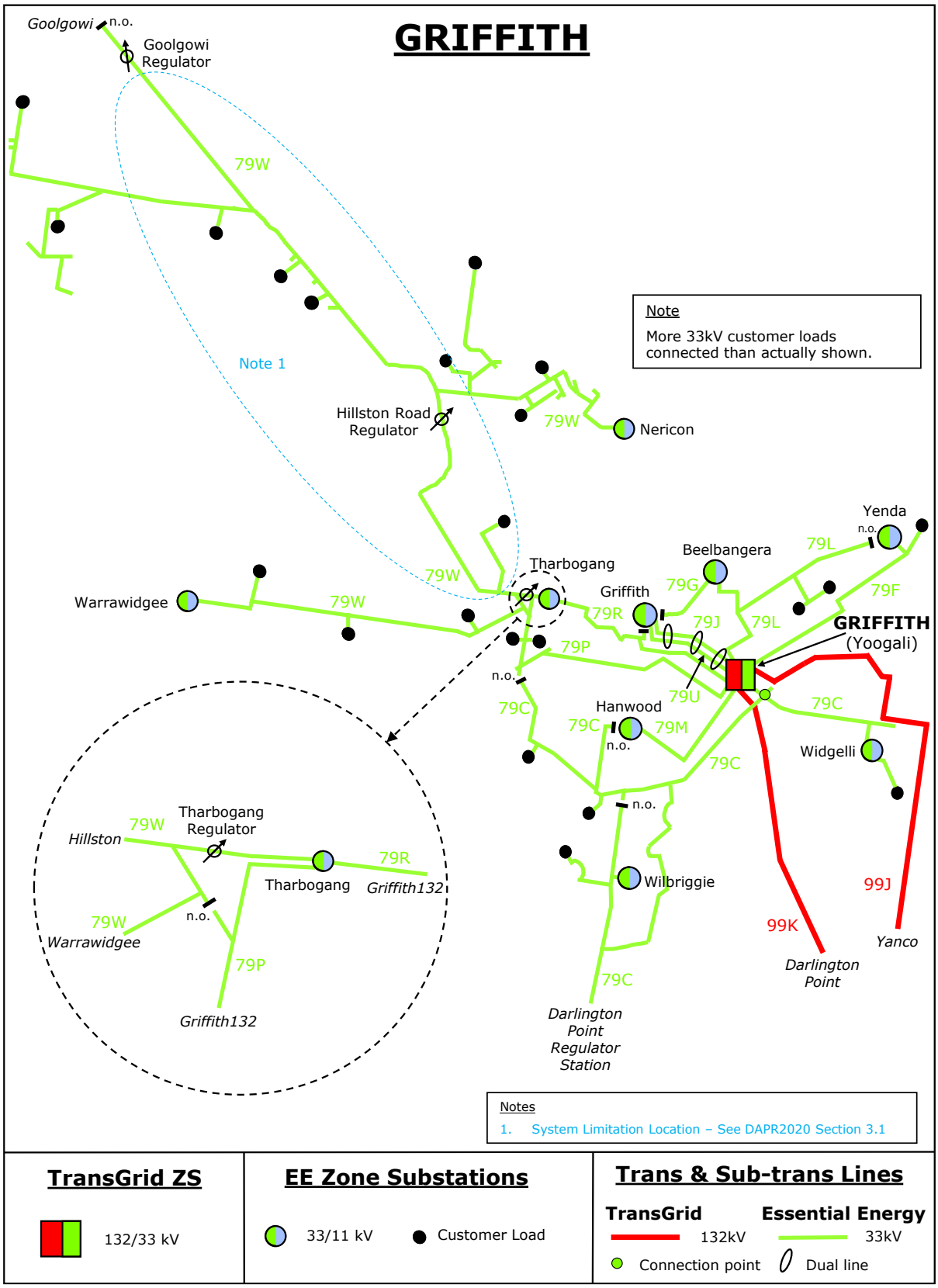
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
79C/1	33	TransGrid Griffith 132/33kV STS	Widgelli / Willbriggie Tee	10	5.4	5.5	5.4	5.4	5.4	19	4.9	5.0	5.1	5.1	5.1
79C/2	33	Widgelli / Willbriggie Tee	Widgelli ZS	10	1.0	1.0	1.0	1.0	1.0	19	0.8	0.8	0.9	0.9	0.9
79C/3	33	Widgelli / Willbriggie Tee	Willbriggie Tee	10	4.4	4.4	4.4	4.4	4.4	19	4.1	4.1	4.2	4.2	4.3
79C/4	33	Willbriggie Tee	Willbriggie ZS	10	3.9	3.9	3.9	3.9	3.9	19	3.6	3.6	3.7	3.7	3.7
79C/5	33	Willbriggie Tee	79C / 79P Tee	10	0.5	0.5	0.5	0.5	0.5	19	0.4	0.4	0.5	0.5	0.5
79F	33	TransGrid Griffith 132/33kV STS	Yenda ZS	22	10.6	10.6	10.6	10.6	10.6	27	7.3	7.4	7.5	7.5	7.6
79G	33	Beelbangera ZS	Griffith ZS	10	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0.0	0.0
79J	33	TransGrid Griffith 132/33kV STS	Griffith ZS	51	0.0	0.0	0.0	0.0	0.0	56	0.0	0.0	0.0	0.0	0.0
79L	33	TransGrid Griffith 132/33kV STS	Beelbangera ZS	10	11.9	11.9	11.9	11.8	11.8	19	6.9	7.0	7.1	7.1	7.2
79M	33	TransGrid Griffith 132/33kV STS	Hanwood ZS	22	12.9	13.3	13.7	14.1	14.5	27	10.5	10.9	11.2	11.5	11.9
79P	33	TransGrid Griffith 132/33kV STS	Warrawidgee Tee	22	8.4	8.4	8.4	8.4	8.4	27	6.5	6.6	6.7	6.7	6.8
79W	33	Warrawidgee Tee	Warrawidgee ZS	6	1.9	2.0	1.9	1.9	1.9	9	1.5	1.5	1.5	1.5	1.5
79W	33	Warrawidgee Tee	Nericon Tee	21	5.9	5.9	5.9	5.8	5.8	27	4.6	4.6	4.7	4.7	4.8
79W	33	Nericon Tee	Nericon ZS	6	2.6	2.6	2.6	2.6	2.6	9	1.6	1.6	1.6	1.6	1.7
79R	33	TransGrid Griffith 132/33kV STS	Tharbogang ZS	31	15.4	15.2	15.1	14.9	14.9	34	9.5	9.6	9.6	9.7	9.7
79U	33	TransGrid Griffith 132/33kV STS	Griffith ZS	51	26.8	26.7	26.6	26.4	26.4	56	19.7	20.0	20.3	20.6	20.8

STS and ZS load forecast

SUMMER	Griffith Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Beelbangera	33/11	10/12.5	10/12.5		13.75	0.95	11.6	11.7	12.0	12.2	12.4	3.02	4
Griffith	33/11	40/50	40/50		55	1.00	26.8	26.7	26.6	26.4	26.4	6.61	3.5
Hanwood	33/11	15/17/25	15/17/25		27.5	1.00	12.9	13.3	13.7	14.1	14.5	1.08	46
Nericon	33/11	5/8			0	0.94	2.2	2.2	2.3	2.3	2.4	0.51	11
Tharbogang	33/11	15/20/25	15/20/25		27.5	0.94	15.4	15.2	15.1	14.9	14.9	4.30	5
Warrawidgee	33/11	2.5	3		2.75	0.85	1.5	1.5	1.5	1.5	1.6	0.22	14.5
Widgelli	33/11	1			0	0.90	0.4	0.4	0.4	0.4	0.4	0.00	5.5
Willbriggie	33/11	5/8			0	0.94	2.1	2.1	2.1	2.1	2.1	0.26	6
Yenda	33/11	7.5/9.5	7.5/9.5		10.45	1.00	7.2	7.2	7.2	7.3	7.2	1.28	2

WINTER	Griffith Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Beelbangera	33/11	10/12.5	10/12.5		15	0.98	6.7	7.0	7.3	7.6	8.0	3.02	4
Griffith	33/11	40/50	40/50		60	1.00	19.7	20.0	20.3	20.6	20.8	6.61	5
Hanwood	33/11	15/17/25	15/17/25		30	1.00	10.5	10.9	11.2	11.5	11.9	1.08	7.5
Nericon	33/11	5/8			0	0.96	1.2	1.1	1.1	1.1	1.1	0.51	5
Tharbogang	33/11	15/20/25	15/20/25		30	1.00	9.5	9.6	9.6	9.7	9.7	4.30	4
Warrawidgee	33/11	2.5	3		3	0.87	0.7	0.7	0.7	0.7	0.7	0.22	1
Widgelli	33/11	1			0	0.92	0.4	0.4	0.4	0.4	0.5	0.00	7.5
Willbriggie	33/11	5/8			0	0.97	1.5	1.5	1.5	1.5	1.5	0.26	22
Yenda	33/11	7.5/9.5	7.5/9.5		11.4	0.99	4.1	4.3	4.5	4.7	4.9	1.28	4

Sub-transmission Single Line Diagram of Griffith area



2.3.54 Yanco Supply Area

Description of Yanco area

All zone substations in the Yanco area are in the Central region.

The Yanco area sub-transmission system is supplied from TransGrid's 132/33/66kV sub-transmission substation. The 66kV sub-transmission system originates from TransGrid's 132/33/66kV sub-transmission substation via an Essential Energy 33/66kV transformer.

YANCO – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

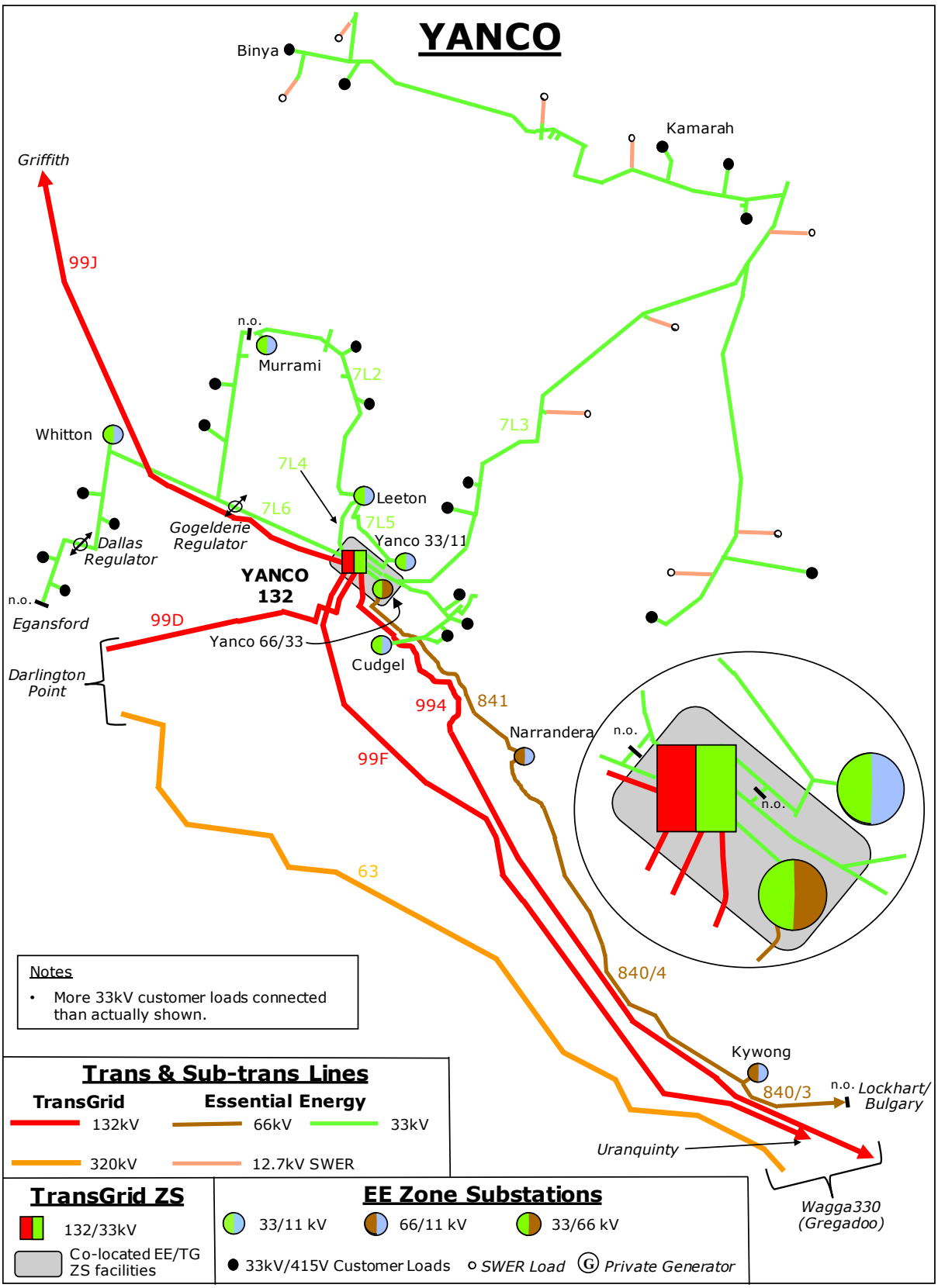
Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
840/4	66	Narrandra ZS	Kyw ong ZS	16	0.4	0.4	0.4	0.4	0.4	25	0.2	0.2	0.2	0.2	0.2
841:YNC	66	TransGrid Yanco 132/33/66kV STS	Narrandera ZS	15	10.0	10.0	10.1	10.0	10.1	25	7.4	7.5	7.6	7.7	7.8
7L3	33	TransGrid Yanco 132/33/66kV STS	Cudgel ZS	8	1.0	1.0	1.0	1.0	1.0	13	0.9	0.9	0.9	0.9	0.9
7L6	33	TransGrid Yanco 132/33/66kV STS	Whitton / Murrami Tee	15	6.5	6.6	6.7	6.8	6.8	18	5.0	5.0	5.0	5.0	5.0
7L6	33	Whitton / Murrami Tee	Whitton ZS	8	4.9	5.0	5.2	5.3	5.4	13	2.3	2.3	2.5	2.6	2.6
7L6	33	Whitton / Murrami Tee	Murrami ZS	8	0.9	0.9	0.9	0.9	0.9	13	0.4	0.4	0.4	0.4	0.4
7L5	33	TransGrid Yanco 132/33/66kV STS	Yanco ZS	8	12.3	12.4	12.5	12.6	12.7	13	9.0	9.1	9.1	9.2	9.2
7L5	33	Yanco ZS	Leeton ZS	6	9.5	9.5	9.5	9.6	9.6	9	7.9	8.0	8.0	8.0	8.0
7L4	33	TransGrid Yanco 132/33/66kV STS	Leeton ZS	31	10.3	10.3	10.3	10.4	10.4	34	8.3	8.3	8.3	8.3	8.4

STS and ZS load forecast

SUMMER	Yanco Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Kywong	66/11	3			0	0.96	0.4	0.4	0.4	0.4	0.4	0.09	4.5
Leeton	33/11	15/20/25	15/20/25		27.5	0.94	19.7	19.8	19.9	20.0	20.0	4.96	4
Murrami	33/11	5	5		5.5	0.92	0.9	0.9	0.9	0.9	0.9	0.35	3.5
Narrandera	66/11	10/16	10/16		17.6	0.98	10.0	10.1	10.1	10.1	10.1	3.06	5
Whitton	33/11	5/6.25	5/6.25		6.875	0.93	4.9	5.0	5.2	5.3	5.4	0.64	21.5
Yanco 33/11kV	33/11	5			0	0.95	2.8	2.9	2.9	3.0	3.0	0.91	4.5
Yanco 33/66kV	33/66	15			0	1.00	10.9	10.9	11.0	11.0	11.1	0.43	5

WINTER	Yanco Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Kywong	66/11	3			0	0.96	0.2	0.2	0.2	0.2	0.2	0.09	5
Leeton	33/11	15/20/25	15/20/25		30	0.98	16.5	16.6	16.7	16.7	16.7	4.96	1
Murrami	33/11	5	5		6	0.93	0.4	0.4	0.4	0.4	0.4	0.35	1.5
Narrandera	66/11	10/16	10/16		19.2	1.00	7.5	7.6	7.7	7.8	7.9	3.06	19
Whitton	33/11	5/6.25	5/6.25		7.5	0.92	2.3	2.3	2.5	2.6	2.6	0.64	1
Yanco 33/11kV	33/11	5			0	0.98	2.0	2.1	2.1	2.2	2.2	0.91	2.5
Yanco 33/66kV	33/66	15			0	0.98	10.2	10.3	10.5	10.6	10.8	0.43	1

Sub-transmission Single Line Diagram of Yanco area



2.3.55 Buronga Supply Area

Description of Buronga area

All zone substations in the Buronga area are in the Murray region.

Supply to the Dareton, Wentworth and Buronga areas originates from the Powercor 66kV sub-transmission substations at Merbein and Mildura in Victoria, which is in turn supplied from the Red Cliffs Victoria 220/66kV sub-transmission substation south east of Mildura.

The Balranald area is supplied from TransGrid's 220/22kV substation. Backup supply is seasonal limited via Moulamein 22kV system.

BURONGA – Identified System Limitations	
SYSTEM LIMITATION	Refer to DAPR Section
Nil	

Sub-transmission feeder load forecast

Feeder #	Feeder Voltage kV	Feeder Origin	Feeder Destination	Summer						Winter					
				Line Rating	Line Forecast MVA					Line Rating	Line Forecast MVA				
				MVA	20/21	21/22	22/23	23/24	24/25	MVA	2021	2022	2023	2024	2025
87G	66	Dareton ZS	Ellerslie ZS	67	12.6	12.7	12.7	12.7	12.8	78	11.2	11.2	11.2	11.2	11.3
87H/1	66	Ellerslie ZS	Ginkgo Snapper Tee	45	11.4	11.4	11.5	11.5	11.6	56	10.8	10.8	10.9	10.9	10.9
87H/2	66	Ginkgo Snapper Tee	Ginkgo ZS	20	6.7	6.7	6.7	6.6	6.7	39	7.2	7.2	7.3	7.3	7.3
87H/3	66	Ginkgo Snapper Tee	Snapper ZS	12	5.2	5.3	5.3	5.4	5.4	19	4.8	4.8	4.8	4.8	4.8
83U	66	Powercor Mildura ZS (NSW Border)	Buronga ZS	22	20.2	20.2	20.3	20.2	20.2	43	13.4	13.4	13.4	13.4	13.4
83W	66	Buronga ZS	Dareton ZS	22	0.0	0.0	0.0	0.0	0.0	43	0.0	0.0	0.0	0.0	0.0
Merbein - Dareton Line	66	Powercor Mildura ZS (NSW Border)	Dareton ZS	49	17.1	17.1	17.1	17.1	17.1	61	13.0	12.9	12.9	12.9	13.0

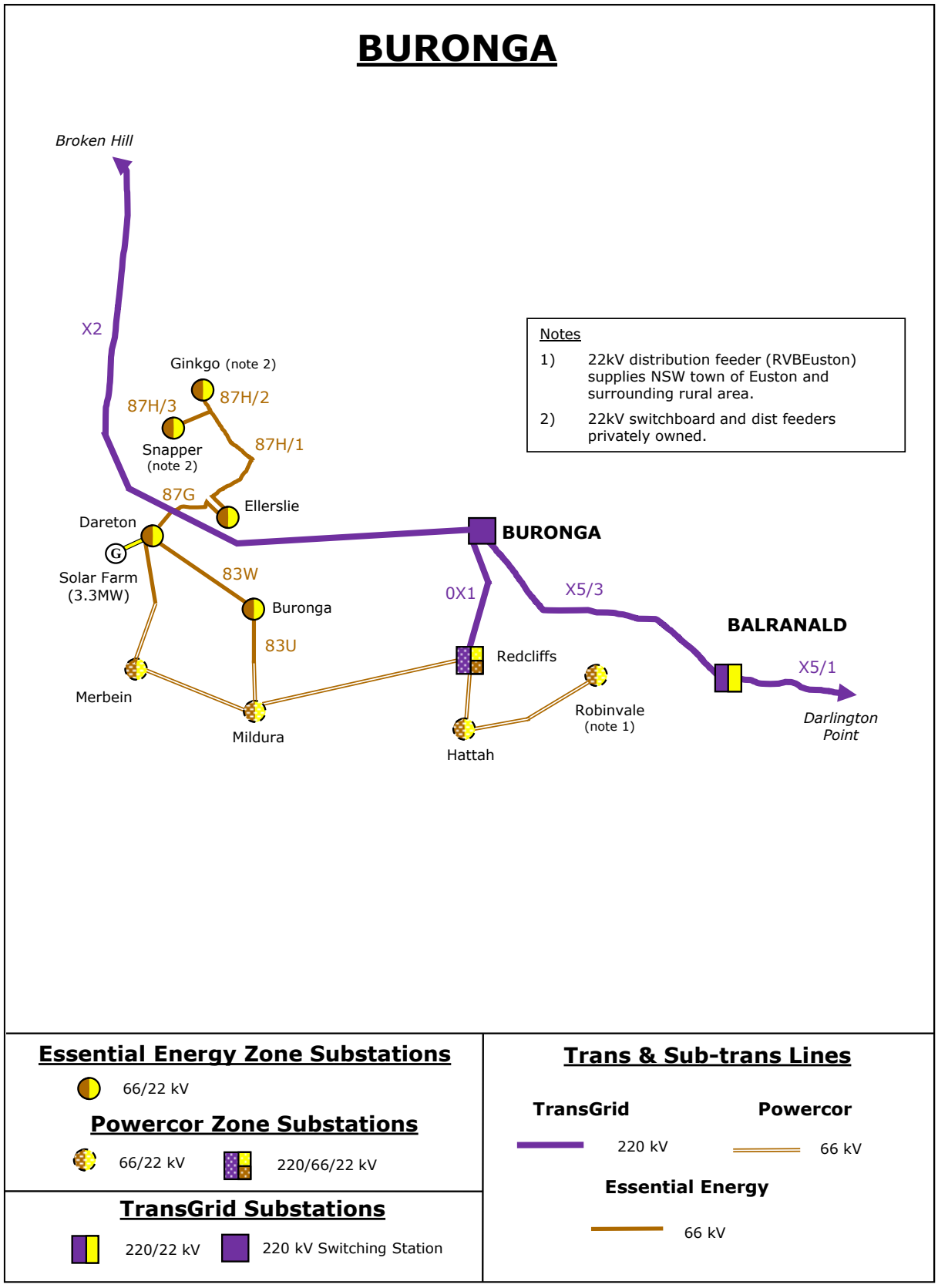
STS and ZS load forecast

SUMMER	Buronga Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			20/21	21/22	22/23	23/24	24/25		
Powercor Robinvale 22kV Euston Distribution Supply						0.96	6.3	6.3	6.3	6.3	6.3	1.28	2.5
TransGrid 220/22kV Total Balranald 22kV Supply						1.00	4.1	4.2	4.2	4.2	4.3	0.84	5
Buronga Town	66/22	20/30	20/30		33	0.96	13.3	13.6	13.9	14.1	14.4	2.97	6
Dareton	66/22	24/30	24/30		33	0.97	13.7	13.6	13.7	13.7	13.7	2.13	7
Ellerslie	66/22	5/8			0	0.99	2.6	2.6	2.6	2.6	2.6	0.43	3.5
Ginkgo	66/22	12.5/16			0	0.94	6.7	6.7	6.7	6.6	6.7	0.00	41.5
Snapper	66/22	10/16			0	0.97	5.2	5.3	5.3	5.4	5.4	0.00	12

WINTER	Buronga Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2021	2022	2023	2024	2025		
Powercor Robinvale 22kV Euston Distribution Supply						0.97	3.1	3.1	3.1	3.1	3.1	1.28	1
TransGrid 220/22kV Total Balranald 22kV Supply						0.98	2.7	2.7	2.7	2.7	2.8	0.84	2
Buronga Town	66/22	20/30	20/30		36	0.99	7.9	7.8	7.8	7.8	7.8	2.97	3.5
Dareton	66/22	24/30	24/30		36	1.00	6.7	6.8	6.8	6.8	6.8	2.13	4
Ellerslie	66/22	5/8			0	0.99	1.6	1.6	1.6	1.6	1.6	0.43	4.5
Ginkgo	66/22	12.5/16			0	0.89	7.2	7.2	7.3	7.3	7.3	0.00	52
Snapper	66/22	10/16			0	0.97	4.8	4.8	4.8	4.8	4.8	0.00	7

A 3.3MW solar generator is located at Dareton on the 22kV network.

Sub-transmission Single Line Diagram of Buronga area



2.4 Future Connection Points

There are no Future Connection Points that are in progress for Essential Energy. A 330/11kV connection to TransGrid is being explored for the resupply of Cabramurra and Selwyn, identified in Section 4.3 Urgent and Unforeseen Investments.

2.5 Transmission – Distribution Connection Point Load Forecast

The embedded generation includes all major generation capacity but excludes the rooftop PV generation (which is shown against the individual zone substation forecasts).

2.5.1 Transmission – Distribution Connection Point load forecast

Transmission Distribution Connection Point POE50 Indicative Demand Forecast													
Connection Point	Forecast PF	Summer Forecast (MVA)					Forecast PF	Winter Forecast (MVA)					Major Embedded Generation (MW)
		20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025	
Albury (Corowa)	0.97	19.3	19.5	19.6	19.7	19.9	0.99	13.5	13.6	13.7	13.8	13.9	0
Albury (Mulwala)	0.98	13.8	13.8	13.8	13.8	13.8	0.99	10.0	10.0	10.1	10.2	10.2	0
Albury (Union Rd + Jelbart)	0.98	92.2	92.0	92.0	92.0	92.0	0.99	71.0	71.2	71.2	71.2	71.4	0
Armidale	1.00	30.0	30.0	30.1	30.1	30.1	1.00	44.6	44.7	44.8	44.9	45.0	5
Balranald	1.00	4.1	4.2	4.2	4.2	4.3	0.98	2.7	2.7	2.7	2.8	2.8	0
Beryl	0.98	73.9	74.8	75.5	76.4	77.2	0.99	80.6	81.3	81.9	82.6	83.3	0
Boambee South	1.00	17.3	17.3	17.2	17.1	17.1	1.00	17.3	17.3	17.3	17.3	17.2	0
Broken Hill 22kV	0.97	41.2	41.2	41.2	41.2	41.3	1.00	38.6	38.6	38.6	38.6	38.6	50
Casino	0.96	32.0	32.1	32.4	32.7	32.8	0.99	21.8	21.9	22.0	22.1	22.2	0
Coffs Harbour	0.99	60.9	61.0	61.2	61.4	61.5	0.99	58.8	59.2	59.4	59.6	59.7	0
Coleambally	0.93	21.5	21.5	21.5	21.4	21.5	0.96	15.6	15.7	15.9	16.1	16.2	0
Cooma 132kV	0.85	34.7	34.6	34.6	34.6	34.6	0.85	52.8	53.7	54.6	55.6	56.0	118
Cooma 66kV (Includes Generation)	0.99	13.6	13.6	13.6	13.5	13.5	1.00	25.2	25.3	25.3	25.2	25.3	1.1
Cowra (Includes Generation)	0.99	35.8	36.0	36.1	36.4	36.6	1.00	36.4	36.9	37.3	37.7	38.2	22.5
Darlington Point	0.90	24.7	24.9	25.1	25.2	25.4	0.82	24.4	24.3	24.2	24.2	24.1	0
Deniliquin	0.98	48.8	48.8	48.8	48.8	48.8	1.00	31.2	30.9	30.7	30.4	30.2	0
Dorrigo	0.97	2.9	2.9	2.9	3.0	3.0	0.98	2.8	2.8	2.8	2.8	2.8	0
Dunoon	1.00	6.7	6.7	6.9	7.0	7.1	1.00	6.9	7.0	7.1	7.2	7.3	0
Evans Lane	1.00	37.2	37.3	37.4	37.5	37.7	1.00	57.6	58.7	59.8	60.8	61.8	0
Finley 132kV	-	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0
Finley 66kV (Includes Generation)	0.99	16.9	16.9	16.9	16.9	16.9	1.00	12.4	12.4	12.4	12.4	12.4	2.5
Forbes	0.99	34.6	34.6	34.6	34.7	34.7	0.98	25.6	25.5	25.4	25.4	25.3	4.1
Glen Innes	0.97	9.4	9.4	9.4	9.4	9.4	0.98	13.7	13.6	13.6	13.6	13.5	5.5
Griffith	1.00	81.0	81.2	81.0	80.9	81.0	0.99	53.2	53.9	54.8	54.9	55.5	0
Gunnedah 66kV	0.98	40.3	40.3	40.4	40.4	40.5	0.98	36.4	36.3	36.1	36.0	35.9	7
Hawks Nest	1.00	10.3	10.4	10.6	10.7	10.8	0.99	9.2	9.3	9.4	9.5	9.5	0
Herons Ck	0.98	11.9	12.2	12.6	12.9	13.4	0.99	11.6	11.9	12.2	12.5	12.8	0
Inverell	0.98	34.6	35.1	35.5	35.9	36.3	0.96	33.9	34.1	34.2	34.4	34.5	22.5
Kempsey 33kV	0.99	30.1	30.3	30.5	30.7	31.0	1.00	33.5	34.2	34.8	35.6	36.4	0
Koolkhan	0.99	62.3	62.4	62.7	63.0	63.4	0.99	48.7	48.9	49.2	49.4	49.6	0
Lismore 132kV	0.97	89.9	91.0	91.7	92.8	93.5	0.99	70.7	70.9	70.8	70.8	70.8	37.5
Macksville	0.99	8.8	8.8	8.9	8.9	8.9	1.00	9.9	10.0	10.1	10.2	10.2	0
Manildra	0.94	10.8	10.9	11.1	11.2	11.3	0.97	10.2	10.4	10.6	10.8	11.0	48.5
Marulan (Includes Generation)	0.98	67.1	68.7	70.1	71.6	73.1	0.99	59.9	60.4	61.0	61.5	62.1	118
Merbein	0.96	17.0	17.0	17.0	17.0	17.0	0.98	13.0	12.9	12.9	12.9	13.0	0
Mildura	0.96	20.2	20.2	20.3	20.2	20.2	0.99	13.4	13.4	13.4	13.4	13.4	3.3
Molong	1.00	5.8	5.9	5.9	5.9	6.0	0.99	5.3	5.4	5.4	5.4	5.5	0

2.5.2 Transmission – Distribution Connection Point load forecast – Continued

Transmission Distribution Connection Point POE50 Indicative Demand Forecast													
Connection Point	Forecast PF	Summer Forecast (MVA)					Forecast PF	Winter Forecast (MVA)					Major Embedded Generation (MW)
		20/21	21/22	22/23	23/24	24/25		2021	2022	2023	2024	2025	
Moree	0.99	23.8	23.8	23.8	23.8	23.7	0.99	28.3	28.3	28.3	28.3	28.3	61
Morven	0.98	9.3	9.4	9.5	9.7	9.8	1.00	6.6	6.6	6.6	6.6	6.6	0
Mudgee	0.99	27.4	27.5	27.4	27.4	27.4	1.00	24.7	25.2	25.7	26.3	26.8	0
Mullumbimby	1.00	51.2	52.3	53.5	54.8	56.0	1.00	56.1	57.2	58.3	59.6	60.7	0
Munyang	0.93	3.2	3.2	3.2	3.2	3.2	0.95	34.2	34.2	34.2	34.5	34.5	0
Murrumbateman	1.00	7.4	7.5	7.6	7.7	7.8	1.00	7.3	7.5	7.7	7.9	8.1	0
Murrumburrah	0.98	44.8	44.8	44.8	44.8	44.7	1.00	35.5	35.6	35.7	35.9	36.0	0
Nambucca	0.99	7.2	7.2	7.3	7.3	7.4	0.99	8.8	8.8	8.9	8.9	8.9	0
Narrabri	0.97	44.5	44.5	44.4	44.5	68.5	0.99	42.2	42.1	42.1	65.9	65.9	16
Orange 132kV	0.99	166.2	183.1	180.2	179.5	180.6	0.99	168.2	185.0	182.8	182.4	182.6	0
Orange 66kV	0.97	59.9	59.9	60.0	60.2	60.3	0.97	69.4	70.0	70.6	71.2	71.8	0
Panorama (Includes Generation)	0.99	84.5	85.2	86.0	86.5	87.0	0.99	76.3	76.8	77.4	77.9	78.4	10
Parkes 132kV	0.93	53.1	53.1	53.1	53.2	53.2	0.93	54.2	54.8	55.2	55.8	56.3	0
Parkes 66kV	0.95	29.5	29.3	29.4	29.3	29.3	0.97	28.0	28.6	29.2	29.7	30.3	0
Port Macquarie	0.99	73.2	74.5	76.0	77.4	78.7	1.00	83.1	84.6	86.0	87.2	88.9	0
Queanbeyan 132kV	0.97	10.0	10.7	11.5	12.2	19.8	0.99	12.3	13.7	15.3	16.8	25.2	0
Queanbeyan 66kV	0.99	65.2	69.5	71.9	74.3	69.3	1.00	66.4	71.0	73.7	76.4	71.7	0
Raleigh	0.98	10.3	10.5	10.6	10.8	11.0	1.00	10.7	10.9	11.0	11.1	11.3	0
Robinvale	0.96	6.3	6.3	6.3	6.3	6.3	0.97	3.1	3.1	3.1	3.1	3.1	0
Snowy Adit	-	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0
Stroud	1.00	37.8	38.8	39.7	40.6	41.5	0.99	32.3	32.8	33.1	33.6	33.9	0
Tamworth	0.98	125.8	126.4	126.4	126.7	126.6	1.00	96.6	97.6	98.3	99.2	100.1	0
Taree 33kV	0.99	33.7	34.4	35.1	35.9	36.6	0.99	26.9	27.2	27.4	27.7	28.0	0
Taree 66kV	0.99	51.1	51.2	51.3	51.4	51.6	1.00	54.8	54.8	54.8	55.0	55.0	0
Tenterfield	0.99	3.8	3.8	3.8	3.8	3.8	1.00	5.3	5.3	5.3	5.3	5.3	0
Terranora	0.99	94.0	95.1	100.7	101.2	101.7	1.00	95.8	97.2	103.1	104.0	105.1	30
Tumut (Includes Generation)	0.94	33.7	33.7	33.7	33.7	33.7	0.94	35.6	35.7	35.7	35.6	35.6	14
Wagga 66kV	0.98	91.0	90.6	89.8	89.3	88.7	1.00	69.0	68.4	68.0	67.6	67.1	0
Wagga North 132kV	1.00	69.1	69.6	70.0	70.6	70.9	0.98	60.1	59.9	59.9	59.8	59.7	0
Wagga North 66kV	0.95	24.8	24.6	27.6	27.3	27.1	0.99	22.6	22.4	25.4	25.3	25.2	0
Waggamba	1.00	19.9	19.9	19.9	19.9	19.9	1.00	18.3	18.4	18.3	18.4	18.4	0
Wallerawang 132kV	0.86	28.3	28.6	28.9	29.2	29.5	0.86	29.3	29.4	29.4	29.5	29.5	0
Wallerawang 66kV	0.99	4.3	4.3	4.3	4.3	4.3	0.98	6.7	6.7	6.8	6.8	6.8	0
Wellington 132kV	1.00	182.1	181.7	181.6	181.4	181.7	1.00	157.7	157.7	158.2	158.5	158.8	251.3
Yanco	0.99	43.5	44.0	44.6	45.0	45.5	0.99	33.5	33.6	33.6	33.5	33.4	0
Yass 132kV	-	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0
Yass 66kV	0.99	15.8	15.9	15.9	15.9	16.0	0.97	14.6	14.8	15.0	15.3	15.5	0

2.6 Forecast of Reliability Target Performance

The 2019/20 financial year is the fifth year since the introduction of the Service Target Performance Incentive Scheme (STPIS) to Essential Energy. The STPIS provides incentives for improved normalised reliability performance and penalises reduced normalised reliability performance against System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) targets.

The following targets have been set by the AER for the network performance component of STPIS for the period 2019/20 - 2023/24. These targets are based on the average performance level of Essential Energy's network over the previous regulatory period.

Table 4 – STPIS targets 2019/20 to 2023/24

Feeder Category	Unplanned SAIDI (minutes)	Unplanned SAIFI (interruptions)
Urban	72.99	0.896
Short Rural	204.31	1.850
Long Rural	447.38	2.942

In addition to the targets listed in Table 4, are the Reliability and Performance licence conditions set out by IPART that impose reliability performance standards on electricity distributors. These are categorised by different feeder lengths and load densities. Reliability performance standards were met for all feeder categories in 2019/20. Essential Energy uses this data to make efficient investment decisions for the sub-transmission and distribution networks.

According to the normalised index that covers the average number of interruptions (SAIFI) and the average time customers are without electricity (SAIDI) during the year, Essential Energy's network reliability in the reporting period increased compared to the previous period.

Customers were without electricity for an average of 243 minutes in 2019/20 (SAIDI), compared to 236 minutes in 2018/19. The average frequency of interruptions per customer (SAIFI) was 1.798 in 2019/20, compared to 1.875 in the previous year. The restoration of performance to atypical levels can be attributed to poor weather conditions over the course of the year.

3. IDENTIFIED SYSTEM LIMITATIONS

A major part of the planning process involves performing network analysis using the latest demand forecast to establish network performance under different loading and network configurations that relate to the planning criteria outlined in Essential Energy's licence conditions and internal guidelines.

The process identifies whether the network performance obligations are satisfied within the forward planning period or if corrective action is required to address a network limitation. It should be noted that limitations identified in this report have been assessed under the network conditions and licence requirements pertaining at the time of assembly, and are subject to review in the event of any significant change to either. Essential Energy defines the normal cyclic ratings for zone substation transformers as 110 per cent of nameplate rating in summer and 120 per cent of nameplate rating in winter.

Only primary distribution feeder limitations where network proposals have been developed are included in this section. A distribution feeder strategic review is underway to provide more comprehensive advice in subsequent reports.

The NER requires distribution network service providers to investigate non-network options by utilising a thorough consultation process to facilitate input into the planning of major network upgrades. This provides opportunity for interested parties and the community to submit options and ideas allowing for the development of cost effective demand management and other system support options.

The NER calls for a 'screening test' to be performed for all capital investments above $6M to determine if a non-network option is credible and should be investigated further. If a non-network option is deemed to be feasible, Essential Energy will conduct a detailed investigation to determine the objective and targets for a non-network option to be successful and publish this information in a Non-Network Options Report. Alternatively, a notice must be published if it is determined on reasonable grounds there are no feasible non-network options to address the investment.

The AER published a distribution system limitation template in June 2017 to enable the delivery of useable and consistent information to non-network service providers for addressing identified network needs. The template is designed to improve the quality of the information provided, and enable rapid evaluation of alternative solutions. All investments provided within this template have not yet been assessed for internal or external non-network solutions.

This section outlines the identified network limitations and provides an indication of the potential network solutions against which the credible non-network alternatives will be assessed.

The detailed list of identified limitations, asset ratings and whole feeder historical load traces are published in separate files to this report. These supplementary files are available for download on the Essential Energy website https://www.essentialenergy.com.au/our-network/network-pricing-and-regulatory-reporting/regulatory-reports-and-network-information.

3.1 Sub-transmission Feeder Limitations

IDENTIFIED SUBTRANSMISSION FEEDER LIMITATIONS								
Region	Feeder Number and Name	System Limitation			Potential Load Transfer	Load reduction required for 1 year deferral (MW)	Impact on Transmission-Distribution Connection Point	Potential Credible Solutions
		Details	Driver	Timing				
Southern Wagga	8WF Kooringal Tees to Kooringal	Network limitations associated with tee connection	Capacity/ Growth	Existing	0	12.9	Nil	Install high speed protection (fibre) between TransGrid BSP and Kooringal ZS
Southern Wagga	8WM Morrow St	Total loss of supply at Morrow St ZS for loss of feeder 8WM	Capacity/ Growth	Existing	0	12.3	Nil	Construct 66 kV bus bar at Morrow St ZS
Southern Griffith	79W Goolgowi	Voltage and thermal limitations under contingent conditions	Capacity/ Growth	Jun-22	0	2	Nil	1. Install 2nd 33kV line from Tharbogang to Nericon tee 2. Demand Management Alternative
South Eastern Yass	823/5 Marilba	Separation of Marilba subtransmission from Yass ZS	Reliability	Jun-22	0	0	Nil	Install 66kV Circuit Breaker at Yass ZS
Riverina Slopes Cootamundra	850 Bethungra	Separation of Bethungra subtransmission from Cootamundra ZS	Reliability	Jun-22	0	0	Nil	Install 66kV Circuit Breaker at Cootamundra ZS

3.2 Sub-transmission and Zone Substation Limitations

IDENTIFIED SUBTRANSMISSION and ZONE SUBSTATION LIMITATIONS								
Region	Substation Name	System Limitation			Potential Load Transfer (MW)	Load reduction required for 1 year deferral (MW)	Impact on Transmission-Distribution Connection Point	Potential Credible Solutions
		Details	Driver	Timing				
Queanbeyan	Googong Town	Single transformer supply with high forecast growth	Reliability	Jun-23	5	7	Nil	Installation of second transformer

3.3 Primary Distribution Feeder Limitations

Essential Energy primary distribution feeder investments have been included within the latest limitation template provided by ISF, and a summary of these identified limitations are included below. The detailed information for these limitations are included in supplementary documents available for download on the Essential Energy website https://www.essentialenergy.com.au/our-network/network-pricing-and-regulatory-reporting/regulatory-reports-and-network-information.

SUMMARY OF IDENTIFIED DISTRIBUTION FEEDER LIMITATIONS								
Operations Area	Zone Substation Name	Feeder	Primary Driver	Preferred Network Solution	Estimated Captial Cost	Demand Reduction Required for 1 Year Deferral	Segment Asset Rating	Load At Risk
Coastal	Cudgen 11kV	CUD3B3 Duranbah	Reliability	Option 3 - Install river bank re-inforcement for 10 poles, to be installed over 2020 to 2025 period	$ 447,102	0.5 MVA	2021 - 6.973 MVA; 2022 - 6.973 MVA; 2023 - 6.973 MVA; 2024 - 6.973 MVA; 2025 - 6.973 MVA	2021 - 0.5 MW; 2022 - 0.5 MW; 2023 - 0.5 MW; 2024 - 0.5 MW; 2025 - 0.5 MW
Coastal	Grafton South	SGN3B7 Grafton Sth Town	Asset Condition	Replace HV switchgear and cast iron cable termination	$ 83,410	0 MVA	2021 - 5.621 MVA; 2022 - 5.621 MVA; 2023 - 5.621 MVA; 2024 - 5.621 MVA; 2025 - 5.621 MVA	2021 - 1 MW; 2022 - 1 MW; 2023 - 1 MW; 2024 - 1 MW; 2025 - 1 MW
Ranges	Casino 66/11kV	CSO3B2 Kyogle Rd	Reliability	OH -Reconduct 4600m HV - McDonalds Bridge Rd, Stratheden	$ 202,377	0 MVA	2021 - 2.777 MVA; 2022 - 2.777 MVA; 2023 - 2.777 MVA; 2024 - 2.777 MVA; 2025 - 2.777 MVA	2021 - 0.7 MW; 2022 - 0.7 MW; 2023 - 0.7 MW; 2024 - 0.7 MW; 2025 - 0.7 MW
Ranges	Dunoon	DUN3B4 Mt Nardi	Asset Condition	Replace failing HV conductor	$ 219,093	1.374 MVA	2021 - 3.516 MVA; 2022 - 3.516 MVA; 2023 - 3.516 MVA; 2024 - 3.516 MVA; 2025 - 3.516 MVA	2021 - 1.36 MW; 2022 - 1.421 MW; 2023 - 1.481 MW; 2024 - 1.542 MW; 2025 - 1.602 MW
Ranges	Galloway St	GLS3B7 City Central	Asset Condition	Replace failed HV/LV cables and replace 500kVA pad sub with a 750kVA	$ 304,040	2.609 MVA	2021 - 7.24 MVA; 2022 - 7.24 MVA; 2023 - 7.24 MVA; 2024 - 7.24 MVA; 2025 - 7.24 MVA	2021 - 2.5 MW; 2022 - 2.5 MW; 2023 - 2.5 MW; 2024 - 2.5 MW; 2025 - 2.5 MW
Ranges	Glen Innes	GNI3B3 Red Range/Kookabookra	Asset Condition	Glen Innes Pinket Mainline End of Life	$ 352,221	0 MVA	2021 - 2.431 MVA; 2022 - 2.431 MVA; 2023 - 2.431 MVA; 2024 - 2.431 MVA; 2025 - 2.431 MVA	2021 - 0.656 MW; 2022 - 0.658 MW; 2023 - 0.659 MW; 2024 - 0.661 MW; 2025 - 0.662 MW

SUMMARY OF IDENTIFIED DISTRIBUTION FEEDER LIMITATIONS								
Operations Area	Zone Substation Name	Feeder	Primary Driver	Preferred Network Solution	Estimated Captial Cost	Demand Reduction Required for 1 Year Deferral	Segment Asset Rating	Load At Risk
Mid North Coast	Forster	FOR17262 Wells St	Asset Condition	Replace existing consac LV with 240mm AL XLPE	$ 202,171	0 MVA	2021 - 0.18 MVA; 2022 - 0.18 MVA; 2023 - 0.18 MVA; 2024 - 0.18 MVA; 2025 - 0.18 MVA	2021 - 0.097 MW; 2022 - 0.097 MW; 2023 - 0.097 MW; 2024 - 0.097 MW; 2025 - 0.097 MW
Mid North Coast	Owen St	OPM3B1 Granite St	Asset Condition	HV UG DEFRECT replace HV cable 400m McLaren Drv nr sub 2-41451 Port Macquarie	$ 225,999	0 MVA	2021 - 9.088 MVA; 2022 - 9.088 MVA; 2023 - 9.088 MVA; 2024 - 9.088 MVA; 2025 - 9.088 MVA	2021 - 0.645 MW; 2022 - 0.645 MW; 2023 - 0.645 MW; 2024 - 0.645 MW; 2025 - 0.645 MW
Northern Tablelands	Gunnedah 22kV	GDH6501 M65 Wandobah	Voltage	HV Recon- 7.70 km 7/16 SC/GZ with 7/3.00 AAAC, 75-L501421 Gunnedah	$ 231,137	0.476 MVA	2021 - 2.036 MVA; 2022 - 2.036 MVA; 2023 - 2.036 MVA; 2024 - 2.036 MVA; 2025 - 2.036 MVA	2021 - 1.197 MW; 2022 - 1.203 MW; 2023 - 1.209 MW; 2024 - 1.215 MW; 2025 - 1.222 MW
Northern Tablelands	Narrabri	NBI8B7 M6 Wee Waa	Asset Condition	HV reconductor section on NBI8B5 due to multiple splices	$ 228,004	0 MVA	2021 - 12.537 MVA; 2022 - 12.537 MVA; 2023 - 12.537 MVA; 2024 - 12.537 MVA; 2025 - 12.537 MVA	2021 - 1.972 MW; 2022 - 1.972 MW; 2023 - 1.972 MW; 2024 - 1.972 MW; 2025 - 1.972 MW
Northern Tablelands	Narrabri	NBI8B10 M16 Mount Dowe	Asset Condition	Narrabri- NBI8B8 - Reconductor 75-L11408 to pole 07047366 - Condition	$ 216,326	0 MVA	2021 - 12.537 MVA; 2022 - 12.537 MVA; 2023 - 12.537 MVA; 2024 - 12.537 MVA; 2025 - 12.537 MVA	2021 - 0.664 MW; 2022 - 0.664 MW; 2023 - 0.664 MW; 2024 - 0.664 MW; 2025 - 0.664 MW
Northern Tablelands	Walcha South 66/22kV	WLS8B5 Uralla/Walcha Rd/Wollun	Asset Condition	Replace failing end of life HDBC HV conductor	$ 422,071	0 MVA	2021 - 4.2 MVA; 2022 - 4.2 MVA; 2023 - 4.2 MVA; 2024 - 4.2 MVA; 2025 - 4.2 MVA	2021 - 0.5 MW; 2022 - 0.5 MW; 2023 - 0.5 MW; 2024 - 0.5 MW; 2025 - 0.5 MW
Northern Tablelands	Warialda	WRA2W08 Northern	Asset Condition	Yarran Rd, Warialda, ICW, OH, HV Reconductoring, 8.5 km	$ 320,000	0.6 MVA	2021 - 4.788 MVA; 2022 - 4.788 MVA; 2023 - 4.788 MVA; 2024 - 4.788 MVA; 2025 - 4.788 MVA	2021 - 0.557 MW; 2022 - 0.562 MW; 2023 - 0.568 MW; 2024 - 0.573 MW; 2025 - 0.579 MW
North Western	Gilgandra	GID12 Gilgandra Town No.1	Safety	Gilgandra_Main Street_Replace ABC Attached To Fascia Of Buildings	$ 300,401	0 MVA	2021 - 1.233 MVA; 2022 - 1.233 MVA; 2023 - 1.233 MVA; 2024 - 1.233 MVA; 2025 - 1.233 MVA	2021 - 0.6 MW; 2022 - 0.6 MW; 2023 - 0.6 MW; 2024 - 0.6 MW; 2025 - 0.6 MW

SUMMARY OF IDENTIFIED DISTRIBUTION FEEDER LIMITATIONS								
Operations Area	Zone Substation Name	Feeder	Primary Driver	Preferred Network Solution	Estimated Captial Cost	Demand Reduction Required for 1 Year Deferral	Segment Asset Rating	Load At Risk
Macquarie	Blayney	BNY3B4 Millthorpe	Asset Condition	Millthorpe-BurtonsLn&WilsonsLn-HVReconductoring-Refurb	$ 276,936	0 MVA	2021 - 5.239 MVA; 2022 - 5.239 MVA; 2023 - 5.239 MVA; 2024 - 5.239 MVA; 2025 - 5.239 MVA	2021 - 0.305 MW; 2022 - 0.305 MW; 2023 - 0.305 MW; 2024 - 0.305 MW; 2025 - 0.305 MW
Macquarie	Canowindra	CWD33 Eugowra	Capacity	Refurbish CWD33 Feeder From L884 to open point L891	$ 345,279	0.19 MVA	2021 - 2.726 MVA; 2022 - 2.726 MVA; 2023 - 2.726 MVA; 2024 - 2.726 MVA; 2025 - 2.726 MVA	2021 - 0.2 MW; 2022 - 0.2 MW; 2023 - 0.2 MW; 2024 - 0.2 MW; 2025 - 0.2 MW
Macquarie	Manildra	MDA3B6 Monument	Capacity	Reconductor 6.4kms steel line Sandy Creek Rd Manildra	$ 283,479	0.953 MVA	2021 - 12.232 MVA; 2022 - 12.232 MVA; 2023 - 12.232 MVA; 2024 - 12.232 MVA; 2025 - 12.232 MVA	2021 - 0.897 MW; 2022 - 0.897 MW; 2023 - 0.897 MW; 2024 - 0.897 MW; 2025 - 0.897 MW
Macquarie	Molong 11kV	MLO22 East	Asset Condition	Reconductor 6.65kms Wagtail and steel conductor Belgravia Rd Molong	$ 283,809	0.095 MVA	2021 - 4.153 MVA; 2022 - 4.153 MVA; 2023 - 4.153 MVA; 2024 - 4.153 MVA; 2025 - 4.153 MVA	2021 - 0.094 MW; 2022 - 0.094 MW; 2023 - 0.094 MW; 2024 - 0.094 MW; 2025 - 0.094 MW
Macquarie	Raglan	RAG3B5 OConnell	Asset Condition	Bathurst - O'Connell Road - End of Life - HV Reconductoring	$ 219,628	0 MVA	2021 - 7.24 MVA; 2022 - 7.24 MVA; 2023 - 7.24 MVA; 2024 - 7.24 MVA; 2025 - 7.24 MVA	2021 - 1.366 MW; 2022 - 1.377 MW; 2023 - 1.388 MW; 2024 - 1.399 MW; 2025 - 1.41 MW
Riverina Slopes	Kooringal	KOO3B6 Lake Albert	Asset Condition	Replace 36 x St Light-LV Pillar Triangular Columns -Jasmin Cres Lake Albert Wagga	$ 188,632	0 MVA	2021 - 8.955 MVA; 2022 - 8.955 MVA; 2023 - 8.955 MVA; 2024 - 8.955 MVA; 2025 - 8.955 MVA	2021 - 0.18 MW; 2022 - 0.18 MW; 2023 - 0.18 MW; 2024 - 0.18 MW; 2025 - 0.18 MW
Riverina Slopes	Paytens Bridge	PYB3B1 Eugowra	Asset Condition	Eugowra - Reco Main Line PYB12 Feeder from L901 to open point L891	$ 463,437	0 MVA	2021 - 2.777 MVA; 2022 - 2.777 MVA; 2023 - 2.777 MVA; 2024 - 2.777 MVA; 2025 - 2.777 MVA	2021 - 0.152 MW; 2022 - 0.152 MW; 2023 - 0.152 MW; 2024 - 0.152 MW; 2025 - 0.152 MW
Riverina Slopes	Uranquinty	UQT8B2 Uranquinty Nth	Asset Condition	OH Reconductor to replace ageing HDBC - continual failure. conductor has reached EOL	$ 200,000	0 MVA	2021 - 12.537 MVA; 2022 - 12.537 MVA; 2023 - 12.537 MVA; 2024 - 12.537 MVA; 2025 - 12.537 MVA	2021 - 1.313 MW; 2022 - 1.337 MW; 2023 - 1.36 MW; 2024 - 1.383 MW; 2025 - 1.407 MW

SUMMARY OF IDENTIFIED DISTRIBUTION FEEDER LIMITATIONS								
Operations Area	Zone Substation Name	Feeder	Primary Driver	Preferred Network Solution	Estimated Captial Cost	Demand Reduction Required for 1 Year Deferral	Segment Asset Rating	Load At Risk
Central	Griffith	GFH3B6 Illilliwa	Asset Condition	Backyard ABC 96-2537 Illilliwa st curtin cedar mcnabb 1000mtrs Griffith	$ 200,639	0 MVA	2021 - 8.002 MVA; 2022 - 8.002 MVA; 2023 - 8.002 MVA; 2024 - 8.002 MVA; 2025 - 8.002 MVA	2021 - 0.3 MW; 2022 - 0.3 MW; 2023 - 0.3 MW; 2024 - 0.3 MW; 2025 - 0.3 MW

3.4 Network Asset Retirements and De-ratings – Sub-transmission

3.4.1 Casino to Mallanganee 33kV Feeder

Asset Description

The 8401 sub-transmission feeder from Casino to Mallanganee consists of 15km and 21km sections of radial 7/.080 copper conductor, supplying around 2,000 customers in total between Mallanganee, Bonalbo and Urbenville zone substations.

The feeder was constructed in 1950, consisting of 239 spans with single pole, predominantly delta pin pole top construction and 7/.080 copper conductor. It has 11kV underslung for the entire length, except for a short section near Casino, the underslung 11kV is also mostly copper conductor of same era. The average pole age is 37 years, with 80 of the 239 poles over 50 years old.

The feeder transverses from the relatively flat areas at Casino rising into the hills and into the Great Dividing Range near Mallanganee. Located in a small area of NSW that has the highest average lightning ground flash density, the feeder is susceptible to thunder storms and lightning strikes, particularly in the higher area near Mallanganee. Having delta pin pole top construction, the feeder has no overhead earthwire protection, other than small sections (<1km) at the exit of Casino and entry to Mallanganee zone substations.

Assessment

The 67-year-old 7/.080 copper conductor on this feeder is reaching end of serviceable life and is subject to regular failure, resulting in poor reliability for customers and an increasing public safety risk.

Being in an area susceptible to lightning strikes, the conductor is struck excessively, producing fault currents that overheat the conductor, leading to annealing of the copper strands. The copper hardens over the long term and combined with pitting, strands begin to fracture and the conductor breaks.

The original design of the feeder has inherent problems. The spans lengths are relatively long in areas traversing hills. The chance of inter-circuit conductor clash is increased as conductor swings are exacerbated in the areas with longer spans, leading to further conductor failure.

The conductor can be joined with short sections of new conductor, splices and compression sleeves but over time the rate of failure increases exponentially as the conductor reaches end of life. The Casino – Mallanganee feeder has over 200 joints/splices.

Date of retirement

Replacement of an initial 15km section of copper conductor is planned for 2020/21.
Replacement of the next 21km section of copper conductor is planned for 2024/25.

Changes since previous DAPR

There were delays due to bushfires in replacing the first 15km section, this is now nearing completion. A diesel generator is being installed at Urbenville ZS to improve the reliability due to its radial supply, and the second section to be replaced has been revised to a later year.

3.5 Network Asset Retirements and De-ratings – Zone Substation

3.5.1 Indoor Switchboard Replacement, Refurbishment and Conversion

Zone Substation Indoor Switchboards (Replacement, Refurbishment & Conversion)		
Asset Description and Location	Timing	Reason Identified
Bathurst 66/11kV ZS Switchboard Refurbishment/Replacement	Jun-21	ECONOMIC END OF LIFE, SAFETY
Cartwrights Hill 66/11kV ZS Switchboard Refurbishment/Replacement	Jun-22	ECONOMIC END OF LIFE, SAFETY
Forster Z/Sub 11kV Switchboard & 66kV CB's Refurbishment / Replacement	Jun-23	ECONOMIC END OF LIFE, SAFETY
Narooma ZS Refurbishment / Replacement	Jun-23	ECONOMIC END OF LIFE, SAFETY
Narrandera ZS Refurbishment / Replacement	Jun-21	ECONOMIC END OF LIFE, SAFETY
Owen St ZS Refurbishment / Replacement	Jun-23	ECONOMIC END OF LIFE, SAFETY
Woolgoolga ZS Refurbishment / Replacement	Dec-21	ECONOMIC END OF LIFE, SAFETY
Googong Dam ZS Refurbishment / Replacement	Jun-23	ECONOMIC END OF LIFE, SAFETY
Laurieton ZS Refurbishment / Replacement	Jun-23	ECONOMIC END OF LIFE, SAFETY
Perisher ZS Refurbishment / Replacement	Jun-24	ECONOMIC END OF LIFE, SAFETY

3.5.2 Power Transformer Replacement

Zone Substation Power Transformer Replacement		
Asset Description and Location	Timing	Reason Identified
Bourke ZS Equipment Replacement/Refurbishment project	Jun-21	ECONOMIC END OF LIFE
Cartwrights Hill Z/Sub Replace TX1	Jun-21	ECONOMIC END OF LIFE
Forster TX1 and TX2 Refurbishment	Jun-23	ECONOMIC LIFE EXTENSION
Geurie Z/Sub Replace TX1	Jun-23	ECONOMIC END OF LIFE
Goulburn TX1 Replacement	Jun-25	ECONOMIC END OF LIFE
Goulburn TX3 and TX4 refurbishment	Jun-23	ECONOMIC LIFE EXTENSION
Gulgong ZS Replace TX1	Jun-24	ECONOMIC END OF LIFE
Kempsey North St Replace TX2	Dec-20	ECONOMIC END OF LIFE
Moulamein TX2 Replacement	Jun-24	ECONOMIC LIFE EXTENSION
Oura Z/Sub Replace TX4	Jun-23	ECONOMIC END OF LIFE
Owen St TX1 Replacement	Jun-21	ECONOMIC END OF LIFE
Peak Hill ZS Replace TX2	Nov-21	ECONOMIC END OF LIFE
Stewart TX1 Refurbishment	Jun-23	ECONOMIC LIFE EXTENSION
Stewart TX2 Refurbishment	Jun-22	ECONOMIC LIFE EXTENSION
Trundle ZS 66/22kV TX2 Replacement	Oct-21	ECONOMIC END OF LIFE
Trundle ZS 22/11kV TX4 Replacement	Jun-21	ECONOMIC END OF LIFE
Wee Waa Z/Sub Replace 66kV Regulator	Jun-21	ECONOMIC END OF LIFE
Wee Waa Z/Sub Replace TX2	Dec-21	ECONOMIC END OF LIFE
Yenda Replace TX 1 33/11 kV	Jun-22	ECONOMIC END OF LIFE
ZS Eucumbene - TX1 Replacement	Jun-22	ECONOMIC END OF LIFE
ZS Yallaroi - TX1 Replacement	Jun-21	ECONOMIC END OF LIFE

3.5.3 Circuit Breaker Replacement

Zone Substation Circuit Breaker Replacement		
Asset Description and Location	Timing	Reason Identified
Batemans Bay ZS - Replace 132 kV Transformer CBs 4422 and 4412	Jun-22	ECONOMIC END OF LIFE
Coffs Harbour North Z/Sub - Replace 3 EOL 66kV CB's & associated CT's	Jun-21	ECONOMIC END OF LIFE
Goulburn 132 - Replace 7 66kV CBs	Jun-21	ECONOMIC END OF LIFE
Hillston 132kV Z/Sub - Replace 33kV CB & CT's	Jun-21	ECONOMIC END OF LIFE
Temora 132 - Replace 6 66kV CBs and CTs	Jun-21	ECONOMIC END OF LIFE
Terranora Replace 132kV CBs	Jun-21	ECONOMIC END OF LIFE
Ulan Switching Station - Replace 5 Live Tank CBs	Jun-21	ECONOMIC END OF LIFE
Woolgoolga Z/S 66kV CB and CT's EOL	Jun-21	ECONOMIC END OF LIFE

3.5.4 Combined Asset Retirements and De-Ratings

Combined Asset Replacements			
Asset Description	Region	Timing	Reason Identified
Zone Substation Circuit Breaker replacement	South Eastern, Northern Tablelands, Macquarie	Jun-23	Economic End Of Life, Safety
Zone Substation Circuit Breaker replacement	Coastal, Mid North Coast, Ranges, South Eastern	Jun-24	Economic End Of Life, Safety
Zone Substation Outdoor Bus and Isolator Refurbishment and Replacement	Murray	Jun-22	Economic End Of Life, Safety
Zone Substation Outdoor Bus and Isolator Refurbishment and Replacement	Northern Tablelands	Jun-23	Economic End Of Life, Safety
Zone Substation Voltage Transformer Replacement	North Western	Jun-21	Economic End Of Life, Safety
Zone Substation Voltage Transformer Replacement	Riverina Slopes	Jun-23	Economic End Of Life, Safety
Wooden Pole Staking and Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Wooden Pole Staking and Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Wooden Pole Staking and Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Wooden Pole Staking and Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Wooden Pole Staking and Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Concrete/Steel/Other Pole Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Concrete/Steel/Other Pole Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Concrete/Steel/Other Pole Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Concrete/Steel/Other Pole Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Concrete/Steel/Other Pole Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Pole Top Structure Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Pole Top Structure Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Pole Top Structure Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Pole Top Structure Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Pole Top Structure Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Overhead Conductor Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Overhead Conductor Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Overhead Conductor Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Overhead Conductor Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Overhead Conductor Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Underground Cable Replacement	All Regions	Jun-21	Asset Age, Asset Failure

Combined Asset Replacements			
Asset Description	Region	Timing	Reason Identified
Underground Cable Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Underground Cable Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Underground Cable Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Underground Cable Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Service Line Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Service Line Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Service Line Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Service Line Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Service Line Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Pole Mounted Transformer Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Pole Mounted Transformer Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Pole Mounted Transformer Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Pole Mounted Transformer Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Pole Mounted Transformer Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Kiosk/Chamber/Other Transformer Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Kiosk/Chamber/Other Transformer Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Kiosk/Chamber/Other Transformer Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Kiosk/Chamber/Other Transformer Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Kiosk/Chamber/Other Transformer Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Network Switchgear Replacement	All Regions	Jun-21	Asset Age, Asset Failure
Network Switchgear Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Network Switchgear Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Network Switchgear Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Network Switchgear Replacement	All Regions	Jun-25	Asset Age, Asset Failure
Public Lighting Replacement	All Regions	Jun-21	Asset Age, Asset Failure

Combined Asset Replacements			
Asset Description	Region	Timing	Reason Identified
Public Lighting Replacement	All Regions	Jun-22	Asset Age, Asset Failure
Public Lighting Replacement	All Regions	Jun-23	Asset Age, Asset Failure
Public Lighting Replacement	All Regions	Jun-24	Asset Age, Asset Failure
Public Lighting Replacement	All Regions	Jun-25	Asset Age, Asset Failure
SCADA, Network Control and Protection Systems Replacement	All Regions	Jun-21	Asset Age, Asset Failure
SCADA, Network Control and Protection Systems Replacement	All Regions	Jun-22	Asset Age, Asset Failure
SCADA, Network Control and Protection Systems Replacement	All Regions	Jun-23	Asset Age, Asset Failure
SCADA, Network Control and Protection Systems Replacement	All Regions	Jun-24	Asset Age, Asset Failure
SCADA, Network Control and Protection Systems Replacement	All Regions	Jun-25	Asset Age, Asset Failure

4. NETWORK INVESTMENTS

4.1 Regulatory Test / RIT-Ds Completed or in Progress

There are no RIT-Ds that have been completed or were in progress in 2020.

4.2 Potential RIT-Ds for Identified System Limitations

Essential Energy has not identified any network system limitations that may require the publication of a RIT-D.

4.3 Urgent and Unforeseen Investments

There were urgent or unforeseen investments in 2019/20, relating to bushfire damage in the Snowy region – Cabramurra and Selwyn. Temporary power supplies were put in place to support the community in a timely manner whilst work continues on a permanent solution. The AER will review these investments as part of Essential Energy's Cost Pass Through Application for the 2019/20 bushfire costs. (Note: The Options assessment for the permanent solution was completed in accordance with the principles of the RIT-D).

URGENT AND UNFORESEEN INVESTMENTS						
Title	Status	Alternative Solutions	Assessment	Market Benefit Capital Cost ($M)	Market Benefit 40Yr NPV ($M)	Estimated Operational Date
Cabramurra and Selwyn Supply Options	In Progress	Ravine 33kV Supply	Not feasible	N/A	N/A	N/A
		330/11kV Supply from TransGrid Upper Tumut Switching Station	Preferred	-9.2	-12.4	May-21
		Rebuild 33kV powerline (bushfire damaged)	Lower initial cost, higher NPV	-4.2	-13.5	N/A
		SAPS and Microgrid	Cost prohibitive	-16	-29.1	N/A
		Snowy Hydro supply	Not feasible	N/A	N/A	N/A

5. JOINT PLANNING

Joint Planning is a requirement under Clause 5.14 of the NER, which requires Essential Energy to carry out Joint Planning with each Network Service Provider (NSP) to which its networks are connected. Consequently, Essential Energy conducts Joint Planning activities with TNSPs – TransGrid and Powerlink Queensland. At a DNSP level, it conducts such activities with Energex and Ergon Energy (of parent company Energy Queensland formed as of 1 July 2016), Ausgrid, Endeavour Energy, Evoenergy (formerly ActewAGL) and Powercor Australia.

The frequency, process and methodology of such Joint Planning depends on the timing of emerging network constraints due to growth, reliability and refurbishment needs, as well as other external drivers such as third-party connection requests to service new or augmented major loads and generators.

Joint Planning aims to identify the most efficient network or non-network option to address the need in a prudent manner, regardless of ownership, jurisdiction or boundary.

In general, the process and methodology establishes a formal Joint Planning committee between the relevant parties (Essential Energy and the NSP or in some cases multiple NSPs) which, depending upon the emerging limitation(s), severity and impact, will then meet to jointly confirm, quantify, review, recommend and resolve the matter(s).

This is undertaken using agreed technical, unit cost, fiscal, risk and sensitivity assessment assumptions and criterion to compare and evaluate the credible non-network and network alternatives in order to select, plan and deliver the most prudent investment(s) in accordance with NER requirements and objectives.

In the case of shared investments over a combined total cost threshold of $6M, regulatory consultation documentation and notifications are prepared and published jointly in accordance with the NER process requirements.

For investments below this threshold value, the appropriate investment case documentation is shared and held by the joint parties. In both instances, where necessary, a Joint Planning Report (JPR) is executed to define the high-level responsibilities of all parties in delivering, funding and owning the investment or parts thereof.

5.1 Results of Joint Planning with the TNSP TransGrid

5.1.1 Summary of the Process and Methodology

An existing Joint Planning committee, made up of network planning staff from Essential Energy and TransGrid, met regularly (approximately every quarter) throughout the past year. A Joint Planning Charter, detailing a formally structured approach and guiding principles, sets the basis. Issues and outcomes were minuted with actions, and where necessary, issues were referred to an overseeing Joint Executive Steering Committee.

TransGrid has a Transmission Reliability Standard (enforced from 1 July 2018), and as an ongoing consequence TransGrid and Essential Energy have consulted with each other via Joint Planning, and where cost effective, are initiating works to reduce expected unserved energy supplied from TransGrid Bulk Supply Points.

5.1.2 Investments Jointly Planned

Several matters have required Joint Planning collaboration with TransGrid throughout 2020:

Joint Planning between Essential Energy and TransGrid is underway regarding the apparent and emerging 132kV network constraints in the Orange, Parkes/Forbes, Beryl/Wellington and Gunnedah/Narrabri areas of NSW.
This is presently ongoing due to the uncertainty of spot load developments and small to large embedded generation proposals.

A project to renew the secondary systems at the joint-use Coleambally 132/33kV substation has been planned and agreed to through Joint Planning in May 2020. It is anticipated that project works will commence in early 2021 and be completed in early 2022.

Due to the recent renewable generation developments in the Far West of NSW, the fault level at the TransGrid Broken Hill 220/22kV substation has substantially increased and will continue to increase with planned network developments. TransGrid is currently investigating if the existing 220kV equipment at its Broken Hill substation is suitable for the expected higher fault levels.

TransGrid has also requested Essential Energy review the fault rating of its 22kV equipment on the nearby Broken Hill distribution network to confirm if any augmentation is required. This resulted in Essential Energy providing TransGrid with a fault level impact assessment for consideration, aimed at aiding with identifying the most cost-effective fault level management strategy for both NSP's and local customers.

TransGrid and Essential Energy have also agreed to a project for Essential Energy to install an 11kV earthing transformer at its Talbingo 66/11kV zone substation to minimise the risks posed by the unearthed 11kV network supplying the Talbingo town when it is being back-fed from the Lower Tumut substation. This was one of four feasible options considered, also being the lowest cost and most reliable option.

Essential Energy and TransGrid have also being engaged in Joint Planning regarding the feasible options and selection of a recommended option to re-instate supply to Cabramurra, Selwyn Ski Fields and Selwyn communication tower customers following the early January 2020 bushfires which destroyed large sections of the 33kV powerline from Providence Portal sourced from the TransGrid Cooma substation.

The most likely outcome of this is the establishment of a 330/11kV bulk supply point at the TransGrid Upper Tumut Switching Station and a new single 11kV supply to support the Cabramurra, Selwyn Ski Fields and Selwyn communication tower customer load. (Refer to Section 4.3 Urgent and Unforeseen Investments).

5.1.3 Additional Information

Additional detailed information regarding the above considerations may be obtained from the Essential Energy and TransGrid websites, and as published in the preceding and latest TransGrid Transmission Annual Planning Reports.

5.2 Results of Joint Planning with the TNSP Powerlink

5.2.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Powerlink Queensland as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Powerlink and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

5.2.2 Investments Jointly Planned

There has been ongoing Joint Planning with Powerlink, Energex and Directlink regarding the restoration options for contingent emergency supply to the Far Northern Eastern NSW region should both the 110kV (757 & 758) circuits between Mudgeeraba and Terranora substations, incur a sustained unplanned outage due to the damage or failure of their supporting single steel-lattice-tower structures.

The most obvious option would be to reinstate at least one of the 110kV circuit/s (757 or 758), however this may not provide a suitable response time for part or progressive restoration depending upon the severity of the outage.

Both Directlink-islanded support and provision of limited alternate 66kV supply support from the Energex Kirra substation (via the substation 11kV busbar), are being considered as viable full/partial support options, subject to Market Benefit justification.

Also, in 2020, there has been Joint Planning coordination regarding the impacts and requirements for the Powerlink upgrade of secondary systems at Mudgeeraba substation and the replacement of the Directlink related ECS (Emergency Control Scheme). As part of the replacement works staging plan, the ECS is scheduled for commissioning in the last quarter of 2021.

5.2.3 Additional Information

Nil.

5.3 Results of Joint Planning with the DNSP Energex

5.3.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Energex as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Powerlink and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

5.3.2 Investments Jointly Planned

In 2020, there were a few Joint Planning interactions with both Energex (and Powerlink Queensland, as well as Directlink) related to restoration options for contingent emergency supply to the Far Northern Eastern NSW region should both the 110kV (757 & 758) circuits between Mudgeeraba and Terranora substations, incur a sustained unplanned outage due to the damage or failure of their supporting single steel-lattice-tower structures. (Refer to Section 5.2.2 above).

5.3.3 Additional Information

Nil.

5.4 Results of Joint Planning with the DNSP Ergon

5.4.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Ergon as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

However, in 2020, there has been no material need to conduct formal Joint Planning with Ergon Energy. This is mainly due to the past and sustained decline in peak demand forecasts and the fact that no limitations on the interconnecting 132kV sub-transmission and 33kV distribution networks are imminent. Joint Planning has therefore been limited to a few telephone/email discussions between the respective network planning and customer connection teams.

5.4.2 Investments Jointly Planned

Nil.

5.4.3 Additional Information

Nil.

5.5 Results of Joint Planning with the DNSP Ausgrid

5.5.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Ausgrid as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Ausgrid and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

In 2020, there has been no material need to conduct formal Joint Planning meetings with Ausgrid. This is mainly due to the fact that no limitations on the interconnecting 33kV and 11kV networks are imminent, driven by the past decline and continued flat trend in peak demand forecasts. Joint Planning has therefore been limited to a few telephone/email discussions between the respective network planning, system operations and customer connection teams.

5.5.2 Investments Jointly Planned

Nil.

5.5.3 Additional Information

Nil.

5.6 Results of Joint Planning with the DNSP Endeavour Energy

5.6.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Endeavour Energy as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Endeavour Energy and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

During 2020, Joint Planning between Essential Energy and Endeavour Energy was undertaken regarding the emerging and forecast 132kV network constraints in the Dapto, Nowra, Ulladulla, Batemans Bay areas of NSW. Load forecasts were shared with Endeavour Energy, to continue evaluating options to alleviate the constraints.

5.6.2 Investments Jointly Planned

Nil.

5.6.3 Additional Information

Nil.

5.7 Results of Joint Planning with the DNSP Evoenergy

5.7.1 Summary of the Process and Methodology

For the purposes of effective network planning, Essential Energy has collaborated in regular Joint Planning with Evoenergy as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have (and are) undertaken regularly, as required, based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Evoenergy and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

5.7.2 Investments jointly planned

In 2020, Joint Planning consultation was undertaken with Evoenergy regarding options to supply the proposed South Jerrabomberra Development Area – a broad mix of time-staged precincts (including residential, retail, business, industrial, education, sporting, community and open space).

Several feasible options have been identified, yet due to the fact that the development is large, complex, diverse, and time-staged, having several Developer Proponents, as well as environmentally sensitive considerations, an outcome is yet to be realised subject to ongoing network planning review and commercial agreement with the Proponents.

5.7.3 Additional Information

Nil.

5.8 Results of Joint Planning with the DNSP Powercor Australia

5.8.1 Summary of the Process and Methodology

For the purpose of effective network planning, Essential Energy has collaborated in regular Joint Planning with Powercor Australia as part of an established continual process. Necessary collaboration regarding network matters such as emerging constraints and planned developments have and are undertaken regularly, as required based on project need.

This is facilitated through face-to-face meetings or videoconferencing between Joint Planning representatives from both organisations. These interactions have formal agendas and minuted outcomes with assigned responsibilities. The Joint Planning representatives from Powercor and Essential Energy are from the respective Joint Planning teams and may from time-to-time consist of representatives from specialist technical teams outside of network planning.

During 2020, there has been no material need to conduct formal Joint Planning meetings with Powercor Australia. This is mainly due to the fact that no limitations on the interconnecting 66kV and 22kV networks are imminent. Joint Planning has therefore been limited to a few telephone/email discussions between the respective network planning, system operations and customer connection teams.

5.8.2 Investments jointly planned

Nil.

5.8.3 Additional Information

Nil.

6. NETWORK PERFORMANCE

6.1 Reliability Performance

The AER STPIS has been applied to Essential Energy since the 2015/16 financial year. Reporting is in accordance with the excluded interruption conditions of the STPIS, which include the removal of days where the distribution network exceeds the defined major event day boundary. The reliability measures used are SAIDI, average minutes without supply per customer, and SAIFI, average number of interruptions experienced per customer. Performance is monitored at distribution feeder level for unplanned interruptions.

Distribution feeders are categorised as Urban, Short Rural or Long Rural, based on feeder length and load density. Essential Energy's distribution network consists of 302 Urban Feeders, 922 Short Rural Feeders and 244 Long Rural Feeders, with over 60 per cent of customers on Short Rural Feeders.

6.1.1 Feeder Category Performance against STPIS Targets

Reliability outcomes by feeder category for the 2019/20 financial year fell outside STPIS targets for urban and long rural feeders.

Table 5 – Feeder Performance by Category

Feeder Category	SAIDI (minutes)		SAIFI (no of interruptions)	
	Target	Actual	Target	Actual
Urban	73	72	0.90	0.77
Short Rural	204	234	1.85	1.89
Long Rural	447	536	2.94	2.96

6.1.2 Performance against Individual Feeder Standards

The performance objectives for organisational average performances by feeder category are not sufficient to identify when customers on a particular feeder experience unsatisfactory reliability performance. For this reason, SAIDI and SAIFI criteria (after 'excluded interruptions' are disregarded) act as a trigger for investigation and exception reporting purposes. The figures contained in the licence conditions are shown in Table 6 and Table 7.

Table 6 – Individual feeder standards specified in the Licence Conditions applicable to Essential Energy

	Feeder Category		
	Urban	Short Rural	Long Rural
SAIDI	400	1,000	1,400
SAIFI	6	8	10

Performance outside this range results in the following actions:

- Immediate investigation of the causes for each feeder exceeding the individual feeder standards
- By the end of the quarter following the quarter in which the feeder first exceeded the individual feeder standard, complete an investigation report identifying the causes and action required to improve the performance
- Complete any operational actions identified in the investigation report by the end of the third quarter following the quarter in which the feeder first exceeded the standard

- Where the investigation report identifies actions, other than operational actions, that are required to improve the performance of a feeder to the individual feeder standards, an investment plan is developed. The investment plan includes an implementation timetable of required capital works. This timetable details the commencement of implementation by the end of the second quarter following the quarter in which the feeder first exceeded the individual feeder standards.

Table 7 – Individual Feeder Performance against the Standard Summary

Feeder Category	Urban	Short Rural	Long Rural
Feeders (Total Number each Type)	302	922	244
Feeders that Exceeded the Standard During the Year (Total Number)	12	60	30

6.2 Quality of Supply Performance

The Electricity Supply Standards adopted by Essential Energy are set out in the document *CEOP8026 Electricity Supply Standard,* in accordance with the *Code of Practice – Electricity Service Standards.* A copy of *CEOP8026* can be downloaded from https://www.essentialenergy.com.au/.
CEOP8026 also outlines Essential Energy's adoption of the Australian Standard AS 61000.3.100 – 2011 (Amendment No.1 -2016) and Australian Standard *AS 60038 – 2012 Standard Voltages.*

The main areas addressed include:

- Voltage fluctuations (LV) managed in accordance with Australian Standards AS/NZS 61000.3.3:2012, SA/SNZ TS IEC 61000.3.5: 2013 and SA/SNZ TR IEC 61000.3.5: 2013
- Switching transients (voltage waveform distortion) limited where possible to less than twice normal supply voltage
- Frequency variation and Essential Energy's role in notifying AEMO of any sustained fluctuations
- Voltage swells and voltage dips (sags) managed through best practice network improvement and augmentation (Recommended voltage swell and dip thresholds given in Australian Standard AS 61000.3.100 – 2011 (Amendment No.1 -2016)
- Steady state voltage differences between neutral and earth limited to less than 10 volts at the customer's point of supply
- Lightning strikes limited in their impact on supply where possible by adherence to industry best practice system design and maintenance principles
- Limitation of 'step and touch' voltage differentials managed in accordance with industry standards, namely ENA EG-0 Power System Earthing Guide – ENA DOC 025-2010
- Essential Energy's objective is to limit voltage unbalance to levels as required by the National Electricity Rules. This is generally 2% on the high voltage network and up to 6% on the LV network using 10min average values. This level may be exceeded occasionally in some rural areas. However, Voltage Unbalance allocations for new customer connections are managed through the latest Australian Standard for Voltage Unbalance (AS/NZS TR IEC 61000.3.13: 2012 and ENA Guideline for Power Quality – Voltage Unbalance)
- Harmonic content of voltage and current waveforms managed in accordance with Australian Standards AS/NZS TR IEC 61000.3.6:2012. Harmonic emission allocation process for new customer connections are managed through the Australian Standard and ENA Guideline for Power Quality – Harmonics
- Voltage fluctuations, flicker, and rapid voltage changes in HV network are managed in accordance with AS/NZS TR IEC 61000.3.7: 2012 Standard. Like the harmonics and unbalance, all the new HV customer connections and emissions allocations are managed through the latest Australian standard and the ENA Guideline for Power Quality – Flicker

- Mains signalling reliability set at a target of 99.5 per cent failsafe to ensure correct switching and metering functions.

Quality of supply is monitored through power quality enquiries received from customers and also through participation in the Power Quality Compliance Audit conducted by the University of Wollongong and a number of other distributors throughout Australia. This survey studies parameters such as steady state voltage, voltage total harmonic distortion (THD), voltage sags and voltage unbalance on three phase sites.

All valid complaints assessed as being network related, or issues identified via network monitoring are addressed to ensure the situation is rectified and maintained within standards.

Remedial actions could include but are not limited to adjusting tap settings on transformers, adjusting voltage regulation levels, installing additional or larger transformers, augmenting network capacity, repairing network faults and balancing network loads.

Table 8 – Completed Investigations from Network Complaints

Network Complaint Investigations Completed		2019/20	
Category	**Nature of Complaint**	**Number**	**Number Valid**
Voltage	Sustained over voltage	178	133
	Sustained under voltage	47	23
	Voltage fluctuations	122	50
	Voltage dips	49	22
	Voltage swell	4	3
	Switching transients	0	0
	N-E voltage difference	102	28
	Ground fault voltage	1	0
	Voltage unbalance	4	0
	Mains signalling voltages (Outside defined range)	0	0
	HV injection (HV/LV Intermix)	0	0
	Notching	0	0
	Invalid (248 confirmed invalid)		
Subtotal (Supply Voltage Complaints)		**507**	**259**
Current	Direct current	0	0
	Harmonic content	1	0
	Inter Harmonics	0	0
	Invalid (1 confirmed invalid)		
Subtotal (Supply Current Complaints)		**1**	**0**
Other Quality	Mains signalling reliability	2	0
	Noise & Interference	15	2
	Level of supply capacity	17	8
	Embedded Generation (Solar)	672	566

Category	Nature of Complaint	Number	Number Valid
Other Quality Continued	Embedded Generation (Wind)	0	0
	Supply frequency	0	0
	Level of EMF	2	0
	Customer Equipment Failure	55	9
	Invalid (178 confirmed invalid)		
Subtotal (Other Quality of Supply Complaints)		**763**	**585**
Subtotal (All Quality of Supply Complaints)		**1271**	**844**
Reliability	No. of supply failures	23	6
	Duration of supply failures	4	1
	Outages Miscellaneous	31	7
	No. of <1 min. interruptions	20	9
	Invalid (55 confirmed invalid)		
Subtotal (Reliability of Supply)		**78**	**23**
Total Completed		**1349**	**867**
Other	IN Communities	0	0
	Under Investigation (not validated)	4	0
Totals		**1353**	**867**

The total number of Network Complaints decreased by 12% in the 19/20 FY compared to last financial years total which discontinues the increasing trend of the last 4 years. The total number of Voltage Complaints decreased by 19% and Embedded Generation Solar continued to be the leading complaint with a total of 672 complaints and an increase of 13% overall compared to last FY.

The total number of Sustained overvoltage complaints was exactly the same compared to last FY (178), however sustained undervoltage decreased by 38% compared to last FY which is a pleasing result.

7. ASSET MANAGEMENT

7.1 Essential Energy's Asset Management Approach

7.1.1 Introduction

Essential Energy is undertaking significant development across asset management with a target to be certified to the ISO 55001:2014 standard by February 2022. Further, Essential Energy is continually improving its asset management capabilities by keeping abreast of asset management developments domestically and abroad. This includes undertaking external reviews to benchmark our capability against ISO 55001 and inform our processes. The present format of Essential Energy's asset management system includes:

- Asset Management Policy. This document's the key asset management principles in which the Asset Management System (AMS) adheres to
- Strategic Asset Management Plan (SAMP). This is the overarching document that defines the asset management framework and defines the key processes associated with Essential Energy's AMS. Its purpose is to translate Essential Energy's strategic objectives and priority actions to specific, measurable, achievable, realistic and timely asset management objectives
- Network, Asset Class and System strategies. These strategies perform Asset Lifecycle analysis in order for Essential Energy to understand the activities it must undertake to get the outcomes it needs from its assets in support of its asset management objectives. These strategies set direction for the business in establishing programs of work to manage the network we are accountable for
- Asset Management planning identifies specific targeted actions to deliver on the network and asset class strategies. These planning activities identify needs and develop options that feed a strategic network portfolio optimisation process that achieves the asset management objectives through an appropriate balance of performance, cost and risk.

The following sections detail the specifics of Essential Energy's network and asset lifecycle management strategies to provide an overview of the high-level direction used to manage network performance.

7.1.2 Distribution Growth Strategy

Essential Energy has developed this strategy to instil a systematic and consistent approach to the management of demand and load growth throughout the asset management functions.

The Distribution Growth Strategy defines the components that constitute distribution network demand and load growth, the impacts of such peak demand and load growth, and how those components should be managed. The strategy informs the investment expenditure for network optimisation, augmentation and the management of growth on Essential Energy's distribution network.

Additionally, the Distribution Growth Strategy includes Demand Management initiatives to improve the utilisation of the distribution network and to present the most efficient investment option between new technologies and traditional type augmentation for network investments. Investments have been included for increasing the proactive monitoring capabilities for load and demand growth and voltage performance of the distribution network that will assist in system optimisation and increasing network utilisation. These investments in demand management and network monitoring will allow for the deferral, reduction or modification of investments required to cater for localised demand growth.

7.1.3 Reliability Strategy

The primary purpose of the reliability strategy is to set strategies for achieving targets for duration and frequency of interruptions to network supply, considering business objective to maintain reliability while realising benefits from STPIS and ensuring compliance with NSW Reliability and Performance Licence Conditions for Electricity Distributors.

In terms of jurisdictional licence conditions, there are two applicable components, both overall network reliability standards (Schedule 2) and individual feeder standards (Schedule 3). To meet these requirements, Essential Energy incorporates the following strategic approaches into its overall reliability strategy:

- Reliability management framework, structured to meet regulations and standards but not surpass
- Individual Feeder Standards management targets reliability improvement, both capital and operational, of individual distribution feeders where underlying performance has trended outside the Individual Feeder Standards (Schedule 3) set out in the Reliability and Performance Licence Conditions.

In addition to the above strategies, two other key components of the reliability strategy include:

- Worst performing feeder segment management targets the worst performing of Essential Energy's feeder segments. These segments are identified initially when their performance is recorded as being in excess of two times the feeder category average for 3 concurrent years, after which causal analysis is used to identify any underlying issues. These issues, often due to the customer densities involved, are not sufficient to impact overall feeder performance and as such the regulatory environment typically does not drive changes in performance. As a result, in developing the worst performing feeder segment strategy through stakeholder engagement, it was identified that the program required the support of consumer groups, which to date has been the case with many agreeing that it is in line with the needs of the customer. Essential Energy always welcomes further feedback from customer groups on issues such as this.
- In keeping with the reliability management framework, under the AERs STPIS, Essential Energy is aiming to maintain reliability.

7.1.4 Power Quality Strategy

The primary purpose of the Power Quality Strategy is to manage the ability of the distribution system to perform and meet customer expectations in terms of voltage flicker, unbalance and harmonic performance, whilst also providing direction across Essential Energy's asset management functions to ensure compliance with the standards and regulations stipulated in Electricity Supply Standard (CEOP8026). The scope of this strategy covers measurement, monitoring, maintenance and improvement of power quality across Essential Energy's network.

The strategic elements of the overall Power Quality strategy are:

Reactive Measures

- Investigate received power quality complaints and customer feedback quickly and efficiently
- Verify that power quality problems are indeed network related and are outside the levels prescribed in Electricity Supply Standards
- Rectify any local or wider area problems in a timely, economic and effective manner, including the use of alternate remediation solutions
- Consult with and keep customers advised during all steps of the investigation and rectification process.

Proactive Measures

- Migrate towards a more proactive power quality management approach through improved visibility of network power quality performance delivered by leveraging the rollout of network technology and monitoring equipment. This is supported by the power quality emissions allocations process for new customer connections to capture the background Power Quality measurement information which is based on methodologies given in ENA Guides for Power Quality by means of advanced modelling in SINCAL power system analysis software
- Plan and implement a gradual migration in the median distribution voltage to 230 volts, in line with Australian Standard AS 61000.3.100 – 2011 (Amendment No.1 – 2016), which will minimise overvoltage situations and provide 'headroom' for distributed generation
- Systematic modelling and management of HV feeder voltage profiles and performance
- Improved management of new and additional loads and embedded generator connections.

7.1.5 Safety and Sustainability Strategy

The safety and sustainability strategies apply to Essential Energy's network assets and seek to ensure the provision of an electricity supply that manages safety risk to workers and the public and that minimises harm to the environment, so far as is reasonably practicable (SFAIRP).

The safety strategy meets our compliance obligations and our business objective for continuous improvement in safety performance, while also addressing customer expectations, as expressed through customer engagement studies. Key components of the safety strategy include:

- An uplift in organisational knowledge of SFAIRP principles and the Electricity Network Safety Management System (ENSMS)
- The development of a clear line of sight to corporate metrics and asset class strategies to embed the management of safety performance
- The application of investment tools within the asset class strategies that facilitate the management of asset safety risk within the corporate risk appetite
- Investigation of a mechanism to regularly obtain and quantify the value placed by customers on asset safety performance
- Development of a Formal Safety Assessment (FSA) control register to allow mapping of controls to responsible business units
- Improved detailed causal data for safety incidents through linkages to asset failure data.

Key components of the sustainability strategy include consideration of:

- Improved oil storage facilities ensuring compliance with the requirements of AS 1940
- The cessation of inspection, maintenance or operational activities in high risk environmentally sensitive areas, where alternative options are available
- Targeted procurement or use of less or non-hazardous materials
- Development of a business-wide approach to oil management
- Targeted reduction of emissions causing nuisance to the community in high risk areas
- Implementation of an effective asbestos management program

Other aspects of the network safety and environment strategy include the continuous improvement of data, analytics and information management capabilities as well as people and culture aspects of our approach to safety and environmental risk management.

7.1.6 Bushfire Prevention Strategy

Essential Energy's bushfire and risk management strategy aims to prevent or minimise the impacts of fire ignition from electrical assets, so far as is reasonably practicable. The following strategic elements are those relating more specifically to bushfire prevention even though many others exist which may have an indirect relationship. Bushfire prevention strategies include:

- Identification of high bushfire risk zones to ensure planning, design, construction, operations and maintenance activities are undertaken with an increased awareness of bushfire start risk
- Consideration of bushfire risk in network asset planning and design decisions
- Prioritisation of asset inspection[5] and maintenance with a focus on high fire risk areas, helping to ensure fire start risks are identified and appropriately actioned
- The completion of vegetation management in the form of tree cutting and clearing to manage the risk of trees or vegetation coming into contact with live lines or equipment and igniting fires

[5] Asset inspection includes the use of LiDAR and pre-bushfire season annual fly over inspection of the network

- The provision of advice and information to owners of private lines to inform them of fire risks on their lines and to make recommendations on risk control actions. Where no action is taken to correct defects on private lines within the prescribed notice period in high bushfire risk areas, Essential Energy will undertake works to correct the defect on a “do and charge” basis
- The implementation of operational limitations[6] on total fire ban days to minimise the risk of lines or equipment inadvertently starting a bushfire
- Analysis of fire starts proven to be caused by Essential Energy’s network and completion of root cause analysis to identify improved control or prevention measures that can be instituted or developed.

7.1.7 Asset Class Strategies

Essential Energy’s Asset Class strategies seek to ensure that network assets continue to achieve service level obligations while optimising the lifecycle costs.
Elements considered in these strategies include inspection, maintenance, refurbishment, replacement, and disposal. Intervention Strategies can be categorised as either:

- Time-based: requiring asset treatments based on set time intervals
- Condition-based: requiring asset treatments based on identified asset condition or health
- Risk-based: requiring asset treatments based on the risk of asset failure, including consideration of the likelihood and consequence(s) of failure based on observed risk factors, or
- Predictive: requiring asset treatments based on consideration of the outputs of predictive analytics, particularly relating to the likelihood of asset failure.

Strategies will identify the optimum timing for treatment, including whether this is preventative or corrective, based on an understanding of the risks and costs associated with alternative practicable options.

Strategies are subject to regular review and improvement, based on findings from investigations and benefits realisation studies.

7.1.8 Asset Risk Management & Optimisation

Essential Energy has adopted a risk-based approach to achieving performance objectives from network assets at optimum whole of life cost.

- Asset Risk Management is the overarching risk assessment framework. It provides a consistent approach for calculating risk value from understanding an asset’s probability of failure and likelihood of consequence across Essential Energy’s network assets. It also provides the approach for undertaking risk evaluation and identifying risk treatments
- Appraisal Value Framework is the framework for monetising different types and levels of consequence resulting from network asset failures. This supports the asset risk management procedure towards a monetised risk and value-based approach to asset management decision making
- Risk Informed Optimisation is the methodology used for optimising a portfolio of investment. Using a risk-informed approach, Essential Energy develops a prudent and efficient portfolio of expenditure which provides improved value within a reasonable financial constraint. Essential Energy will continue to refine the portfolio and optimisation process as improvements are made to data, systems and modelling.

7.1.9 Delivering the Network, Asset Class and System Strategies

Across the three categories of strategies (Network, Asset Class and System) targets and measures are specified that align to the organisation’s Asset Management Objectives. Constraints are then applied to the Essential Energy network to identify network needs and options to address these needs. Options analysis is completed through the

[6] Operational limitations include managing the number of auto reclose operations on specific circuit breakers on total fire ban days.

network planning process to determine and justify prudent and optimised expenditure. Rational planning decisions enable the delivery of the strategies through the successful completion of identified, justified and approved investments and programs of work. The delivery of the investments and ongoing programs is undertaken by Customer & Network Services, Accredited Service Providers and external contractors.

Other relevant documents which support the Asset Management System are listed below.

7.1.10 Network Planning Procedure

Essential Energy's Network Planning Procedure ensures the network assets can continue to achieve the service level obligations at an optimum lifecycle cost. The key elements of the overall Network Planning strategy aim to:

- Provide an electricity network that is capable of supplying a customer's load requirements before they connect to the network
- Forecast where new network augmentation or zone substations and associated sub-transmission lines and sub-transmission stations are required
- Maintain an appropriate quality of supply and level of reliability on the existing network in accordance with the reliability and quality of supply strategies
- Facilitate preparation of annual and longer-term budgets that are economically efficient, taking into account both prudent capital investment and ongoing maintenance costs.

7.1.11 Network Operating Procedures

The operating procedures applicable to Essential Energy's network assets seek to enable achievement of service level obligations while minimising the overall lifecycle costs, through active risk management and operational practices that maintain compliance with design parameters.

To achieve this outcome Essential Energy employs operating procedures that help to ensure:

- Asset availability is proactively managed
- Operational risk is understood and managed
- Operations are aided by engineered protective measures and 24-hour monitoring where possible
- Assets are operated within design parameters and, where design parameters are unknown, conservative limits are applied in-line with industry guidelines and standards
- Operational resources are strategically deployed
- Guaranteed service levels, including payments to eligible customers where these service levels are not met.

7.2 Treatment of Distribution Losses

Distribution losses refer to the losses incurred in transporting energy across the distribution network. Of the total 2019/20 energy input into Essential Energy's widely spread network, 5.17 per cent was consumed in the form of network losses.

Essential Energy's investment decisions are guided primarily by the need to achieve the service level obligations at the optimum lifecycle cost. The value of network losses is used in comparing alternative network or non-network solutions, which either act to reduce the average current through the network or lower the resistance. Accordingly, Essential Energy's approach ensures that the value of network losses influences decision making with respect to:

- Any network planning and subsequent augmentation specifically the selection of voltage, conductor and transformers
- Network performance, operation and switching
- Asset maintenance and replacement decisions
- Procurement of equipment.

Network losses are considered in the investment development stage, as well as in the detailed planning and approval stages.

7.3 Asset Issues Impacting Identified System Limitations

Network limitations are identified in the preparation of long-term network strategies. These limitations are then subject to detailed planning studies which consider any related issues arising from individual asset management strategies which are likely to have a material impact on the studied network.

The detailed planning studies include an assessment of non-network alternatives, fault levels, voltage levels, quality of supply considerations, asset replacement, asset refurbishments and new connection applications.

Present Value analysis is used to align the constraint solutions with other network requirements and optimise the investment profile to achieve service level obligations at the lowest lifecycle cost.

7.4 Obtaining Further Information on the Asset Management Strategy and Methodology

Further information on Essential Energy's asset management approach is available by contacting:

Essential Energy
Joshua Thomas
PO Box 5730
Port Macquarie NSW 2444
Email: josh.thomas@essentialenergy.com.au

8. DEMAND MANAGEMENT

8.1 Demand Management Activities in the Preceding Year

Essential Energy's internal demand management procedures for 2019/20 complied with the obligations set out in the National Electricity Rules. For 2019/20 this process included:

- Maintenance of a Register of Interested Parties
- The Distribution Annual Planning Report
- Review of emerging constraints in line with RIT-D process
- Screening of all projects below the RIT-D threshold
- Publication of Consultation Papers where appropriate via AEMO and Essential Energy external web pages
- Notification to Interested Parties of Demand Management opportunities
- Use of non-network service providers to investigate and advise on demand management options
- Consultation with prospective Demand Management Service Providers
- Collaborative agreements with leading academic institutions
- Participation in related industry working groups
- Pooling of demand management knowledge with other distribution network service providers
- Constraint and Growth mapping in conjunction with ISF which aims to promote non-network proposals from a variety of proponents.

There have been no consultations for major network augmentations during 2019/20. However, Essential Energy continues to screen all investments below the RIT-D threshold for Demand Management and Non Network potential as network constraints arise. Such screening tests include assessing the feasibility of a reliability based microgrid solution to back up a zone substation as a potential lower cost solution compared to reconductoring part of the aging sub-transmission network that is causing a reduction to network reliability.

New and Ongoing Innovative Demand Management developments during 2019/20 included:

- Completion of a joint industry research project (Networks Renewed) with the Australian Renewable Energy Agency (ARENA), University of Technology Sydney, Reposit Power, AusNet Services and Fronius. The Networks Renewed project, has provided real-world evidence of customer inverters overlayed with smart control providing voltage management services to Distribution Networks through dynamic control of both real and reactive power. This has enabled a higher uptake of solar PV with minimal customer impact, whilst enabled customer battery storage systems to be centred as a solution to address networks constraints at a potentially lower cost compared to traditional network options. The project (also known as the "Collombatti Trial" within Essential Energy) has also provided valuable insight into the value a Distribution Level Market can provide to both customers and networks. In addition, it has helped identify and prioritise some of the foundation work required before networks can operate in an environment with a high uptake of Distributed Energy Resources (DER) that supports effective and efficient integration of renewables while maintaining downward pressure on network charges.
- Completion of Dynamic Limits DER Feasibility Study (ARENA Funded) The Dynamic Limits DER Feasibility Study explored implementing dynamic distributed energy resources (DER) export limits to better manage voltage and thermal constraints on the electricity network, focusing on local dynamic schemes.
- Completion of a collaborative industry project to test a Dynamic Connection Agreement for Electric Vehicle Chargers for the purpose of increasing the utilisation of the network and establishing flexible connection standards to drive lower cost methods to connect to the network.
- Continuation of joint industry research project (Evolve) with the Australian Renewable Energy Agency (ARENA), Australian National University, Energy Queensland, Ergon Energy, Energex, Endeavour Energy, Ausgrid, Reposit Power, Evergen, Redback Technologies, SwitchDIn, and the NSW Government. The Evolve DER

project aims to increase the network hosting capacity of distributed energy resources (DER) by maximising their participation in energy, ancillary and network service markets, while ensuring the secure technical limits of the electricity networks are not breached.

- Continuation of Network Visibility initiatives seeking to identify the balance between network and third-party measurement and state estimation techniques to build visibility across the network with a focus on the Low Voltage Level of the network.
- During the 2019/20 east coast bushfires Essential Energy installed 9 quick-deploy SAPS to expedite the re-connection of supply, and to permit assessment of prudent long term least cost supply options in areas of the network significantly impacted by the bushfires.

Linked to the quick-deploy SAPS sites, Essential Energy approached the market in the first half of 2020 to assess current SAPS options to inform Essential's SAPS strategy and to improve Essential Energy's catalogue of non-network options considered through the demand management screen test process as network constraints arise.

- Constraint and growth mapping in conjunction with the Institute for Sustainable Futures which aims to promote non-network proposals from a variety of proponents.

There was one zone substation capacitor bank installation refurbished in 2019/20, resulting in continued demand reduction across the sub-transmission and transmission networks. Essential Energy has also continued to invest in upgraded load control functionality to enhance the dynamic management of the network to support the uptake of renewables while enabling lower cost solution to address network constraints as they arise.

8.2 Plans for demand management and embedded generation

Essential Energy has several strategic objectives which aim to ensure positive outcomes for its customers now and in the future through proactive and efficient promotion, development and implementation of demand management and non-network alternatives. These objectives include:

- Enhancement of the business case to further enable demand management and non-network alternatives as a primary element of the planning process and as a broad-based strategy
- Efficient development and refinement of demand management and non-network alternatives based technical skills, experience and solutions.

Throughout 2020/21 new innovative Demand Management developments include:

- Development of a network wide DER hosting capacity model to forecast, at a program level, export constraints and efficient cost to effectively increase the hosting capacity of the network where resulting in a positive market net benefit for customers.
- Leveraging smart meter data to improve network visibility. Essential Energy is exploring access arrangements and cost compared to network side solutions with a range of smart meter data providers to build visibility across the network with a focus on the low voltage (LV) level to assist with planning and operating the network.

8.3 Issues arising from applications to connect embedded generation

Essential Energy's distribution network continues to experience an increasing number of isolated issues relating to voltage rise from embedded generation units, resulting in over voltage tripping of the inverters, and in some cases supplying customers with voltages above Australian Standard limits.

Issues may arise where the service, consumer mains and/or submains conductor is incorrectly sized, incorrectly identified, or the maximum system output is calculated based on an underestimated conductor length. There are also issues that revolve around voltage rise along the low voltage distribution network due to a high penetration of embedded generation within localised areas. This issue typically arises in overhead network areas consisting of original overhead network low voltage conductor.

Export limited inverters have allowed for the reduction in voltage rise issues at the customer's switchboard and provides greater equity in systems where multiple customers share a single transformer. The export limit allows customers to install the most economically sized systems while capping the amount that can be fed back into the network. The embedded generation installer often nominates an export limit during the initial application, and Essential Energy has suggested appropriate export limits depending on network limitations and the size of the installation.

As part of Essential Energy's commitment to improving network connection standards for the purpose of enhancing the solar PV hosting capacity of the network to drive higher utilisation of customer distributed energy resources (DER) and the network, from September 2018 Essential Energy mandated Volt-Var and Volt-Watt power quality response modes in alignment with AS4777.2 for all new Solar PV and battery storage installations. The new requirement assists with managing network voltage in high DER uptake areas of the network, increases the DER hosting capacity of the network, whilst minimising inverter tripping from excessive voltage rise on the network through the activation of 'soft' limits.

Going forward, Essential Energy will continue to identify more efficient options to address the issue of large increases in low voltage network voltage 'swing' brought about by localised pockets of embedded generation, for the long-term interests of customers. Based on learning outcomes from recent trials, such new methods to facilitate the effective and efficient uptake of embedded generation include but not limited to; a shift from static to dynamic connection standards and cost reflective pricing to drive efficient use of the network.

Linked to the history of electricity distribution development within New South Wales, Essential Energy's network was planned, designed, and operated for peak load, due to such, reverse power flow for some areas of the high voltage network is resulting in abnormal asset operation, amplifying existing voltage rise issues and incorrect measurements from network monitoring equipment. Such emerging issues are driving changes to Essential Energy's Asset Management policies and procedures to ensure asset configuration and capability is compatible with reverse power flow conditions, in addition, voltage regulation practices across all levels of the network.

The integration of increasing numbers of embedded generators has required some minor changes to operational procedures. The use of Fameca FC3000 LV network identification equipment produces inconsistent results during times of reverse power flow, requiring local embedded generation to be temporarily disabled or use of the equipment outside of peak generation hours. When mobile diesel generation is used on LV street circuits during planned outages, solar installations resynchronise and supply real power only, requiring the mobile generation to supply much of the reactive power for the LV loads along with the small amount of remaining real power. This poor power factor or even reverse power can lead to tripping of the mobile generation. To prevent this, local embedded generation must be manually disabled during planned outages where temporary generators are used. The alternative of operating the generation outside the embedded generation anti islanding frequency range has not been adopted within Essential Energy.

There are a growing number of distribution substations experiencing high PV penetration, in extreme cases causing network protection to operate during maximum export. These areas are being investigated to verify network performance and to confirm PV installations are operating within their connection application limits to prevent these outages from occurring.

Network costs to address constraints linked to the uptake of DER across the network continues to increase each year. Noting such costs to enable greater export capacity is currently borne by all customers who are connected to

the network, not just those who choose to export energy, with the majority of such costs recovered from non-export customers due to the current cost recovery mechanism based on energy consumed, Essential Energy is actively involved within industry and customer working groups to identify a fair and equitable network access and cost recovery process to guide the future uptake of DER for the long term interest of all customers.

Residential and small business installed solar capacity has seen constant growth as shown in Figure 5.

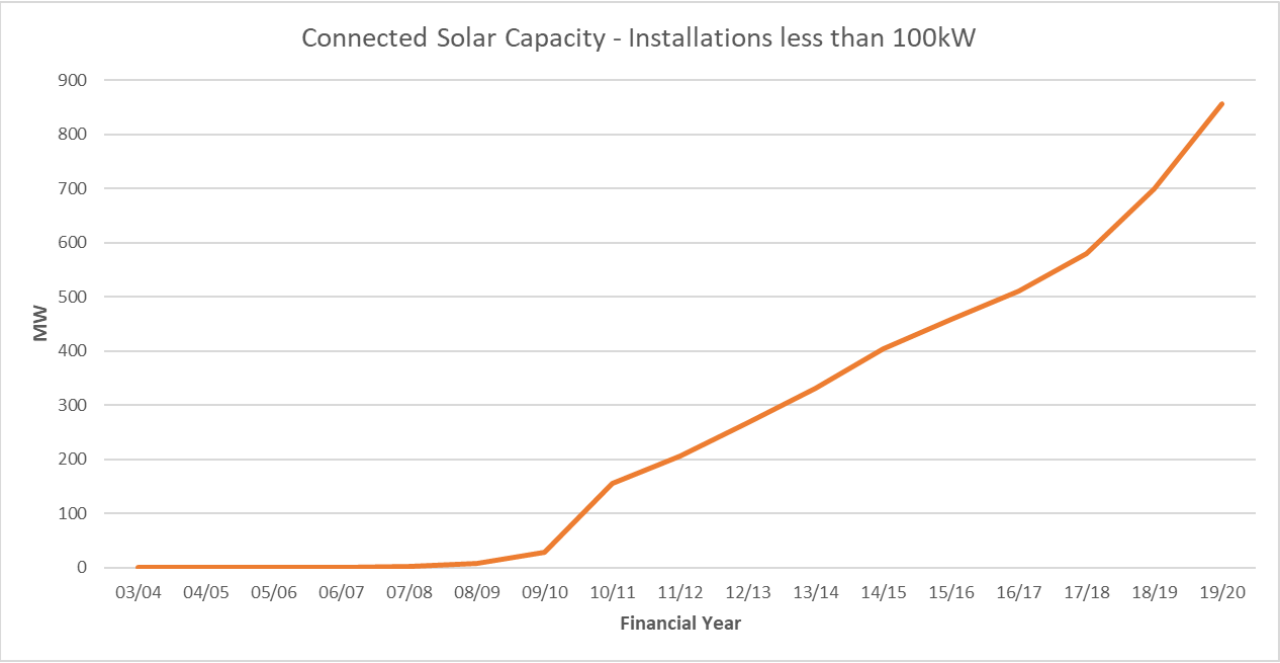


Figure 5 – Installed Solar Capacity, Excluding Large Scale Generation

8.4 Embedded Generation Connection Details

We are unable to differentiate between embedded generation enquiries and general connection enquiries as only simple statistics are recorded. The telephone statistics are based on the number of calls through 13 21 91 and selected option 2 for Network Connections, including solar (previously option 4), and the online portal counts total number of enquiries. The number of embedded generation applications processed has increased significantly from previous years. The introduction of Power of Choice meter contestability and upgrades related to the increased volume of battery installations contributed to an average of approximately 2000 applications per month.

Table 9 – Connection Enquiries and Applications

Connection Enquiries and Applications	Number 2019/20
Phone connection enquiries received	14,942
Online portal connection enquiries received	801
Load connection applications processed	11,509
Generation connection applications processed	35,586
Total connection applications received	57,761
Days to process generation applications	2.0

9. INFORMATION TECHNOLOGY and COMMUNICATION SYSTEMS

9.1 Information Technology

This section of the document defines digital technologies Essential Energy has or is executing to effectively enable the business to deliver on its Customer, Regulatory and Stakeholder requirements. Table 10 outlines the functional area of implementation and a brief description of the investments for the 2019/20 period and Table 11 provides the areas of investment focus for the 2020/21 to 2021/22 period.

Table 10 – Information Technology Investments 2019/20

Functional Area	Technology Initiative
Network Systems	Major initiatives in this area included: • Planning for replacement of the existing Network Asset Management system to improve integration to core systems and support best practice processes (EAM) (continuing to FY21) • Implementation of supply chain technology to deliver integration with core systems and support field related activities (ERP) (continuing to FY21) • Continued implementation of PowerOn Advantage to create a more flexible working environment for field staff and manage demand on Network Operations (continuing to FY21) • Completion of the Asset Inspection System replacement (From DAIS to ASPECT) • Development of several key mobile apps to digitise and automate field work processes.
Customer Systems	Major initiatives in this area included: • Continued remediation of hazard data in existing systems, enable capture of new data and ensure it is provided in a timely manner to both Essential Energy staff and external parties to improve safety (continuing to FY21) • Customer contact centre digitisation, automation, and optimisation to enhance customer and employee experience, including the development of an online customer portal (continuing to FY21) • Planning for the replacement of existing Customer Relationship Management system to improve customer interaction and streamline processes (CRM) (continuing to FY21) • Planning for the implementation of Omnichannel technology to streamline customer interaction (continuing to FY21).
Enterprise Systems	Major initiatives in this area included: • Implementation of the Enterprise Resource Planning (ERP) replacement program (continuing to FY21) • Implementation of a new budgeting and forecasting system.
Data Management	Major initiatives in this area included: • A renewal of the data platform to support and better inform business decision making (continuing to FY21) • Completion of the FY20 Regulatory Information Notice (RIN) automation and optimisation program.

Functional Area	Technology Initiative
Technology Infrastructure	Major initiatives in this area included: • Completed rationalisation project for a set of defined applications and infrastructure • Planning for a holistic technology modernisation program, including data centre and application rationalisation and enterprise application integration (continuing to FY22) • Windows 10 deployment and client device renewal in line with end user device strategy • Continuation of the Cybersecurity tools and capability uplift program (Phase 1) to meet regulatory requirements • Implementation of technology solutions to enable mobility and collaboration in the refurbished head office premises.
Telecommunications Systems	• Completion of the upgrade and diversification of core network, data centres and WiFi capabilities to improve resilience and increase bandwidth and coverage.

Table 11 – Information Technology Investments 2020/21 to 2021/22

Functional Area	Project Description
Network Systems	Major initiatives in this area included: • Implementation of the replacement of the existing Network Asset Management system to improve integration to core systems and support best practice processes (EAM) (continuing to FY23) • Completion of supply chain technology to deliver integration with core systems and support field related activities (ERP) • Completion of the PowerOn Advantage implementation to create a more flexible working environment for field staff and manage demand on Network Operations • Continued digitisation and automation of manual processes to enable field workers
Customer Systems	Major initiatives in this area included: • Completion of the remediation of hazard data in existing systems, enable capture of new data and ensure it is provided in a timely manner to both Essential Energy staff and external parties to improve safety • Implementation of Customer contact centre digitisation, automation, and optimisation to enhance customer and employee experience, including the development of an online customer portal • Implementation of a new Customer Relationship Management system to improve customer interaction and streamline processes (CRM) • Implementation of Omnichannel technology implementation to streamline customer interaction
Enterprise Systems	Major initiatives in this area included: • Completion of the Enterprise Resource Planning (ERP) replacement program, including Finance, HCM and Supply Chain capability
Data Management	Major initiatives in this area included: • Completion of the data platform to support and better inform business decision making • Implementation of data enablement and integration initiatives to consolidate and centralise data flow and management
Market Systems	Major initiatives in this area include: • Planning of the replacement of existing market management systems including market settlements, metering and billing (continuing to FY23) • Implementation of 5-minute settlement market compliance requirements
Technology Infrastructure	Major initiatives in this area included: • Completion of a technology modernisation program, including data centre rationalisation, application rationalisation and enterprise application integration • Delivery of client device renewal in line with new end user device strategy • Completion of the Cybersecurity tools and capability uplift program (Phase 1) to meet regulatory requirements • Commencement of the Cybersecurity uplift program (Phase 2)

Table 12 below provides a summary of actual Information and Communication Technology (ICT) investment in the 2019/20 period and forecast investment for the 2020/21 to 2024/25 period.

Table 12 – ICT Investment actual 2019/20 and forecast 2020/21 to 2024/25 (nominal $)

	Actual ($M)	Forecast ($M)				
	FY20	FY21	FY22	FY23	FY24	FY25
Total ICT Capital Investment	36	80	64	81	72	22

10. REGIONAL DEVELOPMENT PLANS

The tables in the preceding sections (1-10) are structured along Essential Energy's planning hierarchy of:

- Operational Region
  - Connection Point
    - Sub-transmission Line
      - Sub-transmission Substation
        - Zone Substation
          - Distribution Feeder.

Semi-geographic single line diagrams of the electrical network for each supply area have been included in the relevant sections of the zone substation and sub-transmission feeder demand forecasts and where system limitations have been identified these are noted on those diagrams.

The map in Figure 6 show the new configuration of one region and ten operational areas. The map also includes the depots and offices associated with each area.

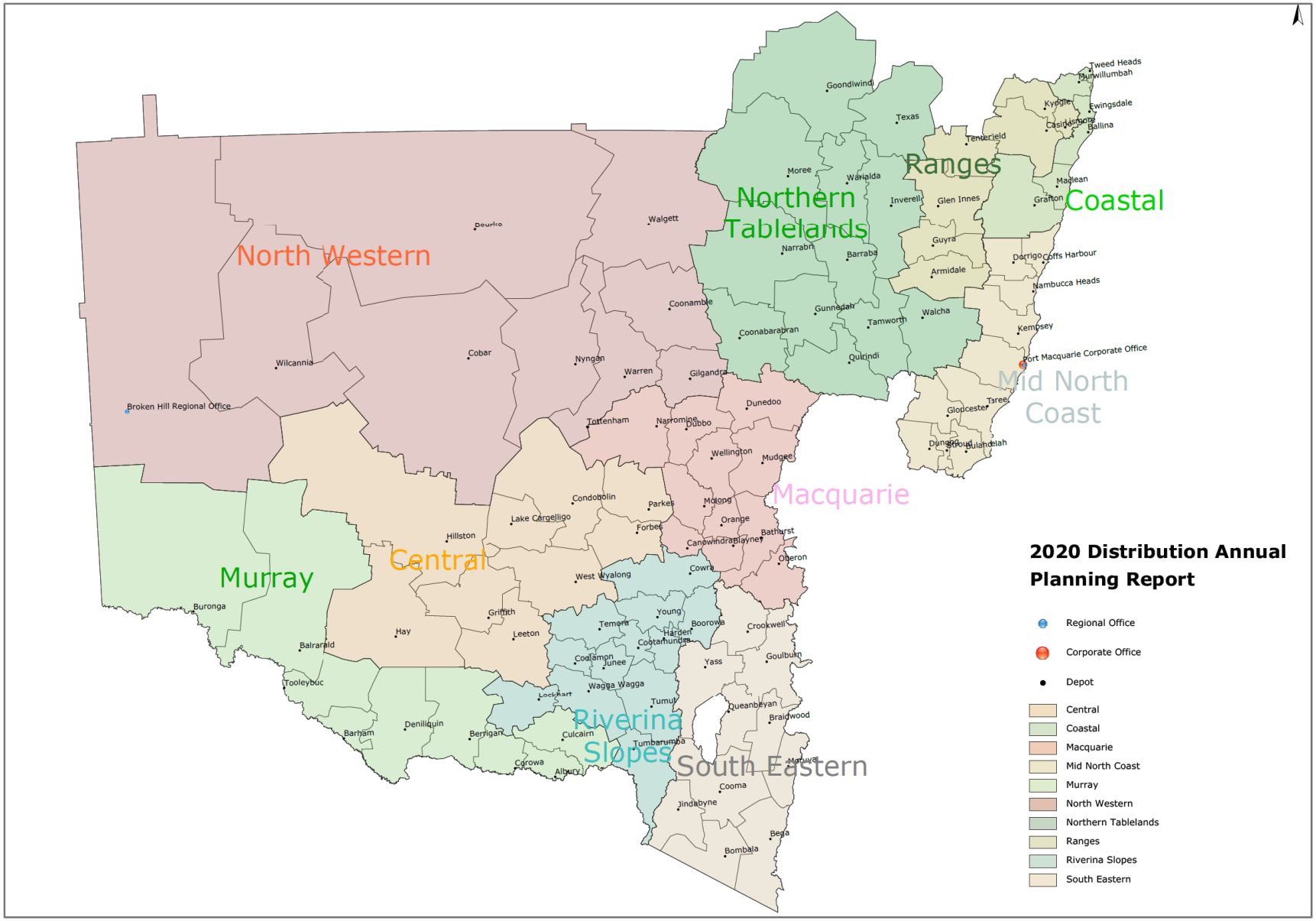


Figure 6 – Diagram of Essential Energy's Operational Areas

11. GLOSSARY

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMP	Asset Management Plan
AMS	Asset Management System
AREMI	Australian Renewable Energy Mapping Infrastructure
CAPEX	Capital Expenditure
CVR	Conservation Voltage Reduction
DAPR	Distribution Annual Planning Report
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
ENSMS	Electricity Network Safety Management System
FSA	Formal Safety Assessment
FY	Financial Year
GWh	Gigawatt-Hour
HV	High Voltage (>1000V AC)
ICT	Information and Communication Technology
IN	Intelligent Network
IPART	Independent Pricing and Regulatory Tribunal
ISF	Institute of Sustainable Futures
kV	Kilovolt
LV	Low Voltage (typically 230V/400V)
MEPS	Minimum Energy Performance Standards
MVA	Megavolt-Ampere
MVAr	Megavolt-Ampere-Reactive
MW	Megawatt
NECF	National Electricity Customer Framework
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
OPEX	Operational Expenditure
PV	Photovoltaic (Solar Panels)
RIT-D	Regulatory Investment Test for Distribution
SAMP	Strategic Asset Management Plan
STS	Sub-transmission Substation
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SFAIRP	So Far As Is Reasonably Practicable
STPIS	Service Target Performance Incentive Scheme
SWER	Single Wire Earth Return
TNSP	Transmission Network Service Provider
TX	Transformer
VCR	Value of Customer Reliability
WHS	Workplace Health and Safety
ZS	Zone Substation

12. NER CROSS REFERENCE

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(a) information regarding the Distribution Network Service Provider and its network, including:	
(1) a description of its network;	1.1 About Essential Energy
(2) a description of its operating environment;	1.1.1 Operating Environment 1.1.2 Essential Energy Statistics
(3) the number and types of its distribution assets;	1.2 Essential Energy's Network 1.2.1 Number and Types of Distribution Assets
(4) methodologies used in preparing the Distribution Annual Planning Report, including methodologies used to identify system limitations and any assumptions applied; and	1.3 Annual Planning Review 1.3.1 Network Planning Process
(5) analysis and explanation of any aspects of forecasts and information provided in the Distribution Annual Planning Report that have changed significantly from previous forecasts and information provided in the preceding year;	1.4 Significant Changes from previous DAPR 1.4.1 Analysis and explanation of forecast changes 1.4.2 Analysis and explanation of changes in other information
(b) forecasts for the forward planning period, including at least:	
(1) a description of the forecasting methodology used, sources of input information, and the assumptions applied;	2.1 Load Forecasting Strategy 2.2 Load Forecasting Methodology and Process 2.2.1 Sources of load forecast input information 2.2.2 Assumptions applied to load forecasts
(2) load forecasts: (i) at the transmission-distribution connection points; (ii) for sub-transmission lines; and (iii) for zone substations, including, where applicable, for each item specified above: (iv) total capacity; (v) firm delivery capacity for summer periods and winter periods; (vi) peak load (summer or winter and an estimate of the number of hours per year that 95% of peak load is expected to be reached); (vii) power factor at time of peak load; (viii) load transfer capacities; and (ix) generation capacity of known embedded generating units;	2.3 Supply Area Forecasts 2.5 Transmission – Distribution Connection Point Load Forecast

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(3) forecasts of future transmission-distribution connection points (and any associated connection assets), sub-transmission lines and zone substations, including for each future transmission-distribution connection point and zone substation: (i) location; (ii) future loading level; and (iii) proposed commissioning time (estimate of month and year);	2.4 Future Connection Points
(4) forecasts of the Distribution Network Service Provider's performance against any reliability targets in a service target performance incentive scheme; and	2.6 Forecast of Reliability Target Performance
(5) a description of any factors that may have a material impact on its network, including factors affecting; (i) fault levels; (ii) voltage levels; (iii) other power system security requirements; (iv) the quality of supply to other Network Users (where relevant); and (v) ageing and potentially unreliable assets;	2.3 Supply Area Forecasts
(b1) for all network asset retirements, and for all network asset de-ratings that would result in a system limitation, that are planned over the forward planning period, the following information in sufficient detail relative to the size or significance of the asset:	
(1) a description of the network asset, including location;	3.4 Network Asset Retirements and De-ratings – Sub-transmission 3.5 Network Asset Retirements and De-ratings – Zone Substation
(2) the reasons, including methodologies and assumptions used by the Distribution Network Service Provider, for deciding that it is necessary or prudent for the network asset to be retired or de-rated, taking into account factors such as the condition of the network asset;	
(3) the date from which the Distribution Network Service Provider proposes that the network asset will be retired or de-rated; and	
(4) if the date to retire or de-rate the network asset has changed since the previous Distribution Annual Planning Report, an explanation of why this has occurred;	
(b2) for the purposes of subparagraph (b1), where two or more network assets are:	
(1) of the same type;	3.5.4 Combined Asset Retirements and De-Ratings
(2) to be retired or de-rated across more than one location;	
(3) to be retired or de-rated in the same calendar year; and	
(4) each expected to have a replacement cost less than $200,000 (as varied by a cost threshold determination), those assets can be reported together by setting out in the Distribution Annual Planning Report:	
(5) a description of the network assets, including a summarised description of their locations;	
(6) the reasons, including methodologies and assumptions used by the Distribution Network Service Provider, for deciding that it is necessary or prudent for the network assets to be retired or de-rated, taking into account factors such as the condition of the network assets;	
(7) the date from which the Distribution Network Service Provider proposes that the network assets will be retired or de-rated; and	
(8) if the calendar year to retire or de-rate the network assets has changed since the previous Distribution Annual Planning Report, an explanation of why this has occurred;	

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(c) information on system limitations for sub-transmission lines and zone substations, including at least:	
(1) estimates of the location and timing (month(s) and year) of the system limitation;	3.1 Sub-transmission Feeder Limitations 3.2 Sub-transmission and Zone Substation Limitations
(2) analysis of any potential for load transfer capacity between supply points that may decrease the impact of the system limitation or defer the requirement for investment;	
(3) impact of the system limitation, if any, on the capacity at transmission-distribution connection points;	
(4) a brief discussion of the types of potential solutions that may address the system limitation in the forward planning period, if a solution is required; and	
(5) where an estimated reduction in forecast load would defer a forecast system limitation for a period of at least 12 months, include: (i) an estimate of the month and year in which a system limitation is forecast to occur as required under subparagraph (1); (ii) the relevant connection points at which the estimated reduction in forecast load may occur; and (iii) the estimated reduction in forecast load in MW or improvements in power factor needed to defer the forecast system limitation;	
(d) for any primary distribution feeders for which a Distribution Network Service Provider has prepared forecasts of maximum demands under clause 5.13.1(d)(1)(iii) and which are currently experiencing an overload, or are forecast to experience an overload in the next two years the Distribution Network Service Provider must set out:	
(1) the location of the primary distribution feeder;	3.3 Primary Distribution Feeder Limitations
(2) the extent to which load exceeds, or is forecast to exceed, 100% (or lower utilisation factor, as appropriate) of the normal cyclic rating under normal conditions (in summer periods or winter periods);	
(3) the types of potential solutions that may address the overload or forecast overload; and	
(4) where an estimated reduction in forecast load would defer a forecast overload for a period of 12 months, include: (i) estimate of the month and year in which the overload is forecast to occur; (ii) a summary of the location of relevant connection points at which the estimated reduction in forecast load would defer the overload; (iii) the estimated reduction in forecast load in MW needed to defer the forecast system limitation;	

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(e) a high-level summary of each RIT-D project for which the regulatory investment test for distribution has been completed in the preceding year or is in progress, including:	
(1) if the regulatory investment test for distribution is in progress, the current stage in the process;	4.1 Regulatory Test / RIT-Ds Completed or in Progress
(2) a brief description of the identified need;	
(3) a list of the credible options assessed or being assessed (to the extent reasonably practicable);	
(4) if the regulatory investment test for distribution has been completed a brief description of the conclusion, including: (i) the net economic benefit of each credible option; (ii) the estimated capital cost of the preferred option; and (iii) the estimated construction timetable and commissioning date (where relevant) of the preferred option; and	
(5) any impacts on Network Users, including any potential material impacts on connection charges and distribution use of system charges that have been estimated;	
(f) for each identified system limitation which a Distribution Network Service Provider has determined will require a regulatory investment test for distribution, provide an estimate of the month and year when the test is expected to commence;	4.2 Potential RIT-Ds for Identified System Limitations
(g) a summary of all committed investments to be carried out within the forward planning period with an estimated capital cost of $2 million or more (as varied by a cost threshold determination) that are to address:	
(1) a refurbishment or replacement need; or	4.3 Urgent and Unforeseen Investments
(2) an urgent and unforeseen network issue as described in clause 5.17.3(a)(1), including:	
(1) a brief description of the investment, including its purpose, its location, the estimated capital cost of the investment and an estimate of the date (month and year) the investment is expected to become operational;	
(2) a brief description of the alternative options considered by the Distribution Network Service Provider in deciding on the preferred investment, including an explanation of the ranking of these options to the committed project. Alternative options could include, but are not limited to, generation options, demand side options, and options involving other distribution or transmission networks;	

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(h) the results of any joint planning undertaken with a Transmission Network Service Provider in the preceding year, including:	
(1) a summary of the process and methodology used by the Distribution Network Service Provider and relevant Transmission Network Service Providers to undertake joint planning;	5.1 Results of Joint Planning with the TNSP TransGrid 5.2 Results of Joint Planning with the TNSP Powerlink
(2) a brief description of any investments that have been planned through this process, including the estimated capital costs of the investment and an estimate of the timing (month and year) of the investment; and	
(3) where additional information on the investments may be obtained;	
(i) the results of any joint planning undertaken with other Distribution Network Service Providers in the preceding year, including:	
(1) a summary of the process and methodology used by the Distribution Network Service Providers to undertake joint planning;	5.3 Results of Joint Planning with the DNSP Energex 5.4 Results of Joint Planning with the DNSP Ergon 5.5 Results of Joint Planning with the DNSP Ausgrid 5.6 Results of Joint Planning with the DNSP Endeavour Energy 5.7 Results of Joint Planning with the DNSP Evoenergy 5.8 Results of Joint Planning with the DNSP Powercor Australia
(2) a brief description of any investments that have been planned through this process, including the estimated capital cost of the investment and an estimate of the timing (month and year) of the investment; and	
(3) where additional information on the investments may be obtained;	
(j) information on the performance of the Distribution Network Service Provider's network, including:	
(1) a summary description of reliability measures and standards in applicable regulatory instruments;	6.1 Reliability Performance 6.2 Quality of Supply Performance
(2) a summary description of the quality of supply standards that apply, including the relevant codes, standards and guidelines;	
(3) a summary description of the performance of the distribution network against the measures and standards described under subparagraphs (1) and (2) for the preceding year;	
(4) where the measures and standards described under subparagraphs (1) and (2) were not met in the preceding year, information on the corrective action taken or planned;	
(5) a summary description of the Distribution Network Service Provider's processes to ensure compliance with the measures and standards described under subparagraphs (1) and (2); and	
(6) an outline of the information contained in the Distribution Network Service Provider's most recent submission to the AER under the service target performance incentive scheme;	

National Electricity Rules Version 150 Schedule 5.8 Distribution Annual Planning Report For the purposes of clause 5.13.2(c), the following information must be included in a Distribution Annual Planning Report:	DAPR 2020 Section
(k) information on the Distribution Network Service Provider's asset management approach, including:	
(1) a summary of any asset management strategy employed by the Distribution Network Service Provider;	7.1 Essential Energy's Asset Management Approach
(1A) an explanation of how the Distribution Network Service Provider takes into account the cost of distribution losses when developing and implementing its asset management and investment strategy;	7.2 Treatment of Distribution Losses
(2) a summary of any issues that may impact on the system limitations identified in the Distribution Annual Planning Report that has been identified through carrying out asset management; and	7.3 Asset Issues Impacting Identified System Limitations
(3) information about where further information on the asset management strategy and methodology adopted by the Distribution Network Service Provider may be obtained;	7.4 Obtaining Further Information on the Asset Management Strategy and Methodology
(l) information on the Distribution Network Service Provider's demand management activities, including:	
(1) a qualitative summary of: (i) non-network options that have been considered in the past year, including generation from embedded generating units; (ii) key issues arising from applications to connect embedded generating units received in the past year; (iii) actions taken to promote non-network proposals in the preceding year, including generation from embedded generating units; and (iv) the Distribution Network Service Provider's plans for demand management and generation from embedded generating units over the forward planning period;	8.1 Demand Management Activities in the Preceding Year 8.2 Plans for demand management and embedded generation 8.3 Issues arising from applications to connect embedded generation
(2) a quantitative summary of: (i) connection enquiries received under clause 5.3A.5; (ii) applications to connect received under clause 5.3A.9; and (iii) the average time taken to complete applications to connect;	8.4 Embedded Generation Connection Details
(m) information on the Distribution Network Service Provider's investments in information technology and communication systems which occurred in the preceding year, and planned investments in information technology and communication systems related to management of network assets in the forward planning period; and	9.1 Information Technology
(n) a regional development plan consisting of a map of the Distribution Network Service Provider's network as a whole, or maps by regions, in accordance with the Distribution Network Service Provider's planning methodology or as required under any regulatory obligation or requirement, identifying:	
(1) sub-transmission lines, zone substations and transmission-distribution connection points; and	2.3 Supply Area Forecasts 10 Regional Development Plans
(2) any system limitations that have been forecast to occur in the forward planning period, including, where they have been identified, overloaded primary distribution feeders.	

13. ZONE SUBSTATION INDEX