Powerlink
QUEENSLAND

ANNUAL PLANNING REPORT 2008

Please direct Annual Planning
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EXECUTIVE SUMMARY

Planning and development of the transmission network are integral to Powerlink Queensland meeting its obligations under the National Electricity Rules and various jurisdictional instruments. This Annual Planning Report (APR) is a key part of this process. It provides information about the Queensland electricity transmission network to Registered Participants and interested parties. It includes information on electricity demand forecasts, the existing electricity supply system including committed generation and network developments, as well as estimates of grid capability and potential network and non-network developments required in the future to meet growing customer demand for electricity in a timely manner.

Electricity Demand Forecast

Electricity usage in Queensland has grown strongly during the past ten years, and this trend is expected to continue over the next ten years. Notwithstanding this growth, a combination of unusual circumstances resulted in only a marginal increase in summer maximum electricity demand (weather and diversity corrected) for 2007/08 compared to 2006/07. These circumstances include:

- A very mild summer with no working days in South East Queensland reaching the 50% PoE reference temperature resulting in low demand and reduced load sensitivity to temperature;
- Similarly in North, Central and South West Queensland no working days reached their 90% PoE reference temperature;
- An increased diversity across Queensland that was evident over the summer period, particularly at the time of State peak;
- Additional embedded generation partially offsetting the delivered demand;
- Delays to the connection of several new industrial loads in Central and North Queensland; and
- Substantial reductions in mining load due to floods in Central Queensland.

Population growth and air conditioning installation was strong over the last two mild summers and accordingly the 2008/09 forecast for average weather conditions gives a large increase over the 2007/08 actual values. On average, summer maximum electricity demand is forecast to increase at an average rate of 3.6% per annum from 8,729MW in 2008/09 to 12,034MW in 2017/18.

A sustained high growth in demand forecast, based on a return to average weather conditions, is attributable to several factors. These include ongoing population migration, the connection of several new industrial loads and continued growth in the mining sector. Beyond 2009/10, the penetration of domestic air conditioning is forecast to continue to grow but at a slower rate, and the annual demand growth rate is expected to move closer to the long term trend.

While an increased diversity has reduced the load at the time of State peak, expected demand growth within each of the areas that make up Queensland remains strong. This strong demand growth will require significant future augmentation to the Queensland transmission network to ensure grid capability keeps pace with demand, particularly in the south eastern part of the State.

Electricity Energy Forecast

Annual energy to be delivered by the Queensland transmission grid is forecast to increase at an average rate of 3.2% per annum over the next ten years for the medium economic growth scenario.

These latest energy forecasts, for average weather conditions, are generally consistent with those from the 2007 and 2006 APRs, which predicted statewide energy growth of around 3.4%.

Forecast energy growth is relatively constant over the ten year outlook period. Incorporated in this growth is:

- An increase in electricity consumption in the coal mining sector over the next five years;
- Increased penetration of domestic air conditioning;
- Some new small industrial loads;
- Continuation of strong population growth;
- Additional water pumping and treatment loads associated with the South East Queensland Water Grid; and
- Allowance for mandated energy conservation measures.

Transmission Projects Completed

Significant projects completed since the 2007 Annual Planning Report include:

- The Woree 275/132kV transformer reinforcement, which has augmented transmission capability to the Cairns area;
- The Ross to Townsville South 132kV transmission reinforcement, which has augmented transmission capability to the southern industrial areas of Townsville;
- Installation of the Strathmore 275kV Static VAr compensator (SVC) which has augmented transmission capability to North Queensland and Far North Queensland;
- The Nebo to Pioneer Valley 132kV transmission reinforcement, which has augmented transmission capability to the Mackay and Proserpine areas;
- The Lilyvale to Blackwater 132kV transmission reinforcement, which has augmented transmission capability to the Blackwater area;
- Establishment of the Teebar Creek 275/132kV Substation which has augmented transmission capability to the Wide Bay zone;
- The Middle Ridge to Greenbank 275kV transmission reinforcement, which has augmented transmission capability to South East Queensland; and
- Establishment of the Mudgeeraba 110/33kV Substation to augment supply capability to the ENERGEX distribution network.

In addition, network support contracts were maintained with power stations in North Queensland to assist in meeting peak electricity demand requirements in the region.

Transmission Projects in Progress

Powerlink is currently implementing the following major augmentation projects.

Four 275kV transmission lines:

- Between Broadsound and Nebo and also between Nebo and Strathmore, to increase transfer capability between Central and Northern Queensland;
- Between South Pine and Sandgate, including additional 275/110kV transformer capacity at South Pine, to increase transfer capability to North East Brisbane; and
- Between Ross (Townsville) and Yabulu South, including Yabulu South Substation, to increase transfer capability into the Townsville area.

Establishment or augmentation of four 275kV substations:

- New substation at Abermain to augment transmission capability to the Ipswich area;
- New SVC at Woolooga to augment transmission capability between Central and Southern Queensland;
- New SVC at Greenbank to augment transmission capability in South East Queensland; and
- An additional 275/110kV transformer at Murarrie Substation to augment transmission capability to the Australia TradeCoast and Brisbane CBD.

Two 132kV transmission lines:

- Between Townsville South and Townsville East to augment supply to the eastern CBD areas and the port of Townsville; and
- Between Bouldercombe and Pandoin to augment transmission capability to Rockhampton and surrounding areas.

One new bulk supply substation at El Arish to augment transmission capability in the Mission Beach area.

Smaller augmentations such as the installation of capacitor banks and transformer upgrades to maintain network reliability standards are also underway.

Generation Capacity

The total generation supply capability within Queensland was increased during 2007 with the commissioning of a 750MW coal fired power station at Kogan Creek (near Chinchilla).

Powerlink has also been advised of the commitment of several new gas and liquid fuel generating stations in North Queensland, Central Queensland and South West Queensland within the next three years which will significantly increase generation capacity to supply forecast electricity demand in Queensland and the interconnected states of New South Wales, Victoria, South Australia and Tasmania.

Queensland/New South Wales Interconnector (QNI)

Powerlink and TransGrid have completed comprehensive technical and economic studies related to a potential upgrade of QNI in accordance with the Australian Energy Regulator (AER) Regulatory Test. The outcomes of these studies have been published within an Interim Report for Market Consultation, which was made available on the Powerlink and TransGrid websites.

The studies show that the installation of series compensation across the existing 330kV interconnector circuits at a cost of around $120 million provide the highest net market benefits across the majority of scenarios. The studies also show that the optimum timing for such an upgrade was 2015/16 under the most plausible scenario. The AER Regulatory Test requires optimal timings to be identified as well as the optimal technical solution.

Accordingly, Powerlink and TransGrid consider it premature to recommend an upgrade option at this time, although both organisations will continue to monitor market developments which could materially impact on the timing and scope of a potential upgrade. A Final Report is expected to be published in July 2008.

Major Flow Paths

Although delivered peak demand in summer 2007/08 was lower than forecast, the transmission network was highly utilised due to the atypical dispatch patterns arising from water restricted operation of major base load generation.

The Central Queensland to South Queensland (CQ-SQ) limit bound for 11.07% of the time over the winter period. This was due to a combination of water conservation measures implemented by Tarong and Swanbank Power Stations and the export of electricity to New South Wales. Commissioning of new generating plant in South Queensland, relaxation of water restrictions and mild weather summer loading in southern Queensland resulted in this grid section binding for only 0.13% of the time during the summer 2007/08.

The Tarong limit experienced minor binding over the 2007/08 summer, again due primarily to water restricted generation reductions. To keep pace with the high load growth in South East Queensland, an SVC at Greenbank and additional shunt compensation have been committed for the 2008/09 summer. These projects will increase transfer capabilities to ensure reliable transmission is maintained for forecast peak electricity demands in South East Queensland.

The Central Queensland to North Queensland (CQ-NQ) limit is managed by network support arrangements between Powerlink and North Queensland generators which have been approved under the AER Regulatory Test process. The staged CQ-NQ transmission project due for completion between 2007 and 2010 will improve transfer capability to meet forecast electricity demand in North Queensland and reduce transmission losses.

Future Augmentations

The predominant driver for augmentations to network capability will continue to be the need to maintain mandated reliability standards as demand continues to grow. Powerlink is committed to continually reviewing and expanding its transmission network in a timely manner to meet this growth.

The National Electricity Rules requires the APR to identify emerging network limitations which are expected to arise some years into the future, assuming that demand for electricity continues to grow as forecast. This allows Powerlink to identify and implement appropriate augmentations to maintain a reliable power supply to customers (including, where appropriate non-network solutions).

The APR highlights those potential future limitations for which Powerlink intends to implement augmentations and/or initiate consultation with Registered Participants and interested parties in the near future.

Consultation on Network Augmentations

Powerlink has recently issued papers to inform Registered Participants and interested parties about expected future network limitations in the Bowen, North and Far North Queensland, and South East Queensland areas, and to seek advice on possible solutions. Powerlink expects to initiate consultation processes for a number of other expected future network limitations within the next 12 months so that augmentations can be planned and implemented in a timely manner.

This APR also contains details of the following proposed new small network assets:
- Installation of a 132kV harmonic filter in the Gladstone area; and
- Installation of a 132kV shunt capacitor bank at Moura Substation.

Powerlink invites submissions on these proposed new small network augmentations by 25 July 2008.

Proposed Network Replacements

In addition to developing its network to meet forecast electricity demand, Powerlink is also required to maintain the capability of its existing network. Powerlink undertakes asset replacement projects when assets are deemed to reach the end of their life. Powerlink has included in this report a list of potential replacement works over the value of $5 million that are envisaged to occur in the next five years.

CHAPTER ONE

Introduction

1.1 Introduction

Powerlink Queensland is a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM), and owns, develops, operates and maintains Queensland's high voltage electricity transmission network. It has also been appointed by the Queensland Government as the Jurisdictional Planning Body responsible for transmission network planning within the State.

As part of its planning responsibilities, Powerlink undertakes an annual planning review of the capability of its transmission network to meet forecast electricity demand requirements. Pursuant to the National Electricity Rules (NER), Powerlink is required to inform industry participants and other interested parties of the findings of this review in its Annual Planning Report (APR) which is published in June each year.

This 2008 APR provides details of Powerlink's latest planning review. The report includes information on electricity demand forecasts, the existing electricity supply system including committed generation and transmission network developments and forecasts of network capability. Emerging limitations in the capability of the network are identified and possible solutions to address these limitations are discussed. Interested parties are encouraged to provide input to facilitate identification of the most economic solution (including non-network solutions) to ensure supply reliability can be maintained to customers in the face of continued strong growth in electricity demand.

Powerlink's annual planning review and report are an important part of the process of planning the Queensland transmission network to continue to meet the needs of participants in the NEM and consumers of electricity in Queensland.

1.2 Context of the Annual Planning Report

All bodies with jurisdictional planning responsibilities in the NEM are required to undertake the annual planning review and reporting process prescribed in the NER.

Information from this process is also provided to the National Electricity Market Management Company (NEMMCO) to assist it in preparing the Statement of Opportunities (SOO).

The SOO is the primary document for examining electricity supply and demand issues across all regions in the NEM and covers the following issues:

Adequacy of NEM electricity supplies to meet projected electricity demand; The Annual National Transmission Statement (ANTS), which reviews National Transmission Flow Paths (NTFPs), forecast constraints and options to relieve those constraints; and Supplementary economic, developmental and historical information.

Powerlink recommends that interested parties review its 2008 APR in conjunction with NEMMCO's 2008 SOO, which is expected to be published by 31 October 2008.

1.3 Purpose of the Annual Planning Report

The purpose of Powerlink's APR is to provide information about the Queensland electricity transmission network to Registered Participants and interested parties.

It aims to provide information that assists interested parties to:
- Identify locations that would benefit from significant electricity supply capability or demand side management initiatives;
- Identify locations where major industrial loads could be connected;
- Understand how the electricity supply system affects their needs;
- Consider the transmission network's capability to transfer quantities of bulk electrical energy; and
- Provide input into the future development of the transmission network.

Readers should note that this document is not intended to be relied upon or used for other purposes, such as for the evaluation of participants' investment decisions.

1.4 Role of Powerlink Queensland

As the owner and operator of the electricity transmission network in Queensland, Powerlink is registered with NEMMCO as a TNSP under the NER.

In this role, and in the context of this APR, Powerlink's transmission network planning and development responsibilities include the following:

- Ensuring that its network is operated with sufficient capability, and augmented if necessary, to provide network services to customers;
- Ensuring that its network complies with technical and reliability standards contained in the NER and jurisdictional instruments;
- Conducting annual planning reviews with Distribution Network Service Providers (DNSP) and other TNSPs whose networks are connected to Powerlink's transmission network, that is, ENERGEX, Ergon Energy, Country Energy and TransGrid;
- Advising Registered Participants and interested parties of emerging network limitations within the time required for action;
- Developing recommendations to address emerging network limitations through joint planning with DNSPs and consultation with Registered Participants and interested parties. Solutions may include network upgrades or non-network options such as local generation and demand side management initiatives; and
- Undertaking the role of proponent of regulated transmission augmentations in Queensland.

Powerlink has also been nominated by the Queensland Government, under Clause 5.6.3(b) of the NER, as the entity having transmission network planning responsibility in Queensland (also known as the Jurisdictional Planning Body). In this role, Powerlink represents the Queensland jurisdiction on the Inter-Regional Planning Committee (IRPC). Powerlink's role on the IRPC includes:

- Providing information on the Queensland network to allow NEMMCO to carry out its obligations, such as publication of the SOO and preparation of the ANTS;
- Providing advice, where necessary, of proposed Queensland augmentations which have a material inter-network effect;
- Participating in inter-regional system tests associated with new or augmented interconnections; and
- Participating in the technical evaluation of proposals for network developments which have a material inter-network effect.

The function of the IRPC is described in Clause 5.6.3 of the NER.

1.5 Overview of Planning Responsibilities

The development of the Queensland transmission network encompasses the following:

- Connection of new participants, or alteration of existing connections;
- Augmentation of the shared network within Queensland; and
- Augmentation to existing interconnectors, or development of new interconnectors between Powerlink's network and networks owned by other TNSPs.

1.5.1 Planning of Connections

Participants wishing to connect to the Queensland transmission network include new and existing generators, major loads and DNSPs. Planning of new connections or alterations to existing connections involves consultation between Powerlink and the connecting party, determination of technical requirements and completion of connection agreements.

1.5.2 Planning of the Shared Network within Queensland

Powerlink is responsible for planning the shared transmission network within Queensland. The NER sets out the planning process and requires Powerlink to apply the Regulatory Test promulgated by the Australian Energy Regulator (AER) to new regulated network augmentation proposals. The planning process requires consultation with registered participants and interested parties including customers, generators and DNSPs. The significant inputs into the network planning process within Queensland are:

- The forecast of customer electricity demand (including demand side management) and its location;
- Location, capacity and expected operation of generation;
- The assessment of future network capability;
- Planning criteria for the network; and
- Prediction of future loadings on the transmission network.

The ten year forecasts of electrical demand and energy across Queensland are used together with forecast generation patterns to determine potential flows on transmission network elements. The location and capacity of existing and committed generation in Queensland is sourced from the NEMMCO SOO, unless modified following advice from relevant participants. Information about existing and committed embedded generation and demand management within distribution systems is provided by the DNSPs.

Powerlink examines the capability of its existing network and future capability following any changes resulting from committed augmentations. This involves consultation with the relevant DNSP where the performance of the transmission system may be affected by the distribution system (for example, where the two systems operate in parallel).

Where potential flows on transmission system elements could exceed network capability, Powerlink is required to notify market participants of these forecast network limitations. If augmentation is considered necessary, joint planning investigations are carried out with the DNSPs (or other TNSPs if relevant) in accordance with the provisions of Clause 5.6.2 of the NER. The objective of this joint planning is to identify the most cost effective network solution.

In addition to the requirement for joint planning, Powerlink has other obligations that govern how it should address forecast network limitations.

The Electricity Act 1994 (Queensland) requires that Powerlink "ensure as far as technically and economically practicable, that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid".

It is a condition of Powerlink's Transmission Authority that it meets licence and NER requirements relating to technical performance standards during intact and contingency conditions. Under its Transmission Authority, Powerlink must plan and develop its network to be capable of supplying the forecast peak demand, even if the most critical network element is out of service. (This is known as the N-1 criterion).

In addition, other obligations are contained in Schedule 5.1 of the NER. The NER sets out minimum performance requirements of the network and connections and requires that reliability standards at each connection point be included in the relevant connection agreement.

New network developments may be proposed to meet these legislative and NER obligations. Powerlink may also propose network augmentations that deliver a net market benefit when measured in accordance with the AER Regulatory Test.

The requirements for initiating new regulated network developments are set down in Clauses 5.6.2, 5.6.6, and 5.6.6A of the NER. These clauses apply to different types of proposed augmentations.

While each of these clauses involves a slightly different process, particularly with respect to consultation with interested parties, the main steps in network planning can be summarised as follows:

- Disclosure of information regarding the need for augmentation. This examines the demand growth and its impact on network capability;
- Generation and network capability to determine the time when additional capability is required;
- Consultation on assumptions made and potential solutions, which may include transmission or distribution network augmentation, local generation or demand side management initiatives;
- Where a network development has a material inter-network impact, either the agreement of the entities responsible for those affected networks must be obtained, or the development must be examined by the IRPC;
- Analysis of the feasible options to determine the one that satisfies the AER Regulatory Test. In the case of an augmentation required to meet reliability and quality standards, this involves a cost effectiveness analysis to determine the option that minimises present value of costs. In all other cases, the Regulatory Test requires that the proposed development maximises the net market benefit as defined in the Regulatory Test; and
- Consultation and publication of a recommended course of action to address the identified future network limitation.

1.5.3 Planning of Interconnectors

Development and assessment of new or augmented interconnections between Queensland and New South Wales (or other States) are the responsibility of the respective TNSPs.

Powerlink will develop plans in association with the owners of connected networks to augment interconnection capability where justified. Any plans to establish or augment interconnectors will be outlined in Powerlink's APR (refer Chapter 2). The NER also provides a role to be carried out by the IRPC. This committee, convened by NEMMCO, includes a representative of the entity having transmission planning responsibility in each State jurisdiction. The inter-jurisdictional planning process involves NEMMCO publishing the SOO by 31 October each year. The SOO provides information on the projected supply/demand balance for each NEM region.

The ANTS, a component of the SOO, provides information relevant to the technical and economic need for augmentation of NTFPs. This includes information on the significance of forecast constraints on power transfers between regions. It also identifies options for the reduction or removal of future network constraints.

CHAPTER TWO

Summary of Relevant National Transmission Flow Path Developments

2.1 Purpose

The Annual National Transmission Statement (ANTS) provides information on the projected need and potential future development of National Transmission Flow Paths (NTFPs) across the National Electricity Market (NEM).

Information relating to potential projects which could affect NTFPs is to be identified by the relevant Transmission Network Service Providers (TNSPs) within their Annual Planning Report (APR).

This section of the APR summarises potential projects identified by Powerlink which could affect transmission flow paths within the Queensland region.

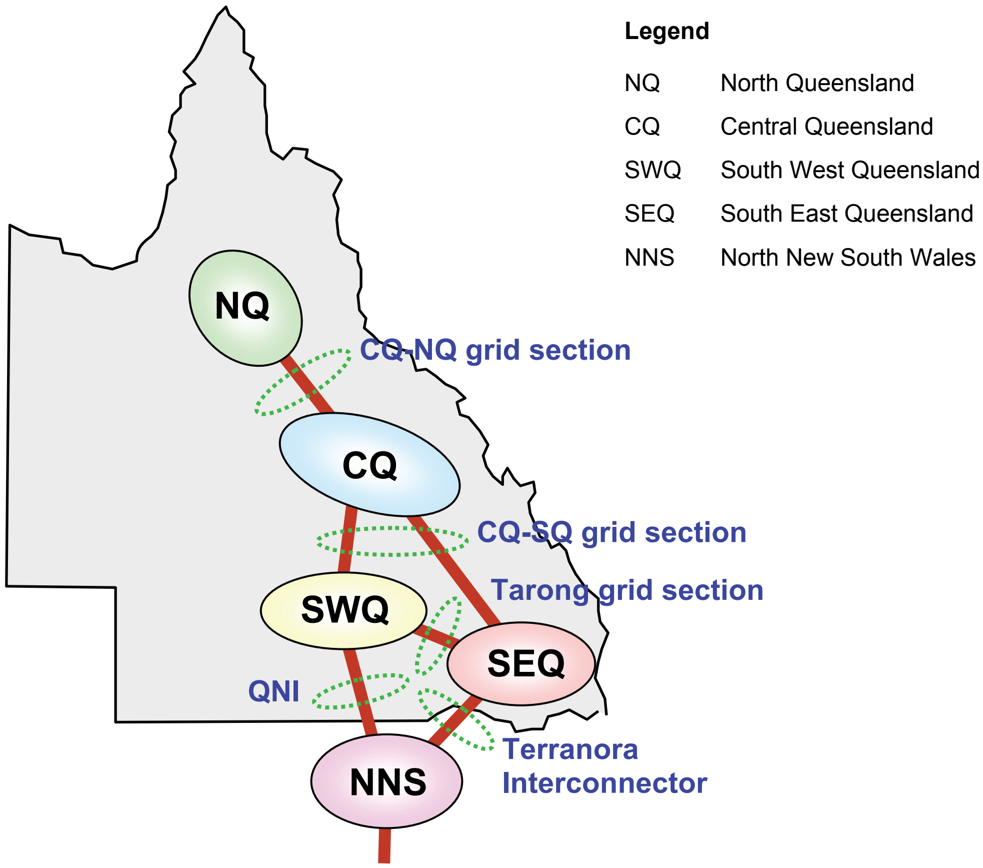
2.2 National Transmission Flow Paths

In 2005, the National Electricity Market Management Company (NEMMCO) defined the criteria for NTFPs as well as the proposed flowpaths for the 2005 ANTS. These flow paths will remain unchanged within the Queensland region for the 2008 ANTS.

The NTFPs within Queensland correspond with parts of the transmission system used to transport significant amounts of electrical power between generation and load centres. These flow paths also align with key intra-regional network sections described within Section 5.3.

The NTFPs for the Queensland region are shown within Figure 2.1.

Figure 2.1: Queensland Major Transmission Flow Paths



2.3 Categories of Augmentations

NEMMCO has defined three categories to classify the status of flow path augmentations for the ANTS. These categories indicate the level of certainty of a particular augmentation. Powerlink has indicated the status of potential augmentations according to these categories which are summarised as follows:

Committed augmentation:	Projects which have satisfied the Regulatory Test, Board commitment has been achieved and funding has been approved.
Routine augmentation:	Projects that are not yet committed for which there is a reasonable expectation that the project will be undertaken to maintain network capability, meet mandated standards, or to ensure transfer capability is not restricted by equipment that can be installed in a low cost and economic manner.
Conceptual augmentation:	Projects identified as potential network options to increase the transfer capability of a NTFP.

2.4 Potential Augmentations to Flow Paths

Potential augmentations which may increase the transfer capability of NTFPs for the Queensland region are summarised within Tables 2.1 and 2.2.

It should be noted that under the NER both non-network and network options are required to be evaluated and compared within the NER prescribed processes for regulated network augmentations. This section provides information relating to network options only.

Table 2.1: Committed and Routine Augmentations for the Queensland Region

FLOW PATH	PROJECT DESCRIPTION	AUGMENTATION BASIS	IMPACT ON NETWORK LIMITS	EXPECTED COMPLETION	STATUS
CQ-NQ	Staged construction of a 275kV transmission line between Nebo and Ross substations	Transfer capability plus local generation may be insufficient to meet future demand	Increases maximum CQ-NQ transfer levels by around 450-520MW	Staged completion for summer 2010/11	Committed
	Stringing of the second side of the existing Stanwell to Broadsound 275kV circuit and installation of reactive compensation	Transfer capability plus local generation may be insufficient to meet future demand	Increases maximum CQ-NQ transfer levels by around 200-300MW	Summer 2012/13	Routine
CQ-SQ (1)	Installation of static VAr compensator (SVC) at Woolooga 275kV Substation	Transfer capability plus local generation may be insufficient to meet future demand	Increases maximum CQ-SQ stability limits by around 100-300MW, increases the Tarong voltage stability limit by around 60MW, and increases the Gold Coast voltage stability limit by around 10MW	Summer 2008/09	Committed
SWQ-SEQ	Installation of 120MVAr capacitor bank at South Pine 275kV Substation	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 25MW and the Gold Coast voltage stability limit by around 10MW	Summer 2008/09	Committed
	Establishment of Abermain 275kV Substation and installation of 275/110kV transformer	This project addresses localised reliability requirements within the south west Brisbane area	Increases the Tarong voltage stability limit by around 25MW and the Gold Coast voltage stability limit by around 10MW	Summer 2008/09	Committed
	Installation of SVC at Greenbank 275kV Substation	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 100MW and the Gold Coast voltage stability limit by around 35MW	Summer 2008/09	Committed
	Installation of 200MVAr capacitor banks at Tarong and Greenbank, and 120MVAr capacitor banks at Mt England and South Pine 275kV substations	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 135MW and the Gold Coast voltage stability limit by around 50MW	Summer 2009/10	Committed
	Installation of SVC at South Pine 275kV Substation	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 75MW and the Gold Coast voltage stability limit by around 25MW	Summer 2009/10	Routine

Table 2.1: Committed and Routine Augmentations for the Queensland Region (Cont'd)

FLOW PATH	PROJECT DESCRIPTION	AUGMENTATION BASIS	IMPACT ON NETWORK LIMITS	EXPECTED COMPLETION	STATUS
SWQ-SEQ (Cont'd)	Installation of two 120MVAr shunt line connected capacitor banks on the Millmerran to Middle Ridge 330kV circuits (at the Middle Ridge end)	Transfer capability plus local generation may be insufficient to meet future demand	Preserves the existing SWQ voltage stability transfer capability to levels above thermal ratings	Summer 2010/11	Routine
	Construction of new double circuit transmission line between Braemar and Tarong	Transfer capability plus local generation may be insufficient to meet future demand	Expected to increase the SWQ limit by around 850MW	Summer 2011/12	Routine
	Installation of 120MVAr capacitor bank at Belmont 275kV Substation	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 25MW and the Gold Coast voltage stability limit by around 10MW	Summer 2011/12	Routine
	Installation of 50MVAr capacitor banks at Ashgrove West and Loganlea 110kV substations	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong voltage stability limit by around 30MW and the Gold Coast voltage stability limit by around 10MW	Summer 2011/12	Routine
	Installation of third 275/110kV transformer at Molendinar Substation	This project addresses localised reliability requirements within the Gold Coast area	Provides an initial capacity increase in the Gold Coast voltage stability limit of around 15MW, and also increases the Tarong voltage stability limit by around 15MW	Summer 2012/13	Routine
	Installation of reactive compensation within SEQ as required to address increasing load growth	Transfer capability plus local generation may be insufficient to meet future demand	Increases the Tarong and Gold Coast voltage stability limits	Summer 2012/13 onwards (2)	Routine
	Establishment of Halys 275kV Substation (near Tarong), and construction of double circuit 500kV transmission line from Halys to Blackwall (initially operating at 275kV)	Transfer capability plus local generation may be insufficient to meet future demand	Provides an initial capacity increase to the Tarong voltage stability limit of around 300-400MW, increases the SWQ limit by around 800MW, and increases the Gold Coast voltage stability limit by around 75MW	Summer 2013/14	Routine

Notes:

(1) The CQ-SQ heading represents the combined CQ-SWQ and CQ-SEQ flow paths. The flow paths have been combined to align with the current representation of the CQ-SQ limit within the National Electricity Market Dispatch Engine (NEMDE).

(2) It is expected that an on-going program of static and dynamic reactive compensation routine projects will be required to address increasing SEQ load growth into the future.

Table 2.2 Conceptual Augmentations for the Queensland Region

FLOW PATH	PROJECT DESCRIPTION	AUGMENTATION BASIS	FLOW PATH IMPROVEMENT	INDICATIVE COST
CQ-SQ (1)	*Option 1* (2) Construction of a switching station at the mid-point of the Tarong-Calvale circuits (Auburn River) and installation of series capacitors	Transfer capability plus local generation may be insufficient to meet future demand. There may also be market benefits under certain generation development scenarios	Increases the maximum CQ-SQ transient stability limit by around 600MW	$80M (approximately)
	Option 2 (2) Construction of a new 275kV double circuit transmission line from Central Queensland to South Queensland along an inland route	Transfer capability plus local generation may be insufficient to meet future demand. There may also be market benefits under certain generation development scenarios	Increases the maximum CQ-SQ transfer limit by around 750MW	$310M (approximately)
	Option 3 (2) Construction of a new staged 275kV double circuit transmission line from Central Queensland to South Queensland along a coastal route	Transfer capability plus local generation may be insufficient to meet future demand. There may also be market benefits under certain generation development scenarios	Increases the maximum CQ-SQ transfer limit by around 950MW	$410M (approximately)
	Option 4 (2) Construction of a new 500kV double circuit transmission line from Central Queensland to South Queensland	Transfer capability plus local generation may be insufficient to meet future demand. There may also be market benefits under certain generation development scenarios	Increases the maximum CQ-SQ transfer limit by around 1600MW	$460M (approximately)
SWQ-SEQ	Establishment of Halys and Blackwall 500kV substations, and conversion of the double circuit Halys to Blackwall transmission line to 500kV operation (3)	Transfer capability plus local generation may be insufficient to meet future demand	Provides an additional capacity increase to the Tarong voltage stability limit of around 350MW, increases the Tarong thermal limit by around 1600MW, and increases the Gold Coast voltage stability limit by around 75MW	$200M (approximately)
	Rebuild of an existing Greenbank to Mudgeeraba 275kV single circuit to double circuit, and upgrade of two existing Mudgeeraba 275/110kV transformers	Transfer capability plus local generation may be insufficient to meet future demand	Increases the thermal transfer capability to the Gold Coast by around 125MW	$90M (approximately)

Table 2.2 Conceptual Augmentations for the Queensland Region (Cont'd)

FLOW PATH	PROJECT DESCRIPTION	AUGMENTATION BASIS	FLOW PATH IMPROVEMENT	INDICATIVE COST
NNS-SWQ and SWQ-NNS	*Option 1 - Series Compensation* Installation of series compensation incorporating thyristor controlled component across the Bulli Creek to Dumaresq and Dumaresq to Armidale 330kV circuits together with minor supporting works	This project may be justified under the market benefits limb of the AER Regulatory Test	This potentially increases the voltage, transient and oscillatory stability limits by up to 300-400MW	$120M (approximately)
	Option 2 - Northern NSW SVC Installation of SVC at Armidale 330kV Substation	This project may be justified under the market benefits limb of the AER Regulatory Test	This potentially increases the voltage stability limits by around 150MW in the northerly direction	$35M (approximately)
	Option 3 - System Protection Scheme Implementation of high speed system protection schemes and the installation of a braking resistor at Loy Yang Substation in Victoria	This project may be justified under the market benefits limb of the AER Regulatory Test	This potentially increases the voltage and transient stability limits by up to 200-300MW in the southerly direction	$35M (approximately)
	Option 4 - HVDC Back to Back Link Installation of a 1500MW HVDC back to back asynchronous link located within the interconnected system between Bulli Creek and Dumaresq substations	This project may be justified under the market benefits limb of the AER Regulatory Test	This potentially increases the power transfer capability by around 500MW in both directions	$470M (approximately)
	Option 5 - Second HVAC Interconnector Construction of an additional 330kV double circuit transmission line and intermediate switching stations between Bulli Creek and Bayswater substations	This project may be justified under the market benefits limb of the AER Regulatory Test	This potentially increases the power transfer capability between Queensland and NSW by around 500MW in the northerly direction and 1000MW in the southerly direction	$900M (approximately)

Notes:

(1) The CQ-SQ heading represents the combined CQ-SWQ and CQ-SEQ flow paths. The flow paths have been combined to align with the current representation of the CQ-SQ limit within NEMDE.

(2) These augmentation options may be dependent on the location and size of potential new entry generation, and are not necessarily substitutable or designed to be implemented in the order shown.

(3) This conceptual augmentation is a further development of the Halys to Blackwall routine augmentation detailed within Table 2.1.

CHAPTER THREE

Intra-Regional Energy and Demand Projections

3.1 Background to Load Forecasts

3.1.1 Sources of Load Forecasts

In accordance with the National Electricity Rules (NER), Powerlink has obtained summer and winter demand forecasts over a ten year horizon from Distribution Network Service Providers (DNSPs) based on their post winter 2007 review, and from directly connected customers, at each connection supply point in Powerlink's transmission network. These individual connection supply point forecasts were aggregated into estimated demand forecasts for the total Queensland region and for ten geographical zones as defined in Table 3.12 in Section 3.4, using temperature corrections and diversity factors observed from historical trends up to the end of winter 2007.

Energy forecasts for each connection supply point were also obtained from the DNSPs and directly connected customers, and these have also been aggregated for the Queensland region and for each of the ten geographical zones in Queensland.

The National Institute of Economic and Industrial Research (NIEIR) was engaged by Powerlink to provide an independent assessment of energy and demand forecasts for the Queensland region and for sub-regions within Queensland in December 2007. These forecasts were based on a 'top-down' economic growth perspective with high and low growth scenarios and predicted levels of embedded generation.

National Electricity Market Management Company (NEMMCO) also engaged NIEIR to provide an updated independent assessment of economic outlook for all the regions of the National Electricity Market (NEM) in April 2008, including high and low growth scenarios and embedded generation levels. These assessments contained an increase in the Queensland economic growth outlook over the previous year, whilst showing little change in the Australian economic growth outlook. The forecasts in this chapter will be consistent with the Queensland forecasts in NEMMCO's 2008 Statement of Opportunities (SOO).

3.1.2 Basis of Load Forecasts

Economic Activity

Three forecast scenarios of economic activity in all NEM states were updated by NIEIR in April 2008. The three scenarios can be characterised as:

- Medium Growth Scenario (the base case), considered to be most probable;
- High Growth Scenario; and
- Low Growth Scenario.

The average economic growth for the High, Medium and Low Growth Scenarios developed by NIEIR over the period 2007/08 to 2017/18 are:

Table 3.1: Economic Growth

	HIGH	MEDIUM	LOW
Australian Gross Domestic Product (average growth p.a.)	4.0%	3.1%	2.1%
Queensland Gross State Product (average growth p.a.)	5.3%	4.2%	3.1%

For Queensland these updated growth rates are significantly higher for all three economic growth scenarios compared then NIEIR predictions outlined in the Powerlink 2007 Annual Planning Report (APR) and NEMMCO 2007 Statement of Opportunities (SOO). The Australian growth rate forecast has negligible change.

This is consistent with a recent surge in new and expansion coal mining projects, particularly in the Bowen Basin, and related capacity increases in rail and ports.

Weather Conditions

Within each of these three economic growth scenarios, NIEIR also prepared three forecasts to incorporate sensitivity of maximum summer and winter demands to prevailing ambient temperature weather conditions across Queensland, namely:

- A 10% probability of exceedance (PoE) forecast region peak corresponding to one year in ten hot summer or cold winter conditions;
- A 50% PoE forecast region peak corresponding to one year in two corresponding to average summer or average winter conditions; and
- A 90% PoE forecast region peak corresponding to mild summer or mild winter conditions, which would be expected to be exceeded in nine years out of ten.

Non-Scheduled and Exempted Embedded Generation

The NIEIR 2008 forecasts for existing and future embedded generation projects now include further refinements by categorising these into non-scheduled or exempted, and into various renewable or non-renewable fuel source classes. Exempted generation is generation that is exempt from the requirement to register with NEMMCO, and so does not participate in the NEM. Generation categories are as follows:

- Existing and projected exempted generators are not included in the delivered and native forecasts of this APR, as these generation outputs in Queensland have always been accounted for in the net loading forecasts provided by customers.
- The NIEIR forecasts also include some as yet undefined and uncommitted projects at levels to meet the targets of the existing government Mandatory Renewable Energy Target schemes. However, as these have all been classed as exempted by NIEIR, they could be expected to be associated with other, also as yet undefined and uncommitted new plant loads, and accordingly their output is not accounted for in the delivered and native forecasts in this APR.
- Non market non-scheduled generator outputs within a customer plant where there is never, or only rarely, a net export to the grid, are also not included in delivered and native forecasts in this APR, as these generation outputs have always been accounted for in the net loading forecasts provided by customers. Where such installations are expected to frequently provide net export to the grid, this generation forms part of the difference between the delivered and native forecasts in this APR.
- Market non-scheduled generator outputs form the remainder of the difference between the delivered and native forecasts in this APR, except where the generation is smaller than 5MW, metering data is not yet available to Powerlink, and the output is accounted in a customer net loading forecast.

Tables 3.2 and 3.3 show the forecast total installed capacity and net sent out output of non-scheduled transmission connected and embedded generation projects. It should be noted that Tables 3.2 and 3.3 are not the total of all embedded generation in Queensland, as they exclude the output of the existing Roma, Barcaldine and Townsville (Yabulu) Power Stations. Whilst embedded in the distribution networks, Roma, Barcaldine and the 66kV output component of Townsville (Yabulu) Power Stations are scheduled market generators and, as such, their output will contribute to the 'delivered from network' as well as the native forecasts in this APR.

Tables 3.2 and 3.3 do include the output of the existing Invicta Sugar Mill Power Station and the Kareeya Unit 5 hydro generation, which are non-scheduled despite being connected to the transmission network. Accordingly, their output is included within both Tables 3.2 and 3.3, and will contribute to the 'delivered from network' as well as native forecasts.

The recently upgraded Pioneer Sugar Mill generators (embedded non-scheduled), located at Ayr, south of Townsville, reduce the energy supplied from Clare Substation in the Ross zone.

Similarly, the recent new German Creek and Oaky Creek coal seam methane multi unit power stations (embedded non-scheduled), located within Central Queensland coal mines, reduce the energy supplied from Lilyvale 132/66kV Substation in the Central West zone.

Also, the recent new Daandine gas power station generators (embedded non-scheduled), located between Dalby and Chinchilla, reduce the energy supplied from Middle Ridge Substation in the redefined South West zone.

Table 3.2: Forecast of Non-Scheduled and Exempted Generation Installed Capacity

NIEIR Forecast of Queensland Non-scheduled and Exempted Generation Total Installed Capacity (MW) (1) (2)

AT YEAR ENDING 30 JUNE	NON-SCHEDULED GENERATION (1)			EXEMPTED GENERATION (2)	
	RENEWABLE	NON-RENEWABLE	TOTAL	RENEWABLE	NON-RENEWABLE
2008	214	135	349	271	109
2009	214	137	351	271	109
2010	266	137	403	271	117
2011	266	137	403	271	117
2012	266	137	403	271	127
2013	266	137	403	281	127
2014	278	137	415	281	137
2015	278	137	415	291	137
2016	278	137	415	291	147
2017	278	137	415	301	157
2018	278	137	415	301	157

Notes:

(1) The non-scheduled generation includes Invicta Sugar Mill bagasse cogeneration and Kareeya Unit 5 hydro generation, which are directly connected to the transmission grid. Their output does not adjust Powerlink's delivered and native forecasts.

(2) Exempted generation is generation that is exempt from the requirement to register with NEMMCO and so does not participate in the NEM. Typically public metering data is not available. The majority of sugar mills in Queensland are exempted.

Table 3.3: Forecast of Non-Scheduled Generation Sent Out Energy

NIEIR Forecast of Queensland Non-scheduled Generation Annual Energy Net Sent Out (GWh) (1) (2)

YEAR	TRANSMISSION CONNECTED (1) (ALL RENEWABLE)	EMBEDDED GENERATION		TOTAL NON-SCHEDULED (2)
		RENEWABLE	NON-RENEWABLE	
2007/08	113	429	508	1,050
2008/09	113	429	512	1,054
2009/10	113	683	512	1,308
2010/11	113	683	512	1,308
2011/12	113	683	512	1,308
2012/13	113	683	512	1,308
2013/14	113	721	512	1,345
2014/15	113	721	512	1,345
2015/16	113	721	512	1,345
2016/17	113	721	512	1,345
2017/18	113	721	512	1,345

Notes:

(1) This includes Invicta Sugar Mill bagasse cogeneration and Kareeya Unit 5 hydro sent out energy, which are connected to the transmission network and accordingly, will not be subtracted off in this APR 2008 Delivered and Native forecasts.

(2) This total, less the transmission connected component, is the difference between native and delivered energy forecasts in this APR. However, these values exclude both non-scheduled and exempted generation where it is within a large industrial plant, where there is never, or only rarely, a net export to the grid, and where the customer provides a net loading forecast.

Wivenhoe Pumping Load
As in previous reports, the energy delivered to the Wivenhoe pumps is excluded from both the demand and energy forecasts in this report.

Native Demand
Since late 2006, there has been a significant increase in the establishment and operation of new embedded non-scheduled power stations larger than 5MW. Most notably, these include the upgraded Pioneer Sugar Mill (one 30.86MW unit and one 36.92MW unit), an upgraded sugar mill at Isis (25MW single unit), the Daandine gas fired power station (total 27.5MW), the Oaky Creek coal seam methane power station (total 12MW) and the German Creek coal seam methane power station (total 32MW).

Generation at these recent new embedded power stations and a number of recent smaller installations (as included within Tables 3.2 and 3.3), has reduced the energy and demand delivered directly from the Powerlink network and from embedded scheduled generators (the “delivered” forecast). This has the potential of understating the underlying growth in electricity utilisation in Queensland. Accordingly, a correction for the output of the embedded non-scheduled generators, which can at times export into the grid, is necessary to more accurately reflect underlying growth rates. This is achieved by measurement of native demand to the extent that metering data allows.

Native demand refers to the actual demand delivered into the distribution networks and to transmission connected consumers, after netting out the output of exempted and non-market non-scheduled generators which don’t export to the grid. Referring to Figure 3.1, it is the sum of delivered demand (energy) from a TNSP, from embedded scheduled generators, and from significant non-scheduled embedded generation. In the case of Queensland, this non-scheduled embedded generation includes a small number of sugar mill cogenerators, thermal landfill and biomass generation.

This APR 2008 now reports more comprehensively on forecasting of both delivered and native demand, with particular emphasis on native demand to reflect underlying economic growth rates. Historical data in this report has also been corrected to native values but only back to 2006/07 as differences between native and delivered demand before then are not material.

Interconnector Loads
Energy flows across the Queensland/New South Wales Interconnector (QNI) and the Terranora Interconnector are not included in the forecast loads in this Chapter, as they are not part of the Queensland customer load. These flows will increase or decrease the dispatch of generation within Queensland and the loading on parts of the transmission network to meet the demand.

New Large Loads - Committed
A number of new industrial and port handling facility loads reported as committed in the 2006 and 2007 Annual Planning Reports have encountered delays in completion, which has contributed to reductions to expected energy and demand over the past year. The initial phases of these load increases will now materialise over the coming year.

The first new coal loader in the Gladstone area has not yet reached full loading but this is expected by late 2008. The new Wiggins Island coal loader in the Gladstone area has been delayed, but environmental approval has now been granted, and it is expected to reach full loading in 2009.

The second stage of Rio Tinto Aluminium Yarwun Alumina Refinery (west of Gladstone) is expected to be commissioned by summer 2008/09. The forecasts now include a ramp up of loading at the Boyne Island smelters from 2011/12 onwards, totalling about 125MW over six years.

Expansion of coal handling port facilities at Dalrymple Bay (Mackay) and associated railway load increase, is expected by late 2009.

The forecast now includes the first two stages of port handling facility upgrades at Abbot Point (Bowen). The “Northern Missing Link” railway project is also expected by 2010 and this has led to a large number of new and expanded Bowen Basin coal mines recently making connection applications. At this stage, Ergon Energy expects about 60% of this potential, or about 160MW, new coal mine load to come on line from 2009 to 2013, and this is also now included in the forecast.

Increased pumping loads due to the South East Queensland Water Grid and the new desalination plant at Tugun by 2010 are included within this forecast.

New Large Loads - Uncommitted

There have been several proposals for large metal processing or other industrial loads which are not yet considered to be committed, and are therefore not included in the medium economic forecast.

These include the following possible or proposed projects:

- Major expansions of an existing zinc smelter plant (Townsville);
- Stage 3 Port Handling facility upgrade at Abbot Point (Bowen);
- Future electrification of the Bowen Basin to Abbot Point Railway Line ("Northern Missing Link");
- Further new and expanded coal mining loads in the Bowen Basin;
- A large chemical plant in the Yarwun (Gladstone) area;
- A new aluminium smelter at Aldoga (south west of Gladstone);
- Several additional coal mines in the Wandoan and Surat Basin area including one very large project, possibly associated with the “Southern Missing Link” railway proposal;
- Additional desalination plants in South East Queensland; and
- Industrial loads in the Swanbank area (including a steel mill).

Some of these additional demands have been included in the high growth scenario in accordance with the data provided by customers. These developments could translate to the following additional load, to be supplied from the network.

Table 3.4: Uncommitted Large Loads

ZONE	TYPE OF PLANT	POSSIBLE LOAD
Ross	Zinc	Up to 120MW
North	Further port facilities upgrade and increased railway	Up to 80MW
Central West & North	Greater than forecast increase in coal mining load	Up to 120MW
Gladstone	Aluminium, zinc and chemical plant	Up to 1100MW
Moreton	Steel mill and further desalination plant	Up to 200MW

DNSP and NIEIR Forecast Reconciliation

Powerlink also contracted NIEIR to provide an economic outlook and embedded generation forecast for Queensland together with ‘top-down’ econometric load forecasts which include impacts from projected future electricity price rises under an emissions trading scenario. These NIEIR reports were subsequently updated and expanded in recent reports to NEMMCO.

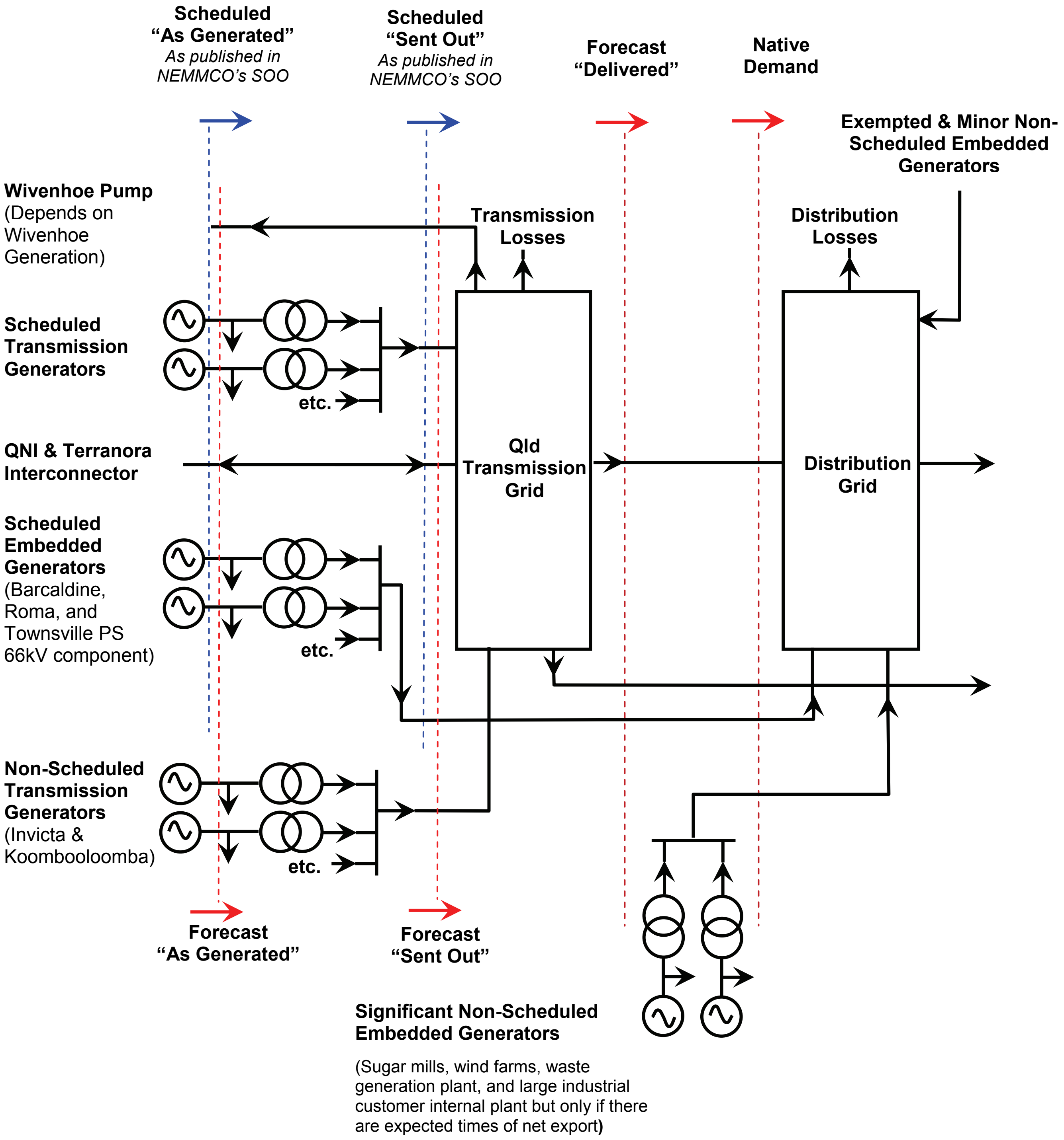
Reconciliation between the NIEIR forecast and the more detailed forecasts provided by DNSPs and customers, was undertaken for the medium growth scenario and average weather conditions. This was found to give close agreement, including consistency with Powerlink's trend and weather analysis, connection applications knowledge, and the NIEIR embedded generation reports.

The forecasts do not include the prospect of much higher growth rates eventuating in the second half of the next ten year period should a major new gas pipeline eventuate in Queensland within that timeframe, creating a flow-on economic growth stimulus.

3.1.3 Load Forecast Definitions

The relationship between the classes of generation and the forecast quantities in this report is shown in Figure 3.1.

Figure 3.1 : Load Forecast Definitions



3.2 Recent Energy and Demands

3.2.1 Recent Summers

A summary for South East Queensland of recent summer electricity demands, seasonal energy and prevailing weather conditions, is shown in Table 3.5. All forecast and historic data excludes the Tweed Shire of New South Wales.

Summer 2007/08 in South East Queensland was mild in average temperature terms, similar to summer 2006/07. However, it was dominated by above average rainfall and overcast conditions, to the extent that the average daytime temperature was significantly lower than for the slightly overall milder 2006/07 summer, with associated higher average night time temperatures. This effect caused even lower air conditioning utilisation than the average temperature would predict. Similar conditions occurred across all parts of Queensland. There was substantial flooding in central and northern Queensland during late January to early February leading to reductions in demand and energy, particularly in mining areas.

Across the State, there was a lack of working days with temperatures approaching 90% PoE temperature conditions. These factors combined to produce a summer with low use of domestic air conditioning, despite surveys showing ongoing strong growth in air conditioning sales and penetration levels. The normal growth of the daily demand sensitivity to temperature going into and throughout the summer was not fully initiated. Accordingly, linear best fit analysis generally showed much lower than expected levels of observed sensitivity.

Even when each broad area of Queensland approached its own hotter weather period, these tended to be at different times, so there was no driver for a high Queensland total region demand. The actual Queensland total demands recorded were well below forecast average weather and diversity levels, and without significant corrections, provide no guide to future forecasts.

The weather and diversity corrected, summer 2007/08 maximum native demand for Queensland was 8,057MW, as outlined in Appendix F. This increased from 7,976MW in summer 2006/07, representing a 1.0% increase. Appendices F and G describe the specific attributes associated with summer 2007/08 across all areas of Queensland which impacted on the correction process. The standard weather correction could not completely compensate for the predominance of days of near average and slightly above average temperatures which produced lower demands than expected due to the lack of hot days over the whole summer.

At the time of Queensland actual peak demand for summer 2007/08, the weather pattern diversity across the State was much greater than previously seen at 89.8% coincidence compared with the previous ten year average of 97.1% coincidence.

The South East Queensland peak demand was on a different day (Saturday 23 February 2008) to the State peak demand (Friday 22 February 2008). At the time of the State peak, the South East Queensland demand was 439MW below its own temperature corrected peak. Until recent years, South East Queensland local summer peak tended to coincide with the State total summer peak, but recent divergence to this behaviour is now being factored into the forecasts in this report.

The actual delivered summer energy for Queensland in 2007/08 was a modest 1.5% higher than in summer 2006/07, but the growth was 2.3% on a native basis. In South East Queensland the growth in summer native energy was 3.0% over summer 2006/07. Further comment can be found in Appendices F and G.

Recent surveys have shown that the increase in air conditioning sales during 2007 in South East Queensland, both for new penetration or for upgrades, continued at similar strong levels to the previous year, although still at slower growth than predicted by the 2005 survey and slower than the growth rate observed from 2002 to 2006. It is expected that the increased air conditioning installations over the last two mild weather years will produce strong energy and demand growth next year, and subsequently if average weather conditions occur.

Table 3.5: Comparison of Recent South East Queensland Summer Native Demand

SUMMER (1)	NATIVE ENERGY GWh (2)	MAXIMUM NATIVE DEMAND (MW) (2)	PREVAILING QUEENSLAND WEATHER CONDITIONS	BRISBANE TEMPERATURE (3)		
				SUMMER AVERAGE °C	PEAK DEMAND DAY °C	NO DAYS >28.4°C
1997/98	3,928	2,596	Hot	26.12	29.00	10
1998/99	3,973	2,762	Average	24.68	29.75	8
1999/00	4,085	2,946	Mild	22.66	31.95	2
2000/01	4,352	2,977	Average, dry	24.39	28.90	4
2001/02	4,694	3,120	Sustained hot and dry, extreme central to north	25.58	26.95	10
2002/03	4,746	3,383	Mild, late wet season in north	24.41	28.95	2
2003/04	5,282	3,847	Hot and humid	26.01	30.60	17 (4)
2004/05	5,373	4,024	Average	25.09	28.10	4
2005/06	5,917	4,149	No very hot working weekday conditions, but high temperatures at other times leading to high energy consumption	26.20	27.90	7 (5)
2006/07	5,572	4,300	Mild - no extreme conditions	24.00	28.30	3 (6)
2007/08	5,741	4,114 (7)	Mild - no hot working weekdays and generally very overcast giving lower daytime maximum temperatures	24.23 (8)	30.30 (7)	1 (7)

Notes:

(1) In this table summer includes all the days of December, January and February.

(2) In this table demands are 'Native' for 2006/07 and 2007/08, but are 'Delivered' for prior years. In the case of South East Queensland there is only a relatively small amount of embedded non-scheduled market generation to date and this is dominated by Rocky Point power station.

(3) In this report, Brisbane temperature is measured at Archerfield. Day temperatures refer to average of daily minimum and daily maximum to represent the driver for cooling load, with a 25% loading of the previous day temperatures if hotter. The 28.4°C is the 50% PoE reference temperature which is expected to be exceeded two to three days per summer on average.

(4) This included ten days from 12 to 23 February 2004.

(5) Only one of these seven days was on a working week day. This day was in early December when general air conditioning demand is not as high as later in summer.

(6) In addition to the three summer days where the 50% PoE temperature was met or exceeded, there were two days in March and one day in November where it was also exceeded.

(7) For the summer 2007/08 the only day hotter than the 50% PoE reference temperature was Saturday 23 February 2008 and this registered the highest peak demand. The day before, Friday 22 February 2008 recorded the highest working day peak demand of 4092MW at a temperature of 27.15°C, well below the 50% PoE reference temperature. No other summer working day exceeded 26.6°C and only five working days exceeded 25.55°C. The impact of the lack of hot days over the whole summer was that the normal domestic sensitivity to temperature dependant air conditioning use was not fully initiated (see also Note 8).

(8) In addition to the lack of hot days the summer was characterised by consistent overcast conditions which meant that average daytime temperature was significantly lower than that encountered even in the slightly milder 2006/07 summer, but with higher average night time temperature. This also contributed to lack of initiation of the normal domestic sensitivity to temperature dependant air conditioning use, as described in Note (7).

3.2.2 Recent Winters

A summary for South East Queensland of recent winter electricity demands, seasonal energy and prevailing weather conditions, is shown in Table 3.6. All forecast and historic data excludes the Tweed Shire of New South Wales.

The South East Queensland winter of 2007 was mild to average overall, having followed three consecutive mild winters. It contained a more typical total of four days of equal or cooler than the 50% PoE reference temperature. This resulted in more use of air conditioning for heating than in other recent winters, and the peak native demand in South East Queensland for winter 2007 was 4,118MW which, after temperature correction, showed a 4.0% increase over the winter 2006.

The actual recorded Queensland region maximum winter 2007 delivered demand was 7,166MW, a significant increase of 4.0% over winter 2006. The actual native 2007 peak was 7,223MW which is temperature and diversity corrected to 7,201MW.

The growth in actual native winter energy in 2007 was 2.8% for Queensland and 3.7% for South East Queensland. The effect of increasing domestic air conditioning on winter electricity consumption has now become clear since reverse cycle units have now largely replaced less efficient means of household heating. As shown in Appendix F, a discernable growth in sensitivity of winter daily peak demands against Brisbane temperature has now emerged. As reverse cycle air conditioning becomes even more prevalent in the future, the increase in this sensitivity is expected to continue.

Table 3.6: Comparison of Recent South East Queensland Winter Native Demand

WINTER (1)	NATIVE ENERGY GWh (2)	MAX NATIVE DEMAND MW (2)	PREVAILING QUEENSLAND WEATHER CONDITIONS	BRISBANE TEMPERATURE (3)		
				WINTER AVERAGE °C	PEAK DEMAND DAY °C	NO DAYS <10.9°C
1998	3,982	2,617	Mild to warm	16.45	11.85	0
1999	4,227	2,769	Mild	15.32	15.50	0
2000	4,456	2,992	Cooler than average	14.32	8.80	2
2001	4,543	2,975	Mild	14.99	10.10	3
2002	4,775	2,999	Average	14.57	12.85	1
2003	4,921	3,325	Mild but one 8 day cold snap	14.96	10.95	4
2004	5,094	3,504	Mild	15.40	11.80	0
2005	5,252	3,731	Mild	15.68	10.50	2
2006	5,420	3,882	Mild	15.55	13.85	0
2007	5,610	4,118	Average to Mild	15.14	10.05	4

Notes:

(1) In this table, winter means all the days of June, July and August.

(2) In this table energy and demands are 'Native' for 2006 and 2007, but are 'Delivered' for prior years. In the case of South East Queensland there is only a relatively small amount of embedded non-scheduled market generation to date and this is dominated by Rocky Point power station.

(3) In this report, Brisbane temperature is measured at Archerfield - being more representative of general South East Queensland weather conditions than previous reference to Brisbane Airport. Day temperatures refer to average of daily minimum and daily maximum to represent the driver for heating load, with a 25% loading of the previous day temperatures if cooler. The 10.9°C is the 50% PoE reference temperature. Actual temperatures are expected to be below this for two to three days per winter on average.

3.2.3 Seasonal Growth Patterns

The hot summers of 1997/98, 2001/02, 2003/04 and 2005/06 resulted in large increases in summer delivered energy. The relatively cooler than average winters of 1997 and 2000 also resulted in higher winter delivered energy. These effects can be seen in Figure 3.2 by comparison to the trend line of summer and winter energy delivered to DNSPs. Figure 3.2 excludes the energy delivered to major industrial customers connected directly to the transmission network, so that it is indicative of the underlying trend of electricity consumption growth in Queensland.

Of particular note is the reduction in energy delivered to DNSPs from the hot 2005/06 summer to the mild 2006/07 summer, and a further reduction to the mild 2007/08 summer. This emphasises the fact that Queensland non-industrial load is increasingly temperature sensitive over the summer period. Other factors further contributed to the lower than expected energy over the 2007/08 summer, as outlined in this report.

3.2.4 Temperature and Diversity Correction of Demands

Powerlink and the DNSPs analyse the temperature dependence of demands for all zones and major areas across Queensland, with reference to weather station data from eight locations, as outlined in Appendix F.

Queensland is too large geographically to be accurately described as having a demand that is dependent on a single location's weather. The three recent hot summers of 2001/02, 2003/04 and 2005/06 and the mild 2007/08 summer have shown that such an approach can be misleading.

In the 2001/02 summer, the maximum Queensland region demands coincided with the hottest weather and highest demands in northern Queensland. However, in summer 2003/04 and 2007/08, the northern Queensland demands and temperatures were relatively low at the times of hottest weather and highest demands in southern Queensland.

In the 2007/08 summer, the level of non-coincidence of hot weather and associated high demands across all areas was more pronounced than in any recent summer. This is expressed as demand diversity which calculated to only 89.8% for the 2007/08 summer, compared with the previous ten year average of 97.1%. This accounts for a major correction upwards to the recorded Queensland region demand.

Furthermore, in the last three summers a new trend has emerged where the South East Queensland demand has exhibited an increased diversity to the total Queensland demand. This trend is consistent with increased air conditioning driving each area of Queensland to become more sensitive to its local weather conditions, rather than responding more collectively to general conditions over the whole State.

Accordingly, Powerlink continues to review and dynamically update the methodology of weather correcting historical Queensland region demand, and continues to separate the analysis into five components for separate correction, according to updated average historical coincidence factors. The components are:

- Northern Queensland area, less its large industrial loads, corrected against Townsville temperature;
- Major industrial loads which might exhibit fluctuating levels independent of temperature conditions are corrected to typical levels coincident with time of Queensland region maximum demand;
- Central Queensland area (which includes the Wide Bay area) less its large industrial loads, corrected against Rockhampton temperature;
- South West Queensland area, corrected against Toowoomba temperature; and
- South East Queensland area, (which does not include the Wide Bay area) corrected against Brisbane (Archerfield) temperature.

The recent significant increase in embedded non-scheduled generation has led to a revision of temperature analysis for native demands rather than delivered demands, as this generation has not displayed a temperature dependent pattern. The correction to native analysis has been carried out for summer 2006/07 and winter 2007 based on available embedded generation data.

Queensland region corrected demands for all winters and summers from 1999, under the revised methodology, are shown on Figure 3.3. Figure 3.4 shows the same information for South East Queensland alone. The methodology is further outlined in Appendix F.

Figure 3.2: Historic Native Energy to DNSPs in Queensland

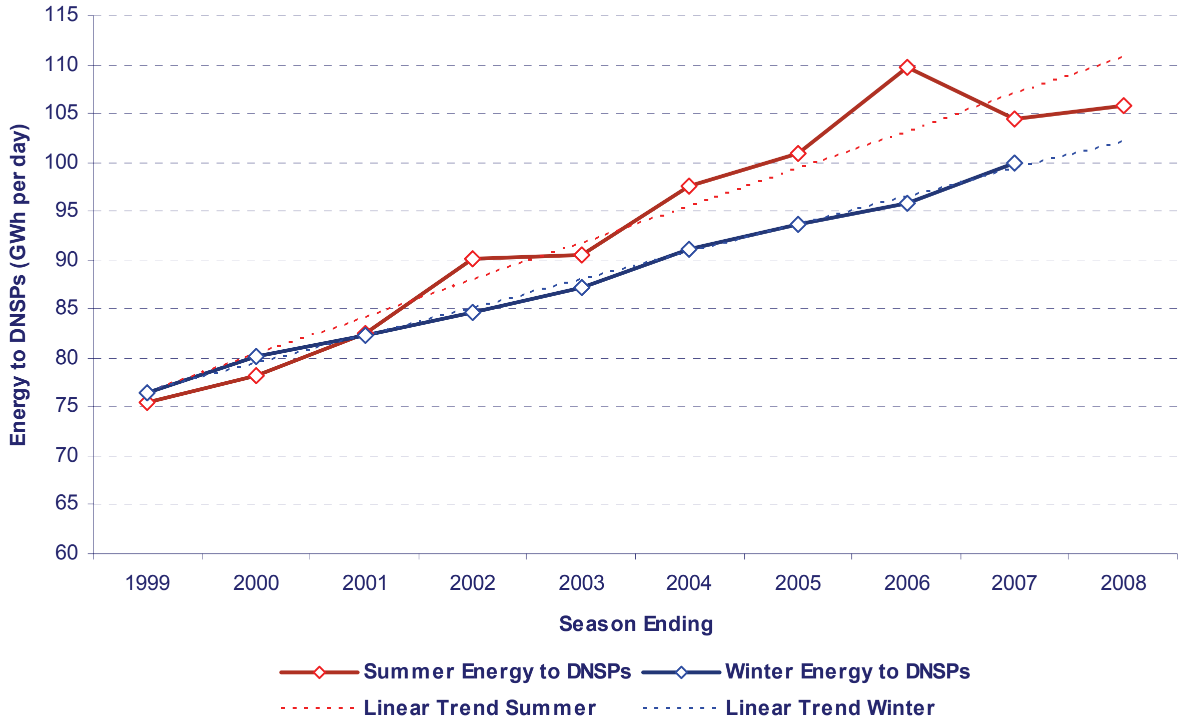


Figure 3.3: Historic Native Demand for Queensland (Including Temperature and Diversity Correction)

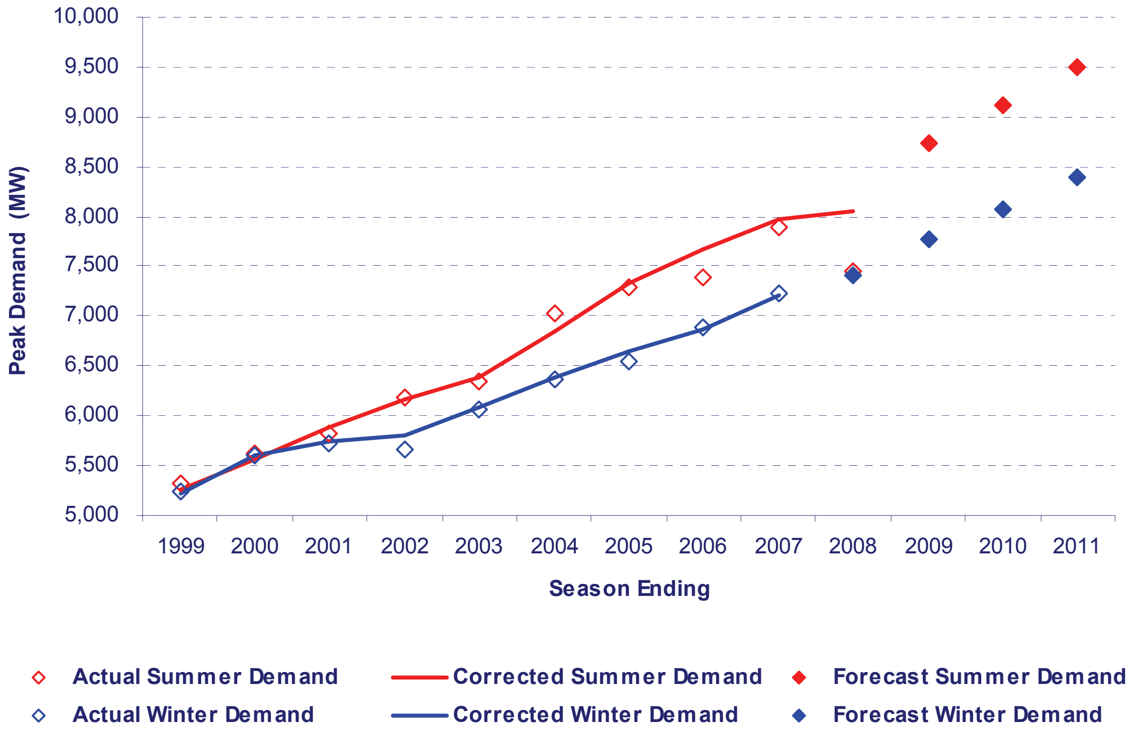
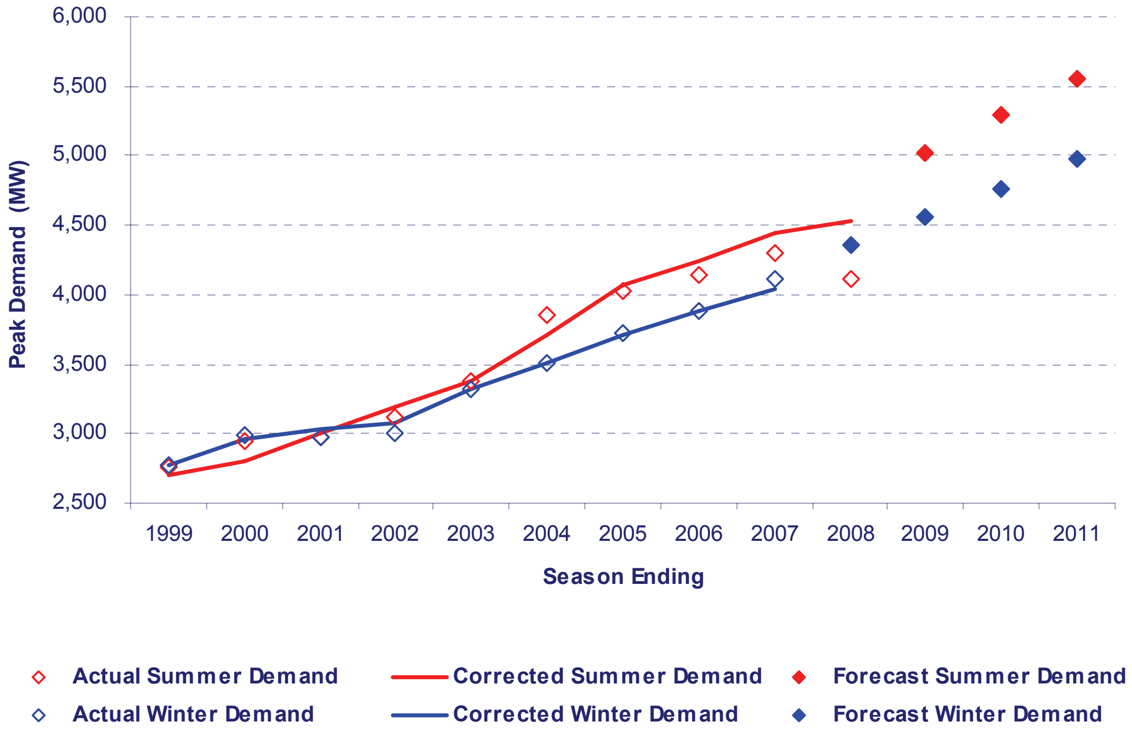


Figure 3.4: Historic Native Demand for South East Queensland (Including Temperature Correction)



3.3 Comparison with the 2007 Annual Planning Report

In comparison with the 2007 forecast, the forecast in this APR shows a similar demand growth rate for summer over the next ten years. However, the growth rates in this APR are expressed from a 2008/09 starting point, as a distortion would be introduced using the low 2007/08 recorded demand, which reflects two consecutive mild summers. When the recent weather and other recent adverse factors are accounted (as outlined in Appendices F and G) and known projects are included, Powerlink, its customers and NIEIR consider that little change to the average condition Queensland summer demand forecast is appropriate.

A small reduction in South East Queensland summer peak demand, and increased diversity of summer demands across Queensland, have been countered by an increase in coal mining and associated loads in Central and Northern Queensland.

The forecasts have been converted to native demand to account for the recent and current strong growth in embedded non-scheduled generation.

Winter demands have been closely following forecast levels and accordingly, there is also little change to the winter demand forecast. This has also been converted to native demand to account for the recent and current strong growth in embedded non-scheduled generation.

There is also little change to forecast growth rate for annual delivered and native energy, for the same reasons that apply to the summer demand forecasts.

3.4 Forecast Data

The information pertaining to the forecasts is shown in tables and figures as follows.

3.4.1 Energy Forecast

Table 3.8 and Figures 3.5 and 3.6 show the historical and ten year forecast of net energy delivered from the transmission network together with embedded scheduled generators in the Queensland region for the Low, Medium and High Economic Growth scenarios. It also shows native energy for 2006/07 and projected 2007/08, with an adjustment to add to the various scenario forecasts of delivered energy.

3.4.2 Summer Demand Forecast

Table 3.9 and Figure 3.7 show the historical and ten year Queensland region summer delivered demand (from the network and embedded scheduled generators) forecast for each of the three economic scenarios and also for 10%, 50% and 90% PoE weather conditions. It also shows native demand for summer 2006/07 and 2007/08, with an adjustment to add to the various scenario forecasts of delivered demand.

3.4.3 Winter Demand Forecast

Table 3.10 and Figure 3.8 show the historical and ten year Queensland region winter delivered demand (from the network and embedded scheduled generators) forecast for each of the three economic scenarios and also for 10%, 50% and 90% PoE weather conditions. It also shows native demand for winter 2007, with an adjustment to add to the various scenario forecasts of delivered demand.

3.4.4 Transmission Losses and Auxiliaries

Table 3.11 shows the Medium Growth Scenario forecast of average weather winter and summer maximum coincident region electricity delivered and native demand including estimates of Transmission Network Losses, Power Station Sent Out and As Generated Demands.

Table 3.12 shows the Medium Growth forecast of one in ten year or 10% PoE weather winter and summer maximum coincident region electricity delivered and native demand including estimates of Transmission Network Losses, Power Station Sent Out and As Generated Demands.

3.4.5 Load Profiles

Figure 3.9 shows the daily load profile on the days of the recent 2007 winter and 2007/08 summer Queensland region peak demand delivered from the transmission network and from embedded scheduled generators. Figure 3.10 shows the cumulative annual load duration curve for the completed 2006/07 financial year.

3.4.6 Connection Point Forecasts

The forecast loading at connection points to Powerlink's network for summer and winter are shown in Appendix E.

It should be noted that the forecasts have been derived from information and historical revenue metering data up to and including March 2008, and are based on assumptions and third party predictions that may or may not prove to be correct. The 'projected actual' forecast for 2007/08 accounts for actual energy delivery in the first nine months of the financial year, that is, up to the end of March 2008, plus forecast energy from April 2008 to the end of June 2008 which is based on statistical 'as generated' data, and a nominal growth rate applied to equivalent months in 2007.

In summary, the forecast average annual growth rates for the Queensland region over the next ten years under low, medium and high economic growth scenarios are shown in Table 3.7. These growth rates are measured from 2008/09 onwards as they would otherwise be distorted by a large increase in the year from 2007/08 for energy and summer demand.

Table 3.7: Average Annual Growth Rate over Next Ten Years

	ECONOMIC GROWTH SCENARIO		
	HIGH	MEDIUM	LOW
Queensland Gross State Product	5.3%	4.2%	3.1%
Native Energy (1)	5.1%	3.2%	1.8%
Native Summer Peak Demand (50% PoE) (2)	5.0%	3.6%	2.4%
Native Winter Peak Demand (50% PoE) (2)	5.8%	3.6%	1.7%

Notes:

(1) This is energy delivered from the transmission network, and from embedded scheduled generators, and from significant embedded non-scheduled generators. It does not include the output from any exempted generators, nor from embedded non-scheduled generators which never, or rarely expect to have times of net export into the grid.

(2) This is the half hour average power delivered from the transmission network, and from embedded scheduled generators, and from significant embedded non-scheduled generators. It does not include the output from any exempted generators, nor from embedded non-scheduled generators which never, or rarely expect to have times of net export into the grid.

Table 3.8: Annual Energy Native with and Delivered Energy Adjustment GWh – Actual and Forecast

YEAR	SENT OUT (1)			TRANSMISSION LOSSES (2)			NATIVE ENERGY (3)			DELIVERED ENERGY ADJUST-MENT
1998/99	36,189			1,540			34,649			N/A
1999/00	38,052			1,471			36,581			N/A
2000/01	39,804			1,625			38,179			N/A
2001/02	41,869			1,974			39,895			N/A
2002/03	42,687			1,837			40,850			N/A
2003/04	44,586			1,924			42,662			N/A
2004/05	45,684			1,794			43,890			N/A
2005/06	47,261			1,652			45,609			N/A
2006/07	47,751			1,844			46,172			-272
2007/08 (4)	48,134			1,877			47,162			-905
FORECAST	**LOW**	**MED**	**HIGH**	**LOW**	**MED**	**HIGH**	**LOW**	**MED**	**HIGH**	**DELIVERED ENERGY ADJUST-MENT**
2008/09	50,987	52,307	54,075	1,965	2,040	2,142	49,964	51,208	52,874	-941
2009/10	51,942	54,056	56,928	2,034	2,157	2,328	51,103	53,094	55,796	-1,195
2010/11	53,151	56,023	60,406	2,114	2,284	2,551	52,232	54,934	59,050	-1,195
2011/12	53,965	57,940	63,276	2,106	2,338	2,661	53,054	56,797	61,810	-1,195
2012/13	54,859	59,579	66,250	2,082	2,351	2,748	53,972	58,423	64,697	-1,195
2013/14	56,012	61,477	69,626	2,076	2,381	2,860	55,168	60,328	67,999	-1,232
2014/15	56,842	63,286	73,100	2,053	2,405	2,973	56,021	62,113	71,359	-1,232
2015/16	57,573	65,252	76,673	2,018	2,426	3,076	56,787	64,058	74,828	-1,232
2016/17	58,305	67,325	80,403	1,984	2,453	3,185	57,553	66,104	78,449	-1,232
2017/18	59,219	69,536	84,662	2,008	2,544	3,399	58,443	68,224	82,496	-1,232

Notes:

(1) This is the input energy that is sent into the Queensland network from Queensland scheduled generators, Invicta Mill and Koombooloomba (transmission connected but non-scheduled), and net imports to Queensland. The energy to Wivenhoe Pumps is not included in this table as it is not predictable and is accordingly assumed to be netted off any Wivenhoe generation.

(2) This includes the Queensland share of losses on the Queensland/New South Wales Interconnector. Recent relatively lower loss levels reflect better load sharing following commissioning of the Millmerran-Middle Ridge 330kV line and increased generation levels in northern Queensland which reduces Central to Northern Queensland power flow levels. The table assumes that future transmission works will provide a partial check against escalating loss levels otherwise due to general growth in power flow levels.

(3) The difference between native and delivered demand before summer 2006/07 is negligible. Accordingly, native energy is assumed to be equal to delivered energy prior to the 2006/07 year.

(4) These projected end of financial year values are based on revenue and statistical metering data until March 2008.

Figure 3.5: History and Forecasts of Annual Delivered Energy for Medium Economic Growth Scenario

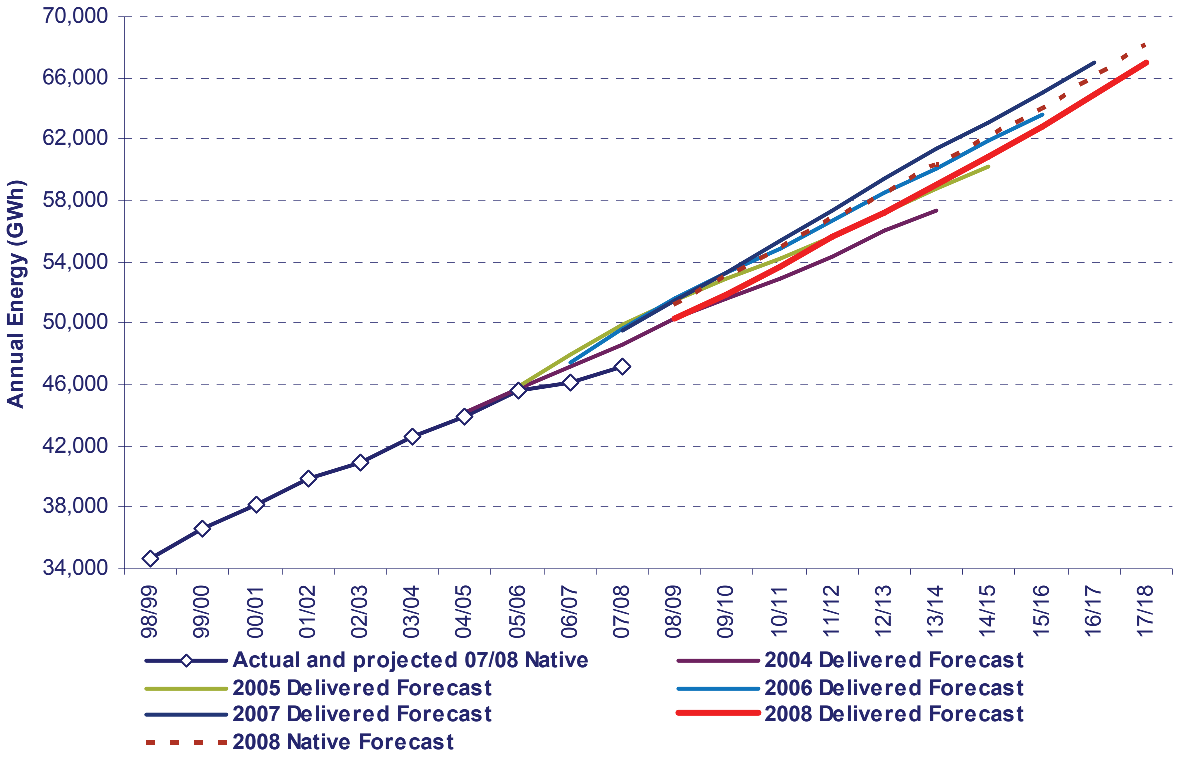


Figure 3.6: History and Forecast of Native Energy for Low, Medium and High Economic Growth Scenarios

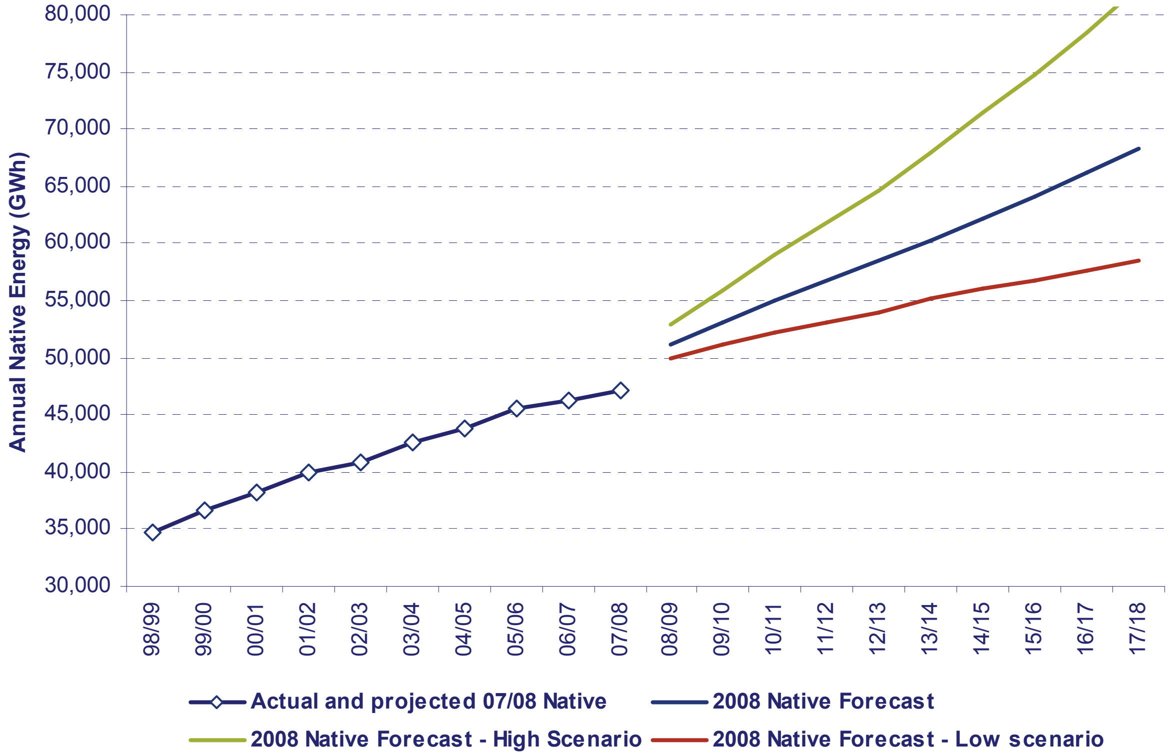


Table 3.9: Peak Summer Native Demand (MW) with Delivered Demand Adjustment

SUMMER	ACTUAL DELIVERED	ACTUAL NATIVE	WEATHER AND DIVERSITY CORRECTED NATIVE DEMAND (1)	DELIVERED DEMAND ADJUST-MENT
1998/99	5,330	N/A	5,253	N/A
1999/00	5,620	N/A	5,569	N/A
2000/01	5,830	N/A	5,878	N/A
2001/02	6,183	N/A	6,157	N/A
2002/03	6,336	N/A	6,391	N/A
2003/04	7,020	N/A	6,842	N/A
2004/05	7,282	N/A	7,320	N/A
2005/06	7,388	N/A	7,671	N/A
2006/07	7,832	7,887	7,976	-55
2007/08	7,357	7,442	8,057	-85

SUMMER NATIVE DEMAND FORECASTS	HIGH GROWTH SCENARIO			MEDIUM GROWTH SCENARIO			LOW GROWTH SCENARIO			DELIVERED DEMAND ADJUST-MENT
	10% POE	50% POE	90% POE	10% POE	50% POE	90% POE	10% POE	50% POE	90% POE	
2008/09	9,476	8,961	8,603	9,233	8,729	8,379	9,045	8,554	8,210	-199
2009/10	10,056	9,502	9,116	9,660	9,124	8,751	9,347	8,832	8,471	-199
2010/11	10,689	10,093	9,678	10,076	9,508	9,113	9,640	9,103	8,724	-199
2011/12	11,233	10,599	10,156	10,503	9,903	9,485	9,889	9,331	8,936	-199
2012/13	11,802	11,128	10,657	10,885	10,254	9,814	10,153	9,573	9,161	-199
2013/14	12,338	11,626	11,130	11,232	10,573	10,114	10,388	9,789	9,363	-199
2014/15	12,909	12,158	11,634	11,595	10,907	10,427	10,599	9,984	9,543	-199
2015/16	13,509	12,718	12,166	12,001	11,281	10,779	10,815	10,183	9,727	-199
2016/17	14,102	13,274	12,696	12,400	11,651	11,129	10,983	10,338	9,870	-199
2017/18	14,757	13,887	13,278	12,815	12,034	11,489	11,208	10,547	10,063	-199

Note:

(1) The difference between native and delivered demand before summer 2006/07 is negligible. Accordingly temperature and diversity corrections have been calculated on delivered demand prior to summer 2006/07 and on native demand for the 2006/07 and 2007/08.

Figure 3.7: Queensland Region Summer Peak Native Demand

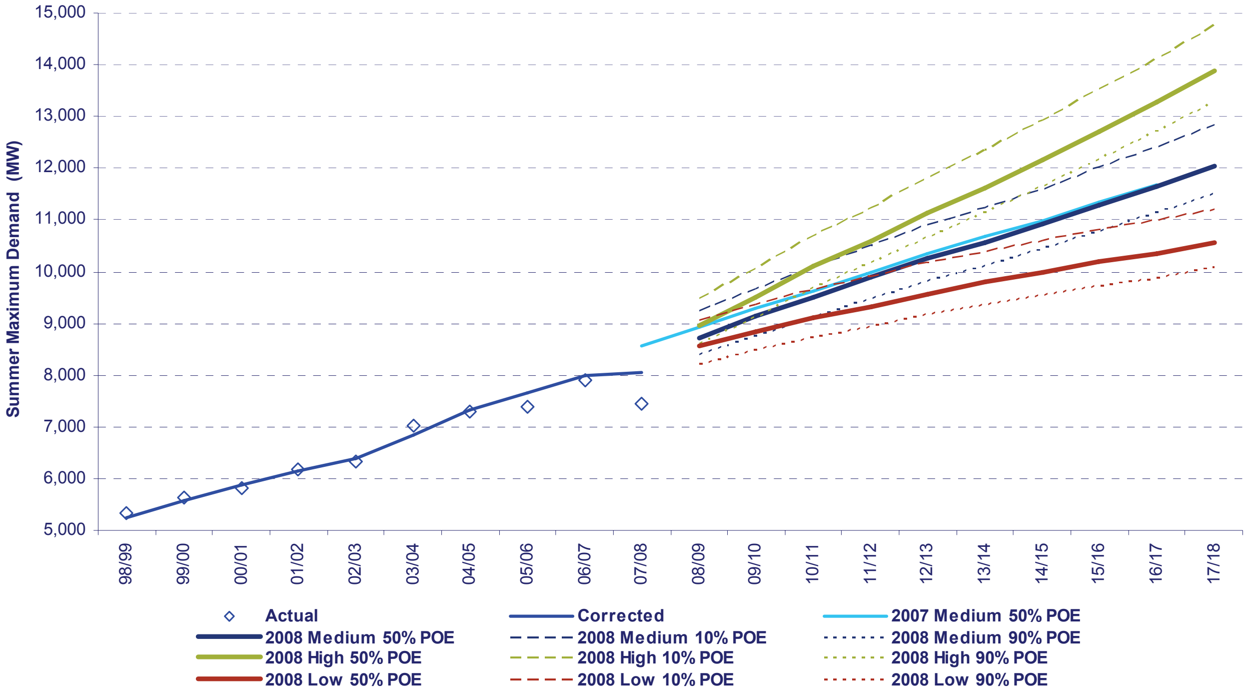


Table 3.10: Peak Winter Native Demand (MW) with Delivered Demand Adjustment

WINTER	ACTUAL DELIVERED	ACTUAL NATIVE	WEATHER AND DIVERSITY CORRECTED NATIVE DEMAND (1)	DELIVERED DEMAND ADJUSTMENT
1999	5,233	N/A	5,214	N/A
2000	5,609	N/A	5,602	N/A
2001	5,731	N/A	5,744	N/A
2002	5,671	N/A	5,796	N/A
2003	6,066	N/A	6,083	N/A
2004	6,366	N/A	6,390	N/A
2005	6,553	N/A	6,647	N/A
2006	6,891	N/A	6,873	N/A
2007	7,166	7,223	7,201	-56

WINTER NATIVE DEMAND FORECASTS	HIGH GROWTH SCENARIO			MEDIUM GROWTH SCENARIO			LOW GROWTH SCENARIO			DELIVERED DEMAND ADJUSTMENT
	10% POE	50% POE	90% POE	10% POE	50% POE	90% POE	10% POE	50% POE	90% POE	
2008	7,692	7,580	7,438	7,527	7,419	7,282	7,418	7,310	7,177	-159
2009	8,246	8,126	7,973	7,893	7,780	7,636	7,647	7,536	7,398	-199
2010	8,793	8,664	8,500	8,194	8,075	7,924	7,815	7,700	7,559	-199
2011	9,289	9,152	8,978	8,515	8,390	8,232	7,949	7,832	7,686	-199
2012	9,853	9,707	9,521	8,827	8,697	8,532	8,122	8,001	7,851	-199
2013	10,406	10,252	10,056	9,126	8,992	8,821	8,286	8,163	8,010	-199
2014	10,958	10,796	10,591	9,396	9,258	9,083	8,389	8,265	8,110	-199
2015	11,509	11,339	11,124	9,677	9,535	9,355	8,462	8,337	8,181	-199
2016	12,103	11,926	11,701	9,994	9,848	9,663	8,522	8,397	8,240	-199
2017	12,752	12,565	12,328	10,308	10,158	9,967	8,625	8,499	8,340	-199

Note:

(1) The difference between native and delivered demand before winter 2007 is negligible. Accordingly, temperature and diversity corrections have been calculated on delivered demand prior to winter 2007 and on native demand for winter 2007.

Figure 3.8: Queensland Region Winter Peak Native Demand

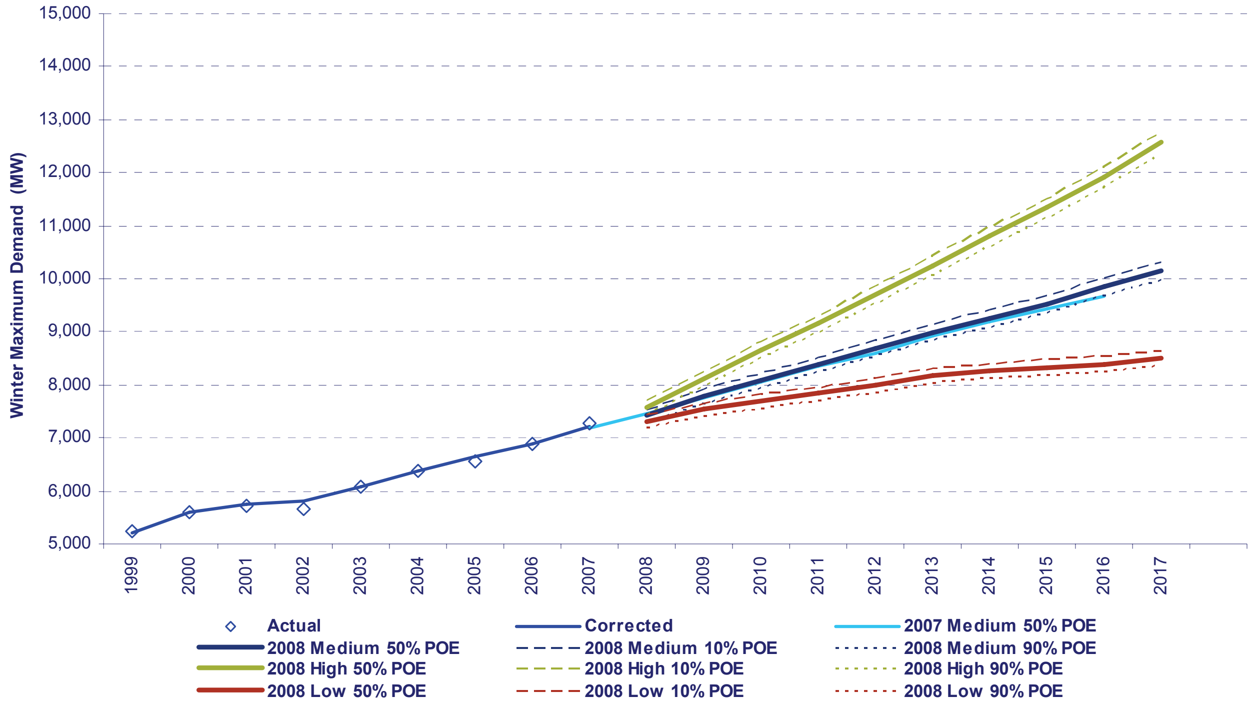


Table 3.11: Maximum Delivered, Sent Out and "As Generated" Queensland Region Demand (MW) – 50% PoE Delivered Forecast

	STATION "AS GENERATED" DEMAND	STATION AUXS & LOSSES	STATION "SENT OUT" DEMAND	TRANSMISSION LOSSES	DELIVERED FROM NETWORK DEMAND (1)
Winter State Peak					
2008	8,075	522	7,553	293	7,260
2009	8,436	539	7,897	316	7,581
2010	8,761	550	8,211	335	7,876
2011	9,092	561	8,531	340	8,191
2012	9,413	570	8,843	345	8,498
2013	9,721	578	9,143	350	8,793
2014	9,997	583	9,414	355	9,059
2015	10,285	589	9,696	360	9,336
2016	10,609	595	10,014	365	9,649
2017	10,930	601	10,329	370	9,959
Summer State Peak					
2008/09	9,493	617	8,876	346	8,530
2009/10	9,930	634	9,296	371	8,925
2010/11	10,355	650	9,705	396	9,309
2011/12	10,777	665	10,112	408	9,704
2012/13	11,143	675	10,468	413	10,055
2013/14	11,474	682	10,792	418	10,374
2014/15	11,821	690	11,131	423	10,708
2015/16	12,209	699	11,510	428	11,082
2016/17	12,592	707	11,885	433	11,452
2017/18	12,987	714	12,273	438	11,835

Note:

(1) 'Delivered from Network' includes the demand taken directly from the transmission network as well as net power output from embedded scheduled generators (currently Barcaldine, Roma and the 66kV output component of Townsville Power Stations).

Table 3.12: Maximum Delivered, Sent Out and "As Generated" Queensland Region Demand (MW) – 10% PoE Delivered Forecast

	STATION "AS GENERATED" DEMAND	STATION AUXILIARIES & LOSSES	STATION "SENT OUT" DEMAND	TRANSMISSION LOSSES	DELIVERED FROM NETWORK DEMAND (1)
Winter State Peak					
2008	8,196	530	7,666	297	7,368
2009	8,562	547	8,015	320	7,694
2010	8,893	558	8,335	340	7,995
2011	9,246	570	8,676	361	8,316
2012	9,591	581	9,010	382	8,628
2013	9,919	590	9,329	402	8,927
2014	10,214	596	9,618	421	9,197
2015	10,521	602	9,919	440	9,478
2016	10,868	610	10,258	463	9,795
2017	11,212	617	10,596	486	10,109
Summer State Peak					
08/09	10,042	653	9,389	366	9,023
09/10	10,516	672	9,844	393	9,451
10/11	10,976	689	10,287	420	9,867
11/12	11,450	706	10,744	448	10,296
12/13	11,869	719	11,150	473	10,677
13/14	12,250	728	11,522	497	11,024
14/15	12,648	738	11,910	522	11,388
15/16	13,095	749	12,345	551	11,794
16/17	13,535	759	12,776	580	12,196
17/18	13,988	769	13,219	610	12,608

Note:

(1) 'Delivered from Network Demand' includes the demand taken directly from the transmission network as well as net power output from embedded scheduled generators (currently Barcaldine, Roma and the 66kV output component of Townsville Power Stations).

3.5 Zone Forecasts

The ten geographical zones referred to throughout this report are defined as follows:

Table 3.13: Zone Definitions

ZONE	AREA COVERED
Far North	North of Tully including Chalumbin.
Ross	North of Proserpine and Collinsville, including Tully, but excluding the Far North zone.
North	North of Broadsound and Dysart, including Proserpine and Collinsville but excluding the Far North and Ross zones.
Central West	Collectively encompasses the area south of Nebo, Peak Downs and Mt McLaren, and north of Gin Gin, but excluding that part defined as the Gladstone zone.
Gladstone	Specifically covers the Powerlink transmission network connecting Gladstone power station, Callemondah (railway supply), Gladstone South, QAL supply, Wurdong and Boyne Smelter supply.
Wide Bay	Gin Gin, Teebar Creek and Woolooga 275kV Substation loads excluding Gympie.
Bulli	Goondiwindi (Waggamba) load and the 275/330kV network south of Braemar and west of Millmerran.
South West	Tarong and Middle Ridge load areas west of Postmans Ridge.
Moreton	South of Woolooga and east of Middle Ridge, but excluding the Gold Coast zone.
Gold Coast	South of Coomera to the Gold Coast and excludes Tweed Shire of NSW.

Each zone normally experiences its own zone peak demand, which is usually greater than that shown in Tables 3.17 to 3.20, as it does not coincide with the time of Queensland region maximum demand.

Table 3.14 shows the average ratio of forecast zone peak demand to zone demand at the time of forecast Queensland region peak demands. These values can be used to multiply demands in Tables 3.17 to 3.20 to estimate each zone's individual peak demand, not necessarily coincident with the time of Queensland region peak demand. The ratios are based on historical trends and customer future expectations. The higher than previous ratios for the Ross zone reflect increased diversity at the time of Queensland region peak demand of the large industrial loads within this zone.

The Moreton North and Moreton South zones have been combined into a single Moreton zone. The (old) South West zone has been split into two zones; (new) South West and Bulli.

Table 3.14: Average Ratio of Zone Peak Demand to Zone Demand at Time of Queensland Region Peak

ZONE	WINTER	SUMMER
Far North	1.19	1.19
Ross	1.40	1.30
North	1.27	1.09
Central West	1.05	1.06
Gladstone	1.01	1.00
Wide Bay	1.00	1.03
Bulli	1.01	1.02
South West	1.01	1.02
Moreton	1.01	1.00
Gold Coast	1.07	1.08

Tables 3.15 and 3.16 show the forecast of energy supplied from the transmission network and embedded scheduled generators for the Medium Growth Scenario for each of the ten zones in the Queensland region. Forecasts are presented as Delivered Demand, including effects of Non-scheduled Embedded Generators, and Native Demand, excluding Non-scheduled Embedded Generators.

Tables 3.17 and 3.18 show the forecast of winter demand delivered from the transmission network and embedded scheduled generators (coincident with the Queensland region winter peak) for each of the ten zones within Queensland. It is based on the Medium Growth Scenario and average winter weather. Forecasts are presented as Delivered Demand, including effects of Non-scheduled Embedded Generators, and Native Demand, excluding Non-scheduled Embedded Generators.

Tables 3.19 and 3.20 show the forecast of summer demand delivered from the transmission network and embedded scheduled generators (coincident with the Queensland region summer peak) for each of the ten zones within Queensland. It is based on the Medium Growth Scenario and average summer weather. Forecasts are presented as Delivered Demand, including effects of Non-scheduled Embedded Generators, and Native Demand, excluding Non-scheduled Embedded Generators.

Table 3.15: Annual Delivered Energy by Zone

Actual and Forecast Annual Delivered Energy (GWh) delivered from the transmission network including from embedded scheduled generators in each zone for the medium growth scenario. Includes reduction effects of non-scheduled embedded generators.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
1999/00	1,430	2,454	1,963	2,789	8,660	1,088	1,575		14,217	2,404	**36,581**
2000/01	1,457	2,962	2,055	2,876	8,697	1,187	1,659		14,754	2,531	**38,179**
2001/02	1,536	2,971	2,219	3,069	8,948	1,257	1,717		15,515	2,663	**39,896**
2002/03	1,549	2,934	2,296	3,109	9,098	1,256	1,738		16,149	2,721	**40,850**
2003/04	1,631	3,095	2,397	3,174	9,285	1,327	1,828		16,984	2,942	**42,662**
2004/05	1,673	3,010	2,542	3,269	9,452	1,419	1,943		17,548	3,034	**43,890**
2005/06	1,745	2,937	2,571	3,363	9,707	1,468	2,092		18,472	3,253	**45,609**
2006/07	1,770	3,087	2,733	3,163	9,945	1,461	2,047		18,470	3,225	**45,900**
Projected 2007/08	1,836	3,199	2,709	3,170	10,096	1,418	1,834		18,701	3,294	**46,257**
Forecasts											
2008/09	1,908	3,239	3,184	3,444	10,484	1,524	2,001	92	20,866	3,526	**50,267**
2009/10	1,987	3,367	3,123	3,594	10,566	1,574	2,062	93	21,819	3,716	**51,899**
2010/11	2,051	3,517	3,392	3,723	10,629	1,623	2,128	94	22,768	3,814	**53,739**
2011/12	2,121	3,605	3,541	3,833	10,707	1,676	2,190	95	23,779	4,054	**55,602**
2012/13	2,189	3,674	3,641	3,901	10,936	1,726	2,255	95	24,571	4,239	**57,228**
2013/14	2,223	3,743	3,741	3,970	11,165	1,779	2,322	96	25,622	4,435	**59,096**
2014/15	2,293	3,811	3,814	4,036	11,421	1,832	2,390	97	26,633	4,555	**60,881**
2015/16	2,363	3,880	3,888	4,102	11,712	1,894	2,459	98	27,723	4,706	**62,826**
2016/17	2,431	3,949	3,963	4,169	11,979	1,948	2,529	99	28,924	4,881	**64,872**
2017/18	2,500	4,019	4,039	4,237	12,252	2,003	2,602	100	30,177	5,063	**66,992**

Table 3.16: Annual Native Energy by Zone

Actual and Forecast Annual Native Energy (GWh) delivered from the transmission network including from embedded scheduled generators in each zone for the medium growth scenario. Excludes effects of non-scheduled embedded generators. Native demand for years prior to 2006/07 is the same as delivered demand, this is due to insignificant amounts of non-scheduled embedded generation online during these periods.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
2006/07	1,770	3,141	2,761	3,270	9,945	1,461	2,068		18,533	3,225	**46,172**
Projected 2007/08	1,836	3,375	2,756	3,455	10,076	1,441	2,060		18,859	3,294	**47,162**
Forecasts											
2008/09	1,936	3,416	3,223	3,767	10,484	1,562	2,146	92	21,056	3,526	**51,207**
2009/10	2,015	3,544	3,377	3,917	10,566	1,612	2,207	93	22,049	3,716	**53,094**
2010/11	2,079	3,694	3,646	4,046	10,629	1,661	2,273	94	22,998	3,814	**54,934**
2011/12	2,149	3,782	3,795	4,156	10,707	1,714	2,335	95	24,009	4,054	**56,797**
2012/13	2,217	3,851	3,895	4,224	10,936	1,764	2,400	95	24,801	4,239	**58,423**
2013/14	2,288	3,920	3,995	4,293	11,165	1,817	2,467	96	25,852	4,435	**60,328**
2014/15	2,358	3,988	4,068	4,359	11,421	1,870	2,535	97	26,863	4,555	**62,113**
2015/16	2,428	4,057	4,142	4,425	11,712	1,932	2,604	98	27,953	4,706	**64,058**
2016/17	2,496	4,126	4,217	4,492	11,979	1,986	2,674	99	29,154	4,881	**66,104**
2017/18	2,565	4,196	4,293	4,560	12,252	2,041	2,747	100	30,407	5,063	**68,224**

Table 3.17: State Winter Peak Delivered Demand by Zone

Actual and Forecast Delivered Demand (MW) on the transmission network and embedded scheduled generators in each zone at the time of coincident state winter peak 50% PoE demand for average weather and diversity conditions and medium growth scenario. Includes reduction effects of non-scheduled embedded generators.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
2000	179	354	271	423	986	198	312		2,430	454	**5,609**
2001	184	378	255	442	1,019	189	301		2,475	487	**5,731**
2002	163	339	285	383	1,055	160	286		2,548	452	**5,671**
2003	177	348	295	412	1,009	181	318		2,825	500	**6,066**
2004	206	354	323	425	1,092	216	345		2,867	539	**6,366**
2005	192	257	277	431	1,081	261	343		3,146	564	**6,553**
2006	207	322	325	409	1,157	228	361		3,284	598	**6,891**
2007	219	309	286	442	1,165	297	410		3,449	590	**7,166**
Forecasts											
2008	208	260	327	448	1,168	212	316	15	3,663	643	**7,260**
2009	219	262	337	480	1,219	223	326	15	3,824	676	**7,581**
2010	226	270	369	496	1,230	230	337	16	4,008	695	**7,876**
2011	233	287	415	504	1,233	238	351	16	4,204	709	**8,191**
2012	241	293	472	518	1,241	245	360	16	4,353	758	**8,498**
2013	249	300	515	527	1,263	253	369	17	4,515	787	**8,793**
2014	256	306	536	535	1,290	261	378	17	4,673	805	**9,059**
2015	264	312	543	543	1,317	270	386	18	4,853	829	**9,336**
2016	273	319	550	552	1,351	278	395	18	5,055	859	**9,649**
2017	281	326	564	560	1,378	287	404	18	5,250	891	**9,959**

Table 3.18: State Winter Peak Native Demand by Zone

Actual and Forecast Native Demand (MW) on the transmission network and embedded scheduled generators in each zone at the time of coincident state winter peak 50% PoE demand for average weather and diversity conditions and medium growth scenario. Excludes effects of non-scheduled embedded generators. Native demand for winters prior to 2007 is the same as delivered demand, this is due to insignificant amounts of non-scheduled embedded generation online during these periods.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
2007	219	309	291	467	1,165	298	410		3,475	590	**7,223**
Forecasts											
2008	209	311	338	491	1,168	217	349	15	3,678	643	**7,418**
2009	220	313	387	523	1,219	228	360	15	3,839	676	**7,780**
2010	227	321	420	539	1,230	235	370	16	4,023	695	**8,075**
2011	234	338	466	547	1,233	242	384	16	4,219	709	**8,390**
2012	242	344	523	561	1,241	250	393	16	4,368	758	**8,697**
2013	249	351	565	570	1,263	258	402	17	4,530	787	**8,992**
2014	257	357	587	578	1,290	266	411	17	4,688	805	**9,257**
2015	265	363	594	586	1,317	274	420	18	4,868	829	**9,535**
2016	273	370	601	595	1,351	283	429	18	5,070	859	**9,848**
2017	282	377	615	603	1,378	291	438	18	5,265	891	**10,157**

Table 3.19: State Summer Peak Delivered Demand by Zone

Actual and Forecast Delivered Demand (MW) on the transmission network and embedded scheduled generators in each zone at the time of coincident state summer 50% PoE peak demand with average weather and diversity conditions and medium growth scenario. Includes reduction effects of non-scheduled embedded generators.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
2000/01	252	458	294	391	993	195	270		2,540	437	**5,830**
2001/02	278	504	355	436	1,040	222	258		2,644	447	**6,183**
2002/03	264	410	307	426	1,048	200	298		2,896	488	**6,336**
2003/04	265	452	318	459	1,087	253	339		3,277	570	**7,020**
2004/05	277	425	342	482	1,107	276	349		3,415	609	**7,282**
2005/06	284	447	373	492	1,115	292	351		3,438	596	**7,388**
2006/07	329	461	452	509	1,164	296	375		3,635	611	**7,832**
2007/08	292	372	386	476	1,193	243	330		3,465	600	**7,357**
Forecasts											
2008/09	327	446	463	553	1,254	261	344	17	4,172	693	**8,530**
2009/10	340	464	503	573	1,265	269	360	18	4,400	732	**8,925**
2010/11	353	491	557	588	1,269	277	379	18	4,630	748	**9,309**
2011/12	367	506	624	608	1,278	285	392	19	4,828	797	**9,704**
2012/13	381	522	674	623	1,301	293	405	19	5,006	829	**10,055**
2013/14	395	539	704	637	1,329	302	419	19	5,177	853	**10,374**
2014/15	409	556	718	652	1,358	311	432	20	5,375	878	**10,708**
2015/16	424	574	731	666	1,393	319	446	20	5,600	908	**11,082**
2016/17	439	593	752	681	1,421	328	460	21	5,819	940	**11,452**
2017/18	454	611	773	696	1,449	338	474	21	6,046	973	**11,835**

Table 3.20: State Summer Peak Native Demand by Zone

Actual and Forecast Native Demand (MW) on the transmission network and embedded scheduled generators in each zone at the time of coincident state summer 50% PoE peak demand with average weather and diversity conditions and medium growth scenario. Excludes effects of non-scheduled embedded generators. Native demand for summers prior to 2006/07 is the same as delivered demand, this is due to insignificant amounts of non-scheduled embedded generation online during these periods.

YEAR	FAR NORTH	ROSS	NORTH	CENTRAL WEST	GLAD-STONE	WIDE BAY	SOUTH WEST	BULLI	MORETON	GOLD COAST	TOTAL
Actuals											
2006/07	329	492	457	527	1,164	297	376		3,636	611	**7,887**
2007/08	292	404	390	488	1,193	243	341		3,491	600	**7,442**
Forecasts											
2008/09	328	497	513	596	1,254	266	377	17	4,187	693	**8,729**
2009/10	341	515	554	616	1,265	274	393	18	4,415	732	**9,123**
2010/11	354	542	608	631	1,269	282	412	18	4,645	748	**9,508**
2011/12	368	557	674	651	1,278	290	426	19	4,843	797	**9,902**
2012/13	381	573	725	666	1,301	298	439	19	5,021	829	**10,253**
2013/14	395	590	755	680	1,329	306	452	19	5,192	853	**10,573**
2014/15	410	607	769	695	1,358	315	466	20	5,390	878	**10,907**
2015/16	425	625	782	709	1,393	324	479	20	5,615	908	**11,281**
2016/17	440	644	803	724	1,421	333	493	21	5,834	940	**11,651**
2017/18	455	662	824	739	1,449	342	507	21	6,061	973	**12,034**

3.6 Daily and Annual Load Profiles

The daily load profiles for the Queensland region on the days 2007 winter and 2007/08 summer peak demand delivered from the transmission network and embedded scheduled generators are shown on Figure 3.9.

The annual cumulative load duration characteristic for the Queensland region demand delivered from the transmission network and from embedded scheduled generators is shown on Figure 3.10 for the 2006/07 financial year.

Figure 3.9: Summer and Winter Peaks 2007/08

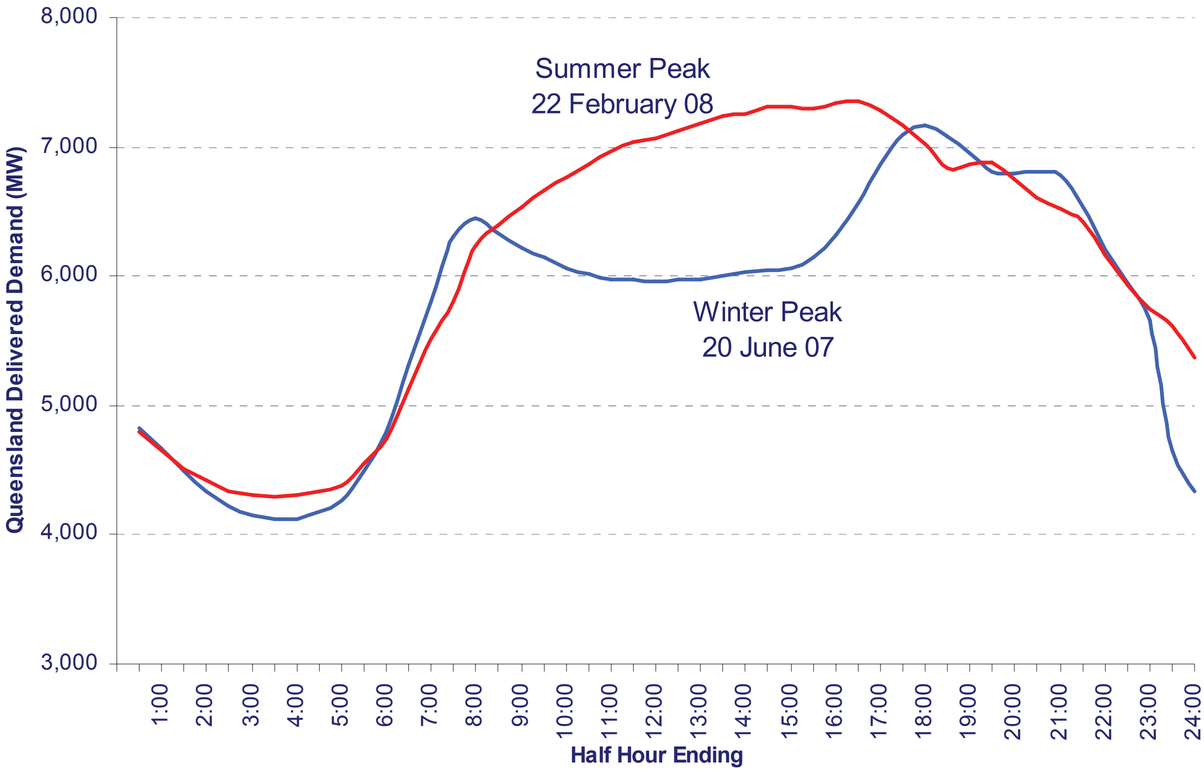
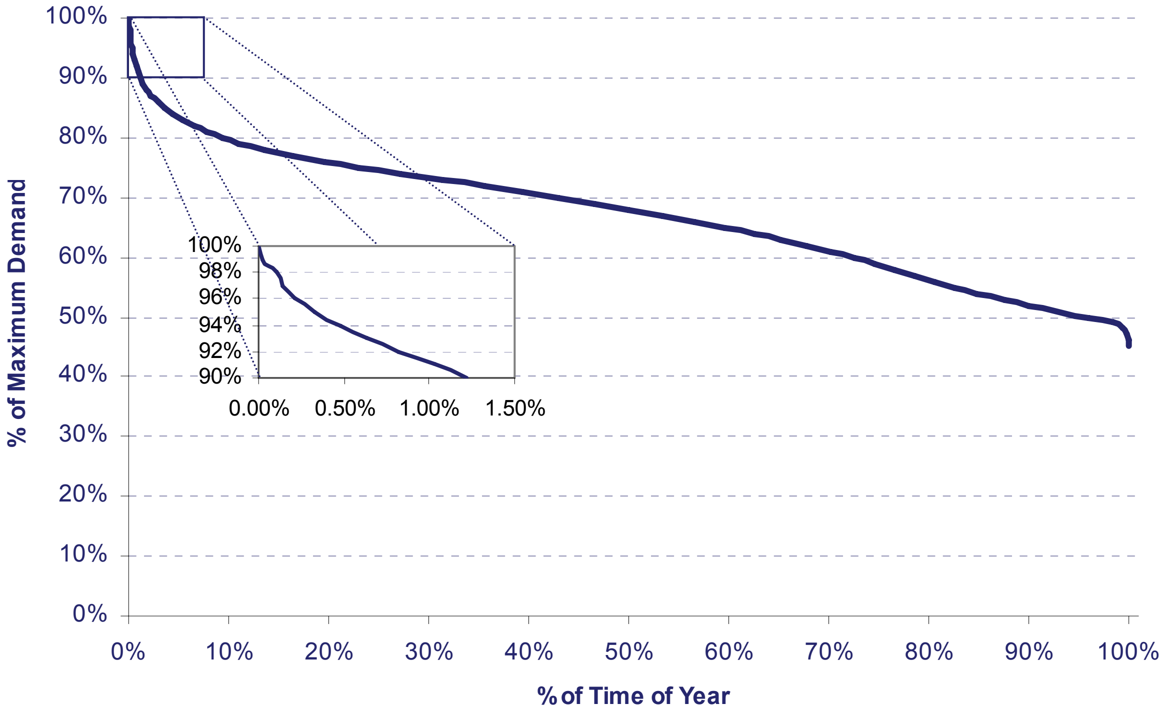


Figure 3.10: Cumulative Annual Load Duration 2006/07



CHAPTER FOUR

Intra-Regional Committed Network Augmentations

4.1 Transmission Network

The 1,700km long Queensland transmission network comprises 275kV transmission from Cairns in the north to Mudgeeraba in the south, with 110kV and 132kV systems providing transmission in local zones and providing some backup to the 275kV network. Also, 330kV lines link Braemar, Middle Ridge, Millmerran and Bulli Creek to the New South Wales network.

The single line diagrams of the Queensland network as shown in the previous Annual Planning Report (APR) have been updated to include recently completed augmentations outlined in this Chapter. Figures 4.1 and 4.2 are single line diagrams showing the Queensland network.

4.2 Committed Transmission Projects

Table 4.1 lists transmission network developments commissioned since Powerlink's 2007 APR was published in June 2007.

Table 4.2 lists transmission network developments which are committed and under construction at June 2008.

Table 4.3 lists transmission connection works that have been commissioned since Powerlink's 2007 APR was published in June 2007.

Table 4.4 lists new transmission connection works for supplying loads which are committed and under construction at June 2008. These connection projects resulted from agreement reached with relevant connected customers, generators or Distribution Network Service Providers (DNSPs) as applicable.

Table 4.5 lists network replacements which are committed and under construction at June 2008.

Table 4.1: Commissioned Transmission Developments

Commissioned since June 2007

PROJECT	PURPOSE	ZONE LOCATION	DATE COMMISSIONED
Major Developments			
Woree second 275/132kV transformer and line reconfiguration (1)	Increase supply capability to Cairns	Far North	December 2007
Ross to Townsville South 132kV line	Increase supply capability to the Townsville area	Ross	December 2007
Strathmore 275kV SVC	Increase supply capability to North, Ross and Far North Queensland zones	North	October 2007
Nebo to Pioneer Valley 132kV line	Increase supply capability to the Mackay to Proserpine area	North	February 2008
Lilyvale to Blackwater 132kV line	Increase supply capability to Blackwater	Central West	October 2007
Teebar Creek 275/132kV Substation	Increase supply capability to Wide Bay	Wide Bay	November 2007 (first transformer) March 2008 (second transformer)
Middle Ridge second 330/275kV transformer and Middle Ridge to Greenbank 330kV/275kV line (2)	Increase supply capability to South East Queensland	South West and Moreton	February 2008
Network Support Arrangements			
Contract with local generators to provide network support in north Queensland	Part of solution to maintain supply reliability to North Queensland	Ross and North	New arrangements established from mid 2005
Minor Developments			
Wurdong third 120MVAr 275kV capacitor bank	Maintain supply capability between Central and South Queensland	Gladstone	October 2007
Palmwoods fourth 50MVAr 132kV capacitor bank	Maintain supply capability between Central and South Queensland	Moreton	September 2007
Greenbank third and fourth 200MVAr 275kV capacitor banks	Capacitive compensation to meet increasing reactive demand	Moreton	November 2007
Molendinar second 275/110kV transformer	Maintain supply capability to Gold Coast and Tweed Shire	Gold Coast	September 2007
Molendinar third 50MVAr 110kV capacitor bank	Capacitive compensation to meet increasing reactive demand	Gold Coast	October 2007

Notes:

(1) Following damage to the coastal 132kV network near Innisfail caused by Cyclone Larry commissioning date was advanced to reinforce supply to the Cairns area for the summer 2007/08.

(2) Middle Ridge second 330/275kV transformer will be commissioned in winter 2008.

Table 4.2: Committed Transmission Developments

Committed and under construction at June 2008

PROJECT	PURPOSE	ZONE LOCATION	PROPOSED COMMISSIONING DATE
Major Developments			
Townsville South to Townsville East 132kV line and Townsville East 132/66kV Substation	Increase supply capability to the Townsville area	Ross	Winter 2008
Ross to Yabulu South 275kV line and Yabulu South Substation	Increase supply capability to the Townsville area	Ross	Winter 2009
Broadsound to Nebo to Strathmore to Ross 275kV lines	Increase supply capability to North, Ross and Far North Queensland zones	Central West, North and Ross	Progressively from Winter 2008 to Summer 2010/11
Bouldercombe to Pandoin 132kV line and Pandoin 132/66kV Substation	Increase supply capability to Rockhampton City and Keppel Coast	Central West	Summer 2009/10
Larcom Creek 275/132kV Substation	Increase supply capability to the Gladstone area	Gladstone	Summer 2009/10
Woolooga 275kV SVC	Increases supply capability between Central and Southern Queensland	Wide Bay	Summer 2008/09
Abermain 275/110kV Substation	Increase supply capability to the Ipswich area	Moreton	Summer 2008/09
Greenbank 275kV SVC	Capacitive compensation to meet increasing reactive demand	Moreton	Summer 2008/09
Murarrie second 275/110kV transformer (1)	Increase supply capability to the Brisbane CBD and Australia Trade Coast	Moreton	Summer 2009/10
Palmwoods 132/110kV transformer augmentation	Increase supply capacity to the Caboolture and Beerwah area	Moreton	Summer 2009/10
South Pine 275/110kV transformer augmentation	Increase supply capability to North East Brisbane	Moreton	Summer 2009/10
South Pine to Sandgate 275kV line	Increase supply capability to North East Brisbane	Moreton	Summer 2009/10

Note:

(1) The associated work will be coordinated with Belmont 110kV substation replacement by summer 2008/09.

Table 4.2: Committed Transmission Developments (Cont'd)

Committed and under construction at June 2008

PROJECT	PURPOSE	ZONE LOCATION	PROPOSED COMMISSIONING DATE
Minor Developments			
Edmonton 30MVAr 132kV capacitor bank	Capacitive compensation to meet increasing reactive demand	Far North	Summer 2008/09
El Arish 132/22kV Substation	Increase supply capability to Mission Beach	Far North	Summer 2008/09
Alligator Creek 132/33kV Substation expansion	Increase supply capability to Hay Point, Dalrymple Bay and south of Mackay	North	Summer 2008/09
Tarong 200MVAr 275kV capacitor bank	Increase supply capability to South West and South East Queensland	South West	Summer 2009/10
South Pine 120MVAr 275kV third and fourth capacitor banks	Capacitive compensation to meet increasing reactive demand	Moreton	Summer 2008/09 (third capacitor bank) Summer 2009/10 (fourth capacitor bank)
Mt England second 120MVAr 275kV capacitor bank	Capacitive compensation to meet increasing reactive demand	Moreton	Summer 2009/10
Greenbank fifth 200 MVAr 275kV capacitor bank	Capacitive compensation to meet increasing reactive demand	Moreton	Summer 2009/10

Table 4.3: Commissioned Connection Works

Commissioned since June 2007

PROJECT	PURPOSE	ZONE LOCATION	DATE COMMISSIONED
Woree 132kV extension for Cairns North	Increase supply capability to Cairns North	Far North	April 2008
Biloela 132/66kV transformer augmentation	Increase supply capability to Biloela	Central West	October 2007
Mudgeeraba 110/33kV Substation establishment	Increase supply capability to south Gold Coast	Gold Coast	November 2007

Table 4.4: Committed Connection Works

Committed and under construction at June 2008

PROJECT	PURPOSE	ZONE LOCATION	PROPOSED COMMISSIONING DATE
Alligator Creek 132kV connection for Louisa Creek	Provide supply to new Ergon Energy substation	North	Summer 2008/09
QR Bolingbroke Rail Supply	Increase supply capability to Bolingbroke rail site	North	Winter 2009
Pandoin 132kV connection for Keppel	Provide supply to new Ergon Energy substation	Central West	Summer 2009/10
QAL 132/33kV Substation	New connection point to QAL	Gladstone	Winter 2008
Yarwun 132kV Substation	New connection point to Rio Tinto Aluminium Yarwun and Ergon Energy Boat Creek substation	Gladstone	Winter 2009
Darling Downs Power Station Connection	New connection to Darling Downs Power Station	Bulli	Summer 2009/10
Braemar 2 Power Station Connection	New connection to Braemar 2 Power Station	Bulli	Winter 2010
Oakey 110/33kV Substation	New connection point to Ergon Energy	South West	Winter 2008
Loganlea 110kV extension for Browns Plains	Increase supply capability to Browns Plains	Moreton	Winter 2008
Bundamba 110/11kV transformer augmentation	Increase supply capability to Bundamba	Moreton	Winter 2009

Table 4.5: Committed Network Replacements

Committed and under construction at June 2008

PROJECT	PURPOSE	ZONE LOCATION	PROPOSED COMMISSIONING DATE
Major Replacements			
Tully to Innisfail 132kV line (Kareeya to Innisfail 132kV line replacement)	Maintain supply reliability to the Far North zone	Far North	Winter 2008
Innisfail to Edmonton 132kV line replacement	Maintain supply reliability to the Far North zone	Far North	Summer 2009/10
Clare Substation primary plant	Maintain supply reliability to the Ross zone	Ross	Winter 2009
Ingham to Yabulu 132kV line replacement	Maintain supply reliability to the Ross zone	Ross	Summer 2010/11
Alligator Creek 132/33kV transformer replacement	Maintain supply reliability to Hay Point, Dalrymple Bay and south of Mackay	North	Summer 2008/09
Bouldercombe to South Pine overhead earthwire replacement	Maintain supply reliability to Southern Queensland	Central West , Gladstone, Wide Bay and Moreton	Progressively from winter 2007
Woolooga primary plant replacement	Maintain supply reliability to the Wide Bay zone	Wide Bay	Winter 2009
Tarong Substation 275kV circuit breaker replacement	Maintain supply reliability to the South West zone	South West	Summer 2008/09
South Pine 275/110kV transformer replacement and 110kV substation replacement	Maintain supply reliability to the Moreton zone	Moreton	Summer 2008/09 Summer 2009/10
West Darra 110kV Substation replacement	Maintain supply reliability to the Moreton zone	Moreton	Summer 2008/09
Belmont 275/110kV transformer replacements and 110kV substation replacement	Maintain supply reliability to the Moreton zone	Moreton	Summer 2010/11
Minor Replacements			
Turkinje Substation primary plant	Maintain supply reliability to the Far North zone	Far North	Summer 2008/09
Abermain 110/33kV transformer replacement	Maintain supply reliability to Ipswich in South East Queensland	Moreton	Winter 2009

Figure 4.1: Existing 330/275/132kV Network June 2008 – North and Central Queensland

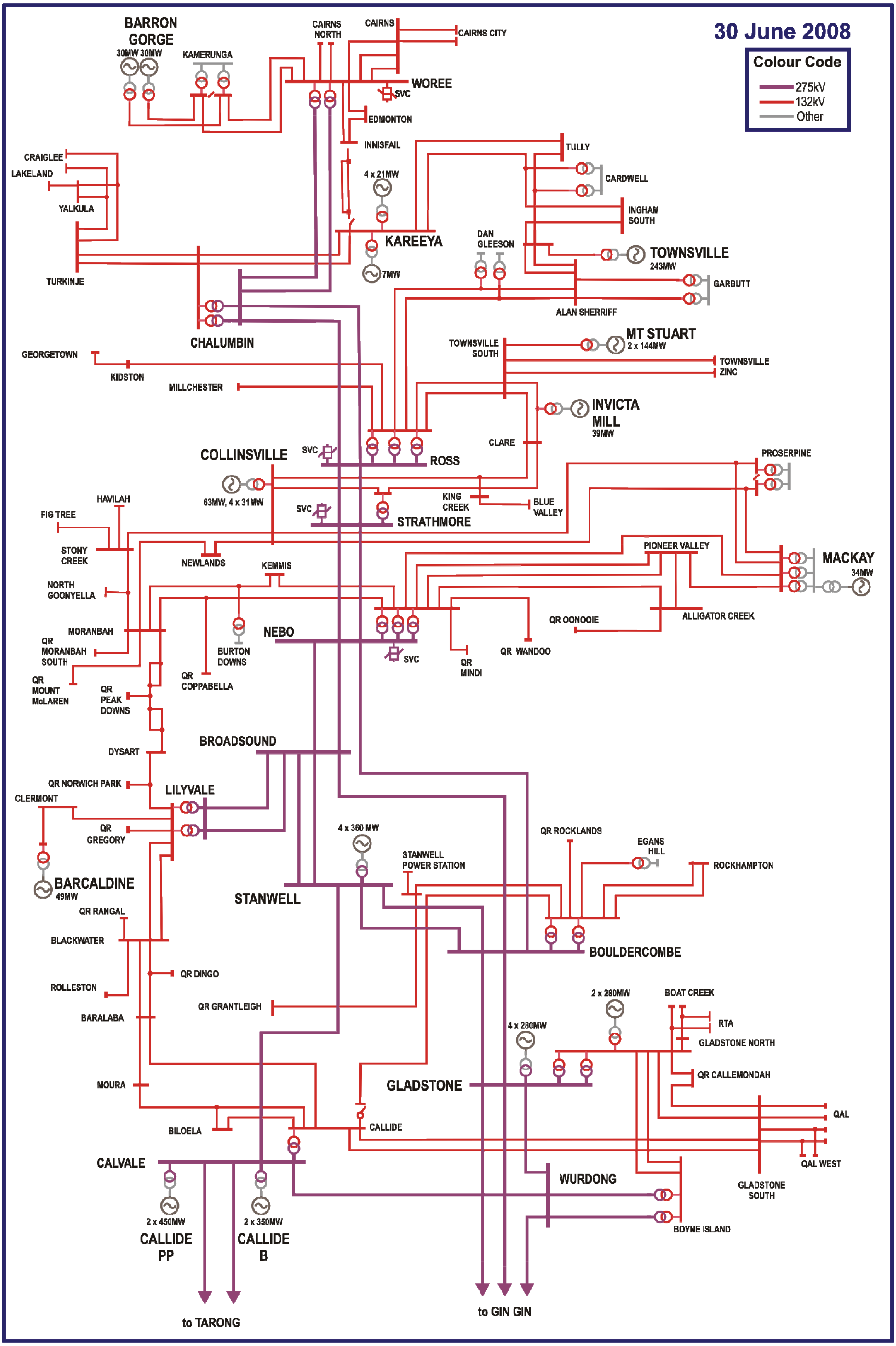
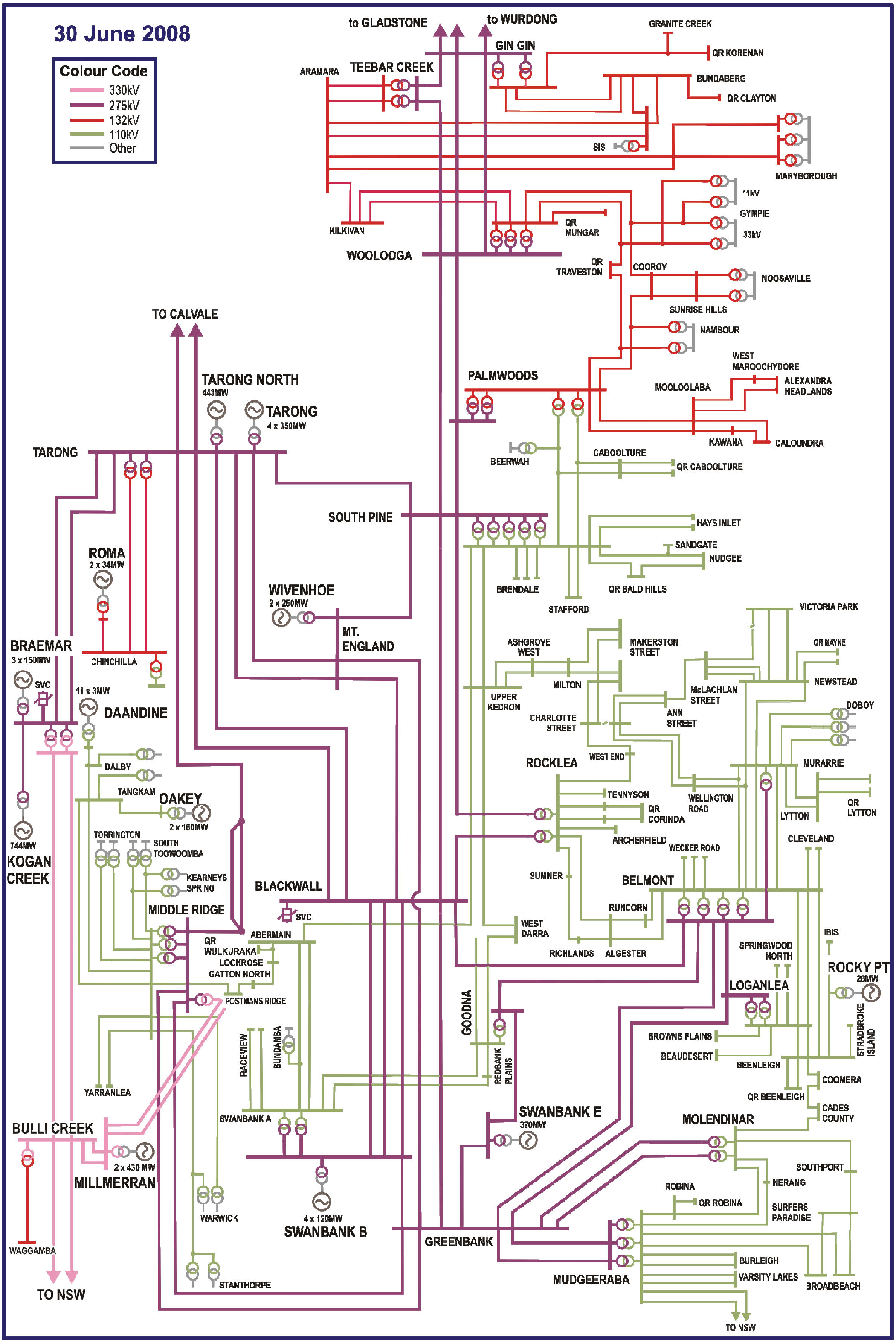


Figure 4.2: Existing 330/275/132/110kV network June 2008 – South Queensland



CHAPTER FIVE

Intra-Regional Proposed Network Developments Within Five Years

5.1 Introduction

The National Electricity Rules (NER) (Clause 5.6.2A(b)(3)) requires the Annual Planning Report (APR) to provide “a forecast of constraints and inability to meet the network performance requirements set out in NER Schedule 5.1 or relevant legislation or regulations of a participating jurisdiction over 1, 3 and 5 years”.

This Chapter on proposed network developments provides this and other related information. It contains:

- A background on factors that influence network capability;
- Sample network power flows at times of forecast Queensland maximum summer and winter demands under a range of interconnector flows and sample generation dispatch patterns within Queensland;
- A qualitative explanation of factors affecting power transfer capability at key grid sections on the Powerlink network;
- Identification of emerging future limitations with potential to affect supply reliability;
- A table summarising the outlook for network constraints and network limitations over a five year horizon;
- Details of those limitations for which Powerlink intends to implement action or initiate consultation with market participants and interested parties;
- A table summarising possible connection point proposals; and
- A table summarising works for assets reaching the end of their technical life.

Identification of forecast limitations in this Chapter does not mean that there is a supply reliability risk. The NER requires identification of such limitations which are expected to arise some years into the future, assuming that demand for electricity continues to grow as outlined in this document. Early identification allows Powerlink to implement appropriate solutions, as outlined in this Chapter, to maintain a reliable power supply to customers.

The capability of Powerlink's transmission network to meet forecast demand is dependent on a number of factors that are subject to uncertainty.

In general terms, Queensland’s transmission network is more highly utilised during summer than winter. During higher summer temperatures reactive power requirements are greater, and transmission plant has lower power carrying capability. Also, high summer peak demands generally last for many hours, whereas winter peak demands are for short evening periods (as shown in Figure 3.9).

The location and pattern of power generation dispatch influences power flows across most of the Queensland network. Future generation dispatch patterns and interconnector flows are uncertain in the deregulated electricity market and will also vary substantially, due to the effect of planned or unplanned outages of generation plant. Power flows on transmission network elements can also vary substantially with planned or unplanned outages of transmission lines and transformers. Power flow levels can also be higher at times of local area or zone peak demands, as distinct from those at time of Queensland region maximum demand. Power flows can also be higher when embedded generation levels are lower than forecast.

This Chapter outlines some of these sensitivities using illustrative network power flows over the next three years under a range of interconnector flows and sample generation dispatch patterns within Queensland. Qualitative explanation is also provided on factors which impact power transfer capability at key grid sections on the Powerlink network, and on the cause of emerging limitations which may affect supply reliability.

5.2 Sample Winter and Summer Network Power Flows

Powerlink has selected 18 sample scenarios to illustrate possible network power flows for forecast Queensland region summer and winter maximum demands () over the period winter 2008 to summer 2010/11 for 50% probability of exceedance (PoE) medium economic growth scenario demand forecast outlined in Chapter 3 of this report. These sample scenarios, included in Appendix A, show possible network power flows under the range of import and export conditions on the Queensland/ New South Wales Interconnector (QNI) as indicated.

Network power flows in Appendix A are based on existing network configuration, committed projects and proposed new network assets (as outlined in Section 5.7) only, and assume the network is in its 'normal' or 'intact' state, that is, all network elements in service. Power flows can be higher than those levels during network or generation contingencies, during times of local area peak demands and/or different generation dispatch periods.

This information is based on possible sample generation dispatch patterns to meet nominated forecast Queensland region maximum demand conditions and only provides an indication of potential network power flows. Actual network power flows can vary significantly for different load conditions and generator bidding behaviour. In providing this information, Powerlink has not attempted to predict market outcomes.

The dispatch assumed is broadly based on the relative outputs of generators since commencement of the National Electricity Market (NEM) but is not intended to imply a prediction of future market behaviour. The southerly power flow on Terranora Interconnector is based on expected levels to meet reliability requirements in northern New South Wales.

Sample conditions in Appendix A include:

Figure A.1: Generation and Load Legend for Figures A.3 to A.20
Figure A.2: Power Flow and Limits Legend for Figures A.3 to A.20
Figure A.3: Winter 2008 Qld Peak 300MW Northerly QNI Flow
Figure A.4: Winter 2008 Qld Peak Zero QNI Flow
Figure A.5: Winter 2008 Qld Peak 700MW Southerly QNI Flow
Figure A.6: Winter 2009 Qld Peak 300MW Northerly QNI Flow
Figure A.7: Winter 2009 Qld Peak Zero QNI Flow
Figure A.8: Winter 2009 Qld Peak 700MW Southerly QNI Flow
Figure A.9: Winter 2010 Qld Peak 300MW Northerly QNI Flow
Figure A.10: Winter 2010 Qld Peak Zero QNI Flow
Figure A.11: Winter 2010 Qld Peak 700MW Southerly QNI Flow
Figure A.12: Summer 2008/09 Qld Peak 200MW Northerly QNI Flow
Figure A.13: Summer 2008/09 Qld Peak Zero QNI Flow
Figure A.14: Summer 2008/09 Qld Peak 400MW Southerly QNI Flow
Figure A.15: Summer 2009/10 Qld Peak 200MW Northerly QNI Flow
Figure A.16: Summer 2009/10 Qld Peak Zero QNI Flow
Figure A.17: Summer 2009/10 Qld Peak 400MW Southerly QNI Flow
Figure A.18: Summer 2010/11 Qld Peak 200MW Northerly QNI Flow
Figure A.19: Summer 2010/11 Qld Peak Zero QNI Flow
Figure A.20: Summer 2010/11 Qld Peak 400MW Southerly QNI Flow

5.3 Network Transfer Capability

5.3.1 Location of Grid Sections and Observation Points

Powerlink has identified a number of grid sections that allow network capability and forecast limitations of the whole network to be assessed in a structured manner. For the current system, limit equations have been derived for each of these grid sections. These limit equations quantify maximum secure power transfer across these grid sections. Maximum power transfer may be set by transient stability, voltage stability, thermal plant ratings or protection relay load limits. National Electricity Market Management Company (NEMMCO) has incorporated these limit equations as part of constraints within the market dispatch process, namely the National Electricity Market Dispatch Engine (NEMDE).

In addition to these grid sections, Powerlink also monitors power flows across several 'observation points'. These 'observation points' may be useful to define maximum secure power transfer particularly under network outage conditions.

Figure A.2 in Appendix A shows the location of relevant grid sections (where limit equations apply) and 'observation points' on the Queensland network. The significance for separate Moreton North and Moreton South zones, as included in previous years, has receded due to recent network augmentations. Additionally, generator commitments at Braemar have necessitated the creation of the Bulli zone and redefinition of the South West grid section. Potential limitations where flows may reach transfer capability under some circumstances in the next five years are summarised in Table 5.8.

5.3.2 Determining Network Transfer Capability

Transfer capability across each grid section varies with different system operating conditions. Transmission limits in the NEM are not generally amenable to definition by a single number. Instead, Transmission Network Service Providers (TNSPs) define capability of their network using multi-term equations. These equations quantify the relationship between system operating conditions and network transfer capability, and are implemented into NEMMCO's market systems for optimal dispatch of generation. This is relevant in Queensland as the network transfer capability is highly dependent on which generators are in service and their dispatch level.

This limit equation approach aims to maximise transmission capability available to electricity market participants at any point in time depending on prevailing system conditions.

Trade-off for this maximisation of network transfer capability is the complexity of analysis required to define network capability. The process of developing transfer limit equations from a large number of network analysis cases involves use of regression techniques and is time consuming. It also involves a due diligence process by NEMMCO before these equations are implemented in market dispatch processes.

Present limit equations derived by Powerlink, at the time of publication of this report, are provided in Appendix B. It should be noted that limit equations will change over time with demand, generation and network development.

Such detailed and extensive analysis on the future limit equations has not been carried out for future network and generation developments for this report. Section 5.4 provides a qualitative description of main system conditions that affect capability of each of the grid sections.

Table A.1 in Appendix A shows power flows at each of these grid sections for intact operation (that is, with all network elements in service) at time of forecast Queensland region peak demand, corresponding to the sample generation dispatch shown in Figures A.3 to A.20. It also shows where network flows are expected to exceed the relevant limit and mode of instability that determines the limit.

5.4 Grid Section Performance

This section is a qualitative summary of main system conditions that affect transfer capability across key grid sections of the Queensland transmission network.

Powerlink has also provided a qualitative outlook for the likelihood that these grid sections will translate into restrictions on generator dispatch (that is, binding limits). This outlook is provided to assist readers to understand information provided in Appendix A, and is in no way meant to imply that this outlook holds true for system conditions other than those in sample power flows.

Network power flows and transfer capability are highly sensitive to actual demand and generator dispatch patterns, and embedded non-scheduled generation output and Powerlink makes no prediction of market outcomes in the information provided.

It should be noted that power flows across grid sections can be higher than shown in Figures A.3 to A.20 at times of local area or zone peak demands. However, transmission capability may also be higher under such conditions depending on how generation or interconnector flow varies to meet higher local demand levels.

For each of the grid sections discussed below, the proportion of time that the limit equation has recently bound is provided for two periods, namely from April to September 2007 (winter) and from October 2007 to March 2008 (summer).

This information on binding periods, sourced from the NEM InfoServer, includes all dispatch intervals in the relevant period. No attempt has been made to distinguish dispatch intervals when planned or forced outages may have affected network capability.

This binding constraint information is provided for information of readers and is not intended to imply that historical information represents a prediction of constraints in the future.

Table A.1 in Appendix A shows power flows at each of these grid sections for intact operation (that is, with all network elements in service) at time of forecast Queensland region peak demand, corresponding to sample generation dispatch shown in Figures A.3 to A.20. Power transfers across all grid sections are forecast to be within transfer capability of the network for sample generation scenarios shown within Appendix A. This outlook is based on 50% PoE forecast demand conditions.

5.4.1 Far North Queensland Grid Section

Maximum power transfer across the Far North Queensland grid section is set by voltage stability associated with an outage of a Ross to Chalumbin 275kV transmission circuit.

The present limit equation, derived by Powerlink is shown in Table B.1 of Appendix B. The equation shows that the following variables have the most significant effect on transfer capability:

- The diversity of Far North Queensland to North Queensland demand;
- Generation (MW) within the Far North zone; and
- Local reactor and capacitor banks online.

Local hydro MW output reduces network transfer capability, but more demand can be securely supported in the Far North zone. This is because reduction in grid section transfer capability is more than offset by the reduction in power transfers resulting from increased MW output by local generators.

Information pertaining to duration of constrained operation for the Far North Queensland grid section over the period April 2007 to March 2008 is summarised in Table 5.1.

Table 5.1: Far North Queensland Grid Section Constraint Times for April 2007 - March 2008

FNQ GRID SECTION	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	0.00	0.00
October 2007 to March 2008	0.13	5.75

Power flows across this grid section can be higher than shown in Figures A.3 to A.20 at times of local area peak demands or during more severe weather than in 50% PoE forecast conditions. Flows can also be higher during non-availability or low output of the hydro generators, or if output from embedded generators at sugar mills and the wind farm in North Queensland is lower than forecast.

Powerlink recently installed a second 275/132kV transformer at Woree and energised the second 275kV Chalumbin to Woree circuit (previously operated at 132kV).

Further action to maintain reliability of supply to the Far North zone in the form of additional reactive power support may again be required from summer 2011/12 onwards.

5.4.2 Central Queensland to North Queensland Grid Section

Maximum power transfer across the Central Queensland to North Queensland (CQ-NQ) grid section is set by transient stability, voltage stability or thermal plant rating following a transmission or generation contingency.

Maximum transfer capability may be set by thermal ratings associated with an outage of a 275kV transmission circuit between Broadsound and Nebo, Nebo and Strathmore, or Strathmore and Ross Substations, under certain prevailing ambient conditions.

Power transfers may also be constrained by stability limitations associated with the trip of the largest generating unit in North Queensland. Stability limitations associated with a 275kV transmission contingency can also constrain power flows.

Present limit equations, derived by Powerlink are shown in Table B.2 of Appendix B. The equations show that the following variables have the most significant effect on transfer capability:

- Highest generation (MW) of Townsville or Mt Stuart gas turbines;
- Collinsville generation (MW); and
- Local reactor and capacitor banks online.

Information pertaining to duration of constrained operation for the CQ-NQ grid section over the period April 2007 to March 2008 is summarised in Table 5.2.

Table 5.2: CQ-NQ Grid Section Constraint Times for April 2007 - March 2008

CQ-NQ GRID SECTION (1)(2)	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	2.15	94.25 (3)
October 2007 to March 2008	0.71	31.33

Notes:

(1) Powerlink has network support agreements with generators in North Queensland to manage power flows across this grid section within the transfer capability.

(2) The figures do not include occurrences of binding constraints associated with these network support agreements. NEMMCO does not consider that periods of congestion that are managed through a network support agreement contribute to the total number of hours of a binding intra-regional constraint.

(3) The majority of constraint times are due to thermal constraint equations, derived by NEMMCO, ensuring operation within plant thermal ratings during planned outages. For example, 49.33 hours were constraints on Townsville PS during the outages of 132kV lines north of the power station required to replace damaged insulators.

The existing network transfer capability is highly utilised, with limits reached at times of summer peak demands in North Queensland. This limitation is currently managed by network support contracts that Powerlink has with local North Queensland generators.

Power flows across this grid section can be higher than as shown in Figures A.3 to A.20 at times of local area or North Queensland peak demands or during more severe weather than in 50% PoE forecast conditions. Flows can also be higher during non-availability or low output of the hydro generators, or if output from embedded generators at sugar mills and the wind farm in North Queensland is lower than forecast.

In late 2005, Powerlink finalised regulatory processes for the following new large network assets to ensure supply reliability is maintained:

- Stage 1 - Construction of a 275kV transmission line between Broadsound and Nebo Substations, and 275kV Static VAr compensator (SVC) at Strathmore;
- Stage 2 - Construction of a 275kV transmission line between Nebo and Strathmore Substations; and
- Stage 3 - Construction of a 275kV transmission line between Strathmore and Ross Substations.

Powerlink is currently reviewing the future network support requirements taking account of latest demand forecasts and generation commitments (including the third Mt Stuart unit). This is discussed in Section 5.5.3.

5.4.3 Gladstone Grid Section

The maximum power transfer across this grid section is set by thermal rating of the 275kV lines between Central West and Gladstone zones (usually the 275kV circuit between Calvale and Wurdong) and potentially thermal rating of the Calvale 275/132kV transformer. The highest loadings on the Calvale to Wurdong 275kV circuit generally occur following a contingency of the Calvale to Stanwell 275kV circuit, or following a contingency of the Gladstone to Wurdong 275kV circuit.

The present equation, derived by NEMMCO, for the Gladstone grid section is shown in Table B.3 of Appendix B. The NEMMCO equation predicts flow on the critical Calvale to Wurdong 275kV circuit following an outage of the Calvale to Stanwell 275kV circuit.

If the rating would otherwise be exceeded following this contingency, then generation is re-dispatched to alleviate transfers across this line. To minimise the affect on the market, Powerlink updates the rating of the line to take account of prevailing ambient weather conditions. The appropriate rating is passed to NEMMCO for implementation in NEMDE.

Powerlink has also implemented network switching and support strategies which can be utilised during times when transfers reach the capability of this grid section. The strategies also extend to managing the flow through the Calvale 275/132kV transformer and 132kV network between Callide A and Baralaba within the rating under contingency conditions. These strategies have been implemented to minimise the incidence of network constraints. These strategies may extend to opening the 132kV lines at Callide A and/or Baralaba from time to time. Due to ongoing demand growth, from late 2010, a 132kV line outage is forecast to result in unacceptably low voltage conditions in the Moura area during summer peak demand periods. This emerging limitation is addressed in Section 5.5.4.

Information pertaining to duration of constrained operation for the Gladstone grid section over the period April 2007 to March 2008 is summarised in Table 5.3.

Table 5.3: Gladstone Grid Section Constraint Times for April 2007 - March 2008

GLADSTONE GRID SECTION (1)	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	0.14	6.25
October 2007 to March 2008	0.68	29.75

Note:

(1) This constraint is managed by the Gladstone limit equation. Increasing Gladstone generation reduces the incidence of binding.

Power transfers are most likely to reach transfer capability of this grid section under market dispatch scenarios that lead to high Callide generation and low Gladstone generation.

In addition, increasing power transfer either between Central and North Queensland or between Central and South Queensland places higher loading on this grid section. Depending on location and timing of as yet uncommitted generation and/or load this may result in an emerging reliability limitation requiring action. This is discussed in Section 5.5.5.

Due to the commitment of Rio Tinto Aluminium Yarwun (Stage 2), Powerlink is proceeding with the establishment of Larcom Creek 275/132kV Substation in the Gladstone State Development Area by late 2009 (consistent with Final Report published in late 2005). Further augmentation between the Central West and Gladstone zones may be required for additional load development, and the Larcom Creek Substation may form a key component of the strategy to ensure ongoing reliability of supply in the area.

5.4.4 Central Queensland to South Queensland Grid Section

Maximum power transfer across Central Queensland to South Queensland (CQ-SQ) grid section is set by transient and voltage stability following a transmission or generation contingency.

The voltage stability limit is set by insufficient reactive power reserves in the Central West and Gladstone zones following a contingency. More generating units on line within these zones increase reactive power support and therefore transfer capability.

Present voltage stability limit equations derived by Powerlink for the CQ-SQ limit are shown in Table B.4 of Appendix B. The equations show that the following variables have most significant effect on transfer capability:

- Number of generating units on line in the Central West and Gladstone zones; and
- Generation (MW) at the Gladstone power station.

Information pertaining to the duration of constrained operation for the CQ-SQ limit over the period from April 2007 to March 2008 is summarised in Table 5.4.

The abnormally high level of constraint hours in Winter 2007 were primarily due to the significant reduction in output from South Queensland generators due to water restrictions which have since been eased.

Table 5.4: CQ-SQ Grid Section Constraint Times for April 2007 - March 2008

CQ-SQ GRID SECTION (1)	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	11.07	486.25 (2)
October 2007 to March 2008	0.13	5.83

Notes:

(1) The duration of binding events outlined in Table 5.4 include periods when spare capability across this grid section was fully utilised by the QNI or Terranora Interconnector transferring power south into NSW. These binding periods coincided with southerly flows on QNI.

(2) Power flow across this grid section increased due to the water conservation operation of Tarong and Swanbank Power Stations.

Power flows across this grid section can be higher than shown in Figures A.3 to A.20 of Appendix A at times of more severe weather than 50% PoE forecast conditions and/or different generation patterns. The latter is the most variable and has the largest potential for increasing transfers across the grid section.

The introduction of additional plant within South Queensland, that displaces generation within Central or North Queensland, can reduce the level of power transfers across this grid section. The advent of large load developments within Central or North Queensland (not currently included in forecasts), without corresponding increases in North or Central Queensland generation, can also significantly reduce the levels of CQ-SQ transfers.

At transfers above 1900MW, the CQ-SQ transfer is limited by transient instability following a fault on a Calvale to Tarong 275kV circuit. Powerlink previously identified that capability of the CQ-SQ transmission network would be fully utilised by summer 2008/09.

In this regard, Powerlink will establish a 350MVAr SVC at Woolooga Substation by summer 2008/09 to increase the transfer limit. This is discussed in Section 5.5.6.

5.4.5 Tarong Grid Section

Maximum power transfer across this grid section is set by voltage stability associated with loss of a large generating unit, or a 275kV transmission circuit either between Central and South Queensland or between Millmerran and greater Brisbane load centre. The limitation arises from insufficient reactive power reserves within South Queensland.

Depending on generation patterns and power system conditions, one of four critical contingencies can limit maximum secure power transfer across this grid section. These contingencies are:

- Calvale to Tarong 275kV transmission circuit;
- Swanbank E generating unit;
- Wivenhoe generating unit; and
- Millmerran to Middle Ridge 330kV transmission circuit.

Present limit equations derived by Powerlink for the Tarong grid section are shown in Table B.5 of Appendix B. The equations show that the following variables have the most significant effect on the transfer capability:

- Transfer on QNI and Generation (MW) within the South West and Bulli zones;
- Number of generators on line in the Moreton zone; and
- Generation (MW) within the Moreton zone.

There is inter-dependence between the CQ-SQ transfer and the Tarong transfer capability. High flows between Central and South Queensland reduce Tarong transfer capability.

Any increase in generation west of this grid section, with a corresponding reduction in generation north of the grid section, reduces the CQ-SQ power flow and increases the Tarong limit. Increasing generation east of the grid section reduces the transfer capability, but increases the overall amount of supportable South East Queensland demand. This is because reduction in transfer capability is more than offset by reduction in power transfers resulting from increased generation east of this grid section.

Information pertaining to duration of constrained operation for the Tarong grid section over the period April 2007 to March 2008 is summarised in Table 5.5.

Table 5.5: Tarong Grid Section Constraint Times for April 2007 - March 2008

TARONG GRID SECTION	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	0.00	0.08
October 2007 to March 2008	0.03	1.33

Based on the sample generation scenarios shown within Appendix A, power flows across this grid section are forecast to increase steadily over time. These scenarios are based on 50% PoE demand forecasts with all generation plant being available within the Moreton zone.

Powerlink previously identified that the capability of the Tarong grid section will be fully utilised by summer 2008/09.

In this regard, Powerlink will establish a new large network asset by summer 2008/09. Along with static reactive compensation in South East Queensland, a 350MVAr SVC is to be established at Greenbank substation.

Further generation capacity needed to meet future load in Queensland may locate in South West Queensland. This will increase utilisation of the Tarong grid section and necessitate further increases in transfer capability. The likely option to address this need is referred to in Section 5.5.7.

5.4.6 Gold Coast Grid Section

Maximum power transfer across this grid section is set by voltage stability associated with loss of the Swanbank E generating unit, or the 275kV circuit from Greenbank to Molendinar or from Greenbank to Mudgeeraba.

The present equation derived by Powerlink for the Gold Coast transfer capability is shown in Table B.6 of Appendix B. The equation shows that the following variables have the most significant effect on transfer capability:

- Number of generating units on line in Moreton zone;
- Loading (MW and MVAr) of Terranora Interconnector;
- Capacitive compensation levels on the Gold Coast and Moreton zones; and
- The diversity of the Gold Coast to the greater Brisbane demand.

Voltage limits are higher when more Swanbank B or E units are on line. Reducing southerly flow on Terranora Interconnector reduces transfer capability, but increases overall amount of supportable Gold Coast demand. This is because reduction in transfer capability is more than offset by reduction in power transfers resulting from the reduction in southerly flow on Terranora Interconnector.

Information pertaining to duration of constrained operation for the Gold Coast grid section over the period April 2007 to March 2008 is summarised in Table 5.6.

Table 5.6: Gold Coast Grid Section Constraint Times for April 2007 - March 2008

GOLD COAST GRID SECTION (1) (2)	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	0.05	2.17
October 2007 to March 2008	0.03	1.50

Notes:

(1) Directlink was transferred to prescribed status in March 2006. The Terranora Interconnector, an 110kV double circuit transmission line between Mudgeeraba and Terranora, links the Queensland and New South Wales regions.

(2) The duration of binding events outlined in Table 5.6 include periods when spare capability across this grid section was fully utilised by the Terranora Interconnector transferring power into New South Wales.

Based on the sample generation scenarios shown within Appendix A, power flows across this grid section are forecast to increase steadily over time but remain within the transfer capability. These scenarios are based on 50% PoE demand forecasts and expected flow on Terranora Interconnector to meet reliability requirements in northern New South Wales.

5.4.7 South West Queensland Grid Section

The South West Queensland (SWQ) grid section defines the capability of transmission system to transfer power from generating stations located within the Bulli zone (including import from NSW on QNI), to the rest of the State.

The capability of this grid section is currently set by the thermal rating of Braemar 330/275kV transformers (following an outage of the parallel transformer) and voltage stability for an outage of a Braemar to Tarong 275kV circuit. The loss of Tarong to Braemar double circuit can be declared a credible contingency. During these conditions, the capability of this grid section is set by the thermal rating of the Middle Ridge 330/275kV transformer. Prior to the recent commissioning of the Middle Ridge to Greenbank 275kV double circuit, capability was set by the thermal rating of Tarong to Middle Ridge 275kV.

The Braemar limit equation applies to this grid section. The present equation derived by Powerlink for the Braemar transfer capability is shown in Table B.7 of Appendix B.

Information pertaining to duration of constrained operation for the South West transfer capability over the period April 2007 to March 2008 is summarised in Table 5.7.

Table 5.7: South West Queensland Grid Section Constraint Times for April 2007 - March 2008

SOUTH WEST GRID SECTION (1)	PROPORTION OF TIME CONSTRAINT EQUATION BOUND (%)	EQUATION BOUND (HOURS)
April to September 2007	0.91	39.83
October 2007 to March 2008	1.16	51.08

Note:

(1) Excludes constraint times on Oakey due to Tangkam to Middle Ridge thermal limits caused by the recent commissioning of Daandine embedded generator.

The capability of the SWQ grid section for intact network conditions is not expected to be reached prior to the advent of further new generation within the Bulli zone. The capability of the SWQ grid section will then depend on location, capacity and operation of existing and new generation entrants.

This capability will be set by the thermal rating of the Middle Ridge 330/275kV transformer or Middle Ridge to Greenbank 275kV circuit, and/or voltage stability for an outage of a 275kV or 330kV circuit within South West Queensland or between South West Queensland and South East Queensland.

Due to strong load growth in South East Queensland, these limits may require augmentation to meet mandated reliability obligations to South East Queensland by summer 2011/12. This is discussed in Section 5.5.6.

5.4.8 Interconnector Limits (Queensland to New South Wales and Terranora Interconnectors)

The QNI was designed and constructed of assets having plant ratings of at least 1,000MW. However the actual transfer capability will vary from time to time depending on system conditions.

For intact system operation, the southerly transfer capability of QNI is most likely to be set by the following:

- Transient stability associated with loss of the largest load in Queensland;
- Transient stability associated with transmission faults in Queensland;
- Transient stability associated with transmission faults in the Hunter Valley;
- Transient stability associated with transmission faults in Victoria;
- Thermal ratings of the 132kV transmission network within northern NSW; and
- Oscillatory stability upper limit of 1078MW (conditional).

For intact system operation, the combined northerly transfer capability of QNI and Terranora Interconnector are most likely to be set by the following:

- Transient and voltage stability associated with transmission faults in the Hunter Valley;
- Transient and voltage stability associated with the loss of generating units within Queensland;
- Transient stability associated with transmission faults in Queensland;
- Thermal ratings of the 330kV and 132kV transmission network in NSW; and
- Oscillatory stability upper limit of 700MW.

Powerlink and TransGrid have recently undertaken detailed studies to investigate whether an upgrade to QNI would be economically justifiable. This is discussed further within Section 6.2.3.

5.5 Forecast 'Reliability' Limitations

It is a condition of Powerlink's Transmission Authority that it meets licence and NER requirements relating to technical performance standards during intact and contingency conditions. Under its Transmission Authority, Powerlink must plan and develop its network so that it can supply the forecast peak demand, even if the most critical network element is out of service. (The N-1 criterion).

Identification of forecast limitations in this Chapter can therefore be viewed as 'triggers' for planning action, not indicators of a supply reliability risk. The NER requires identification of such limitations which are expected to arise some years into the future, assuming that demand for electricity continues to grow as forecast in this document. This forward planning allows Powerlink adequate time to implement appropriate solutions to maintain a reliable power supply to customers.

Powerlink will consult with Registered Participants and interested parties on feasible solutions identified through this process. Solutions may include provision of network support from existing and/or new generation, demand side management initiatives (either from individual providers or aggregators) and network augmentations.

The information presented in this section provides advance notice of anticipated consultation processes and thereby extends the time available to interested parties to develop solutions. Further information will be provided during the relevant consultation process, as and when this is required (refer Section 5.7 for current and anticipated consultation processes).

Solution providers should be aware that there is some uncertainty surrounding the timing in which action will be required to address some of the following emerging limitations. Timing is dependent on demand growth in the identified areas and developments in the wholesale electricity market.

5.5.1 Far North Queensland Zone

Voltage Control/Transformer Capability

Sufficient capability is forecast to be available in this zone until summer 2008/09, when an outage of the 275kV circuit between Chalumbin and Woree may result in voltage instability at times of high demand without action to augment supply. Thermal capability of the 132kV line between Chalumbin and Woree, during an outage of the adjacent 275kV circuit, is forecast to be reached by summer 2010/11 without action to augment supply.

These identified limitations have been addressed by the installation of an additional transformer at Woree and energisation at 275kV of the second Chalumbin to Woree circuit previously operating at 132kV (refer Table 4.1). These upgrades were advanced to summer 2007/08 to reinforce supply to the Cairns area following damage to the coastal 132kV network near Innisfail caused by Cyclone Larry.

Voltage limitations are forecast to recur in this zone from summer 2011/12 due to ongoing load growth in the event of a critical contingency without action to augment supply.

A feasible network solution to the identified voltage limitation may involve the installation of a capacitor bank at Woree Substation at an approximate cost of $2 to $4 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply to Mission Beach Area

Sufficient capability is forecast to be available until summer 2008/09. Due to ongoing demand growth, from summer 2008/09 an outage of one of the 22kV distribution lines from Tully 132/22kV Substation is forecast to result in unacceptably low voltage conditions in the Mission Beach area during summer peak demand periods without action to augment supply.

This identified limitation is being addressed by a committed project comprising of construction of a 132/22kV substation at El Arish by summer 2008/09 (refer Table 4.2).

5.5.2 Ross Zone

Supply to Northern and Western Townsville Area (Thuringowa)

Sufficient capability is forecast to be available until summer 2008/09 when thermal capability limitations are expected to arise in the 132kV line between Ross and Dan Gleeson under contingency conditions if action to augment supply is not undertaken.

This identified limitation is being addressed by a committed project consisting of establishment of a new 132kV substation at Yabulu South and construction of a 275kV double circuit transmission line between Ross and Yabulu South for initial operation at 132kV by summer 2008/09 (refer Table 4.2).

Townsville Area 132/66kV Transformer Capability

Sufficient transformer capability is forecast to be available in the Townsville area until summer 2011/12, at which time limitations are forecast to arise under contingency conditions without action to augment supply. Thermal limitations are also forecast to occur in Ergon Energy's 66kV network by this timeframe without action to augment supply.

A feasible network solution may be the installation of an additional 132/66kV transformer in the Townsville area at an approximate cost of $10 to $15 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

5.5.3 North Zone

Supply to Bowen Area

Electricity demand in the Bowen Area is forecasted to grow strongly due to the staged expansion of the Abbot Point coal loading terminal in addition to the proposed electrification of rail traffic. Within the five year outlook period, voltage and thermal limitations are expected to arise in the local 66kV distribution network if action to augment supply is not undertaken.

An Application Notice published in June 2008 (refer Section 5.7.3) proposed a feasible network solution involving a new 132kV line from Strathmore Substation to a new 132/66kV substation in the Bowen area.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply to South Mackay Area

Electricity demand in the South Mackay area is forecast to increase sharply in the near term due to the expansion of the coal loading terminals at Dalrymple Bay and Hay Point, and consequent increases in electrified rail traffic.

This forecast demand growth is expected to result in thermal limitations in the local 33kV distribution network during contingency conditions without action to augment supply.

A committed project is underway to address these identified limitations. The project comprises the expansion of Alligator Creek Substation by Powerlink to provide for the construction by Ergon Energy of a new 132kV double circuit line to Louisa Creek by summer 2008/09 (refer Table 4.2).

CQ-NQ Transfer Limit

Summer peak electricity demand requirements in North and Far North Queensland are currently met by the transmission system operating in conjunction with local generators. Powerlink previously identified that this combined capability was insufficient to meet required reliability of supply to North Queensland from summer 2007/08. As a result, Powerlink committed to staged augmentation between Broadsound and Ross Substations (refer Tables 4.1 and 4.2) to address this limitation as follows:

- Construction of a 275kV transmission line between Broadsound and Nebo substations and installation of a SVC at Strathmore;
- Construction of a 275kV transmission line between Nebo and Strathmore substations; and
- Construction of a 275kV transmission line between Strathmore and Ross substations.

The Strathmore SVC was commissioned in October 2007. The 275kV transmission line between Broadsound and Nebo substations is scheduled to be commissioned in winter 2008, and the second stage between Nebo and Strathmore substations is expected to be completed by winter 2009.

Powerlink published a Request for Information (RFI), “Network Support Services – North and Far North Queensland” on 28 February 2008. The RFI invited submissions from proponents of genuine and feasible network support services that may be able to operate in conjunction with transmission network to reliably supply the forecast demand. Possible services could include local generators or demand side management initiatives.

Based on these submissions, Powerlink published an Application Notice in June 2008 which considered network support including the third combustion turbine at Mt Stuart. The analysis also confirmed the timing of the North Queensland Stage 3 augmentation is summer 2010/11.

Following this staged augmentation between Broadsound and Ross substations, power transfer capability into North Queensland may be limited by thermal, voltage or transient instability. Depending on future generation and/or load development in North Queensland, thermal limitations may arise between Stanwell and Broadsound under contingency conditions without action to augment supply from 2015.

In 2002, Powerlink constructed a double circuit 275kV transmission line between Stanwell and Broadsound substations, with only one circuit of this double circuit line strung at that time. It is anticipated that the most economic option to address this emerging (2015) reliability limitation is to string the second circuit of the 275kV double circuit Stanwell to Broadsound line at an approximate cost of $20 to $40 million.

Lengthy outages of the double circuit line would be required to string the second circuit, and would be scheduled in the winter and shoulder months. Investigations indicate that the ability to schedule outages to perform the proposed transmission line works may not be feasible after summer 2012/13.

Supply to Bowen Basin Coal Mining Area

Electricity demand in the Bowen Basin coal mining area is forecast to grow strongly due to new coal mining developments in the Moranbah area. As a result, thermal limitations are expected to arise in the 132kV network supplying the area without action to augment supply.

A feasible network solution may involve construction of a new transmission line from Nebo or Lilyvale to the Peak Downs/Moranbah area. The approximate cost of this option is in the range of $60 to $110 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

5.5.4 Central West Zone

Supply to the Rockhampton Area

Sufficient capability is forecast to be available until summer 2009/10 when an outage of either Bouldercombe to Rockhampton circuit is forecast to cause an overload in the companion circuit. In addition, voltage and thermal limitations are forecast to arise in the event of single contingencies on the 66kV distribution network without action to augment supply.

A committed project is underway to address these identified limitations. The project comprises establishment of a new 132/66kV substation at Pandoin and construction of a new 132kV double circuit transmission line between Bouldercombe and Pandoin substations by summer 2009/10 (refer Table 4.2).

Supply to Inland Central Queensland Area

Sufficient capability is forecast to be available until summer 2010/11 when the 132kV transmission capability between Callide, Biloela and Moura substations is expected to be reached under contingency conditions if action to augment supply is not undertaken. Opening the 132kV transmission lines north of Baralaba to alleviate this overload is forecast to result in unacceptably low voltage conditions in the Moura area during summer peak demand periods without action to augment supply.

A proposed new small network asset consisting of a 132kV capacitor bank at Moura Substation has been recommended to address this identified limitation at an estimated cost of $2.3 million (refer Section 5.7.4).

5.5.5 Gladstone Zone

Supply to Gladstone Area

The Boyne Island aluminium smelter dominates the load in the Gladstone area, but there is also significant demand at the Queensland Alumina plant, Rio Tinto Aluminium Yarwun, Boat Creek and Gladstone North and Gladstone South substations. Moreover, there continues to be several proponents considering additional developments in the area.

In response to ongoing demand growth and commitment of Rio Tinto Aluminium Yarwun, Powerlink is proceeding with establishment of Larcom Creek 275/132kV Substation in the Gladstone State Development Area (GSDA) by late 2009 (as per the Final Report published November 2005).

The establishment of Larcom Creek Substation addresses 275/132kV transformation capacity requirements at Gladstone, along with thermal limitations in the 132kV network fed from Gladstone Substation. In addition, the fault level at the Gladstone Substation 132kV bus has reached existing plant rating. Larcom Creek substation allows connection of additional 275/132kV transformation capacity without further exceeding these fault ratings.

As detailed in Section 5.4.3, transmission limitations may also occur between Central West and Gladstone zones. These limitations arise due to power transfer from Central West zone to the Gladstone zone and then beyond to North and South Queensland. These thermal limitations are currently managed by operational strategies and redispatch of generation. These operational strategies include re-rating critical transmission lines to take account of prevailing ambient weather conditions and post-contingent network rearrangement.

Due to ongoing demand growth, this thermal limitation is forecast to increase constraints on dispatch of generation. The materiality of this will depend on:

- Availability and bidding behaviour of existing and committed generators ;
- Commitment and location of additional load (particular in the GSDA); and
- Commitment and location of new generation.

Such constraints, in absence of new favourably located generation in Central or North Queensland, may result in the thermal limitation impacting significantly on market dispatch and eventually reliability of supply (particularly to the Gladstone area and North Queensland). This limitation is forecast to occur from 2012.

A feasible network solution to the identified thermal limitation may involve construction of a transmission line within the Central West zone or between Central West and Gladstone zones at an approximate cost of $90 to $150 million.

Non-network solutions may include favourably located generation and/or other demand side management initiatives.

Gladstone Area Harmonics

Large industrial enterprises are located in the Gladstone area. They include refineries, processing plants, smelters and traction loads. It is typical for these types of activities to generate harmonics, which causes voltage waveform distortion and quality of supply issues.

The NER provides for large direct connect customers to manage the level of harmonic waveform distortion within prescribed levels; and for TNSPs to also manage the level of residual harmonic waveform distortion within prescribed levels. Generally, resultant background levels of harmonics in load centres fall within prescribed limits, where large customers take action to control their levels. However in the case of Gladstone load centre, with its large concentration of industrial processing plants with complex interactions, background harmonic levels are expected to exceed prescribed values. Consequently, Powerlink has identified that a shared network augmentation is necessary to meet its power quality obligations, with a proposed timing of winter 2010.

A proposed new small network asset consisting of a harmonic filter at Gladstone South Substation has been recommended to address this identified limitation at an estimated cost of $3.8 million (refer Section 5.7.4).

5.5.6 Wide Bay and South West Zones

Supply to North Toowoomba Area

Sufficient capability is forecast to be available until early 2010. Due to ongoing demand growth in the northern Toowoomba area, thermal capability limitations are forecast to arise in Ergon Energy's 33kV networks supplying this area by winter 2010 if action to augment supply is not undertaken.

A feasible network solution may be the establishment of a new 110/33kV substation at Toowoomba North and an associated 110kV line. Part of Powerlink's spare 275kV circuit between Murphys Creek and Middle Ridge may be operated at 110kV as part of this augmentation, at an approximate cost of $3 to $10 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

CQ-SQ Transfer Limit

Powerlink has assessed there will be sufficient capability available until summer 2008/09, when the combination of local generation and grid transfer capability will be insufficient to maintain reliability of supply to South Queensland customers during contingencies without action to augment supply.

This identified limitation is being addressed by a committed project comprising construction of a 350MVAr SVC at Woolooga Substation by summer 2008/09 (refer Table 4.2). This project also provides reactive support to the main transmission network in the Sunshine Coast area.

Due to ongoing load growth, network limitations between Central and South Queensland may recur under contingency conditions unless action is taken to augment supply. Based on existing committed generation, it is expected that this limitation will not be reached before 2013.

Depending on future generation developments, feasible network solutions may include establishment of a switching station and series capacitors near the future Auburn River Substation (approximate cost $70 to $80 million) or additional transmission line development between Central and South Queensland (approximate cost $310 to $460 million).

Non-network solutions may include local generation and/or other demand side management initiatives.

South West Queensland Transfer Limit

Powerlink has assessed there will be sufficient capability available until 2010. Due to ongoing demand growth in the Queensland region and the commitment of new generation capacity in the South West zone, power transfer across the South West Queensland grid section will continue to increase. This required power transfer across the South West Queensland grid section is forecast to reach the capability of the existing network from summer 2010/11.

Network limitations in summer 2010/11 relate to thermal overload of a 330/275kV transformer at Middle Ridge Substation (following an outage of the parallel transformer) and voltage stability limitations in South West Queensland following a critical transmission outage.

The transformer thermal limitation is planned to be addressed by implementing an automatic network switching solution at Middle Ridge. A feasible network solution may be installing shunt capacitor banks connected to the 330kV at Middle Ridge Substation to address the potential voltage stability limitation. Powerlink expects to consult on these capacitor banks during 2009.

Due to ongoing load growth, the voltage stability limitation may recur depending on location of new generation commitments by summer 2011/12.

A feasible network solution may be the construction of a new transmission line between Braemar and Halys by summer 2011/12 at an approximate cost of $130 to $160 million.

Non-network solutions may include generation located in South East Queensland and/or other demand side management initiatives.

5.5.7 Moreton Zone

North Sunshine Coast Area

Bulk supply to the Sunshine Coast area is provided from 275/132kV substations at Woolooga and Palmwoods. Electricity is then transferred over ENERGEX's 132kV and 110kV network to supply Gympie, Cooroy, Nambour, the Sunshine Coast and Caboolture.

Taking into account ENERGEX’s committed minor upgrades, sufficient capability is forecast to be available until summer 2014/15. From summer 2014/15, thermal capability limitations are expected to arise in ENERGEX's 132kV network between Woolooga and Gympie during critical 132kV network outages without action to augment supply.

A feasible network solution has been identified involving construction of a new 275kV transmission line from Woolooga to a 275/132kV substation in the north Sunshine Coast area (Cooroy South) at an approximate cost of $80 to $90 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

Sunshine Coast 132/110kV Transformer Capability

Palmwoods and South Pine substations supply the Caboolture/Beerwah area via the ENERGEX 110kV network. Due to ongoing demand growth in the area, the transfer capacity from Palmwoods is forecast to be limited by the 132/110kV transformer ratings from summer 2009/10 under a single credible contingency.

A committed project is underway to address this identified limitation. The project comprises the construction of a new 132/110kV transformer at Palmwoods Substation by summer 2009/10 (refer Table 4.2).

Supply to North Brisbane

Significant demand growth is forecast to continue in the North Brisbane area as a result of population growth, new water pumping load and extensive commercial/industrial development such as the Brisbane Airport commercial precinct. As a result, thermal capability limitations are expected to arise in ENERGEX's 110kV network between South Pine and Nudgee under contingency conditions by summer 2009/10, if action to augment supply is not undertaken. A further thermal limitation is expected to arise in transformer capacity at South Pine Substation in the next five years without action to augment supply.

A committed project is underway to address these identified limitations. This project comprises construction of a 275kV transmission line between South Pine and the ENERGEX substation at Sandgate with increased transformer capacity at South Pine Substation and splitting the 110kV bus to provide two 275/110kV substations by summer 2009/10 (refer Table 4.2).

South East Queensland Voltage Control

The South East Queensland area is the most densely populated part of Queensland. Growing demand results in higher reactive power loadings, as well as greater reactive losses in the system due to increased transmission and transformer loadings. The combined effect is an annual increase in reactive demand above that already being supplied through existing reactive devices and ancillary services arrangements.

Powerlink must ensure the security of the 275kV transmission network and meet reliability of supply obligations. Augmentation of supply is required to ensure acceptable voltages are maintained.

To address voltage stability, an acceptable balance between static and dynamic compensation in South East Queensland must be maintained. Sufficient capacity is forecast to be available until summer 2008/09, at which time voltage limitations are forecast to arise in the event of a critical contingency on transfer corridors into South East Queensland.

A committed project is underway to address this identified limitation, comprising the construction of a 350MVAr SVC at Greenbank Substation by summer 2008/09 (refer Table 4.2).

The combined effect of higher reactive power loadings and losses will require additional reactive power compensation to ensure adequate reserves over the period summer 2009/10 to summer 2011/12.

An Application Notice published in May 2008 (refer Section 5.7.3) proposed a feasible network solution involving the construction of a 350MVAr SVC at South Pine Substation by summer 2009/10 and shunt capacitor banks at Ashgrove West (50MVAr), Loganlea (50MVAr) and Belmont (120MVAr) substations by summer 2011/12.

Powerlink advised in the South East Queensland (2005) Regulatory Test consultation that it will review and inform of any changes to scope and/or timing of the recommended capacitor bank program. To this extent, recent planning studies have identified that the combined effect of demand growth and changing demand characteristics requires installation of some shunt capacitor banks at different timings to that advised in the 2007 Annual Planning Report. The capacitor banks planned for installation at Belmont and Loganlea substations by summer 2009/10 are now required by summer 2011/12, and an additional 50MVAr capacitor bank is required at Ashgrove West by summer 2011/12 (refer Section 5.7.3).

Moreton 275/110kV Transformer Capability

Demand in the Moreton zone is forecast to grow at over 4.9% per annum over the next five years. This demand is supplied from the 110kV network which receives supply via the 275kV system. The 275/110kV transformer capacity must keep pace with demand growth to avoid unacceptable overloads following transformer outages.

A new 275/110kV substation has been commissioned at Goodna, but due to ongoing load growth, limitations are forecast to recur by summer 2008/09 under contingency conditions if action to augment supply is not undertaken.

A committed project is underway to establish a new 275/110kV substation at Abermain by summer 2008/09 to address this identified limitation (refer Table 4.2).

Based on forecast demand growth, Powerlink has identified a 275/110kV transformer capacity limitation on the Murarrie transformer. Augmentation to supply is needed to ensure that this transformer is operated within its rating during contingency conditions from summer 2009/10.

A committed project is underway to address this identified limitation, comprising installation of a second 375MVA 275/110kV transformer at Murarrie Substation by summer 2009/10 (refer Table 4.2).

Moreton 110/33kV and 110/11kV Transformer Capability

Due to ongoing demand growth from summer 2009/10, an outage of the 110/11kV transformer at Bundamba Substation is forecast to result in thermal capability of ENERGEX's 33kV network in the local area being exceeded during summer demand peak demand periods without action to augment supply.

A committed project is underway to address this identified limitation, comprising installation of a second 110/11kV transformer at Bundamba Substation by winter 2009 (refer Table 4.4).

Due to significant ongoing demand growth in Moreton zone, thermal capability limitations are forecast to arise in various parts of ENERGEX's 33kV and 11kV network and 110/33kV or 110/11kV transformation capacity in the next five year period if action to augment supply is not undertaken.

Possible network solutions include establishment of new 110/33kV or 110/11kV supply points, augmentation of existing transformation capacity (that is, additional transformers), or upgrade of ENERGEX's 33kV and 11kV network.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply to Lockyer Valley

Sufficient capability is forecast to be available until early 2010. Due to ongoing demand growth, thermal capability limitations are forecast to arise in ENERGEX's 110kV network supplying Lockyer Valley by winter 2010 if action to augment supply is not undertaken.

A feasible network solution may be establishment of a second 110kV supply to ENERGEX's Postmans Ridge Substation from Middle Ridge Substation. Part of Powerlink's spare 275kV circuit between Murphys Creek and Middle Ridge may be operated at 110kV as part of this augmentation at an approximate cost of $3 to $10 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply within South Brisbane Area

The South Brisbane area is defined as the area east of West Darra and Goodna substations, north to Murarrie and south to Logan City. Sufficient capability is forecast to be available in this area for summer 2010/11. From summer 2010/11, 110kV line limitations to Richlands, Algester and Runcorn substations may occur under critical contingencies without action to augment supply.

A feasible network solution may involve the establishment of a new 275/110kV substation (Larapinta) in the South Brisbane area and associated 110kV transmission lines at an approximate cost of $50 to $70 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply to South Brisbane, CBD and Eastern Suburbs

Sufficient capability is forecast to be available until summer 2011/12, when thermal limitations are expected to arise on sections of line between Blackwall, Swanbank and Belmont under contingency conditions without action to augment supply.

A feasible network solution may involve construction of a new 275kV transmission line on sections between the Blackwall and the Belmont areas at an approximate cost of $60 to $90 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

Supply to South East Queensland

Power is supplied to South East Queensland from local generation and transmission connections from adjacent zones. The majority of power is transferred to the area via seven 275kV circuits between Tarong and the wider Brisbane area, and between Middle Ridge and Greenbank.

A program of capacitor banks and SVCs provides sufficient capability until summer 2013/14, when voltage limitations will limit power transfers into South East Queensland due to insufficient reactive power reserves under critical contingencies without action to augment supply. In addition, thermal limitations on the Middle Ridge to Greenbank transmission lines, the southern part of the transfer corridor into South East Queensland, are reached without action to augment supply.

A feasible network solution may involve establishment of a new substation at Halys and the construction of a new double circuit transmission line between Halys and Blackwall substations at an approximate cost of $200 to $250 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

5.5.8 Gold Coast Zone

275/110kV Transformer Capability
Sufficient transformer capability is forecast to be available in the Gold Coast zone area until summer 2012/13, at which time limitations are forecast to arise under contingency conditions without action to augment supply.

A feasible network solution may be the installation of a third 275/110kV transformer at Molendinar Substation at an estimated cost of $20 to $25 million.

Non-network solutions may include local generation and/or other demand side management initiatives.

5.6 Summary of Forecast Network Limitations

Limitations discussed in Sections 5.4 and 5.5 have been summarised in Table 5.8.

This table provides an outlook (based on demand, generation and committed network development assumptions contained in Chapters 3, 4 and 5) for potential limitations in Powerlink's transmission network over a one, three and five year timeframe.

Table 5.8: Summary of Forecast Network Limitations

ANTICIPATED LIMITATION	REASON FOR CONSTRAINT OR LIMITATION	TIME LIMITATION MAY BE REACHED		
		1 YR OUTLOOK	3 YR OUTLOOK	5 YR OUTLOOK
Far North and Ross zones				
Far North voltage control / transformer capability	275kV outages in Far North Queensland may result in unacceptable voltage conditions			2011/12
Supply to Mission Beach area	22kV outages in the Mission Beach area may result in unacceptable voltage conditions	2008/09 Committed project in progress (1)		
Supply to Edmonton / Gordonvale area	Outage of the 132kV Woree-Edmonton line may result in unacceptable voltage conditions	2008/09 Committed project in progress (1)		
Supply to northern and western Townsville area (Thuringowa)	Future 132kV network thermal capability limitations in meeting demand growth in northern and western Townsville	2008/09 Committed project in progress (1)		
Townsville area 132/66kV transformer capability	Future 132/66kV transformer capability and 66kV network limitations in Townsville area under contingency conditions			2011/12
North zone				
Supply to Bowen area	Due to potential industrial load growth, voltage and thermal limitations expected to occur in local 66kV distribution network		2010/11 (4)	
Supply to south Mackay area	Due to industrial demand growth, thermal limitations expected to occur in 132/33kV transformers at Alligator Creek as well as the 33kV distribution network under contingency conditions	2008/09 Committed project in progress (1)		
CQ-NQ transfer limit	Voltage, dynamic instability and thermal limitations expected to result from single contingencies during periods of high northern Queensland demand	2007-2010 Committed project in progress (1)		2012/13
Supply to Bowen Basin Coal Mining area	Due to potential mining growth, thermal limitations expected to occur in the 132kV network supplying this area			2011/12(4)

Table 5.8: Summary of Forecast Network Limitations (Cont'd)

ANTICIPATED LIMITATION	REASON FOR CONSTRAINT OR LIMITATION	TIME LIMITATION MAY BE REACHED		
		1 YR OUTLOOK	3 YR OUTLOOK	5 YR OUTLOOK
Central West and Gladstone zones				
Supply to Rockhampton area	Due to demand growth, an outage of one of the Bouldercombe-Rockhampton 132kV circuits expected to result in thermal overloading of the remaining circuit in service		2009/10 Committed project in progress (1)	
Supply to inland Central Queensland area	Due to demand growth, 132kV network between Callide, Biloela and Moura expected to reach thermal capability limitations in the event of a single contingency and may result in unacceptably low voltages in the Moura area		2010/11 (2)	
Supply to Gladstone area	Potential for overload of Calvale-Wurdong 275kV line and/or Calvale and Gladstone 275/132kV tie transformer, and power transfer limitations out of Central West and Gladstone zones.	Currently managed by switching and support arrangements (3)	2009/10	2012 onwards (4)
	Due to industrial demand growth, future 275/132kV supply capability limitations are anticipated		2009/10 Committed project in progress (1)	
Gladstone area harmonics	Mitigating increasing harmonic levels in the Gladstone Area		2010/11 (2)	
Wide Bay and South West zones				
Supply to north Toowoomba area	Due to demand growth, thermal capability limitations are expected in the 33kV network supplying this area		2010	
CQ-SQ transfer limit	Continued demand growth in SQ expected to give rise to binding transfer limits for flows between CQ and SQ	2008/09 Committed project in progress (1)		2013 onwards (4)
SWQ transfer limit	Continued demand growth in SEQ expected to lead to SWQ transfer limit being reached		2010/11	2011/12

Table 5.8: Summary of Forecast Network Limitations (Cont'd)

ANTICIPATED LIMITATION	REASON FOR CONSTRAINT OR LIMITATION	TIME LIMITATION MAY BE REACHED		
		1 YR OUTLOOK	3 YR OUTLOOK	5 YR OUTLOOK
Moreton zone				
Northern Sunshine Coast area	Demand growth expected to result in thermal limitations in ENERGEX's 132kV network between Woolooga and Gympie during a critical 275kV or 132kV outage			2014/15 (5)
Sunshine Coast 132/110kV transformer capability	Transformer limitation forecast in supplying Caboolture and Beerwah Substation from Palmwoods Substation under contingency conditions		2009/10 Committed project in progress (1)	
Supply to north Brisbane	Demand growth expected to result in thermal limitations in ENERGEX's 110kV network and Powerlink 275/110kV transformers		2009/10 Committed project in progress (1)	
South East Queensland voltage control	Increasing reactive demand due to demand growth expected to require program of action to satisfy voltage control standards.	2008-10 Committed projects in progress (1)	2009-11 (2)	
Moreton 275/110kV transformer capability	Due to demand growth, future 275/110kV transformer capability limitations are anticipated	Committed project in progress (1)	2009/10 Committed project in progress (1)	
Moreton 110/33kV and 110/11kV transformer capability	Due to demand growth, future 110kV transformer limitations and 33kV and 11kV line limitations are anticipated at multiple locations		2009/10 Committed project in progress (1)	
Supply to Lockyer Valley	Due to demand growth, thermal capability limitations are forecast to arise in ENERGEX's 110kV network supplying this area		2010	
Supply within South Brisbane area	Due to demand growth, thermal capability limitations are expected in the 110kV network supplying this area			2011 onwards
Supply to South Brisbane, CBD and eastern suburbs	Demand growth is forecast to result in thermal limitations in sections of 275kV line from Blackwall to Swanbank and Belmont area.			2011/12
Supply to South East Queensland	High demand growth expected to result in limitations in supply to entire South East Queensland area	2008-10 Committed projects in progress (1)	2009-11 (2)	2013 onwards (4)

Table 5.8: Summary of Forecast Network Limitations (Cont'd)

ANTICIPATED LIMITATION	REASON FOR CONSTRAINT OR LIMITATION	TIME LIMITATION MAY BE REACHED		
		1 YR OUTLOOK	3 YR OUTLOOK	5 YR OUTLOOK
Gold Coast zone				
275/110kV transformer capability	Due to demand growth, Mudgeeraba 275/110kV transformers expected to reach thermal capacity limitations in the event of an outage of the Molendinar 275/110kV transformer			2012/13

Notes:

(1) Refer Tables 4.2 and 4.4 - Committed Augmentations.

(2) Refer to Section 5.7 - Proposed Network Developments.

(3) Other action may be required if new loads occur in the Gladstone area.

(4) The actual timing of the forecast limitation will be driven by major industrial developments and/or new generation.

(5) Associated easement project falls within the outlook period.

5.7 Proposed Network Developments

Network development to meet forecast demand depends on the location and capacity of generation developments and the pattern of generation dispatch in the competitive electricity market. Uncertainty about the generation pattern creates uncertainty about the power flows on the network and subsequently, which parts of the network will experience limitations. This uncertainty is a feature of the competitive electricity market and has been particularly evident in the Queensland region, where a significant amount of new large generation capacity has entered the market over the past few years.

The previous section of this report outlined forecast limitations that may arise in Powerlink's transmission network in the near future. The possible timing and effect of these limitations is dependent on demand growth and market developments.

This section focuses on those limitations for which Powerlink intends to implement action or initiate consultation with Registered Participants and interested parties in the near future. Information is also provided on potential connection point proposals.

It should be noted that the information provided in this section regarding Powerlink's network development plans may change and should therefore be confirmed with Powerlink before any action is taken based on this information.

5.7.1 Processes for Proposed Network Developments

Sections 5.4-5.6 of this report identified anticipated network limitations and constraints that may arise in the Queensland transmission network over the next five years. Where action is considered necessary, Powerlink will:

- Notify Registered Participants of anticipated limitations within the timeframe required for action;
- Seek information from Registered Participants and interested parties on feasible non-network solutions to address anticipated constraints;
- Powerlink's general approach is to seek input, via the APR, on potential solutions to network limitations which may result in new small network assets. Those that cannot be identified for inclusion in the APR will be the subject of separate consultation with Registered Participants and interested parties;
- For emerging network limitations which may result in new large network assets, Powerlink's approach is to issue detailed information papers outlining the limitations to assist in identifying non-network solutions;
- Carry out detailed analysis to determine feasible network solutions that Powerlink may propose to address identified network constraints;
- Consult with Registered Participants and interested parties on all genuine and feasible alternatives (network and non-network) and recommended solutions; and
- In the event a regulated solution (network or network support) is found to satisfy the AER's Regulatory Test, Powerlink will implement the recommended solution.

Alternatively, Powerlink may undertake network augmentations under the 'funded augmentation' provisions of the NER.

5.7.2 Proposed New Large Network Assets

Proposals for new large network assets are progressed under the provisions of Clause 5.6.6 of the NER.

Powerlink carries out separate consultation processes for each proposed new large network asset. Summary information is provided in this APR. Interested parties are referred to consultation documents published on Powerlink's website for further information.

Information on other network limitations that could result in a recommendation to implement a new large network asset, but where consultation on alternative solutions is still underway, is provided in Section 5.7.3.

Committed New Large Network Assets

Interested parties are advised that during 2007/08, Powerlink finalised regulatory processes associated with the new large network assets outlined in Table 5.9.

Table 5.9: New Large Network Asset Consultations Finalised In 2007/08

PROJECT NAME	DESCRIPTION OF WORKS	COST	EXPECTED COMMISSIONING DATE
Southern Queensland	Construction of a new 275kV SVC at Woolooga Substation.	$32.8M (1)	Summer 2008/09
South Eastern Queensland	Capacitor banks at Greenbank (200MVAr) and Molendinar (50MVAr) substations and 275kV SVC at Greenbank.	$44.2M (1)	Progressively 2007-2009
North Brisbane	Construction of a double circuit 275kV line between South Pine and Sandgate substations (initial operation 110kV), and increased transformer capacity at South Pine Substation and splitting of the 110kV bus to provide two 275/110kV substations.	$76.1M (2)	Summer 2009/10

Notes:

(1) Cost in 06/07 dollars consistent with amount published in the Final Report.

(2) Joint project with ENERGEX. Only Powerlink works and costs included in Table 5.9.

5.7.3 Consultation - Proposed New Large Network Assets

Consultations Underway

Network limitations have been identified that could give rise to a requirement for a proposed new large network asset at a number of locations. Table 5.10 provides a summary of the status of action to address future supply requirements, in various areas around Queensland.

Table 5.10: Consultations Underway

AREA	PUBLICATION OF APPLICATION NOTICE	PUBLICATION OF FINAL REPORT
Bowen	June 2008	Anticipated August 2008
North and Far North Queensland	June 2008	Anticipated August 2008
South East Queensland	May 2008	Anticipated July 2008
QNI Project Upgrade (1)	February 2008	Anticipated July 2008

Note:

(1) Based on market benefits (not a reliability limitation). This report on the study into a potential QNI upgrade is not an Application Notice.

Anticipated Consultation Processes

Other consultation processes likely to be initiated in the next twelve months are summarised in Table 5.11.

Table 5.11: Consultation Likely Within 12 Months

LOCATION (1)
Supply to South Brisbane, CBD and Eastern Suburbs
South West to South East Queensland
Bowen Basin Coal Mining Development
Gladstone Area Transmission Reinforcement

Note:

(1) For further details on each of these limitations refer to Sections 5.4 and 5.5.

Emerging limitations other than those listed will be monitored and Powerlink will initiate action, including consultation with interested parties, should this be required.

5.7.4 Outline of Proposed New Small Network Assets

This section outlines proposed network augmentations which are required to be progressed under the provision of Clause 5.6.6A of the NER (new small network assets - capitalisation value between $1 million and $10 million). At the time of publication of this report, Powerlink has developed plans for the proposed new small network augmentations listed in Table 5.12 to the point where they can be consulted on through this document.

Table 5.12: Proposed New Small Network Assets

PROPOSED NEW SMALL NETWORK ASSET	DATE TO BE OPERATIONAL	CAPITAL COST
Gladstone Area 132kV Harmonic Filter	Winter 2010	$3.77M
Moura 132kV Capacitor Bank	Summer 2010/11	$2.32M

Further details on each of these proposed new small network assets, including purpose, possible alternatives and the reasons that Powerlink is recommending these augmentations proceed, are provided in Appendix D.

Registered Participants and interested parties are invited to make submissions regarding these proposed augmentations and any non-network options they consider to be an alternative. The closing date for submissions is 25 July 2008. Submissions should be addressed to:

Manager Network Assessments
Powerlink Queensland
PO Box 1193
Virginia Queensland 4014
networkassessments@powerlink.com.au

If there are any material changes required following consideration of submissions, Powerlink will publish its conclusions and a revised recommendation. If no changes are required, Powerlink will proceed to implement these proposed new small network assets in the required timeframes. Other proposed new small network assets will be subject to separate assessment and consultation as per Clause 5.6.6A of the NER, if commitment is required prior to the publication of the 2009 Annual Planning Report.

5.7.5 Connection Point Proposals

Table 5.13 lists connection works that may be required over the next few years. Planning of new or augmented connections involves consultation between Powerlink and the connecting party, determination of technical requirements and completion of connection agreements. New connections can result from joint planning with the relevant DNSP or be initiated by generators or customers.

Table 5.13: Possible Connection Works

POTENTIAL PROJECT	PURPOSE	ZONE	POSSIBLE COMMISSIONING DATE
Mt Stuart Power Station Unit 3 Connection	Connection of new generation unit	Ross	Summer 2009/10
Townsville Area 132/66kV transformer augmentation	Increase transformer capacity to meet growing demands	Ross	Summer 2011/12
Alligator Creek connection for QR Mackay Ports	New supply to QR Mackay Ports Substation	North	Winter 2009
Middle Ridge 110kV connection for Postmans Ridge	Second supply to ENERGEX's Postmans Ridge Substation and supply to Ergon Energy's North Toowoomba	South West and Moreton	Winter 2010
South Pine 110kV bay for Griffin	New supply to ENERGEX's Griffin Substation	Moreton	Summer 2010/11
Palmwoods 132kV bays for Pacific Paradise	New supply to ENERGEX's Pacific Paradise Substation	Moreton	Summer 2010/11
Loganlea 110kV bay for Jimboomba	New supply to ENERGEX's Jimboomba Substation	Moreton	Summer 2010/11
South Pine 110kV bay for Strathpine West	New supply to ENERGEX's Strathpine West	Moreton	Summer 2010/11
Swanbank 'F' Power Station Connection	Connection of new power station	Moreton	Winter 2011
West Darra 110/11kV Substation	New connection point to ENERGEX to cater for increasing demand growth	Moreton	Summer 2011/12
Abermain 110kV bays for Wulkuraka	New supply to ENERGEX's Wulkuraka Substation	Moreton	Summer 2011/12
Asia Pacific Seamless Tubes connection	Connection of new industrial plant	Moreton	Summer 2011/12
South Pine 2nd 110kV bay for Griffin	New supply to ENERGEX's Griffin Substation	Moreton	Summer 2012/13
Upper Kedron 110kV bays for 110/11kV transformers	New supply to ENERGEX's 110/11kV transformers	Moreton	Summer 2012/13
Molendinar 110kV bays for Bundall	New supply to ENERGEX's Bundall Substation	Gold Coast	Summer 2010/11
Molendinar 110/33kV transformer augmentation	Increase transformer capacity to meet growing demand	Gold Coast	Summer 2011/12
Mudgeeraba 110kV bays for Tugun	New supply to ENERGEX's Tugun Substation	Gold Coast	Summer 2012/13

5.8 Proposed Network Replacement

In addition to developing its network to meet forecast electricity demand, Powerlink is also required to maintain the capability of its existing network. Powerlink undertakes asset replacement projects when assets are determined to reach the end of their life. Table 5.14 lists potential replacement works over the value of $5 million that are expected to occur in the next five years.

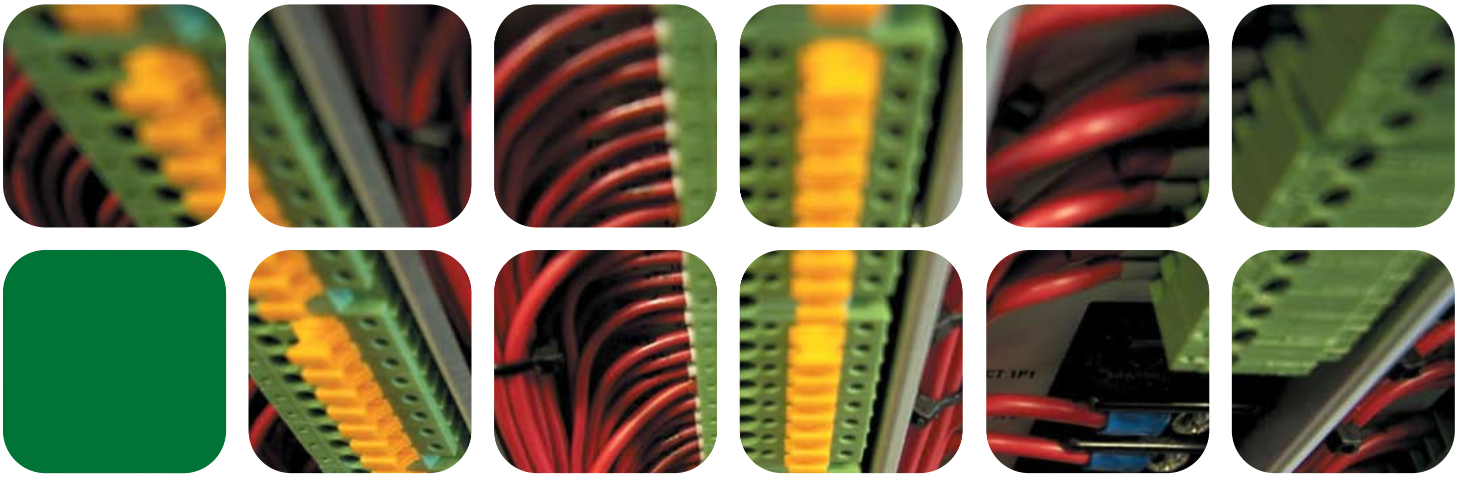
The identification of potential replacement projects does not indicate a supply reliability risk. Replacement programs are planned some years into the future to allow Powerlink to schedule works such that it can continue to provide a reliable power supply to customers.

Table 5.14: Possible Replacement Works

POTENTIAL PROJECT	ZONE	POSSIBLE COMMISSIONING DATE
Kareeya Substation primary plant	Far North	Summer 2011/12
Cardwell to Ingham 132kV line replacement	Ross	Summer 2011/12
Tully to Cardwell 132kV line replacement	Ross	Winter 2012
Garbutt to Alan Sherriff 132kV line life extension	Ross	Summer 2012/13
Proserpine Substation primary plant	North	Winter 2012
Callide A Substation primary plant	Central West	Summer 2012/13
Gladstone Substation primary plant	Gladstone	Summer 2011/12
Gin Gin transformer replacement	Wide Bay	Summer 2011/12
Swanbank B Substation primary plant	Moreton	Winter 2011
Swanbank A Substation primary plant	Moreton	Winter 2010
Richlands Substation primary plant	Moreton	Summer 2012/13

CHAPTER SIX

Other Relevant Planning Issues



6.1 Existing and Committed Generation Developments

6.1.1 Generation

Generation in Queensland is a combination of coal fired, gas turbine and hydro electric generators. An increasing number of new generation proposals are being developed for the south west Queensland area with several projects recently being commissioned and committed.

Table 6.1 summarises power stations currently connected or committed for connection to the Powerlink transmission network including the non-scheduled market generators at Invicta and Koombooloomba. This table also includes existing and committed scheduled embedded generators at Barcaldine, Roma and Condamine.

The information within this table has been provided by the owners of the generators and shows the registered installed capacity of generating stations.

Table 6.1: Generation Capacity

Existing and Committed Plant Connected to the Powerlink Transmission Network and Embedded Scheduled Generators

LOCATION	CAPACITY MW GENERATED (1)					
	WINTER 2008	SUMMER 2008/09	WINTER 2009	SUMMER 2009/10	WINTER 2010	SUMMER 2010/11
Coal Fired						
Collinsville	187	187	187	187	187	187
Stanwell	1,440	1,384	1,448	1,392	1,456	1,400
Gladstone	1,680	1,680	1,680	1,680	1,680	1,680
Callide A (2)	0	0	0	0	0	0
Callide B	700	700	700	700	700	700
Callide Power Plant	900	900	900	900	900	900
Tarong North	443	443	443	443	443	443
Tarong	1,400	1,400	1,400	1,400	1,400	1,400
Swanbank B	480	480	480	480	480	480
Kogan Creek	744	724	744	724	744	724
Millmerran	852	852	852	852	852	852
Total Coal Fired	8,826	8,750	8,834	8,758	8,842	8,766
Combustion Turbine						
Townsville (Yabulu)	243	232	243	232	243	232
Mt Stuart	288	260	288	381	415	381
Mackay	32	32	32	32	32	32
Barcaldine	37	37	37	37	37	37
RTA Yarwun	-	-	-	-	169	148
Roma	68	54	68	54	68	54
Condamine	-	-	138	135	138	135
Oakey	332	275	332	275	332	275
Swanbank E	370	350	370	350	370	350
Braemar Stage 1	450	450	450	450	450	450
Braemar Stage 2	-	-	519	462	519	462
Darling Downs	-	-	-	-	621	551
Total Combustion Turbine	1,820	1,640	2,477	2,408	3,394	3,107
Hydro Electric						
Barron Gorge	60	60	60	60	60	60
Kareeya (including Koombooloomba)	94	94	94	94	94	94
Wivenhoe (3)	500	500	500	500	500	500
Total Hydro Electric	654	654	654	654	654	654
Sugar Mills						
Invicta	39	39	39	39	39	39
TOTAL ALL STATIONS	**11,339**	**11,133**	**12,004**	**11,859**	**12,929**	**12,566**

Notes:

(1) The capacities shown are at the generator terminals and are therefore greater than power station net sent out nominal capacity due to station auxiliary loads and step-up transformer losses. The capacities are nominal as the available rating depends on ambient conditions. Some additional overload capacity is available at some power stations depending on ambient conditions.

(2) Callide A Power Station is in storage awaiting future use in CS Energy Oxyfuel Clean Coal Project.

(3) Wivenhoe Power Station is shown at its full capacity (500MW). However output can be limited depending on water storage in the upper dam.

6.2 Changes to Supply Capability

6.2.1 Generation

Since the Powerlink 2007 Annual Planning Report, CS Energy has commissioned the Kogan Creek 724MW coal fired power station within the Surat Basin area in south west Queensland.

Powerlink has been advised that the following generating stations are now committed:
- Origin Energy Mt Stuart third unit (liquid fuel);
- Rio Tinto Aluminium (RTA) Yarwun (gas);
- Queensland Gas Company Condamine (combined cycle gas);
- ERM Power Braemar Stage 2 (open cycle gas); and
- Origin Energy Darling Downs (combined cycle gas).

These recently commissioned and committed changes to supply capability in Queensland have been incorporated within Table 6.1.

6.2.2 Interconnectors

The Queensland transmission network is interconnected to the New South Wales (NSW) transmission system through the Queensland/New South Wales Interconnector (QNI) and Terranora Interconnector.

The combined QNI plus Terranora Interconnector maximum northerly capability is set by thermal ratings, voltage stability, transient stability and oscillatory stability (as detailed within Section 5.4.8).

The capability of these interconnectors can vary significantly depending on the status of plant and load conditions in both Queensland and NSW. For these reasons, QNI capability is regularly reviewed particularly when new generation enters the market.

6.2.3 Interconnector Upgrades

Powerlink and TransGrid have recently completed comprehensive technical and economic studies relating to an upgrade of QNI power transfer capability in accordance with the Australian Energy Regulator (AER) Regulatory Test. The outcomes of these studies have been published within the Interim Report for Market Consultation which is available for download on both the Powerlink and TransGrid websites.

Within these studies, TransGrid and Powerlink identified five technically feasible options each delivering different increments in QNI transfer capability. Comprehensive studies were carried out to determine the technical parameters of the upgrade options and respective increases to thermal ratings and power system stability.

The net market benefits were calculated through the use of forward looking market simulations, carried out across a range of reasonable market development scenarios and sensitivities as prescribed within the Regulatory Test. The economic assessment, consistent with the Regulatory Test, indicated that the installation of series compensation with an estimated cost of around $120 million provided the highest net market benefits within the majority of scenarios, with the optimum timing under the most plausible scenario being 2015/16.

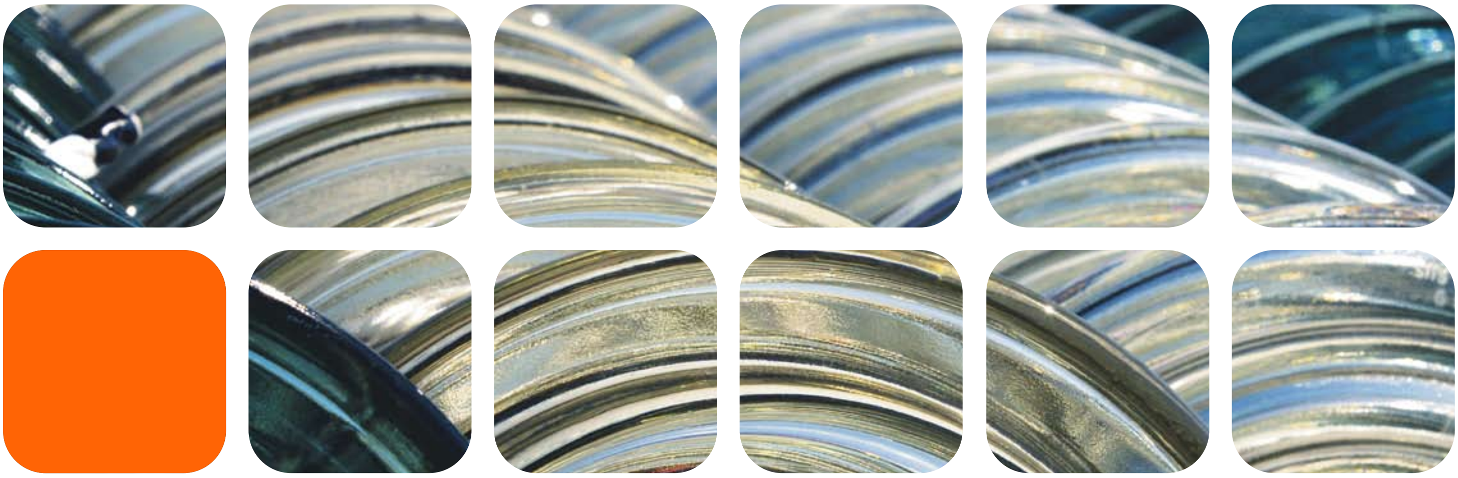
Based on the above, TransGrid and Powerlink consider it premature to recommend an upgrade option at this time. However, both organisations will continue to monitor market developments which could materially impact on the timing of a potential upgrade.

The closing date for submissions to the Interim Consultation Report was 24 April 2008. Powerlink and TransGrid are currently reviewing submissions and expect to publish a Final Report in July.

6.3 Supply Demand Balance

The outlook for the supply demand balance for the Queensland region was published in the NEMMCO 2007 Statement of Opportunities (SOO). As part of the normal annual planning cycle, NEMMCO will publish a revised outlook in the 2008 SOO. Interested parties who require information regarding the future supply demand balance should consult this document.

APPENDICES



APPENDIX A – ESTIMATED NETWORK POWER FLOWS

Appendix A illustrates 18 sample grid power flows (figures A.3 to A.20) for the Queensland region for each summer and winter over three years from winter 2008 to summer 2010/11. Each sample shows possible grid power flows at the time of winter or summer region 50%PoE forecast peak demand, with a range of import and export conditions on the Queensland/New South Wales Interconnector (QNI).

The sample power flows include southerly power flows on the Terranora Interconnector that are based on the expected levels to meet reliability requirements in northern New South Wales.

Sample conditions[1] in Appendix A include:

Figure A.3: Winter 2008 Qld Peak 300MW Northerly QNI Flow
Figure A.4: Winter 2008 Qld Peak Zero QNI Flow
Figure A.5: Winter 2008 Qld Peak 700MW Southerly QNI Flow
Figure A.6: Winter 2009 Qld Peak 300MW Northerly QNI Flow
Figure A.7: Winter 2009 Qld Peak Zero QNI Flow
Figure A.8: Winter 2009 Qld Peak 700MW Southerly QNI Flow
Figure A.9: Winter 2010 Qld Peak 300MW Northerly QNI Flow
Figure A.10: Winter 2010 Qld Peak Zero QNI Flow
Figure A.11: Winter 2010 Qld Peak 700MW Southerly QNI Flow
Figure A.12: Summer 2008/09 Qld Peak 200MW Northerly QNI Flow
Figure A.13: Summer 2008/09 Qld Peak Zero QNI Flow
Figure A.14: Summer 2008/09 Qld Peak 400MW Southerly QNI Flow
Figure A.15: Summer 2009/10 Qld Peak 200MW Northerly QNI Flow
Figure A.16: Summer 2009/10 Qld Peak Zero QNI Flow
Figure A.17: Summer 2009/10 Qld Peak 400MW Southerly QNI Flow
Figure A.18: Summer 2010/11 Qld Peak 200MW Northerly QNI Flow
Figure A.19: Summer 2010/11 Qld Peak Zero QNI Flow
Figure A.20: Summer 2010/11 Qld Peak 400MW Southerly QNI Flow

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[1] The single line transmission network diagrams shown in this appendix are high level representations only, used to indicate major flow paths and committed large capital projects. For a detailed network diagram refer to Figures 4.1 and 4.2.

Table A.1: Summary of Figures A.3 to A.20 - Possible Grid Power Flows and Limit Stability States

GRID SECTION(1)	ILLUSTRATIVE GRID POWER FLOWS (MW) AND LIMIT STABILITY AT QUEENSLAND REGION PEAK LOAD TIME (2)						LIMIT DUE TO (3)
	2008 WINTER	2009 WINTER	2010 WINTER	2008/09 SUMMER	2009/10 SUMMER	2010/11 SUMMER	
FIGURE	A3 / A4 / A5	A6 / A7 / A8	A9 / A10 / A11	A12 / A13 / A14	A15 / A16 / A17	A18 / A19 / A20	
Far North Transfer Ross into Chalumbin 275kV (2 circuits) Tully into Kareeya 132kV (1 circuit) Tully into Innisfail / El Arish / Woree 132kV (2 circuits – configuration changes due to staging of ongoing refurbishment project) Ingham South / Cardwell into Kareeya 132kV (1 circuit)	152 / 152 / 152	163 / 163 / 163	170 / 170 / 170	258 / 258 / 258	272 / 272 / 272	285 / 285 / 285	V
CQ-NQ Transfer Bouldercombe into Nebo 275kV (1 circuit) Broadsound into Nebo 275kV (3 circuits) Dysart to Peak Downs 132kV (1 circuit)	431 / 430 / 431	452 / 452 / 451	559 / 559 / 502	835 / 679 / 679	906 / 906 / 764	999 / 998 / 998	Tr V Th
Gladstone Transfer Bouldercombe into Gladstone 275kV (2 circuits, one circuit via Larcom Creek from summer 2009/10) Calvale into Wurdong 275kV (1 circuit) Callide A into Gladstone South 132kV (2 circuits)	1347 / 1222 / 1051	1247 / 1170 / 892	945 / 854 / 794	852 / 915 / 803	661 / 637 / 590	625 / 604 / 519	Th
CQ-SQ Transfer Wurdong into Gin Gin 275kV (1 circuit) Gladstone into Gin Gin 275kV (2 circuits) Calvale into Tarong 275kV (2 circuits)	1095 / 1396 / 1759	1236 / 1419 / 2060	845 / 1147 / 1474	1222 / 1424 / 1685	1137 / 1213 / 1602	1140 / 1204 / 1468	Tr V
SWQ Transfer Braemar to Tarong 275k (2 circuits) Millmerran to Middle Ridge 330kV (2 circuits)	1762 / 1462 / 903	1761 / 1462 / 902	2395 / 2096 / 1681	2071 / 1871 / 1469	2362 / 2307 / 1905	2703 / 2648 / 2391	Th
Tarong Transfer Tarong to South Pine, Mt England and Blackwall 275kV (5 circuits) Middle Ridge to Greenbank 275kV (2 circuits)	3563 / 3397 / 3011	3532 / 3325 / 3051	4059 / 3968 / 3715	3897 / 3800 / 3661	4221 / 4199 / 3981	4506 / 4480 / 4345	V

Table A.1: Summary of Figures A.3 to A.20 - Possible Grid Power Flows and Limit Stability States (Cont'd)

GRID SECTION (1)	**ILLUSTRATIVE GRID POWER FLOWS (MW) AND LIMIT STABILITY AT QUEENSLAND REGION PEAK LOAD TIME (2)**						**LIMIT DUE TO (3)**
	2008 WINTER	**2009 WINTER**	**2010 WINTER**	**2008/09 SUMMER**	**2009/10 SUMMER**	**2010/11 SUMMER**	
FIGURE	**A3 / A4 / A5**	**A6 / A7 / A8**	**A9 / A10 / A11**	**A12 / A13 / A14**	**A15 / A16 / A17**	**A18 / A19 / A20**	
Gold Coast Transfer							
Greenbank into Mudgeeraba 275kV (2 circuits) Greenbank into Molendinar 275kV (2 circuits) Coomera into Cades County 110kV (1 circuit)	785/ 791 / 817	844 / 849 / 908	868 / 873 / 911	885 / 891 / 896	932 / 938 / 943	985 / 995 / 1006	V

Notes:

(1) The Grid Sections defined are as illustrated in Figure A2. X **into** Y – the MW flow between X and Y measured at the Y end; X **to** Y – the MW flow between X and Y measured at the X end.

(2) Grid power flows are derived from the assumed generation dispatch cases shown in Figures A3 to A20. The flows estimated for system intact (that is, all network circuits in service), are based on existing network configurations, committed projects and proposed new assets in Chapter 5. Power flows within each grid section can be higher at times of local zone peak.

(3) Tr = Transient stability limit, V = Voltage stability limit and Th = Thermal limit.

(4) All power flows studied were stable.

Table A.2: Transformer Capacity and Sample Loadings of 275kV Substations

275KV SUBSTATION (1) (2)	POSSIBLE MVA LOADING AT QUEENSLAND REGION PEAK (3)(4)						DEPENDENCE OTHER THAN LOCAL LOAD		OTHER COMMENTS
NO. TRANSFORMERS X MVA NAMEPLATE RATING	WINTER 2008	WINTER 2009	WINTER 2010	SUMMER 2008/09	SUMMER 2009/10	SUMMER 2010/11	SIGNIFICANT DEPENDENCE ON	MINOR DEPENDENCE ON	
Woree 275/132kV (2x375MVA)	157	154	134	210	221	207	Barron Gorge generation	Kareeya generation	
Chalumbin 275/132kV (2x200MVA)	24	34	33	32	55	74	Kareeya generation	Townsville, Barron Gorge and Mt Stuart generation	
Ross 275/132kV (2x250 & 1x200MVA)	114	109	125	158	176	264	Mt Stuart, Townsville and Invicta generation	Collinsville generation	
Strathmore 275/132kV (1x375MVA)	18	43	78	60	94	67	Collinsville and Invicta generation	Townsville and Mt Stuart generation	
Nebo 275/132kV (2x200 & 1x250MVA)	242	242	278	360	357	390	Mackay GT generation	Collinsville generation	
Bouldercombe 275/132kV (2x200MVA)	141	147	152	191	199	207			
Lilyvale 275/132kV (2x375MVA)	170	196	216	208	220	226	Barcaldine generation	CQ-NQ flow	
Calvale 275/132kV (1x250MVA)	131	137	166	175	186	199	Central Queensland generation		
Larcom Creek 275/132kV (2x375MVA)	-	-	74	-	115	68			New substation summer 2009/10
Gin Gin 275/132kV (2x120MVA)	139	166	147	166	167	166	132kV transfers to/from Teebar Creek	CQ-SQ flow	132kV network can have open points to reduce loading
Teebar Creek 275/132kV (2x375MVA)	110	105	114	119	129	131	132kV transfers to/from Woolooga	CQ-SQ flow	
Woolooga 275/132kV (2x120 and 1x250MVA)	230	241	225	222	223	249	132kV transfers to/from Gin Gin and Teebar Creek	CQ-SQ flow	
Palmwoods 275/132kV (2x375MVA)	387	351	443	335	421	439	132/110kV transfers to/from South Pine and Woolooga	CQ-SQ flow	
South Pine 275/110kV (2x375, 1x250 and 1x200MVA)	914	947	-	1054	-	-	110kV transfers to/from Rocklea and Palmwoods	CQ-SQ flow and Swanbank generation	South Pine Substation split into South Pine East and South Pine West substations from summer 2009/10
South Pine East 275/110kV (3x375MVA)	-	-	804	-	839	877	110kV transfers to/from Rocklea and Palmwoods	CQ-SQ flow and Swanbank generation	
South Pine West 275/110kV (1x375 and 1x250MVA)	-	-	278	-	328	339	110kV transfers to/from Rocklea and Palmwoods	CQ-SQ flow and Swanbank generation	
Rocklea 275/110kV (2x375MVA)	500	486	449	557	537	558	110kV transfers to/from South Pine and Belmont	110kV transfers to/from Swanbank and Swanbank B generation	

Table A.2: Transformer Capacity and Sample Loadings of 275kV Substations (Cont'd)

275KV SUBSTATION (1) (2)	POSSIBLE MVA LOADING AT QUEENSLAND REGION PEAK (3)(4)						DEPENDENCE OTHER THAN LOCAL LOAD		OTHER COMMENTS
NO. TRANSFORMERS X MVA NAMEPLATE RATING	**WINTER 2008**	**WINTER 2009**	**WINTER 2010**	**SUMMER 2008/09**	**SUMMER 2009/10**	**SUMMER 2010/11**	**SIGNIFICANT DEPENDENCE ON**	**MINOR DEPENDENCE ON**	
Belmont 275/110kV (2x250 & 2x200MVA)	637	557	655	668	760	875	110kV transfers to/from Loganlea	110kV transfers to/from Rocklea	Summer 2009/10 - 1 x 375MVA transformer to replace 1 x 200MVA Summer 2010/11 - 1 x 375MVA transformer to replace 1 x 200MVA
Murarrie 275/110kV (1x375MVA)	239	366	363	450	453	479	110kV transfers to/from Belmont		Summer 2008/09 - 2nd 375MVA transformer
Swanbank 275/110kV (1x250 and 1x240MVA)	298	172	180	220	206	214	110kV transfers to/from South Pine, Millmerran and Oakey GT generation	110kV transfers to/from Rocklea and Swanbank B generation	
Abermain 275/110kV (1x375MVA)	-	135	155	178	176	183	110kV transfers to/from Swanbank and Goodna	Tarong flow	New substation summer 2008/09
Goodna 275/110kV (1x375MVA)	199	169	138	210	176	179	110kV transfers to/from Swanbank and Abermain	Tarong flow	
Loganlea 275/110kV (2x375MVA)	481	502	532	528	568	595	110kV transfers to/from Belmont	110kV transfers to/from Molendinar and Mudgeeraba	
Molendinar 275/110kV (2x375MVA)	455	476	483	478	503	537	110kV transfers to/from Loganlea and Mudgeeraba	Terranora Interconnector	
Mudgeeraba 275/110kV (3x250MVA)	423	496	497	485	512	553	110kV transfers to/from Molendinar and Terranora Interconnector	110kV transfers to/from Loganlea	
Middle Ridge 275/110kV (3x250MVA)	248	352	340	299	268	283	Oakey GT generation	Swanbank B generation	
Tarong 275/132kV (2x90MVA)	67	68	71	28	136	121	Roma generation		
Tarong 275/66kV (2x90MVA)	40	43	45	44	48	49			

Notes:

(1) Not included are the 275/132kV tie transformers within the Power Station switchyard at Gladstone. Loading on these transformers vary considerably with local generation.

(2) Also not included are 330/275kV transformers located at Braemar and Middle Ridge substations. Loading on these transformers are dependent on QNI transfer and south west Queensland generation output.

(3) Substation loadings are derived from the assumed generation dispatch cases shown within Figures A3 to A20. The loadings are estimated for system normal (that is, all network elements in service), and are based on existing network configurations, committed projects, and proposed new assets in Chapter 5. MVA loadings for transformers depend on power factor, and may be different under other generation patterns, outage conditions, local or zone peak demand times or different availability of local and downstream capacitor banks.

(4) Substation loadings are the maximum of each of the northerly/zero/southerly QNI scenarios for each year/season shown within the assumed generation dispatch cases in Figures A3 to A20.

Figure A.1: Generation and Load Legend for Figures A.3 to A.20

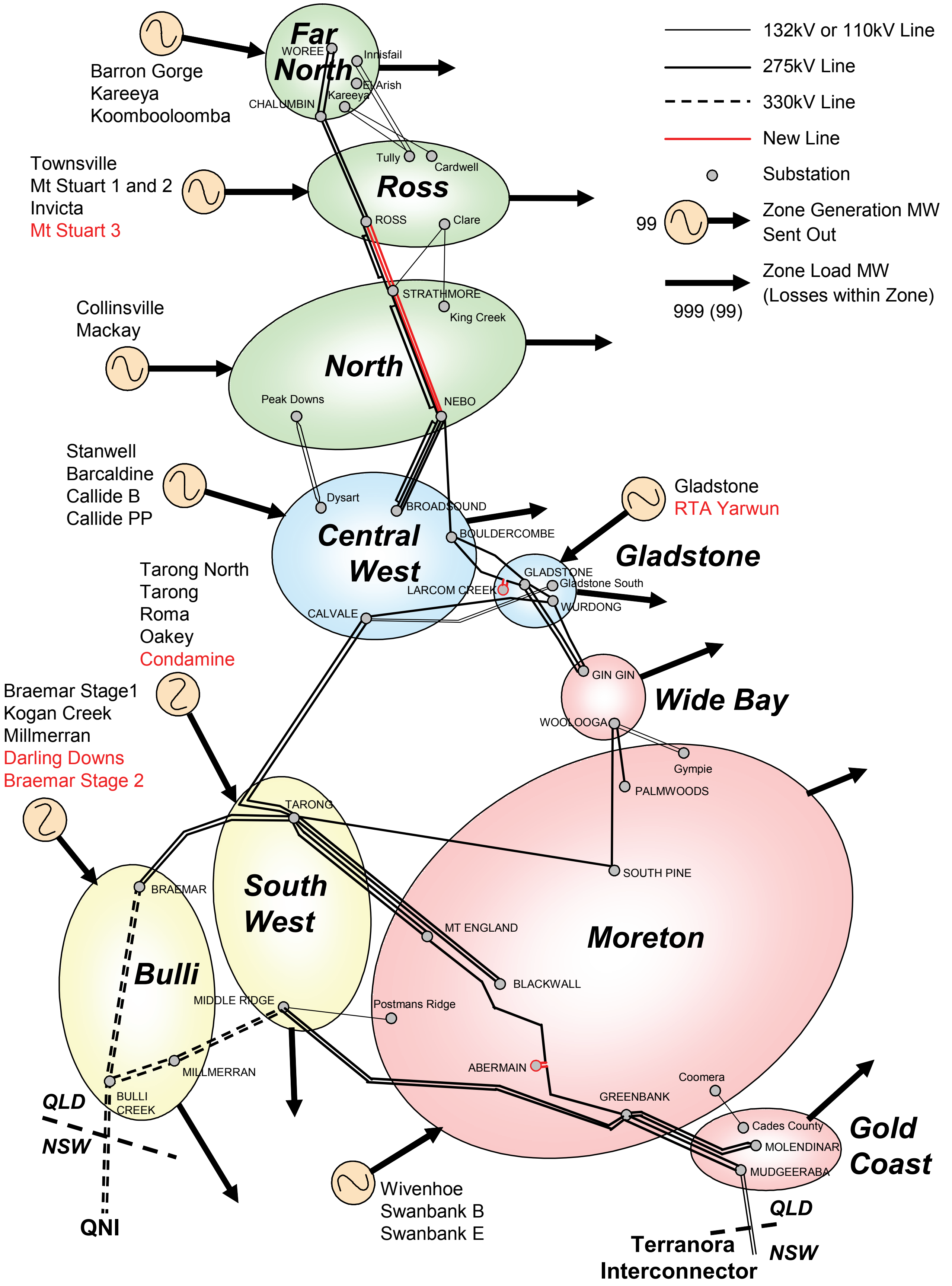


Figure A.2: Power Flow and Limits Legend for Figures A.3 to A.20

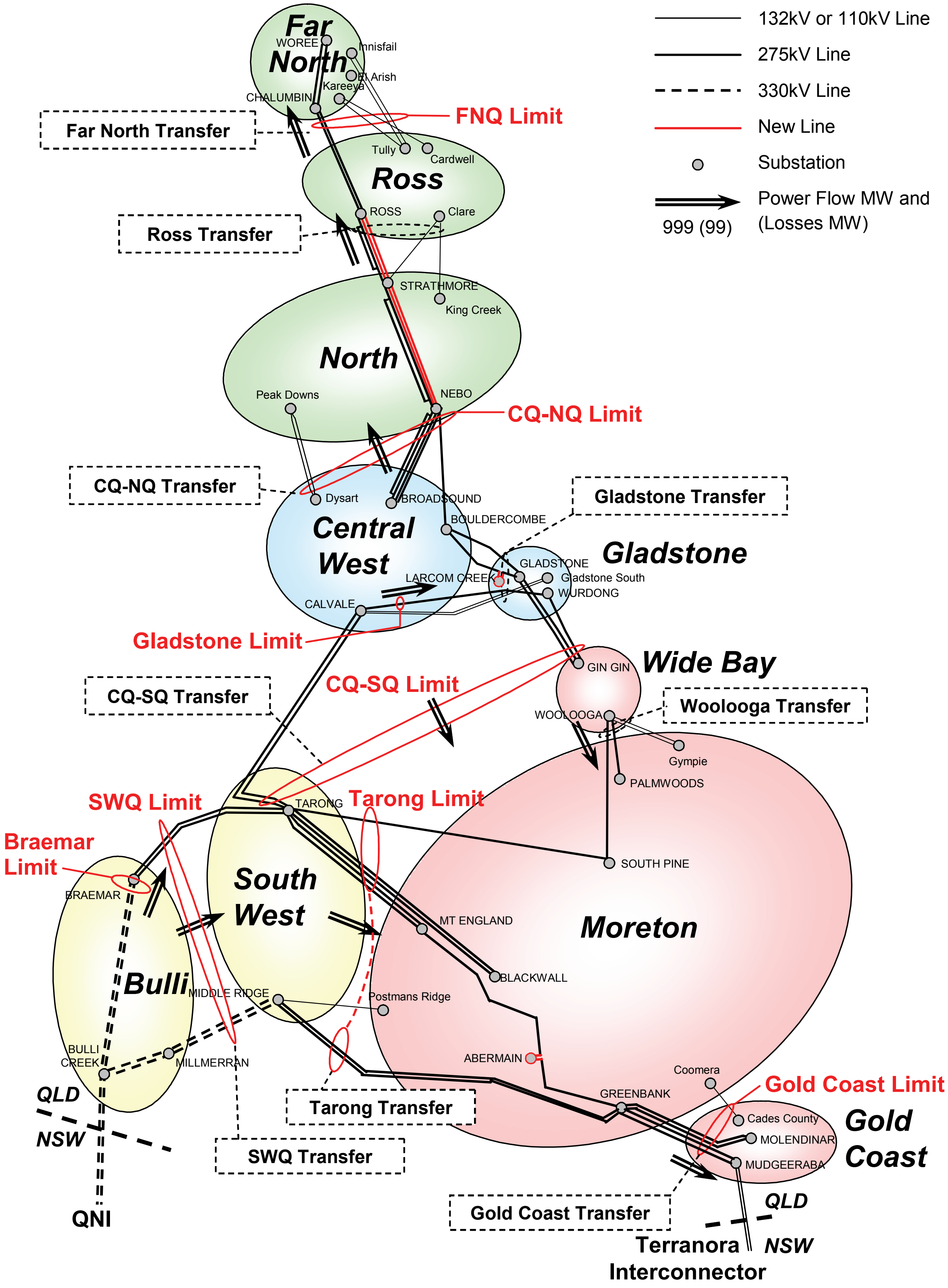
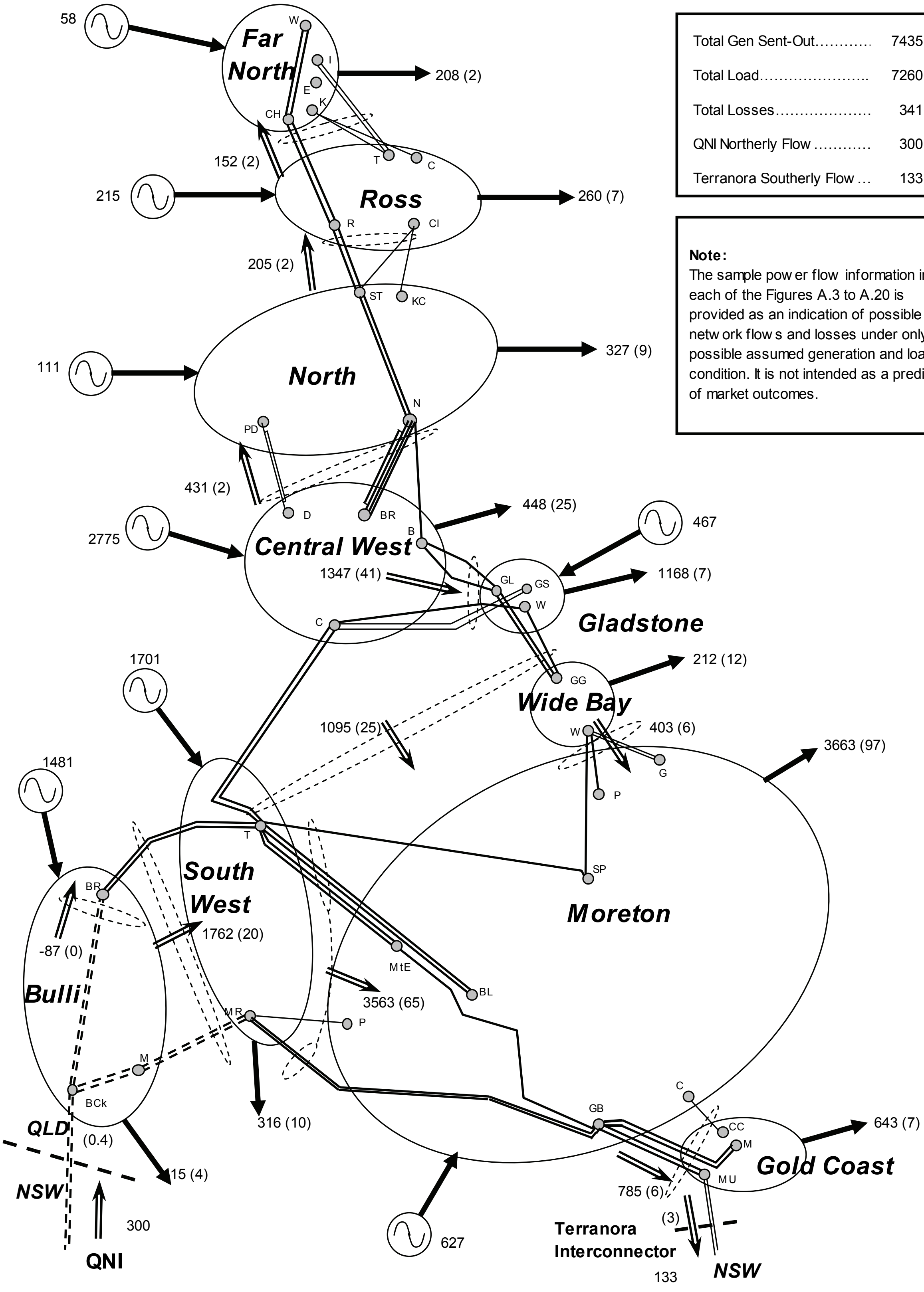


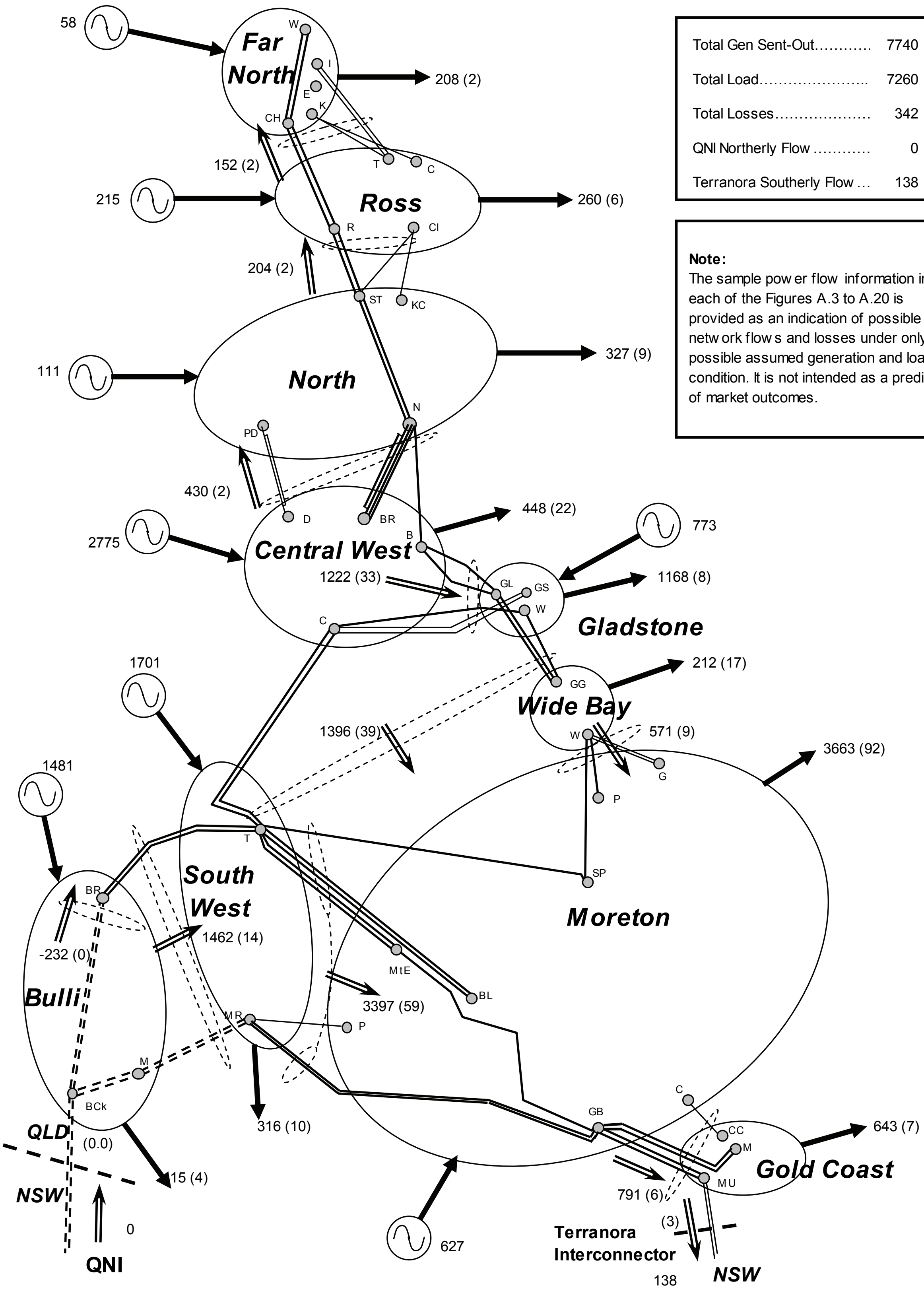
Figure A.3: Winter 2008 Qld Peak 300MW Northerly QNI Flow



Total Gen Sent-Out…………	7435	MW
Total Load……………………	7260	MW
Total Losses…………………	341	MW
QNI Northerly Flow …………	300	MW
Terranora Southerly Flow …	133	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

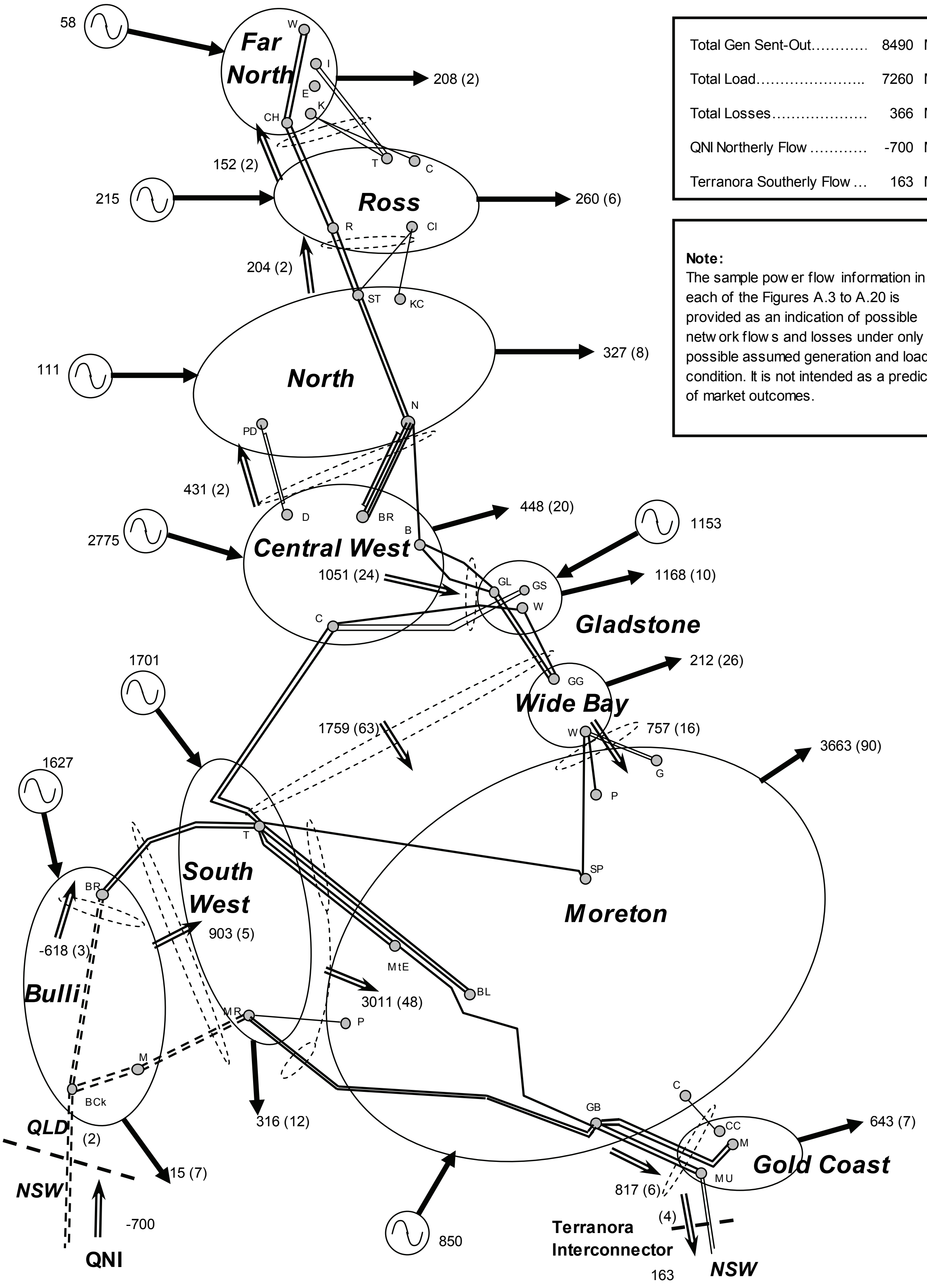
Figure A.4: Winter 2008 Qld Peak Zero QNI Flow



Total Gen Sent-Out…………	7740	MW
Total Load……………………	7260	MW
Total Losses………………	342	MW
QNI Northerly Flow …………	0	MW
Terranora Southerly Flow …	138	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

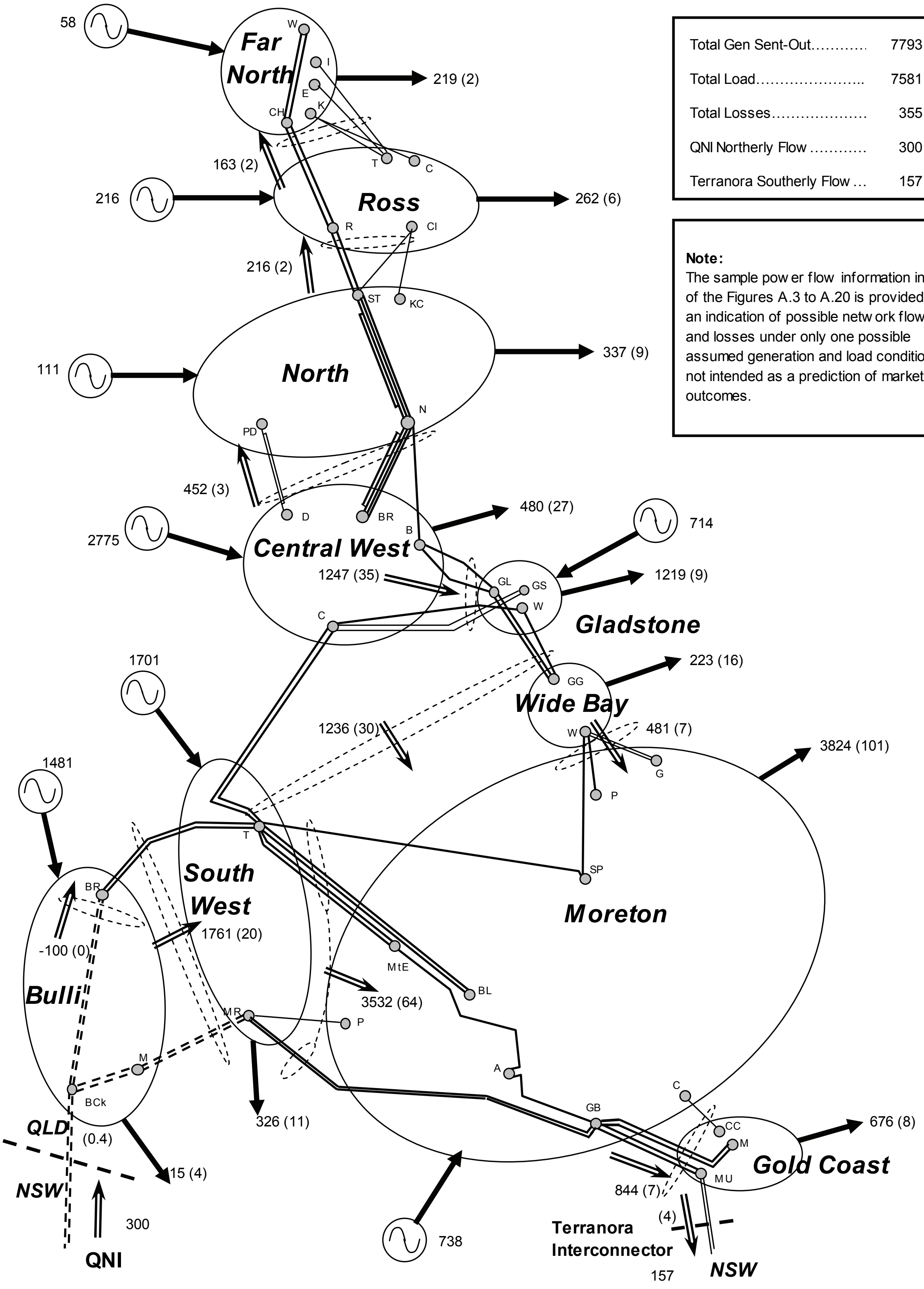
Figure A.5: Winter 2008 Qld Peak 700MW Southerly QNI Flow



Total Gen Sent-Out…………	8490	MW
Total Load…………………..	7260	MW
Total Losses………………	366	MW
QNI Northerly Flow …………	-700	MW
Terranora Southerly Flow …	163	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

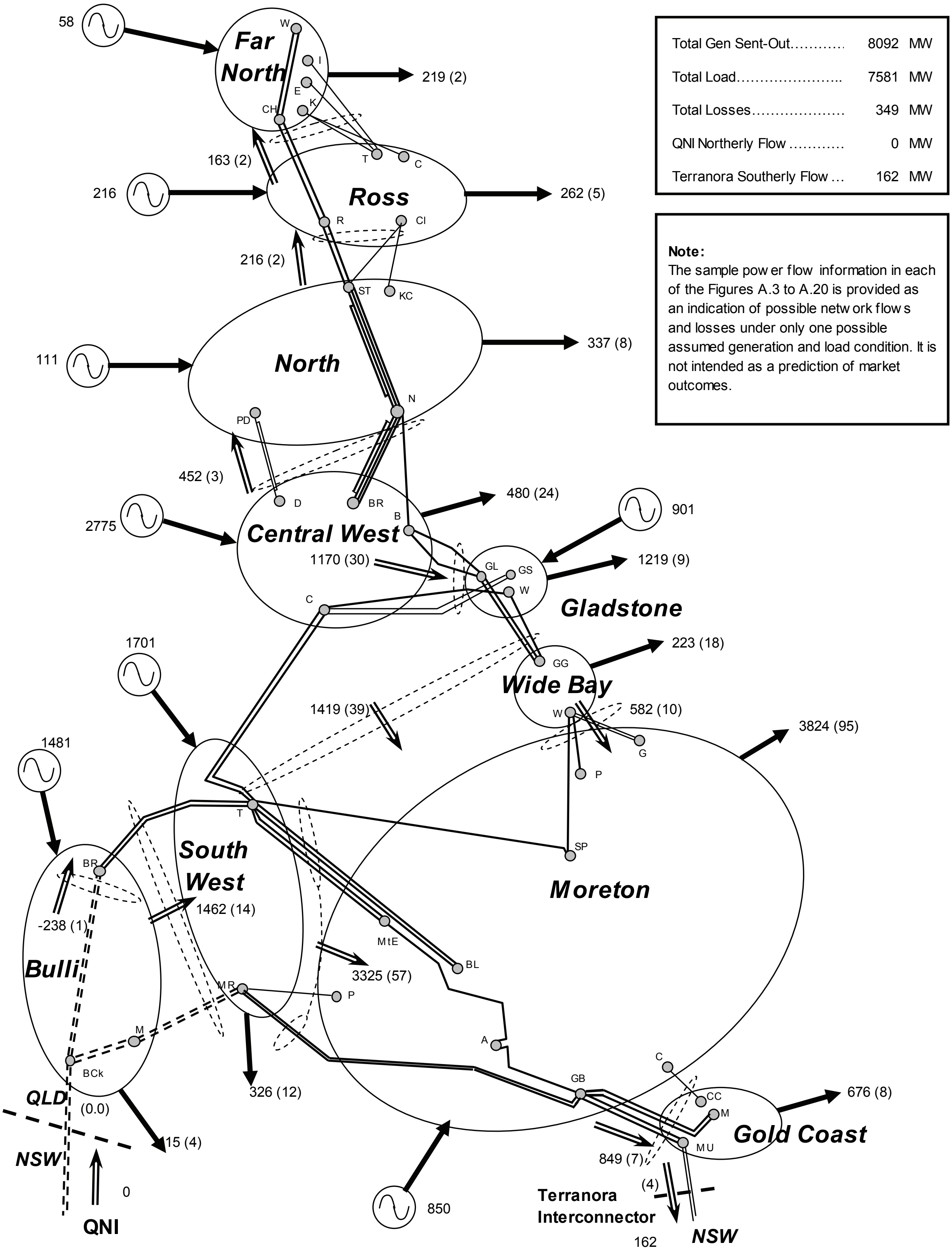
Figure A.6: Winter 2009 Qld Peak 300MW Northerly QNI Flow



Total Gen Sent-Out…………	7793	MW
Total Load…………………..	7581	MW
Total Losses………………	355	MW
QNI Northerly Flow …………	300	MW
Terranora Southerly Flow …	157	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

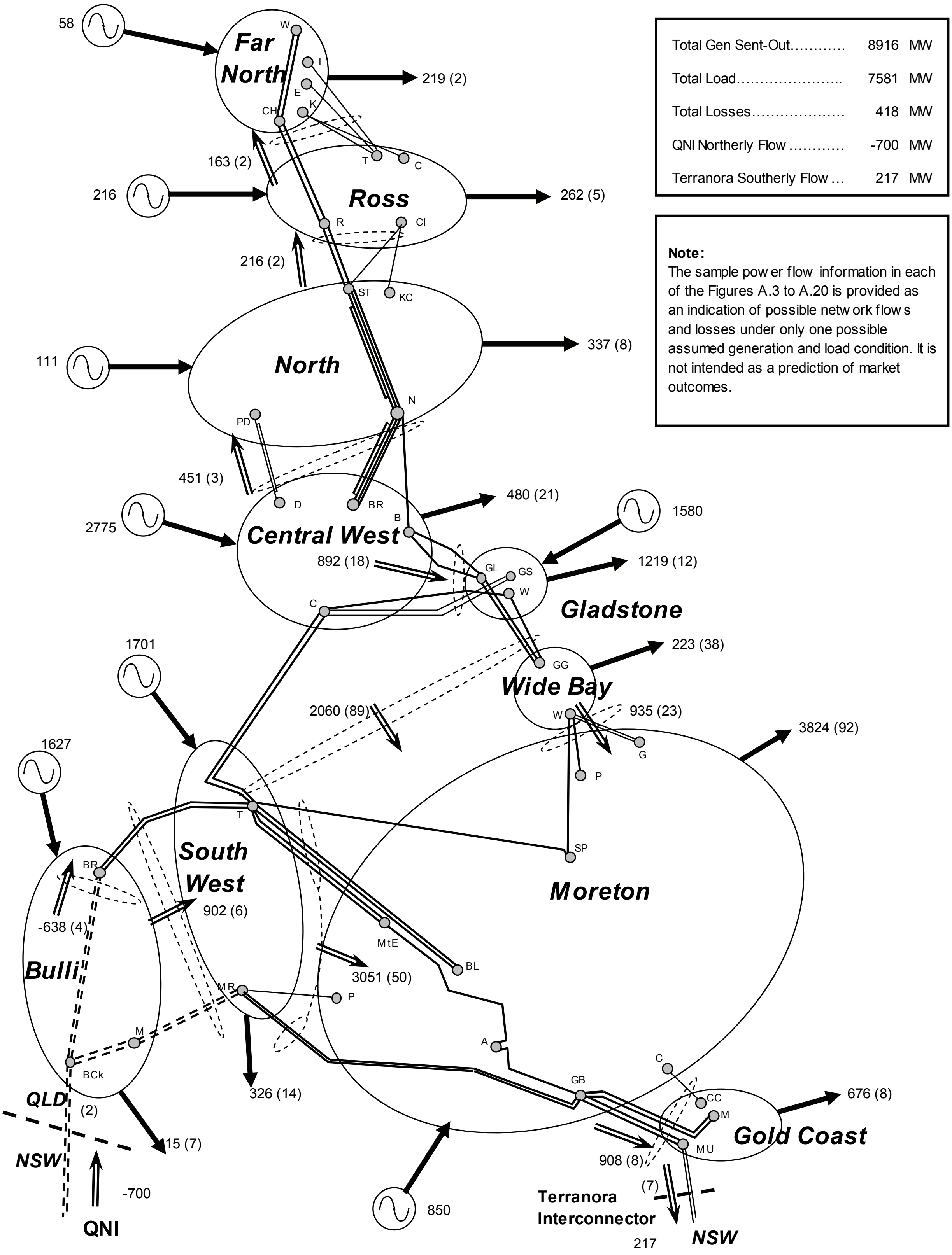
Figure A.7: Winter 2009 Qld Peak Zero QNI Flow



Total Gen Sent-Out............	8092	MW
Total Load........................	7581	MW
Total Losses.....................	349	MW
QNI Northerly Flow	0	MW
Terranora Southerly Flow ...	162	MW

Note:
The sample pow er flow information in each of the Figures A.3 to A.20 is provided as an indication of possible netw ork flow s and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

Figure A.8: Winter 2009 Qld Peak 700MW Southerly QNI Flow



Total Gen Sent-Out…………	8916	MW
Total Load…………………..	7581	MW
Total Losses………………..	418	MW
QNI Northerly Flow …………	-700	MW
Terranora Southerly Flow …	217	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

Figure A.9: Winter 2010 Qld Peak 300MW Northerly QNI Flow

Total Gen Sent-Out…………	8131	MW
Total Load…………………..	7876	MW
Total Losses………………..	394	MW
QNI Northerly Flow …………	300	MW
Terranora Southerly Flow …	161	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

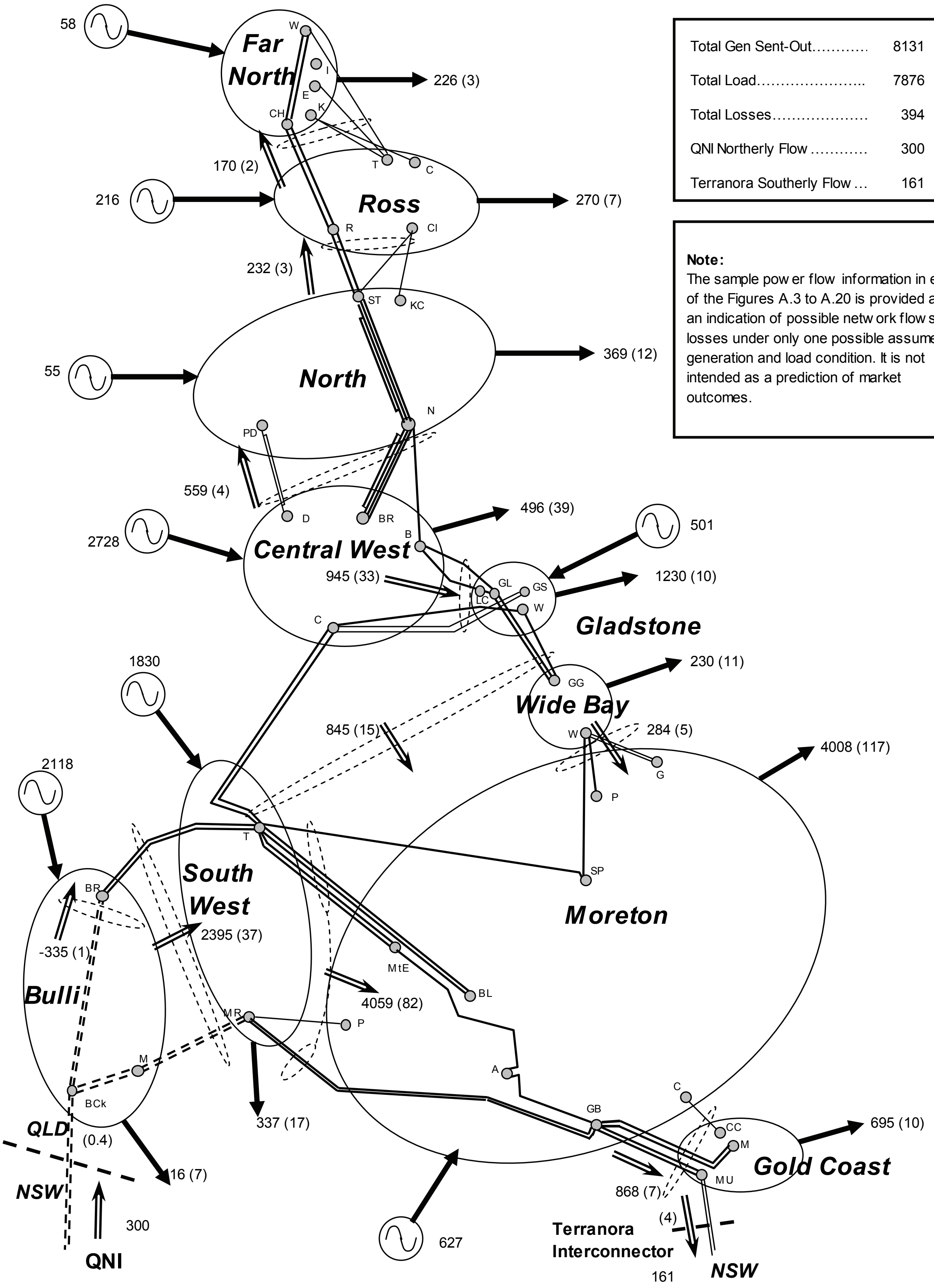
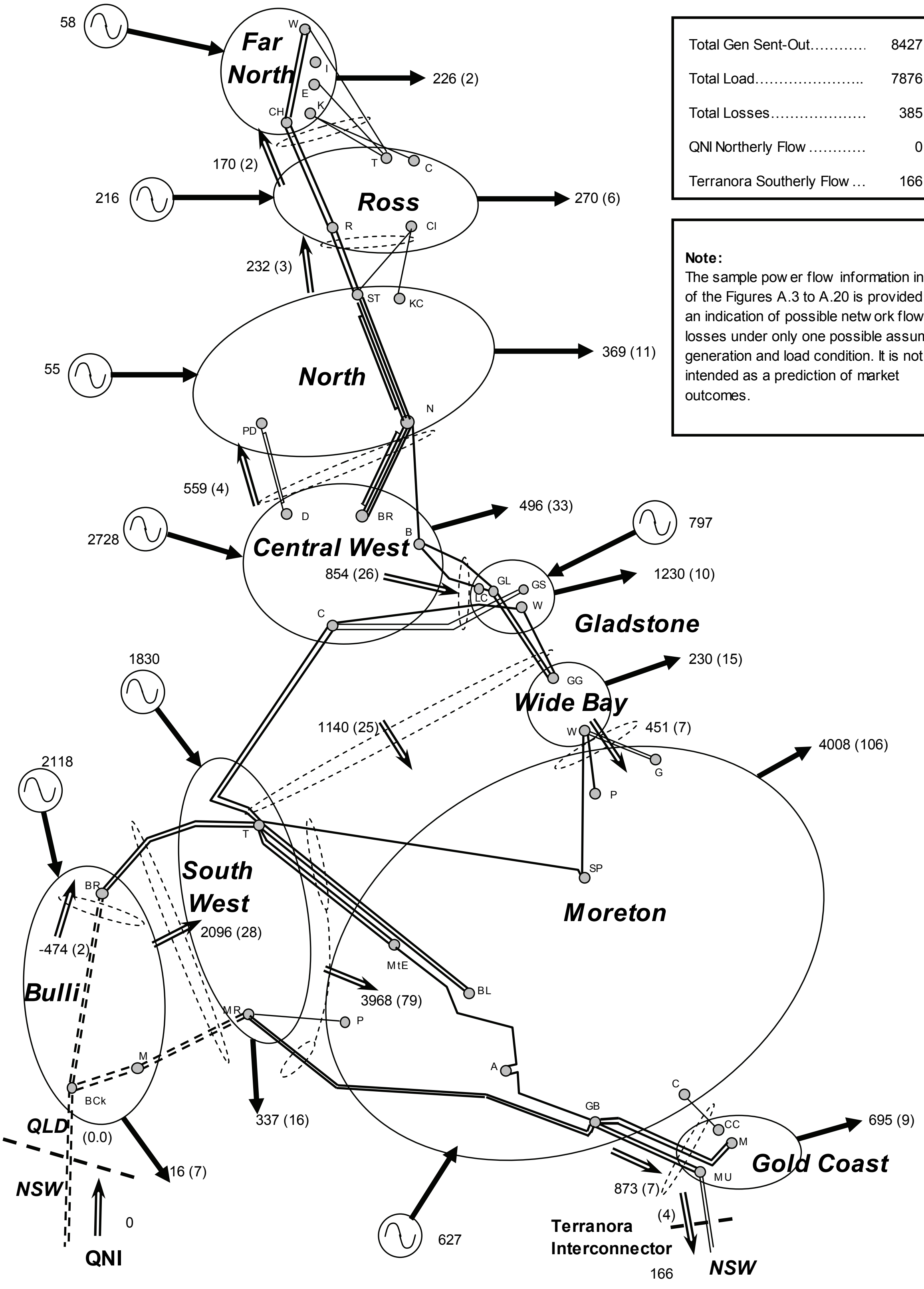


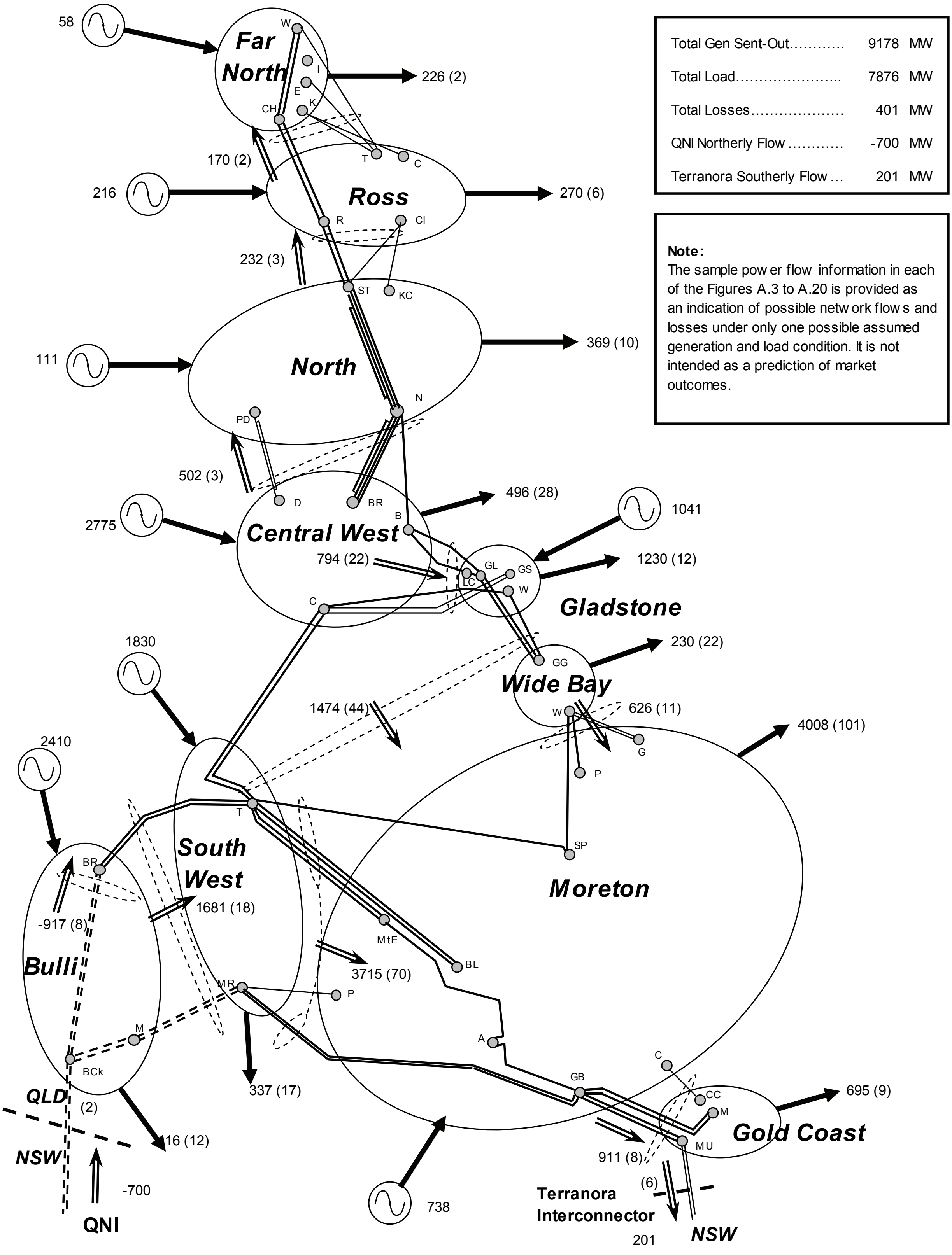
Figure A.10: Winter 2010 Qld Peak Zero QNI Flow



Total Gen Sent-Out…………	8427	MW
Total Load…………………..	7876	MW
Total Losses…………………	385	MW
QNI Northerly Flow …………	0	MW
Terranora Southerly Flow …	166	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

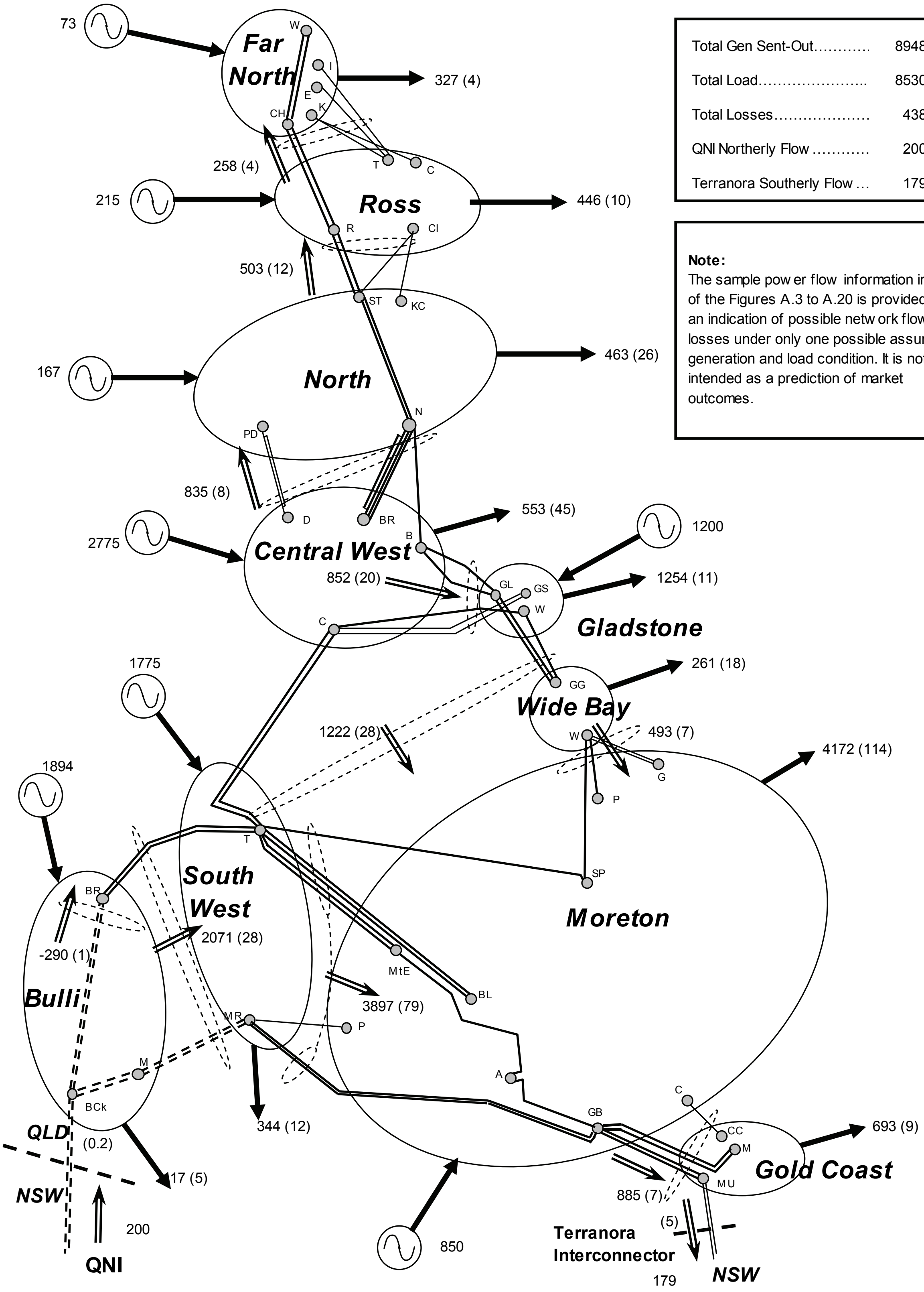
Figure A.11: Winter 2010 Qld Peak 700MW Southerly QNI Flow



Total Gen Sent-Out…………	9178	MW
Total Load…………………..	7876	MW
Total Losses………………..	401	MW
QNI Northerly Flow ………..	-700	MW
Terranora Southerly Flow …	201	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

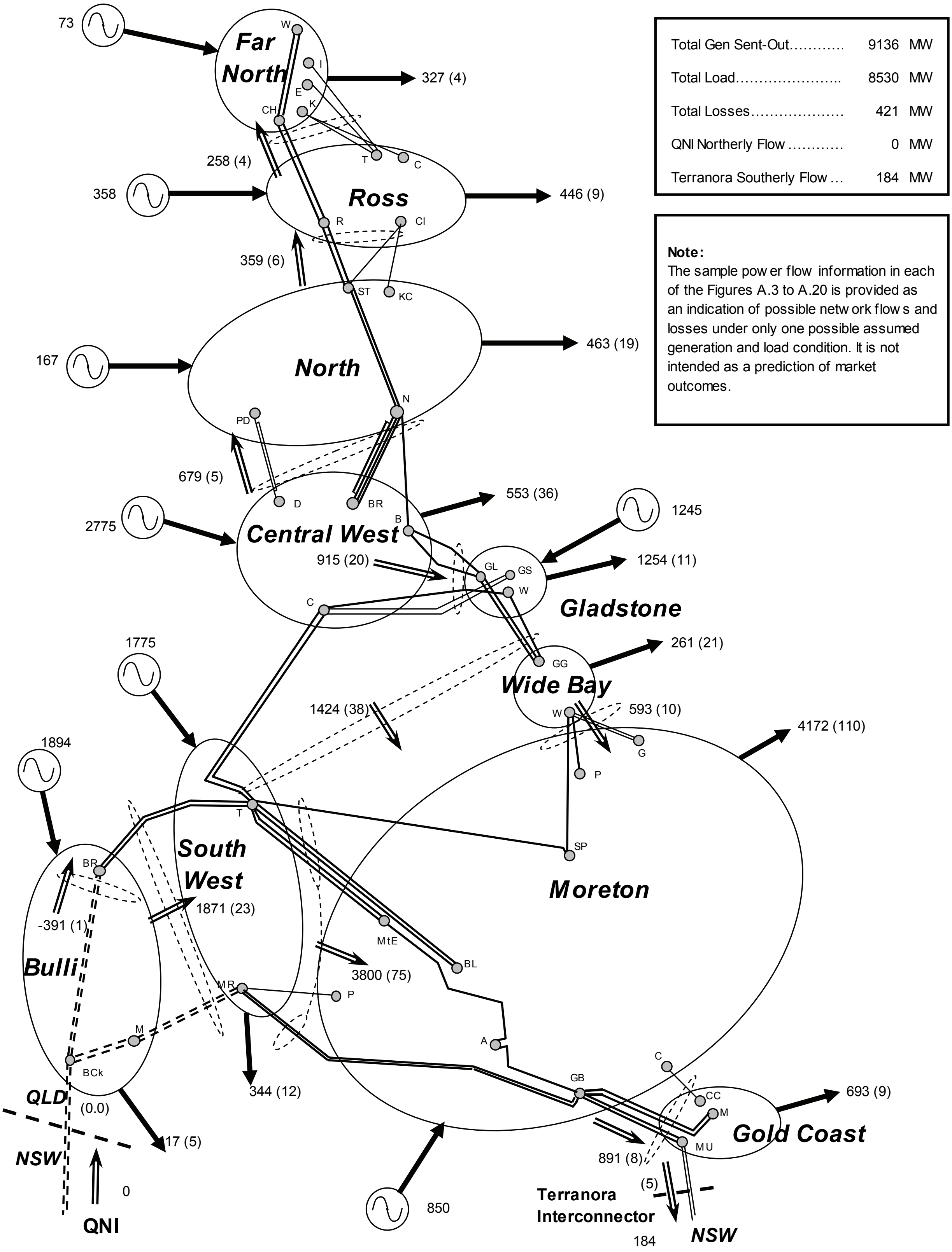
Figure A.12: Summer 2008/09 Qld Peak 200MW Northerly QNI Flow



Total Gen Sent-Out…………	8948	MW
Total Load…………………..	8530	MW
Total Losses………………	438	MW
QNI Northerly Flow …………	200	MW
Terranora Southerly Flow …	179	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

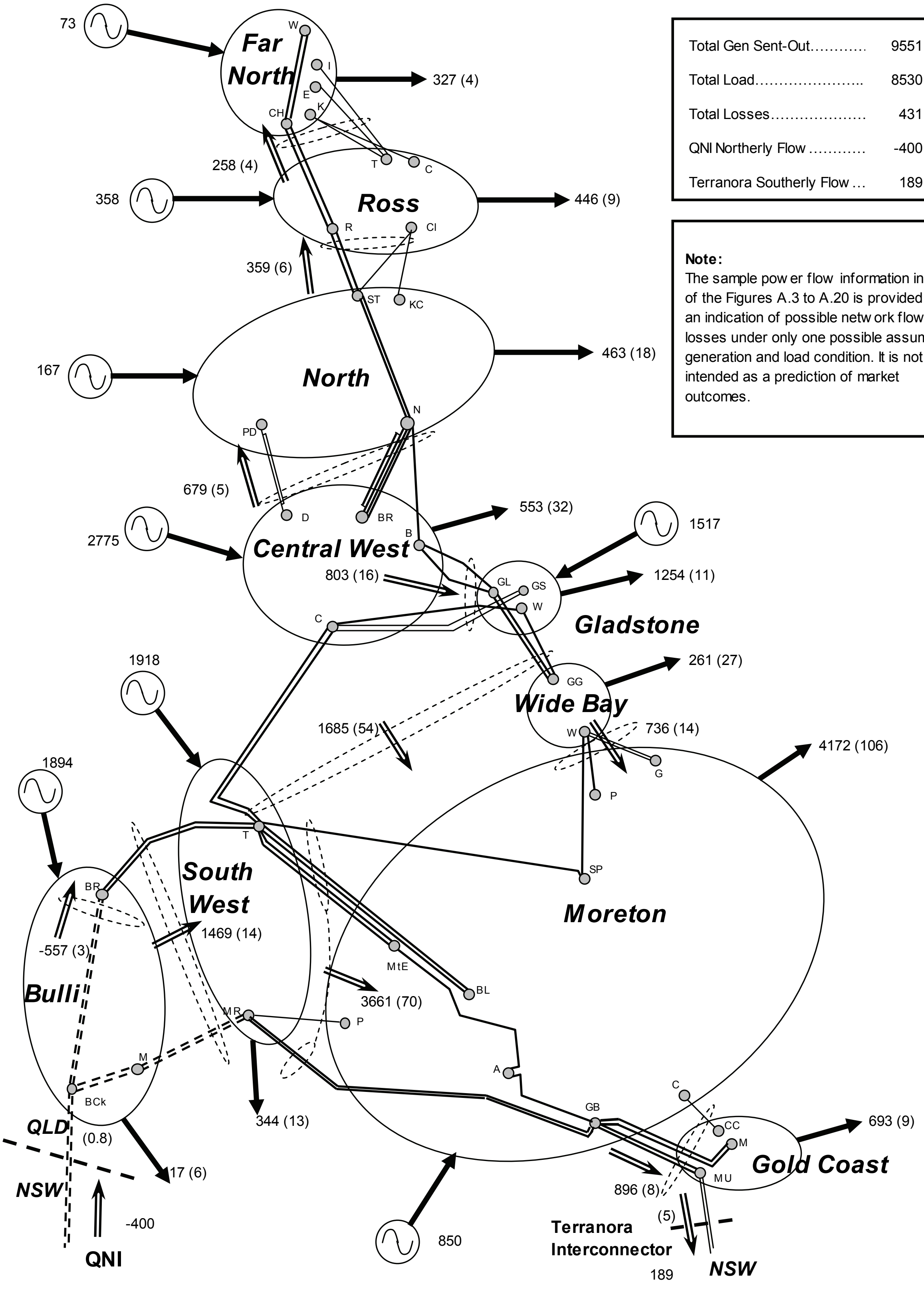
Figure A.13: Summer 2008/09 Qld Peak Zero QNI Flow



Total Gen Sent-Out…………	9136	MW
Total Load…………………..	8530	MW
Total Losses……………….	421	MW
QNI Northerly Flow …………	0	MW
Terranora Southerly Flow …	184	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

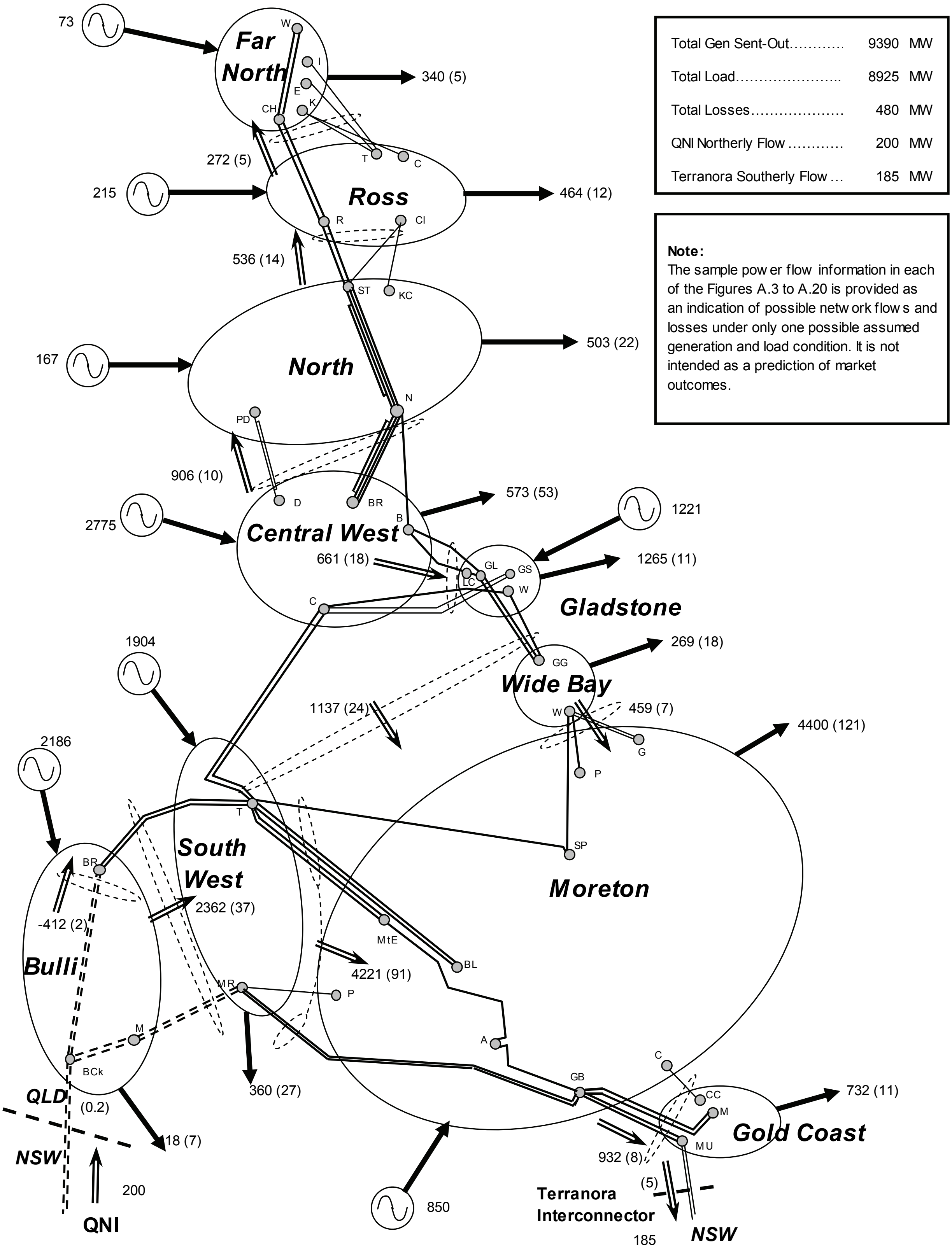
Figure A.14: Summer 2008/09 Qld Peak 400MW Southerly QNI Flow



Total Gen Sent-Out…………	9551	MW
Total Load…………………..	8530	MW
Total Losses………………	431	MW
QNI Northerly Flow …………	-400	MW
Terranora Southerly Flow …	189	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

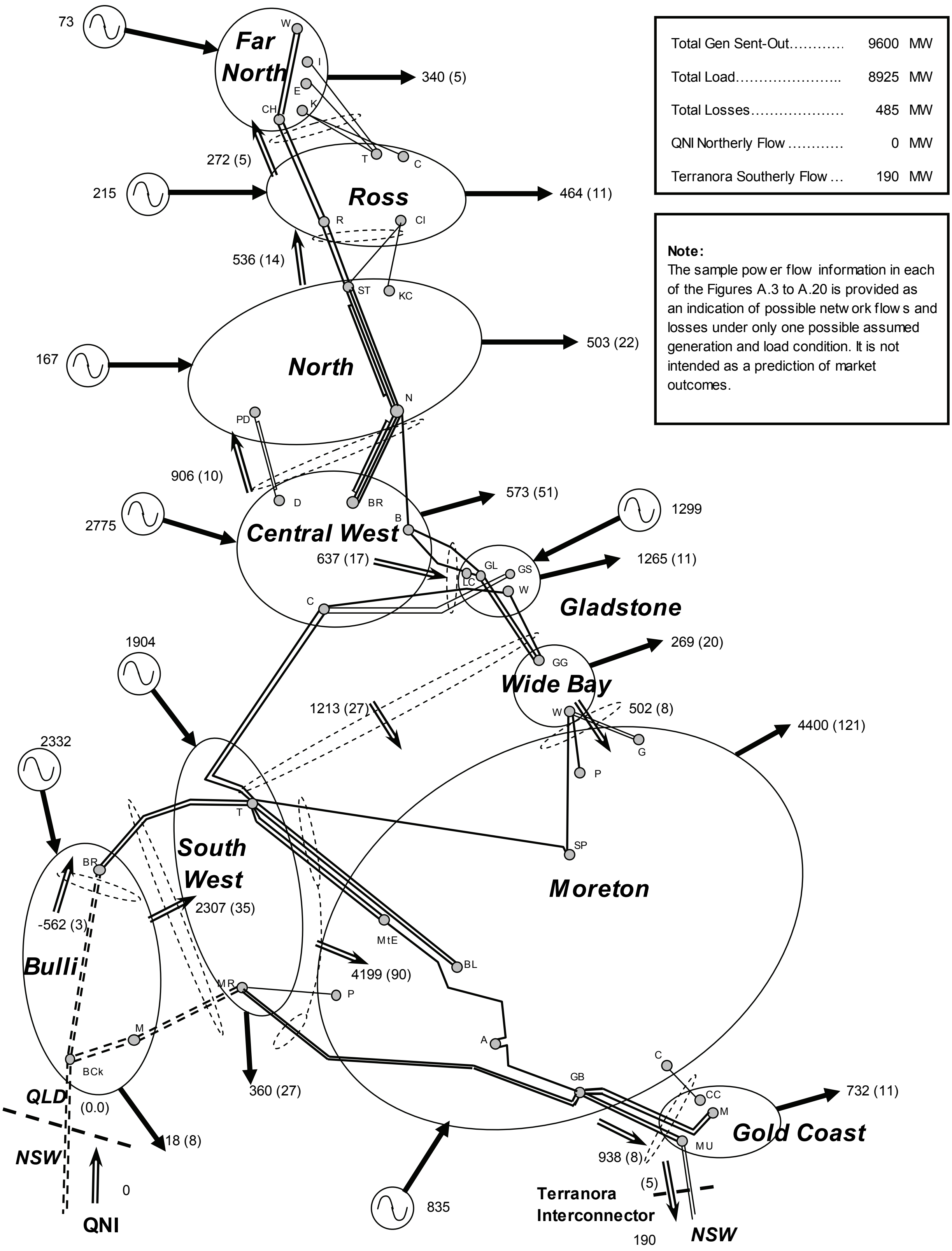
Figure A.15: Summer 2009/10 Qld Peak 200MW Northerly QNI Flow



Total Gen Sent-Out…………	9390	MW
Total Load…………………..	8925	MW
Total Losses………………	480	MW
QNI Northerly Flow …………	200	MW
Terranora Southerly Flow …	185	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

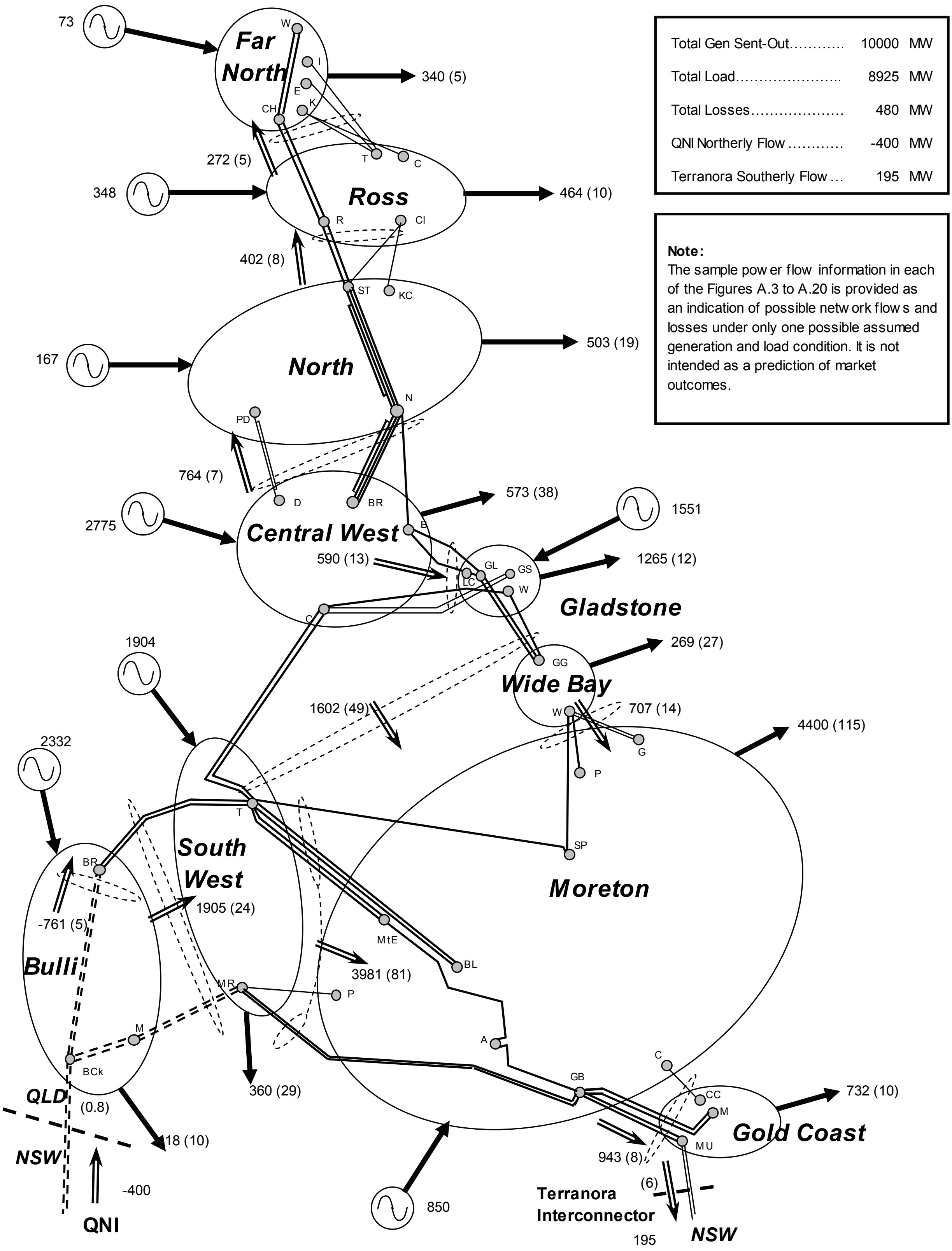
Figure A.16: Summer 2009/10 Qld Peak Zero QNI Flow



Total Gen Sent-Out…………	9600	MW
Total Load…………………..	8925	MW
Total Losses………………	485	MW
QNI Northerly Flow …………	0	MW
Terranora Southerly Flow …	190	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

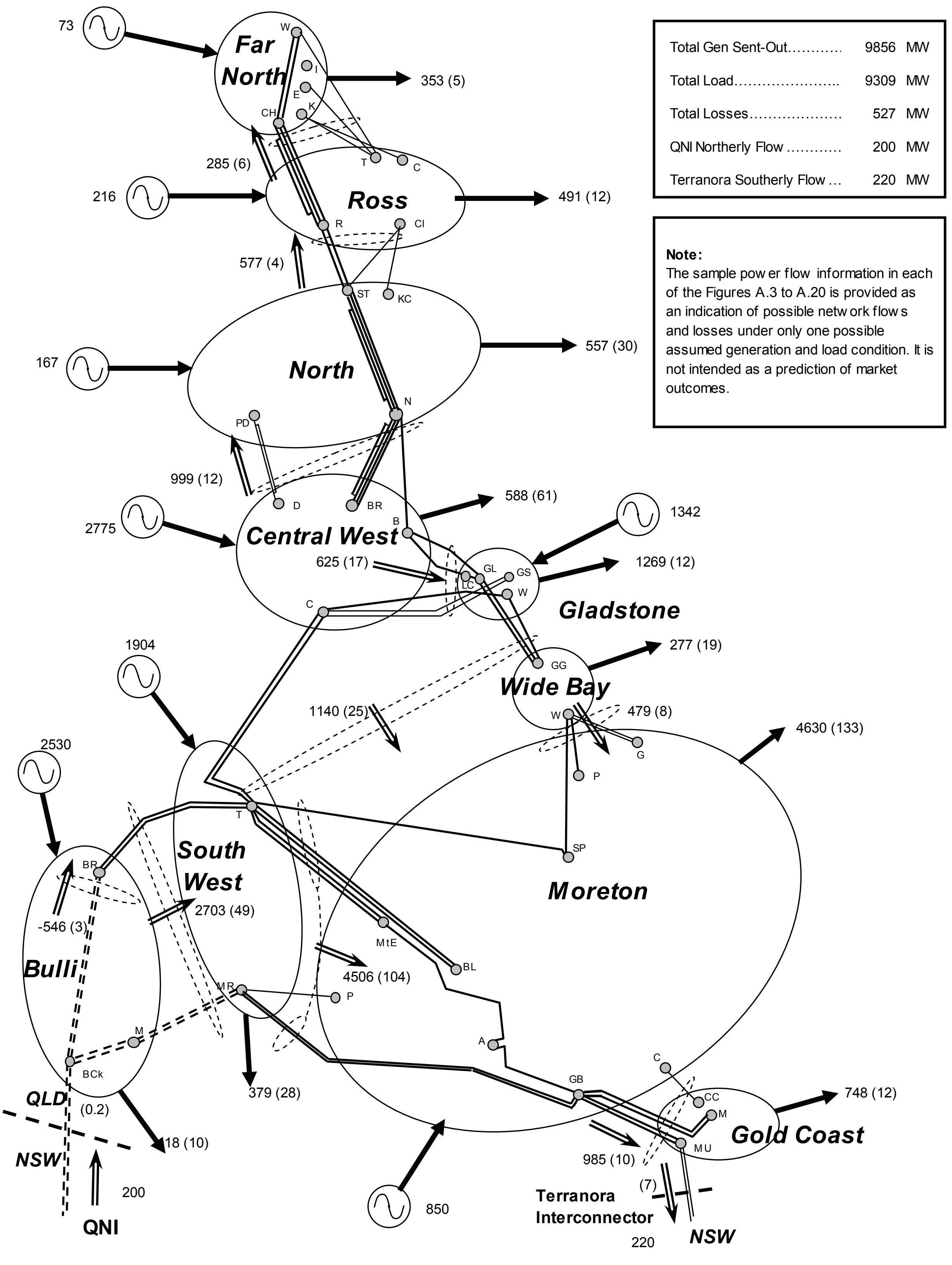
Figure A.17: Summer 2009/10 Qld Peak 400MW Southerly QNI Flow



Total Gen Sent-Out…………	10000	MW
Total Load…………………..	8925	MW
Total Losses………………	480	MW
QNI Northerly Flow …………	-400	MW
Terranora Southerly Flow …	195	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

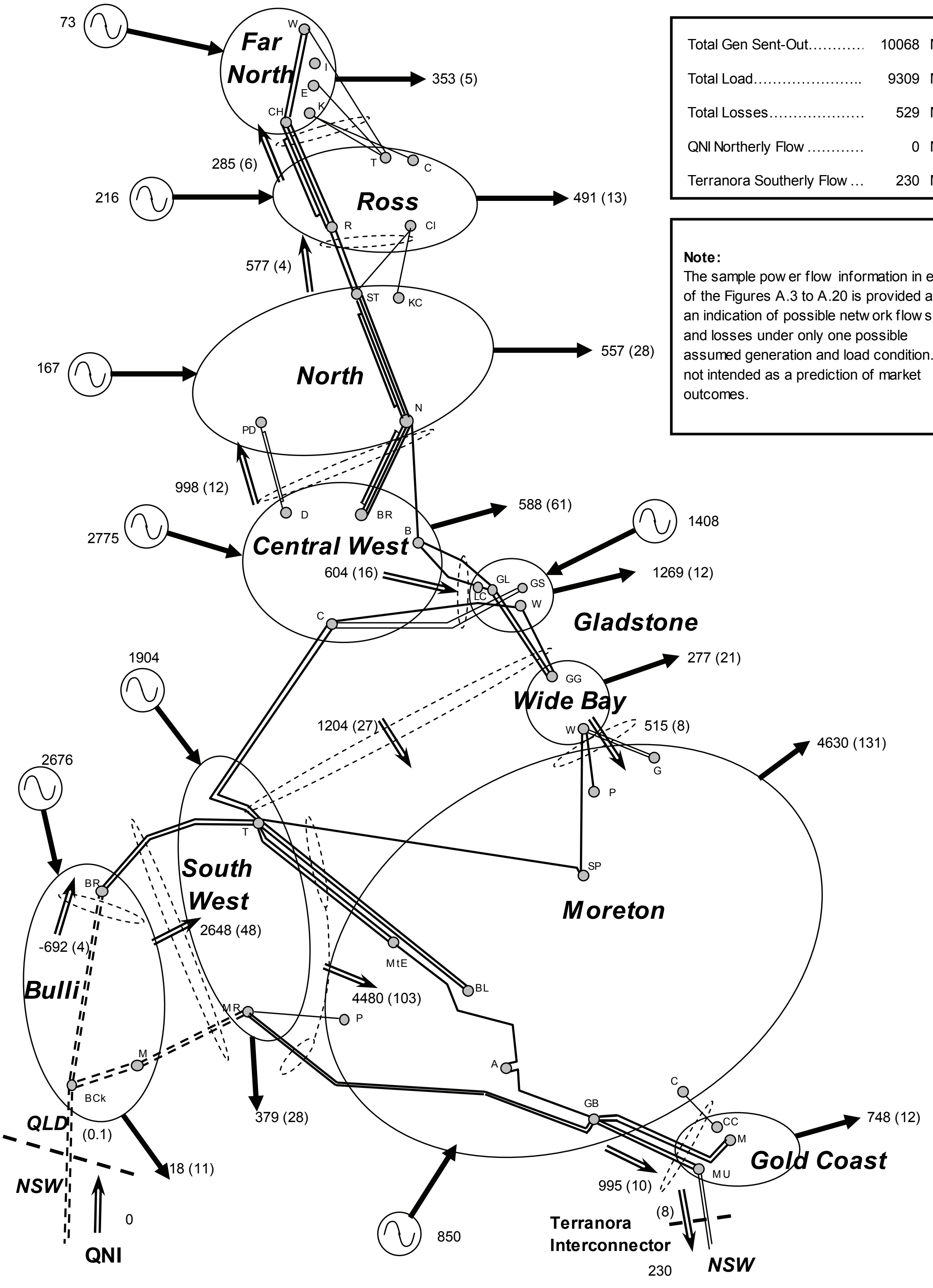
Figure A.18: Summer 2010/11 Qld Peak 200MW Northerly QNI Flow



Total Gen Sent-Out…………	9856	MW
Total Load…………………..	9309	MW
Total Losses……………….	527	MW
QNI Northerly Flow ………..	200	MW
Terranora Southerly Flow …	220	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

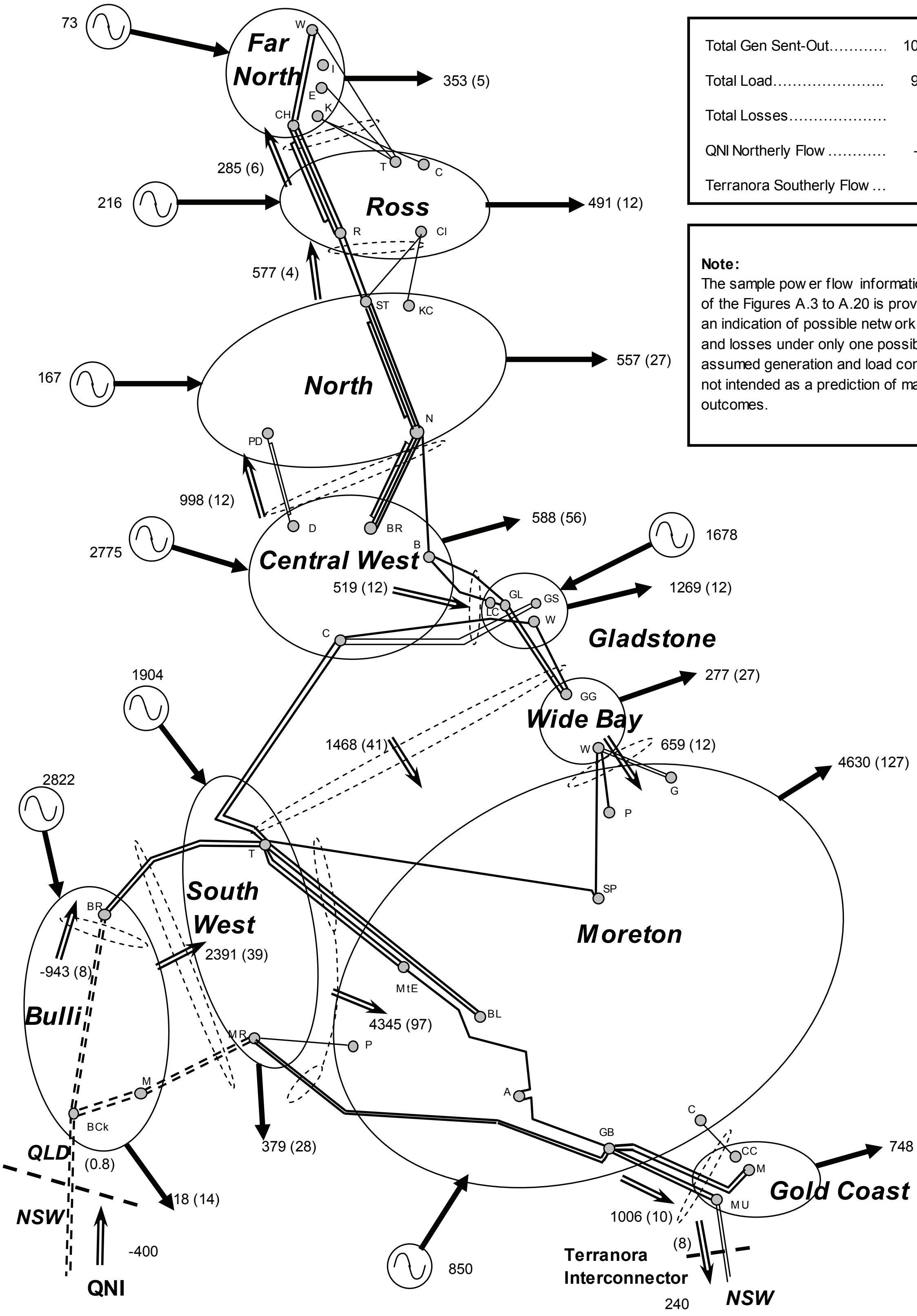
Figure A.19: Summer 2010/11 Qld Peak Zero QNI Flow



Total Gen Sent-Out…………	10068 MW
Total Load…………………..	9309 MW
Total Losses………………..	529 MW
QNI Northerly Flow …………	0 MW
Terranora Southerly Flow …	230 MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

Figure A.20: Summer 2010/11 Qld Peak 400MW Southerly QNI Flow



Total Gen Sent-Out…………	10485	MW
Total Load…………………..	9309	MW
Total Losses………………	535	MW
QNI Northerly Flow …………	-400	MW
Terranora Southerly Flow …	240	MW

Note:
The sample power flow information in each of the Figures A.3 to A.20 is provided as an indication of possible network flows and losses under only one possible assumed generation and load condition. It is not intended as a prediction of market outcomes.

APPENDIX B – LIMIT EQUATIONS

This appendix contains the Queensland intra-regional limit equations derived by Powerlink and valid at the time of publication. NEMMCO's market systems may also contain other limit equations for the Queensland region. These other equations are derived for thermal limits and are maintained by NEMMCO. The NEMMCO derived Gladstone thermal limit equation is included in this appendix as it is referred to in Section 5.4.3.

It should be noted that these equations are continually under review to take into account changing market and network conditions.

Please contact Powerlink to confirm the latest form of the relevant limit equation.

Table B.1: Far North Queensland Voltage Stability Equations

MEASURED VARIABLE	COEFFICIENT
Constant term (intercept)	-86
FNQ Demand Percentage (1) (2)	14.5545
Total MW generation at Barron Gorge, Kareeya and Koombooloomba PS	-0.5892
Total MW generation at Mt Stuart and Townsville PS	0.2392
Total MW generation at Collinsville and Mackay PS	0.1432
Total MVAr shunt capacitors within nominated north Queensland locations (3)	0.1179
Total MVAr shunt reactors within nominated north Queensland locations (4)	-0.1179

Notes:

(1)

$$\text{FNQ Demand Percentage} = \frac{\text{Far North Zone Demand}}{\text{North Queensland Demand}} \times 100$$

Far North Zone Demand (MW) = FNQ grid section transfer + Barron Gorge + Kareeya + Koombooloomba PS

North Queensland Demand (MW) = CQ-NQ grid section transfer + Barron Gorge + Kareeya + Koombooloomba + Townsville + Mt Stuart + Collinsville + Invicta + Mackay PS

(2) The FNQ Demand Percentage is bounded between a lower value of 22 and an upper value of 31.

(3) The shunt capacitor bank locations, sizes and quantities comprise of the following:

Chalumbin 132kV:	1 x 50MVAr
Ross 132kV:	1 x 50MVAr
Townsville South 132kV:	2 x 50MVAr
Townsville South 66kV:	2 x 20MVAr
Dan Gleeson 66kV:	2 x 24MVAr
Garbutt 66kV:	2 x 15MVAr
Clare 132kV:	1 x 20MVAr

(4) The shunt reactor bank locations, sizes and quantities comprise of the following:

Chalumbin 275kV:	2 x 29.4MVAr
Chalumbin 19.1kV:	2 x 20.2MVAr
Ross 275kV:	2 x 29.4MVAr
Ross 19.1kV:	2 x 20.2MVAr

Table B.2: Central to North Queensland Stability Equations

MEASURED VARIABLE	COEFFICIENT (1)	
	FEEDER TRIP	GT TRIP
Constant term (intercept)	960	1090
Highest MW output of north Queensland gas turbine (2)	1	-1
Total MW generation at Collinsville 132kV PS	0.5	-
Reactive MVAr output of Ross SVC	-	-0.5
Number of 120MVAr capacitor banks online at Nebo [0 to 2]	-	50
Number reactors online at Nebo [0 to 3]	-	-8
Equation Upper Limit	1060	1060

Notes:

(1) Previous constraint equations were invoked based on the status of a GT with only one of the equations was active at any time. The present implementation with both equations running concurrently is consistent with other cutsets.

(2) North Queensland gas turbine refers to any of the Townsville or Mt Stuart gas turbine units. The combined cycle arrangement at Townsville PS means that both the 132kV and 66kV components can trip as a single contingency.

Table B.3: Prediction of Post Contingent MVA Flow on the Calvale to Wurdong Circuit

MEASURED VARIABLE	COEFFICIENT
System normal flow on Calvale to Wurdong (MVA)	1
System normal flow on Calvale to Stanwell (MW)	0.6520

Table B.4: Central to South Queensland Voltage Stability Equations

MEASURED VARIABLE	COEFFICIENT	
	EQUATION 1 (1) CALVALE-TARONG CONTINGENCY	EQUATION 2 (2) CALVALE-TARONG CONTINGENCY
Constant Term (intercept)	1227	1217
Total generation at Gladstone 275kV PS	0.0731	0.0812
Number of Gladstone 275kV units online [0 to 4]	72.2846	70.3649
Total generation at Gladstone 132kV PS	0.1062	0.1152
Number of Gladstone 132kV units online [0 to 2]	75.8105	73.3362
Number of Callide B units online [0 to 2]	47.7783	54.0629
Number of Callide C units online [0 to 2]	74.2664	86.2947
(Calvale 275kV p.u. voltage - 1.07) x 1000	1.1843	0.8860
(Gladstone 275kV p.u. voltage - 1.07) x 1000	-1.5421	-1.5181
Equation Lower Limit	1750	1750
Equation Upper Limit	1900	1900

Notes:

(1) Equation 1 preserves the required MVAr margin at Gladstone 275kV.

(2) Equation 2 preserves the required MVAr margin at Calvale 275kV.

Table B.5: Tarong Voltage Stability Equations

MEASURED VARIABLE	COEFFICIENT (1)			
	EQUATION 1	EQUATION 2	EQUATION 3	EQUATION 4
	CALVALE-TARONG CONTINGENCY	SWANBANK E CONTINGENCY (2)	WIVENHOE CONTINGENCY (3)	TARONG-BLACKWALL CONTINGENCY (4)
Constant term (intercept)	498	1077	982	888
Total MW generation at Callide B and Callide C PS	0.0939	0.0990	0.0951	0.1007
Total MW generation at Gladstone 275kV and Gladstone 132kV PS	-	-0.0213	-0.0127	-0.0185
Total MW generation at Tarong, Tarong North, Roma, Kogan Creek, Braemar, Oakey, Millmerran PS plus QNI MW transfer (5)	0.7739	0.5756	0.6004	0.5693
Total MW generation at Wivenhoe, Swanbank B and Swanbank E	-0.1720	-	-	-0.3244
Generation MW at Swanbank E PS	-	-0.4570	-	-
Total MW generation at Wivenhoe and Swanbank B PS	-	-0.3469	-	-
Generation MW from highest generating Wivenhoe unit	-	-	-0.4993	-
Total MW generation at Wivenhoe, Swanbank B and Swanbank E PS minus generation MW from highest generating Wivenhoe unit	-	-	-0.2845	-
Active power transfer MW across Terranora Interconnector (5)	-0.1348	-0.1975	-0.1994	-0.2039
Reactive power transfer MVAr across Terranora Interconnector (5)	-	0.2172	0.2037	0.2228
Number of Tarong units online [0 to 4]	-	4.7324	4.0563	4.0200
Number of Tarong North units online [0 to 1]	-	16.4501	18.5456	44.1412
Number of Wivenhoe units online [0 to 2]	19.4105	39.8357	26.9525	37.7149
Number of Swanbank B units online [0 to 4]	5.2373	14.2983	11.5502	14.4350
Number of Swanbank E units online [0 to 1]	14.5525	-	42.7529	56.9197
Number of 200MVAr capacitor banks available within South East Queensland (6)	14.8916	45.6777	39.3116	41.3225
Number of 120MVAr capacitor banks available within South East and part of South West Queensland (7)	12.8756	26.9327	24.6652	26.5708
Number of 50MVAr capacitor banks available within South East and part of South West Queensland (8)	4.9721	12.2710	11.3513	12.0073
Equation Lower Limit	3200	3200	3400	3240

Notes:

(1) Equations are offset by -100MW when the Middle Ridge to Abermain 110kV loop is run closed.
(2) This limit is only applicable if Swanbank E unit is generating.
(3) This limit is only applicable if either of the Wivenhoe units is generating.
(4) The intercept and equation lower limit includes a -160MW offset to account for the possible loss of Millmerran to Middle Ridge 330kV. This offset will be removed upon commissioning of the second Middle Ridge 330/275kV transformer.
(5) Positive transfer denotes northerly flow.
(6) There are currently 2 capacitor banks sized 200MVar which may be available within this area.
(7) There are currently 12 capacitor banks sized 120MVar which may be available within this area.
(8) There are currently 35 capacitor banks sized 50MVAr which may be available within this area.

Table B.6: Gold Coast Voltage Stability Equation

MEASURED VARIABLE	COEFFICIENT
Constant term (intercept)	1301
Moreton to Gold Coast Demand Ratio (1) (2)	-137.50
Number of Wivenhoe units online [0 to 2]	17.7695
Number of Swanbank B units online [0 to 4]	8.5650
Number of Swanbank E units online [0 to 1]	-20.0000
Active power transfer MW across Terranora Interconnector (3)	-0.9029
Reactive power transfer MVAr across Terranora Interconnector (3)	0.1126
Number of 200MVAr capacitor banks available within South East Queensland (4)	14.3339
Number of 120MVAr capacitor banks available within South East Queensland (5)	10.3989
Number of 50MVAr capacitor banks available within South East Queensland (6)	4.9412

Notes:

(1) $$\text{Moreton to Gold Coast Demand Ratio} = \frac{\text{Moreton Zone Demand}}{\text{Gold Coast Zone Demand}}$$

(2) The Moreton to Gold Coast Demand Ratio is bounded between a lower value of 4.7 and an upper value of 6.0.

(3) Positive transfer denotes northerly flow.

(4) There are currently 2 capacitor banks sized 200MVAr which may be available within this area.

(5) There are currently 11 capacitor banks sized 120MVAr which may be available within this area.

(6) There are currently 33 capacitor banks sized 50MVAr which may be available within this area.

Table B.7: Braemar Thermal and Voltage Stability Equation

MEASURED VARIABLE	COEFFICIENT
Constant Term (intercept)	1125
Offset [applied depending on the unavailability of southern Queensland capacitive support including generator lagging capability and 275kV and 110kV capacitor banks]	-100

APPENDIX C – ESTIMATED MAXIMUM SHORT CIRCUIT LEVELS

Tables C.1 to C.3 show estimates of the three phase and single phase to earth short circuit levels in the Powerlink transmission network in the period 2008 to 2010. They also show the short circuit interruption capacity of the lowest rated circuit breaker(s) at each location.

This information should be taken only as an approximate guide to conditions at each location. The effects of some of the more significant embedded non-scheduled generators are included as noted in the tables. However, other embedded non-scheduled generators have been excluded. Some of these excluded generators are also noted in the tables. As a result, fault levels may be higher at some locations than shown. Interested parties needing to consider the effects of their proposals on system short circuit levels should consult Powerlink and/or the relevant Distribution Network Service Provider (DNSP) for detailed information.

The short circuit level calculations were determined:

- Using a simple system model, in which generators are represented as a voltage source of 110% of nominal voltage behind sub-transient reactance; and
- With system loads and all shunt admittances not represented.

The short circuit levels shown in Tables C.1 to C.3 have been determined on the basis of the generation capacity shown in Table 6.1 (together with any noted embedded non-scheduled generators) and on the network development as at the end of each calendar year. These network models are based on the existing network configuration, committed projects and proposed new network assets (as proposed in Chapter 5).

The fault levels determined assume the grid is in its ‘normal’ or ‘intact’ state, that is, all network elements in service. At some locations where the short circuit level appears to be above the switchgear rating, either the critical switchgear is required to interrupt only a portion of the total fault current and that portion is less than the switchgear rating over the three year outlook period, or operational measures are taken to ensure that short circuit levels are within the switchgear rating.

No account has been taken of short circuit interruption capability of switchgear in the distribution systems.

Table C.1: Estimated Maximum Short Circuit Levels - Northern Queensland - Powerlink Transmission Network 2008 to 2010

SUBSTATION	VOLTAGE kV	CB FAULT RATING (LOWEST kA)	FAULT LEVELS					
			2008		2009		2010	
			3 PHASE kA	L - G kA	3 PHASE kA	L - G kA	3 PHASE kA	L - G kA
Alan Sherriff	132	40.0	10.6	11.6	11.6	12.4	12.0	12.7
Alligator Creek	132	31.5	4.2	4.9	4.2	5.5	4.2	5.6
Bollingbroke	132	40.0	-	-	2.1	1.6	2.1	1.6
Burton Downs	132	19.3	4.9	4.6	4.9	4.7	5.0	4.7
Cairns	132	12.1	4.6	6.3	5.3	7.2	5.0	6.8
Cardwell	132	19.3	2.6	2.1	2.9	2.3	2.7	1.9
Chalumbin	275	21.9	3.5	3.7	3.6	3.8	3.5	3.8
Chalumbin	132	31.5	6.3	7.3	6.5	7.5	6.0	7.0
Clare	132	8.8	7.2	6.9	7.5	7.7	7.5	7.7
Collinsville	132	15.3	12.0	14.1	12.2	14.3	12.3	14.4
Coppabella	132	31.5	2.9	3.3	3.0	3.3	3.0	3.3
Dan Gleeson	132	40.0	10.1	11.1	11.1	11.9	11.4	12.2
Edmonton	132	40.0	4.4	5.6	4.7	5.9	4.5	5.7
El Arish	132	40.0	2.4	3.0	3.3	3.9	3.0	3.7
Garbutt	132	NO CB	9.0	9.4	9.7	10.0	10.0	10.1
Ingham South	132	40.0	2.6	2.9	2.7	2.9	3.7	3.4
Innisfail	132	40.0	2.2	2.8	2.9	3.5	2.7	3.3
Invicta	132	19.3	4.9	4.5	5.1	4.6	5.1	4.6
Kamerunga	132	15.3	3.7	4.5	4.0	4.9	3.9	4.8
Kareeya	132	10.9	6.3	7.3	6.5	7.4	5.9	6.9
Kemmis	132	40.0	5.4	6.1	5.5	6.1	5.5	6.1
King Creek	132	40.0	4.8	3.9	4.9	4.0	4.9	4.0
Mackay	132	15.7	5.9	6.4	5.9	6.5	6.0	6.5
Mindi	132	40.0	4.8	4.1	4.8	4.1	4.9	4.1
Moranbah	132	15.3	6.6	7.6	6.7	7.7	6.7	7.9
Moranbah South	132	40.0	5.0	4.6	5.0	4.6	5.0	4.7
MT McLaren	132	31.5	1.9	2.1	1.9	2.1	1.9	2.1
Nebo	275	31.5	8.9	9.2	9.0	9.3	9.4	9.7
Nebo	132	21.9	11.3	12.7	11.4	12.7	11.7	13.0
Newlands	132	31.5	3.1	3.1	3.1	3.1	3.1	3.1
North Goonyella	132	19.3	3.3	2.6	3.3	2.6	3.3	2.6
Oonooie	132	31.5	2.9	3.4	3.0	3.5	3.0	3.5
Peak Downs	132	40.0	4.8	4.1	4.8	4.1	4.8	4.1
Pioneer Valley	132	40.0	6.2	6.6	6.2	6.7	6.3	6.8
Proserpine	132	21.9	3.5	3.7	3.5	3.7	3.5	3.7

Table C.1: Estimated Maximum Short Circuit Levels - Northern Queensland - Powerlink Transmission Network 2008 to 2010 (Cont'd)

SUBSTATION	VOLTAGE kV	CB FAULT RATING (LOWEST kA)	FAULT LEVELS					
			2008		2009		2010	
			3 PHASE kA	L - G kA	3 PHASE kA	L - G kA	3 PHASE kA	L - G kA
Ross	275	31.5	6.0	7.0	6.4	7.3	7.6	8.4
Ross	132	31.5	13.2	15.7	14.9	17.4	15.9	18.3
Stony Creek	132	40.0	3.6	3.4	3.6	3.4	3.6	3.4
Strathmore	275	50.0	7.6	7.9	7.7	8.0	8.5	8.7
Strathmore	132	40.0	11.5	12.4	11.6	12.5	11.8	12.7
Townsville East	132	40.0	10.2	10.3	11.6	11.4	12.0	11.6
Townsville South	132	21.9	12.9	16.0	15.2	18.8	15.8	19.4
Townsville GT PS	132	31.5	9.4	10.2	10.0	10.7	9.6	10.3
Tully	132	31.5	3.1	3.6	4.3	4.4	3.8	4.0
Turkinje	132	15.7	2.6	3.0	2.7	3.0	2.6	3.0
Wandoo	132	40.0	4.2	2.9	4.2	2.9	4.2	3.0
Woree	275	50.0	2.3	2.8	2.4	2.9	2.4	2.8
Woree	132	40.0	4.6	6.4	5.3	7.3	5.1	7.0
Yabulu South	132	40.0	10.1	10.0	11.0	10.6	11.0	10.8

Table C.2: Estimated Maximum Short Circuit Levels - Central Queensland - Powerlink Transmission Network 2008 to 2010

SUBSTATION	VOLTAGE kV	CB FAULT RATING (LOWEST kA)	FAULT LEVELS					
			2008		2009		2010	
			3 PHASE kA	L - G kA	3 PHASE kA	L - G kA	3 PHASE kA	L - G kA
Baralaba	132	15.3	4.6	3.7	4.6	3.7	4.6	3.7
Biloela	132	40.0	7.4	7.6	7.4	7.6	7.4	7.6
Blackwater	132	12.3	5.5	6.4	5.5	6.4	5.5	6.4
Bouldercombe	275	31.5	16.5	16.4	16.6	16.5	17.0	16.8
Bouldercombe	132	25.0	9.0	10.7	9.0	10.7	9.1	10.8
Broadsound	275	31.5	10.3	8.1	10.4	8.1	10.7	8.2
Callemondah	132	31.5	20.8	21.2	20.9	21.1	21.2	21.4
Callide A Power Station	132	12.3	10.3	11.2	10.3	11.2	10.4	11.2
Calvale	275	31.5	19.9	22.4	20.0	22.4	20.1	22.5
Calvale	132	NO CB	10.3	11.2	10.3	11.2	10.4	11.2
Dingo	132	31.5	2.6	2.8	2.6	2.8	2.6	2.8
Dysart	132	19.9	4.3	4.9	4.3	4.9	4.4	4.9
Egans Hill	132	NO CB	6.1	6.4	6.1	6.4	6.1	6.4
Gladstone	275	31.5	19.6	22.1	19.6	22.4	20.7	23.5
Gladstone (1)	132	31.5	26.5	32.4	26.5	32.2	27.0	32.7
Gladstone South	132	40.0	17.4	17.6	17.5	17.7	17.7	17.8
Grantleigh	132	31.5	2.4	2.5	2.4	2.5	2.4	2.5
Gregory	132	31.5	8.4	9.7	8.4	9.7	8.5	9.7
Larcom Creek	275	40.0	-	-	14.6	14.7	15.9	15.8
Larcom Creek	132	NO CB	-	-	10.0	11.4	12.3	13.7
Lilyvale	275	40.0	5.3	5.3	5.4	5.4	5.4	5.4
Lilyvale	132	25.0	8.8	10.4	8.8	10.4	8.9	10.5
Moura	132	12.3	3.9	4.2	3.9	4.2	3.9	4.2
Norwich Park	132	40.0	3.4	2.5	3.4	2.5	3.4	2.5
Pandoin	132	40.0	-	-	5.0	5.0	5.0	5.0
Rockhampton	132	12.3	6.1	6.6	6.2	6.6	6.2	6.6
Rocklands	132	40.0	5.8	5.3	5.8	5.3	5.8	5.3
Stanwell Switchyard	275	31.5	17.9	19.6	18.0	19.7	18.4	20.0
Stanwell Switchyard	132	31.5	4.7	4.4	4.7	4.4	4.7	4.4
Wurdong	275	31.5	15.7	15.0	15.7	15.1	16.2	15.4
Yarwun	132	40.0	-	-	9.6	10.2	12.9	14.7

Note:

(1) The lowest rated circuit breaker(s) at these locations are required to interrupt short circuit current which is less than the maximum fault current and below the circuit breaker rating.

Table C.3: Estimated Maximum Short Circuit Levels – Southern Queensland - Powerlink Transmission Network 2008 to 2010

SUBSTATION	VOLTAGE kV	CB FAULT RATING (LOWEST kA)	FAULT LEVELS					
			2008		2009		2010	
			3 PHASE kA	L - G kA	3 PHASE kA	L - G kA	3 PHASE kA	L - G kA
Abermain	275	40.0	16.3	16.0	16.5	16.2	16.6	16.2
Abermain	110	31.5	21.2	23.3	21.2	23.5	21.3	23.7
Algester	110	40.0	21.1	20.4	21.3	20.5	21.5	20.6
Ashgrove West	110	25.0	20.0	18.6	19.0	17.9	19.0	18.5
Belmont	275	31.5	17.0	18.3	17.3	18.5	17.3	18.6
Belmont (1) (2)	110	25.0	28.7	34.5	29.6	35.9	30.1	36.9
Blackwall	275	50.0	23.5	25.5	24.0	26.0	24.1	26.0
Braemar	330	50.0	16.4	16.9	20.2	21.3	23.6	25.2
Braemar	275	40.0	21.4	22.9	28.0	31.0	34.9	39.3
Bulli Creek	330	50.0	16.1	13.0	17.5	13.6	18.4	14.0
Bulli Creek	132	40.0	3.7	4.1	3.7	4.2	3.7	4.2
Bundamba	110	40.0	16.5	14.8	16.5	14.8	16.6	15.3
Gin Gin	275	31.5	10.2	8.8	10.2	8.8	10.3	8.9
Gin Gin	132	21.9	8.8	9.0	8.8	9.0	8.8	9.1
Goodna	275	40.0	14.8	15.0	15.0	15.1	15.0	15.1
Goodna	110	40.0	25.1	26.6	25.1	26.6	25.1	26.6
Greenbank	275	40.0	21.7	23.7	22.1	24.1	22.2	24.2
Kogan Creek	275	40.0	16.7	17.0	20.6	19.3	23.2	21.0
Loganlea	275	50.0	15.1	15.2	15.3	15.4	15.3	15.4
Loganlea (1)	110	25.0	22.4	25.9	22.7	26.3	22.7	26.4
Middle Ridge – 4T	330	NO CB	12.2	11.8	12.5	12.0	12.5	12.0
Middle Ridge – 5T	330	NO CB	12.6	12.2	12.9	12.4	12.9	12.4
Middle Ridge	275	40.0	17.6	17.6	18.1	17.9	18.1	18.0
Middle Ridge	110	26.2	19.8	23.1	20.0	23.3	20.1	23.5
Millmerran Switchyard	330	50.0	17.2	18.5	18.3	19.4	18.3	19.4
Molendinar – 1T	275	40.0	8.2	7.8	8.3	7.8	8.3	7.9
Molendinar – 2T	275	40.0	8.2	7.8	8.3	7.8	8.3	7.8
Molendinar	110	40.0	19.4	23.3	19.6	23.4	19.6	23.4
Mt England	275	31.5	22.6	22.5	23.1	22.9	23.1	23.0
Mudgeeraba	275	31.5	9.4	9.4	9.5	9.4	9.5	9.5
Mudgeeraba	110	31.5	17.9	21.8	18.0	21.9	18.0	22.2
Murarrie – 3T	275	40.0	13.1	13.0	13.2	13.1	13.2	13.1
Murarrie – 2T	275	40.0	13.1	13.1	13.2	13.3	13.2	13.3
Murarrie	110	40.0	24.4	28.3	24.8	28.7	25.0	28.9
Oakey GT PS	110	40.0	10.8	11.8	10.8	11.9	10.8	11.9
Oakey	110	40.0	10.0	9.8	10.0	9.8	10.0	9.8
Palmwoods	275	31.5	8.1	8.3	8.1	8.4	8.1	8.4
Palmwoods	132	21.8	12.4	14.7	12.5	15.0	12.6	15.2
Palmwoods	110	NO CB	5.5	5.8	6.8	7.1	6.8	7.1

Table C.3: Estimated Maximum Short Circuit Levels – Southern Queensland - Powerlink Transmission Network 2008 to 2010 (Cont'd)

SUBSTATION	VOLTAGE kV	CB FAULT RATING (LOWEST kA)	FAULT LEVELS 2008 3 PHASE kA	FAULT LEVELS 2008 L - G kA	FAULT LEVELS 2009 3 PHASE kA	FAULT LEVELS 2009 L - G kA	FAULT LEVELS 2010 3 PHASE kA	FAULT LEVELS 2010 L - G kA
Redbank Plains	110	31.5	20.8	18.9	20.8	18.9	20.8	19.0
Richlands	110	18.3	17.6	17.7	17.7	17.7	17.7	17.8
Rocklea – 1T	275	40.0	13.4	12.4	13.5	12.5	13.5	12.5
Rocklea – 2T	275	40.0	8.6	8.2	8.6	8.3	8.6	8.3
Rocklea	110	40.0	24.9	28.4	24.8	28.4	24.8	28.4
Runcorn	110	21.9	18.9	18.9	19.1	19.1	19.3	19.2
South Pine	275	31.5	18.6	20.6	18.9	21.4	18.9	21.5
South Pine East	110	40.0	26.7	32.7	20.2	23.1	20.2	23.1
South Pine West	110	40.0	-	-	21.1	26.6	21.1	26.9
Sumner	110	40.0	20.6	20.0	20.5	20.0	20.6	20.0
Swanbank A (1) (2)	110	18.3	25.3	21.1	25.4	21.2	25.5	21.3
Swanbank B	275	31.5	18.6	19.8	18.9	20.0	18.9	20.0
Swanbank E	275	40.0	16.4	17.9	16.6	18.1	16.7	18.1
Tangkam	110	40.0	12.8	11.8	12.8	11.8	12.8	11.8
Tarong (2)	275	31.5	29.7	31.7	31.4	33.0	31.4	33.1
Tarong	132	31.5	5.2	5.5	5.4	5.7	5.4	5.7
Tarong	66	21.9	14.0	15.3	14.0	15.4	14.0	15.4
Teebar Creek	275	40.0	4.8	5.3	4.8	5.3	4.8	5.4
Teebar Creek	132	40.0	8.1	9.4	8.1	9.4	8.1	9.4
Tennyson	110	40.0	15.8	15.2	15.8	15.1	15.8	15.2
Upper Kedron	110	40.0	23.0	18.8	21.2	17.7	21.1	17.9
West Darra	110	40.0	24.4	22.9	24.3	22.9	24.4	22.9
Woolooga	275	31.5	8.9	10.0	8.9	10.0	8.9	10.1
Woolooga	132	21.9	12.3	14.4	12.4	14.4	12.5	14.9

Note:

(1) These locations are operated with open points to keep short circuit levels below switchgear ratings.

APPENDIX D – PROPOSED SMALL NETWORK ASSETS

D.1 Gladstone Area 132kV Harmonic Filter

Project Name:	Gladstone Area Harmonic Mitigation
Proposed Timing:	Winter 2010
Estimated Cost:	$3.77 million

Background

Large industrial enterprises are located in the Gladstone Area. They include refineries, processing plants, smelters and traction loads. It is typical for these types of activities to generate harmonics, which causes voltage waveform distortion and quality of supply issues. Source of harmonics include DC and AC motor drives, uninterruptible power supplies, rectifiers used for electrolysis of aluminium, discharge lamps and transformers due to nonlinear magnetisation curves. Voltage waveform distortion disturbs the function of many types of equipment requiring high-quality electricity, such as computers and telephones. Voltage distortion may also overload cables and cause failures of relays or fuses.

The National Electricity Rules (NER) provides for large direct connect customers to manage the level of harmonic waveform distortion to within prescribed levels and for Transmission Network Service Providers (TNSPs) to also manage the level of residual harmonic waveform distortion to within prescribed levels. Generally resultant background levels of harmonics in load centres fall within prescribed limits, where large customers take action to control their levels. However in the case of Gladstone load centre, with its large concentration of industrial processing plants with complex interactions, background harmonic levels are expected to exceed prescribed values. Consequently, Powerlink has identified that a shared network augmentation is necessary to meet its power quality obligations.

Suppression of harmonics within a network can be achieved by one of two basic technical solutions using a harmonic filter or by using blocking reactors. Studies have identified that effective harmonic suppression cannot be assured through use of blocking reactors. These studies have shown suppression of background harmonic waveform distortion in the Gladstone area can be effectively achieved by a single harmonic filter bank. Furthermore, the filter bank has the benefit of providing reactive support which will assist in meeting the increasing reactive power requirements in the Gladstone area.

Powerlink has reliability and quality of supply obligations under the NER, its Transmission Authority and connection agreements with customers. It is a condition of Powerlink's Transmission Authority that it meets licence and NER requirements relating to technical performance standards during intact and contingency conditions. Under its Transmission Authority, Powerlink plans and develops its network to supply forecast peak demand during a single network element outage. Without action, Powerlink will be unable to meet its power quality obligations. Therefore the proposed solution is classified as a reliability augmentation under the Regulatory Test requirements.

All regulated network augmentations are required to satisfy the Regulatory Test promulgated by the Australian Energy Regulator (AER). For a reliability augmentation, this test requires that a proposed solution minimises the present value cost of meeting objective performance standards compared with other feasible alternatives.

Network Options Considered

- ***Option 1: Harmonic filter***

Under this option a filter tuned to the 5th and 7th harmonic is installed at Gladstone South on the 132kV bus. Harmonic analysis has identified that this will provide adequate mitigation of harmonics in the Gladstone area. This option involves installing one double tuned 132kV 50MVAr filter with a suitably sized reactor/s.

These works would be scheduled to commence in late 2009 to meet a commissioning date of winter 2010.

The total cost of this option is $3.77 million.

- ***Option 2: SVC***

The harmonics and increased reactive demand could also be met by the installation of a Static VAr Compensator (SVC) with additional harmonic filtering at Gladstone South. The SVC would need to have a range similar to the capacitor bank described in Option 1.

The total capital cost of this option is estimated to be $20.0 million.

Construction of the SVC would be scheduled to commence mid 2009 to meet a commissioning date of winter 2010.

- ***Option 3: Non-Network Options Considered***

Powerlink is not aware of any non-network solutions that could address the future quality of supply requirements by the required timing.

- ***Summary of Options and Economic Analysis***

There are two technically feasible options that are capable of addressing the quality of supply requirements in the Gladstone area. The present value cost of each of these options was calculated over a period of 15 years. The results of this economic analysis for the medium growth forecast are summarised in Table D.1 and Table D.3.

Table D.1: Summary of Economic Analysis for Medium Growth for Gladstone Area 132kV Harmonic Filter

OPTIONS	PRESENT VALUE COST (MEDIUM GROWTH)	RANKING
1. Harmonic Filter	$2.16M	1
2. SVC	$11.46M	2
3. Non-network options	N/A	N/A

No market scenarios were considered in the financial analysis as the timing for action is not sensitive to varying economic growth rates.

The sensitivity of the present value calculations to key input variables such as discount rate and capital costs (variation of +/- 15%) has been examined and the results are summarised in Table D.2. Sensitivity to the commissioning date was not examined, as all options are required as early as practicable with a commissioning date of winter 2010.

Table D.2: Results of Sensitivity Analysis for Gladstone Area 132kV Harmonic Filter

	DISCOUNT RATE					
	7%		9%		11%	
	BEST RANKED OPTION	FREQUENCY OF WINS	BEST RANKED OPTION	FREQUENCY OF WINS	BEST RANKED OPTION	FREQUENCY OF WINS
Scenario A Medium Growth	1	100%	1	100%	1	100%

The result of the analysis is that Option 1, installation of a new harmonic filter minimises the present value cost of mitigating harmonics in the Gladstone area, and as such is considered to satisfy the Regulatory Test.

This project has no material impact on other transmission networks.

Recommendation

It is recommended that a harmonic filter be installed at Gladstone South substation to assist mitigating background harmonics from winter 2010.

Table D.3: Cash Flow for Gladstone Area 132kV Harmonic Filter

SCENARIO A		MEDIUM GROWTH FORECAST														
		1 08/09	**2 09/10**	**3 10/11**	**4 11/12**	**5 12/13**	**6 13/14**	**7 14/15**	**8 15/16**	**9 16/17**	**10 17/18**	**11 18/19**	**12 19/20**	**13 20/21**	**14 21/22**	**15 22/23**
Option 1 $M		***Harmonic Filter***														
==> TUOS		0.000	0.000	0.000	0.416	0.410	0.405	0.399	0.393	0.388	0.382	0.377	0.371	0.366	0.360	0.355
==> PV of TUOS	$2.16															
Total for Option 1	**$2.16**															
Option 2 $M		***SVC***														
==> TUOS		0.000	0.000	0.000	2.205	2.176	2.146	2.117	2.087	2.058	2.029	1.999	1.970	1.940	1.911	1.882
==> PV of TUOS	$11.46															
Total for Option 2	**$11.46**															

D.2 Moura 132kV Shunt Capacitor

Project Name:	Moura 132kV Shunt Capacitor
Proposed Timing:	Summer 2010/11
Estimated Cost:	$2.32 million

Background

Moura 132/66/11kV substation supplies the town of Moura and surrounding coal mining area in central Queensland west. This substation is supplied from the 132kV network with two lines. The 132kV network in the central west area has three 132kV lines connected to Callide A Substation and two 132kV lines connected to Baralaba Substation. Callide A is supplied from a single 275/132kV transformer at Calvale and two 132kV lines from Gladstone South (refer Figure 4.1).

A 132kV line outage between either Callide and Baralaba substations, or Callide and Biloela substations, may thermally overload the 'teed' line between Callide and Moura substations. At present this is managed by opening the feeders north of Baralaba. Due to ongoing demand growth, including new loads in North Queensland, from 2010 certain network conditions will increase power transfer north of Baralaba above the nominal rating for system intact conditions. Therefore the feeders north of Baralaba are required to be opened in advance of any contingency. Under these conditions a 132kV line outage between Callide and Moura substations is forecast to result in unacceptably low voltage conditions in the Moura area during summer peak demand periods. Low voltage conditions can result in 'brown-outs' and failure of/damage to customer equipment (for example electric motors).

Powerlink has reliability and quality of supply obligations under the NER, its Transmission Authority and connection agreements with customers. It is a condition of Powerlink's Transmission Authority that it meets licence and NER requirements relating to technical performance standards during intact and contingency conditions. Under its Transmission Authority, Powerlink plans and develops its network to supply forecast peak demand during a single network element outage. Without action, Powerlink will be unable to meet these obligations. Therefore the proposed solution is classified as a reliability augmentation.

All regulated network augmentations are required to satisfy the Regulatory Test promulgated by the AER. For a reliability augmentation, this test requires that a proposed solution minimises the present value cost of meeting objective performance standards compared with other feasible alternatives.

Network Options Considered

- ***Option 1: 132kV Shunt Capacitor Bank at Moura***

Under this option it is proposed to install a 20MVAr, 132kV shunt capacitor bank at Moura Substation to maintain voltages for a 132kV line contingency.

Construction of the capacitor bank would commence in early 2010 to meet the required commissioning date of summer 2010/11.

The total cost of this option is $2.32 million.

- ***Option 2: 132kV Series Reactor at Callide***

This option involves establishing a 132kV series reactor at Callide A Substation to control power flows for a 132kV line contingency. The reactor also helps reduce fault levels and will defer the requirement to open the 132kV lines north of Baralaba pre-contingent.

Construction of the series reactor would commence in early 2010 to meet the required commissioning date of summer 2010/11.

The total cost of this option is $1.79 million.

The limitation will arise again from 2013 onwards at which point the 132kV lines north of Baralaba are required to be opened pre-contingent and further network augmentation is required. This option will involve establishing a 20MVAr, 132kV shunt capacitor bank at Moura to maintain voltages for a 132kV line contingency by summer 2013/14 as per Option 1.

The total cost of these additional works is $2.32 million.

- ***Option3: Non-Network Options Considered***

Powerlink is not aware of any demand side management initiatives, local generation developments or other non-network solutions that could address the future supply requirements by the required timing of summer 2010/11.

- ***Summary of Options and Economic Analysis***

There are two feasible options that are capable of supplying the additional reactive demand at Moura by summer 2010/11. The present value cost of each of these options was calculated over a period of 15 years. The results of this economic analysis for the medium growth forecast are summarised in Table D.4.

Table D.4: Summary of Economic Analysis for Medium Growth for Moura Shunt Capacitor Bank

OPTIONS	PRESENT VALUE COST (MEDIUM GROWTH)	RANKING
1. Shunt Capacitor Bank	$1.33M	1
2. Series Reactor	$1.90M	2
3. Non-network options	N/A	N/A

A range of market scenarios were also considered including demand growth at rates associated with high and low range estimates of economic growth rates in Australia. Economic analysis and the results of these scenarios are in Tables D.7 and D.9. The possible introduction of new embedded generation in the Blackwater or Moura area is expected to produce similar results as low demand growth rates. As a result, no generation investments were considered in formulating scenarios for the economic analysis.

Table D.5: Summary of Scenario Analysis for Moura Shunt Capacitor Bank

	OPTION ONE SHUNT CAPACITOR BANK		OPTION TWO SERIES REACTOR	
	PV $M	RANKING	PV $M	RANKING
Scenario A Medium Growth	1.33	1	1.90	2
Scenario B High Growth	1.51	1	2.04	2
Scenario C Low Growth	0.87	1	1.19	2

The sensitivity of the present value calculations to key input variables such as discount rate and capital costs (variation of +/- 15%) has been examined and the results are summarised in Table D.7. Sensitivity to the commissioning date was not examined, as both options are required to be in service by summer 2010/11 to meet forecast peak load.

Table D.6: Results of Sensitivity Analysis for Moura Shunt Capacitor Bank

	DISCOUNT RATE					
	7%		9%		11%	
	BEST RANKED OPTION	FREQUENCY OF WINS	BEST RANKED OPTION	FREQUENCY OF WINS	BEST RANKED OPTION	FREQUENCY OF WINS
Scenario A Medium Growth	1	100%	1	100%	1	100%
Scenario B High Growth	1	100%	1	100%	1	100%
Scenario C Low Growth	1	100%	1	100%	1	100%

The result of the analysis is that Option 1, the installation of a 132kV shunt capacitor bank at Moura Substation minimises the present value cost of addressing the network limitation in all cases, and as such is considered to satisfy the Regulatory Test.

This project has no material impact on other transmission networks.

Recommendation

It is recommended that a 20MVAr, 132kV shunt capacitor bank be installed at Moura Substation by summer 2010/11.

Table D.7 Cash Flow for Moura Shunt Capacitor Bank

SCENARIO A		MEDIUM GROWTH FORECAST														
		1 08/09	**2 09/10**	**3 10/11**	**4 11/12**	**5 12/13**	**6 13/14**	**7 14/15**	**8 15/16**	**9 16/17**	**10 17/18**	**11 18/19**	**12 19/20**	**13 20/21**	**14 21/22**	**15 22/23**
Option 1 $M		***Shunt Capacitor Bank***														
==> TUOS		0.000	0.000	0.000	0.256	0.252	0.249	0.246	0.242	0.239	0.235	0.232	0.228	0.225	0.222	0.218
==> PV of TUOS	$1.33															
Total for Option 1	**$1.33**															
Option 2 $M		***Series Reactor***														
==> TUOS		0.000	0.000	0.000	0.197	0.195	0.192	0.445	0.439	0.433	0.427	0.421	0.415	0.409	0.403	0.397
==> PV of TUOS	$1.90															
Total for Option 2	**$1.90**															

Table D.8: Cash Flow for Moura Shunt Capacitor Bank

SCENARIO B		HIGH GROWTH FORECAST														
		1 07/08	**2 08/09**	**3 09/10**	**4 10/11**	**5 11/12**	**6 12/13**	**7 13/14**	**8 14/15**	**9 15/16**	**10 16/17**	**11 17/18**	**12 18/19**	**13 19/20**	**14 20/21**	**15 21/22**
Option 1 $M		***Shunt Capacitor Bank***														
==> TUOS		0.000	0.000	0.000	0.256	0.252	0.249	0.246	0.242	0.239	0.235	0.232	0.228	0.225	0.222	0.218
==> PV of TUOS	$1.51															
Total for Option 1	**$1.51**															
Option 2 $M		***Series Reactor***														
==> TUOS		0.000	0.000	0.000	0.197	0.195	0.192	0.189	0.443	0.437	0.431	0.424	0.418	0.412	0.406	0.400
==> PV of TUOS	$2.04															
Total for Option 2	**$2.04**															

Table D.9: Cash Flow for Moura Shunt Capacitor Bank

SCENARIO C		LOW GROWTH FORECAST														
		1 **07/08**	**2** **08/09**	**3** **09/10**	**4** **10/11**	**5** **11/12**	**6** **12/13**	**7** **13/14**	**8** **14/15**	**9** **15/16**	**10** **16/17**	**11** **17/18**	**12** **18/19**	**13** **19/20**	**14** **20/21**	**15** **21/22**
Option 1 $M		***Shunt Capacitor Bank***														
==> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.256	0.252	0.249	0.246	0.242	0.239	0.235	0.232	0.228
==> PV of TUOS	$0.87															
Total for Option 1	**$0.87**															
Option 2 $M		***Series Reactor***														
==> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.197	0.195	0.192	0.445	0.439	0.433	0.427	0.421	0.415
==> PV of TUOS	$1.19															
Total for Option 2	**$1.19**															

APPENDIX E – FORECAST OF CONNECTION POINTS

Tables E.1, E.2, E.3 and E.4 show the ten year forecasts of summer and winter demand at connection points, or groupings of connection points, coincident with the time of forecast total Queensland region summer and winter maximum demand.

Groupings of some connection points are used to protect the confidentiality of specific customer loadings.

It should be noted that generally connection points will have their own summer and winter maximum loadings at times other than coincident with Queensland region maximum and these may be significantly higher than as shown in the tables.

In Tables E.1, E.2, E.3 and E.4 the zones in which connection points are located are allocated by abbreviation as follows:

FN	Far North Zone
R	Ross Zone
N	North Zone
CW	Central West Zone
GL	Gladstone Zone
WB	Wide Bay Zone
SW	South West Zone
B	Bulli Zone
M	Moreton Zone
GC	Gold Coast Zone

Table E.1: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Summer Maximum Demand

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Abermain 110kV (Lockrose, Wulkuraka BS and QR)	M	48.58	50.75	52.25	64.45	66.53	68.40	68.19	70.90	73.61	76.43
Abermain 33kV	M	100.80	92.69	95.23	83.01	86.74	88.71	93.55	96.70	99.70	102.81
Alan Sherriff 132kV	R	19.77	20.69	21.64	22.64	23.69	24.79	25.93	27.13	28.39	29.70
Algester 33kV	M	72.27	94.99	90.88	94.05	96.55	111.74	115.77	120.38	125.94	131.76
Alligator Creek 33kV	N	16.77	17.85	18.92	19.99	21.07	22.14	23.22	24.29	25.36	26.48
Ashgrove West 33kV	M	76.18	78.22	80.85	84.14	87.18	89.94	102.78	107.18	111.85	116.73
Belmont 110kV (Cleveland and Capalaba North)	M	153.31	155.84	162.41	169.95	176.09	181.76	188.98	197.15	205.86	214.95
Biloela 66kV	CW	32.90	34.34	35.09	35.84	36.58	37.33	38.08	38.83	39.58	40.34
Blackwater 66kV	CW	94.18	96.43	98.74	101.12	103.56	106.08	108.66	111.33	114.07	116.87
Broadlea 66kV	N	0.00	0.00	28.37	29.08	29.73	29.79	29.61	29.38	29.38	29.38
Bundamba 110kV	M	18.48	29.03	30.10	31.44	31.19	32.30	33.73	35.35	37.01	38.74
Cairns 22kV	FN	72.37	75.47	78.71	82.08	85.60	89.27	93.10	97.09	101.26	105.61
Cairns City 132kV	FN	53.55	55.95	58.46	61.08	63.83	66.70	69.71	72.85	76.14	79.58
Cairns North 132kV	FN	26.36	27.54	28.77	30.05	31.39	32.79	34.25	35.78	37.37	39.04
Cardwell 22kV	R	3.93	4.02	4.11	4.20	4.30	4.39	4.48	4.57	4.66	4.75
CBD East 110kV	M	406.62	419.40	453.97	555.36	571.28	575.12	589.70	627.93	649.61	672.05
CBD South 110kV	M	61.09	63.19	65.81	69.00	72.03	97.24	101.40	106.08	110.81	115.75
CBD West 110kV	M	160.07	178.35	191.96	197.78	202.92	207.32	208.97	215.89	222.72	229.76
Clare 66kV	R	25.98	27.20	28.43	29.66	30.89	32.12	33.34	34.57	35.80	37.07
Collinsville 33kV	N	11.38	11.79	12.19	12.59	12.99	13.39	13.80	14.20	14.60	15.01
Dan Gleeson 66kV	R	89.63	94.56	99.87	105.59	111.76	118.41	125.57	133.29	141.61	150.45
Dysart 66kV	CW	47.47	47.95	48.43	54.18	54.67	55.18	55.68	56.20	56.71	57.24
Edmonton 22kV	FN	34.15	35.63	37.17	38.78	40.46	42.21	44.04	45.95	47.94	50.01
Egans Hill 66kV	CW	62.05	59.72	61.83	63.94	66.04	68.15	70.25	72.36	74.47	76.64
El Arish 22kV	FN	2.81	2.93	3.06	3.19	3.33	3.47	3.62	3.78	3.94	4.12
Garbutt 66kV	R	97.93	100.20	102.54	104.97	107.63	110.16	112.44	115.08	117.27	119.51
Gin Gin 132kV (Bundaberg)	WB	113.95	116.90	119.98	123.21	126.59	130.15	133.89	137.83	142.00	146.41

Table E.1: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Gladstone 132kV (Boat Creek and RTA Yarwun)	GL	100.63	102.84	103.60	104.90	105.66	106.41	107.17	107.92	108.67	109.44
Gladstone North 132kV	GL	31.49	37.73	37.73	37.73	37.73	37.73	37.73	44.94	44.94	44.94
Gladstone South 66kV	GL	68.47	71.27	73.55	75.79	77.99	80.14	82.24	84.27	86.23	88.23
Goodna 33kV	M	93.98	96.66	100.58	110.98	114.94	118.54	123.21	128.50	133.82	139.36
Ingham 66kV	R	18.13	18.53	18.93	19.35	19.77	20.21	20.65	21.11	21.57	22.04
Innisfail 22kV	FN	27.14	27.56	27.99	28.41	28.83	29.24	29.65	30.06	30.47	30.88
Kamerunga 22kV	FN	43.43	45.25	47.08	48.90	50.72	52.54	54.36	56.18	58.01	59.89
Lilyvale 132kV (Clermont and Barcaldine)	CW	39.37	44.13	44.77	45.42	46.07	46.72	47.38	48.04	48.70	49.38
Lilyvale 66kV	CW	77.69	80.10	82.51	84.92	87.33	89.74	92.15	94.56	96.97	99.44
Loganlea 110kV	M	431.61	486.07	525.85	542.17	573.98	554.70	573.18	596.41	615.34	634.86
Loganlea 33kV	M	112.32	87.54	90.27	83.42	77.93	91.63	97.03	100.47	103.86	107.36
Louisa Creek 33kV	N	31.05	31.12	31.19	31.25	31.32	31.39	31.45	31.52	31.59	31.66
Mackay 33kV	N	89.62	94.35	99.02	103.70	108.54	113.32	118.06	122.73	127.35	132.14
Middle Ridge 110kV	SW	238.89	236.95	249.29	257.69	266.08	274.48	282.88	291.28	299.69	308.34
Middle Ridge 110kV (Postmans Ridge and Gatton)	M	23.28	23.82	25.68	27.73	28.50	29.05	29.86	30.80	31.72	32.67
Molendinar 110kV	GC	377.01	389.10	392.06	428.28	443.16	428.64	449.48	467.17	487.70	509.13
Moranbah 66kV and 11kV	N	88.32	103.48	115.97	168.97	206.38	223.36	224.04	224.77	232.69	240.90
Moura 66kV	CW	43.44	44.48	45.52	46.56	47.60	48.64	49.68	50.72	51.76	52.82
Mudgeeraba 110kV	GC	315.83	343.18	355.63	369.17	386.00	424.08	428.92	440.53	452.03	463.84
Murarrie 110kV (Doboy, Lytton BS and QR, and Wakerley)	M	234.31	253.67	263.61	275.53	284.08	295.62	303.99	300.01	310.47	321.29
Nebo 11kV	N	2.12	2.21	2.30	2.40	2.49	2.59	2.68	2.77	2.87	2.96
Newlands 66kV	N	20.80	21.50	22.20	22.89	23.49	24.08	24.67	25.27	25.86	26.47
Palmwoods 132kV and 110kV	M	321.54	341.83	365.37	386.60	406.10	426.82	455.79	488.11	515.74	544.92
Pandoin 66kV	CW	0.00	9.13	9.51	9.87	10.17	10.57	10.88	11.21	11.55	11.90
Pioneer Valley 66kV	N	46.39	48.62	50.90	53.25	55.38	57.56	59.79	62.07	64.39	66.81
Proserpine 66kV	N	63.11	68.30	70.47	72.65	74.86	77.09	79.35	81.63	83.95	86.32
Redbank Plains 11kV	M	19.70	19.96	20.71	15.99	16.60	17.17	17.90	18.73	19.56	20.43

Table E.1: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Richlands 33kV	M	92.24	101.13	105.05	102.84	106.95	109.58	113.14	113.56	117.44	121.46
Rockhampton 66kV	CW	110.10	111.01	115.18	119.64	123.76	127.81	131.57	135.32	139.05	142.89
Rocklea 110kV (Archerfield)	M	94.30	75.29	76.88	79.03	80.90	95.71	98.21	101.12	103.96	106.87
Ross 132kV (Kidston, Milchester and Georgetown)	FN	29.62	32.45	45.67	46.56	47.46	48.38	49.31	50.27	51.24	52.24
Runcorn 33kV	M	73.67	74.36	82.67	78.58	80.53	88.56	91.16	94.17	97.47	100.89
South Pine 110kV	M	909.82	951.45	1000.48	1048.54	1093.38	1127.37	1168.73	1216.39	1265.99	1317.62
Sumner 11kV	M	34.62	39.97	45.59	40.27	41.27	42.11	43.32	48.85	50.38	51.97
Sun Water Pumps (King Creek) 132kV	N	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Sun Water Pumps (Stony Creek) 132kV	N	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Swanbank 110kV (Raceview)	M	95.35	101.48	104.54	105.70	109.32	111.82	115.26	119.22	123.12	127.15
Tangkam 110kV (Dalby and Oakey)	SW	-3.77	8.87	10.14	11.43	12.72	14.02	15.33	16.64	17.97	19.61
Tarong 132kV (Chinchilla and Roma)	SW	74.15	76.58	79.03	81.52	84.04	86.60	89.19	91.82	94.49	97.24
Tarong 66kV (Wide Bay)	SW	40.60	43.35	44.61	45.87	47.13	48.38	49.64	50.90	52.16	53.45
Teebar Creek 132kV (Isis and Maryborough)	WB	133.40	138.22	143.05	147.88	152.70	157.53	162.35	167.18	172.00	176.98
Tennyson 33kV	M	186.55	206.03	211.51	196.29	201.99	161.77	182.57	185.19	190.96	196.91
Townsville East 66kV	R	23.70	24.14	24.59	25.06	25.54	26.04	26.55	27.08	27.63	28.19
Townsville South 66kV	R	79.07	82.02	84.45	86.96	89.77	92.23	94.78	98.30	101.05	103.87
Tully 22kV	R	13.21	13.52	13.84	14.17	14.50	14.84	15.19	15.55	15.91	16.29
Turkinje 132kV (Craiglee and Lakeland)	FN	16.71	16.20	16.38	16.56	16.74	16.92	17.10	17.28	17.46	17.64
Turkinje 66kV	FN	50.25	53.90	55.68	57.93	59.72	61.50	63.28	65.07	66.39	67.73
Waggamba 132kV (Bulli Creek)	B	17.40	17.78	18.17	18.57	18.98	19.40	19.83	20.26	20.71	21.16
Wecker Rd 33kV (Belmont)	M	168.23	187.23	196.42	159.51	164.23	165.55	172.74	182.92	189.38	196.06
West Darra 11kV	M	0.00	0.00	0.00	25.39	26.49	71.93	58.78	61.58	64.41	67.37
Woolooga 132kV (Gympie)	M	173.44	180.68	182.94	191.44	199.96	207.73	218.62	227.95	239.03	250.65
Woolooga 132kV (Kilkivan)	WB	12.77	12.89	13.00	13.12	13.24	13.36	13.47	13.59	13.71	13.83

Table E.1: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Direct Connected Industrial Loads (Sun Metals, QLD Nickel, Invicta Load - R, BSL and QAL - GL)	Various	1093.13	1094.49	1095.25	1100.98	1121.45	1146.88	1172.32	1197.76	1223.20	1249.23
Transmission Grid Connected Mining Loads (Rolleston - CW, Burton Downs, Goonyella North and Hail Creek - N)	Various	49.65	51.66	52.03	52.58	53.10	53.66	54.04	54.42	54.81	55.20
Transmission Grid Connected Queensland Rail substations (Gregory, Rangal, Dingo, Grantleigh, Rocklands, Norwich Park - CW, Mt McLaren, Coppabella, Moranbah South, Oonooie, Wandoo, Peak Downs, Bolingbroke, Mindi - N, Callemondah - GL, Korenan and Mungar - WB)	Various	96.98	106.08	107.21	108.38	109.53	110.67	111.85	113.05	114.24	115.46
TOTAL QLD SUMMER DELIVERED PEAK		**8530.32**	**8924.73**	**9309.32**	**9703.56**	**10054.59**	**10374.33**	**10708.16**	**11082.18**	**11452.20**	**11836.46**

Table E.2: Forecasts of Connection Point Native Demands (MW) Coincident With State Summer Maximum Demand

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Abermain 110kV (Lockrose, Wulkuraka BS and QR)	M	48.58	50.75	52.25	64.45	66.53	68.40	68.19	70.90	73.61	76.43
Abermain 33kV	M	100.80	92.69	95.23	83.01	86.74	88.71	93.55	96.70	99.70	102.81
Alan Sherriff 132kV	R	19.77	20.69	21.64	22.64	23.69	24.79	25.93	27.13	28.39	29.70
Algester 33kV	M	72.27	94.99	90.88	94.05	96.55	111.74	115.77	120.38	125.94	131.76
Alligator Creek 33kV	N	16.77	17.85	18.92	19.99	21.07	22.14	23.22	24.29	25.36	26.48
Ashgrove West 33kV	M	76.18	78.22	80.85	84.14	87.18	89.94	102.78	107.18	111.85	116.73
Belmont 110kV (Cleveland and Capalaba North)	M	153.31	155.84	162.41	169.95	176.09	181.76	188.98	197.15	205.86	214.95
Biloela 66kV	CW	32.90	34.34	35.09	35.84	36.58	37.33	38.08	38.83	39.58	40.34
Blackwater 66kV	CW	94.18	96.43	98.74	101.12	103.56	106.08	108.66	111.33	114.07	116.87
Broadlea 66kV	N	0.00	0.00	28.37	29.08	29.73	29.79	29.61	29.38	29.38	29.38
Bundamba 110kV	M	18.48	29.03	30.10	31.44	31.19	32.30	33.73	35.35	37.01	38.74
Cairns 22kV	FN	72.37	75.47	78.71	82.08	85.60	89.27	93.10	97.09	101.26	105.61
Cairns City 132kV	FN	53.55	55.95	58.46	61.08	63.83	66.70	69.71	72.85	76.14	79.58
Cairns North 132kV	FN	26.36	27.54	28.77	30.05	31.39	32.79	34.25	35.78	37.37	39.04
Cardwell 22kV	R	3.93	4.02	4.11	4.20	4.30	4.39	4.48	4.57	4.66	4.75
CBD East 110kV	M	406.62	419.40	453.97	555.36	571.28	575.12	589.70	627.93	649.61	672.05
CBD South 110kV	M	61.09	63.19	65.81	69.00	72.03	97.24	101.40	106.08	110.81	115.75
CBD West 110kV	M	160.07	178.35	191.96	197.78	202.92	207.32	208.97	215.89	222.72	229.76
Clare 66kV	R	76.98	78.20	79.43	80.66	81.89	83.12	84.34	85.57	86.80	88.05
Collinsville 33kV	N	11.38	11.79	12.19	12.59	12.99	13.39	13.80	14.20	14.60	15.01
Dan Gleeson 66kV	R	89.63	94.56	99.87	105.59	111.76	118.41	125.57	133.29	141.61	150.45
Dysart 66kV	CW	47.47	47.95	48.43	54.18	54.67	55.18	55.68	56.20	56.71	57.24
Edmonton 22kV	FN	34.15	35.63	37.17	38.78	40.46	42.21	44.04	45.95	47.94	50.01
Egans Hill 66kV	CW	62.05	59.72	61.83	63.94	66.04	68.15	70.25	72.36	74.47	76.64
El Arish 22kV	FN	2.81	2.93	3.06	3.19	3.33	3.47	3.62	3.78	3.94	4.12
Garbutt 66kV	R	97.93	100.20	102.54	104.97	107.63	110.16	112.44	115.08	117.27	119.51
Gin Gin 132kV (Bundaberg)	WB	115.75	118.70	121.78	125.01	128.39	131.95	135.69	139.63	143.80	148.21

Table E.2: Forecasts of Connection Point Native Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Gladstone 132kV (Boat Creek and RTA Yarwun)	GL	100.63	102.84	103.60	104.90	105.66	106.41	107.17	107.92	108.67	109.44
Gladstone North 132kV	GL	31.49	37.73	37.73	37.73	37.73	37.73	37.73	44.94	44.94	44.94
Gladstone South 66kV	GL	68.47	71.27	73.55	75.79	77.99	80.14	82.24	84.27	86.23	88.23
Goodna 33kV	M	93.98	96.66	100.58	110.98	114.94	118.54	123.21	128.50	133.82	139.36
Ingham 66kV	R	18.13	18.53	18.93	19.35	19.77	20.21	20.65	21.11	21.57	22.04
Innisfail 22kV	FN	27.14	27.56	27.99	28.41	28.83	29.24	29.65	30.06	30.47	30.88
Kamerunga 22kV	FN	43.43	45.25	47.08	48.90	50.72	52.54	54.36	56.18	58.01	59.89
Lilyvale 132kV (Clermont and Barcaldine)	CW	39.37	44.13	44.77	45.42	46.07	46.72	47.38	48.04	48.70	49.38
Lilyvale 66kV	CW	120.69	123.10	125.51	127.92	130.33	132.74	135.15	137.56	139.97	142.42
Loganlea 110kV	M	446.61	501.07	540.85	557.17	588.98	569.70	588.18	611.41	630.34	649.85
Loganlea 33kV	M	112.32	87.54	90.27	83.42	77.93	91.63	97.03	100.47	103.86	107.36
Louisa Creek 33kV	N	31.05	31.12	31.19	31.25	31.32	31.39	31.45	31.52	31.59	31.66
Mackay 33kV	N	89.62	94.35	99.02	103.70	108.54	113.32	118.06	122.73	127.35	132.14
Middle Ridge 110kV	SW	242.39	240.45	252.79	261.19	269.58	277.98	286.38	294.78	303.19	311.84
Middle Ridge 110kV (Postmans Ridge and Gatton)	M	23.28	23.82	25.68	27.73	28.50	29.05	29.86	30.80	31.72	32.67
Molendinar 110kV	GC	377.01	389.10	392.06	428.28	443.16	428.64	449.48	467.17	487.70	509.13
Moranbah 66kV and 11kV	N	139.13	154.29	166.78	219.78	257.19	274.17	274.85	275.58	283.50	291.64
Moura 66kV	CW	43.44	44.48	45.52	46.56	47.60	48.64	49.68	50.72	51.76	52.82
Mudgeeraba 110kV	GC	315.83	343.18	355.63	369.17	386.00	424.08	428.92	440.53	452.03	463.84
Murarrie 110kV (Doboy, Lytton BS and QR, and Wakerley)	M	234.31	253.67	263.61	275.53	284.08	295.62	303.99	300.01	310.47	321.29
Nebo 11kV	N	2.12	2.21	2.30	2.40	2.49	2.59	2.68	2.77	2.87	2.96
Newlands 66kV	N	20.80	21.50	22.20	22.89	23.49	24.08	24.67	25.27	25.86	26.47
Palmwoods 132kV and 110kV	M	321.54	341.83	365.37	386.60	406.10	426.82	455.79	488.11	515.74	544.92
Pandoin 66kV	CW	0.00	9.13	9.51	9.87	10.17	10.57	10.88	11.21	11.55	11.90
Pioneer Valley 66kV	N	46.39	48.62	50.90	53.25	55.38	57.56	59.79	62.07	64.39	66.81
Proserpine 66kV	N	63.11	68.30	70.47	72.65	74.86	77.09	79.35	81.63	83.95	86.32
Redbank Plains 11kV	M	19.70	19.96	20.71	15.99	16.60	17.17	17.90	18.73	19.56	20.43

Table E.2: Forecasts of Connection Point Native Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Richlands 33kV	M	92.24	101.13	105.05	102.84	106.95	109.58	113.14	113.56	117.44	121.46
Rockhampton 66kV	CW	110.10	111.01	115.18	119.64	123.76	127.81	131.57	135.32	139.05	142.89
Rocklea 110kV (Archerfield)	M	94.30	75.29	76.88	79.03	80.90	95.71	98.21	101.12	103.96	106.87
Ross 132kV (Kidston, Milchester and Georgetown)	FN	29.62	32.45	45.67	46.56	47.46	48.38	49.31	50.27	51.24	52.24
Runcorn 33kV	M	73.67	74.36	82.67	78.58	80.53	88.56	91.16	94.17	97.47	100.89
South Pine 110kV	M	909.82	951.45	1000.48	1048.54	1093.38	1127.37	1168.73	1216.39	1265.99	1317.62
Sumner 11kV	M	34.62	39.97	45.59	40.27	41.27	42.11	43.32	48.85	50.38	51.97
Sun Water Pumps (King Creek) 132kV	N	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Sun Water Pumps (Stony Creek) 132kV	N	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Swanbank 110kV (Raceview)	M	95.35	101.48	104.54	105.70	109.32	111.82	115.26	119.22	123.12	127.15
Tangkam 110kV (Dalby and Oakey)	SW	26.23	38.87	40.14	41.43	42.72	44.02	45.33	46.64	47.97	49.33
Tarong 132kV (Chinchilla and Roma)	SW	74.15	76.58	79.03	81.52	84.04	86.60	89.19	91.82	94.49	97.24
Tarong 66kV (Wide Bay)	SW	40.60	43.35	44.61	45.87	47.13	48.38	49.64	50.90	52.16	53.45
Teebar Creek 132kV (Isis and Maryborough)	WB	136.10	140.92	145.75	150.58	155.40	160.23	165.05	169.88	174.70	179.68
Tennyson 33kV	M	186.55	206.03	211.51	196.29	201.99	161.77	182.57	185.19	190.96	196.91
Townsville East 66kV	R	23.70	24.14	24.59	25.06	25.54	26.04	26.55	27.08	27.63	28.19
Townsville South 66kV	R	79.07	82.02	84.45	86.96	89.77	92.23	94.78	98.30	101.05	103.87
Tully 22kV	R	13.21	13.52	13.84	14.17	14.50	14.84	15.19	15.55	15.91	16.29
Turkinje 132kV (Craiglee and Lakeland)	FN	16.71	16.20	16.38	16.56	16.74	16.92	17.10	17.28	17.46	17.64
Turkinje 66kV	FN	51.09	54.74	56.52	58.77	60.56	62.34	64.12	65.91	67.23	68.57
Waggamba 132kV (Bulli Creek)	B	17.40	17.78	18.17	18.57	18.98	19.40	19.83	20.26	20.71	21.16
Wecker Rd 33kV (Belmont)	M	168.23	187.23	196.42	159.51	164.23	165.55	172.74	182.92	189.38	196.06
West Darra 11kV	M	0.00	0.00	0.00	25.39	26.49	71.93	58.78	61.58	64.41	67.37
Woolooga 132kV (Gympie)	M	173.44	180.68	182.94	191.44	199.96	207.73	218.62	227.95	239.03	250.65
Woolooga 132kV (Kilkivan)	WB	12.77	12.89	13.00	13.12	13.24	13.36	13.47	13.59	13.71	13.83

Table E.2: Forecasts of Connection Point Native Demands (MW) Coincident With State Summer Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Direct Connected Industrial Loads (Sun Metals, QLD Nickel, Invicta Load - R, BSL, and QAL - GL)	Various	1093.13	1094.49	1095.25	1100.98	1121.45	1146.88	1172.32	1197.76	1223.20	1249.23
Transmission Grid Connected Mining Loads (Rolleston - CW, Burton Downs, Goonyella North and Hail Creek - N)	Various	49.65	51.66	52.03	52.58	53.10	53.66	54.04	54.42	54.81	55.20
Transmission Grid Connected Queensland Rail substations (Gregory, Rangal, Dingo, Grantleigh, Rocklands, Norwich Park - CW, Mt McLaren, Coppabella, Moranbah South, Oonooie, Wandoo, Peak Downs, Bolingbroke, Mindi - N, Callemondah - GL, Korenan and Mungar - WB)	Various	96.98	106.08	107.21	108.38	109.53	110.67	111.85	113.05	114.24	115.46
TOTAL QLD SUMMER NATIVE PEAK		**8728.97**	**9123.38**	**9507.97**	**9902.21**	**10253.24**	**10572.98**	**10906.81**	**11280.83**	**11650.85**	**12034.69**

Table E.3: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Winter Maximum Demand

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Abermain 110kV (Lockrose, Wulkuraka BS and QR)	M	46.12	47.83	49.35	50.93	61.36	63.32	64.98	64.59	67.24	69.75
Abermain 33kV	M	89.37	89.75	82.59	85.05	73.71	76.89	78.50	82.89	85.79	88.36
Alan Sherriff 132kV	R	12.68	13.26	13.87	14.52	15.19	15.89	16.62	17.39	18.20	19.04
Algester 33kV	M	65.18	66.07	81.58	77.50	80.28	82.56	95.38	98.80	102.97	108.13
Alligator Creek 33kV	N	31.94	10.58	11.34	12.10	12.86	13.63	14.39	15.15	15.91	16.67
Ashgrove West 33kV	M	77.75	78.75	80.98	83.95	87.23	90.38	93.10	101.82	106.37	110.98
Belmont 110kV (Cleveland and Capalaba North)	M	165.72	164.53	170.72	178.45	187.18	193.95	199.93	207.69	217.04	226.46
Biloela 66kV	CW	25.43	27.11	27.89	27.96	28.02	28.09	28.15	28.21	28.28	28.34
Blackwater 66kV	CW	85.27	86.71	88.17	89.67	91.19	92.75	94.34	95.96	97.62	99.31
Broadlea 66kV	N	0.00	0.00	0.00	25.87	26.52	27.11	27.16	27.00	26.79	26.79
Bundamba 110kV	M	16.53	16.63	26.37	27.44	28.63	28.48	29.47	30.76	32.31	33.82
Cairns 22kV	FN	49.88	45.16	47.15	49.24	51.41	53.69	56.06	58.55	61.14	63.85
Cairns City 132kV	FN	38.87	30.37	31.23	32.12	33.03	33.97	34.93	35.91	36.92	37.96
Cairns North 132kV	FN	0.00	18.58	19.40	20.27	21.17	22.12	23.10	24.13	25.20	26.33
Cardwell 22kV	R	2.57	2.59	2.62	2.64	2.67	2.69	2.72	2.74	2.77	2.79
CBD East 110kV	M	211.18	213.16	231.29	244.62	323.61	333.10	337.06	345.23	369.47	382.13
CBD South 110kV	M	32.41	32.83	34.00	35.50	37.15	38.77	55.66	57.96	60.70	63.33
CBD West 110kV	M	68.71	85.70	90.97	97.10	99.79	102.29	104.27	106.70	110.33	113.67
Clare 66kV	R	-5.42	-4.52	-3.61	-2.70	-1.80	-0.89	0.02	0.92	1.83	2.74
Collinsville 33kV	N	8.18	8.35	8.52	8.69	8.86	9.03	9.20	9.37	9.54	9.71
Dan Gleeson 66kV	R	59.60	58.76	60.36	62.03	63.79	65.62	67.54	69.55	71.65	73.85
Dysart 66kV	CW	42.37	47.99	48.53	49.08	54.72	55.28	55.85	56.42	57.00	57.59
Edmonton 22kV	FN	17.87	18.72	19.61	20.54	21.52	22.54	23.61	24.73	25.91	27.14
Egans Hill 66kV	CW	41.66	46.62	42.73	43.27	43.80	44.34	44.87	45.41	45.94	46.48
El Arish 22kV	FN	0.00	2.00	2.09	2.18	2.28	2.37	2.48	2.58	2.70	2.81
Garbutt 66kV	R	83.47	73.66	74.15	74.66	75.19	75.79	76.31	76.54	77.06	77.08
Gin Gin 132kV (Bundaberg)	WB	83.69	90.65	93.88	97.27	100.84	104.59	108.54	112.71	117.12	121.79

Table E.3: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gladstone 132kV (Boat Creek and RTA Yarwun)	GL	61.87	98.64	100.94	101.82	103.24	104.12	105.00	105.87	106.75	107.62
Gladstone North 132kV	GL	25.67	31.42	37.65	37.65	37.65	37.65	37.65	37.65	44.84	44.84
Gladstone South 66kV	GL	52.51	51.14	53.15	54.61	55.99	57.29	58.49	59.58	60.54	61.36
Goodna 33kV	M	84.57	83.75	87.40	91.21	100.96	104.66	107.89	112.14	117.26	122.14
Ingham 66kV	R	11.61	11.67	11.74	11.81	11.87	11.94	12.01	12.08	12.14	12.21
Innisfail 22kV	FN	21.08	20.38	20.77	21.16	21.57	21.97	22.39	22.81	23.24	23.68
Kamerunga 22kV	FN	31.83	33.11	34.40	35.68	36.97	38.25	39.54	40.82	42.11	43.39
Lilyvale 132kV (Clermont and Barcaldine)	CW	23.90	31.99	35.77	35.95	36.13	36.32	36.50	36.68	36.87	37.05
Lilyvale 66kV	CW	67.51	73.07	75.52	77.98	80.43	82.89	85.34	87.80	90.25	92.71
Loganlea 110kV	M	401.24	443.34	469.40	508.05	519.49	551.23	535.57	552.82	576.04	594.10
Loganlea 33kV	M	115.25	94.84	97.31	100.66	93.90	87.67	103.12	108.74	112.77	116.50
Louisa Creek 33kV	N	0.00	30.06	30.12	30.18	30.24	30.30	30.36	30.42	30.49	30.55
Mackay 33kV	N	73.27	64.21	66.86	69.48	72.20	74.89	77.56	80.21	82.83	85.44
Middle Ridge 110kV	SW	228.88	235.73	223.86	233.96	240.03	246.10	252.15	258.19	264.22	270.23
Middle Ridge 110kV (Postmans Ridge and Gatton)	M	40.68	40.66	41.35	44.81	48.41	49.94	50.83	52.19	53.91	55.48
Molendinar 110kV	GC	327.24	329.91	341.06	343.95	373.43	390.65	374.75	393.40	409.13	427.19
Moranbah 66kV and 11kV	N	77.71	63.35	77.03	90.79	140.46	175.40	190.35	190.65	191.01	198.20
Moura 66kV	CW	41.35	41.97	42.60	43.23	43.85	44.48	45.10	45.73	46.36	46.98
Mudgeeraba 110kV	GC	315.75	345.99	354.20	365.43	384.53	395.93	430.26	435.96	449.42	463.55
Murarrie 110kV (Doboy, Lytton BS and QR, and Wakerley)	M	218.36	234.92	244.11	252.88	264.21	272.12	283.32	290.95	288.06	297.57
Nebo 11kV	N	1.42	1.47	1.51	1.56	1.61	1.65	1.70	1.75	1.79	1.84
Newlands 66kV	N	18.03	18.26	18.50	18.74	18.97	19.16	19.36	19.55	19.74	19.94
Palmwoods 132kV and 110kV	M	319.26	334.62	355.12	381.16	402.73	422.80	450.28	479.70	507.29	535.52
Pandoin 66kV	CW	0.00	0.00	9.12	9.49	9.86	10.15	10.55	10.87	11.19	11.53
Pioneer Valley 66kV	N	6.13	18.52	19.13	19.76	20.42	21.00	21.59	22.20	22.83	23.48
Proserpine 66kV	N	39.95	42.25	46.54	47.53	48.54	49.55	50.57	51.59	52.63	53.67
Redbank Plains 11kV	M	18.12	21.06	21.10	21.94	16.98	17.63	18.21	18.96	19.86	20.73

Table E.3: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Richlands 33kV	M	77.55	83.82	87.27	90.81	89.11	92.33	94.42	97.35	98.36	101.61
Rockhampton 66kV	CW	77.97	77.09	77.55	79.46	81.65	83.50	85.29	86.79	88.27	89.75
Rocklea 110kV (Archerfield)	M	62.03	61.82	51.81	53.06	54.47	55.76	65.14	66.80	68.91	70.81
Ross 132kV (Kidston, Milchester and Georgetown)	FN	21.44	17.05	19.39	31.49	31.99	32.51	33.03	33.56	34.10	34.65
Runcorn 33kV	M	74.85	79.09	77.03	85.83	82.06	84.11	91.08	93.68	96.93	99.94
South Pine 110kV	M	827.58	865.90	904.21	947.93	991.27	1033.90	1064.37	1102.02	1148.64	1193.50
Sumner 11kV	M	28.63	35.36	40.21	41.26	36.07	36.95	37.64	38.67	42.84	44.13
Sun Water Pumps (King Creek) 132kV	N	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Sun Water Pumps (Stony Creek) 132kV	N	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Swanbank 110kV (Raceview)	M	81.79	84.28	89.56	92.90	94.40	97.25	99.34	102.32	106.02	109.43
Tangkam 110kV (Dalby and Oakey)	SW	-6.11	-5.50	13.31	14.29	15.27	16.27	17.28	18.31	19.34	20.40
Tarong 132kV (Chinchilla and Roma)	SW	59.62	60.42	61.22	62.03	62.83	63.64	64.45	65.27	66.09	66.91
Tarong 66kV (Wide Bay)	SW	38.17	40.37	42.91	43.97	45.03	46.09	47.15	48.21	49.27	50.33
Teebar Creek 132kV (Isis and Maryborough)	WB	112.21	115.96	119.71	123.46	127.21	130.96	134.71	138.46	142.21	145.96
Tennyson 33kV	M	183.95	188.08	198.21	204.20	184.71	190.18	142.77	164.44	167.00	172.14
Townsville East 66kV	R	0.00	17.85	18.13	18.41	18.70	19.00	19.31	19.62	19.95	20.29
Townsville South 66kV	R	42.15	39.98	41.28	42.24	43.23	44.38	45.31	46.26	47.78	48.81
Tully 22kV	R	9.57	8.81	9.03	9.25	9.47	9.70	9.93	10.17	10.41	10.66
Turkinje 132kV (Craiglee and Lakeland)	FN	13.90	14.11	13.45	13.66	13.87	14.08	14.29	14.51	14.72	14.93
Turkinje 66kV	FN	34.36	36.59	38.09	38.47	39.13	39.51	39.89	40.27	40.65	40.75
Waggamba 132kV (Bulli Creek)	B	15.04	15.37	15.71	16.06	16.41	16.77	17.14	17.52	17.90	18.30
Wecker Rd 33kV (Belmont)	M	156.04	173.46	184.43	193.80	149.84	154.26	155.46	162.19	173.07	179.05
West Darra 11kV	M	0.00	0.00	0.00	0.00	22.52	23.48	75.68	61.16	64.14	67.01
Woolooga 132kV (Gympie)	M	192.65	197.57	205.05	208.09	217.50	225.98	234.50	246.71	255.90	268.25
Woolooga 132kV (Kilkivan)	WB	15.00	15.38	15.76	16.14	16.52	16.90	17.29	17.67	18.05	18.43

Table E.3: Forecasts of Connection Point Delivered Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Direct Connected Industrial Loads (Sun Metals, QLD Nickel, Invicta Load - R, BSL and QAL - GL)	Various	1046.36	1056.79	1057.58	1058.11	1063.60	1083.85	1109.06	1134.26	1159.47	1184.67
Transmission Grid Connected Mining Loads (Rolleston - CW, Burton Downs, Goonyella North and Hail Creek - N)	Various	35.90	41.24	42.68	42.96	43.38	43.77	44.20	44.49	44.78	45.08
Transmission Grid Connected Queensland Rail substations (Gregory, Rangal, Dingo, Grantleigh, Rocklands, Norwich Park - CW, Mt McLaren, Coppabella, Moranbah South, Oonooie, Wandoo, Peak Downs, Bolingbroke, Mindi - N, Callemondah - GL, Korenan and Mungar - WB)	Various	82.07	89.46	98.02	99.09	100.17	101.26	102.33	103.43	104.54	105.65
TOTAL QLD SUMMER DELIVERED PEAK		**7259.69**	**7581.28**	**7876.40**	**8191.13**	**8498.07**	**8793.24**	**9058.50**	**9335.94**	**9649.48**	**9958.58**

Table E.4: Forecasts of Connection Point Native Demands (MW) Coincident With State Winter Maximum Demand

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Abermain 110kV (Lockrose, Wulkuraka BS and QR)	M	46.12	47.83	49.35	50.93	61.36	63.32	64.98	64.59	67.24	69.75
Abermain 33kV	M	89.37	89.75	82.59	85.05	73.71	76.89	78.50	82.89	85.79	88.36
Alan Sherriff 132kV	R	12.68	13.26	13.87	14.52	15.19	15.89	16.62	17.39	18.20	19.04
Algester 33kV	M	65.18	66.07	81.58	77.50	80.28	82.56	95.38	98.80	102.97	108.13
Alligator Creek 33kV	N	31.94	10.58	11.34	12.10	12.86	13.63	14.39	15.15	15.91	16.67
Ashgrove West 33kV	M	77.75	78.75	80.98	83.95	87.23	90.38	93.10	101.82	106.37	110.98
Belmont 110kV (Cleveland and Capalaba North)	M	165.72	164.53	170.72	178.45	187.18	193.95	199.93	207.69	217.04	226.46
Biloela 66kV	CW	25.43	27.11	27.89	27.96	28.02	28.09	28.15	28.21	28.28	28.34
Blackwater 66kV	CW	85.27	86.71	88.17	89.67	91.19	92.75	94.34	95.96	97.62	99.31
Broadlea 66kV	N	0.00	0.00	0.00	25.87	26.52	27.11	27.16	27.00	26.79	26.79
Bundamba 110kV	M	16.53	16.63	26.37	27.44	28.63	28.48	29.47	30.76	32.31	33.82
Cairns 22kV	FN	49.88	45.16	47.15	49.24	51.41	53.69	56.06	58.55	61.14	63.85
Cairns City 132kV	FN	38.87	30.37	31.23	32.12	33.03	33.97	34.93	35.91	36.92	37.96
Cairns North 132kV	FN	0.00	18.58	19.40	20.27	21.17	22.12	23.10	24.13	25.20	26.33
Cardwell 22kV	R	2.57	2.59	2.62	2.64	2.67	2.69	2.72	2.74	2.77	2.79
CBD East 110kV	M	211.18	213.16	231.29	244.62	323.61	333.10	337.06	345.23	369.47	382.13
CBD South 110kV	M	32.41	32.83	34.00	35.50	37.15	38.77	55.66	57.96	60.70	63.33
CBD West 110kV	M	68.71	85.70	90.97	97.10	99.79	102.29	104.27	106.70	110.33	113.67
Clare 66kV	R	45.58	46.48	47.39	48.30	49.20	50.11	51.02	51.92	52.83	53.74
Collinsville 33kV	N	8.18	8.35	8.52	8.69	8.86	9.03	9.20	9.37	9.54	9.71
Dan Gleeson 66kV	R	59.60	58.76	60.36	62.03	63.79	65.62	67.54	69.55	71.65	73.85
Dysart 66kV	CW	42.37	47.99	48.53	49.08	54.72	55.28	55.85	56.42	57.00	57.59
Edmonton 22kV	FN	17.87	18.72	19.61	20.54	21.52	22.54	23.61	24.73	25.91	27.14
Egans Hill 66kV	CW	41.66	46.62	42.73	43.27	43.80	44.34	44.87	45.41	45.94	46.48
El Arish 22kV	FN	0.00	2.00	2.09	2.18	2.28	2.37	2.48	2.58	2.70	2.81
Garbutt 66kV	R	83.47	73.66	74.15	74.66	75.19	75.79	76.31	76.54	77.06	77.08
Gin Gin 132kV (Bundaberg)	WB	85.49	92.45	95.68	99.07	102.64	106.39	110.34	114.51	118.92	123.59

Table E.4: Forecasts of Connection Point Native Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gladstone 132kV (Boat Creek and RTA Yarwun)	GL	61.87	98.64	100.94	101.82	103.24	104.12	105.00	105.87	106.75	107.62
Gladstone North 132kV	GL	25.67	31.42	37.65	37.65	37.65	37.65	37.65	37.65	44.84	44.84
Gladstone South 66kV	GL	52.51	51.14	53.15	54.61	55.99	57.29	58.49	59.58	60.54	61.36
Goodna 33kV	M	84.57	83.75	87.40	91.21	100.96	104.66	107.89	112.14	117.26	122.14
Ingham 66kV	R	11.61	11.67	11.74	11.81	11.87	11.94	12.01	12.08	12.14	12.21
Innisfail 22kV	FN	21.08	20.38	20.77	21.16	21.57	21.97	22.39	22.81	23.24	23.68
Kamerunga 22kV	FN	31.83	33.11	34.40	35.68	36.97	38.25	39.54	40.82	42.11	43.39
Lilyvale 132kV (Clermont and Barcaldine)	CW	23.90	31.99	35.77	35.95	36.13	36.32	36.50	36.68	36.87	37.05
Lilyvale 66kV	CW	110.51	116.07	118.52	120.98	123.43	125.89	128.34	130.80	133.25	135.71
Loganlea 110kV	M	416.24	458.34	484.40	523.05	534.49	566.23	550.57	567.82	591.04	609.10
Loganlea 33kV	M	115.25	94.84	97.31	100.66	93.90	87.67	103.12	108.74	112.77	116.50
Louisa Creek 33kV	N	0.00	30.06	30.12	30.18	30.24	30.30	30.36	30.42	30.49	30.55
Mackay 33kV	N	73.27	64.21	66.86	69.48	72.20	74.89	77.56	80.21	82.83	85.44
Middle Ridge 110kV	SW	232.38	239.23	227.36	237.46	243.53	249.60	255.65	261.69	267.72	273.73
Middle Ridge 110kV (Postmans Ridge and Gatton)	M	40.68	40.66	41.35	44.81	48.41	49.94	50.83	52.19	53.91	55.48
Molendinar 110kV	GC	327.24	329.91	341.06	343.95	373.43	390.65	374.75	393.40	409.13	427.19
Moranbah 66kV and 11kV	N	88.52	114.16	127.84	141.60	191.27	226.21	241.16	241.46	241.82	249.01
Moura 66kV	CW	41.35	41.97	42.60	43.23	43.85	44.48	45.10	45.73	46.36	46.98
Mudgeeraba 110kV	GC	315.75	345.99	354.20	365.43	384.53	395.93	430.26	435.96	449.42	463.55
Murarrie 110kV (Doboy, Lytton BS and QR, and Wakerley)	M	218.36	234.92	244.11	252.88	264.21	272.12	283.32	290.95	288.06	297.57
Nebo 11kV	N	1.42	1.47	1.51	1.56	1.61	1.65	1.70	1.75	1.79	1.84
Newlands 66kV	N	18.03	18.26	18.50	18.74	18.97	19.16	19.36	19.55	19.74	19.94
Palmwoods 132kV and 110kV	M	319.26	334.62	355.12	381.16	402.73	422.80	450.28	479.70	507.29	535.52
Pandoin 66kV	CW	0.00	0.00	9.12	9.49	9.86	10.15	10.55	10.87	11.19	11.53
Pioneer Valley 66kV	N	6.13	18.52	19.13	19.76	20.42	21.00	21.59	22.20	22.83	23.48
Proserpine 66kV	N	39.95	42.25	46.54	47.53	48.54	49.55	50.57	51.59	52.63	53.67
Redbank Plains 11kV	M	18.12	21.06	21.10	21.94	16.98	17.63	18.21	18.96	19.86	20.73

Table E.4: Forecasts of Connection Point Native Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Richlands 33kV	M	77.55	83.82	87.27	90.81	89.11	92.33	94.42	97.35	98.36	101.61
Rockhampton 66kV	CW	77.97	77.09	77.55	79.46	81.65	83.50	85.29	86.79	88.27	89.75
Rocklea 110kV (Archerfield)	M	62.03	61.82	51.81	53.06	54.47	55.76	65.14	66.80	68.91	70.81
Ross 132kV (Kidston, Milchester and Georgetown)	FN	21.44	17.05	19.39	31.49	31.99	32.51	33.03	33.56	34.10	34.65
Runcorn 33kV	M	74.85	79.09	77.03	85.83	82.06	84.11	91.08	93.68	96.93	99.94
South Pine 110kV	M	827.58	865.90	904.21	947.93	991.27	1033.90	1064.37	1102.02	1148.64	1193.50
Sumner 11kV	M	28.63	35.36	40.21	41.26	36.07	36.95	37.64	38.67	42.84	44.13
Sun Water Pumps (King Creek) 132kV	N	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Sun Water Pumps (Stony Creek) 132kV	N	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Swanbank 110kV (Raceview)	M	81.79	84.28	89.56	92.90	94.40	97.25	99.34	102.32	106.02	109.43
Tangkam 110kV (Dalby and Oakey)	SW	23.89	24.50	43.31	44.29	45.27	46.27	47.28	48.31	49.34	50.40
Tarong 132kV (Chinchilla and Roma)	SW	59.62	60.42	61.22	62.03	62.83	63.64	64.45	65.27	66.09	66.91
Tarong 66kV (Wide Bay)	SW	38.17	40.37	42.91	43.97	45.03	46.09	47.15	48.21	49.27	50.33
Teebar Creek 132kV (Isis and Maryborough)	WB	114.91	118.66	122.41	126.16	129.91	133.66	137.41	141.16	144.91	148.66
Tennyson 33kV	M	183.95	188.08	198.21	204.20	184.71	190.18	142.77	164.44	167.00	172.14
Townsville East 66kV	R	0.00	17.85	18.13	18.41	18.70	19.00	19.31	19.62	19.95	20.29
Townsville South 66kV	R	42.15	39.98	41.28	42.24	43.23	44.38	45.31	46.26	47.78	48.81
Tully 22kV	R	9.57	8.81	9.03	9.25	9.47	9.70	9.93	10.17	10.41	10.66
Turkinje 132kV (Craiglee and Lakeland)	FN	13.90	14.11	13.45	13.66	13.87	14.08	14.29	14.51	14.72	14.93
Turkinje 66kV	FN	35.20	37.43	38.93	39.31	39.97	40.35	40.73	41.11	41.49	41.59
Waggamba 132kV (Bulli Creek)	B	15.04	15.37	15.71	16.06	16.41	16.77	17.14	17.52	17.90	18.30
Wecker Rd 33kV (Belmont)	M	156.04	173.46	184.43	193.80	149.84	154.26	155.46	162.19	173.07	179.05
West Darra 11kV	M	0.00	0.00	0.00	0.00	22.52	23.48	75.68	61.16	64.14	67.01
Woolooga 132kV (Gympie)	M	192.65	197.57	205.05	208.09	217.50	225.98	234.50	246.71	255.90	268.25
Woolooga 132kV (Kilkivan)	WB	15.00	15.38	15.76	16.14	16.52	16.90	17.29	17.67	18.05	18.43

Table E.4: Forecasts of Connection Point Native Demands (MW) Coincident With State Winter Maximum Demand (Cont'd)

CONNECTION POINTS	ZONE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Direct Connected Industrial Loads (Sun Metals, QLD Nickel, Invicta Load - R, BSL and QAL - GL)	Various	1046.36	1056.79	1057.58	1058.11	1063.60	1083.85	1109.06	1134.26	1159.47	1184.67
Transmission Grid Connected Mining Loads (Rolleston - CW, Burton Downs, Goonyella North and Hail Creek - N)	Various	35.90	41.24	42.68	42.96	43.38	43.77	44.20	44.49	44.78	45.08
Transmission Grid Connected Queensland Rail Substations (Gregory, Rangal, Dingo, Grantleigh, Rocklands, Norwich Park - CW, Mt McLaren, Coppabella, Moranbah South, Oonooie, Wandoo, Peak Downs, Bolingbroke, Mindi - N, Callemondah - GL, Korenan and Mungar - WB)	Various	82.07	89.46	98.02	99.09	100.17	101.26	102.33	103.43	104.54	105.65
TOTAL QLD SUMMER NATIVE PEAK	**-**	**7418.34**	**7779.93**	**8075.05**	**8389.78**	**8696.72**	**8991.89**	**9257.15**	**9534.59**	**9848.13**	**10157.23**

APPENDIX F – TEMPERATURE AND DIVERSITY CORRECTED AREA DEMANDS

For analysis of the dependence of summer and winter daily maximum demands on ambient temperature conditions across parts of Queensland, eight weather station records are used, as shown in Table F.1.

Table F.1: Reference Temperatures at Associated PoE Conditions

WEATHER STATION	AVERAGE DAILY TEMPERATURE PERCENTILES (°C) (1)					
	SUMMER			WINTER		
	10% POE	50% POE	90% POE	10% POE	50% POE	90% POE
Cairns (2)	32.1	30.4	29.1	25.9	24.8	23.7
Townsville (2)	32.0	30.4	29.8	25.7	24.2	23.2
Mackay	30.9	29.3	28.3	11.3	12.4	13.5
Rockhampton	32.6	30.7	29.3	10.2	11.6	12.9
Bundaberg	30.2	28.8	27.7	10.5	11.7	13.0
Toowoomba	29.0	27.0	25.3	4.7	6.0	7.0
Archerfield (Brisbane)	30.5	28.4	27.3	9.6	10.9	12.3
Coolangatta	29.0	27.1	24.5	9.3	10.6	12.2

Notes:

(1) Taken as the average of the maximum temperature on the day and the minimum temperature during the prior night/morning.

(2) In these areas winter demand increases with higher ambient temperature.

Observed temperature sensitivities are determined by linear regression of the daily maximum demands against daily average temperatures on working weekdays. These observations are listed in Table F.2.

As shown in Table F.2, sensitivity of demand to ambient temperature is much higher in summer compared to winter across Queensland.

Table F.2: Observed Temperature Sensitivity of Daily Peak Demands

	DEMAND CHANGE DEPENDENCE ON AVERAGE DAILY TEMPERATURE (MW PER °C) (1)			
	SOUTH EAST	SOUTH WEST	NORTHERN NON-INDUSTRIAL	CENTRAL NON-INDUSTRIAL
Summer				
1998/99	42	4.6	18	10.9
1999/00	40	4.8	23	11.5
2000/01	63	7.0	24	16.2
2001/02	66	5.0	28	14.3
2002/03	78	7.0	32	18.2
2003/04	111	8.6	37	17.8
2004/05	126	9.0	35	19.0
2005/06	162	11.1	40	24.1
2006/07	146	12.0	46	24.9
2007/08	N/A (2)	11.2	50	18.8
Winter				
1999	-36	-6.1	6.0	N/A (4)
2000	-48	-6.9	N/A (3)	
2001	-39	-6.3	6.9	
2002	-40	-6.3	8.8	
2003	-46	-6.7	7.0	
2004	-44	-7.4	3.8	
2005	-46	-6.6	6.8	
2006	-56	-9.2	N/A (3)	
2007	-93	-11.8	7.1	

Notes:

(1) Over summer, the working weekdays in the period mid November to mid March are analysed and the holiday period from Christmas to the first week of January is excluded. Over winter, the working weekdays in the period mid May to early September are analysed. In summer, if the previous day is hotter during a hot period, a 25% weighting of that day's average temperature is included, to capture higher remnant heat in buildings. Similarly, in winter, if the previous day is colder during a cold period, a 25% weighting of that day's average temperature is included.

(2) Due to the lack of relatively hot summer days in South East Queensland over the whole of the 2007/08 summer the temperature correction method was based on fitting the data to a standard response curve normalised from the previous ten summers.

(3) Poor correlation of data in this winter.

(4) Poor correlation of data over most winters. Accordingly, this area's demand is taken to be relatively insensitive to winter temperatures.

The historical coincidence factor averages developed for each of these areas and for the major industrial loads, are used to enable overall correction of Queensland region summer and winter demands, as shown in Tables F.3, F.4 and F.5

Table F.3: Area Summer 50% PoE Demand Temperature Corrections & Coincidence Ratios at State Peak Native (1) Demand

	South East (2)	South West (3)	Northern Non-Industrial (4)	Central Non-Industrial (5)	Major Industrial (6)
Actual at time of Queensland Peak Demand / Actual Own Peak Demands (One value if coincident)					
1998/99	2,762	242 / 254	807 / 845	636 / 662	883 / 900
1999/00	2,922 / 2,946	265 / 268	822 / 887	637 / 704	973 / 1,017
2000/01	2,977	270 / 282	602 / 911	664 / 744	1,017 / 1,037
2001/02	3,091 / 3,120	258 / 284	1,037 / 1,044	765 / 801	1,032 / 1,062
2002/03	3,383	298 / 303	938 / 980	714 / 769	1,003 / 1,085
2003/04	3,846	339 / 340	933 / 1,079	818 / 831	1,083 / 1,108
2004/05	4,024	349 / 358	1,016 / 1,089	883	1,009 / 1,110
2005/06	4,034 / 4,149	351 / 401	1,041 / 1,140	909 / 925	1,054 / 1,141
2006/07	4,246 / 4,300	376 / 396	1,238	967 / 984	1,060 / 1,180
2007/08	4,092 / 4,114	341 / 347	1,060 / 1,158	895 / 925	1,058 / 1,183
Temperature Corrected Area Peak Demand					
1998/99	2,700	265	868	684	
1999/00	2,804	267	938	720	
2000/01	2,999	303	946	779	
2001/02	3,197	298	991	801	
2002/03	3,376	314	1,005	806	N/A (7)
2003/04	3,713	333	1,060	833	
2004/05	4,073	360	1,083	908	
2005/06	4,246	406	1,137	968	
2006/07	4,433	395	1,253	948	
2007/08	4,531	386	1,218	973	
Historical average ratio of demand at time of Qld region peak to area corrected peak	98.6%	93.0%	93.3%	93.4%	94.2%

Notes:

(1) Corrections have been recalculated for native demand in summer 2006/07 and 2007/08 and for winter 2007.

(2) South East Queensland is taken here as Moreton and Gold Coast zones compared to Archerfield (Brisbane) temperatures.

(3) South West Queensland is taken as the South West and Bulli zones and is compared to Toowoomba temperatures.

(4) Northern non-industrial is taken as Far North, Ross and North zones less the SunMetals and Queensland Nickel industrial loads, and is compared to Townsville temperatures.

(5) Central non-industrial is taken as Central West, Gladstone and Wide Bay zones less the Boyne Island Smelter and QAL industrial loads and is compared to Rockhampton temperatures.

(6) Industrial is taken here as the sum of SunMetals, Queensland Nickel, Boyne Island Smelter and QAL direct connected industrial loads.

(7) These major industrial loads are not significantly sensitive to temperature.

Table F.4: Area Winter 50% PoE Demand Temperature Corrections and Coincidence Ratios at State Peak Native (1) Demand

	SOUTH EAST	SOUTH WEST	NORTHERN NON-INDUSTRIAL	CENTRAL NON-INDUSTRIAL	MAJOR INDUSTRIAL
Actual at time of Queensland Peak Demand / Actual Own Peak Demands (One value if coincident)					
1999	2,777	278 / 297	640 / 731	633 / 655	904 / 921
2000	2,968 / 2,992	291 / 318	694 / 776	647 / 709	1,009 / 1,021
2001	2,962 / 2,975	301 / 313	714 / 781	734 / 735	1,019 / 1,052
2002	2,999	286 / 307	685 / 796	648 / 710	1,053 / 1,060
2003	3,325	318 / 322	719 / 806	691 / 739	1,012 / 1,068
2004	3,407 / 3,504	345 / 350	803 / 813	751 / 797	1,061 / 1,099
2005	3,731	343 / 368	706 / 840	752 / 792	1,021 / 1,130
2006	3,882	361 / 373	788 / 850	783	1,077 / 1,162
2007	4,064 / 4,120	410 / 416	784 / 926	895 / 905	1,069 / 1,185
Temperature Corrected Area Peak Demand					
1999	2,775	302	725		
2000	2,963	320	776		
2001	3,036	329	783		
2002	3,078	325	816		
2003	3,327	329	815	N/A(2)	N/A (3)
2004	3,511	365	821		
2005	3,713	372	848		
2006	3,882	409	850		
2007	4,039	419	916		
Historical average ratio of demand at time of Qld region peak to area corrected peak	99.1%	91.9%	89.1%	95.5%	95.6%

Notes:

(1) Corrections have been recalculated for native demand in summer 2006/07 and 2007/08 and for winter 2007.

(2) This area exhibits no inconsistent and insignficant sensitivity to winter temperatures.

(3) These major industrial loads are not significantly sensitive to temperature.

Table F.5: Queensland Region Actual and 50% PoE Temperature and Diversity Corrected Peak Native (1) Demands

SUMMER	ACTUAL	CORRECTED (2)	WINTER	ACTUAL	CORRECTED (3)
1998/99	5,330	5,253	1999	5,233	5,214
1999/00	5,620	5,569	2000	5,609	5,602
2000/01	5,830	5,878	2001	5,731	5,744
2001/02	6,183	6,156	2002	5,671	5,796
2002/03	6,336	6,391	2003	6,066	6,083
2003/04	7,020	6,842	2004	6,366	6,390
2004/05	7,282	7,320	2005	6,553	6,647
2005/06	7,388	7,671	2006	6,891	6,873
2006/07	7,887	7,976	2007	7,223	7,201
2007/08	7,446	8,057	-	-	-

Notes:

(1) Corrections have been recalculated for native demand in summer 2006/07 and 2007/08 and for winter 2007.

(2) Corrections for summer are based on average diversity ratios for the ten years to summer 2006/07. As the diversity was so much lower than this average in summer 2007/08 summer region demand forecasts have now been adjusted to reflect the trend to lower diversity and future corrections will be similarly adjusted.

(3) Corrections for winter are now based on average diversity ratios for the ten years to winter 2007.

APPENDIX G – IMPACT OF MILD SUMMER 2007/08 ON THE FORECASTING MODEL

The Queensland Multiple Area Forecasting Model
Compared to other states in the National Electricity Market (NEM), Queensland's load distribution is decentralised with greater than 40% outside the south east corner of the State. A significant amount of Queensland's load and load growth is industrial, scattered across the rest of the State with an emphasis on the mining industry.

Diverse load and weather patterns across the State require load forecasting methods to be applied to five distinct components of load before combining in a way that accounts for the appropriate weather and load diversity between these components.

There are three parts to Powerlink's load forecasting process:

- Initial load forecasts are supplied from customers, which is generally referred to as a 'bottom up' approach to load forecasting;
- An independent forecast is provided based on econometric and air-conditioning models, which is referred to as a 'top down' approach; and
- Adjustments to the customer forecasts are made, if appropriate, to ensure consistency with the broader economic signals, air-conditioning surveys and historical diversity and temperature sensitivity observations. The diversity factors are annually adjusted to reflect changes to recent moving average weather patterns, as recommended by KEMA Incorporated (2005).

Comparison of Summer 2007/08 to the Forecasting Model
A useful way to check the validity of the multiple area forecasting model is to look at the forecast in the last (2007) Annual Planning Report (APR) for the most recent summer (2007/08) and compare this to what actually occurred. If the model is valid then any variance should be explainable through variance in the components that make up the model. In particular, the inputs or assumptions to each component used for the 2007 APR should be compared with the actual observed input to explain the corresponding change in load.

The actual native peak demand for Queensland for summer 2007/08 was 7,442MW which was 445MW lower than the previous 2006/07 summer actual native peak demand of 7,887MW. Queensland has not experienced a reduction on the previous summer demand over the last ten years. However, as explained in Appendix F and below, the temperature and diversity corrected Queensland summer 2007/08 native peak demand becomes 8,057MW after temperature and diversity correction (615MW upwards) was applied.

Summer 2007/08 Diversity
Due to its large size, Queensland normally experiences significant diversity in weather patterns across the State. Queensland's actual 2007/08 summer native peak demand did not coincide with the peak load in South East Queensland, for the third consecutive year (as shown in Table F.3). Given that South East Queensland represents over 56% of the State summer peak load, this non coincidence reduced the peak State load below where it would otherwise have been under previous coincident assumptions.

Appendix F describes how the State demand is broken into five components for the purpose of temperature correcting demands. Based on the same five components, Table G1 below lists the ratios of each component's demand at the time of actual State peak demand compared to the component's own non-coincident peak demand, temperature corrected where appropriate. It shows the extent of diversity across the State over the last eleven summers in terms of coincidence factors.

The overall diversity for summer 2007/08, measured at 89.8% coincidence, was more pronounced than any of the previous ten years, which averaged 97.1% coincidence. This 7.3% difference explains the large correction applied to the actual recorded peak demand. It was such a low coincidence that it has moved the updated last ten year average coincidence significantly downward to 96.2%. In accordance with KEMA recommendations, Powerlink will factor this change into its forecasting model for the next summer forecast.

Table G1: Queensland Summer Native Peak Demand Diversity (1)

Year	South East	South West	North Non Industrial	Central Non Industrial	Industrial	QLD Diversity (2)
1997/98	100.1%	97.0%	96.3%	93.3%	99.1%	98.3%
1998/99	102.3%	91.1%	92.9%	93.0%	98.1%	98.5%
1999/00	104.2%	99.3%	87.7%	88.5%	95.7%	98.1%
2000/01	99.3%	89.0%	95.3%	85.3%	98.1%	96.2%
2001/02	96.7%	86.5%	104.7%	95.5%	97.2%	97.5%
2002/03	100.2%	94.7%	93.4%	88.6%	92.4%	96.3%
2003/04	103.6%	101.9%	88.0%	98.2%	97.8%	99.7%
2004/05	98.80%	97.03%	93.9%	97.3%	90.9%	96.6%
2005/06	95.0%	86.5%	91.6%	93.9%	92.4%	93.5%
2006/07	95.8%	95.2%	98.8%	102.0%	89.8%	96.1%
2007/08	90.3%	88.4%	87.1%	92.0%	89.5%	89.8%
Last Ten Year Average	98.6%	93.0%	93.3%	93.4%	94.2%	96.2%

Note:

(1) Diversity is expressed by a coincidence factor. Coincidence factors greater than 100% imply that the actual area demand at the time of State peak demand exceeded the area's own temperature corrected peak. Invariably this means that the area actual peak demand has been temperature corrected downwards.

(2) Queensland Diversity is the load weighted average of the component diversities.

Queensland's Mild 2007/08 Summer

Queensland's 2007/08 summer was mild over the entire State, similarly to summer 2006/07.

Table G2 below shows summer average temperatures for Queensland over the last ten years over all days of the summer. Table G2 also shows that overall the 2007/08 summer was similarly as mild as 2006/07 which was the mildest since 2000/01.

Table G2: Queensland Average Summer Temperatures (°C)

YEAR	ARCHERFIELD	TOOWOOMBA	ROCKHAMPTON	TOWNSVILLE
1998/99	24.68	21.09	26.86	27.80
1999/00	22.68	19.94	25.46	26.87
2000/01	24.39	22.09	25.75	26.71
2001/02	25.58	23.87	28.54	29.27
2002/03	24.41	21.96	26.97	28.31
2003/04	26.01	23.31	27.77	28.77
2004/05	25.09	22.56	27.27	28.39
2005/06	26.20	24.12	28.42	28.65
2006/07	24.00	21.75	26.22	27.27
2007/08	24.23	21.17	26.11	27.66
10 Year Average	24.7	22.2	26.9	28.0
50 Year Average	25.3	21.6	26.9	27.8

However, diversity or non-coincidence of the hottest weather patterns in different areas across the State was more pronounced in summer 2007/08. This resulted in the highest temperature and diversity correction applied over the last eleven years, as explained in Appendix F and above.

In the face of surveys indicating ongoing strong sales of domestic air conditioners through the last two mild summers, it would appear that there has been low utilisation of air conditioning, compared with the hot 2005/06 summer.

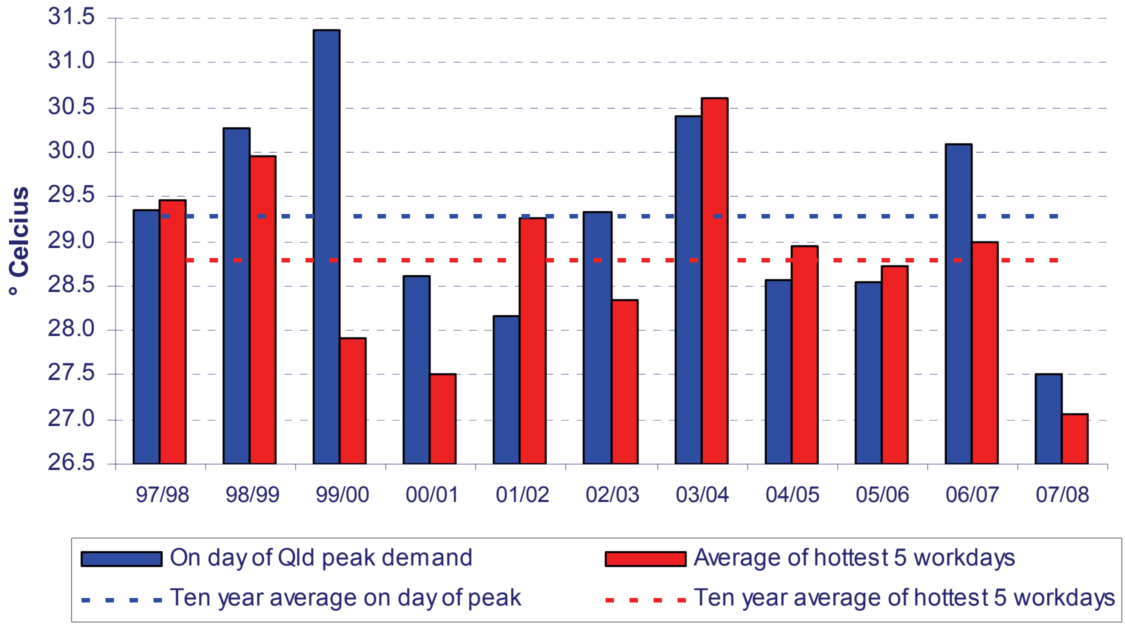
When only working days are counted, the South East Queensland (Archerfield) average temperature for 2007/08 was equally as mild as in summer 2006/07. However, more consistently overcast conditions resulted in the average daytime maximum temperature being close to 1.0 degree celsius cooler in summer 2007/08 compared to summer 2006/07, with conversely 1.0 degree celsius warmer night time minimums. Thus the driver for air conditioning use was even lower in summer 2007/08.

Queensland Load Weighted Summer Temperature

Another accepted approach used to gauge the impact of Queensland weather on any summer day, is a non-industrial load weighted average daily temperature. Each of the component area daily temperatures (minimum plus maximum divided by two) is weighted by its typical share of non-industrial Queensland demand.

Figure G1 shows how the 2007/08 summer contained the lowest level of combined hot weather over the last eleven years and accordingly, the lowest driver for a high maximum demand.

Figure G.1: Weighted Queensland Summer Temperature



Other Impacts over Summer 2007/08

Despite the very high level of temperature and diversity correction, the corrected Summer 2007/08 peak demand of 8,057MW, although a 1.0% increase over the previous summer, was still 504MW (or 5.9%) below the 2007 APR native forecast of 8,561MW, under the medium economic growth and 50%PoE weather scenario.

To explain this variance it is necessary to consider other unexpected events over the summer 2007/08 period, and to refer to various components that make up the forecast.

CQ Flooding

During late January and early February 2008 major flooding occurred across most of Central Queensland. This resulted in lengthy curtailment of port coal handling activities at Dalrymple Bay (Mackay) and at several central Queensland coal mines throughout February. Also the Rockhampton area was experiencing a major flood at the time of Queensland peak demand. It is estimated that a total of about 75MW of load was inoperable at the time of Queensland peak demand. Hence, this is not part of the temperature and diversity correction process.

Delays in New Block Loads

A number of new or expanded block loads that were expected to be on line by summer 2007/08 were delayed but are expected to be operational by summer 2008/09. These delayed loads include some gold, coal mine and port handling expansion loads. These amounted to about 40MW of forecast load delayed and not existing at the time of Queensland peak demand.

New Embedded Non-Scheduled Generation

The level of embedded non-scheduled generation, for which data was available, was marginally higher then previously forecast over summer 2007/08 and is set to increase even further over the next year or two. At the time of actual peak demand there was a measured 85MW compared to a forecast of 72MW.

Whilst this generation reduces the loading delivered directly from the Powerlink transmission grid, it does not impact on the native demand forecasts, as those forecasts include output for such generators which normally produce some net export to the grid.

South East Queensland's Mild 2007/08 Summer

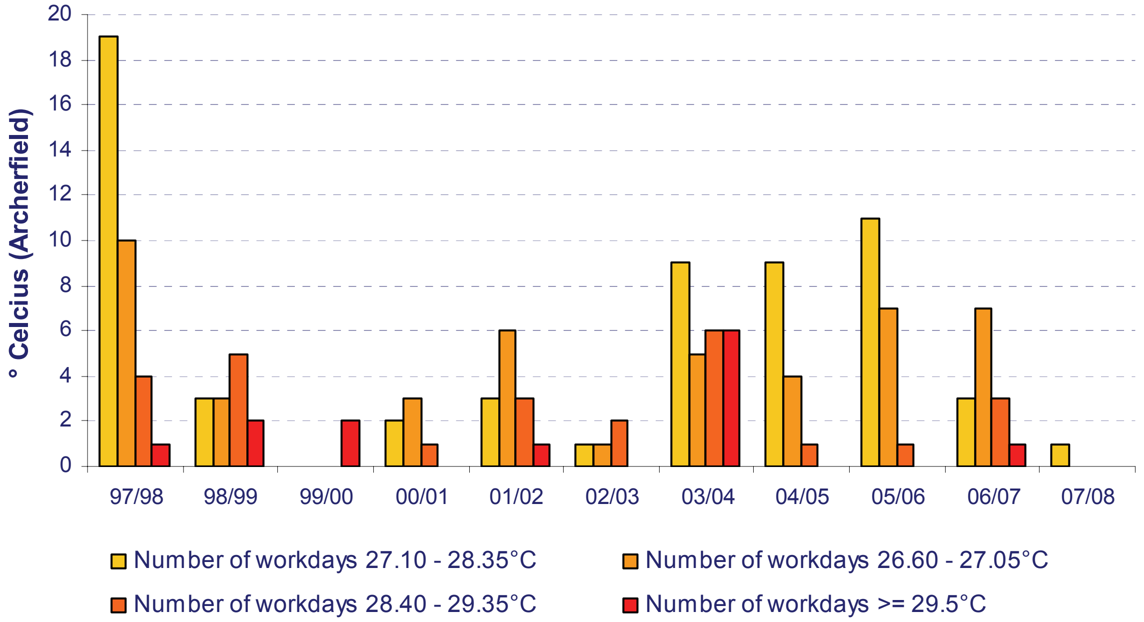
The South East Queensland area had an actual summer native peak demand of 4,114MW which was 686MW (or 14.3%) below the 2007 APR forecast under medium growth 50%PoE conditions. This peak occurred for the first time on non workday, Saturday 23 February 2008, which was the only day of the whole summer where the Archerfield average daily temperature exceeded an 85%PoE reference level. It was also the day after the day of Queensland native peak demand, at which time South East Queensland had its highest workday demand of the summer, at 4,092MW with an average temperature equal to the 85%PoE level at 27.15 degrees celsius.

The temperature corrected South East Queensland summer 2007/08 native peak demand has been calculated at 4,531MW which was still 269MW (or 5.6%) below the 2007 APR forecast.

Figure G.2 shows how the hot day drivers for triggering temperature sensitivity for air conditioner use, were at the lowest level observed over the last eleven years in South East Queensland. As noted above the daytime temperatures were generally lower relative to night time temperatures, due to the consistently overcast conditions.

Accordingly, it is considered that the 2007/08 summer correction process for South East Queensland, did not fully account for the conditions encountered.

Figure G.2: South East Queensland Number of Hot Summer Workdays



Increased Air Conditioning Load

Recent surveys have shown that the number of residences with air conditioning installed in South East Queensland increased from 59.3% to 62.0% over the May 2006 to May 2007 survey period, a similar increase to the previous annual survey period (56.0% to 59.3%). However, the mild 2006/07 and 2007/08 summers have resulted in reduced usage of air conditioning.

Increased Population Growth

Queensland's annual population growth had previously been forecast to drop from 2.3% per annum in 2005/06 to about 1.9% for 2006/07 and slowly declining beyond 2007, predominately caused by a reduction in migration to Queensland. However, the 2006 Census revealed that an underestimation of residential population growth over the previous five years was common particularly across South East Queensland.

The 2005/06 population increase for Queensland was revised upward to 2.4% and for 2006/07 is now estimated at 2.38%, with similar levels continuing into 2007/08. It is expected that the 2011 and beyond population estimates will soon be revised upwards by the Queensland Government.

This argues against a case for a slowdown in electricity demand growth.

Other Queensland Area's Mild 2007/08 Summer

Similarly, to South east Queensland, other area's of Queensland also had a lack of hot workdays during the whole of the 2007/08 summer, and consequently had low triggers for the initiating full sensitivity of air conditioner use to temperature.

Both Central Queensland (Rockhampton temperature) and South West Queensland (Toowoomba temperature), had no working day temperatures equal to or exceeding their 90% PoE level less 0.5 degrees.

Northern Queensland (Townsville temperature) also had no working day temperature equal to or greater than the 90% PoE level less 0.3 degrees.

In all cases, this was the first time in eleven recorded years this maximum workday temperature was lower than the 90% PoE level.

Accordingly, it is considered that the 2007/08 summer temperature correction process in these areas, did not fully account for the conditions encountered.

APPENDIX H – ABBREVIATIONS

AC	Alternating current
AER	Australian Energy Regulator
ANTS	Annual National Transmission Statement
APR	Annual Planning Report
CB	Circuit breaker
CBD	Central Business District
CQ	Central Queensland
DC	Direct current
DNSP	Distribution Network Service Provider
DSM	Demand Side Management
FNQ	Far North Queensland
GSDA	Gladstone State Development Area
GT	Gas turbine
GWh	Gigawatt hour, one million kilowatt hours
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IRPC	Inter Regional Planning Committee
JPB	Jurisdictional Planning Body
kA	Kiloamperes, one thousand amperes
kV	Kilovolts, one thousand volts
MVA	Megavolt Amperes
MVAr	MegaVAr, MegaVolt Amperes reactive, one thousand kiloVolt Amperes reactive
MW	Megawatt, one thousand kilowatts
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NEMDE	National Electricity Market Dispatch Engine
NER	National Electricity Rules
NIEIR	National Institute of Economic and Industrial Research
NNS	Northern New South Wales
NTFP	National Transmission Flow Path
NSW	New South Wales
PV	Present value

NQ	North Queensland
PoE	Probability of Exceedance
PS	Power Station
PSS	Power System Stabiliser
QAL	Queensland Alumina Limited
QLD	Queensland
QNI	Queensland/New South Wales Interconnector
QR	Queensland Rail
RFI	Request For Information
RTA	Rio Tinto Aluminium
SEQ	South East Queensland
SOO	Statement of Opportunities, published annually by NEMMCO
SQ	South Queensland
SVC	Static VAr compensator
SWQ	South West Queensland
TNSP	Transmission Network Service Provider
TUOS	Transmission Use of System
VAr	Volt Ampere reactive

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