ActewAGL Distribution

Capacity Management Strategy

2015 - 2033

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Authorisation

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OVERVIEW

1.1 PURPOSE AND SCOPE

This **Capacity Management** Strategy and Plan has four purposes:

1. To illustrate how the process of capacity management (CM) is conducted for AAD and its interactions with other key processes;
2. To outline the engineering and risk management principles and practices by which CM is undertaken;
3. To summarise major CM-driven projects for AAD assets for the period to 2033, with an emphasis on those to be completed 2016-2021.

1.1.1 EXCLUSIONS

This document covers ActewAGL's gas distribution assets in the Australian Capital Territory, Queanbeyan and Palerang Shire (i.e. Bungendore). The other (non-gas) operations of ActewAGL are not considered here.

In relation to gas supply, this Capacity Management Strategy and Plan (CM Strategy) excludes considerations of capital expenditure for new estate development i.e. the costs associated with the installation of direct gas infrastructure to supply new housing estate areas, termed "**market expansion**". However, CM does include considerations of network augmentation where the connection of these new dwellings in the new estates would trigger significant pressure decrements in the rest of the network.

This CM Strategy summarises **Capacity Development** Projects, providing details only where projects are greater than $500k. This means that projects in medium pressure networks are summarised only, as they are typically short runs of medium pressure main, and therefore at comparatively low cost. Details of these are to be found in the relevant Capacity Assessments.

1.2 STRUCTURE OF THIS CM STRATEGY

This document is structured as depicted in the Table 1 below.

Table 1: CM Strategy and Plan Structure

Theme	Sections
1. The AAD Partnership	• The AAD Distribution Partnership • AAD's strategic objectives
2. The Strategic Context	• Drivers of Asset Management • The AAD Network • AAD's Gas volumes and customers, an overview
3. Capacity Planning	• Capital Expenditure on Networks • Drivers of Capacity Management • Jemena's approach and process to CM • CM and Risk Management
4. AAD's Networks, Growth and Projects	• AAD's Primary Mains and Projects • AAD's secondary mains and projects

2. TECHNICAL REQUIREMENTS

2.1 AUSTRALIAN STANDARDS

This CM Strategy allows for structured design process, appropriate to the requirements of the specific pipeline to ensure that all safety, performance and operational requirements are met during the design life of the pipeline as per the appropriate AS.

Number	Title
AS2885 2008	Pipelines – Gas and Liquid Petroleum
AS4645 2005	Gas Distribution Network Management

2.2 JEMENA TECHNICAL POLICIES AND PROCEDURES

This CM Strategy plans for efficient management of network infrastructure to support changes in gas demand. All proposed designs are revised against known assumptions (design input and projected design provisions) and verified by computer models as per TPG.DES.020 and TPG.DES.040.

Policy	Title
TPG.DES.010	Distribution Network Operating and Metering Pressures
TPG.DES.020	Network Supply Performance Validation
TPG.DES.040	Distribution Network Capacity Planning Criteria
TPG.MAT.010	Approved Materials List for low and medium pressure systems (MAOP<500kPa)

TPG.DES.010, TPG.DES.020 and TPG.DES.040 are included as an Appendix to this document.

2.3 OTHER KEY REFERENCE DOCUMENTS

Jemena is governed by a hierarchy of controls that are codified in specific strategies, plans and manuals. The most relevant of these for Capacity Assessments are specified in this section. The specific version of each is footnoted where the document is cited.

Document Title
ActewAGL Asset Management Plan
ActewAGL Capacity Management Strategy
ActewAGL Risk Management Manual
ACT Territory Plan
ACT Planning and Development Act (2007)

3. OTHER CONSIDERATIONS

3.1 STAKEHOLDERS

There are many stakeholders to the AAD gas networks. The most directly involved are:

Key Internal Stakeholders (Jemena)

- Asset Management;
- Asset Strategy Gas
- Network Development;
- Engineering;
- Capital Projects.

Key External Stakeholders

- ACT Territory and Municipal Services;
- Roads ACT;
- National Capital Authority (NCA);
- ACT Environment and Planning Directorate (Was ACTPLA);
- NSW RMS (Bungendore, Queanbeyan networks);
- Queanbeyan City, Shoalhaven City and Palerang Shire Councils in NSW;
- Customers of the networks.

4. OBJECTIVES

4.1 INTRODUCTION

This Capacity Management Strategy outlines the standards, processes, priorities and major capital expenditure projects for Capacity Management to achieve capacity and service level targets on AAD's gas distribution assets for a 20 year period. This 20 year period is based on winter 2013, and therefore extends to winter 2033.

4.2 AAD DISTRIBUTION PARTNERSHIP

The AAD Distribution Partnership (AAD DP) is the entity which owns, plans, develops, constructs, operates and maintains the electricity network in the Australian Capital Territory (ACT) and the gas networks in the ACT and south east NSW.

Jemena delivers services to the AAD DP via Jemena Asset Management (JAM) and the Distribution Asset Management Agreement (DAMS).

This Capacity Management Strategy and Plan is concerned only with ActewAGL's gas distribution assets.

4.3 AAD'S STRATEGIC OBJECTIVES

The business objectives of AAD Distribution are:

- ActewAGL Distribution intends to meet all regulatory requirements, including commercial, safety and environment;
- ActewAGL Distribution wants to be known as a reliable deliverer of energy to retailers;
- Timeframe Planning: Planning for the network has a six year perspective (with a two year focus) to give an indication for the next access arrangement period;
- Reputation: The network should be commercially managed in such a way that it will not negatively impact ActewAGL Distribution's reputation;
- Commercial Growth: ActewAGL will respond to all prudent commercial customer growth requirements;
- Growth in the residential and **I&C** volume segment to continue through appropriate marketing schemes;
- Profitable growth opportunities outside the budget will be pursued;
- ActewAGL's Strategic outlook to 2022 aims to build, own, operate and maintain alternative generation assets including natural gas co-generation facilities. These co-generation plans are noted but not reflected in this plan as they will be addressed on a case by case basis at the time they are raised. Capacity is available at various network locations.

4.4 JEMENA'S APPROACH TO ASSET MANAGEMENT

Jemena has an overall Asset Management System and Strategy within which the process and practice of Capacity Management Plan is a key element.

In providing services to ActewAGL distribution, Jemena applies its Asset Management System and strategy.

The Asset Management System provides guidance to establishing work programs focused on enhanced safety, performance and efficiency. It brings together the external influences, asset management drivers, business values and selected strategies to deliver sustained performance for the benefit of all stakeholders.

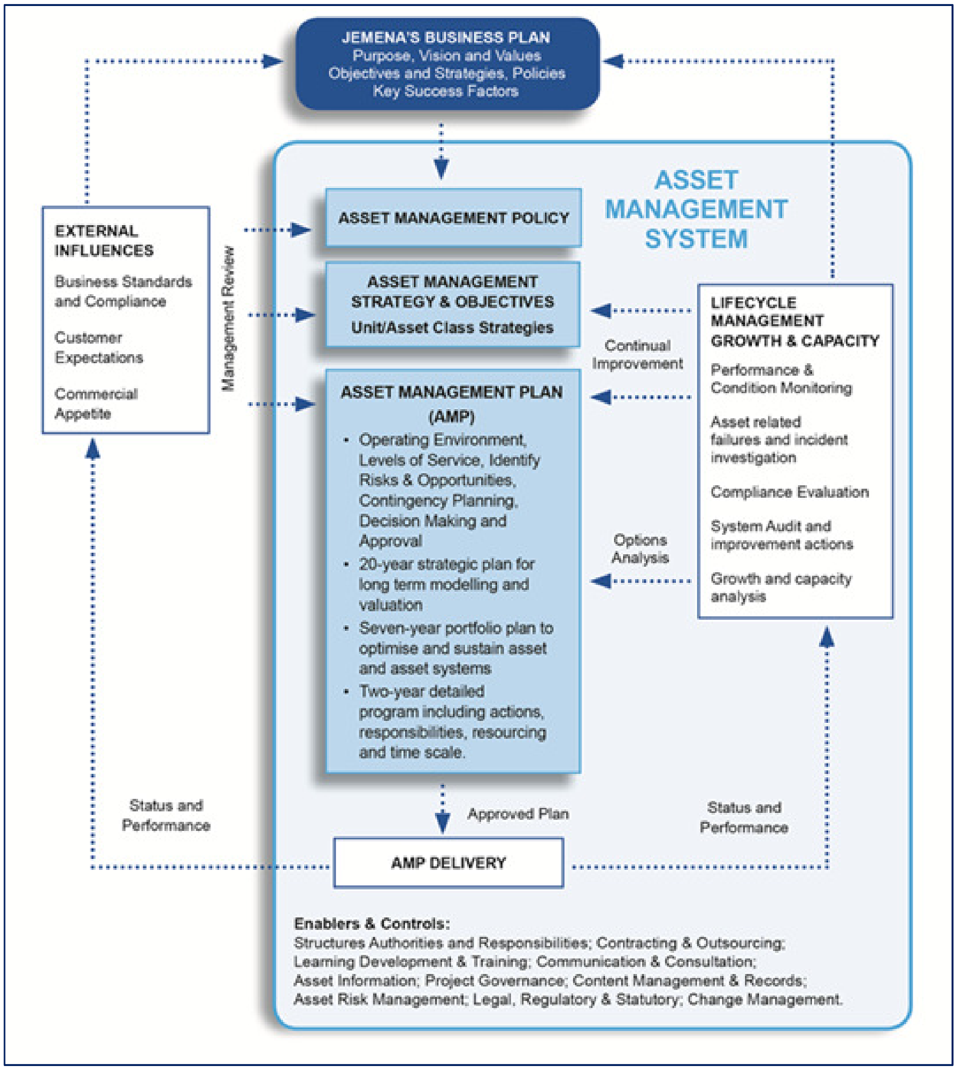

Figure 1: Jemena's Asset Management System

The Asset Management System is summarised above. The interactions of Asset Management and Capacity Development are explained in more detail in Section 6 below.

5. DRIVERS OF ASSET MANAGEMENT

5.1 INTRODUCTION

AAD exists to supply customers, residential or industrial and commercial (I&C), with gas in a reliable, safe and controlled fashion. The standard to which this may be done is in turn is governed by three considerations:

1. Community expectations;
2. Network capacity;
3. Changes in demand for gas over time.

5.2 COMMUNITY EXPECTATIONS

AAD's community of external stakeholders is diverse, including:

- Customers, both residential and industrial/commercial;
- Network users and network suppliers;
- Gas distribution industry regulators;
- ACT government entities, including development, planning, roads and environmental entities;
- The broader community who may be impacted by AAD's gas distribution activities.

As the provider of gas distribution services, AAD is expected by the community to manage within considerations of:

- Environmental responsibility;
- A safe and reliable level of supply;
- Responsive service;
- Enhanced public amenity;
- Common levels of service available to all consumers; and
- Affordable pricing.

5.3 NETWORK CAPACITY

Network capacity is concerned with maintaining supply at specified minimum pressure thresholds at periods of peak demand. Network capacity is driven by:

- Customers' consumption of gas at times of peak demand, typically cold winter mornings and evenings;
- Integrity of the pipelines;
- Regulatory compliance, including Health and Safety;

- Network topology;
- Capacity constraints;
- The age of the pipelines;
- New and changing sources of supply.

5.4 CHANGES IN DEMAND FOR GAS OVER TIME

The gas distribution network is constantly evolving to meet changing patterns in demand for gas. Gas demand must be considered at both an overall level (total volume of gas throughout the network and across time), and in terms of the impact of small-scale changes in localised areas of networks, which might mean a pocket of half a dozen houses. To think about this another way, the gas network as a whole does not run of gas; loss of gas impacts on small pockets of a network, and therefore small localities and individual customers.

5.4.1 FACTORS CHANGING DEMAND FOR GAS

Changes to total demand for gas across time are a result of a combination of factors:

1. New housing developments (i.e. major new housing estate developments on greenfield suburban sites, or what is termed “new estate market expansion”);
2. Changes to major gas users, largely connections, changes and disconnections of I&C customers;
3. Increasing gas demand driven by increasing urban density (through replacement of low density housing with medium or high density housing);
4. Changing demand profiles of existing consumers through changes in gas appliances and their mix of gas and non-gas appliances;
5. New connections in established areas, termed Electricity to Gas (E-G);
6. Changes to the relative perceived value of gas compared to electricity, caused by either changes to their relative cost or the impact of marketing campaigns by suppliers.

A key imperative in the future asset management of the network is to continuously meet these varying demands at the current level of service and maintain security of supply to explicitly identified risk levels by actively managing the capacity of the network.

5.4.2 IMPACT OF MARKET EXPANSION ON EXISTING NETWORKS

The costs of installing networks in new housing estates (“new estate market expansion”) are forecast and managed separately to Capacity Management. However, the impacts of any new housing growth must be progressively included in Capacity Management simulations to ensure any upstream or downstream impacts are understood and managed.

5.4.3 GAS DEMAND FORECASTS

Forecasts considering each of the above impacts have been developed for the AAD gas networks by Core Energy Group Pty Ltd. These show the forecast of total customer numbers and total gas demand in the Canberra region 2014 – 2021.

5.4.4 WHOLE OF AAD'S MARKET VERSUS LOCAL NETWORK CAPACITY

The demand, energy and connection forecasts developed by Core Energy are for the whole of AAD's networks and are designed to reflect the range of macro-scale factors that affect total annual gas demand and trends in connections. By contrast capacity management forecasts must anticipate gas demand in specific (i.e. localised) areas of any network.

A capacity management forecast reflects demand change in specific areas of a network which may not reflect trends in the network as a whole; some areas of the network may be relatively immature with significant growth from new customers as new estates are connected, while other areas or entire networks will be more mature and gas demand change will be at much lower rate, static or negative. Canberra's networks reflect these sorts of differences.

This means capacity management analysis must be conducted on a network-by-network basis, and capacity management decisions made on a street-by-street basis. There are methodological difficulties in accurately identifying changes in demand for gas from the development of new estates compared to underlying changes to demand by established customers when both changes are occurring simultaneously in any network. This in turn impacts on forecasting of peak flows, which is driven by the total number of residential customers on the network, and their propensity to use gas at the same time.

5.4.5 PEAK DEMAND VERSUS AVERAGE DEMAND

The critical consideration in Capacity Management in any local area is not the total or average annual demand, but ***temporal peak demand***. Temporal peak demand simply means the time at which demand for gas is at its peak, be that an hour or a minute. If temporal peak demand causes gas pressure to drop below critical pressure thresholds, customers' gas appliances cease to operate.

In Canberra, management of temporal peak demand is particularly important because the peak is so significant. It occurs on Canberra's cold winter days, in the morning and evening, when domestic use of hot water and heating is at its highest.

AAD manage their networks with the objective of maintaining supply to all their customers. This means maintaining gas pressure for each minute of each hour of the weekday coldest winter morning or evening, which is when the largest numbers of customers are drawing down gas at the same time. What determines available gas pressure is the absolute number of customers simultaneously using their gas appliances and consuming gas during that cold peak period. Capacity management must manage gas pressures to supply peak demand rather than average or total demand.

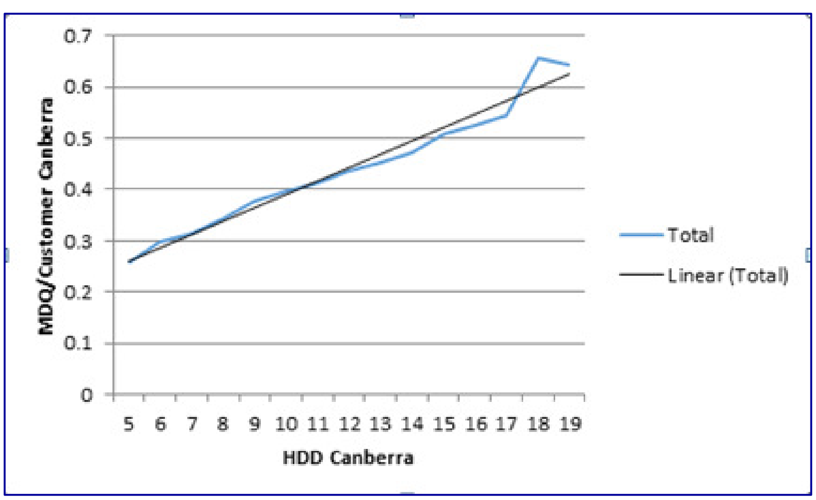

Figure 3: Average MDQ by HDD, Canberra 2003 - 2013

The above chart is drawn from the historical record of daily gas consumption in Canberra winters (June-August) 2003-2013.

The standard measure of "coldness" is Heating Degree Days (HDD), which measures the difference between a normed temperature (18.3 degrees Centigrade) and the average of minimum and maximum temperatures on the day. So a larger HDD value means a colder day.

In the above figure, holidays and weekends are excluded, as gas consumption peaks are much less accentuated on those days. Very clearly, the colder it gets, the greater the consumption of gas by the average Canberra customer. Therefore, the more customers there are on a network, the greater the peak on these cold days.

Maintaining supply to all customers at that peak time is the major challenge of capacity management. For this reason, CM forecasts peak gas demand via forecasting changes to the number of customers in the network. This in turn has methodological challenges in that the extent of housing development and infill development and more particularly the rate at which it occurs is difficult to forecast precisely.

Compared to milder climates like Sydney, Canberra has both higher average usage, and higher peak usage. This is caused by the proportion of gas used by central heating in Canberra, which creates a distinct spike before and around dawn on cold winter mornings; gas use by instant HWS then accentuates that spike some time later. The peak dies away later in the morning as instantaneous HWS and then central heating is shut down for the day. Mathematically, the relative "peakiness" in Canberra can be proportionally lower than that of Sydney, due to the Canberra customers' higher average usage.

5.4.6 TRENDS IN PEAK AND ANNUAL VOLUMES

Jemena's experience and the Core Energy Group modelling show that ***peak usage*** is growing at a different rate than ***annual and average usage*** and has been for some years. This appears to be a result of customers replacing their existing gas appliances with more efficient models. This is particularly true where instantaneous hot water units are replacing storage hot water units. Instantaneous hot water units are inherently more efficient than storage units because water is only heated to the required temperature as it is needed (typically round 45^0 Celsius) rather than the storage temperature (typically 65 – 80^0 Celsius) and because it is heated as it is used rather than stored, thus avoiding heat loss during storage. However, the downside of this overall efficiency gain is that gas demand is subject to significantly larger fluctuations, and gas flows peak at much higher rates in peak periods.

Table 2 below shows a hypothetical example, based on currently-available water heating technologies.

Table 2: Comparable Gas Consumption for Hot Water[1]

		Storage Hot Water	Instantaneous Hot Water	% Difference
Hourly consumption	MJ	9.7	30.9	218
	s m3/h	0.3	0.8	218
Hours used		2.5	0.5	-80
Daily Consumption (MJ)		24.2	15.4	-36

There are two important points to note from the above table:

[1] Based on two 15 minute showers of 50 litres each.

- The instantaneous HWS uses in total approximately 2/3 the gas of the storage HWS, leading to lower total volumes of gas per period; and
- The instantaneous HWS uses the gas at more than ***twice the rate*** of the storage HWS when in operation, causing a significantly higher peak flow. Showers are typically taken at times of peak periods (mornings and evenings), so conversion from a storage hot water service to an instantaneous one will accentuate the existing peak gas demand in an area.

5.4.7 IMPACT OF NEW TECHNOLOGIES IN NEW ESTATES

Jemena expects that in areas where there is significant new estate development, demand will be more “peaky” as customers install modern high efficiency gas appliances, i.e. the proportion of more efficient technologies will be high. In contrast, more established suburbs will see a progressive replacement of older, less efficient gas appliances with more efficient high demand capacity ones, i.e. the proportion of efficient technologies will be lower.

The gas distribution network is constantly evolving to meet these changing needs. Load growth drives system reinforcements and new connections require continuous extensions to the network. Changing patterns of gas use also require alterations to the existing network and sometimes decommissioning of parts of the network.

In the capacity development planning phase, a key driver is to maximise the utilisation of the existing network such that capital expenditure requirements to meet the changing demand are minimised, while maintaining adequate security of supply. Feasibility assessments are performed to review network growth options to arrive at optimum solutions.

5.4.8 CANBERRA’S COLD DAYS AND WINTER SEVERITY FORECASTING

There is another consideration in Capacity Management that is limited to regions subject to periods of intense and sometimes sustained cold weather like Canberra or Orange. Any cold day drains reserve gas from the primary and trunk mains (“Linepack”). Typically, this loss of gas is made up when the weather warms up during the day and temporal gas usage declines below the replenishment rate. Canberra in particular can have a sequence of cold days that drain all reserve gas from the network and exacerbate the risk of loss of supply. This happened in Canberra in 2006, when a sequence of three unusually cold days saw pressures in the network at very low levels due to extended gas use. This one of the reasons that modelling on Canberra networks is on the basis of a one in twenty winter severity, rather than one in ten as is the case in Jemena’s largely coastal networks.

6. CAPACITY MANAGEMENT AND DEVELOPMENT

6.1 INTRODUCTION

This section provides an overview of the philosophy, processes and criteria that underpin the capacity management and capacity development activities for the network.

It is important to understand the meaning of two terms used in capacity management.

Capacity Management

Capacity Management is the ongoing, proactive monitoring and forecasting of network pressures across networks to ensure local gas pressures are capable of supplying demand in every local area at specific future points in time.

This is the principal work function of Jemena's Capacity Management team.

Capacity Development

Capacity Development is the design and implementation of cost-effective network augmentation projects to meet forecast increases in peak demand at a local level. Capacity Development is an engineering and risk management process that grows from the monitoring work of Capacity Management.

6.2 CAPITAL EXPENDITURE ON NETWORKS

Capacity related capital expenditure on AAD's gas networks may be incurred for one of three reasons:

1. Market expansion;
2. Mains and services renewal;
3. Capacity development.

6.2.1 MARKET EXPANSION

Expenditure in this category covers the cost of mains, services and meters and associated equipment required to meet market growth and new connections to the network. The main types of new connections are:

- Electricity to Gas **E-G** conversions where the connection is to a pre-existing main passing the customer's premises;
- New estates where gas infrastructure is installed and connections are made as dwellings are completed;
- Medium density residential developments; and

- Mains extensions where the network is extended to connect one or more new customers, most often at the request of the customers, residential or I&C.

6.2.2 MAINS AND SERVICES RENEWAL

Mains and services renewal capital expenditure is required to:

- Ensure safety and integrity – generally through the replacement of mains and services that have higher than optimal levels of maintenance or do not meet current acceptable levels;
- Ensure consistent levels of service – where pressure restrictions affect the ability of consumers to connect or replace appliances, areas are renewed to provide equivalent levels of service to other network areas; and
- Capacity – where customers are restricted from connecting or where existing customers have pressure lower than that specified for network pressures.

Mains and services renewal expenditure is not significant in AAD's networks, as the networks were designed as an integrated whole and constructed in the 1980s, and are largely modern plastics. While this will change over time, there is no requirement for a rehabilitation programme to be undertaken on AAD's networks in the mid-term future.

6.2.3 CAPACITY DEVELOPMENT

Capacity Development, put most simply, is the design and implementation of engineering projects to existing gas infrastructure to meet increasing demand for gas in established areas. Capacity Development covers augmentation projects and other works, generally deeper in the network, required to support demand growth which is typically occurring at the fringes of the network. This may involve the installation of additional or higher capacity mains, and/or increasing the capacity of pressure reduction equipment. Capacity for this purpose is measured as the peak hourly flow rate that the network can deliver, as opposed to the daily or annual throughput of the network.

Capacity Development is directed towards meeting growth in peak hourly demand on the distribution network. Additional capacity is required to accommodate demand from new customers and to meet organic growth, that is, growth in peak demand from existing customers as they upgrade or add appliances. For example, continuous flow hot water appliances are characterised by more intense but short-term gas consumption than the storage hot water heaters installed historically. AAD has no control over organic growth and actively markets to promote customer-initiated new connections.

6.2.3.1 Security of Supply Considerations

Security of supply refers to cases where for reasons of local geography, past network design or other aspects of network topology, customers are exposed to the risk of loss of supply in the case of a single point failure.

In general, capacity development decisions will take security of supply issues into account where possible; if a design can also create security of supply then that will be preferred. However, capacity development expenditure is rarely undertaken for security of supply reasons alone.

6.3 PRINCIPLES OF CAPACITY MANAGEMENT

Jemena has four key capacity management principles.

6.3.1 TELEMETRY AND SEASONAL GAUGING

Jemena will install network telemetry for monitoring the performance of networks as well as for operational and maintenance needs. Location of telemeters is based on the configuration of the network, as well as the type and distribution of customers. Alarm settings and telemetry requirements are reviewed as part of the capacity management and planning process.

In the absence of telemetry measurement, a sampling process of seasonal gauging is conducted at points identified as at risk in the network. This sampling process is decided annually and conducted through the winter.

6.3.2 DESIGN FOR SUPPLY REDUNDANCY

Jemena, as a business practice, will plan for "backfeeds" to create redundancy of supply wherever possible, including consideration of the capacity of the regulators available to the network. Most new estate areas are designed with one regulator per 3,000 - 5,000 customers and interconnections with the surrounding areas.

6.3.3 FIELD – IDENTIFIED INTERCONNECTIONS

Jemena will initiate mains interconnections at specific network locations as identified by field personnel, with the aim of reducing the risk of loss of supply from third party incidents in a proactive way where possible. This may occur in:

- areas with heightened construction activity (e.g.: bridge and road widening) where a short interconnection would significantly reduce the number of customers at risk in the event of a loss of supply;
- areas downstream of "high risk" isolation areas (e.g. shopping centres, village centres), where an isolation event cuts off supply to downstream properties;
- areas where the risk of erosion "washaways" for single feed mains is high.

6.3.4 OPERATIONAL MEASURES

From time to time, networks may be allowed to operate between the Design and Emergency Pressures when capacity development projects are extensively delayed, or to optimise capital investment. In these cases, contingency plans are in place, which may include additional operating expense activities. These are not long-term sustainable activities, as they create a higher likelihood of adversely affecting key performance indicators, namely **CHOS** (Customer Hours Off Supply) and response times for emergencies or incidents.

6.4 DRIVERS OF CAPACITY DEVELOPMENT

A requirement for a Capacity Development Project (**CDP**) generally arises as part of AAD's capacity planning cycle. Each year Jemena Capacity Planning engineers assess the level of utilisation of each AAD network to assess whether there are any changes to previous assessments requiring action. This is achieved by comparing annual gauging and telemetry information with the periodic validation of network models. These models have load growth forecasts (i.e. peak loads as compared to annual loads) applied to them to predict when there is a risk that network pressures will fall below acceptable limits and supply to customers be jeopardised, given forecast peak loads.

When a network is reaching the stage where the risk of loss of supply is becoming material, network augmentation options that eliminate this risk are identified and the process of business case approval commenced. As a general principle, timing of implementation is scheduled as late as possible, but not so late as to create unacceptable risk of loss of supply.

There may be cases where CDP projects have additional imperatives, such as improving security of supply or mains rehabilitation, as parallel benefits of a CDP, but growth in peak hour demand and consequent pressure decrement in the network is, almost universally, the primary driver.

There are several components of the peak demand growth ("Peak Demand Growth Components") that can lead to CDPs:

a) "Organic growth" or demand growth from established areas or customers. For established customers, this is through increases in the peak demand of existing customers, as a result of more appliances being added, conversion to higher capacity appliances, or household behaviour changes. Organic growth is also driven by housing redevelopment involving increased density, for example the conversion of a large residential block to a cluster of townhouses. This change in peak demand may or may not result in increases in annual volumes, as installation of high efficiency high capacity appliances, such as instantaneous hot water may lead to higher peaks but lower total volumes;

b) "Standard line-of-main" connections. These are "E-to-G"s that are located on line of main that demand less than $6m^3$/hour; these are connected "automatically";

c) Non-standard "line-of-main" connections. These are connections that require additional costs over a standard connection such as when a service is long or difficult. The additional costs above those of a standard service are charged to the customer;

d) Large "line-of-main" connections. These are "E-to-G"s that will not automatically be connected, but will require an assessment of the network's capacity to supply before proceeding with the connection;

e) Short Main Extension connections. These are customers that require a short main extension. These will require an assessment of the network's capacity to supply before proceeding with the connection; and

f) New growth areas. These are new estate areas. The capital expenditure includes costs of laying main extensions to the new estate, within-estate mains and service connections. These will require an assessment of the network's capacity to supply before proceeding with the connection.

6.5 JGN'S APPROACH TO CAPACITY MANAGEMENT AND DEVELOPMENT

6.5.1 INTRODUCTION

Jemena recommends investment to AAD in capacity development projects for the following reasons:

- Supply security and maintenance of supply reliability; and
- To maintain its capacity to supply existing services.

The timing of project implementations are confirmed through monitoring of network pressures, with the intent of maintaining network pressures above minimum design pressure.

6.5.2 CAPACITY MANAGEMENT IN THE ASSET MANAGEMENT CYCLE

Capacity management works within the larger asset management cycle. In Figure 2 below, the grey and blue areas of the circle are the domain of capacity management.

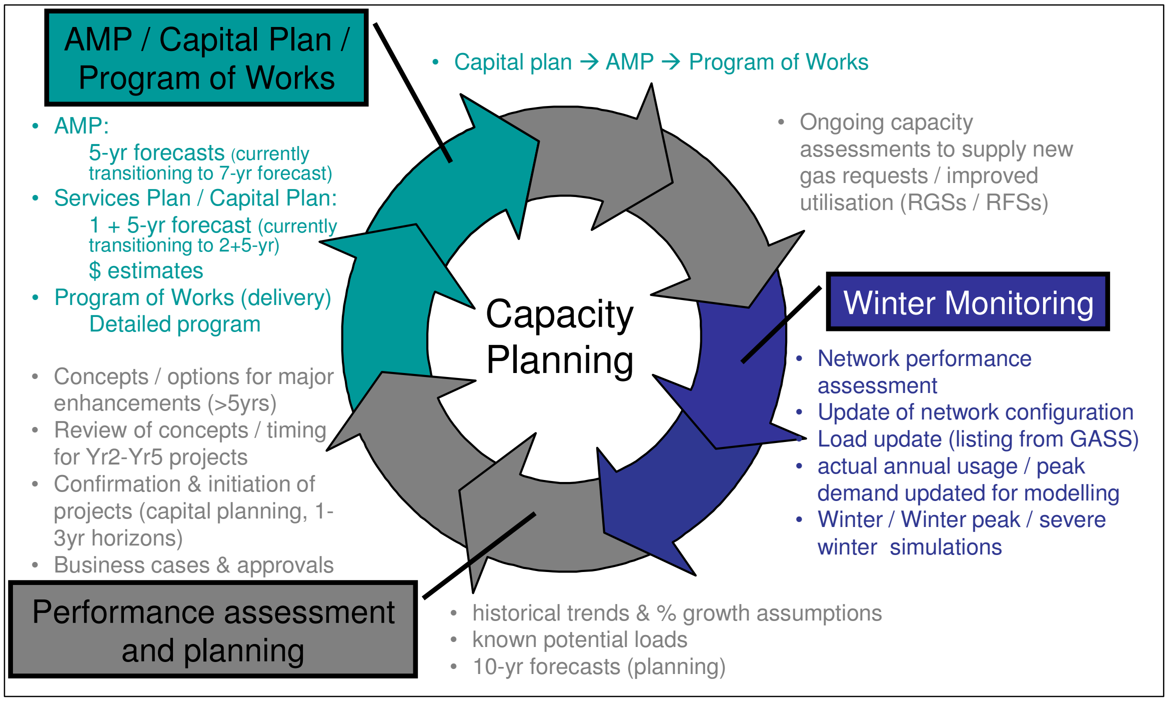

Figure 2: AAD Capacity Management Cycle

6.5.3 JEMENA'S CAPACITY MANAGEMENT CAPABILITY

Capacity Management is a highly specialised engineering discipline. Jemena performs AAD's capacity management function on its behalf. This gives the advantages of resource scale economies, and permits the development of shared learnings and enhanced CM processes.

Jemena has made the conscious decision to resource and support a team of expert managers of network capacity. Capacity Management and development are carried out in the organisation by a team of skilled and experienced Capacity Planning Engineers, whose key task is to understand, manage and ***own*** the capacities, opportunities and challenges of networks in the Region allotted to them.

To this end they must be thoroughly familiar with each of their networks; they are "the first point of reference" for their network in Jemena. Their job purpose statement is below.

Capacity Planning Engineer Job Purpose.

This role reports to the Capacity Planning Manager and is a specialist position responsible for planning expansion/modification and long term configuration of the gas supply network to meet customer supply requirements, while optimising cost, capacity and reliability, reducing losses and contributing to strategic network development.

In Jemena, there is one specialist Capacity Planning Engineer, whose primary focus is AAD's gas networks.

One of the advantages of having this role in Jemena rather than AAD is that the individual may learn from other Capacity Planning Engineers, which they would not be able to do if isolated in Canberra.

6.6 THE PROCESS OF CAPACITY MANAGEMENT

6.6.1 INTRODUCTION

The process of Capacity Management is a continuous one; the networks require a cycle of review and assessment on an ongoing basis as shown in the table above. It is known that customer numbers in some medium pressure networks are growing very slowly, but there are others whose growth in customer numbers is significant. This means that Capacity Management must monitor network pressures in all medium pressure networks at least annually when demand is at a peak. This drives capacity management inputs into the Asset Management Plan.

6.6.2 ASSET MANAGEMENT PLANNING CYCLE

The AAD Asset Management Plan (**AMP**) is the document that sets all priorities for AAD's assets. More importantly, it is the realisation of the shared asset management planning process.

The AAD AMP is updated annually within a planning cycle which sequences the Preliminary (Draft) AMP and Draft Program of Work as the input to the budget. The final approved AMP is updated to be consistent with the approved budget. The final updated two year program of work is issued for continued planning and delivery.

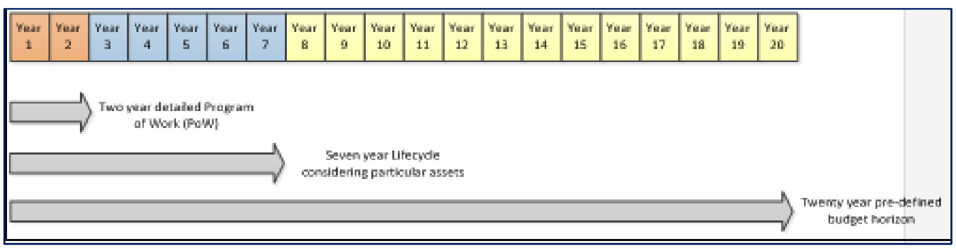

Figure 3: Asset Management System Planning Timeline

The FY16 AMP is scheduled to be signed off by AAD in June 2015. The annual process and deliverables supporting the AMP as presented to AAD are summarised below. These schedules will be harmonised with AAD and Jemena for future years.

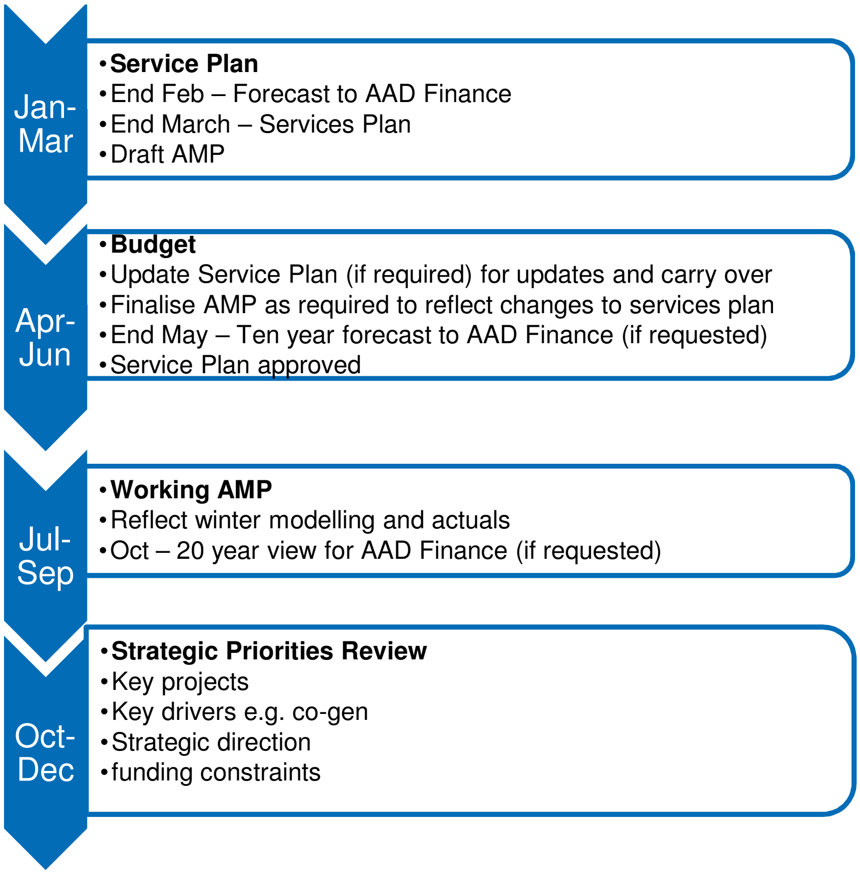

Figure 4: AMP Annual Cycle

The schedule of activities included in the Program of Work (under development) considers the following sequencing of Front End Engineering Design (**FEED**)/planning activities for all non-standard projects (capital and operating) requiring detailed design. A longer term view of planning is being put in place to support timely planning, prudent assessment and efficient delivery. This is summarised in the below diagram.

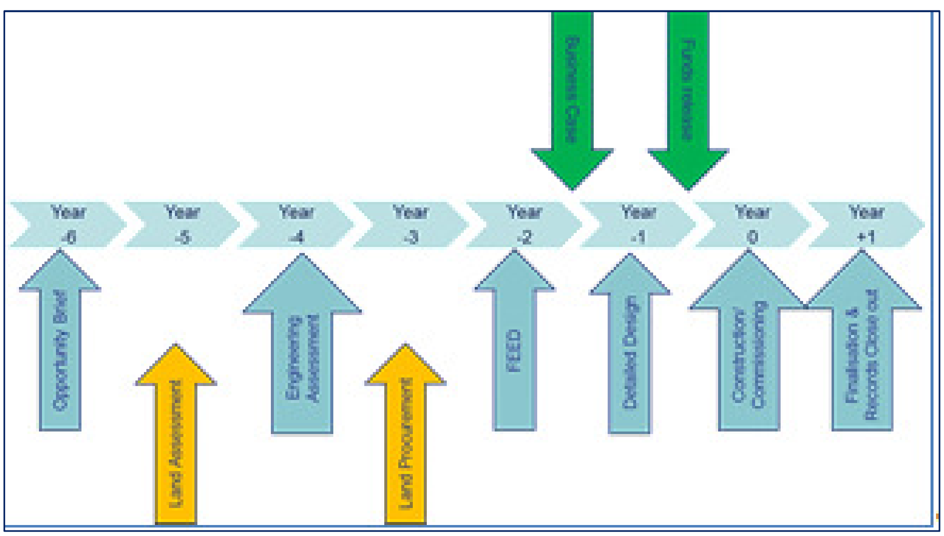

Figure 5: Phases of Planning Activities

6.6.3 CAPACITY PLANNING INPUTS AND OUTPUTS

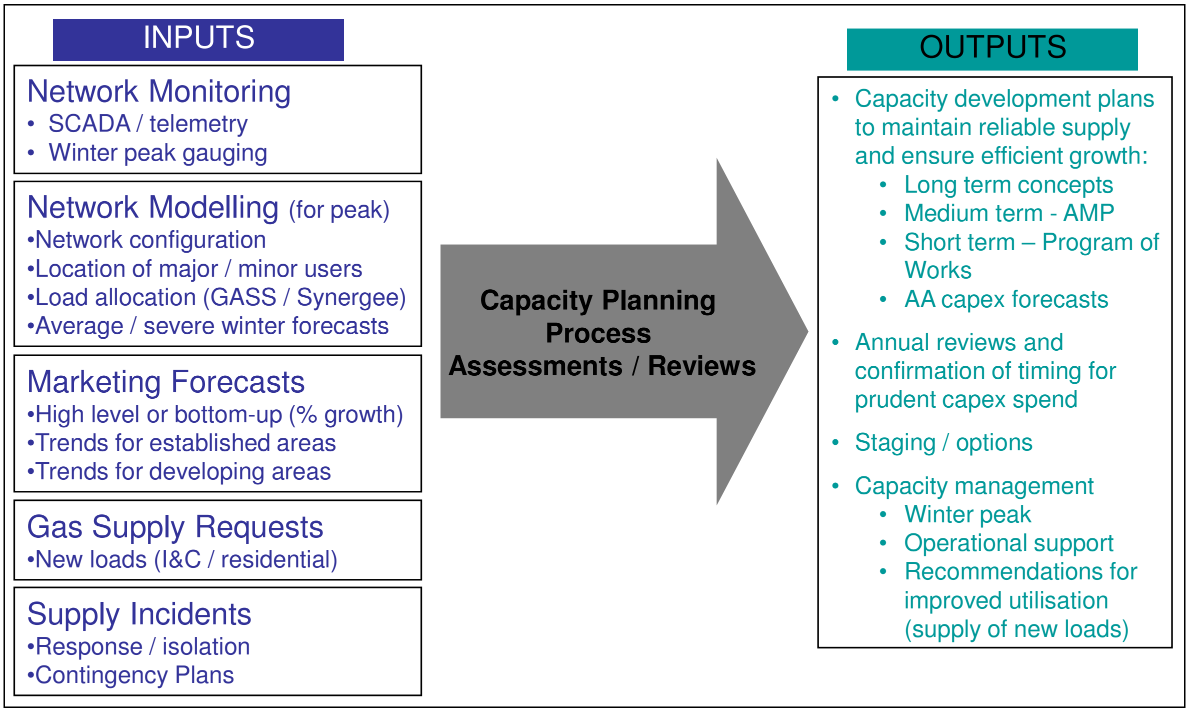

Figure 6: Capacity Management Inputs and Outputs

As illustrated in the above figure, the Capacity Planning process uses the following inputs and outputs:

- Network pressure monitoring – collecting data from SCADA, telemetry and winter pressure gauging;
- Network modelling – including validation against actual measurements and forecasts;
- Local network forecasts – includes top down and bottom up forecasts, load and customer growth trends in established and developing areas;
- Review of trends in gas supply requests; and
- Review of poor/loss of supply statistics.

Outputs of the Capacity Planning process are:

- Risk-based capacity assessments based on network monitoring and modelling;
- Capacity development plans for short term (2 year program of works), medium term (6 year Asset Management Plan) and long term conceptual plans (20 years);
- Annual review and confirmation of timing for prudency assessment;
- Consideration of staging options; and
- Capacity management reviews for winter peak management, provision of operational support and recommendations for improvement of network utilisation.

THE PROCESS OF CAPACITY MANAGEMENT

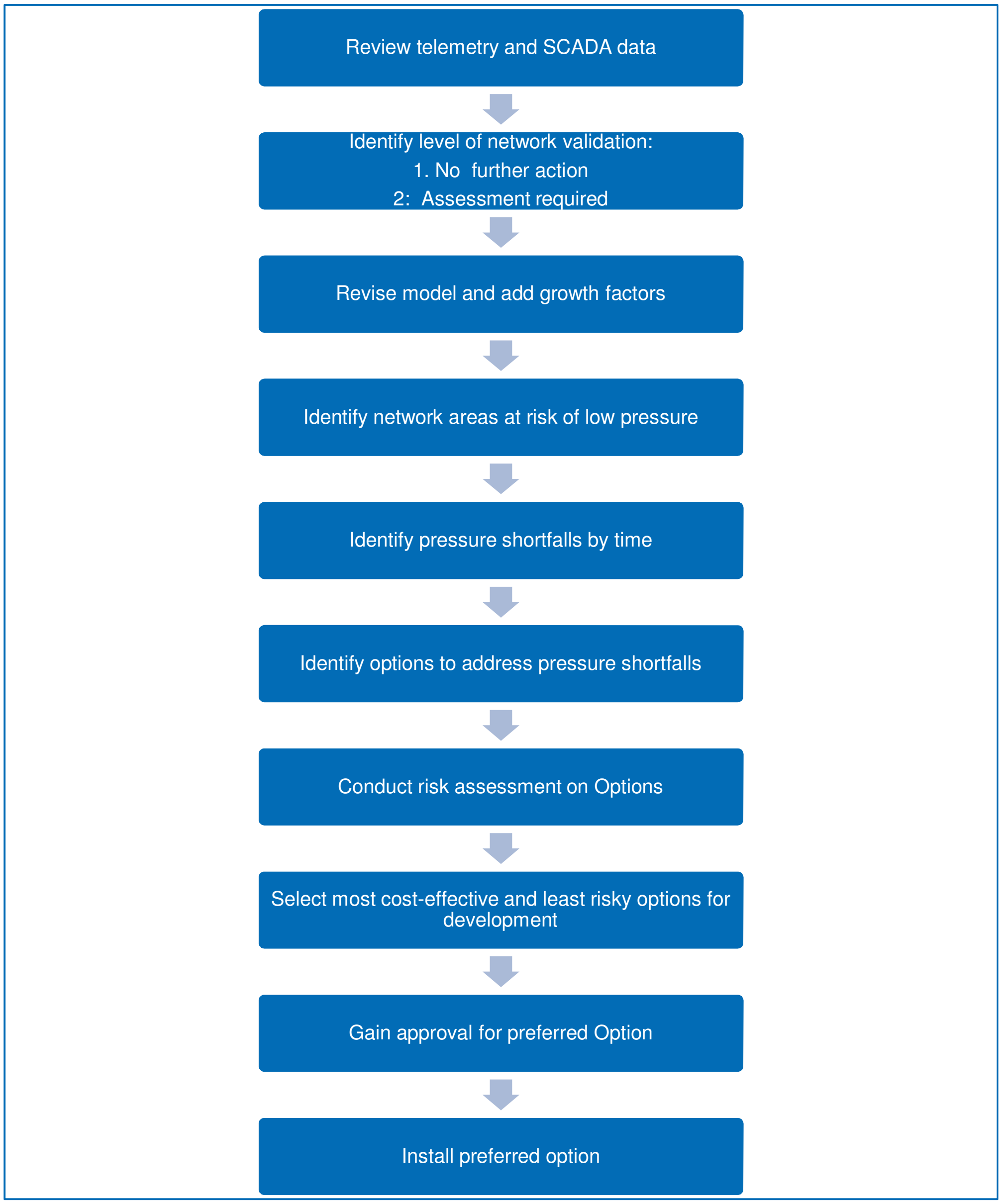

Figure 7: The Process of Capacity Management

6.6.4 CAPACITY MANAGEMENT DECISION-MAKING

6.6.4.1 Introduction

Capacity Management is driven by forecast increases in peak demand reducing network pressures below critical thresholds. These changes of demand, in most cases, occur incrementally as customer numbers increase in parts of any network; even if their approximate final magnitude is known in advance, the rate of addition is not known and the severity of any winter unpredictable in time to implement projects. For example, housing construction in a greenfield housing development may occur over a number of years; the larger the development, the more time elapses for buyers and builders to complete the houses in the development. This means the demand for gas increases at a linear rate, rather than as a step change.

For this reason, capacity development of any significant scale is almost always staged to match a forecast rate of demand change. This may be, for example, by progressive extensions of a medium pressure network as gas demand increases, with a later extension of a secondary main and regulator to augment capacity and maintain reliability of supply in the downstream MP network.

There are cases where housing developments have taken 15-20 years to complete, and capacity developments have matched that growth over two or three AA cycles. One of the key roles of Capacity Management is to estimate the rate of change and therefore the rate of demand growth, year by year, adding an augmentation project at the time when that incremental growth exposes areas of the network to the risk of loss of pressure.

6.6.4.2 Peak Flow Rate

Capacity development is the process of expanding the capacity of the gas network when capacity monitoring and forecast modelling forecast the need to do so at a future point in time. Capacity for this purpose is measured as the ***peak flow rate*** that the network can deliver, as opposed to the annual, average or daily throughput of the network. This is discussed in Section 5.4.
The complication for capacity management purposes is that peak hourly flow rates are not recorded in metering equipment so must be calculated from data that is captured. The methodology for doing this is at Appendix A.
CM is required to maintain supply to existing customers within Jemena's minimum pressure requirements based on historic network performance measures and to ensure the ongoing reliability and integrity of the network. Capacity development involves installing additional or higher capacity mains, and/or adding new regulators.

6.6.4.3 Pressure Loss Risk Minimisation

In Canberra, compared to urban coastal NSW where most of Jemena's gas networks are, this "peakiness" is somewhat different for two reasons:

- In Canberra, heating is a much larger proportion of total gas usage than in milder climates (compare a Canberra house's average annual usage of 40 GJ p.a. with Sydney's 20-25 GJ p.a.). Home heating appliances have not been subject to the technological change seen in HWS, and this reduces the peakiness;
- In Canberra, outlying winter HDD values are larger; these are the uncommon days when households consume more gas in peak periods.

Due to the peakiness of the Canberra winter peak demand, AAD has as a policy that network capacity is modelled on the basis of a one in twenty winter (i.e. a winter of such severity that its probability of occurrence is 5% in any winter). This ensures that customers will not run out of gas at times of peak demand unless winter severity exceeds this threshold. By contrast, Jemena uses a one in ten winter severity in NSW.

6.6.4.4 The ACT's Planning Regime and Its Consequences

In the ACT, a more onerous legislative and planning framework governs utility network extension projects than elsewhere in NSW. The Territory Plan provides a policy framework that prescribes where gas mains may be installed (as a function of the zoning of the areas through which they are to be laid), and an assessment process, the rigorousness of which is a function of the size and pressure of the pipe being laid.

The consequence of this is that the lead time for planning approvals in the ACT is significantly greater than for comparable gas mains in the rest of NSW, and the route of the main is driven by the zoning of the areas though which it may pass. This in turn means that specific routing may be changed by the initial gazettal of zoning or changes to it, resulting in install costs higher than originally predicted. Additionally, a firm designed route cannot be established until planning subdivisions are completed, increasing the risk of changes delaying construction.

This can in turn also impact the seasonal constructions windows available, meaning that a project can be delayed a year or more. For this reason, just-in-time network extensions cannot be undertaken in the ACT.

The implication of this is that relatively rapid changes to projects that can be accomplished in NSW are not possible in the ACT. Capacity Management may be forced to implement projects earlier than would be the case to meet the ACT lead times and project window constraints.

6.6.5 CONSIDERATIONS IN PROJECT DESIGN

When a pressure shortfall has been identified as requiring action, Jemena's Capacity Planning Engineers consider three variables in the development of solutions to identified network pressure risks.

6.6.5.1 The Configuration and Condition of the Existing Network

The existing network configuration, its topology, geography, location and physical state are critical considerations in the development of options. For example, in the Queanbeyan network, the Molonglo river divides the eastern third of the network from the rest, meaning that capacity management decisions must always consider the few river crossings available, and consider security of supply where otherwise it might not be a significant consideration.

Driven by Canberra regional geography of parks, major road corridors and Lake Burley Griffin, most of AAD's medium pressure networks are distinct and not interconnected one with another. This is very different to most Sydney networks, and makes AAD network management much easier.

6.6.5.2 Timing of Project Implementation

As part of the assessment process, the rule is that the CDP will be implemented as late as can be prudently managed, balancing the timing of loss of pressure with the lead time required to implement the project.

Timing is driven by the structure of network optimisation modelling, which in turn is driven by:

- Changes in gas volume as a result of a forecast rate of "organic growth", which is derived from an analysis of historic growth in the network and the current rate of applications for new gas connections. Typical rates of organic growth range for mature residential areas range from 0.5% to 2.0%;
- Changes in demand as a result of significant housing or other customer developments in the network area.

6.6.5.3 The Cost-effectiveness of Potential Options

Capacity Planning Engineers develop alternative options that balance the benefit to the number of customers with the cost of implementation. The table below shows a sample set of options from the current Woden network Capacity Assessment.

Figure 8: Project Options and Scope (Example)

	Option 1	Option 2
Scope	Replace existing DR29 (1600 scmh) regulator with 3000 **scmh** regulator at same location.	Lay 650m extension of 250mm ST at the corner of Launceston St and Callam St. Install new DR and connect to 50mm NY at the corner of Yamba Dr and Wisdom St
Value	$140k	$800k (+/- 50%)
Customers Affected	• Approx 800	• Approx 800
Benefits	• Compliant operation of DR29 • Remove risk of drooping of outlet pressures • Lower capex	• Compliant operation of existing DR29 • Remove risk of drooping of outlet pressures • Additional source of supply into the network, for additional reliability of supply
Disadvantages	• N/A	• Introduces new asset and a maintenance profile • Greater capex expenditure

6.6.6 GAS PRESSURE SIMULATION MODELLING

Jemena uses **SynerGee** network optimisation software for network analysis and modelling. Future gas pressure modelling is central to capacity planning.

The growth data is entered into the SynerGee software, and simulations run on a "winterised" usage basis to model peak flows[2]. The latest possible year, the year in which gas pressures shown by modelling are first significantly below minimum pressures, is chosen as the year by which project installation must be completed

An example is shown below.

[2] In ActewAGL networks, based on risk assessments, a one in 20 winter peak is used. "1 in 20" means that the probability of being subject to a winter of that severity in any year is 5% (i.e. 1 in 20). This is the same as used by UK agencies, which face similar winter temperatures and fluctuations.

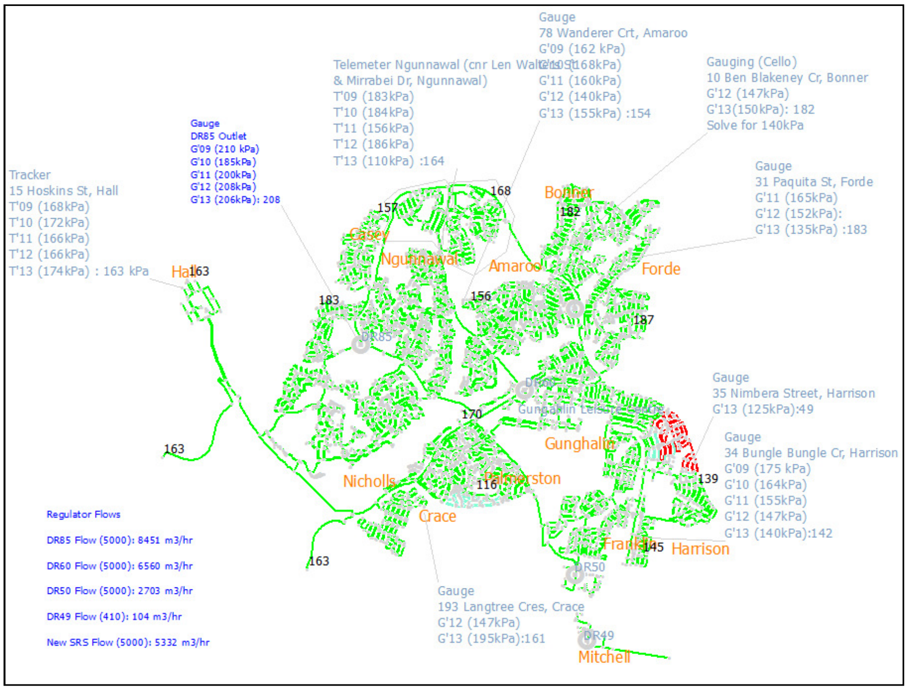

Figure 9: Synergee Gas Pressure Simulation (Example)

The SynerGee plot above shows a simulation of the Gungahlin network pressures forecast for winter 2016, given modelled growth in the network from 2013 (the winter base year) to 2016. In the map, pressures are colour coded, with satisfactory pressures showing in green, marginal pressures in blue, and unsatisfactory pressures showing in red (see the east of the simulation above, where pressures are forecast to be below the minimum 70 kPa set by TPG.DES.10).

In this case, the most efficient solution is to interconnect the upstream 110mm PE to the west of the low pressure area with the 32mm PE network via a short interconnection, as depicted in red below.

Figure 10: Gungahlin Anthony Rolfe Avenue CDP 2016

6.7 RISK MANAGEMENT AND CAPACITY PLANNING

In undertaking capacity assessments, Jemena's Capacity Management Engineers follow a structured risk assessment process, balancing considerations of:

- Operational matters of asset integrity and impact on customers;
- Regulatory and compliance, meeting policy and legal obligations; and
- Stakeholder considerations and reporting.

As part of the capacity assessment process, a structured risk assessment on each option is considered using AAD's risk framework. An example is shown in Appendix D.

7. SUPPLYING AND MANAGING AAD'S NETWORKS

7.1 INTRODUCTION

This section summarises the supply and engineering considerations in managing the gas network supplying the Canberra region.

7.2 CANBERRA NETWORKS SUPPLY POINTS

7.2.1 SOURCES OF SUPPLY

All the gas consumed by AAD's customers is sourced from other States and supplied to AAD via interstate pipelines. This supply comes from two sources:

1. The Moomba to Sydney Pipeline (MSP). The MSP transports natural gas from Moomba in South Australia, across NSW. The Dalton to Watson Lateral pipeline, owned by the Australian Pipeline Trust (APA Group), branches off the MSP and terminates at the Watson CTS;
2. The Eastern Gas Pipeline (EGP) to the east of Canberra, which transports natural gas from Longford in Victoria, through NSW and to Sydney. The AAD Hoskinstown to Fyshwick pipeline interconnects with the EGP at Hoskinstown CTS, and delivers supply into the network via the Fyshwick TRS.

Figure 11: Mains and Supply Points in the Canberra Region

7.2.2 CHANGE OF SUPPLY FROM MSP TO EGP

Historically, Canberra's gas supplies have been transported from the **MSP** via the Watson **TRS**. Around 2000, with the development of the EGP, the possibility of having more than one supply point became a reality. This has produced a number of potential wholesaler/commercial and engineering/security of supply advantages.

To date, a large proportion of Canberra's gas supply has been from the MSP via the Watson TRS, with gas from **EGP** via Hoskinstown TRS being used as a winter top-up. This situation is controlled by wholesaler nominations, not by engineering considerations.

From around 2011-12, the greater proportion of wholesaler nominations is moving from MSP to EGP, and the proportion of nominations via EGP may continue to grow in the future. This has consequences for AAD's network which are currently being assessed, but may include additional infrastructure development.

This development may entail further work at the TRSs, such as higher inlet pressures requiring heating and/or upgrade of pressure control facilities. As this requirement is driven by wholesaler nominations outside of AAD's control, discussions are currently underway to clarify how this might be best managed.

7.3 NETWORK TOPOLOGY

7.3.1 NETWORK INFRASTRUCTURE

AAD distributes natural gas from gas transmission pipeline receipt points (the TRS) to Canberra gas customers via a series of pipelines of descending sizes and pressures. Between the receipt points and the customer, gas pressure steps down from 6,895 kPa (the Primary), to 1,050 kPa (the secondary network), to 210kPa (the medium pressure networks) via a series of receiving stations and regulators.

The customer then receives gas via a meter at the appropriate pressure. Residential and small commercial customers are generally connected via medium pressure and low pressure mains, whilst larger commercial and industrial customers are sometimes connected via secondary mains.

This is illustrated in Figure 12 below.

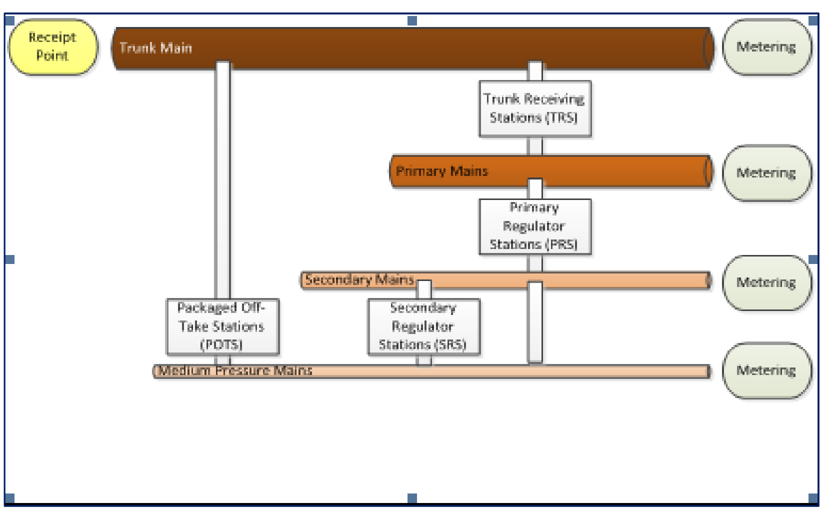

Figure 12: Network Configuration from Receipt Point to Customer

7.3.2 AAD NETWORK ASSET CLASSES

The network consists of approximately 4,500 km of primary, secondary and medium pressure mains. The lengths and magnitude of the various asset classes are shown in Table 3 below.

Table 3: AAD Network by Asset Class 1 July 2014

Network	Number[3]
Trunk Mains	30.3 km
Primary Mains	39 km[4]
Mains <=1050kPa	4,546 km
Trunk Regulating Stations (inc. POTS)	2
Primary Regulating Stations	5[5]
District Regulator Sets	90

7.4 NETWORK OPERATING PRESSURES

Jemena monitors and manages the AAD network operating pressures constantly. In doing so, for each class of main or pipeline, it monitors a number of different values. These are shown in the following table.

Table 4: Network Operating Parameters

Type	Description
Maximum	Maximum allowable operating pressure of the network
Regulator Set Point	Outlet pressure of the regulator that supplies the network; will be slightly below MAOP
Network Design	Outlet pressure of the regulators for simulation purposes; is set conservatively, i.e. slightly below Regulator Set Point
Normal System Minimum	The pressure point at which Capacity Management development projects are triggered
Emergency System Minimum	The network can go down to this pressure in emergencies with operational contingency plans in place.

The objectives of managing network pressures are to:

a) Maintain sufficient capacity to deliver volumes at agreed metering pressures to I&C customers;

b) Meet minimum inlet design pressures to ensure effective pressure control by DRS' feeding lower tier networks is maintained;

c) Maintain sufficient reserve capacity to ensure diurnal peaks in demand can be met; and

d) Maintain sufficient reserve capacity that relatively minor changes in peak demand do not require urgent remedial action.

[3] Based on The Asset Management Plan for the 2017-21 Access Arrangement Information for the ACT Gas Network

[4] Includes 5.6 km of primary main currently operated at secondary pressure

[5] Includes Hume PRS, commissioned February 2015

To this end, Jemena specifies pressure ranges to which its networks are designed and managed. The Networks operate within the parameters specified in the tables below.

Table 5: Trunk and Primary Main Operating Pressures

MAOP	Minimum Inlet Pressure Required	Normal Operating Pressure Limits			Emergency Pressure Limits		Standard Metering Pressures
		Regulator Set Point	Network Design	Network Minimum	Max Over-Pressure Set Point	Network Minimum	
14,895			12000				
6,895	3500	4300	4200	1750	4500	1500	Floating
1,050	1750	1030	1010	525	1155	400	100
210	460	205	200	70	230	40	2.75, 5, 35

JAM manages the AAD networks with the pressure ranges in the tables above.

The diagram below shows network operating pressures for two hypothetical secondary mains across time. Gas pressures on Network 1 (the black line) appear to be stable, with pressures rising and falling, within specified ranges, in the cycle of winters and summers. Network 2, shown as the red line, seems to have falling gas pressures over time, and at the winter peak demand the lowest pressures are close to normal system minimum pressures. In the case of Network 2, if additional growth is anticipated upstream, a severe winter once that growth has occurred will see existing customers at risk of loss of supply. This is a case in which Capacity Management would complete detailed analysis and develop cost-effective options to address the supply risk.

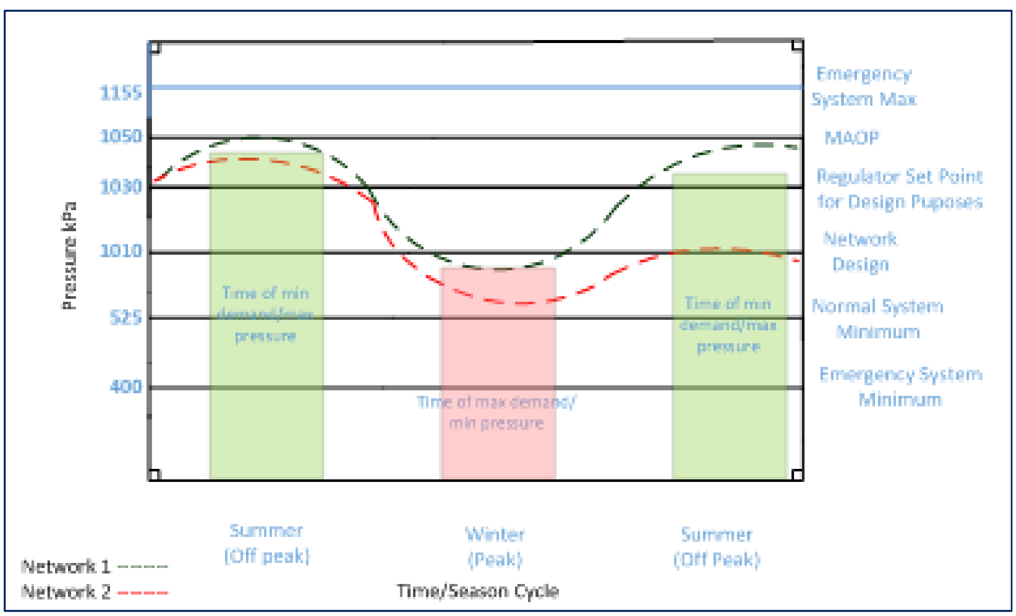

Figure 13: Network Pressure Ranges

8. AAD'S GAS VOLUMES AND CUSTOMERS

8.1 INTRODUCTION

This section provides a brief overview of AAD's customers and the volumes of gas they use.

8.2 AAD'S CUSTOMERS

AAD's customers are of two distinct types, and use gas for very different purposes, at different rates and at very different times of the day and week. This difference in customer type is critically important for CM, because customers must have gas available during their peak demand period, whenever that is and however long; households' peak usage is for hot water and heating is on cold winter mornings and evenings; most I&C customers entire use is during business hours.

There are few of what might be called heavy engineering or industrial customers on AAD's Canberra region networks. The largest single customer is the Australian National University, with gas consumption at around 200 TJs per year; by contrast a very large industrial customer may use ten times that amount of gas per year.

In any network, the presence of one or more large Industrial and Commercial (I&C) customers may bring with it significant capacity management issues. This is why large Industrial and some Commercial customers are often directly connected from the secondary or even primary mains, rather than the normal lower pressure mains.

Table 6: AAD Customer Typology

Customer	Gas Usage	Indicative Annual Volume	Comments
Residential / Domestic	• Home heating • Water heating • Cooking	~40 GJ	• Varies by type of dwelling • Varies significantly by season and region • Transition to reverse cycle a/c has seen the home heating component decline significantly
I&C	• Water heating • Steam raising • Cooking • Other various	variable	• Small commercial up to 300 GJ • Medium commercial 300GJ to 1TJ • Large commercial 1 – 10TJ • Large commercial or industrial > 10TJ • Examples of large commercial customers are: o Hospitals o Shopping centres o Commercial and office buildings o Universities

Residential gas usage demand levels are significantly affected by the weather and the season. Peak gas demand is in midwinter (June-August); average annual domestic gas usage is approximately twice as high in the Canberra region as it is in Jemena's coastal networks.

8.2.1 AAD GAS VOLUME TRENDS

The following table shows the recent pattern of total gas consumption in Canberra. Note that average domestic demand is declining somewhat, but total volume was increasing until the very mild winter of 2013.

Table 7: Recent patterns of Canberra Region Gas Consumption[6]

Load Type			Canberra Region Gas Volumes and Customers by Year						
			2008	2009	2010	2011	2012	2013	%Cmpd
Volume	Domestic	Annual Load (TJ)	4978.6	4947.6	5264.8	5394.1	5477.2	5152.1	0.7
		Average per Customer (GJ)	48.3	46.8	48.1	48.1	47.9	43.8	-1.9
		Number of Customers	103,079	105,808	109,510	112,147	114,260	117,670	2.7
	I&C	Annual Load (TJ)	1601.6	1562.3	1554.0	1623.2	1649.5	1517.0	-1.1
		Number of Customers	2,630	2,609	2,655	2,679	2,700	2,735	0.8
Demand	I&C	Annual Load (TJ)	1218.4	1218.4	1218.4	1218.4	1218.4	1218.4	0.0
		Number of Customers	41	41	41	41	41	41	0.0
Network Overall		Total Annual Load (TJ)	7798.7	7728.3	8037.1	8235.7	8345.0	7887.5	0.2
		Number of Customers	105,750	108,458	112,206	114,867	117,001	120,446	2.6

8.2.2 CUSTOMERS AND VOLUMES BY MEDIUM PRESSURE NETWORK

The numbers of residential and I&C customers connected to each of the medium pressure networks and their gas volumes for FY 2013 are shown below. The overall total of AAD's Canberra customers and the total of the table below are different because of the small number of I&C customers directly connected to the secondary network.

Table 8: Customers and volumes by medium pressure network FY 2013

MP Network	Volume Customers 2013						Demand Customers 2013	Totals 2013	
	Dom. Volume (TJs)	Dom. Custs	Avg Dom. Use (GJs)	I&C Custs	Un-defined Volume (TJ)	Un-defined Custs	Custs	Total Volume (TJs)	Total Custs
Belconnen	1,156.0	26,315	43.9	299	2.0	12	1	1,326.1	26,627

[6] From GASS records, all customers supplied through the AAD secondary mains, therefore including those supplied by downstream MP mains. Includes Bungendore and Queanbeyan network customers

Bungendore	31.4	862	36.5	6	-	2		37.8	870
Gungahlin	723.5	18,916	38.2	160	0.4	8	1	812.2	19,085
North Canberra	523.4	11,860	44.1	545	1.1	23		886.4	12,428
Queanbeyan	467.9	11,451	40.9	334	0.3	14		548.3	11,799
South Canberra	351.7	6,946	50.6	512	0.1	13	1	545.5	7,472
Tuggeranong	1,093.8	24,394	44.8	260	1.6	63	4	1,277.5	24,721
Weston Creek	327.2	7,503	43.6	63	0.1	8		357.7	7,574
Woden	452.3	9,407	48.1	181	0.2	4	1	620.0	9,593
TOTAL	5,127.3	117,654	43.6	2,360	5.7	147	8	6,411.5	120,169

8.3 FUTURE URBAN DEVELOPMENT IN THE CANBERRA REGION

8.3.1 INTRODUCTION

As discussed in Section 7, most network development in any network will be driven by the growth of new housing estates, or “new estate market expansion”. Strictly speaking, market expansion projects are funded separately, and not through Capacity Development projects. However, major housing expansion typically creates a requirement for secondary extensions, and the construction of such secondary extensions can have an impact on the rest of the network.

Additionally, while the timing of significant extensions is governed by changes to customer numbers from developments, the lead time of planning permissions in the ACT dictates that Capacity Management must monitor and manage these extensions and their timing and staging on an continuous basis.

Figure 14 and Table 9 below illustrate the distribution of future urban development in the Canberra region. Some AAD medium pressure networks will have areas of significant urban development, and some not at all.

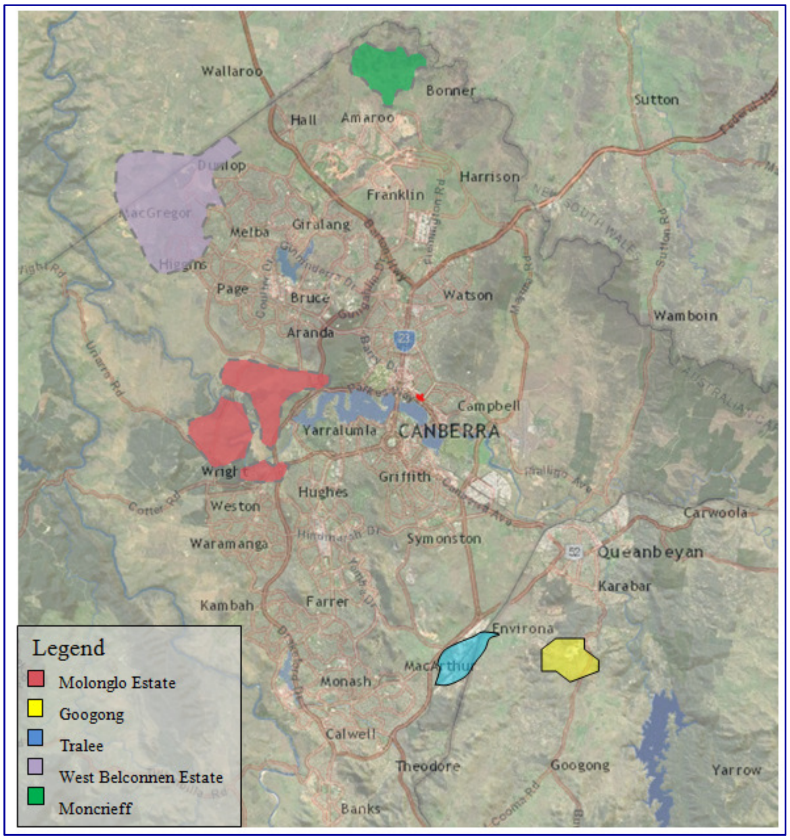

Figure 14: Distribution of Canberra Region Housing Development

Of these developments, the two most significant are Molonglo and West Belconnen; these developments are in the areas supplied by Weston Creek and Belconnen medium pressure networks respectively. However, these networks themselves will be impacted to a relatively small degree, as out lined below.

Table 9: Canberra Region Urban Development

Locality	Secondary Network Area[7]	Total Planned Dwellings	Dwellings to 2033[8]	Comments
Lawson	Belconnen	1,850	1,850	Redevelopment of disused military site near Belconnen Town Centre
West Belconnen	Belconnen	Over 8,000 on both sides of the border over the next 20-30 years	7,300	First block releases 2015. Development of 4,500 dwellings in ACT is firm and under planning; the larger housing developments over the NSW border are contentious and vague.
Molonglo	Weston Creek	16,000	15,800	Large multi-phased development through ACTPLA

7 These large scale developments will be supplied from secondary extensions rather than the medium pressure network itself

8 As allowed for in network pressure modelling

Locality	Secondary Network Area[7]	Total Planned Dwellings	Dwellings to 2033[8]	Comments
Gungahlin	Gungahlin	13,000	N/a	Large development in the NE of the ACT. Will have to be supplied by secondary extensions, of which two are planned.
Googong	Queanbeyan	Around 5,500 homes	2,500	A secondary extension was laid in 2013 to supply the first dwellings. Additional development will have no impact on the high pressure network, given the scale of development and the capacity of the secondary extension.
West Tuggeranong	Tuggeranong	Not specified	Not known	There has been some debate in Canberra about varying current **NCA** development plans and developing across the Murrumbidgee River west of Tuggeranong. At the time of writing, NCA have been asked to investigate the concept; no firm proposals have been received.

9. AAD NETWORKS AND FUTURE DEVELOPMENTS

9.1 INTRODUCTION

The following sections summarise AAD's gas networks. This summary includes each networks' current structure and significant future developments that will impact on the management of their capacities.

Some of the growth described in the summaries below will be associated with changes due to market expansion (i.e. the development of new housing estates on greenfield sites). However, the impact of market expansion housing development on medium pressure networks is that it frequently leads to potential pressure shortfalls in the secondary network upstream. To put this another way, the regions that have the most market expansion at this time also have the greatest need for capacity development projects in the medium to long term.

In this section, assets are split into:

1. AAD trunk and primary mains, operated at 12,000 and 6,095 kPa respectively and governed by AS 2885;
2. Canberra secondary networks, operated at 1,050 kPa, also governed by AS 4645;
3. Canberra medium pressure networks, most of which are operated at 210 kPa, and all governed by AS 4645;

Major proposed projects only are summarised. These projects are a synopsis of the Opportunity Briefs available separately. Estimates provided here are only high level indicative values.

9.2 AAD TRUNK AND PRIMARY NETWORK

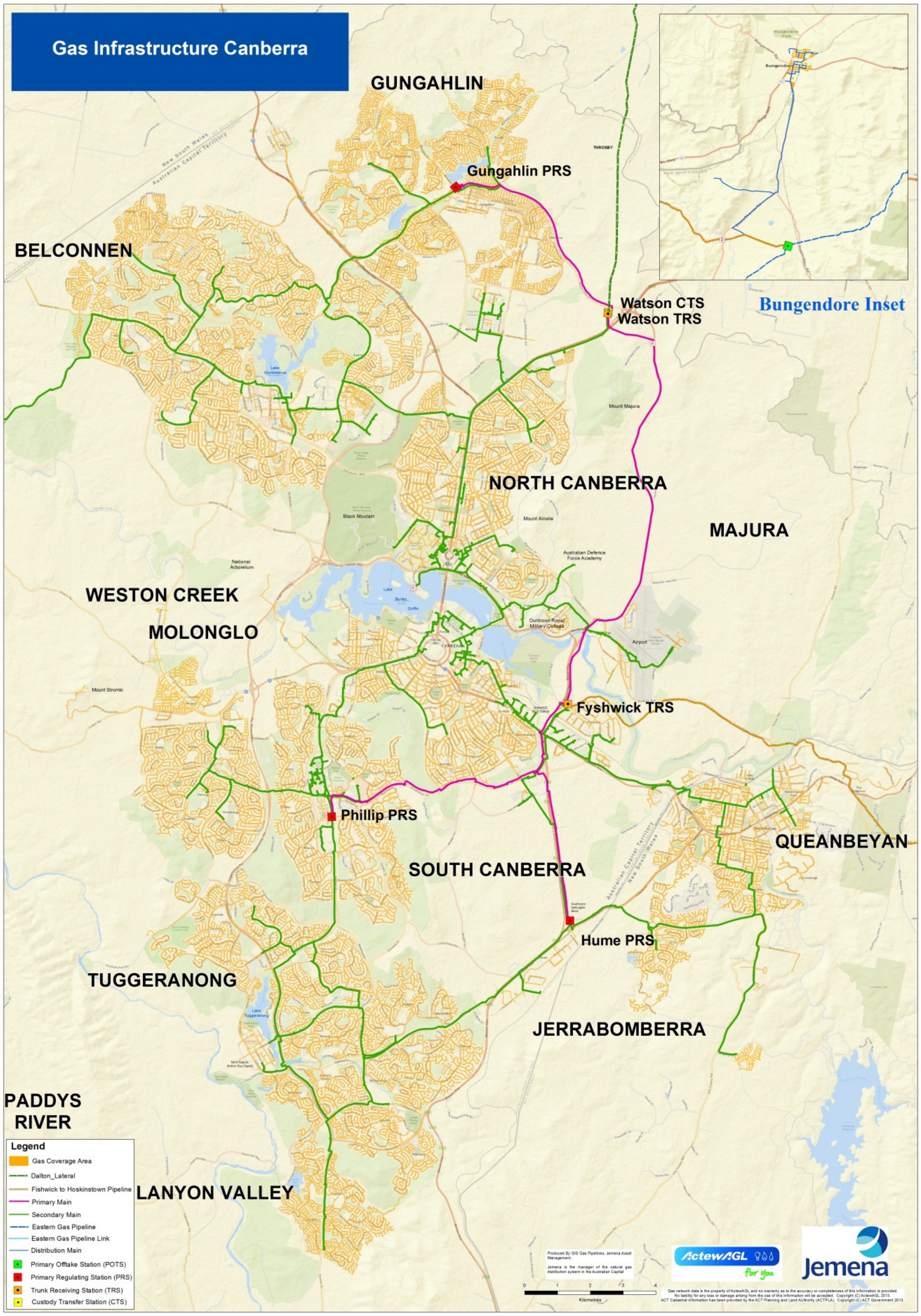

Figure 15: Mains and Supply Points in the Canberra Region

9.2.1 AAD'S TRUNK

AAD operates the Hoskinstown to Fyshwick trunk main, illustrated in orange above. It is operated at a normal pressure of 12,000 kPa. This pipeline is Licensed Pipeline no. 29 in NSW.

The Hoskinstown to Fyshwick trunk main has sufficient capacity to supply the whole of Canberra for the foreseeable future, and no additional projects are anticipated in the next years.

9.2.2 AAD'S CANBERRA PRIMARY NETWORK

Primary mains are steel mains operated at 6,895 kPa. These are used to supply the secondary network via **PRS**s. On the figure above, AAD's primary main runs from the Watson TRS to the Gungahlin PRS, and SW to interconnect at the Fyshwick TRS and thence to the Jerrabomberra POTS and Phillip PRS. On the diagram above, the primary network is illustrated in pink.

In the long term, it is proposed that the primary main will form a loop around Canberra, connecting Gungahlin and Phillip PRSs. The significant benefit of this will be the creation of security of supply in the event of a rupture. This loop will be largely created by planned extensions from Phillip PRS north to support the Molonglo development area, over the next twenty years, ultimately joining into the Belconnen end of the main. The Molonglo extensions are described in the next section.

A section of main between Gungahlin and Belconnen is currently operating at secondary pressure, pending the future installation of the Belconnen PRS and upgrade of the mains, as peak demand increases with increasing customer connections.

The primary loop is a very significant extension, and will be accomplished by incremental extensions as and when customer numbers and gas demand require extensions to the network. The level of expansion activity on the primary and secondary networks is dependent on the location and timing of expected growth in housing development summarised in Section 8 above.

9.2.2.1 AAD Primary Main Projects 2015

The following projects on Canberra's primary main are underway or nearing completion. For simulations for winter 2015 and later, the modelling includes the effects of these projects.

Table 10: Primary Main Capacity Development Projects 2015

Date	Title	Scope and Comments	Value ($,000)
2015	Hume Primary Main Extension	Extension of approximately 5km of 250mm ST from Hindmarsh Drive Narrabundah, to Lanyon Drive Hume. Commissioned February 2015	Completed in 2015
2015	Hume PRS	Install 55,000 m3/hr PRS at the intersection of Lanyon Drive and Monaro Highway. Commissioned February 2015. On completion, the Jerrabomberra **POTS** will be decommissioned.	Completed in 2015

9.2.2.2 AAD Primary Main Projects 2016 and beyond

These projects on Canberra's primary main are required to maintain supply for continuing organic growth in gas demand and to the large-scale housing developments in the Canberra region in the years 2016 and beyond.

In essence, they extend the reach of the primary main in order to maintain pressure in downstream secondary networks.

The timing of each project is tentative, as it is driven by the rate of housing development supplied by downstream networks and the consequence impact on gas pressures.

Table 11: Primary Main Projects 2016 and beyond

Date	Title	Scope and Comments	Value
2020	Molonglo Primary Extension Stage 1	Lay 3.5 kms of 250 mm ST main from Phillip PRS (Woden Town Centre) along Tuggeranong Parkway to Heysen Street. Lay 500 m of 100 mm ST to connect with the secondary network along Heysen Street. The route is to be confirmed by a DA process. This will be operated at secondary pressures until the installation of a PRS at the end of Stage 3.	~$10m
2020	Phillip PRS Upgrade	Upgrade capacity of Phillip PRS to 80,000 **scmh**.	~$6m
2024	Molonglo Primary Extension Stage 2	Lay 2.9 kms of 250mm ST main from the end of Molonglo Primary Stage 1 along Tuggeranong Parkway. Route to be confirmed pending DA process. This will be operated at secondary pressures until the installation of a PRS after the end of Stage 3.	~$5m
2025	Molonglo Primary Extension Stage 3	Lay 3 km of 200mm ST main from the end of Molonglo Primary Stage 2 along Coppins Crossing Road to the proposed site of the Molonglo PRS. Route to be confirmed pending DA process. This will be operated at secondary pressures until the installation of the Molonglo PRS after the end of Stage 3.	~$5m
2027	Watson PRS Upgrade	Upgrade the Watson PRS from 60,000 scmh to 80,000 scmh.	~$3m
2027	Belconnen PRS	Install PRS at Belconnen. Upgrade the Gungahlin to Belconnen section currently operating as secondary main to primary pressure. Timing is driven by the downstream pressures in the Belconnen branch of the secondary network.	~$4.5m
TBC	Molonglo PRS	Install PRS on the end of the Molonglo Primary extension Stage 3 and upgrade operating pressure on Molonglo Primary Extensions 1-3 to 6895 kPa. The timing of this is dependent on the growth in demand; it may be at the same time as Molonglo Extension Stage 3, but is likely to be somewhat later.	TBC

The following diagram shows the tentative routes of the three Molonglo Primary Main extensions.

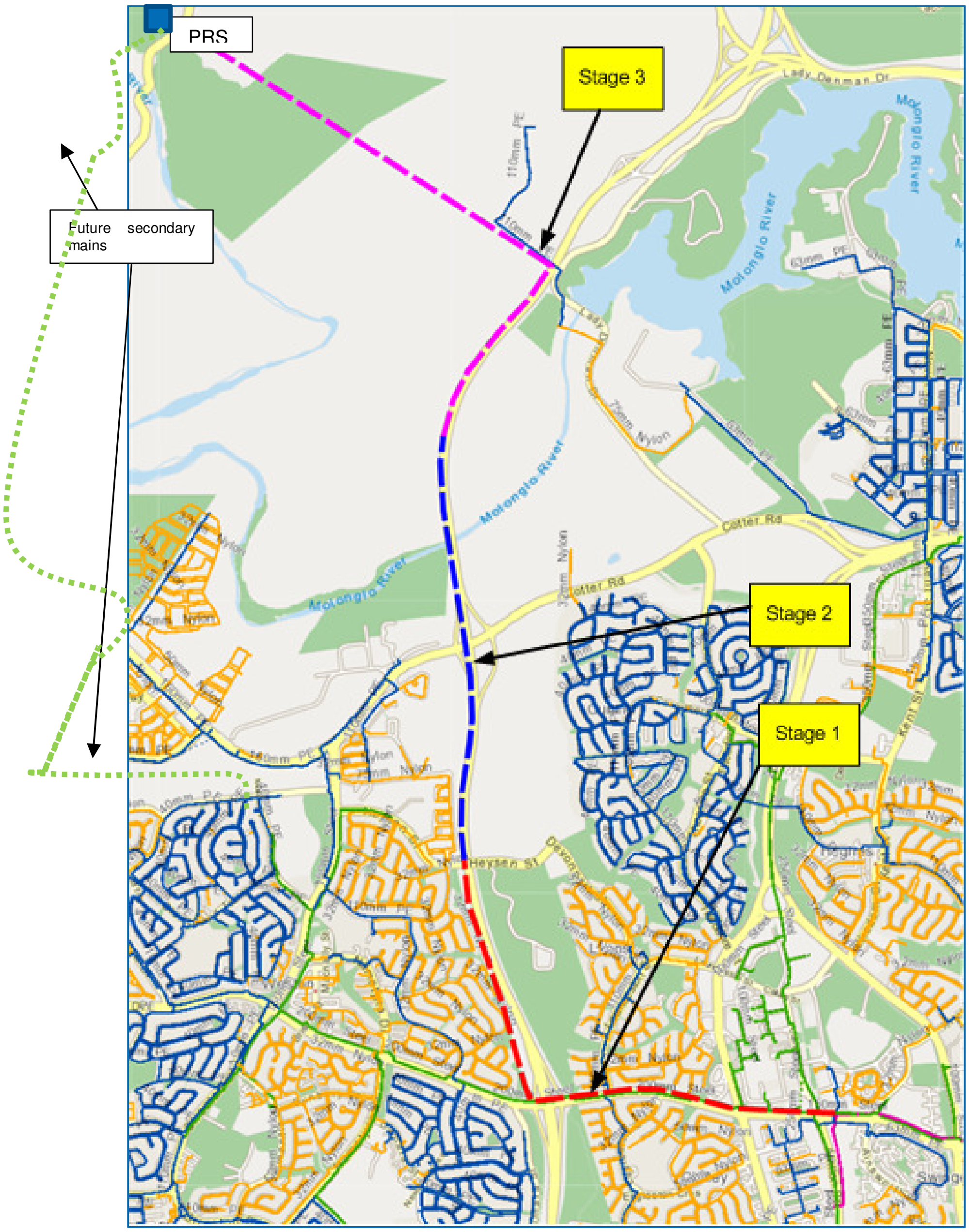

Figure 16: Molonglo Primary Main Extensions

9.3 AAD'S SECONDARY CANBERRA NETWORK

AAD's Canberra region secondary mains, operated at 1,050 kPa, supply gas from the primary main to the medium pressure mains (210 kPa) via SRSs.

Large-scale housing developments impact secondary mains rather than medium pressure networks; supplying large housing estates is achieved by secondary main extensions rather than by incremental extensions of the adjacent medium pressure network itself. These medium pressure networks are constructed as part of the development as market expansion projects. Secondary extensions are needed to:

- Supply the medium pressure network developed as market expansion;
- Provide capacity to supply additional organic growth in the existing medium pressure network.

9.3.1.1 AAD Secondary Main Projects 2016 and beyond

These projects are required to maintain supply and provide capacity to the large-scale housing developments in the Canberra region for 2016 and beyond.

The timing of each project is tentative, as it is driven by the rate of adjacent housing development and the consequent impact on gas pressures.

Table 9–12: Proposed AAD Secondary Main Extensions

Date	Title	Scope and Comments[9]	Value ($,000)
2016	Molonglo Secondary Stage 1	Lay approximately 4 km of 200mm **ST** main from the 100mm ST main in Streeton Drive, Holder into the Molonglo development area. Install one 5,000 m3/hr DR.	~$5m
2016	Moncrieff Secondary Extension	Lay 2.4km of 150mm ST main along Horse Park Drive from the 150mm steel main on Gungahlin Dr. Includes a 5,000 scmh DR installation.	~$4m
2017	West Belconnen Secondary Extension (Stockdill Dr)	Lay approximately 3km of 200mm ST main westwards from end of the existing secondary main on Stockdill Drive. Includes the installation of a 7,000 scmh DR	~$4.5m
2019	Molonglo Secondary Stage 2	Lay approximately 2.5km of 200mm ST main continuing from the end of Molonglo Stage 1 extension along either Coppins Crossing Road or the proposed road extension of John Gorton Drive. Includes 5000 DR installation in Denman Prospect at the end of the extension.	~$3m
2022	Taylor Secondary Extension	Lay approximately 4km of 150mm ST main along Horse Park Drive from the end of the Moncrieff secondary extension. Install a DR at its end.	~$4m
2025	Molonglo Secondary Stage 3	Lay 3.2kms of 200mm ST main continuing from Molonglo Secondary Extension Stage 2 along Coppins Crossing Rd to the proposed location of Molonglo PRS to the north of the Molonglo River. Includes a 5000 scmh DR	~$5.5m
2031	West Belconnen Secondary Extension (Southern Cross Dr West)	Lay approximately 3 km of 200mm ST main from the end of the existing secondary main on Southern Cross Drive in Holt. Install one 7,000scmh DR.	~$5m

[9] Relevant details of these projects are included in the Canberra Network Secondary Capacity Assessment 2013 – 2033, and the relevant Opportunity Briefs.

Date	Title	Scope and Comments[9]	Value ($,000)
2033	West Belconnen Secondary Extension (Southern Cross Drive East)	Approximately 3km of 200mm ST reinforcement along Southern Cross Dr between Kingsford Smith Dr and Spofforth St, interconnecting with the previous Secondary Extension (Southern Cross Drive West). It is likely that Southern Cross Drive West will precede Southern Cross Drive East. Each is independent of the other. However, timing may change as driven by the demand from new housing developments.	~$5m

The scope for each of the projects summarised in Table 9–12 is shown below.

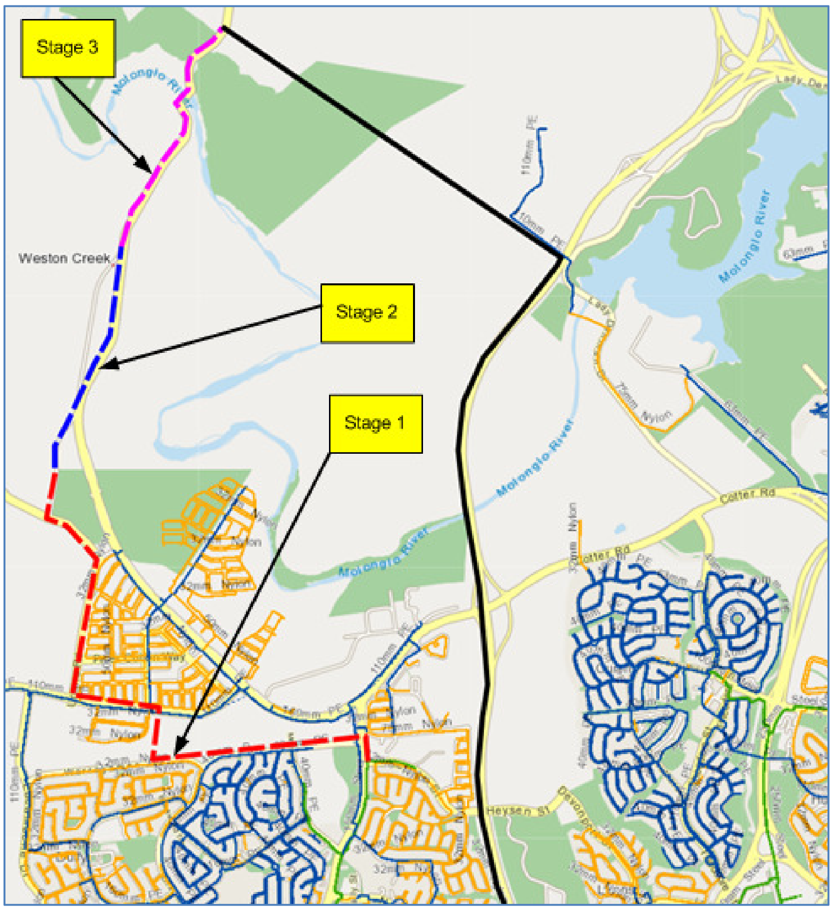

Figure 17: Molonglo Secondary Extensions Stages 1-3, 2016 - 2025

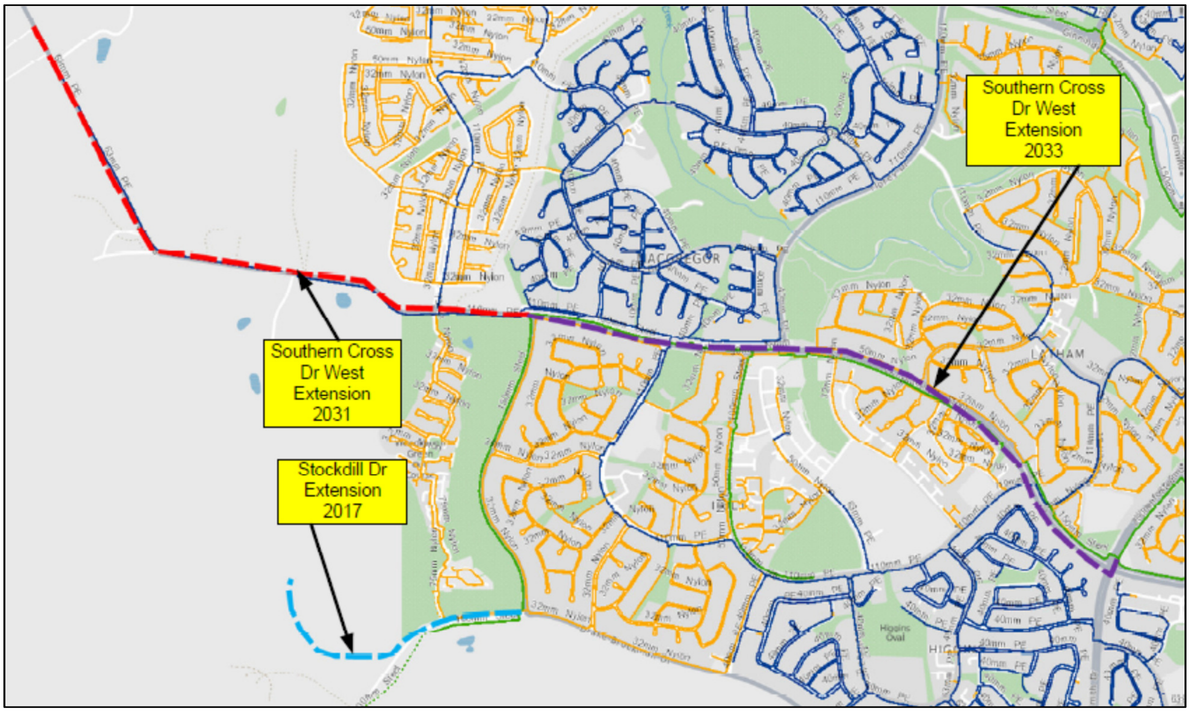

Figure 18: West Belconnen Secondary Extensions, 2017 - 2033

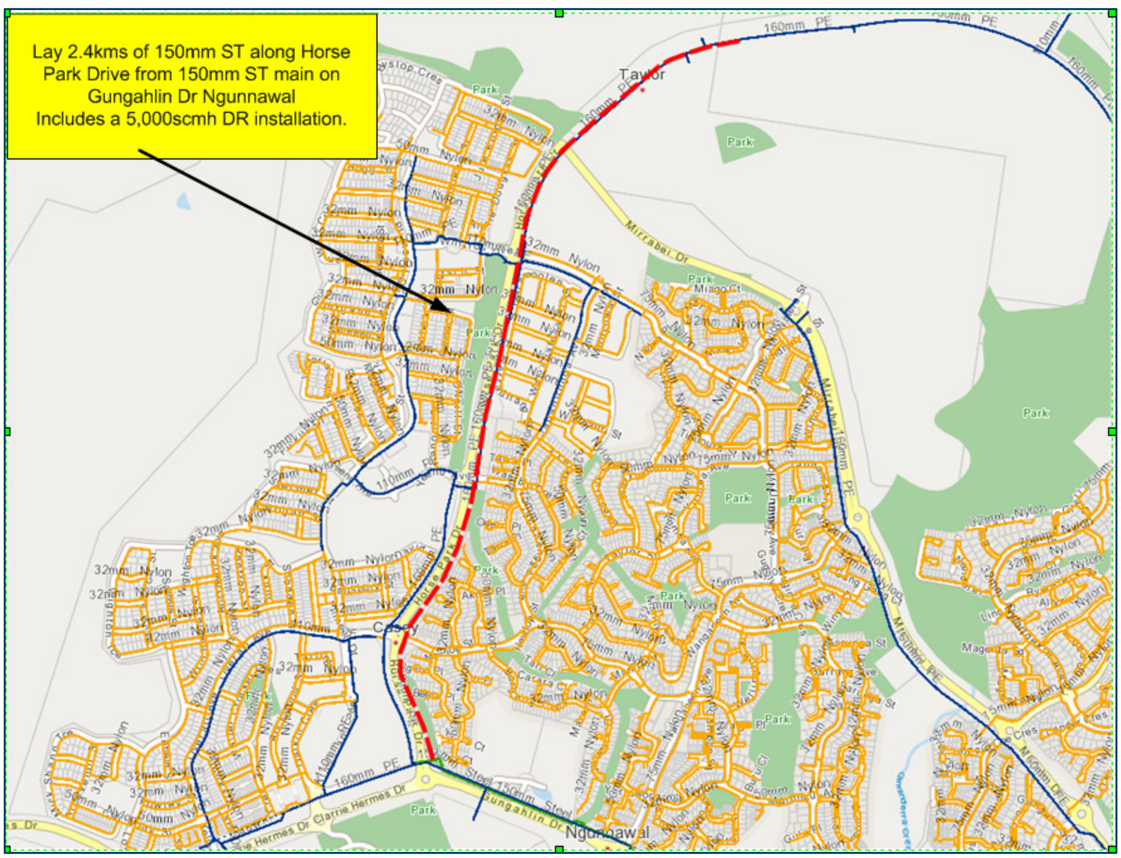

Figure 19: Moncrieff Secondary Extension 2016

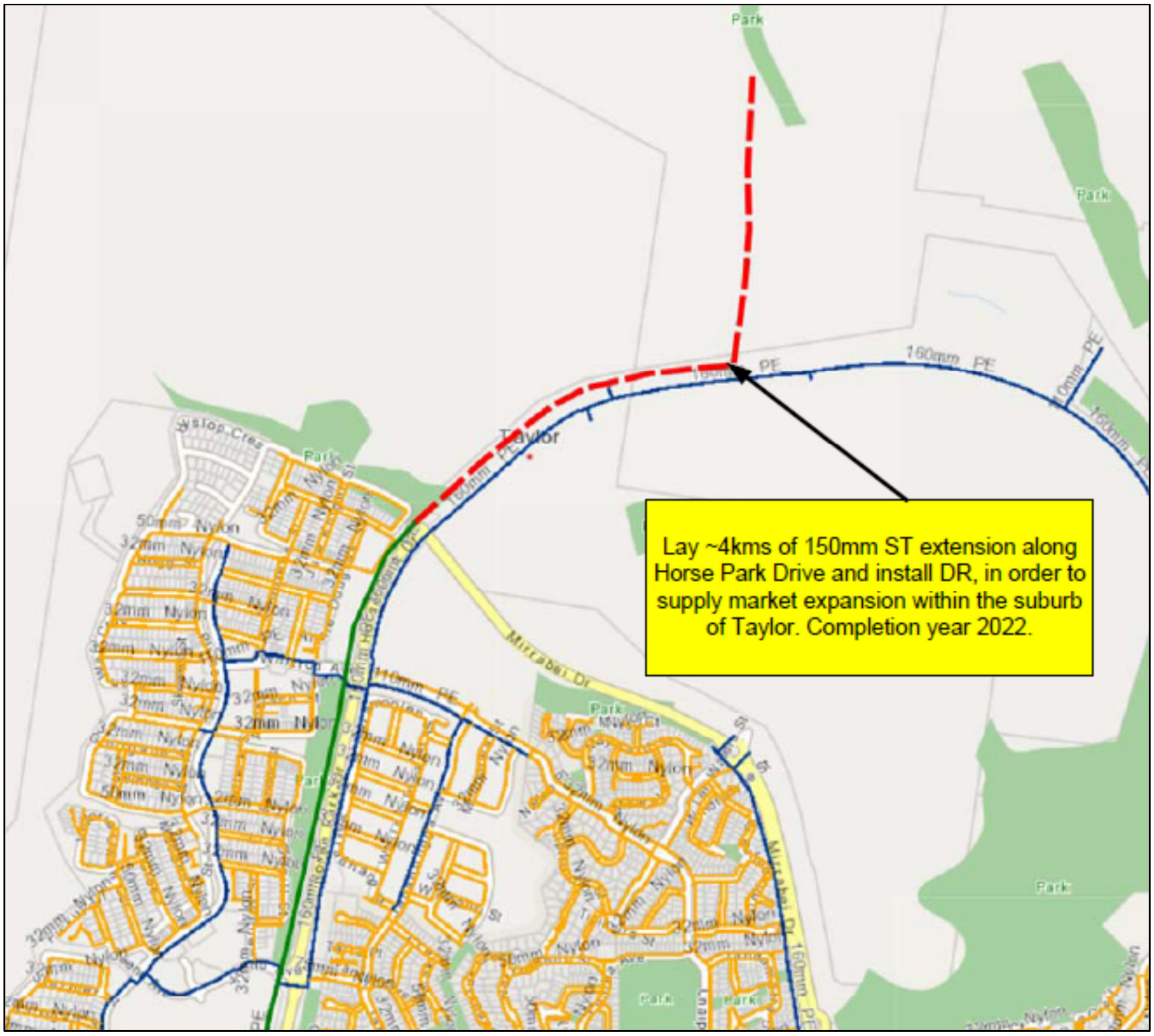

Figure 20: Taylor Secondary Extension 2022

9.4 AAD'S MEDIUM PRESSURE NETWORKS

Medium pressure networks are those operated at 210 kPa, taking gas from the secondary network via District Regulators and supplying it to the local medium pressure distribution network.

The ActewAGL network in the ACT and Queanbeyan is an integrated medium, secondary and primary pressure network covering the entire ACT-and Queanbeyan region. This is broadly illustrated in Figure 11. For the purposes of Capacity Management, however, this entire network is divided into regions or networks. From the north west of Canberra, these networks are:

- Belconnen;
- Gungahlin;
- North Canberra (i.e. north of the lake, Canberra City);

- Weston Creek;
- South Canberra;
- Woden;
- Tuggeranong (including Lanyon Valley);
- Queanbeyan in NSW;
- Bungendore in NSW, which is a small network to the east of Canberra and isolated from the rest of AAD's Canberra networks and supplied directly from the EGP.

In the next section is a summary of each of the Canberra region networks.

9.5 BELCONNEN MEDIUM PRESSURE NETWORK

9.5.1 SUMMMARY OF BELCONNEN NETWORK

The Belconnen medium pressure network is located in the NW part of Canberra, supplying around twenty suburbs with about 27,000 customers in 2013, predominantly residential and small I&C customers.

The Belconnen area, unlike many other parts of Canberra, is heavily impacted by current and planned housing development, with significant new estate construction occurring on greenfield sites in the NW and East of the area supplied by the medium pressure network. These housing developments will ultimately add around 35% to the housing stock supplied by the network. This new housing will be supplied via secondary mains extensions[10] and new medium pressure extensions, but these developments will have impacts elsewhere in the existing network. So proposed capacity development projects are not necessarily close to the areas of housing development.

Natural gas is fed into the Belconnen 210kPa network via 15 District Regulators (**DR**s).

[10] Refer to the AAD Secondary Main Capacity Assessment

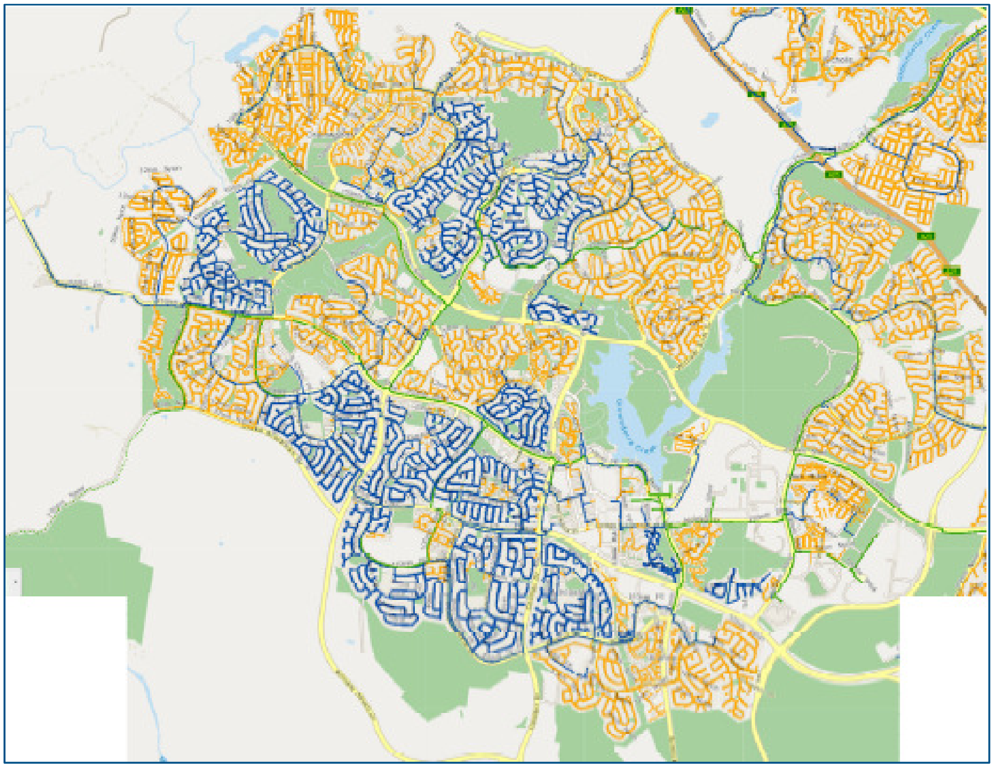

Figure 21: Belconnen Network Locality

9.5.2 BELCONNEN HOUSING DEVELOPMENT AND GROWTH

The area supplied by the Belconnen 210 kPa network is one of the significant growth areas proposed for Canberra. Two large residential development areas have been approved and are under development, as summarised below.

Figure 22: Belconnen Development Sites

Locality	Total Planned Dwellings	Dwellings to 2033	Comments
West Belconnen	Under discussion	7700	First suburban blocks available “early 2015”. 4,500 dwellings envisaged on ACT side of the border with NSW. Secondary mains extensions will be required to reach the land release area and to reinforce the existing network
Lawson	1850	1850	A smaller housing redevelopment of the former Naval radio station bounded by Baldwin and Ginninderra Drives. First suburban blocks sold end 2013, development expected to be reasonably rapid. The Lawson development will be supplied by extending the surrounding network into the area.

These developments will add approximately 35% to current Belconnen network customer numbers.

Separate to these housing developments is growth of customer numbers in existing areas of the network, largely through conversion of low to medium density housing. This organic growth is estimated at 2% per annum for 2013 – 2022, and 1% 2023-2033.

9.5.3 BELCONNEN CAPACITY DEVELOPMENT PROJECTS

Current network performance in the network is generally satisfactory in winter peak period modelling. However, due to the impacts of housing development and organic growth, one or two small CDPs will be required in most years 2016 – 2030, a total of 22 separate projects. These projects range in size from simple road crossings, with costs as low as $3,000 cost, to DRS replacements of around $140,000.

These projects are specified in detail in the Belconnen Capacity Development Plan 2013-2033 and the Capital Plan.

Projects are small and add incrementally to local pressure shortfalls. Therefore their timing is governed by the rate of new housing development and organic growth in the network area.

9.6 GUNGAHLIN NETWORK

9.6.1 SUMMARY OF GUNGAHLIN NETWORK

The Gungahlin Medium Pressure network is the northernmost part of Canberra. It supplies 12 suburbs and about 19,000 active customers. It covers an area with high rate of new estate growth, to the north and east of the current network.

Gas is supplied into the 210kPa Gungahlin medium pressure network via 4 District Regulators (DRs). A project is scheduled to install an additional DR at Amaroo in 2015.

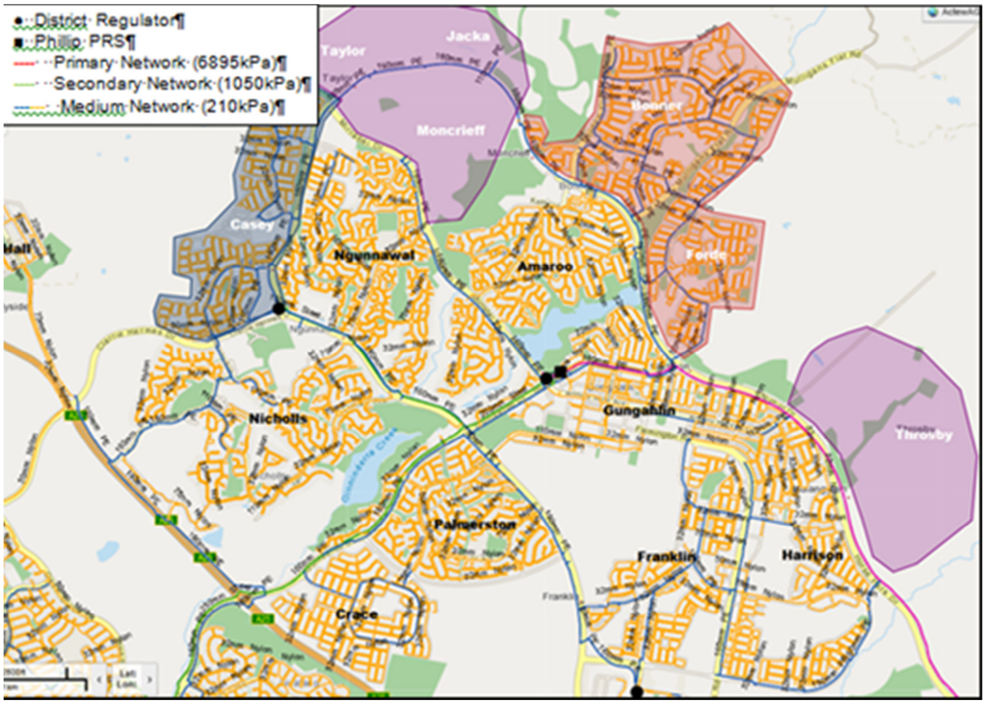

Figure 23: Gungahlin Network Locality

9.6.2 GUNGAHLIN HOUSING DEVELOPMENTS AND GROWTH

The Gungahlin area is seeing ongoing growth in customer numbers and consequently gas volumes and decrement in peak pressures. The current and future growth suburbs are shown in purple on Figure 23 above.

The number of customers supplied by the network will grow from approximately 19,000 in 2013 to approximately 37,000 by 2033. These new housing estates will be supplied by a combination of secondary main extensions and additional SRSs, and via extensions to the periphery of the medium pressure network through market expansion activity . For this reason there are few projects required on the medium pressure network.

9.6.3 GUNGAHLIN CAPACITY DEVELOPMENT PROJECTS

Only three small capacity development projects are forecast for the Gungahlin medium pressure network over the 2016-2033 period, none larger than $11k, and all to remediate local areas of forecast low pressure in a severe winter scenario. Aside from these, the network has capacity to supply its existing customers and organic growth, provided housing developments are supplied via secondary mains extensions, as is anticipated.

9.7 WESTON CREEK MEDIUM PRESSURE NETWORK

9.7.1 SUMMARY OF WESTON CREEK

The Weston Creek medium pressure network is located in the central south west part of Canberra. It is currently one of the smaller Canberra networks, supplying ten suburbs with about 7,500 customers in 2013. The network supplies largely residential customers, with few I&C customers of any size.

Current network performance in the Weston Creek network is generally satisfactory, but forecast organic growth will require two small CDPs in the near future.

Ultimately, with the proposed housing developments at Molonglo on its northern fringe, this medium pressure network will be over three times as large as it was in 2013.

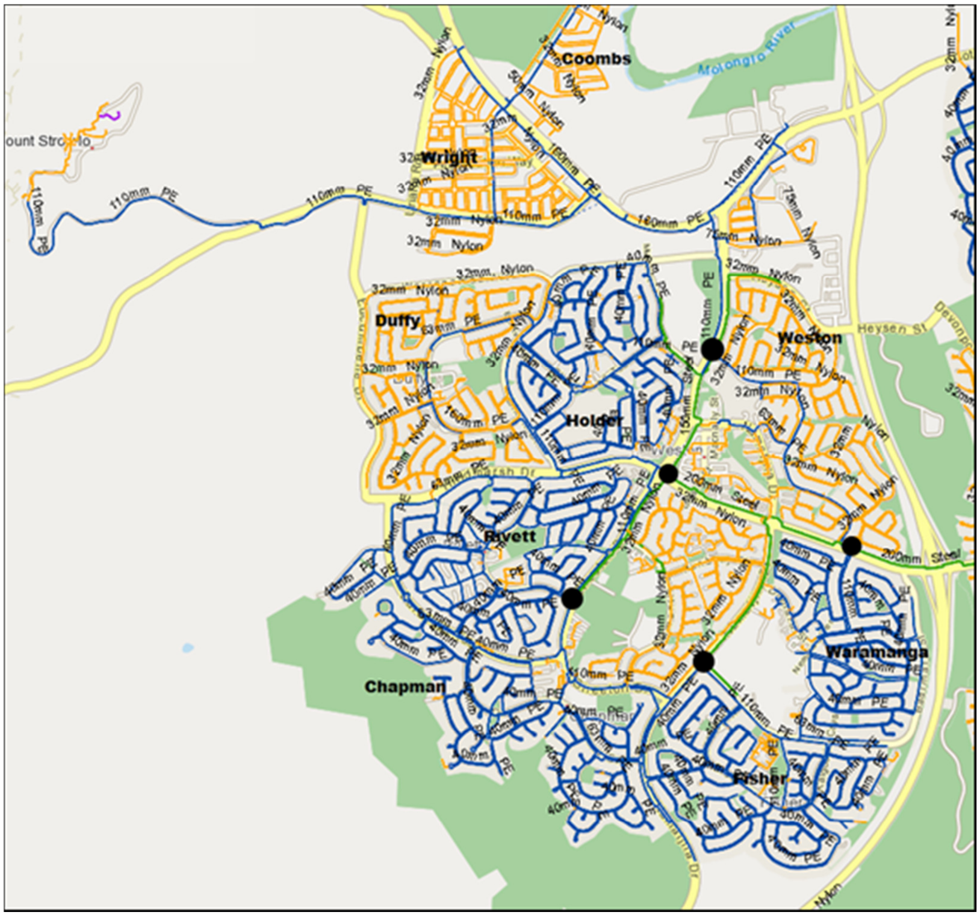

Figure 24: Weston Creek Network, including Molonglo

9.7.2 WESTON CREEK HOUSING DEVELOPMENT AND GROWTH

The Weston Creek network is extending to supply Molonglo and will see significant growth on its northern and western boundaries (adjacent to and beyond the suburbs of Wright and Coombs above). The Molonglo Development, as it is named for planning purposes, is being developed in three major stages. Stage 1 is soon to be completed with 4,500 new dwellings in Wright and Coombs.

Stage 2 and Stage 3, with perhaps 11,000 additional dwellings, will be developed over the next 10-20 years.

These housing developments will be supplied mostly by secondary and primary mains extensions, as well as incremental extensions to the medium pressure network. This means the impact of housing development on the capacity of the existing network will be relatively slight.

As with all Canberra network forecasts, a rate of 2% annual organic growth in gas volumes has been applied to pressure modelling in the years 2013-2022, and 1% annual growth 2023-2033.

9.7.3 WESTON CREEK CAPACITY DEVELOPMENT PROJECTS

However, due to growth in demand on the network, risk of poor supply is forecast in a severe winter scenario in 2016 and 2017 in the suburbs of Rivett and Waramanga in the south of the network, as regulators reach their design capacity. In order to increase capacity, these regulators will be replaced in 2016 and 2017, at a cost of approximately $140k each.

With the implementation of the proposed CDPs, the Weston Creek network will be able to provide the capacity required to sustain the demand growth during winter peaks for 10 years and beyond.

Growth in the new Molonglo suburbs will be addressed via market expansion projects and extensions of the high pressure network.

9.8 NORTH CANBERRA MEDIUM PRESSURE NETWORK

9.8.1 SUMMARY OF NORTH CANBERRA NETWORK

This network is located in the central part of Canberra, north and east of Lake Burley Griffin. It supplies a dozen suburbs with about 12,500 customers in 2013, predominantly residential and small-medium I&C customers. The area supplied by the network includes the Canberra airport precinct, which houses a significant number of I&C customers, largely shops and offices.

The area supplied by this network is fully developed; there is no open space for large-scale urban development and forecast changes in demand for gas are entirely triggered by organic growth.

Gas is supplied into the 210kPa North Canberra medium pressure network via 19 District Regulators.

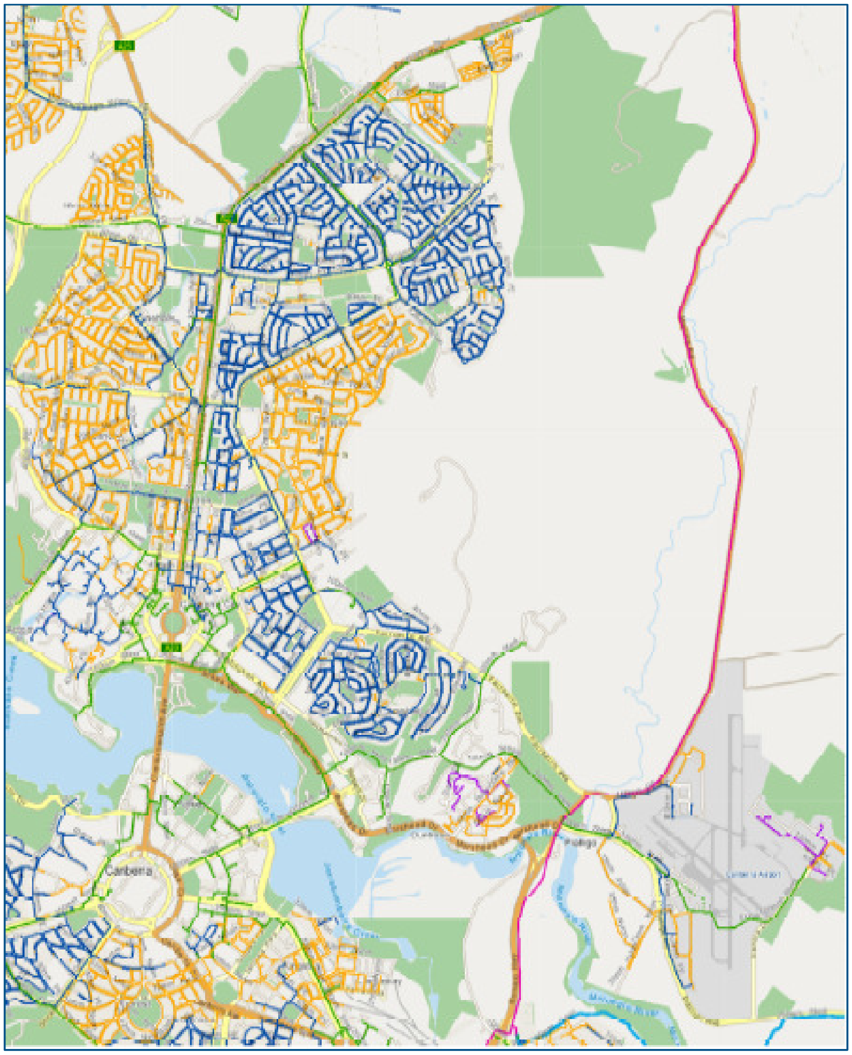

Figure 25: North Canberra Network

9.8.2 NORTH CANBERRA HOUSING DEVELOPMENTS AND GROWTH

As these are some of the oldest suburbs in Canberra, the network has limited potential for growth through housing development compared to some other Canberra networks. North Canberra suburbs are largely developed; most growth in the network will come through redevelopment activities (organic growth), and largely as a consequence of small areas of medium density and commercial building redevelopment. For example, a new hotel is to be constructed on Pialligo Avenue near the airport and the construction of the light rail project may lead to redevelopment of areas surrounding Northbourne Ave.

As with other Canberra networks, a rate of 2% annual organic growth in gas volumes has been applied to forecasts 2015-2022, and 1% annual growth 2023-2033. This is sufficient to allow for a moderate rate of continuing redevelopment.

9.8.3 NORTH CANBERRA CAPACITY DEVELOPMENT PROJECTS

Current network performance in the North Canberra network is generally satisfactory for winter peak period modelling. Over 2016 – 2033, the network is forecast to require a total of eight small projects, mostly interconnections, to maintain pressures at satisfactory levels. The smallest of these projects is $20k, the largest $76k.

In addition, DR 16 is forecast to exceed its inlet pressures by about 2024, requiring an upgrade from 16000 scmh to 5000 scmh. This will cost about $140k.

9.9 SOUTH CANBERRA MEDIUM PRESSURE NETWORK

9.9.1 SUMMARY OF SOUTH CANBERRA NETWORK

The South Canberra Medium Pressure network covers the developed suburbs to the south and southeast of Lake Burley Griffin, including the Fyshwick industrial area in the SE of the network.

Gas is supplied into the South Canberra network via 17 District Regulators (DRs), which supply approximately 7,500 active customers.

The South Canberra network is unusual in that the annual gas volumes taken by **I&C** customers, notably those in Fyshwick in the east of the network, are larger than those taken by domestic customers. The size and location of I&C customers also shows in the number and distribution of DRs.

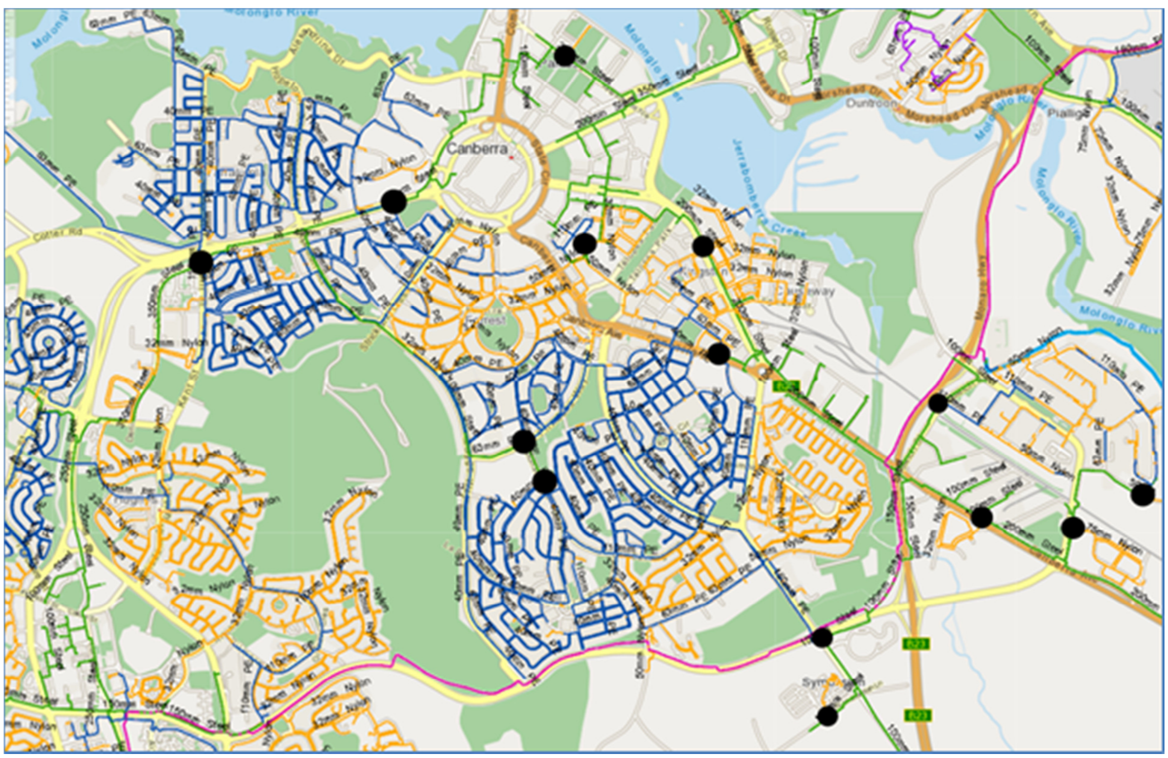

Figure 26: South Canberra Network

9.9.2 SOUTH CANBERRA HOUSING DEVELOPMENTS AND GROWTH

As these are some of the oldest suburbs in Canberra, the network has limited potential for growth through housing development, compared to some other Canberra networks. South Canberra suburbs are largely developed; most growth in the network will come through redevelopment activities (organic growth).

The suburbs of the South Canberra area have experienced relatively high rates of organic growth over the last few years, largely as a result of medium density development on previous industrial lands around Lake Burley Griffin in Kingston.

As with other Canberra networks, a rate of 2% annual organic growth in gas volumes has been applied to forecasts 2015-2022, and 1% annual growth 2023-2033. This is sufficient to allow for a moderate rate of continuing housing redevelopment.

9.9.3 SOUTH CANBERRA CAPACITY DEVELOPMENT PROJECTS

Current network performance in the South Canberra network is generally satisfactory for winter peak period modelling. However, due to organic growth forecast, as early as 2016 one DRS will have to be upgraded as its designed inlet pressure will be exceeded, at a cost of $140k.

Applying organic growth factors to 2033 shows that a pair of small projects would be required in that year; the suburb of Red Hill is forecast to be at risk of significant pressure shortfalls if a severe winter occurs in 2033. To mitigate the risk of pressure loss, two small interconnections at a total cost of $100k are anticipated. The need for such projects will be confirmed in the years ahead through active monitoring of organic growth rates and network pressures.

9.10 WODEN MEDIUM PRESSURE NETWORK

9.10.1 SUMMARY OF WODEN 210 KPA NETWORK

The Woden medium pressure network is a comparatively small network. It is located in the central SW part of Canberra, supplying twelve suburbs with about 9,500 customers in 2013. I&C customers are a relatively small part of the customer base, taking up around a third of gas supplied in 2013.

Gas is supplied into the medium pressure network via 7 District Regulators (DRs),

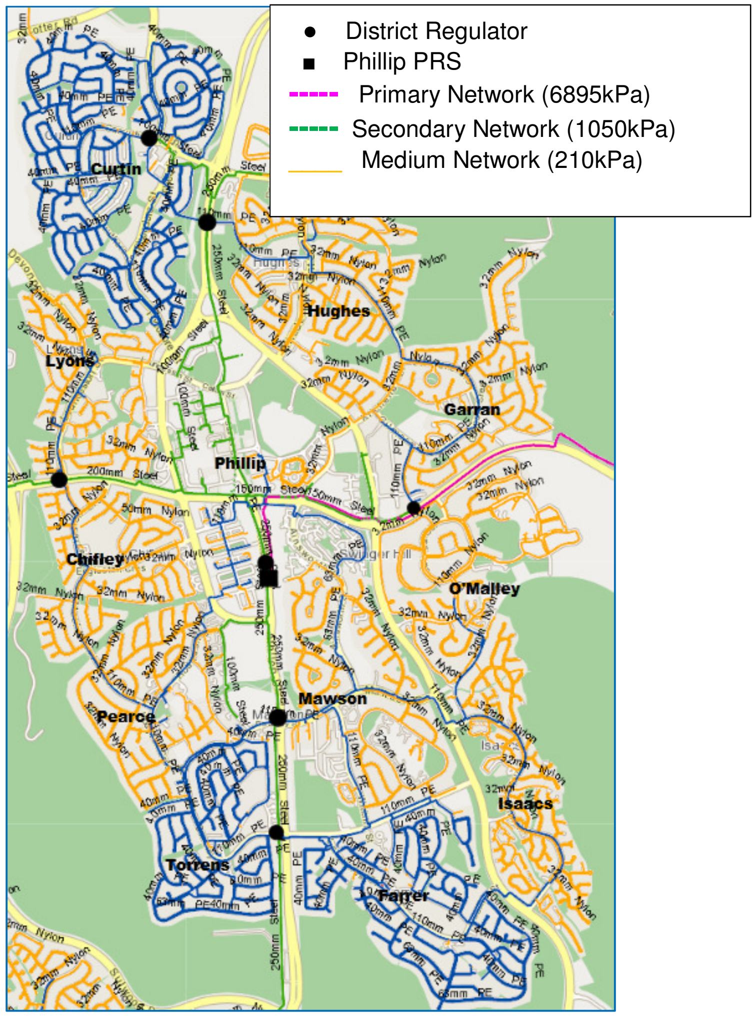

Figure 27: Woden Network Locality

9.10.2 WODEN NETWORK HOUSING DEVELOPMENT AND GROWTH

The network has limited space for housing development compared to some other Canberra networks. The region of Woden is fully developed, and has limited vacant land for future housing development. Most of the development in Canberra is occurring in Molonglo, the adjacent network to the Northwest. There have been controversial high rise redevelopment proposals in areas of Woden Town Centre, but the scaled-back versions now being debated can be managed within the 2% organic growth forecast.

As with all Canberra network forecasts, a rate of 2% annual organic growth in gas volumes has been applied to forecasts for 2015-2022, and 1% annual growth for 2023-2033.

9.10.3 WODEN CAPACITY DEVELOPMENT PROJECTS

Forecast organic growth will create supply risks by a severe winter modelling in 2016, 2018 and 2019, in the suburbs of Hughes and Isaacs respectively. In 2016, the Woden-Garran DR27 will require upgrading to 7,000 scmh inlet capacity, at a cost of approximately $140k.

In 2018 and 2019 there are single projects to interconnect pockets of forecast low pressure, at a cost of $60k and $100k respectively.

With the implementation of the proposed CDPs, the Woden network will be able to provide the capacity required to sustain the demand growth during winter peaks for 10 years and beyond.

9.11 TUGGERANONG MEDIUM PRESSURE NETWORK

9.11.1 SUMMARY OF TUGGERANONG NETWORK

The Tuggeranong medium pressure network is the southernmost of the AAD networks in the ACT, supplying thirteen suburbs with about 25,000 customers in 2013. This makes it the largest of the AAD networks.

The Hume Industrial Area (the eastern projection on the figure below) is a significant feature of the secondary and medium pressure networks in the Tuggeranong area, being managed as part of the medium pressure network but connected separately via a secondary connection.

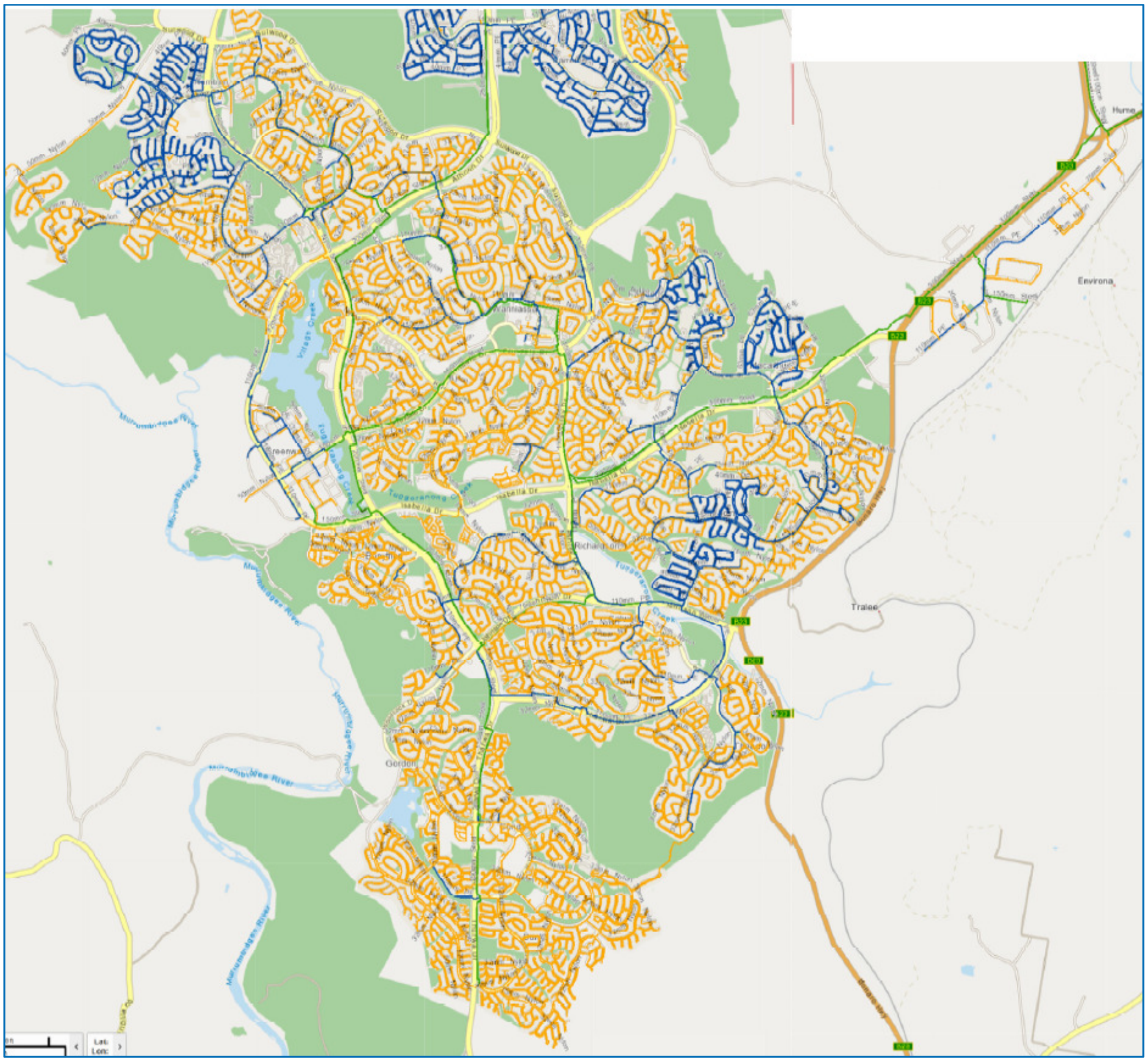

Figure 28: Tuggeranong Network

9.11.2 TUGGERANONG HOUSING DEVELOPMENT AND GROWTH

There is little land available for residential development in Tuggeranong itself, with major development sites being in other areas of Canberra. However, there will be major industrial expansion and smaller housing developments as outlined below.

The Hume industrial area bordering Lanyon Drive and the ACT/NSW border is a large industrial subdivision still being developed. It will expand over time, and with that expansion may come significant I&C and possibly demand customers. Expansion of the gas network's footprint in this area will be achieved through specific market expansion projects.

It is likely that the Tralee area in NSW will be supplied via extensions from the Hume area.

The recently-completed Hume Primary Main Extension and Hume PRS means that the PRS is immediately adjacent to the industrial area, which will continue to be supplied by a direct secondary main. The Hume Primary Mains Extension permits future supply for growth in the entire Tuggeranong and Jerrabomberra areas, including both the industrial area but also the future housing development areas of Googong and Tralee.

There are proposals to redevelop much of Tuggeranong Town Centre which would result in much higher housing densities than today, but nothing is firm at time of writing. In any case, the resulting incremental increase in customer numbers is within organic growth forecasts.

As with all Canberra network forecasts, a rate of 2% annual organic growth in gas volumes has been applied to forecasts 2015-2022, and 1% annual growth 2023-2033.

9.11.3 TUGGERANONG CAPACITY DEVELOPMENT PROJECTS

Current network performance in the Tuggeranong network is generally satisfactory for winter peak period modelling. However, due to organic growth, risks of poor supply to specific local areas are forecast in a severe winter scenario in 2016-2020 (7 projects), and 2021 – 2033 (6 projects). Only two of these projects are estimated to cost over $70k, with most being significantly smaller. Additionally, two DRSs will require an upgrade about 2023 and 2027 when their maximum capacity is significantly exceeded ($140k).

With the implementation of the proposed CDPs, the Tuggeranong network will be able to provide the capacity required to sustain the demand growth during winter peaks out to 2033.

9.12 QUEANBEYAN MEDIUM PRESSURE NETWORK

9.12.1 SUMMARY OF QUEANBEYAN NETWORK

The Queanbeyan Medium Pressure network covers the NSW city to the SE of the ACT, including The Oaks estate in the ACT. Gas is supplied into the 210kPa Queanbeyan medium pressure network via the ACT secondary network. Gas is supplied via 10 District Regulators (DRs). The network supplies approximately 11,000 active customers.

The new estate area of Googong, South of Queanbeyan, is supplied via an extension of the secondary network and managed as part of the Queanbeyan network.

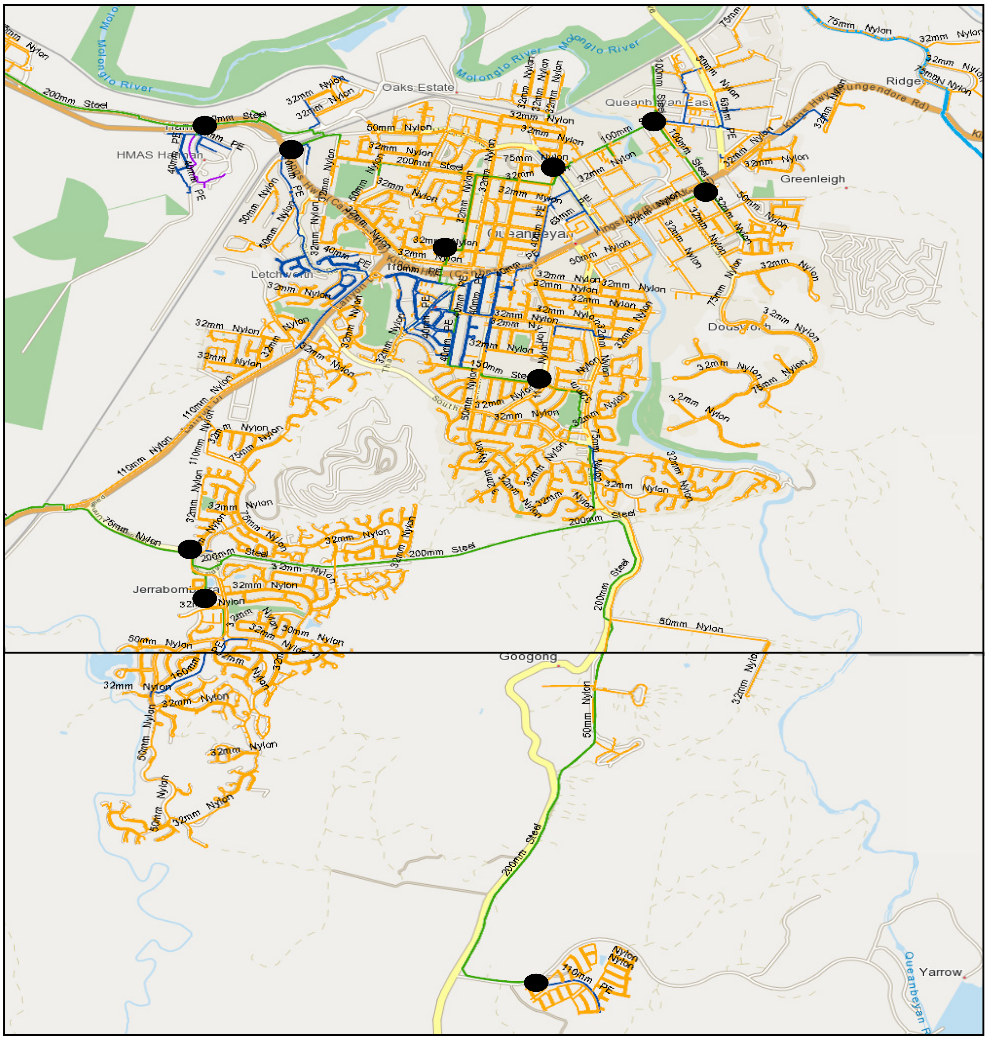

Figure 29: Queanbeyan Network

9.12.2 QUEANBEYAN HOUSING DEVELOPMENTS AND GROWTH

There are no significant industrial or housing developments impacting on the Queanbeyan network for the foreseeable future, so gas demand changes are driven entirely by forecast organic growth.

Googong is proposed to be the central growth area in this network, with 5,500 proposed dwellings expected to be built in the area over a 25 year period. As shown above, Googong is supplied by a secondary mains extension constructed in 2013, and so has no impact on the rest of the Queanbeyan medium pressure network. Ongoing growth in this area will be via market expansion activities.

It is likely that the Tralee new estate area will be supplied from extensions of the Tuggeranong network, from the existing network in Hume.

As with all Canberra network forecasts, a rate of 2% annual organic growth in gas volumes has been applied to forecasts 2015-2022, and 1% annual growth 2023-2033.

9.12.3 QUEANBEYAN PROJECTS

Current network performance in the Queanbeyan network is generally satisfactory for winter peak period modelling, with pressure levels above the minimum design pressure of 70kPa.

However, due to organic growth, a risk of poor supply is forecast in a severe winter scenario in 2019 and 2028 in the suburbs of Queanbeyan, Dodsworth and Jerrabomberra respectively. In order to mitigate these pressure shortfalls, two very small medium pressure CDPs have been proposed for those years in the affected suburbs and a larger one for the Jerrabomberra shortfall in 2028. These are local interconnections that can be constructed relatively rapidly, as and when required.

With the implementation of the proposed CDPs, the Queanbeyan network will be able to provide the capacity required to sustain the demand growth during winter peaks for 10 years and beyond.

9.13 BUNGENDORE MEDIUM PRESSURE NETWORK

9.13.1 SUMMARY OF BUNGENDORE NETWORK

The Bungendore medium pressure network is located 40 km to the east of Canberra, supplying a single township and a major Defence facility. This network supplies a very small number of customers, less than 1,000 in 2013. While the area went through expansion with the establishment of the Defence facility, little further growth is forecast.

The medium pressure network is designed to operate at 400 kPa, but is run at 250 kPa. Pressure is satisfactory, and forecast to continue to be so, given the small rates of expansion in this network.

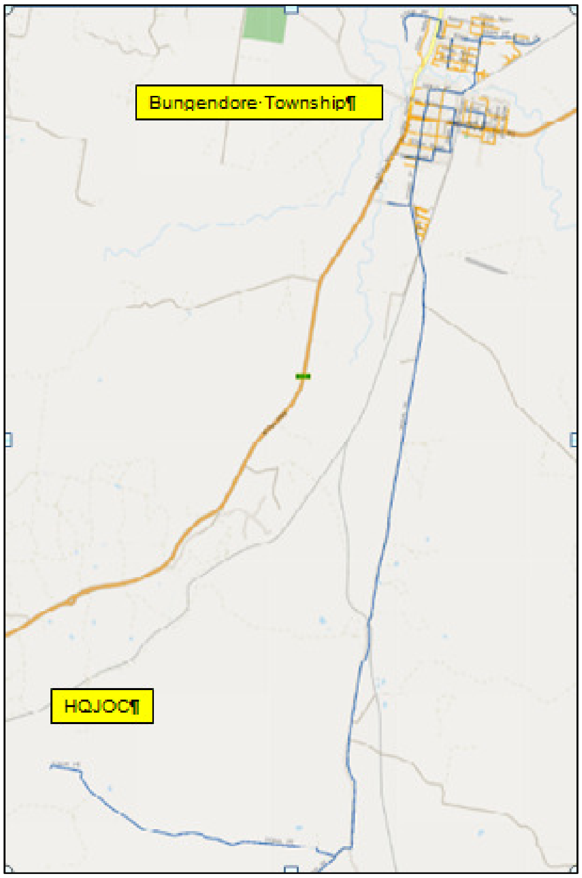

Figure 30: Bungendore Medium Pressure Network including HQJOC

9.13.2 BUNGENDORE HOUSING DEVELOPMENTS

Bungendore is a small, heritage listed town with minor urban developments on its periphery. There are no proposals for significant housing development.

For organic growth, a forecast rate of 2% growth has been applied to modelling across all Canberra networks 2013 – 2023 and a rate of 1% during the outer years 2023-2033.

9.13.3 BUNGENDORE CAPACITY DEVELOPMENT PROJECTS

Current network performance is entirely satisfactory, and forecast to continue so.

No development projects are forecast on current growth rates in the next 20 years.

Appendix A
Peak Flow Calculations

A1. CALCULATION OF PEAK FLOWS

To model gas distribution, it is necessary to determine the maximum hourly peak load that must be supplied by the network.

In general information regarding the peak load of individual customers in the network is not available. However, annual usage of all customers is recorded through JGN customer listings.

This annual usage information can then be used to estimate peak loads in the network by the application of Diversity Factors[11] (f_H) by customer type to known annual usage, using the equation below:

$$MaximumHourlyDemand\left(m^3/hr\right) = f_H\left(\frac{MJ/hr}{GJ/Annum}\right) \times \frac{AnnualUsage\left(GJ/annum\right)}{DesignHeatingValue\left(MJ/m^3\right)}$$

The diversity factor for domestic load has been established empirically from various studies over the last 20 years. The average domestic load diversity factors to be used in network modeling are shown in table below.

Canberra's higher diversity factor reflects the greater range of winter temperatures on winter mornings, leading to greater variability of peak demand.

Area	fH
Coastal Metropolitan (Sydney, Newcastle, Wollongong)	0.6
Country	0.7
Canberra	**0.8**

For I&C customers, diversity factors are listed in table below:

Customer Type	fH at Given Times				
	2 am	7 am	10 am	3 pm	6 pm
Offices, schools, shops	0	0.6	0.54	0.24	0.12
Clubs, Hotels, Motels, restaurants	0.06	0.3	0.42	0.42	0.6
Hospitals	0.06	0.24	0.3	0.24	0.21
Bakeries	0.43	0.6	0.12	0	0
Heavy Industry (8 hour operation)	0.06	0.55	0.44	0.17	0.06
Heavy Industry (24 hour operation)	0.13	0.13	0.13	0.13	0.13

These factors are then adjusted to value such that network terminal point pressure in Synergee network model would match the reading obtained from Winter Gauging data.

A1.1 PEAK FLOW CALCULATION EXAMPLE:

For a single domestic customer with annual consumption of 25GJ per annum, hourly winter peak in standard m3/h would be (25 GJ) x (0.6) / (37.5 MJ/m3) = 0.4 sm3/h

[11] Essentially, the probability that any customer of that type will consume gas in peak periods.

Appendix B
AAD Risk Assessment Tables

B1. AAD RISK ASSESSMENT TABLES

B1.1 RISK MATRIX

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Low	Medium	High	Very High	Very High
Likely	Low	Medium	High	High	Very High
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	Medium

B1.2 RISK RESPONSE

Rating	Required Response
Very High	Prompt corrective action by Executive management is required. The Board and Audit and Risk Management Committee must be kept informed of actions and progress until the exposure is at an acceptable level. Further controls are needed unless impracticable/ financially unviable.
High	Senior management (branch manager/equivalent) must be involved in systematic monitoring. Additional controls may be required to protect ActewAGL's interests, reputation and business.
Medium	Manage by specific monitoring or response procedures, with management responsibility specified.
Low	Managed by existing routine procedures and work practices in ActewAGL.

B1.3 LIKELIHOOD TABLE

Rating	Likelihood of the risk occurring in the next 3 years	
	Description	Estimated probability
Almost Certain	Almost certainly will occur.	>90%
Likely	Is likely to occur in the current operational environment.	70 - 90%
Possible	Will possibly occur in the current operational environment.	30 - 70%
Unlikely	Is unlikely to occur in the current operational environment.	10 - 30%
Rare	May occur in rare circumstances only.	<10%

B1.4 AAD CONSEQUENCE TABLE

ActewAGL's consequence descriptors can be seen in the following table.

Rating	Consequence						
	Financial damages, losses or costs	Disruption to operations	Damage to reputation[12] or competitive position	Health/safety incident	Damage to the environment	Legal/compliance breach	Disruption to program/project
Severe	Organisation[13] >10% of profit[14] Other >10% unfavourable variance	Continuity of supply: disruption to >10% of customers for >72 hours; OR Continuity of operations: severe and/or long term (> 6 months) effects on an element of operations.	Severe dissatisfaction across all primary stakeholder groups and/or sustained (more than one week) adverse local/national media attention across multiple media channels and/or Loss of >25% market share.	One or more fatalities.	Serious environmental damage or long term effects on ecosystems.	Breaches of law with severe consequences such as prosecutions, severe fines, major litigation, and/or license to operate suspended.	Would threaten the survival of not only the program/project, but also related programs; and/or would have a severe impact on program's viability.
Major	Organisation 7% to 10% of profit Other 7 to 10% unfavourable variance	Continuity of supply: disruption to <10% of customers for > 72 hours; OR Continuity of operations: major and/or medium term (months) effects on an element of operations.	Major dissatisfaction across multiple stakeholder groups and/or adverse local/national media attention or public outcry across multiple media channels and/or Loss of 15% to 25% market share.	Irreversible disability, impairment or extensive injuries to one or more persons.	Major detrimental environmental damage or long-term effects.	Breaches of law with major consequences such as litigation, major fines, extensive reporting, audit regimes imposed and/or license to operate reviewed by regulator.	Would threaten the survival or continued effective function of the program/project; and/or would have a major impact on the project's objectives.
Moderate	Organisation 4% to 7% of profit Other 4% to 7% unfavourable variance	Continuity of supply: disruption to <10% of customers for 12 – 72 hours; OR Continuity of operations: moderate and/or short – medium term (weeks/months) effects on an element of operations.	Moderate dissatisfaction across multiple stakeholder groups and/or adverse local media attention and/or Loss of 10% to 15% market share.	Lost Time Injury (LTI) >1 week, modified duties >1 week, hospital/GP visit requiring surgical procedure.	On-site environmental releases contained with outside assistance, moderate medium-term environmental effects.	Breaches of law with moderate consequences such as investigations, threat of litigation, moderate fines, additional reporting and/or audit requirements imposed.	Would not threaten the program or project, but would mean that the program or project could be subject to significant review or changed ways of operation; and/or would moderately impact on the program or project's operational objectives.
Minor	Organisation 1% to 3% of profit Other 1% to 3% unfavourable variance	Continuity of supply: disruption to <10% of customers for < 12 hours; OR Continuity of operations: minor and/or short term (days) effects on an element of operations.	Minor stakeholder dissatisfaction and/or local media enquiries and minor reporting and/or Loss of 5% to 10% market share.	Lost Time Injury (LTI) <1 week, modified duties <1 week, hospital/GP visit not requiring surgical procedure. Minor on site first aid treatment.	Minor environmental effects, any environmental on-site releases are contained.	Breaches of law with minor consequences such as minor legal issues and/or minor fine imposed.	Would threaten the efficiency or effectiveness of some aspect of the program or project, but would be dealt with internally; and/or would have a minor impact on project's objectives.
Insignificant	Organisation <1% of profit Other <1% unfavourable variance	Continuity of supply: disruption to individual customer for < 12 hours; OR Continuity of operations: insignificant and/or short term (days) effects on an element of operations.	Insignificant public or media attention and/or Loss of < 5% market share.	Insignificant injury or ailment, self-administered first aid or no treatment required.	Insignificant effects on environment.	Breaches of law with insignificant consequences and/or breaches of regulations.	Would result in consequences that could be dealt with by routine project management.

12 Stakeholder groups (whose perceptions of ActewAGL might cause damage to reputation): primary - owners, customers, employees, suppliers; secondary – government/regulator, media, public/community, competitors.

13 Organisation refers to risks at the divisional or corporate level, otherwise use 'other'.

14 DM 508006 (Distribution) and DM 508007 provide profit estimates (these documents are accessible by Executives and Divisional Risk Advisers

Appendix C
Technical Policies

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C1. TECHNICAL POLICIES

Table C1–1: List of attached technical policies

Document Number	Title of Policy
TPG.DES.010	Distribution Network Operating and Metering Pressures
TPG.DES.020	Network Supply Performance Validation and Long Term Capacity Planning
TPG.DES.040	Distribution Network Capacity Planning Criteria

Technical Policy Review Committee, Gas

TPG.DES.010

Distribution Network Operating and Metering Pressures

Approved:	
Phil Colvin	
CHAIRPERSON, TECHNICAL POLICY REVIEW COMMITTEE, GAS	

1. Purpose

The purpose of this policy is to define distribution network operating pressure regimes, control requirements and metering pressures for new customers.

2. Scope

Activity	Design & Planning
Clients	Jemena Gas Networks, ActewAGL
Jurisdictions	NSW, ACT
Asset Classes	Secondary Mains & Services, Low and Medium Pressure Mains & Services, TRS, PRS, DRS, Meter Sets

3. References

AS/NZS 5601.1 : Gas Installations – General Installations
AS/NZS 4645 : Gas Distribution Network Management
AS/NZS 4645.1 : Part 1 – Network Management

AS/NZS 4645.2 : Part 2 – Steel Pipe Systems	
AS/NZS 4645.3 : Part 3 – Plastic Pipe Systems	
TPG.DES.020 : Network Supply Performance Validation	
TPC.PROC.4.99.12 : Gas Meter Type Selection and Sizing	

4. Definitions

MAOP	Maximum Allowable Operating Pressure
CHOS	Customer Hours off Supply

5. Distribution Network Operating and Metering Pressures

Tables 5.1 and 5.2 specifies the operating pressure parameters for distribution networks and the standard metering pressures available to customers within these networks.

Table 5.1: Standard Operating and Metering Pressures (kPa)

MAOP	Minimum Inlet Pressure Required	Normal Operating Pressure Limits			Emergency Pressure Limits		Standard Metering Pressures
		Regulator Set Point	Network Design	Network Minimum	Max Over-Pressure Set Point	Network Minimum	
1,050	1,750	1,030	1,010	525	1,155	400	100
400	600	390	380	70	440	40	2.75, 5, 35
300	525	295	290	70	330	40	2.75, 5, 35
210	460	205	200	70	230	40	2.75, 5, 35
7	40	7	6.5	3.5	15	2.8	1.38, 2.75
2	3.5	2	2	1.5	15	1.4	1.38

Table 5.2: 'Non-standard' Operating and Metering Pressures (kPa)

MAOP	Minimum Inlet Pressure Required	Normal Operating Pressure Limits			Emergency Pressure Limits		Standard Metering Pressures
		Regulator Set Point	Network Design	Network Minimum	Max Over-Pressure Set Point	Network Minimum	
100	400	95	90	70	110	40	2.75, 5, 35
30	70, 400	30	25	10	35	5	1.38, 2.75
11	400	11	11	4	15	2.8	1.38, 2.75

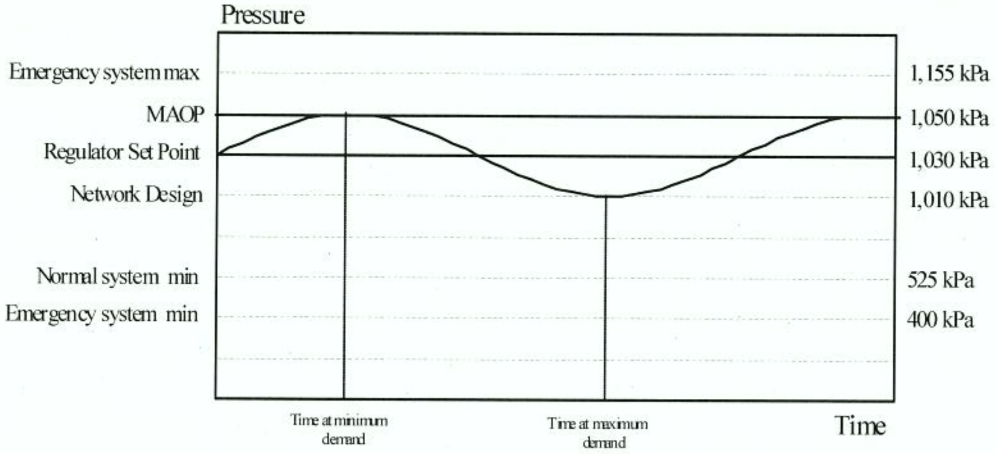
5.1. Notes:

1. At the minimum emergency pressure limits, the full design capacity of meter sets and district regulator sets may not be achieved.
2. Changes to standard metering pressures are not retrospective; existing customer meter sets with non-standard metering pressures do not need to be modified.
3. For networks with a MAOP of 1,050kPa, lower network minimum pressures than 525kPa may be allowed on an individual basis (dependant on the downstream network configuration), subject to approval by Asset Management.
4. Within the 30kPa networks, minimum normal operating network pressure limits defined by the minimum pressure required to provide adequately supply to meter sets requiring pressures above 10kPa to operate effectively.
5. The 11kPa networks are supplied through Green Gnome regulator sets from the secondary network (1,050kPa) in the Wollongong region, supplying only single customers.
6. The asset class strategy for MP mains is to upgrade to 'standard' network operating pressures if the opportunity arises, such as areas with high levels of leakage. For networks highlighted in Table 5.2, consideration should be taken of any adjoining networks and their operating pressures for opportunity to upgrade to 'standard' operating pressures defined in Table 5.1.
7. Tables 5.1 and 5.2 exclude Trunk and Primary networks due to different requirements and standards. At time of writing for this version there is no technical policy relating to network operating and metering pressures for the Trunk and Primary networks.

5.2. Exceptions:

1. Metering pressure for specific end users other than those specified in Table 5.1 will be considered on an individual basis, but must be approved by Asset Management in consultation with the Measurement Centre.
2. For networks with a MAOP of 210kPa, 300kPa or 400kPa, connection of customers with loads in excess of $310m^3/hr$ will only be authorised if, for the duration of the lifetime of that customer, a minimum of 100kPa can be guaranteed at the delivery point.

The following diagram illustrates the relationship between the various pressures in the above table:



6. Documentation

Nil.

7. Compliance Measures

7.1. KPIs

The following KPIs will be used to measure compliance to the policy:

- Occurrences of overpressure reported to the Technical Regulator
- Occurrences of poor or lost supply reported to the Technical Regulator as CHOS

7.2. Audit mechanism

Audit measures will include:

- Network validation process based on Technical Policy TPG.DES.020.

Revision History

Rev.	Date	Description
1	04/07/2003	Consolidation of two policies and updated to reflect new standard metering pressures. This document supersedes TPC.PROC.4.99.1, rev 0 and TPC.PROC.4.99.2, rev 0
2	29/07/2008	Administration changes to names, titles
3	30/11/2011	Copyright statement and "Commercial in Confidence" statement inserted
4	25/04/2012	Modifications made: • Updated References to reflect change in standards naming • Inclusion of Table 5.2 to include non-standard operating pressures • Updated KPI's to reflect actual practice

Technical Policy Review Committee, Gas

TPG.DES.020

Network Supply Performance Validation

Approved:
Phil Colvin
CHAIRPERSON, TECHNICAL POLICY REVIEW COMMITTEE, GAS

1. Purpose

This policy defines control measures to validate network supply performance to ensure network reliability and efficient infrastructure growth, basically an audit of our network systems.

2. Scope

Activities	Design & Planning
Clients	Jemena Gas Networks, ActewAGL
Jurisdictions	NSW, ACT
Asset Classes	Pipelines (Trunk), Primary Mains & Services, Secondary Mains & Services, Low and Medium Pressure Mains & Services, TRS, PRS, DRS

3. References

AS/NZS 4645.1:2008 - Gas Distribution Networks – Network Management
TPG.DES.010 – Distribution Network and Operating Metering Pressures
TPG.DES.040 – Distribution Network Design Criteria

4. Definitions

MAOP	Maximum Allowable Operating Pressure
Network	An interconnected grid of gas distribution mains operating at a single MAOP
SynerGEE	Gas Modelling Software to simulate Gas Distribution Networks.
AMP	Asset Management Plan
ES&P	Engineering Strategy and Planning group

5. Network Supply Performance Validation

5.1 Objective

The objective of network supply performance validation and long term capacity planning is to ensure the network infrastructure is operating to its expected performance capabilities. The activities associated with this process are:

- Gauging program with pressure gauges placed on terminal areas of networks and location reviewed on annual basis against the long term plan.
- Computer model simulations using Synergee Gas Software and undertaking network analysis to validate network supply performance.
- Network capacity development planning for efficient development of network infrastructure to facilitate growth demands.

5.2 Network Modelling

Synergee network models are used as a tool to simulate and validate the network supply performance. Each gas network will have an established and maintained Synergee model, comprising of supply points, pipes and gas loads including tariff and contract customers.

These models will be used to:

- Confirm that networks have sufficient capacity to supply contracted loads;
- Verify network ability to supply proposed loads;
- Simulate new network designs and network changes;
- Guide gradual network growth within long term strategies, and
- Assist in incident / emergency response.

5.3 Model Verification

The network models are revised annually during peak demand to verify network performance. This peak gas demand can either be summer or winter depending on the network.

The network pressures will be monitored at supply and terminal points. The frequency and extent of monitoring will be determined with regard to network capacity, network changes and history of network performance.

5.4 Levels of Network Revision

Following each winter, all network models are to be revised. The annual revision level will be Level 1, unless it is determined that a Level 2 review is required, due to network performance or other issues identified during the preceding year.

Each annual review includes:

- Update of network models / supply points / customers numbers;
- Verification of network performance (gauging / telemetry) and network simulations;
- Winter peak demand / projections for short / medium / long term, in order to confirm timing of identified projects or identify future requirements;
- Input into AMP / Capital Plans.

The level of additional review is to be based on a set of guidelines outlined in the Table below.

Network Type	Network Revision Level	
	Level 1 (Annual Review)	Level 2 (Comprehensive Review)
Timing Requirements	▪ *Annual review*	▪ *At least once every 5 years*
NSW Trunk (MAOP 6,895kPa)	▪ N/A	▪ Comprehensive review for the NSW Trunk to be done on annual basis.
Primary (MAOP 3,500kPa) Secondary (MAOP 1,050kPa) Medium 100kPa ≤ Pressure ≤ 400kPa Low 2 kPa ≤ Pressure ≤ 30kPa	▪ Network spare capacity above 15%. ▪ None to minor capacity development projects within 5 years. ▪ Slow / minimum network growth	▪ Network spare capacity less than 15%. ▪ Significant capacity development projects within 5 years. ▪ Long term plan required. ▪ Significant changes to network configuration. ▪ Network performance issues such as supply problems, frequency of customer complaints, incidents, emergencies, etc.

Note:

- Each network is assigned a revision level.
- A Level 1 revision is required for each network annually, unless a Level 2 revision is performed to occur once every 5 years.
- A Level 2 revision is required on an annual basis only for those networks determined by ES&P to require a Level 2 revision.
- Transient modelling is required for the NSW trunk network.
- Manager, Capacity Planning is to approve level of revision to be performed.

5.5 Scope of Network Model Revision

In order to maintain network supply reliability, the following scope of network model revision is recommended:

Level 1: **Revision of level 1 will include:**

- General balance of Synergee network model against recorded pressure results, with minimal updating of network configuration and major loads.
- Verification of capacity development projects previously implemented.
- Testing and verification of timing of 1-5 year capacity development projects using latest marketing forecasts or documented growth assumptions.
- Confirmation and recommendation of minor network upgrades.
- Output to business case for confirmed projects.

Level 2: **Revision of level 2 will include:**

- Detailed updating of concentrated loads and distribution of tariff loads.
- Verification of capacity of supply points and pipe/size configuration.
- Balance of Synergee network model against recorded pressure results and updated telemetry data.
- Development of the long-term network capacity development plans based on forecasts out to 20 years.
- Risk assessment in relation to supply reliability for the justification of major capacity development projects.
- Verification of supply ability of the interdependent networks.
- Verification of telemetry requirements.
- Review of the isolation ability of area & shopping centre isolation sectors (ie: HRV areas).

6. Documentation

The results of the network revision will be compiled in a spreadsheet and converted to PDF format on a yearly basis. The spreadsheet will include:

Level 1: **Annual Network Performance Status (Spreadsheet)**

- Design inputs to validation process;
- Results of Synergee network modelling;
- Recommendations for network capacity enhancements to ensure supply reliability.

Level 2: Long Term Plan (Report)

- Current configuration and Network Map;
- Network constraints;
- Recommendations for network capacity enhancements to ensure supply reliability;
- Planned network augmentation strategy;
- Relevant options analysis of the planned strategy.

Spreadsheets will be retained via electronic format in the Capacity Planning folder for the given level of network revision.

7. Compliance Measures

- No failure of supply due to poor planning.
- Progressive improvement in network utilisation.
- All network revisions completed for timely input into capital budget and AMP.

Revision History

Rev.	Date	Description
1	14/08/2003	This document supersedes TPC.PROC.4.99.28, rev 0
2	29/07/2008	Administrative changes to titles and scope
3	30/11/2011	Copyright statement and "Commercial in Confidence" statement inserted
4	13/11/2012	Review of validation procedure and update of process

Technical Policy Review Committee, Gas

TPG.DES.040

Distribution Network Capacity Planning Criteria

Approved:
Phil Colvin
CHAIRPERSON, TECHNICAL POLICY REVIEW COMMITTEE, GAS

1. Purpose

The purpose of this policy is to define the criteria to be used in the design of gas distribution networks to ensure that the design meets capacity and security of supply requirements.

2. Scope

Activities	Design & Planning
Clients	Jemena Gas Network, ActewAGL
Jurisdictions	NSW, ACT
Asset Classes	Trunk Mains, Primary Mains & Services, Secondary Mains & Services, Networks, Low ad Medium Pressure Mains & Services, TRS, PRS, DRS

3. References

AS/NZS 4645	Gas Distribution Network Management
TPG.DES.010	Distribution System Operating Pressure and Metering Pressure
TPG.DES.020	Network Supply Performance Validation and Long Term Capacity Planning

4. Definitions

MAOP	Maximum Allowable Operating Pressure
Network	An interconnected grid of gas distribution mains operating at a single MAOP.

5. Distribution Network Capacity Planning Criteria

The Long-Term Plan provides the strategy for implementation of the network design to provide capacity to supply for the contract and tariff markets for the periods after 5, 10 and up to 20 years.

Before implementation of any stage of the long term plan, network enhancement requirements and opportunities for improving reliability and security of supply must be revised against known assumptions and criteria. The capacity planning criteria is detailed in Table 5.1 below.

Table 5.1 – Capacity Planning Criteria

SOURCE OF DESIGN REQUEST	DESIGN INPUTS	DESIGN CAPACITY PROVISION	LONG TERM STRATEGY PLANNING
• New contract and tariff projects • Capacity enhancement for under-performing networks • Enhancement to improve security of supply and reliability of the networks • New distribution networks that require gas	• Performance of existing gas distribution network based upon physical data (eg gauging) • Current load information • Potential loads for tariff and contract markets for periods of 5, 10 and 20 years in consultation with marketing • Analysis of the requirements and opportunities to improve security and reliability of supply in the area • The minimum pipe size for high pressure networks will be 100 mm • Tariff market demand is calculated for a 1:20 year winter load factor	• Existing contract and tariff loads • Requested new contract loads • Projected 5 year (or longer) growth in tariff market • Capacity provision to improve reliability and security of supply in the area, if justifiable • Concept design for project to provide capacity for at least 20 years	• Long-term plan including network augmentation required to provide capacity and security of supply to the network

- All proposed designs must be verified by computer models as described in TPG.DES.020 Section 5.2.
- On completion of the project, the design must be validated as per TPG.DES.020 Section 5.4.

6. Documentation

The results of the network design will be compiled in a report. The report will include:

- Network Description and Validation Map ID Number
- Network revision level and schedule
- Map of network supply configuration
- Design inputs and assumptions
- Results of computer network modelling
- Design Basis of planned network reinforcement

Reports will be retained electronically as per the requirements under the Records Management Plan.

7. Compliance Measures

- No loss of supply to forecasted connections because of undersized network configuration.
- Minimise supply disruptions during planned or unplanned maintenance activities when security of supply opportunities are available at an incremental cost.

Revision History

Rev.	Date	Description
1	27/09/2006	This document supersedes TPC.PROC.4.99.28, rev 0
2	29/07/2008	Administrative changes titles and company names
3	30/11/2011	Copyright statement and "Commercial in Confidence" statement inserted
4	25/05/2012	Reformatted and reviewed Sections 5 and 6