AusNet Gas Services Pty Ltd

Gas Access Arrangement Review 2018–2022

Appendix 6J: Network Capacity Strategy

Submitted: 16 December 2016

missionZero

Network Capacity Strategy

Gas Network

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1 Executive Summary

AusNet Services has an obligation to maintain and manage the supply of natural gas to its customers in accordance with its Gas Safety Case (GSC) (this being compliant with the *Gas Safety Act* and *Gas Safety Regulations*) and the Gas Distribution System Code (GDSC).

AusNet Services' annual augmentation program, which results from forecasts of customer growth, winter performance, and network analysis, is required to create new assets or upgrade the capacity of existing assets to achieve appropriate outcomes for customers and other stakeholders.

The strategy covered by this document aligns with the key gas network objectives as detailed below:

- Maintain network Safety in accordance with the Gas Safety Case by,
  - Maintaining network pressures in line with the GDSC.
- Maintain top quartile operating efficiency by,
  - Minimising network outages or supply interruptions to customers.
- Undertake prudent and sustainable network investment by,
  - Connecting customers in our growth corridors including Wyndham, Melton and Geelong.
- Delivery of valued services to our customers by,
  - Delivering a reliable and safe network.

Demand on AusNet Services' gas network is forecast to remain reasonably stable over the next five years, with customer growth expected to compensate for lower consumption per capita. With strong population growth in Melbourne localities such as Hume, Melton and Wyndham and regional areas such as Bendigo, Ballarat and Geelong, overall customer growth is forecast to increase by an average of 2.1% to 2022.

Contrastingly, smaller housing, energy efficiency and the increasing competitiveness of electrical appliances is expected to reduce residential consumption per household by 1.5% per annum over the same period. The combination of customer growth and lower demand per customer is projected to result in total Tariff V demand increasing by 0.6% in the next five years. Some isolated networks are however predicted to exceed the average rate of customer growth due to their geographical position in the key urban growth zones in Melbourne's west and key regional hubs.

The program outlined for the 2018/19 – 2022/23 financial periods includes installing new City Gate and Field Regulator facilities, upgrades to existing facilities, and laying mains reinforcements. Approximately 27km of mains reinforcements, 5 new facility installations and 7 capacity upgrades to existing facilities have been identified in the augmentation works package up to FY2022/23.

The Appendix contains further financial information, as well as project details pertaining to these works.

Table 1: Planned Augmentation Capital Expenditure (CAPEX) Summary

Augmentation	2018/19	2019/20	2020/21	2021/22	2022/23
Pipe Reinforcements ($ '000)	$3,589	$930	$360	$1,510	$3,090
New Facility Installations ($ '000)	$2950	$1300	-	-	-
Existing Facility Upgrades ($ '000)	-	$1,500	$200	$400	-
Total Direct Expenditure ($'000)	**$6,539**	**$3,730**	**$560**	**$1,910**	**$3,090**

2 Glossary

AEMO	**Australian Energy Market Operator:** Focuses on delivering a range of gas (and electricity) market, operational, development, and planning functions by managing the Victorian gas transmission network and overseeing gas retail markets.
APA GASNET	**Australian Pipeline Trust:** Principal national gas transmission pipeline owner.
CAPEX	**Capital Expenditure**
City Gate	The largest type of gas pressure reduction station and where asset ownership shifts from the principal transmission operator (APA) to the distribution business (AusNet Services).
EDD	**Effective Degree Day:** A composite measure of weather coldness incorporating the effect of temperature; wind, sunshine and time of the year. EDD figures are provided daily by AEMO.
Field Regulator	A pressure regulating facility fed from AusNet Services' Transmission Pipeline in order to supply a high or medium pressure distribution system.
GDSC	**Gas Distribution System Code**
GSC	**Gas Safety Case**
HP	**High Pressure**
I&C	**Industrial and Commercial**
MP	**Medium Pressure**
SCADA	**Supervisory Control and Data Acquisition**
SynerGEE	Gas network modelling software.
TP	**Transmission Pressure**

3 Document Overview

3.1 Purpose

The document articulates AusNet Services' approach to maintaining network capacity. The document is for use by:

- Internal staff and senior management; and
- Regulators: Economic, Technical and Safety.

The Network Capacity Strategy is one of several plant and network strategies developed and maintained for the management of AusNet Services' Gas Distribution Network. It Identifies network areas where existing capacity is insufficient to meet forecast demand and describes proposed network augmentation to meet forecast demand.

3.2 Scope

The Network Capacity Strategy covers AusNet Services' natural gas distribution and transmission assets operating in the western region of metropolitan Melbourne and regional Victoria.

This strategy is only concerned with the available capacity of such assets that physically carry gas sourced from APA's gas transmission pipeline system and their ability to meet consumer demand.

Assets in scope:

- Network regulating stations (City Gates, Field Regulators and District Regulators),[1] and
- Transmission pipelines, supply mains, and reticulation mains.

Assets out of scope:

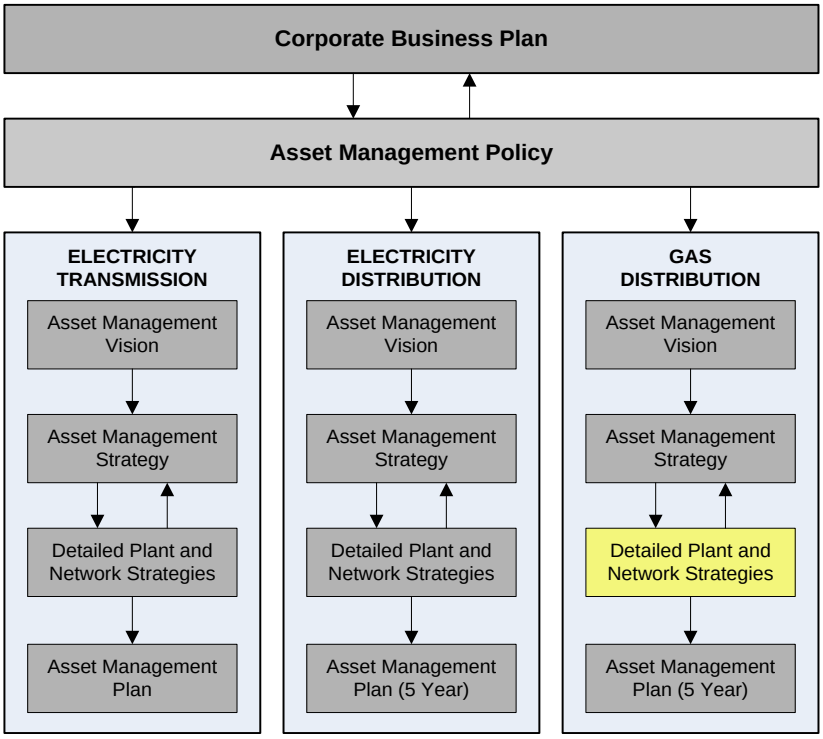
- SCADA,
- City Gate Heaters,
- Cathodic protection,
- Consumer regulators (Domestic, Black Box or Industrial and Commercial (I&C)), and
- Services.

3.3 Relationship with Management Documents

The Network Capacity Strategy is one of a number of asset management related documents developed by AusNet Services in relation to its gas distribution network. As indicated in Figure 1, detailed plant and network strategies, in which the Network Capacity Strategy belongs, informs both the Asset Management Strategy (AMS) and Asset Management Plan (AMP) of the capital required to maintain network capacity and provide the appropriate security of supply to AusNet Services' customers.

[1] Company initiated capital only.

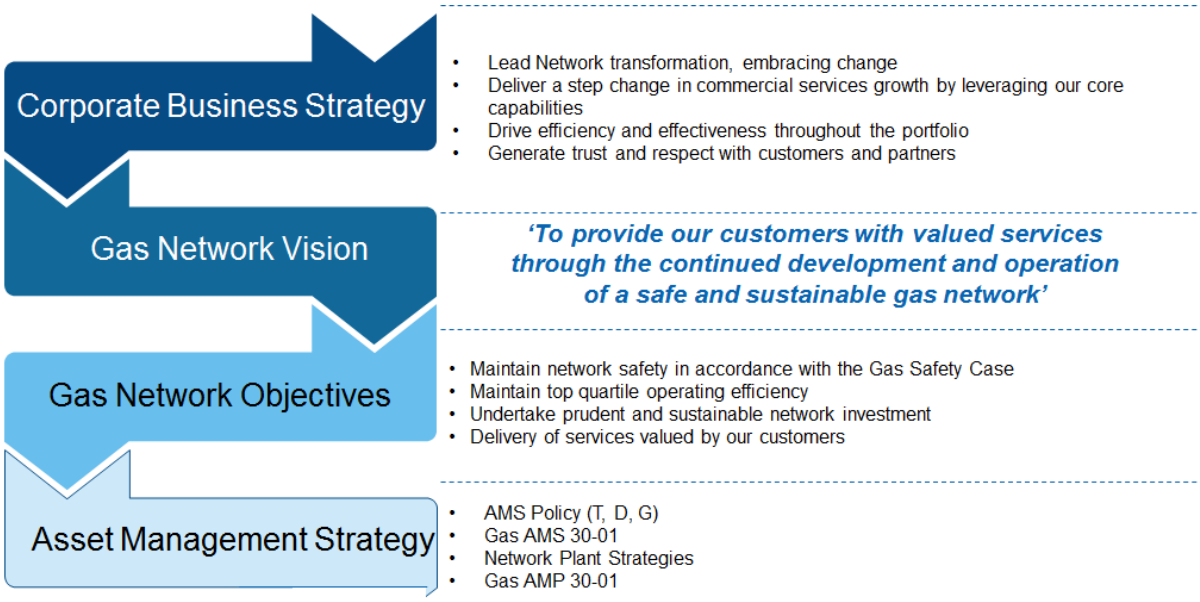
Figure 1: Asset Management System Document interdependencies



4 Alignment of AusNet Services' Business Drivers and Objectives

AusNet Services' purpose statement is to "Empower communities and their energy future". This statement places the customer (as individuals and communities) at the forefront as a business driver and acknowledges the critical relationship with their energy supply and usage, and is a key theme throughout the Corporate Business Strategy. The following diagram provides the linkage between AusNet Services' corporate strategy, and the gas network vision consistent with providing valued customer service and sustainable network investment. The gas network objectives which stems network vision then drives the development of the programs for each of the asset strategies

Figure 2: Alignment of Corporate, Business and Network objectives



The gas network objectives alignment with the business, regulators, and the delivery of plant strategies are detailed below:

Maintain network safety in accordance with the Gas Safety Case

Maintains the alignment to AusNet Services' commitment to 'Mission Zero'. The objective to maintain network safety is in recognition of AusNet Gas Services' current safety performance and design of the network.

Maintain top quartile operating efficiency

Aligns to the Corporate Business Plan with AusNet Services' aspiration to operate "all three core networks in the top quartile of efficiency benchmarks".

Undertake prudent and sustainable network investment

Alignment to AusNet Services' obligation to undertake prudent and sustainable network investment, as defined in the National Gas Rules and Gas Distribution System Code.

Delivery of valued services to our customers

Establishes the need to better understand our customers (their needs and behaviours) and deliver services they value.

4.1 Phasing and Financial Disclosure

All programs within the Network Capacity Strategy are defined in AusNet Services' financial years (i.e. April – March).

All financial figures quoted within this document, including all historic and forecasted expenditure – unless otherwise specifically stated – have the following characteristics:

- Real Expenditure / Cost (reference year – 2016);
- Direct Expenditure only (i.e. excludes overheads and finance costs); and
- In units of $1,000 (i.e. '000).

4.2 References

- Gas Distribution System Code, Version 11, 2014
- AEMO – Victorian Gas Planning Review, Victorian Gas DTS Capacity, Annual Winter Preparedness Strategy.
- APA GasNet – Connection Agreement
- 30-2507-07 Gas Network Planning-Winter Testing Strategy
- Gas Safety Case Regulations
    - GSC 10-00 – Gas Safety Case – Introduction & Facility Description
    - GSC 10-01 – Safety Management System
    - GSC 10-02 – Gas Safety Case – Formal Safety Assessment

5 Planning Overview

5.1 Introduction

The augmentation identified in this strategy outlines the programs required to ensure supply and control of network pressures is maintained through AusNet Services' natural gas distribution system during the period of FY2018/19 – 2022/23.

The gas network in the north western corridor of metropolitan Melbourne has been experiencing significant levels of new customer growth with external factors influencing demand based on the type of development and occupancy numbers.

The western regional districts of Victoria are also experiencing increasing levels of commercial and industrial development due to the economic availability of land and the close proximity to Melbourne and major arterials.

New customer connections are forecast to grow at an average rate of 2.1% per annum to 2022.

To ensure continuity of supply and maintain the minimum network pressures in accordance with the Gas Distribution System Code (Version 11, Schedule 1, Part A), identified areas of the gas network will require augmentation designed on the Victorian accepted methodology.

At the completion of each winter period, a review of the network is undertaken to determine the effectiveness of the augmentation with system pressures being compared to the forecast model. The resulting planning strategy is incorporated into AusNet Services' Capital Program as stated in the Asset Management Plan (AMP 30-01).

The augmentations identified for FY2018/19 – 2022/23 include upgrades and/or new installations for City Gate and Field Regulator facilities, and pipeline reinforcements.

5.2 Planning Methodology

AusNet Services manages approximately ninety (90) gas networks, which are continually expanding due to organic residential growth and commercial and industrial development. To manage this, continued planning and management is undertaken using a computational fluid dynamics program called *SynerGEE* that simulates the actual performance of the networks in the field.

The network models are based on a 1-in-2 Peak Winter Day standard which is based on climate conditions factoring in temperature, sun time, wind speed and seasons which are seen to be experienced once every two winters on average. An algorithm which utilises the variables defines a number known as the Effective Degree Day (EDD) which equates to a value of 14.6. This derivative is provided by AEMO and is based on the system coincident peak day with a 50% probability of exceeding this value in any given year.

EDD is used extensively in Victoria and is based on research of the impact of weather on Victorian residential gas demand.

Modelling of forecast gas consumption indicates the need for future augmentation to the networks to ensure network capacity and fringe pressures are maintained in accordance with the GSC and GDSC.

Figure 3: Effective Degree Day Calculation

Effective Degree Day

EDD = 18 – T	**(Temperature Effect)**
+ [(0.038)(DD)(Avg. Wind)]	**(Wind Chill Factor)**
- [1.8(Sunshine Hours)]	**(Warming effect of Sunshine)**
+ 2Cos[2π(day – 200/365)]	**(Seasonal factor)**

EDD = 0 if the calculated value is negative.

The EDD value will be higher as the temperature gets colder. Eighteen (18) degrees Celsius represents the threshold temperature for residential heating.

A major input to augmentation planning is the annual Winter Testing Program – i.e. a detailed pressure monitoring program conducted at selected locations across the network during peak load conditions. Winter testing data is analysed and used to update the *SynerGEE* models of individual gas networks and identify potential future augmentation of the network.

AusNet Services undertakes detailed winter testing each year on selected areas (networks) of the overall network. Each network undergoes winter testing at least once within an eight-year period. Document *30-2507-7 Gas Network Planning – Winter Testing Strategy* defines the criteria for prioritising and selecting networks for winter testing. The following criteria are considered:

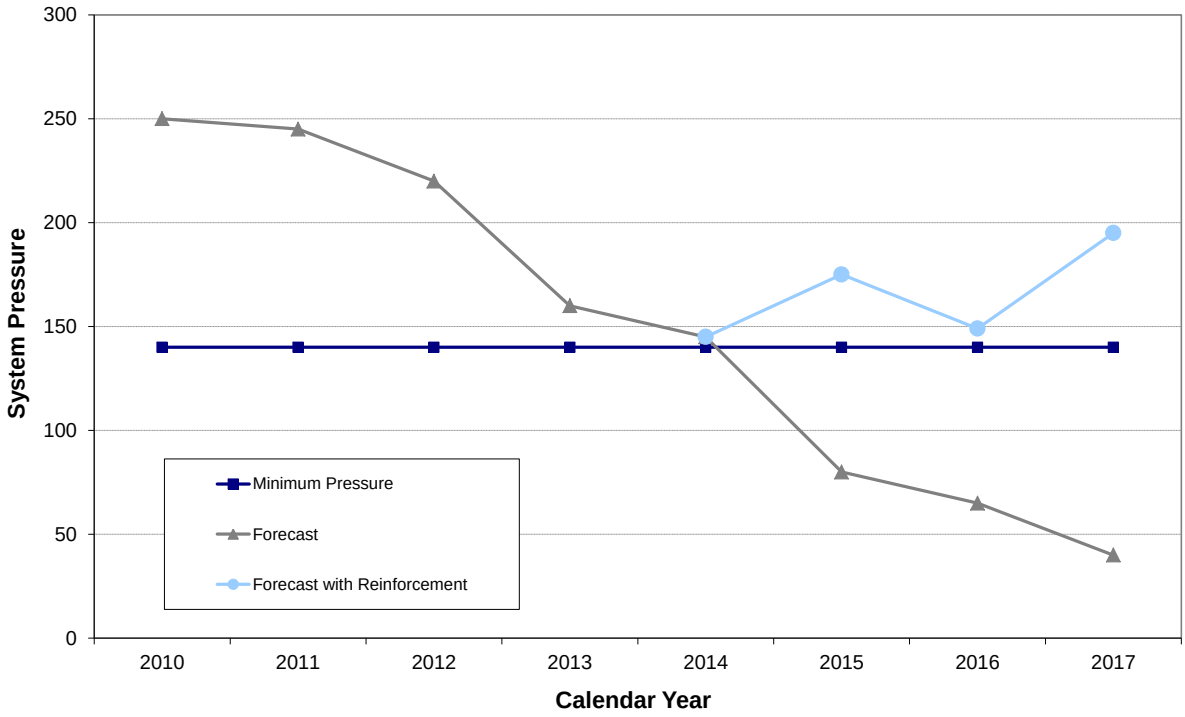
- Date of previous year of winter testing;
- Planned date of next reinforcement;
- Net load growth factor; and
- Network character factor based on fringe rating, interconnection rating, and load factor.

Gas pressures at the fringe of the network are projected forward by reference to current recorded pressures and forecast load growth. This process is used to identify network augmentation requirements to ensure that network fringe pressures remain above required minimum levels.

A typical representation of the behaviour of network pressures with and without undertaking augmentation is depicted in

Figure 4. The graph indicates the consequence of not following the planned augmentation program for the depicted network.

Figure 4: Typical performance of a High Pressure Network (Illustration Only)



Network minimum pressures are expected to fall slightly each winter due to cumulative demand growth. In the example above, indications are that pressure falls below the high pressure benchmark of 140kPa post-2014. All reasonable endeavours are to be made to ensure pressures remain above the minimums stipulated for each pressure tier as required by the GDSC; the identified augmentations (in 2014 and 2016) enable pressures to be maintained above this benchmark, as indicated by the light blue curve. Without undertaking this reinforcement, the trend of falling minimum pressures continues (grey curve).

AusNet Services' obligations under the GDSC to maintain network pressures above minimum levels are highlighted below in Table 2.

Table 2: Gas Distribution System Code Minimum Obligated Network Pressures

Network Pressure Tier	Minimum Obligated Pressure
High Pressure	140kPa
Medium Pressure	7kPa
Low Pressure	1.4kPa

5.3 Prioritisation

Network augmentation is identified by simulating forecast growth and demand, which in turn determines the appropriate timing of each individual project. This ensures compliance with conforming capital criteria as defined within Section 79 of the National Gas Rules, Version 29.

Once augmentation requirements are identified, AusNet Services undertakes feasibility and prioritisation studies for each major proposed capital project. This study comprises a relevant combination of the following elements:

- Proposed network design and associated cost of construction;
- Economic evaluation; and
- Short and long-term requirements.

AusNet Services has divided its gas asset base into ninety (90) separate networks, each managed separately, and operating at a range of pressures. Where required, AusNet Services introduces local reinforcement, e.g. closed loop tie-ins, to cater for specific growth in some areas.

AusNet Services must continue its network augmentation CAPEX programs to maintain asset utilisation at acceptable levels – i.e. to avoid a situation arising when gas demand could create the inability to adequately supply customers due to the incapacity of the system.

5.4 Delivery

Various types of augmentations are undertaken to reinforce the Distribution Network and Transmission Pipeline system including new installations and upgrading of existing specific regulating facilities.

As networks expand due to organic domestic growth, fringe locations become further in distance from the supply point being City Gates, Field Regulators, and even District Regulators.

To ensure adequate network pressures, the Distribution network may require large-diameter supply main duplication, inclusion or extension of a ‘backbone supply main, or providing an additional source of supply.

Transmission Pipelines delivery pressures may also deteriorate with insufficient gas inlet pressures being delivered to the downstream Regulating Facility necessitating duplication of the upstream Transmission Pipeline.

6 Planned Augmentation Program

AusNet Services' planned network augmentation works are summarised in this section. The program is required to ensure GDSC compliance, whilst also being essential to responsibly and efficiently control network performance.

Note:

1. No augmentation works were identified for the Low Pressure networks.

2. All growth forecasts were provided by Economic Regulation in AusNet Services' Regulation & Network Strategy department.

The diagrams in the following section use the below colour scheme for indicating network operating pressure tiers:

Pressure Tier
Transmission
High Pressure 2
High Pressure 1
Medium
Low

6.1 FY2017/18

FY17/18 H26 Ballarat

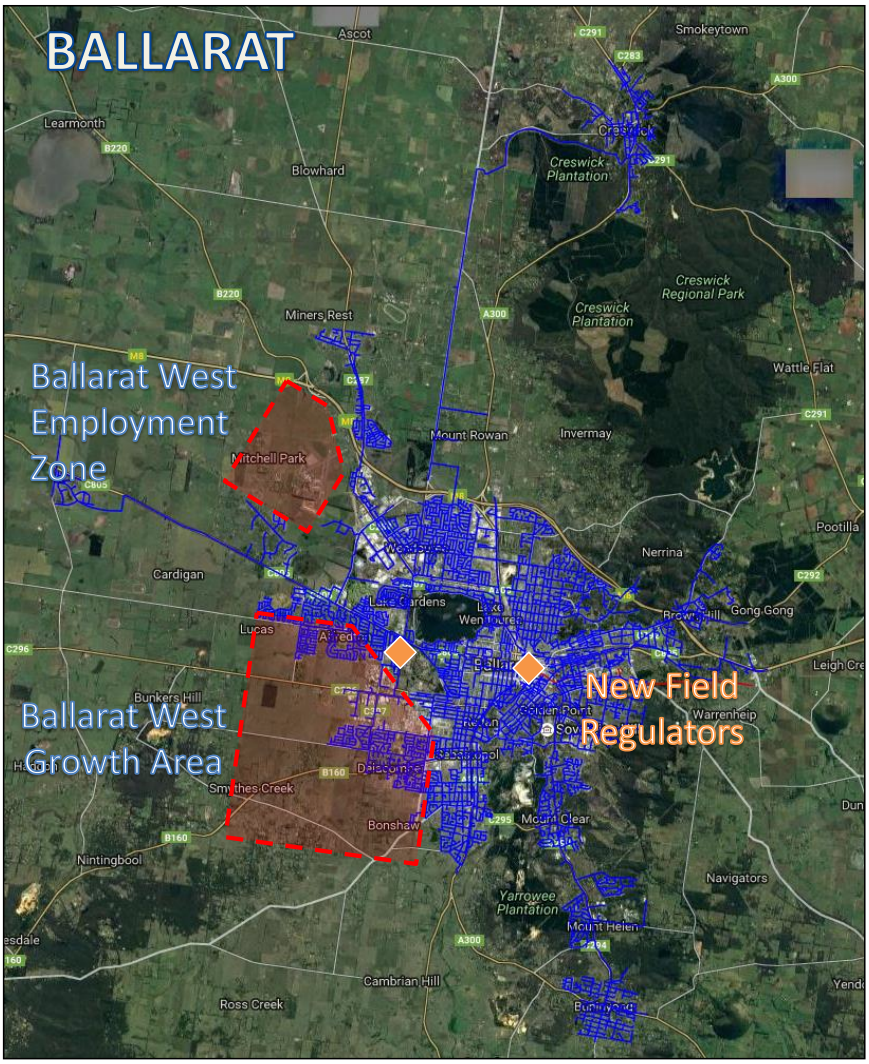
New Facilities (Network Regulators)

The existing Ballarat network cannot support growth concentrated in the west. This project will ensure capacity remains available in growth areas.

Project Overview:

- Install two field regulators in Ballarat.
- Raise the operating pressure of the existing 200mm S7 main from 450kPa (HP1) to 900kPa (HP2).

Figure 5: Ballarat network and growth areas



Project Details:

See Section 0 for additional project details.

FY17/18 H12 Werribee

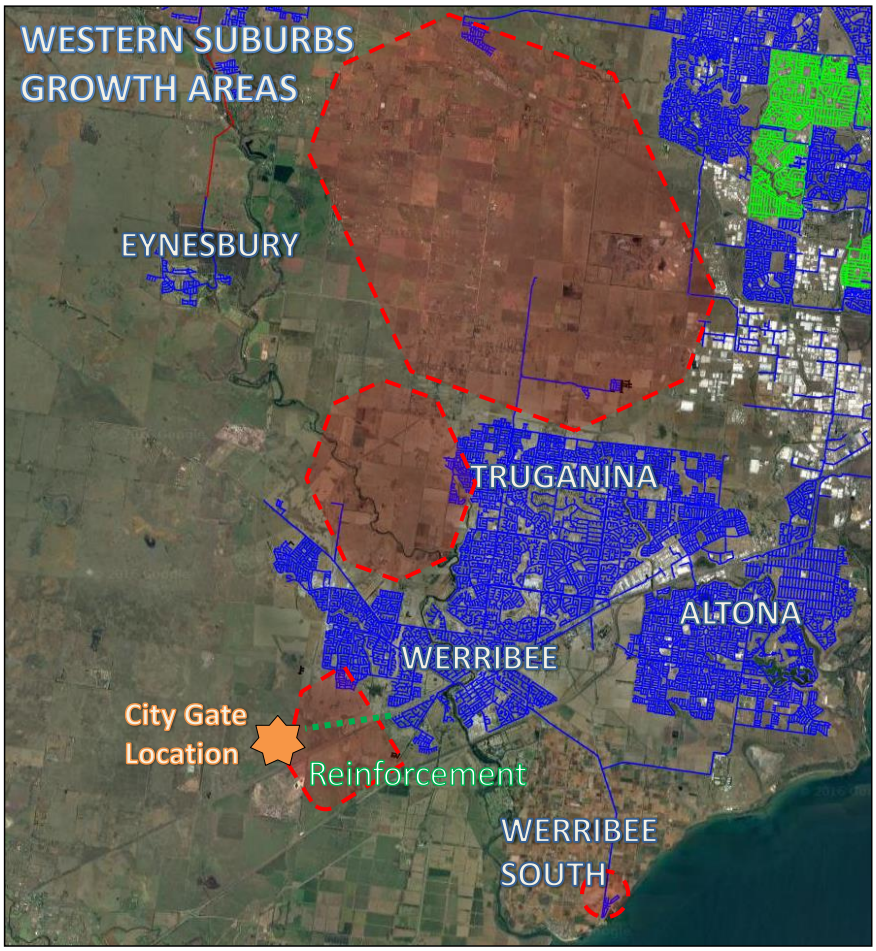
New Facility (City Gate) and Reinforcement

The existing Werribee network cannot support additional connections in western suburbs growth areas. The installation of an additional injection point will sustain projected growth.

Project Overview:

- Install City Gate and 7km of large diameter supply main in Werribee.

Figure 6: Western suburbs network and growth areas



Project Details:

See Section 0 for additional project details.

6.2 FY2018/19

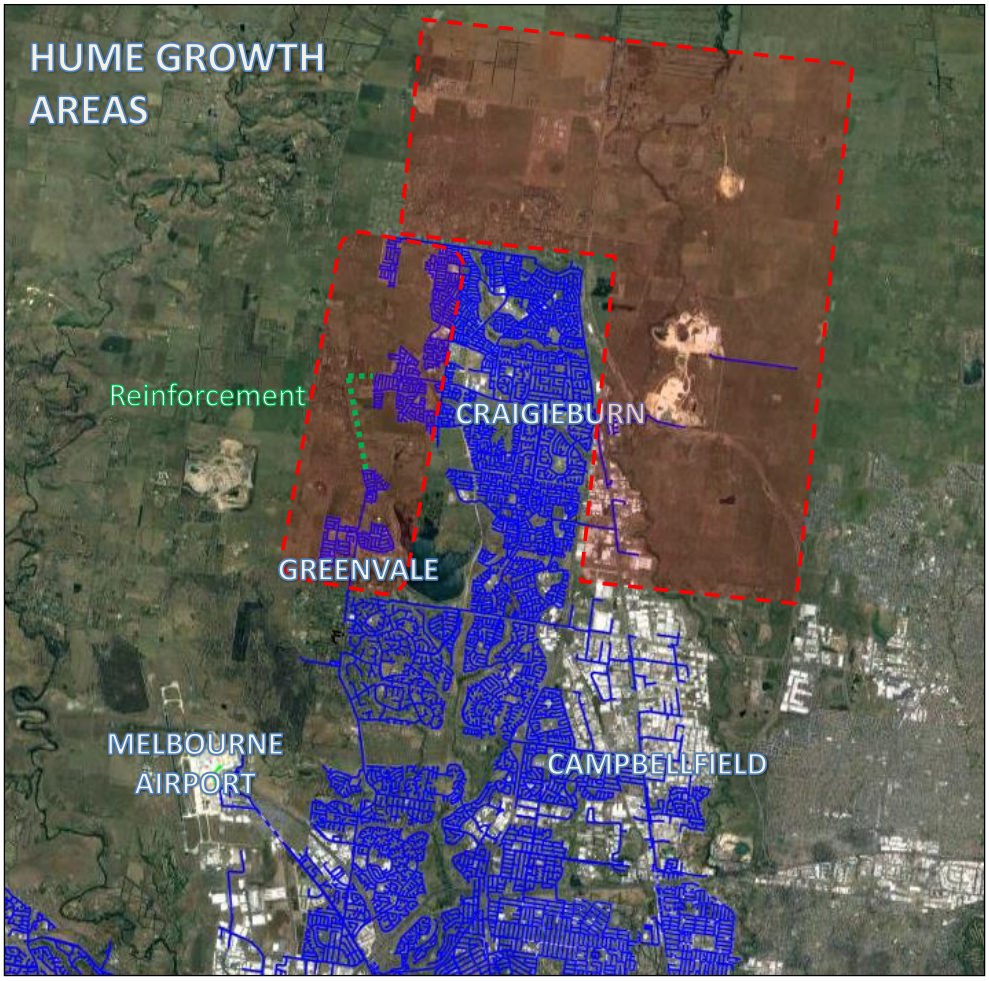
FY18/19 H21 Craigieburn Reinforcement (Stage1)

The Craigieburn network will be unable to support additional connections in the Hume growth area. Along with Stage 2 (FY21/22), these projects will transfer capacity to the areas of the network undergoing growth.

Project Overview:

- Install 4,000m of 180mm P10.

Figure 7: Hume network and growth areas



Project Details:

See Section 0 for additional project details.

FY18/19 H23 Sunbury

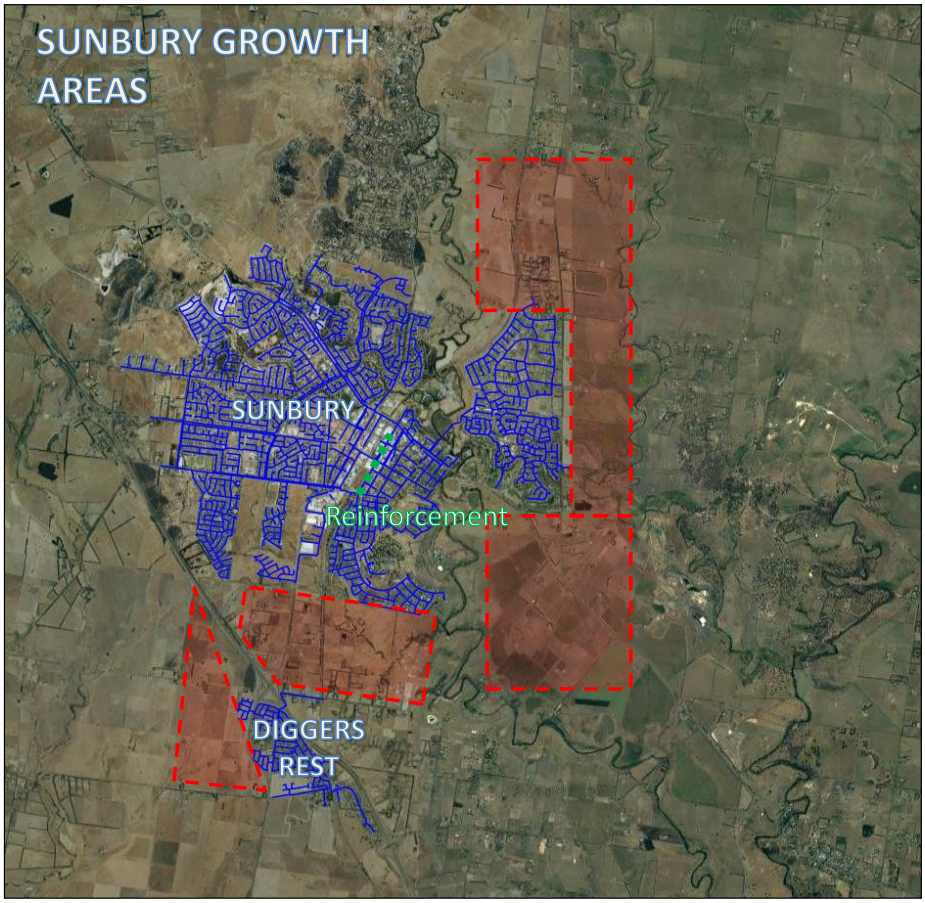
Reinforcement

The Sunbury network will be unable to support projected connection growth. This large-diameter reinforcement project will transfer existing capacity to growth areas.

Project Overview:

- Install 530m of large-diameter 125mm P10.

Figure 8: Sunbury network and growth areas



Project Details:

See Section 0 for additional project details.

6.3 FY19/20

FY19/20 H75 Warrnambool Reinforcement

The Warrnambool network will be unable to maintain supply to the fringes. This project will transfer capacity more effectively through the network via a large-diameter supply main.

Project Overview:

- Connect two large diameter supply mains by installing 950m of 125mm P10.

Figure 9: Warrnambool network

The Eastern Activity Precinct is a mix of standard and medium density residential and commercial use.

Project Details:

See Section 0 for additional project details.

FY19/20: TP System H68 Geelong South – TP Pipeline & Facilities

Project Overview:

- City Gate Installation (Approved in Previous Price Reset)
- 200 mm S7 – 3,000m (TP Extension). (Approved in Previous Price Reset).

Current Network Operation

The Corio City Gate is the sole supply source to the Greater City of Geelong, the Surf Coast Shire, and the Borough of Queenscliff.

The City Gate currently supplies approximately 120,000 domestic customers and approximately fifty (50) major Tariff D customers such as Viva Energy (Previously Shell), CSR, Barrett Burston, and Godfrey Hirst.

Continued growth and development of the Geelong and Coastal area has created the need to extend AusNet Services' 2,760 kPa Transmission Pipeline, license number T23-23, to the southernmost area of the network to service Torquay and Jan Juc. This is an approximate distance of thirty (30) kilometres from the Corio City Gate.

In Conjunction with the growth on the network, the Corio City Gate is sole supply to all customers. In the case of failure to the site or the Brooklyn to Corio Transmission Pipeline operated by the Australian Pipeline Association (APA), the whole network will be off supply.

Increased demand on AusNet Services' Transmission Pipeline indicates that during periods of peak demand, pipeline supply pressures to the south of Geelong deteriorate considerably.

Project Background

To ensure long term security of supply to the region and maintain adequate capacity for future government Precinct Structure Plans (PSP) including the likes of Armstrong Creek and Freshwater Creek, APA GasNet in consultation with AusNet Services, proposed a Transmission Pipeline extension from the Southwest Pipeline to the southern fringe of the Geelong and Coastal Region. This project was identified in the 2013-17 regulatory proposals and expenditure was approved in the final decision.

At the termination point of APA's proposed Transmission extension (also approved in the 2013-17 Regulatory period), AusNet Services will construct a New City Gate facility and Transmission interconnect creating a dual fed network ensuring continuity of supply in the event of an incident and ensuring sufficient capacity for the developing fringe of the Geelong network (see

Figure 10).

The solution to introduce a secondary Transmission injection point provides security of supply to the region and greatly enhances the capacity capability for future growth in line with government structure plans. This solution is considered the most efficient method to cater for the needs of today and the future and importantly, redundancy in the event supply from Corio was interrupted.

Project Issues

A number of major obstacles have been encountered that has delayed the progress of the joint project in association with APA GasNet.

The proposed Transmission Pipeline extension from AusNet Services' existing TP network is to traverse along Ghazeepore Road in an easement owned by Boral Ltd. Negotiations have been undertaken with Boral for in excess of three (3) years and finally, in June 2016, agreement has been reached with terms expected to be finalised during September – October 2016.

Intermediate works in Current Regulatory Period

As a result of the delay, Torquay and Jan Juc experienced poor network pressures, and customer outages resulting in media coverage in the greater Geelong area.

As a result of the imminent loss of supply to the coastal network and the delay in extending the proposed Transmission Pipeline, a fifteen (15) kilometre, 180mm High Pressure Reinforcement was undertaken prior to the winter of 2015.

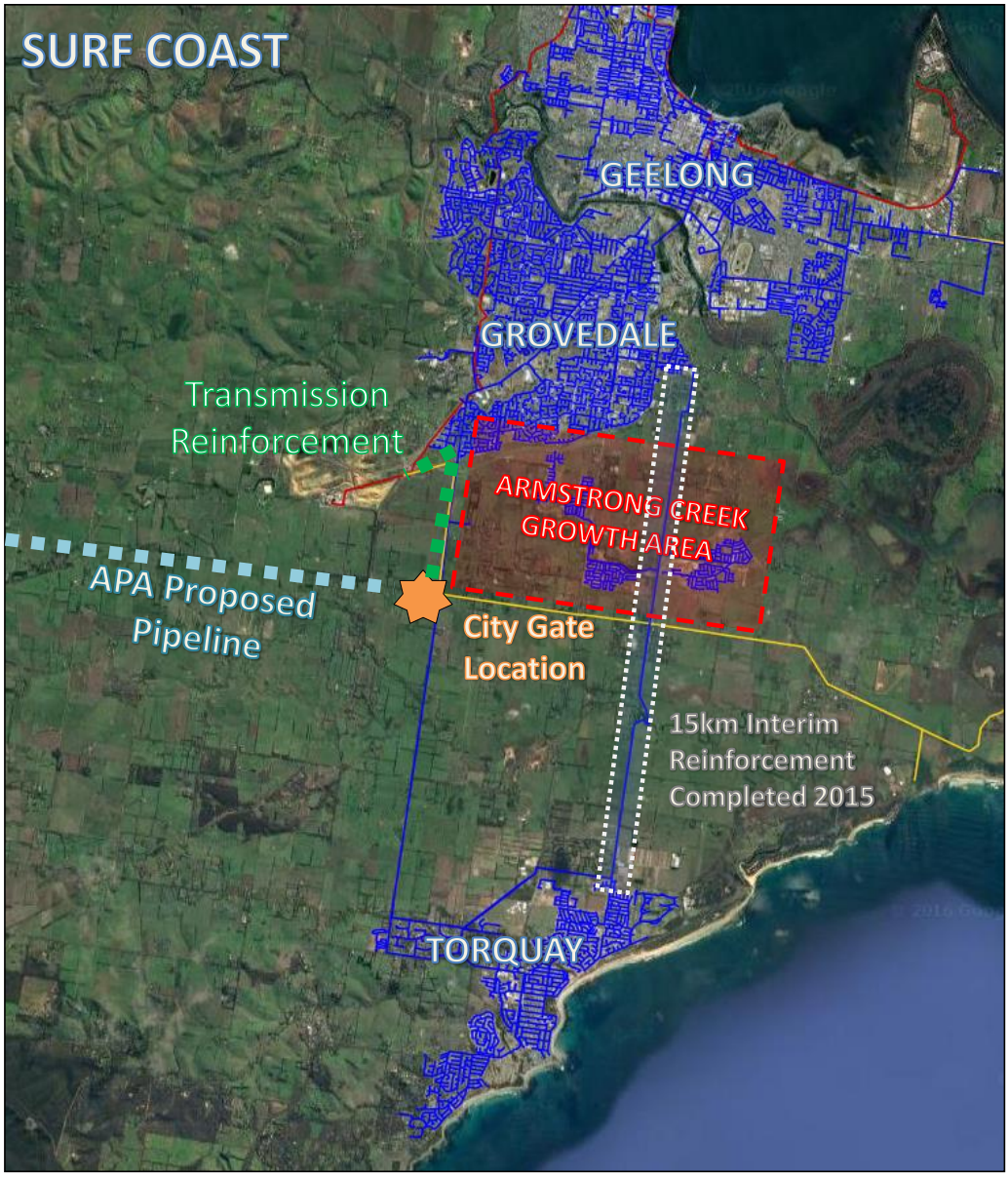
This has provided a temporary solution, and has meet supply needs in winter 2016. However it does not meet future capacity needs with the growth on the surf coast/Geelong, and leaves the Geelong network still as a sole supply.

Table 3: Geelong South Installation and Reinforcement

Asset Type	Capacity / Length	Affected Customers
City Gate	35,000 Sm^3/hr	120,000

The suggested location of the Waurn Ponds City Gate and downstream 200mm Transmission Pipeline interconnection is illustrated below.

Figure 10: Proposed Waurn Ponds City Gate



6.4 FY2020/21

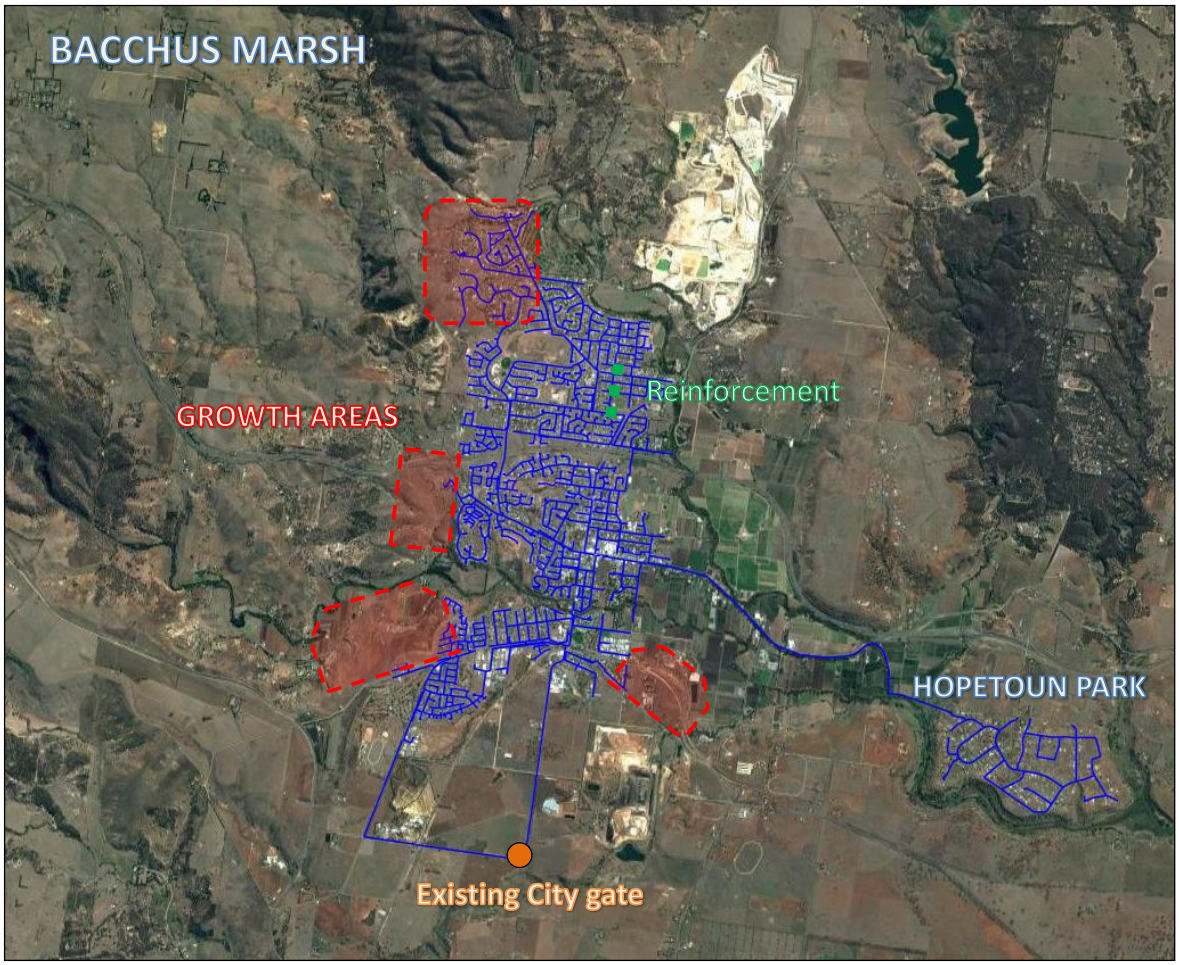
FY2020/21 H27 Bacchus Marsh Reinforcement

The existing Bacchus Marsh network will be unable to support projected growth. Reinforcing the network with a large-diameter supply main will direct gas flow further north towards the growth and improve fringe pressures.

Project Overview:

- Install 500m of 180mm P10.

Figure 11: Bacchus Marsh network and reinforcement



Project Details:

See Section 0 for additional project details.

FY20/21 MP44 Brooklyn

MP to HP Upgrade

The medium pressure network will be unable to support the existing customers. Reinforcing the high pressure network and upgrading the existing steel main from Medium to High pressure will increase the capacity of the existing network to ensure customers' supply is maintained

Project Overview:

- Install 870m of 125mm P10;
- Raise operating pressure of existing steel main from medium to high pressure.

Figure 12: Brooklyn network and reinforcement

Project Details:

See Section 0 for additional project details.

6.5 FY2021/22

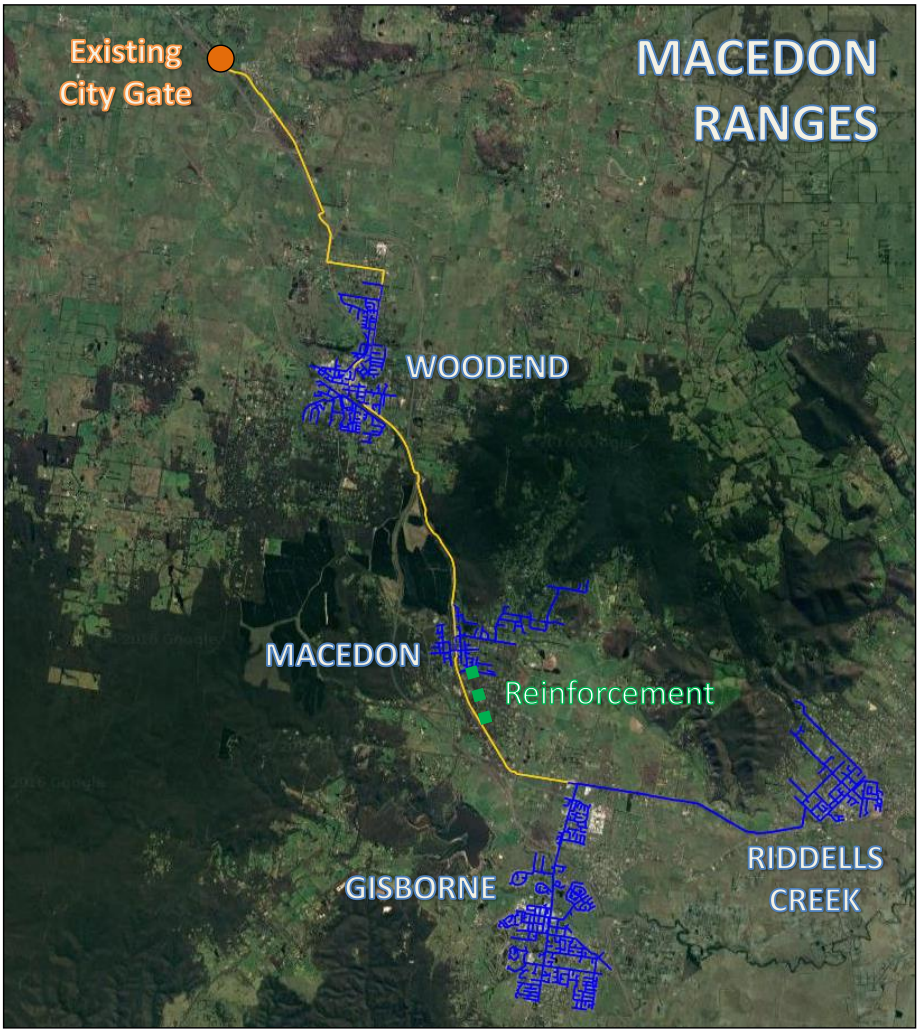
FY21/22 HH2 Macedon Ranges – Reinforcement

The existing Macedon Ranges HP2 network will be unable to maintain downstream pressures required to supply the Gisborne and Riddells Creek townships. Pressures in the HP2 network will be raised to allow for adequate supply downstream.

Project Overview:

- Install 2,700m of 200mm S7.

Figure 13: Macedon Ranges network and reinforcement



Project Details:

See Section 0 for additional project details.

FY21/22 H21 Craigieburn

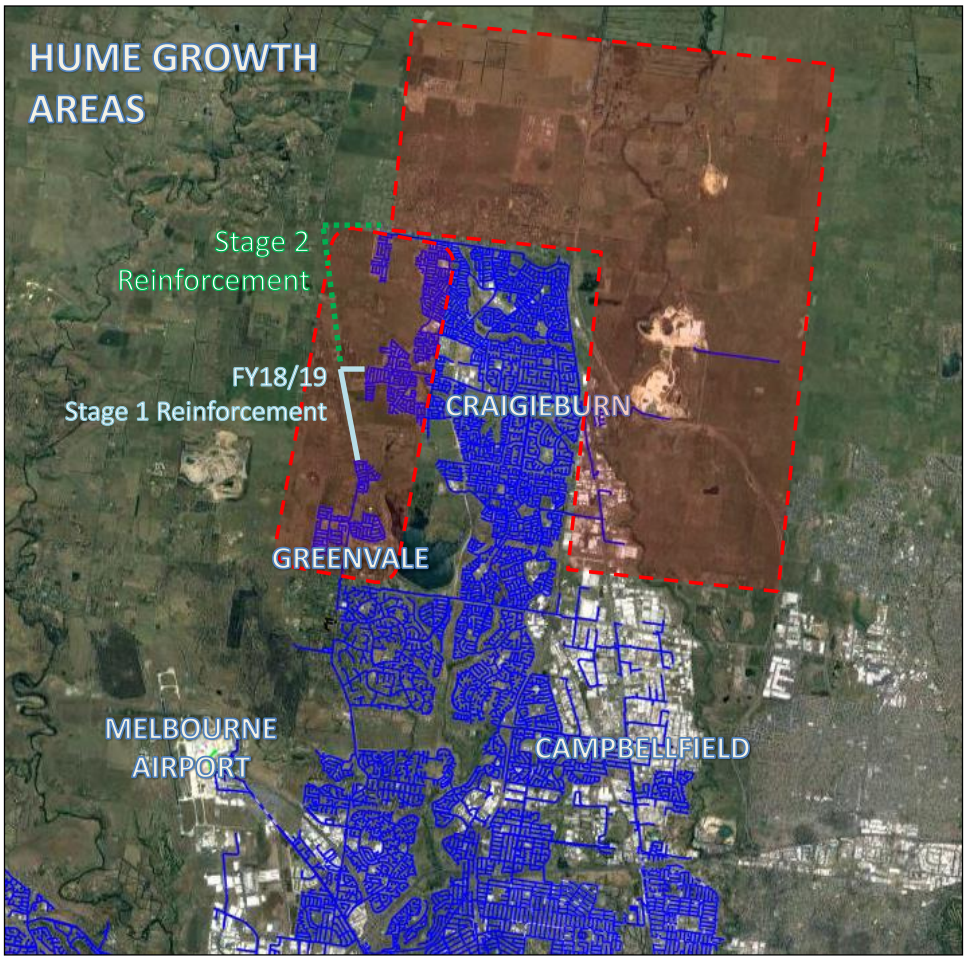
Reinforcement (Stage 2)

The existing Craigieburn network will be unable to support additional connections in the Hume growth area. Stage 2 of this project will reinforce the network with a large-diameter supply main and transfer capacity to the areas of the network undergoing growth.

Project Overview:

- Install 3,600m of 180mm P10.

Figure 14: Hume growth areas and reinforcement



Project Details:

See Section 0 for additional project details.

6.6 FY2022/23

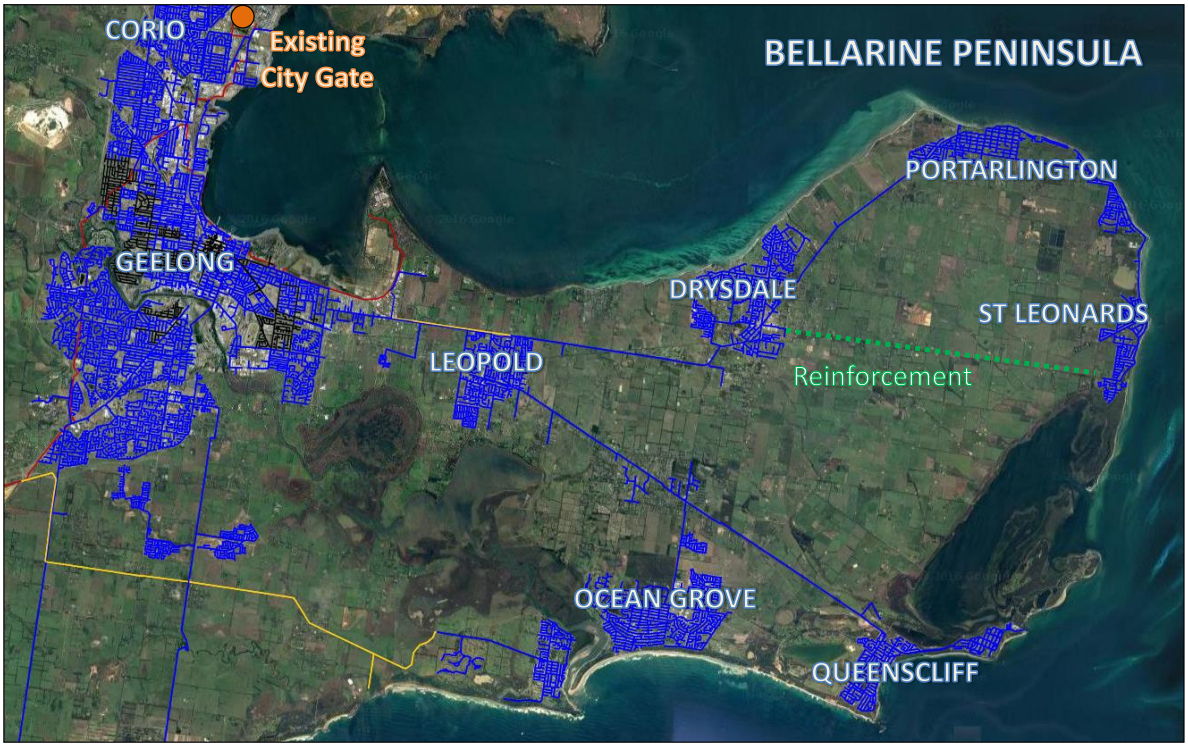
FY22/23 H68 St. Leonards Reinforcement

The existing Bellarine Peninsula network will be unable to support the projected demand in St Leonards. Installation of a large-diameter supply main will improve network pressures and ensure adequate supply.

Project Overview

- Install 10,800m of 125mm P10.

Figure 15: Bellarine Peninsula network and reinforcement



Project Details:

See Section 0 for additional project details.

FY22/23 TP61 Bendigo

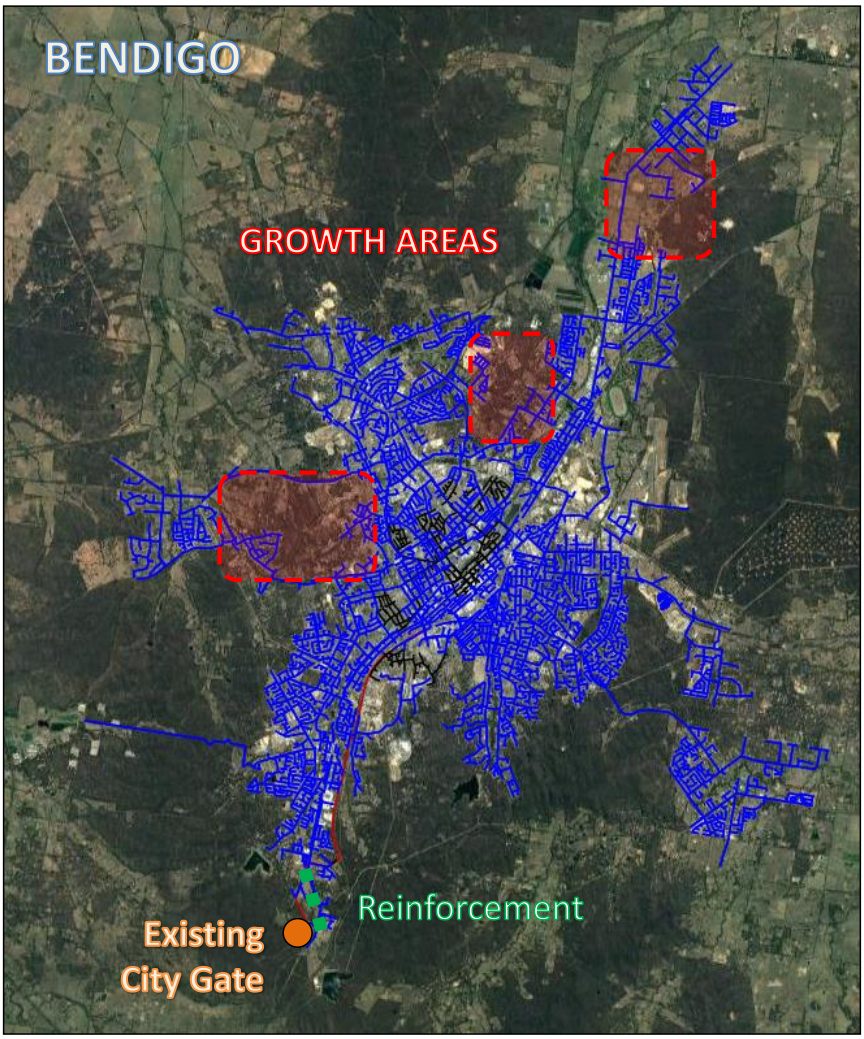
Reinforcement

The existing transmission regulators supplying the Bendigo network cannot support downstream required distribution pressures. This project will restore pressures to adequate levels by reinforcing the existing Bendigo transmission pipeline.

Project Overview

- Install 1,000m of 200mm S7 at transmission pressure.

Figure 16: Bendigo network and reinforcement



Project Details:

See Section 0 for additional project details.

7 Existing Facility Upgrades

The volume of gas a field regulator is capable of delivering depends primarily on its size. As the network expands along with steady demand the existing regulators gradually approach their supply capacity. A number of existing facilities will require sizing upgrades to increase their supply capability and meet network demand.

The capacity of a regulator is represented by gas flow, measured in standard cubic meters per hour, Sm^3/h. The need for a capacity upgrade of a facility arises when the demand (Sm^3/h) is projected to exceed the throughput capacity of the facility. If the facility cannot meet demand then gas flow becomes choked through and accelerates regulator wear.

The network model indicates how much gas is flowing through each station. The tables below are the identified upgrades needed and the timing of those upgrades solely based on the facility demand/capacity relationship.

Table 4: Regulating Facilities Upgrade

Year	Asset Type	Network	Existing Capacity	2019 Forecast Demand	Affected Customers	Capacity Upgrade
FY 2018/19	Abel St. Field Regulator (P4-071)	H25	30,000 Sm^3/hr	35,000 Sm^3/hr	35,000	Regulator Upgrades
	Old Sneydes Road City Gate (P4-237)	H09	Refer AMS 30-51 Regulator Facilities Network Strategy.			Regulators Upgraded, Pipework Requires Upgrade
FY 2019/20	Derrimut City Gate (P4-273)	H88	4,900 Sm^3/hr	6,500 Sm^3/hr	5,000	Forms Part of the Regulating Facilities – Strategy (AMS 30-51).
	Forsyth Road City Gate (P4-128)	H12	9,000 Sm^3/hr	12,000 Sm^3/hr	12,500	Regulators and Pipework to be Upgraded.
	Heath's Road City Gate (P4-064)	H12	15,000 Sm^3/hr	19,000 Sm^3/hr	23,000	Regulator Upgrades
FY 2020/21	Lock Avenue City Gate (P4-157)	H12	4,900 Sm^3/hr	6,500 Sm^3/hr	5,000	Forms Part of the Regulating Facilities Strategy – (AMS 30-51).
	Buckley Grove Field Regulator (P4-049)	H68	12,500 Sm^3/hr	15,000 Sm^3/hr	15,500	Regulator Upgrades
FY 2022/23	Hamilton City Gate (P5-016)	H64	2,500 Sm^3/hr	4,300 Sm^3/hr	3,100	Regulator Upgrades
	Coburns Road Field Regulator Melton (P3-016)	H49	Refer AMS 30-51 Regulator Facilities Network Strategy	Refer AMS 30-51 Regulator Facilities Network Strategy	Refer AMS 30-51 Regulator Facilities Network Strategy	Regulators Upgraded, Pipework requires Upgrading.

8 Appendix

8.1 Project Cost Estimation Tables

Table 5: Reinforcements (FY2018/19 to 2022/23 in $'000)

Network Type	Suburb	Network	Pressure	Main Type	Length (m)	2018/19	2019/20	2020/21	2021/22	2022/23
Transmission	Mt. Duneed	TP60	TP	200mm S7	3,000	$1500	$500			
	Bendigo	TP61	TP	200mm S7	1,000					$1,000
Distribution	Craigieburn (St.1)	H21	HP	180mm P10	4,000	$904				
	Sunbury	H23	HP	125mm P10	530	$185				
	Werribee	H12	HP	180mm P10	7,000	$1000	$200			
	Warrnambool	H75	HP	125mm P10	950		$230			
	Bacchus Marsh	H27	HP	125mm P10	500			$130		
	Sunshine	MP44	MP-HP	125mm P10	870			$230		
	Macedon Ranges	H96	HP2	180mm P9	2,000				$570	
	Craigieburn	H21	HP	180mm P10	3,600				$940	
	St. Leonards	H68	HP	125mm P10	10,800					$2,090
	TOTAL				**27,250**	**$3,589**	**$930**	**$360**	**$1,510**	**$3,090**

Table 6: Facility Installations

Facility Type	Network Supplied	Location of Facility	Required Capacity (Sm^3/h)	Pressure Tiers	Cost ($'000)					
					2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
City Gate	H12 Werribee	Bulban Rd (where APA GasNet TP intersects)	10,000	Non-AusNet TP-HP	$1000	$800			-	
	TP into H68 Geelong South	Waurn Ponds (South of the Railway)	35,000	Non-AusNet TP-HP	$500	$1250	$400			-
Field Regulator	H49 Melton	Coburns & Brooklyn Roads	12,000	TP-HP2	$420					
	H49 Melton	Coburns Rd & Centenary Ave	12,000	HP2-HP	$420					
	H26 Ballarat	Dana St & Anderson St	7,000	TP-HP2	$440				-	-
	H26 Ballarat	Winter St & Russell St	7,000	HP2-HP	$440				-	
	H68 Geelong Sth	Ghazeepore & Mt Duneed Roads	11,000 & 7,000	TP-HP2 HP2-HP		$900			-	
			Total $		$2,200	$2950	$1300			

Table 7: Existing Facility Capacity Upgrades

Facility Type	Site No.	Regulator Name	Network	Cost ($ '000) 2018/19	2019/20	2020/21	2021/22	2022/23
City Gate	P4-128	Forsyth Road	H12 Werribee	-	$900	-	-	-
	P4-064	Heaths Road	H12 Werribee	-	$600	-	-	-
	P4-157	Lock Ave	H12 Werribee	-	-	-	$200	-
Field Regulator	P4-049	Buckley Grove	H68 Pt Henry	-	-	$200	-	-
	P3-016	Coburns Road	H49 Melton	-	-	-	$200	-
	Total Number of Facility Upgrades				2	1	2	
	Total $				$1,500	$200	$400	-

* Forsyth, Heaths, and Coburns road require upgrade to pipework. Derrimut and Hamilton City gate require capacity upgrade; however will be replaced as part of the Network Regulator Strategy for the Welker Jet replacement program (AMS 30-51).

Table 8: Financial Summary

Augmentation	2018/19	2019/20	2020/21	2021/22	2022/23
Pipe Reinforcements ($ '000)	$3,589	$930	$360	$1,510	$3,090
New Facility Installations ($ '000)	$2950	$1300	-	-	-
Existing Facility Upgrades ($ '000)	-	$1,500	$200	$400	-
Total Direct Expenditure ($'000)	**$6,539**	**$3,730**	**$560**	**$1,910**	**$3,090**

8.2 Project Details

The sections below provide the following:

- Justification of the necessity and timing of the works in view of network operating pressure;
- The material requirements and locations of the proposed works;
- The 'before' and 'after' snapshots of the network indicating the improved performance of the network after the planned augmentation.

Schematic (modelled) representations of each included network are shown to depict the network condition before and after the proposed augmentation.

The legend for pressure ranges indicating the pipe operating pressure within a network is noted below:

	High Pressure Network	Medium Pressure Network	Low Pressure Network
	< 140kPa	<15kPa	<1.4kPa
	140kPa – 250kPa	15kPa – 25kPa	1.4kPa – 1.7kPa
	250kPa – 350kPa	25kPa – 35kPa	1.7kPa – 2.0kPa
	350kPa – 450kPa	35kPa – 45kPa	2.0kPa – 2.5kPa
	>450kPa	>45kPa	>2.5kPa

FY17/18 H26 Ballarat

New Facilities (Network Regulators)

Project Background:

The Ballarat network is supplied by five Field Regulators located to the far east of the network. The City of Ballarat has a developing Employment Precinct to the west of the town that is shifting capacity from the outer western fringes.

To ensure minimum obligated pressures are not breached, a new field regulator will be installed at the termination point of the existing Transmission Pipeline and tie to the existing purpose-built 200mm S7 main.

The outlet of the initial regulator will have an outlet pressure of 900kPa (HP2) and will be able to transport capacity to a new secondary field regulator to the western end of the 200 mm S7 main.

The outlet of the secondary field regulator will have an outlet of 450kPa (HP1) to support development in the western precinct of the Ballarat High Pressure Network.

Table 9: Ballarat Growth Forecast

2017	2018	2019	2020	2021
2.2%	2.1%	2.1%	2.1%	2.0%

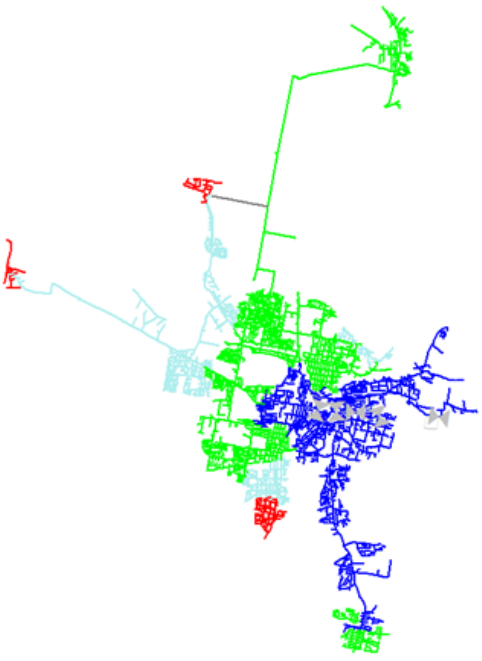
Table 10: Ballarat Forecast Minimum Network Pressures

2017	2018	2019	2019[2]	2020
182kPa	149kPa	131kPa	174kPa	173kPa

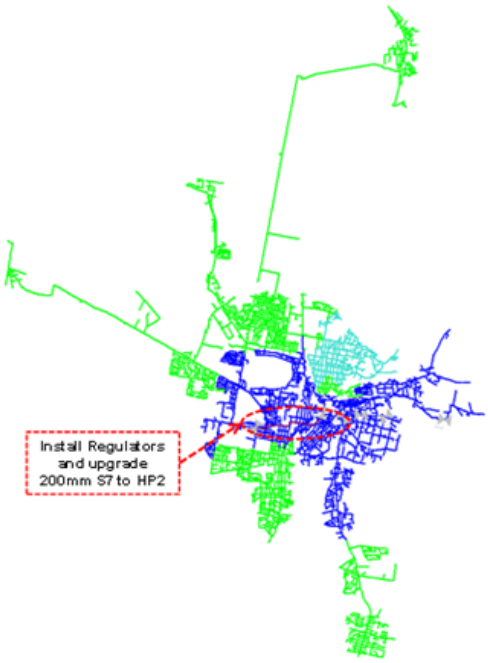
Facility Installation:

- Install a Field Regulator at Dana St / Anderson St.
- Install a Field Regulator at Winter St / Russell St.

Asset Type	Required Capacity	2017 Demand	Affected Customers	Minimum Pressure	
				Before Regulator Installation	After Regulator Installation
TP-HP2 Field Regulator (Dana St / Anderson St)	7,000 Sm^3/hr	5,000 Sm^3/hr	1,100	131kPa	174kPa
HP2-HP1 Field Regulator (Winter St / Russell St)	7,000 Sm^3/hr	5,000 Sm^3/hr			



2019 Before Facility Installation



2019 After Facility Installation

[2] Indicates reinforcement is required to maintain network pressures above 140kPa as required by the Gas Distribution System Code, Version 11, Schedule 1, Part A.

FY17/18 H12 Werribee

New Facilities and Reinforcement

The western Growth Corridor of Werribee has and is continuing to experiencing considerable development. Five regulators support this network and with the south western and northern fringe locations expanding outwards, supply pressures are deteriorating.

As a result and to ensure minimum supply pressures are maintained, the construction of 7,000m of an additional large diameter supply main and City Gate will deliver greater capacity to the south western fringes.

Table 11: Werribee Growth Forecast

2014	2015	2016	2017	2018
6.01%	6.05%	5.62%	5.89%	4.50%

Table 12: Werribee Forecast Minimum Network Pressures

2015	2016	2016[3]	2017	2018	2018[3]
140kPa	42kPa	163kPa	144kPa	76kPa	160kPa

Facility Installation:

A city gate installation is required to provide supply to the Werribee gas network from the south-west This will require the purchase of land (approx. 1,600m^2) near the location where the APA Transmission Pipeline (north-south) crosses Bulban Road.

Table 13: Werribee Facility Installation

Asset Type	Required Capacity	2016 Demand	Affected Customers	Minimum Pressure Before Regulator Installation	Minimum Pressure Post Regulator Installation
City Gate	10,000 Sm^3/hr	3,500 Sm^3/hr	3,000	76kPa	160kPa

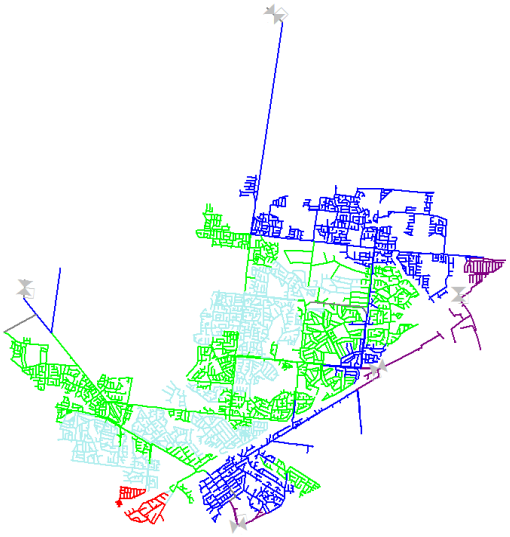
Network Reinforcement:

- Tie-in to proposed City Gate at Bulban Road.
- Lay approximately **7,000m** of **180mm P8** east along **Bulban Road** and north along **McGrath Road**.
- Tie-in to existing 100mm S7 in Black Forest Road.

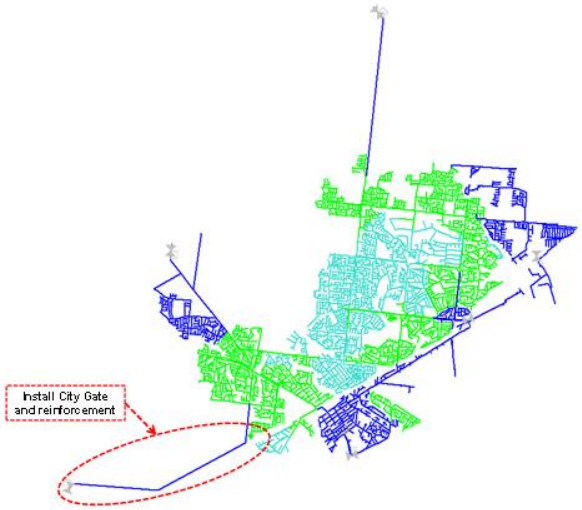
[3] Indicates company initiated reinforcement is required to maintain network pressures above 140kPa as required by the Gas Distribution System Code, Version 11, Schedule 1, Part A.

Table 14: Werribee Identified Network Reinforcement

2018 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
76kPa	1,160	7,000m of 180mm P8	160kPa



2018 Before Reinforcement and Facility



2018 After Reinforcement and Facility

FY2018/19 H21 Craigieburn

Reinforcement (Stage 1)

The northern growth corridor of Craigieburn has and is continuing to experiencing considerable development. The Potter Street field regulator predominately supports this network and with the northern and western fringe locations expanding outwards, supply pressures are deteriorating.

As a result and to ensure minimum supply pressures are maintained, the construction of 4,000m of additional 180mm P10 large diameter supply main along Mickleham road will deliver greater capacity to the western and northern fringes.

Table 15: Craigieburn Growth Forecast

2017	2018	2019	2020	2021
5.6%	5.6%	5.4%	5.2%	5.0%

Table 16: Craigieburn Forecast Minimum Network Pressures

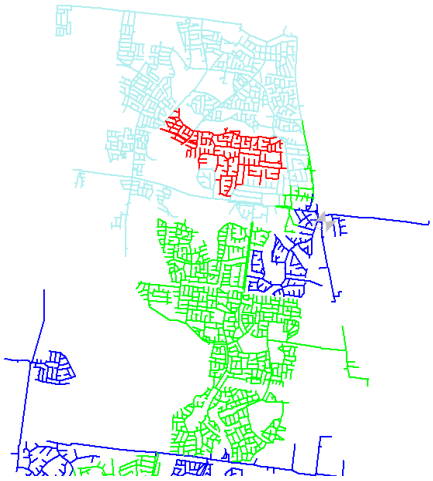
2018	2019	2019R[4]	2020	2021
143kPa	110kPa	194kPa	171kPa	158kPa

Network Reinforcement:

- Tie-in to existing 180mm P8 in Mickleham Road.
- Construct approximately **4,000m** of **180mm P10** northwards along **Mickleham Road**.
- Tie-in to existing 180mm P8 main in Craigieburn Road.

Table 17: Craigieburn Identified Network Reinforcement

2019 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
110kPa	1,500	4,000m of 180mm P10	194kPa



2019 Before Reinforcement

2019 After Reinforcement

[4] Indicates reinforcement is required to maintain network pressures above 140kPa as required by the Gas Distribution System Code, Version 11, Schedule 1, Part A.

FY2018/19 H23 Sunbury

Reinforcement

Continued growth of the Sunbury High Pressure network is expected to reduce system pressures at the fringes. A discontinuance of a larger diameter supply main from the City Gate is restricting flow resulting in higher velocities through smaller diameter mains.

By interconnecting existing 110 P8 and 80mm S7 diameter mains with a proposed 125mm P10 main allows greater capacity within the network and improves outer fringe pressures in accordance with the GDSC. This also reduces the internal erosion on pipelines which are experiencing higher than standard velocities.

Table 18: Sunbury Growth Forecast

2017	2018	2019	2020	2021
2.1%	1.8%	1.8%	1.8%	1.6%

Table 19: Sunbury Forecast Minimum Network Pressures

2018	2019	2019R	2020	2021
163kPa	136kPa	262kPa	253kPa	245kPa

Network Reinforcement:

- Tie-in to existing 10mm P8 in Shield Street.
- Construct approximately **530m** of **125mm P10** along **O'Shannassy Street**.
- Tie-in to existing 80mm S7 main in Station Street.

Table 20: Sunbury Identified Network Reinforcement

2020 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
136kPa	1,100	530m of 125mm P10	262kPa

2019 Before Facility Installation

2019 After Facility Installation

FY2019/20 H75 Warrnambool

Reinforcement

The Warrnambool Network is supplied by one City Gate located to the far east in Allansford. The north eastern fringes of Warrnambool are experiencing reduced fringe pressures due to growth and the distance from the City Gate.

To the north of the network, discontinuance between two (2) larger diameter supply mains separated by a smaller diameter main exists resulting in higher velocities through smaller diameter mains.

By interconnecting an existing 150mm S7 main and a nearby 100 mm S7 diameter main with a proposed 125mm P10 main allows greater capacity and improves outer fringe pressures.

Table 21: Warrnambool Growth Forecast

2017	2018	2019	2020	2021
1.8%	1.7%	1.7%	1.7%	1.5%

Table 22: Warrnambool Forecast Minimum Network Pressures

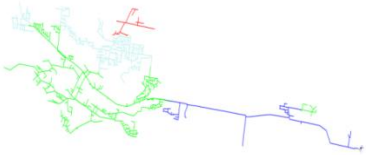
2019	2020	2020R	2021	2022
141kPa	112kPa	262kPa	254kPa	249kPa

Network Reinforcement:

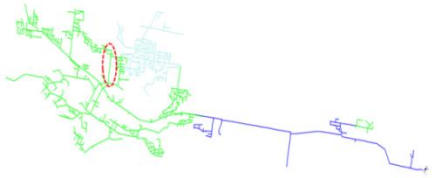
- Tie-in to existing 150mm S7 main at the intersection of Cockman Street and Bromfield Road.
- Construct approximately **950m** of **125mm P10** along **Bromfield Road**.
- Tie-in to existing 100mm S7 main in Donavon's Road.

Table 23: Warrnambool Identified Network Reinforcement

2020 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
112kPa	900	950m of 125mm P10	262kPa



2019 Before Facility Installation



2019 After Facility Installation

FY2020/21 H27 Bacchus Marsh Reinforcement

Bacchus Marsh High Pressure network is divided in to a northern and southern quadrant segregated by the Western Highway with on two supply mains connecting the two. Growth is occurring in the northern quadrant farthest away from the single supplying City Gate.

To move capacity further northwards, a 500m extension of 180 mm P10 main from the existing 150 mm S7 main is proposed.

The supply main extension improves fringe pressures during peak demand by approximately 90 kpa and aligns with minimum obligated pressure requirements as specified in the GDSC.

Table 24: Bacchus Marsh Growth Forecast

2017	2018	2019	2020	2021
2.9%	2.8%	2.8%	2.8%	2.6%

Table 25: Bacchus Marsh Forecast Minimum Network Pressures

2020	2021	2021R	2022	2023
149kPa	132kPa	223kPa	218kPa	202kPa

Network Reinforcement:

- Tie-in to existing 150mm S7 at the intersection of Gisborne Road and Grey Street.
- Construct approximately **500m** of **180mm P10** along **Fitzroy Street**.
- Tie-in to the existing 40mm P8 main in Albert Street.

Table 26: Bacchus Marsh Identified Network Reinforcement

2021 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
132kPa	700	500m of 180mm P10	223kPa

2021 Before Facility Installation **2021 After Facility Installation**

FY20/21 MP44 Brooklyn

MP to HP Upgrade

MP44 is a Medium Pressure network operating at 50kPa. Minimum fringe pressures have been experienced reflected by customer complaints during times of peak winter demand. By interconnecting the network to a nearby High Pressure network, supply issues will be resolved.

The Medium pressure network consists of S7 steel main and is suitable for upgrading.

Table 27: Brooklyn Growth Forecast

2017	2018	2019	2020	2021
1.3%	1.2%	1.1%	1.1%	1.1%

Table 28: Brooklyn Forecast Minimum Network Pressures

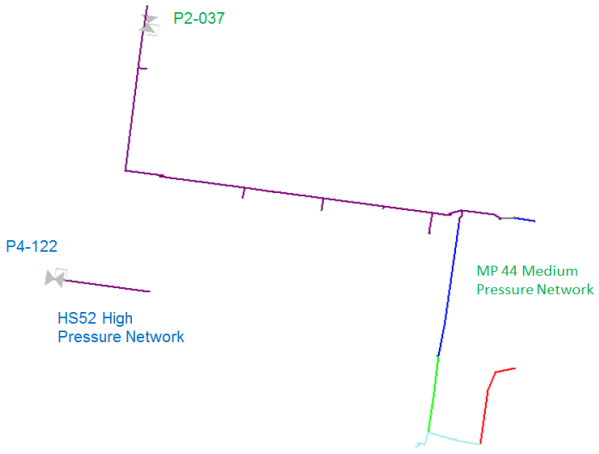
2020	2021	2021R	2022	2023
18kPa	14kPa	334kPa	319kPa	314kPa

Network Reinforcement:

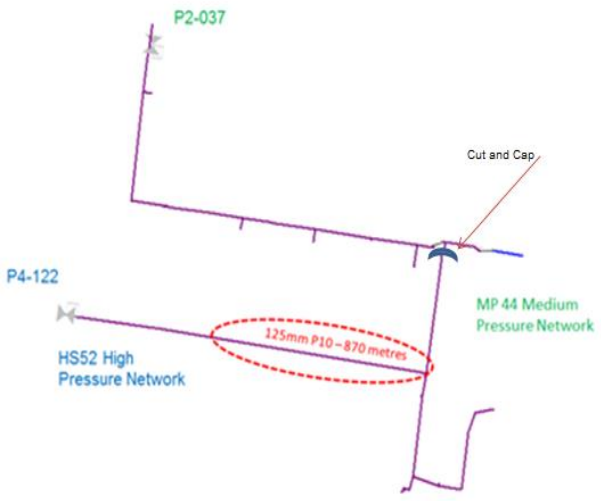
- Tie-in to existing 100mm S7 High Pressure main in Bunting Road.
- Construct approximately **870m** of **125mm P10** along **Bunting Road**.
- Tie-in to existing 100mm S7 main in McDonald Road.

Table 29: Brooklyn Identified Network Reinforcement

2021 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
14kPa	< 50 Commercial	870m of 125mm P10	334kPa



2021 Before Facility Installation



2021 After Facility Installation

FY21/22 HH2 Macedon Ranges

Reinforcement

As a result of continued growth in the Gisborne and New Gisborne network, during winter peak demand, inlet pressures to the existing Gisborne Field Regulator falls to approximately 490kPa, limiting outlet pressure to the downstream network.

Duplicating the existing main for approximately 2,000 metres from the outlet of the Macedon Field Regulator considerably increases the inlet pressure to the Gisborne Field Regulator.

Table 30: Macedon Ranges Growth Forecast

2019	2020	2021	2022	2023
1.11%	1.03%	1.01%	1.01%	1.0%

Table 31: Macedon Ranges Forecast Minimum HP2 Pressures

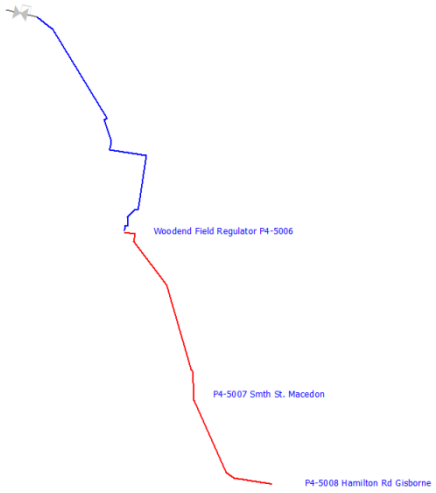
2021	2022	2022R	2023	2024
540kPa	490kPa	710kPa	690kPa	665kPa

Network Reinforcement:

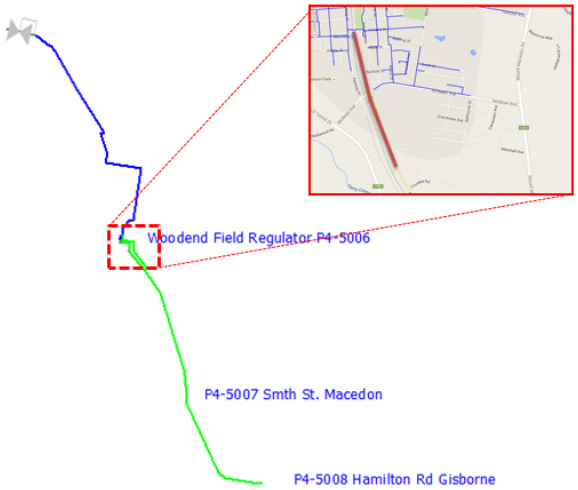
- Tie-in to existing 200mm P9 at the intersection of Victoria Street and Smith Street.
- Construct approximately **2000m** of **200mm S7 or Polyethylene equivalent** along **Smith Street**.
- Tie-in to existing 200mm P9 main in Norton Road south of Crombie Road.

Table 32: Macedon Ranges Identified Network Reinforcement

2022 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
490kPa	3,400	2000m of `200mm S7 or Polyethylene Equivalent	710kPa



2022 Before Facility Installation



2022 After Facility Installation

FY21/22 H21 Craigieburn

Reinforcement (Stage 2)

The northern Growth Corridor of Craigieburn has and is experiencing considerable development. The Potter Street field regulator predominately supports this network and with the northern and western fringe locations expanding outwards, supply pressures are deteriorating.

As a result and to ensure minimum supply pressures are maintained, the construction of extension of the existing 180 mm P10 main undertaken in Stage 1 is to continue and tie in to the existing 180mm P8 main in Mount Ridley Road.

Table 33: Craigieburn Growth Forecast

2019	2020	2021	2022	2023
5.4%	5.2%	5.0%	4.6%	4.2%

Table 34: Craigieburn Forecast Minimum Network Pressures

2021	2022	2022R[5]	2023	2024
158kPa	139kPa	198kPa	184kPa	172kPa

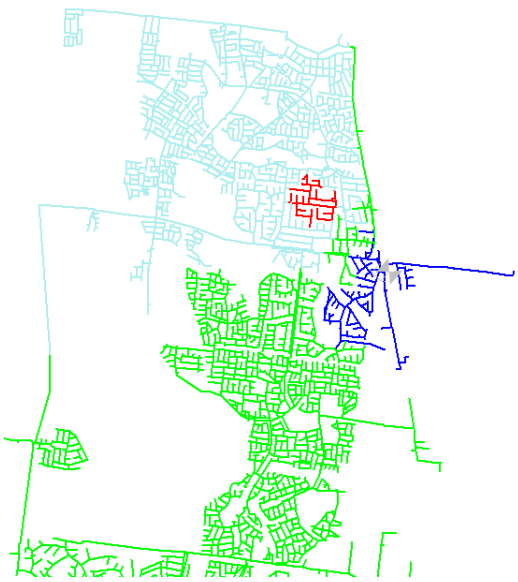
[5] Indicates company initiated reinforcement is required to maintain network pressures above 140kPa as required by the Gas Distribution System Code, Version 11, Schedule 1, Part A.

Network Reinforcement:

- Tie-in to existing 180mm P8 in Mickleham Road.
- Construct approximately **3,600m** of **180mm P10** northwards along **Mickleham Road**.
- Tie-in to existing 180mm P8 main in Mount Ridley Road.

Table 35: Craigieburn Identified Network Reinforcement

2022 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
139kPa	800	3,600m of 180mm P10	198kPa



2022 Before Reinforcement

2022 After Reinforcement

FY22/23 H68 St. Leonards

Reinforcement

The Bellarine Peninsula consists of numerous coastal towns that are expanding in development and size. The northern leg of the area is fed by one (1) field regulator located in Leopold and feeds the towns of Clifton Springs, Drysdale, Portarlington, Indented Heads and finally St. Leonards.

As a result of growth of the towns, St. Leonard sat the fringe of the network experiences diminished pressures.

In addition to this, all towns are fed by one main (sole supply) and in the event of a third party incident, potential exists to lose supply to all towns.

To maintain fringe pressures and ensure security of supply, a link is required to connect the existing 110 mm P8 in Bluff Road, St. Leonards to the existing 100mm S7 main in Murradoc Road, Drysdale.

Table 36: St. Leonards Growth Forecast

2020	2021	2022	2023	2024
3.8%	3.6%	3.4%	3.2%	3.0%

Table 37: St. Leonards Forecast Minimum Network Pressures

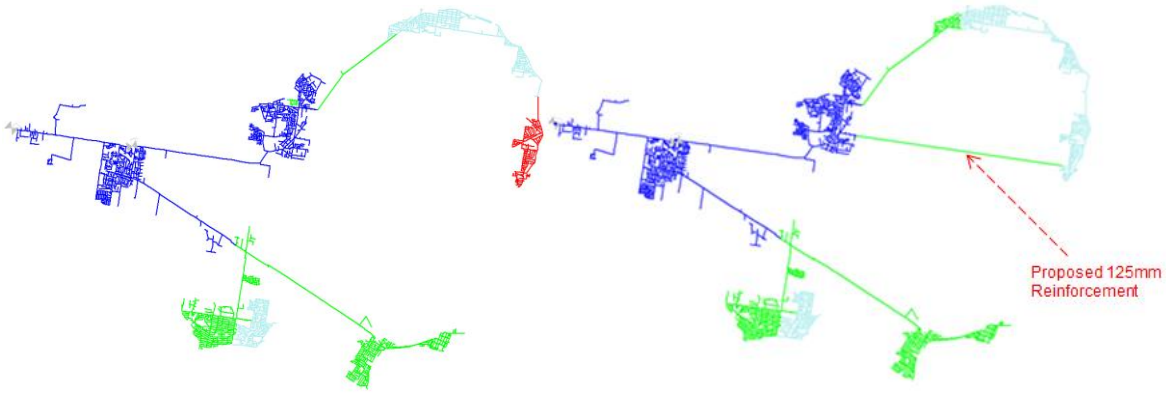
2022	2023	2023R	2024	2025
141kPa	130kPa	172kPa	161kPa	157kPa

Network Reinforcement:

- Tie-in to existing 100mm S7 in Murradoc Road.
- Construct approximately **10,800m** of **125mm P10** along **Murradoc Road**.
- Tie-in to the existing 110mm P8 main in Bluff Road.

Table 38: St. Leonards Identified Network Reinforcement

2023 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
130kPa	750	10,800m of 125mm P10	172kPa



2023 Before Facility Installation **2023 After Facility Installation**

FY22/23 TP61 Bendigo

Reinforcement

As a result of continued growth in the Bendigo Network, during winter peak demand, inlet pressures to the exiting Abel Street Field Regulator falls to approximately 570 kPa limiting outlet pressure to the down stream network.

Duplicating the existing main for approximately 1,000 metres from the outlet of the Bendigo City Gate considerably increases the inlet pressure to the downstream High Pressure network.

Table 39: Bendigo Growth Forecast

2021	2022	2023	2024	2025
2.1%	1.9%	1.8%	1.8%	1.70%

Table 40: Bendigo Forecast Minimum Transmission Pressures

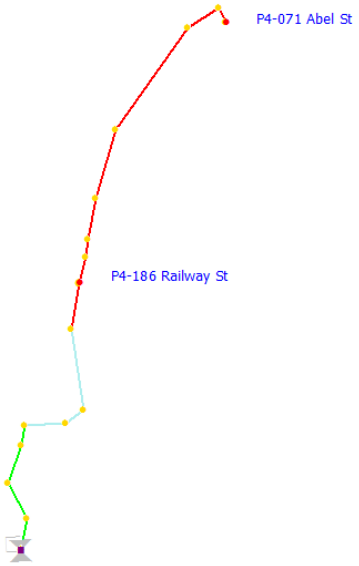
2022	2023	2023R	2024	2025
630kPa	570kPa	745kPa	730kPa	718kPa

Network Reinforcement:

- Tie-in to existing 200mm S7 from Bendigo City Gate.
- Construct approximately **1,000m** of **200mm S7 TP main**.
- Tie-in to existing 200mm S7 TP main north of Hammill Street.

Table 41: Bendigo Identified Transmission Reinforcement

2023 Forecast Minimum Pressure	Affected Customers	Reinforcement Summary	Post Reinforcement Minimum Pressure
570kPa	35,000	1,000m of 200mm S7 Transmission Main	745kPa



2023 Before Facility Installation

2023 After Facility Installation