Zincara

From strategy to action

Access Arrangement 2019
JGN Capital Expenditure Review

Public

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C Residential Gas Meters: Planned Replacement: RY221-25 Analysis

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Abbreviations

AA	Access Arrangement
AER	Australian Energy Regulator
AMP	Asset Management Plan
ALARP	As Low As Reasonably Practicable
AMS	Asset Management System
AEMC	Australian Energy Market Commission
Capex	Capital Expenditure
CPF	Contingent Payment Factor
Core	Core Energy & Resources
CP	Corrosion Protection
DRS	District Regulating Station
EGP	Eastern Gas Pipeline
FEED	Front End Engineering Design
I&C	Industrial and Commercial
ISO	International Organisation for Standardisation
JGN	Jemena Gas Network (NSW)
km	Kilometres
kpa	Kilopascal
kpi	Key Performance indicators
MSP	Moomba to Sydney
NGL	National Gas Law
NGR	National Gas Rules
PEM	Project Estimating Model
PJ	Petajoules
PIG	Pipeline Inspection Gauge
PMM	Project Management Methodology
SPM	Sydney Primary Main
SRS	Secondary Regulator Station
TRS	Trunk Receiving Station

1. EXECUTIVE SUMMARY

In July 2019, JGN submitted its revised Access Arrangement for the period 2021 -2025. As such, the AER has engaged Zincara to provide technical advice on a number of matters related to the JGNs capital expenditure. They include:

- Connections
- Meter replacement
- Facilities and Pipes
- Augmentation
- Mains Replacement

Zincara was also asked to advise on the operation of CESS.

In carrying out the review, Zincara has taken into consideration the requirements of the National Gas Law and the National Gas Rules. Zincara's approach was to review the submission provided by JGN and responses provided by JGN resulting from clarification sought by the AER.

1.1 CAPITAL EXPENDITURE SUMMARY

JGN's capital expenditure over time are provided in the table below.

Table 1-1 JGN's Capital Expenditure over time ($2020, million)

	2010-2015 Actual	2016-2020 Actual/Forecast	2021-2025 Forecast
Connections	436	592	480
Stay In Business			
Metering	99	106	146
Facilities and Pipes	69	78	89
IT	142	119	107
Augmentation	118	50	75
Mains Replacement	21	34	55
Others	99	47	35
Total 1 (Stay In Business)	**548**	**434**	**507**
Total 2 (including connections)	**984**	**1,025**	**989**
Corporate recovery			-76
Total 3	**984**	**1,025**	**913**

Source: JGN 2020Plan Pg.48 (modified to include totals)

Overall, the forecast capital expenditure (Capex) (Total 3), for the forecast period (2021-2025) is less than the actual expenditure for the current and previous periods. This is due to the corporate recovery no longer been added to the capex. However, if the corporate recovery is added back to the forecast period capex, the total capital expenditure (Total 2) is in the same order of magnitude.

Zincara has not considered how corporate recovery is best dealt with as it is out of the scope of this review.

In addition, the table above is in $2020 but the information supplied supporting the forecast capex is in $2018. As such, Zincara has carried out its analysis on direct costs only in $2018. JGN's forecast direct capex for the categories that Zincara has reviewed are shown in the table below.

Table 1-2: JGN's Capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Connections	75,834	72,180	71,228	72,431	75,381	**367,053**
Meter Replacement	17,172	19,195	22,165	25,096	27,130	**110,760**
Facilities and Pipes	23,713	19,994	6,583	6,491	11,321	**68,101**
Augmentation	15,598	18,813	12,469	10,102	550	**57,531**
Mains Replacement	11,096	5,820	6,408	9,144	9,872	**42,340**
Total	**143,413**	**136,002**	**118,853**	**123,264**	**124,254**	**645,785**

Source: Summarised from various JGN's capex models

1.1.1 Connections Capex

Connections capex for the 2021-25 period is forecast to be below the current (2015-20) period in large part due to the unprecedented building activity during the current period and in particular with respect to medium density / high-rise activity. Other factors include JGN has achieving some price reductions with its contractors through its tendering / benchmarking processes and JGN applying its boundary metering product for high-rise market sub-segment and no longer installing hot water meters in these situations.

JGN's connection forecast methodology uses a top down forecast using actual revealed historical costs with some variation to suit the respective market segments. They have used a four-year average to determine average unit rates and applied price adjustments to recognise the contractor tender/benchmarking undertaken in recent years. Zincara considers that some average unit rates may be distorted by particular historic rates and have proposed adjusted rates where we consider these distortions occur.

Zincara's proposed adjustments, determined during a review of the various market segments, are summarised as follows:

- **New homes**: mains length, reduced from [redacted] metres to [redacted] metres and price adjusted unit rate for meters, reduced from $[redacted] to $[redacted].
- **Commercial & Industrial Volume**: price adjusted unit rate for mains, reduced from $[redacted]/m to $[redacted]/m, services price adjusted unit rate reduced from $[redacted] to $[redacted], meters price adjusted unit rate reduced from $[redacted] to $[redacted], and also the length of mains reduced from [redacted]m to [redacted]m.
- **Electricity to Gas**: price adjusted unit rate for mains reduced from $[redacted]/m to $[redacted]/m, service price adjusted unit rate reduced from $[redacted] to $[redacted], and meter price adjusted unit rate reduced from $[redacted] to $[redacted].
- **Medium Density**: Zincara accepts the unit rates for this market segment are reasonable.

- **I&C Demand**: Zincara accepts that the annual expenditure forecast is reasonable.

The resulting Zincara recommended capex forecast for these market segments is as follows:

Table 1-3: Zincara's Recommended Connections Capex ($2018,000)

Market segment	JGN 2020 Plan	Zincara Recommendation	Difference
New Homes	211,071	200,141	- 10,930
Commercial & Industrial Volume	28,535	25,868	- 2,667
Electricity to Gas	78,673	73,675	-4,998
Medium Density	35,007	35,007	Nil
I&C Demand	13,766	13,765	Nil
Total Connection capex	**367,053**	**348,457**	**-18,596**

Source: Zincara's Calculations

It should also be noted that the capex analysis is based on JGN withdrawing its hot water metering product for new connections from July 2020. Zincara's review relates to this changed policy. In the event that the AER rejects this policy, the medium density capex may need to be reviewed.

1.1.2 Meter Replacement Capex

Meter replacement capex covers all metering types that require replacement either as part of a planned program or when found to be defective. The forecast methodology uses revealed historical costs wherever possible, with average unit rates (typically over four years of historical data) applied to the volume forecast (based on asset age profiles and performance). Where the replacement program is relatively steady then average annual historic expenditure is used. Finally, where these approaches are not possible a bottom up project estimation methodology has been used.

Zincara's analysis has resulted in the following:

- Reduction of the planned replacement of meters that will reach its 25 years age. Zincara considered that some families of meters of this age can continue to 30 years life.

- The annual capex for the defective replacement of hot water meters is based on the historical four-year average. 2015 capex is an outlier and as such has distorted the average. The average is now based on the three-year average.

- The capex for replacement of the defective meter loggers is also based on the historical four-year average. 2015 capex has been removed from the average as it is considered an outlier.

- The capex for industrial and commercial meters has been adjusted following advice from JGN regarding an error in the initial submission.

- Similarly, the capex for the replacement of meters have been revised following subsequent advice from JGN.

The recommended capex for the meter replacement is shown in the table below.

Table 1-4: Zincara's Recommended Meter Replacement Capex ($2018, 000)

	JGN Plan	Zincara revision	Variance
Residential gas meters	52,268	44,719	**-7,549**
Hot water meters	21,709	19,321	**-2,388**
Meter data loggers	6,528	6,212	**-316**
I&C meters	26,969	26,393	**-576**
Metreteks	1,614	1,614	**-**
Testing	1,532	1,435	**-98***
Other	139	139	**-**
Total	**110,760**	**99,834**	**-10,926**

Source: Zincara's Calculations

1.1.3 Facilities and Pipes

This category relates to the capex for high pressure pipelines and facilities. JGN advised that the capex is primarily focused on maintaining the safety of the aging assets.

Zincara generally concurs with the need to replace ageing assets and also to ensure that facilities and pipes meet the requirement of industry standards and safety regulations. However, Zincara considers that there is inadequate information on the capex provision for a number of items such as the replacement of minor TRS, SRS and PRS. In addition, Zincara also considers that the capex for the installation of secondary isolation valves on JGN's secondary mains in Sydney CBD needs further justification before it can be recommended.

Details of Zincara's recommendation is provided in the table below.

Table 1-5 Zincara's Recommended Capex for Facilities and Pipes ($2018, 000)

	JGN Plan	Zincara revision	Variance
Facilities Safety Upgrade	16,139	11,636	**-4,503**
Facilities Capacity Upgrade	29	29	**-**
Sydney Primary Mains Risk Reduction	26,949	26,949	**-**
Shallow Secondary Mains	15,182	15,182	**-**
Secondary District Regulator Replacement	3,668	3,068	**-600**
Other Minor Works	6,133	2,984	**-3,149**
Total	**68,101**	**59,848**	**-8,253**

Source: Zincara's calculations

1.1.4 Augmentation

Augmentation capex covers network infrastructure required to continue to supply existing demand growth and new connections. The augmentation projects are related to:

- Aerotropolis
- New Estates
- Sydney Primary Mains

Aerotropolis
Based on the uncertainties currently relating to the Aerotropolis augmentation, we consider that it would be prudent to allow initial funding for JGN to develop its detailed design and approvals processes. JGN can seek additional funding once there is more certainty not only of the detailed scope but also capital expenditure. As no PEM model has been prepared for these projects, we have reviewed other projects and estimated that approximately 15% of project costs occurs at Stage Gate 1, 2 and 3 and therefore recommend initial funding of $2.0 million to initiate the project.

New Estates
Zincara considers that the augmentation programs for the new estates have been arrived on a reasonable basis and therefore recommends acceptance of the program.

Sydney Primary Mains
Zincara under Facilities and Pipes has recommended acceptance of the section of the Sydney Primary Mains from Lane Cove to Willougby as a risk mitigation strategy. The derating will require that the North Sydney Network be augmented to meet the gas supply requirements. Zincara therefore recommends acceptance of the project.

Details of Zincara's recommendation are shown in the table below.

Table 1-6: Zincara's Recommended Capex for Augmentation ($2018, 000)

	JGN 2020 Plan	Recommended	Difference
Aerotropolis	14,362	2,000	**-12,362**
New estate	14,737	14,737	-
Medium density	2,488	2,488	-
Minor: ME and CD projects	2,750	2,750	-
SPM augmentation	23,194	23,194	-
Total	**57,531**	**45,169**	**-12,362**

Source: Zincara's calculations

1.1.5 Mains Replacement/Rehabilitation

JGN's Rehabilitation Plan is mainly focused on cast iron and unprotected steel mains which will be mostly rehabilitated by around CY2040. The Plan also shows that there is also an increasing level of rehabilitation projects addressing old generation PE and nylon mains extending the Plan out to CY2049.

Zincara is aware that other jurisdictions including Victoria and SA have rehabilitation programs in progress. Zincara therefore concurs with the need for a rehabilitation program for cast iron and unprotected steel but also believes that there is an element of discretion in when the rehabilitation is carried out.

JGN proposed to rehabilitate 146kms during the 2020-2025 as compared to 85kms for the current regulatory period. From its condition assessment, Zincara believes that the Newcastle MP1 network rehabilitation project can be extended for one year which will bring it into the regulatory period 2025-2030. This will result in replacement program of around 105km which is higher than the current period replacement of 85kms.

Based on the PEM provided, Zincara has calculated the recommended capex with a one year deferral of the Newcastle MP1. Details of the rehabilitation program is shown in the table below.

Table 1-7 Zincara's Recommended Capex for Mains Replacement ($2018, 000)

Mains Replacement Project	JGN 2020 Plan	Recommended
Kurri Kurri	3,470	3,470
Matraville	9,408	9,408
Mittagong	1,237	1,237
Newcastle	21,307	13,353
Bankstown*	326	326
Haberfield*	341	341
Minor mains renewal	1,500	1,500
Minor connection renewal	4,750	4,750
Total	**42,340**	**34,386**
(deferral of Newcastle MP1 project by one year) Difference = -7,954		

Source: Zincara's calculations

1.1.6 Summary of Zincara's Recommendation

A summary of the capex recommendations is provided below.

Table 1-8: Summary of Recommended Capex ($2018, 000)

	JGN Plan	Recommended	Difference
Connections	367,053	348,457	**-18,596**
Meter Replacement	110,760	99,834	**-10,926**
Facilities and Pipes	68,101	59,848	**-8,253**
Augmentation	57,531	45,169	**-12,362**
Mains Replacement	42,340	34,386	**-7,954**
Total	**645,785**	**587,693**	**-58,092**

Source: Zincara's calculations

1.2 CAPITAL EXPENDITURE SHARING SCHEME (CESS)

In its 2019 submission, JGN proposed a CESS mechanism for the AA period 2021-2025. The CESS scheme is similar to that which the AER approved for the Victorian Gas Distribution Businesses in 2017.

Zincara has not discussed the merit or otherwise of such a CESS mechanism for JGN. However, if there is a CESS, Zincara analysed the factors that should be considered in the operation of a CESS.

In summary, Zincara concurs with JGN's CESS proposal for calculating efficiency gains and losses. Zincara also supports JGN's proposal on the following:

- The mechanism for calculating the efficiency gains and loss.
- Capex should be considered in aggregate.
- AER to adjust the CESS payment when JGN has deferred material capex in the 2020-2025 period. However, Zincara recommends the issue of materiality needs to be sorted out before finalizing the CESS mechanism.
- Any capex that the AER considers is non-conforming during its ex-post review should be excluded from the actual capex when calculating the annual efficiency gain.
- The final year of the regulatory period will only be an estimate. Any adjustment can be done in the future following the receipt of actuals.

Zincara considers the measures and weighting for the measures for the contingent payment indices to be reasonable. However, the targets for the measures based on five year actuals should not be accepted without due consideration of JGN's internal targets or any outliers.

In addition, Zincara also considers that use of a sliding scale to determine the contingent payment factor is reasonable. However, the performance threshold of 80 to 100 for which JGN will receive its CPF is considered too wide. At best, a range of 90-100 would be more acceptable.

2. INTRODUCTION

2.1 BACKGROUND

In July 2019, Jemena Gas Network (NSW) (JGN) submitted its revised Access Arrangement (AA) for the period 2020-2025 for the natural gas distribution system in NSW to the Australian Energy Regulator (AER). The To assist in the review of the capital expenditure (capex), the AER engaged Zincara P/L (Zincara) to advise it on some aspects of the forecast capex. In particular, the AER sought advice on the following:

- Connections
- Meter replacement
- Facilities and Pipes
- Augmentation
- Mains Replacement

Zincara was also asked to advice on the operation of CESS which was part of the JGN's submission.

2.2 SCOPE OF THE CONSULTANCY

The focus of the review is to provide the AER with a view on whether the capex meets the requirements of the National Gas Rules (NGR) and in particular NGR 79.

In addition, the review is also to assess the reasonableness of the operation of JGN's CESS proposal.

2.3 NATIONAL GAS RULES

The NGRs are made by the AEMC under the National Gas Law. Zincara has used NGR 79 as guidance to determine the reasonableness of the capex. The relevant part of NGR 79 which has been applied is:

(1) Conforming capital expenditure is capital expenditure that conforms with the following criteria:

> (a) the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services; and
> (b) the capital expenditure must be justifiable on a ground stated in subrule (2); and
> (c) the capital expenditure must be for expenditure that is properly allocated in accordance with the requirements of subrule (6).

(2) Capital expenditure is justifiable if:

(a) the overall economic value of the expenditure is positive; or
(b) the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or
(c) the capital expenditure is necessary:

(i) to maintain and improve the safety of services; or
(ii) to maintain the integrity of services; or
(iii) to comply with a regulatory obligation or requirement; or
(iv) to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or

(d) the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c).

2.4 DEFINITION FOR PRUDENCE AND EFFICIENCY

As NGR 79 does not define the prudence, efficiency and good industry practice, Zincara has adopted the following definitions:

"Prudence", means "*caution in managing one's activities to avoid undesirable consequences[1]".* Zincara has interpreted this to mean that for the project to be prudent, the decision is made on the basis that it is timely for the project to proceed to rectify ongoing safety and reliability issues.

'Efficiency' means *functioning or producing effectively and with the least waste of effort[1].* This means that the choice of which option to adopt for the project must be made on the basis that the most effective solution has been adopted. The "least amount of effort" refers to the cost of the project and in that context the project must be carried out at market rates.

"Good industry Practice" means that the actions that a prudent operator would adopt in in similar Australian conditions.

2.5 APPROACH

The key steps of Zincara's approach are:

Review the relevant documents provided by JGN in its submission. This includes the capex submission, the asset management plan, the capex and RIN spreadsheets and the Project Estimation Models (PEM) for the vast number of projects.

[1] Australian Concise Oxford Dictionary

- Determine what are the strategic objectives for each project.
- Consider whether the most efficient option has been adopted and the appropriateness of the timing.
- Ensure that the estimated cost for the project meets the efficiency test.

Zincara's analysis is based on the JGN's submission and Zincara has assumed the data to be accurate. Zincara has not verified the accuracy or veracity of the data.

In carrying out the review, Zincara considered:

- the efficiency and prudence of the size, scope and timing of JGN's proposed capital expenditure (capex) allowances;
- the justification for each project or area of forecast capex ;
- the relationship of the capex allowances to the respective drivers of capex, and the efficiency and prudence of the service provider's proposed capex allowances in relation to these drivers;
- the efficiency and prudence of the service provider's proposed capex allowances in relation to capex–opex (operating costs) interactions and potential trade-offs; and
- the appropriateness of the service provider's methods for determining its proposed capex allowances, including whether the forecasts were arrived at on a reasonable basis and represent the best forecast or estimate possible in the circumstances.

2.6 COST REPORTING

All costs shown in this report are in real 2018 dollars unless otherwise stated. Any reference to direct cost means that the cost includes labour, material and contractors but does not include overheads.

This report is presented in regulatory years (e.g. July 2020-June 2021). The sections of the report which is presented in calendar years will have a notation CY.

It should also be noted that some totals in the tables may differ slightly with the addition of the numbers on the tables. This is due to rounding errors.

2.7 STRUCTURE OF THE REPORT

The Report covers the following:

- Description of JGN Gas Networks
- Asset Management Practices
- Connections
- Meter Replacement
- Facilities and Pipes
- Augmentation

- Mains Replacement
- Capital Expenditure Sharing Scheme

3. DESCRIPTION OF JGN GAS NETWORKS

3.1 OVERVIEW

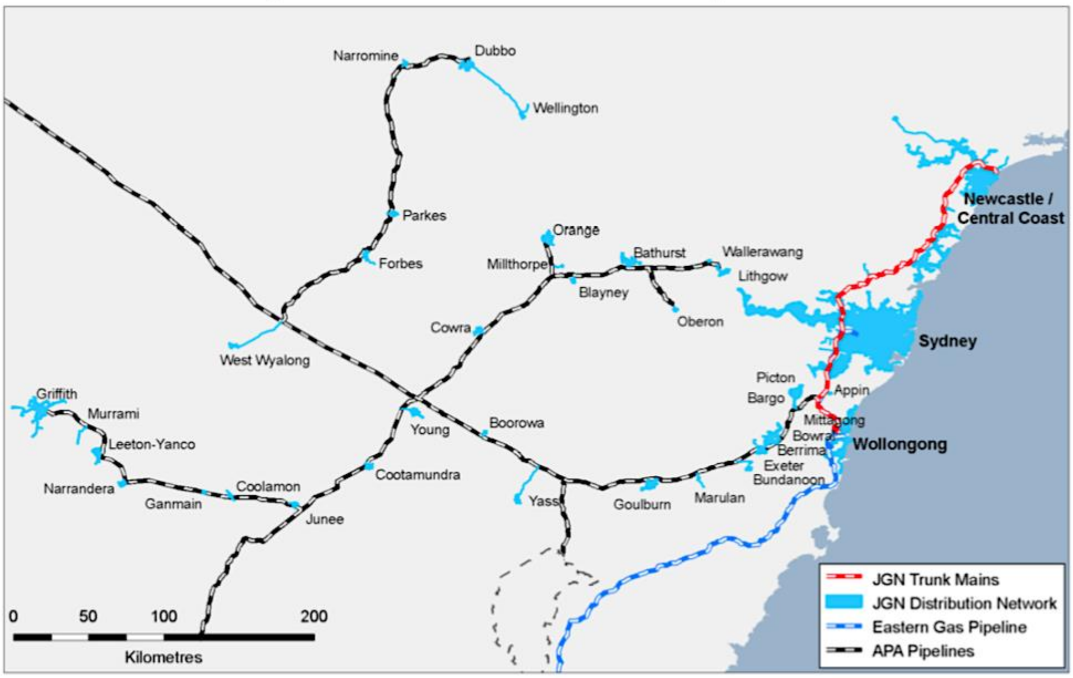
The Jemena Gas Networks is a distribution network owned and operated by Jemena Gas Networks (NSW) Ltd (JGN). JGN distributes natural gas on behalf of network users such as retailers to their customers' premises. JGN currently delivers natural gas to approximately 1.4 million customers covering residential business and industrial sites in Sydney, Newcastle, the Central Coast, Wollongong and over 20 regional centres. The regional centres include the Central West, Central Tablelands, South Western, Southern Tablelands, Riverina and Southern Highlands regions.

The majority of gas consumed in NSW is sourced from other states. Interstate gas is transported to NSW via two main gas transmission pipelines:

- The Moomba to Sydney Pipeline(MSP) owned by APA Group. The pipeline principally transports gas from the Cooper Basin in South Australia.
- The Eastern Gas Pipeline(EGP), owned by Jemena. The pipeline transports gas from the Gippsland Basin in Victoria.

The figure below shows the delivered gas into JGN's networks and the networks footprint.

Figure 3-1 Pipelines Delivering Gas to JGN Network



Source: Access Arrangement Information 2010-2015

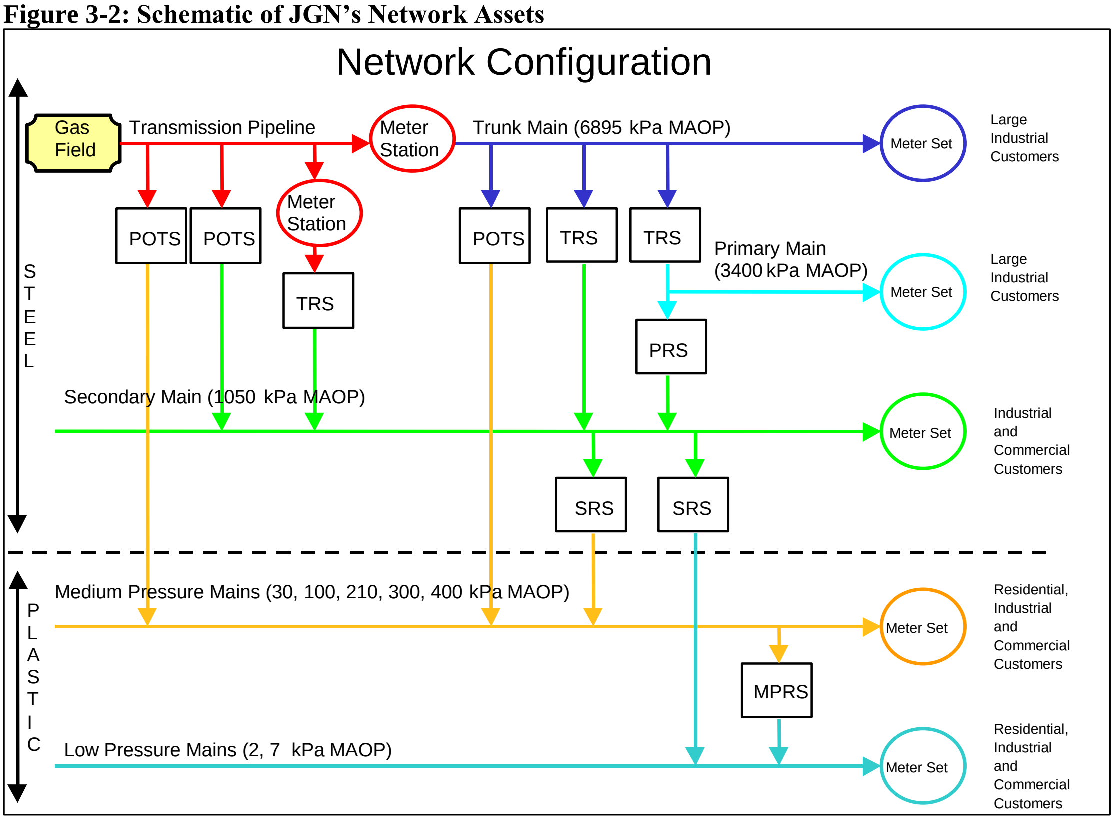
Details of the network are provided in the table below and the network's pressure tiers are represented in the following figure.

Table 3-1: Key JGN Asset Statistics

Network	Quantity
Trunk mains (kms)	271
Primary mains (kms)	144
Secondary mains ≤ 1,050kpa (km)	1,449
Medium and low pressure mains < 1,050kpa (km)	22,848
Trunk receiving stations (including packaged off take stations)	54
Bulk metering stations	4
Primary regulating stations	17
District regulating sets	642

Source: Attachment 5.3 Network Asset Management Plan

Figure 3-2: Schematic of JGN's Network Assets



Source: Jemena Gas Network Pipeline Reclassification Application 2009

3.2 CUSTOMERS

The customers connected to JGN's network are divided into two market segments. The volume market segment consists of customers who consume gas less than 10 terajoules (TJ) per year. The other market segment is the demand market which consists of customers who consume gas greater than 10TJ per year.

During 2017-18, JGN transported approximately 50 petajoules (PJ) of gas to 384 largest customers who consume gas more than 10TJ per annum. JGN advised that these large customers account for approximately 9% of JGN's transportation revenue per annum. JGN transports approximately 39 PJ to customers who consume less than 10TJ per annum. These customers contribute to 91% of JGN's revenue.

The number of customers connected to JGN's network in 2017-18 and their gas consumption are detailed in the table below.

Table 3-2: Customers and Load by Market Type 2017-18

Region	Volume Market (<10TJ per year)		Demand Market (>10TJ per year)	
	Number	**Load (TJ)**	**Number**	**Load (TJ)**
Coastal	1,292,488	34,851	342	45,981
Country	97,423	4,157	42	3,616
Total	1,389,911	39,008	384	49,497

Source: JGN – Attachment 1.2- Background to JGN_s 2020-25 Access Arrangement Proposal

4. ASSET MANAGEMENT PRACTICES

This section describes some of the key elements of JGN's asset management. It covers the following:

- Overview of the Asset Management System
- Asset Lifecycle Activities
- Governance
- Project Management
- Level of Service

4.1 ASSET MANAGEMENT SYSTEM OVERVIEW

JGN's Asset Management System (AMS) is the key system that links the asset management decision-making with its business plan, asset strategy and the details in its 2020 plan. JGN's AMS has been externally audited and conforms with the requirements of ISO 55000[2]. Consistent with the practice as set out in ISO 55000, JGN's AMS provides a continuous improvement method of "Plan, Do, Check and Act" as shown in the table below.

Table 4-1: JGN's Asset Management Method

Phase	Description
Plan	Two-year, seven-year and 20-year capital and expenditure horizons are developed based on assessment of performance, reliability, condition, risk and cost.
Do	Projects and programs are approved in accordance to investment planning and governance processes. Approved works are executed in accordance with approved budgets and controlled and monitored using formal project management methodology.
Check	Key performance indicators are reviewed monthly and reported to Jemena's senior management.
Act	Asset management issues and risks are assessed and prioritised to inform the scope of projects and programs for the development of the next iteration of the Asset Business Strategy and the Asset Investment Plan.

Source: Attachment 5.3 Network Asset Management Plan

In addition to its accreditation to ISO 55000, JGN is also accredited for the following:

- AS/NZS 4801 Occupational Health and Safety Management Systems
- ISO 14001:2015 Environmental Management Systems
- ISO 9001:2015 Quality Management Systems
- AS/NZS 31000:2009 Risk Management Standard

[2] ISO 55 is an international standard covering the management of assets.

4.2 ASSET LIFECYCLE ACTIVITIES

JGN said that it adopts a whole-of-life approach to managing its assets as detailed in the table below.

Table 4-2: JGN's Asset Lifecycle Approach

Phase	Description
Create/Acquire	Asset creation/acquisition involves ensuring all the specification, design, construction, procurement, commissioning and handover activities have been planned and executed, resulting in a new asset. Examples of this phase are in asset installation and capacity augmentation.
Operate/Maintain	Assets are used in the business to produce a range of outputs within strict quality, environmental and safety requirements and obligations. Assets are maintained to ensure optimum performance.
Replacement	Assets are replaced once they are no longer performing within an acceptable level. During the options analysis, like-for-like replacement is considered.
Disposal	Assets are disposed of safely with no damage to the environment or to communities.

Source: Attachment 5.3 Network Asset Management Plan

4.3 GOVERNANCE

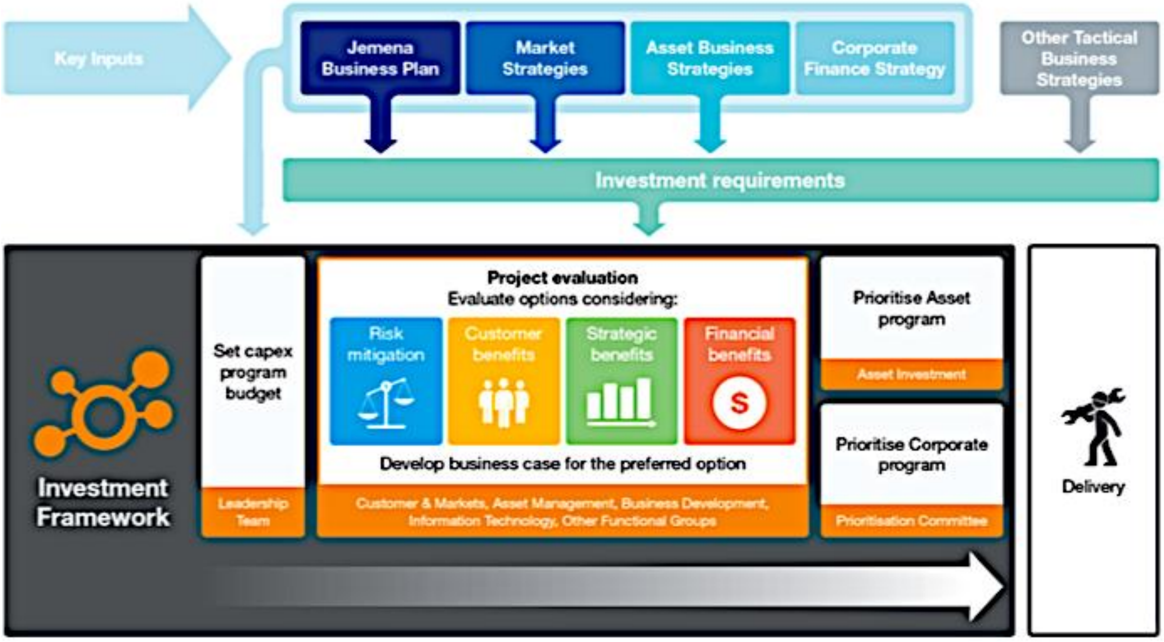
JGN said[3] that its governance framework, and in particular its investment framework, helps ensure that its investments are consistent with the requirements of the NGR, in that:

"*…investments are consistent with those of a prudent service provider, acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services.*"

JGN's investment framework[3] is used to prioritise its investment by offering a consistent method of analysing investment options against four criteria: risk mitigation, customer benefits, strategic benefits and financial benefits. An illustration of its investment framework
Is provided in the figure below.

[3] Asset Management Plan: section 4: Governance

Figure 4-1: JGN's Investment Framework Process Flow



JGN-Attachment 5.3-Network Asset Management Plan-20190531

JGN said that the key components of the investment framework are:

- Set capex program and budget;
- Project evaluation;
- Prioritise asset investment programs; and
- Prioritise corporate investment programs.

Its asset strategies are updated annually to reflect changes in JGN's Business Plan and external factors (e.g. customer or market). In addition, its expenditure forecasts are reviewed and approved through its budgeting process and ultimately by the Board. The approved items are in two categories: routine and non-routine.

In response to the AER's request for information, JGN reiterated[4] that it has a range of corporate group policies which it relies on in making finance and investment decisions. They include:

- Asset Management Policy;
- Risk Management Policy;
- Health Safety and Environmental Policy;
- Procurement and Contracting Policy.

[4] JGN-IR013-Governance and policy framework -20190821

Zincara's Comments

JGN which has a regulated asset base of $3.3b (at 31 December 2018)[5] form part of the regulated business owned by SGSPAA. Given the size of the organisation, it can be expected that the organisation will have an elaborate corporate governance framework. To examine in detail the relation of the capex submission in the context of the corporate governance is out of the scope of this review. In relation to three key aspects of the corporate governance, in particular, the investment strategy, Zincara's comments are described below.

Set capex program and budget

In its submission "JGN-Attachment 5-1 Capital Expenditure", JGN described its customer consultation process and how it had modified its capex following an extensive consultation process.

JGN also described its planning philosophy i.e. long term or medium term. Except for connections which is customer driven, JGN outlined whether the project is required for regulatory, standards, safety or reliability requirements.

Project Evaluation

Where appropriate, JGN has given a number of options for the project and the reasons for its preferred options.

Prioritisation and Investment Program

JGN provided a raft of projects for its capex program. Apart from the connections and meter replacement (regulatory requirements), it is assumed that the projects listed are the high priority projects. Without a clear understand of the total project portfolio, it has to be assumed that the list of projects meets the business strategy.

Conclusion

Zincara therefore believes that there is nothing in the submission to indicate from a qualitative perspective that JGN's capex program is not consistent with its corporate governance.

4.4 PROJECT MANAGEMENT

JGN's Project Management Methodology adopts a stage-gate process as shown in the table below.

Table 4-3: JGN's Project Management Methodology

Stage Gate	Description	Requirement to pass PMM gate
1	Option confirmed	The requirement to pass gate 1 is to establish project requirements and agree on the preferred delivery option. This includes completion of an asset scope with delivery concepts

[5] SGSPAA Investment Update July 2019

		and constraints.
2	Scope and requirements defined	The requirement to pass gate 2 is to conduct the relevant Front End Engineering Design (FEED) including scope feasibility confirmation and solution design.
3	Final financial investment decision and delivery approved	The requirement to pass gate 3 is to develop designs, costings and project delivery plans to support the scope. This also involves obtaining stakeholder acceptance of designs and the cost estimate. The key output from gate 3 is the approved business case or customer offer. The approval of these documents will identify the preferred option to be pursued and the scope of how the work will be delivered. Business case approval within Jemena is via the relevant Delegated Financial Authority Policy.
4	Ready for construction	The requirement to pass gate 4 is to finalise designs, costings and project plans to align with the scope and budget. This involves establishing project management, administration and logistics.
5	Construction complete	The requirement to pass gate 5 is to complete construction of the project, including testing. Site demobilisation will commence at this point in time. Key activities are delivery, monitoring and reporting of the construction work. The key outcome of the gate 5 review process is that all relevant documentation has been adhered to and that the project is ready for commissioning and handover.
6	Project delivered (commissioned)	The requirement to pass gate 6 is to commission the asset or equipment via placing into service and handing it over to the customer. The customer must confirm that all the necessary gate requirements have been satisfied during the delivery phase of the project. The key deliverable is the commissioning and handover of the project. The approval of these documents will deem the project to be commissioned, recognising that project finalisation activities will continue until the project is formally closed at gate 7.
7	Project closed	The requirement to pass gate 7 is to confirm that all the necessary gate requirements have been satisfied and to verify that the project has been formally closed. Key deliverables include the financial settlement of the project and post implementation review.

Source: Attachment 5.3 Network Asset Management Plan

It estimates its projects using four key inputs:

- Actual costs of completed projects that are of a similar scope;
- Cost estimations developed by providing a design brief and functional scope;
- Quotations for external service providers; and
- Industry standard benchmarks.

Zincara's role in the capex review is to ensure that the expenditure is consistent with the requirements of the NGR, in particular Rule 79. As such, Zincara expected that projects that are to commence early in the regulatory period 2021-2025 to have project estimates that are advanced with a lower level of risks when compared to projects which are to commence in the later part of the regulator period. However, all projects submitted irrespective of their commencement time are in Stage 1 with a 25%[6]risk[7]. This has made it more difficult to determine whether the project costs are efficient.

This issue was discussed in at a telephone conference between the AER, Zincara and JGN on 3 October 2019 and later confirmed in a written response[7] to the AER. At the telephone conference, JGN advised that it had compared the costs for 10 projects and the results are:

- Without a scope risk, the actual project cost would be higher than 22%
- Including the scope risk of 25% resulted in the actual cost being 2.9% above its estimated cost.

Zincara has therefore accepted the project estimates with the risk factors as a whole and carried out its review on that basis.

4.5 LEVEL OF SERVICE

JGN has a suite of Key Performance Indicators (KPI) to measure its business and asset performance. There are 29 KPI split into customer services (13 KPI) and asset safety and reliability (16KPI):

- Customer service KPI covers the reliability of gas supply to customers, incident response, gas connection and responsiveness to customer communications.
- Asset safety and reliability of performance is largely determined by factors such as historical design, age, location and condition of the distribution network as well as the changing operational environment that causes variation in asset performance from year-to-year.

Its ongoing performance against its customer service and asset safety and reliability is recorded monthly. Details of the its performance as at January 2019 is provided in Appendix A.

Further discussion on levels of service is covered in Chapter 10.

[6] Based on uncertainty of 10% for internal labour and 30% for external costs.
[7] JGN-IR024-Project Estimated Risks

4.6 CONCLUSION

Zincara notes that JGN is accredited under ISO 55001 Asset Management which is the international standard for asset management practice. Zincara's review of the JGN's asset management practice including its accreditation confirms that JGN's asset management outlined in this section is reflective of a gas distribution business.

Zincara also believes that there is nothing in the submission to indicate from a qualitative perspective that JGN's capex program is not consistent with its corporate governance.

Zincara acknowledges that JGN's comparison of 10 projects for the current regulatory period shows a 2.9% difference between the actual and forecast costs. However, Zincara believes that projects that are to commence in the early part of the regulatory period 2021-2025 should have estimates that are more advanced that Stage Gate 1. This will provide more certainty to the costs which will give more comfort to the accuracy of the estimates.

5. CONNECTIONS

5.1 INTRODUCTION

Connections cover the cost of new mains along streets, services to homes and businesses, and meters to measure gas consumption across the following market segments:

- New homes
- Commercial
- Electricity to gas
- Medium density / high-rise
- Industrial & commercial demand

The capex details used throughout this Connections chapter are presented in direct cost in $2018 (unless noted otherwise), to align with JGN's connection and metering forecast methodology document and its connections capex forecast model. The connections capex total forecast is summarised by market segment in the following table.

Table 5-1: Connections capex forecast ($2018, 000)

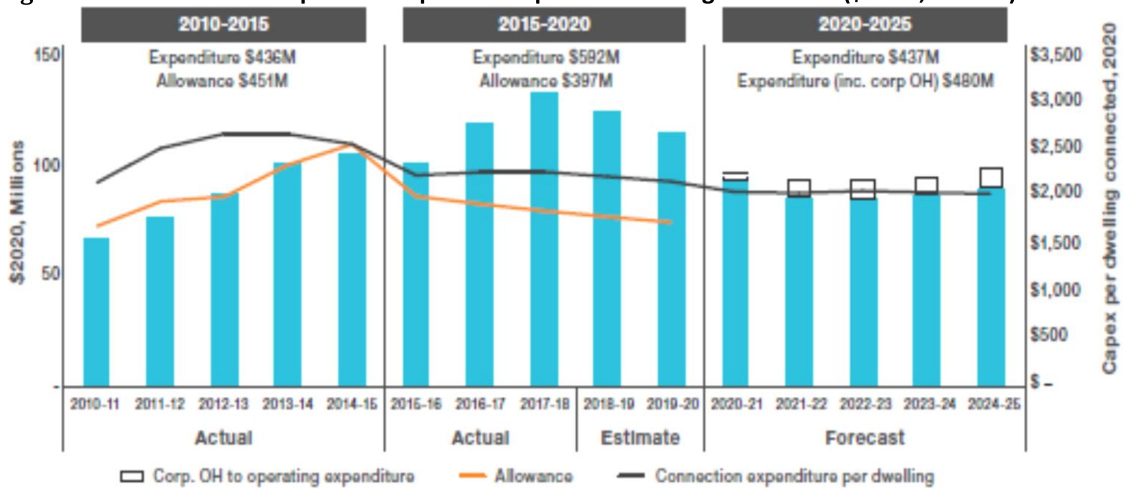
	2021	2022	2023	2024	2025	Total
New homes	44,023	41,248	40,360	41,396	44,046	**211,071**
Commercial	5,707	5,707	5,707	5,707	5,707	**28,535**
Electricity to gas	15,735	15,735	15,735	15,735	15,735	**78,673**
Medium density*	7,616	6,737	6,673	6,840	7,140	**35,007**
I&C demand	2,753	2,753	2,753	2,753	2,753	**13,765**
Total	**75,834**	**72,180**	**71,228**	**72,431**	**75,381**	**367,053**

(Source: Connections capex forecast model: "Forecast capex")
Note: medium density* includes medium density and high-rise connections
Note: summation of capex totals may not align due to rounding

Over the last few years there has been a sustained high demand for connections and in particular a significant increase in high-rise dwelling construction. However, for the forecast period there is a reduction in Connection capex (refer Figure 5-1, below) due to:

- Reduction in the number of connections;
- Reduction in average cost per connection, based on expected changes to supplier charges;
- Reduction in the average cost per connection (dwelling) with JGN no longer installing individual hot water meters in high-rise buildings (using a boundary gas meter instead). Whilst this results in reduced capex for JGN, there will be increased cost for the embedded network operators resulting from the cost of installing an embedded network.

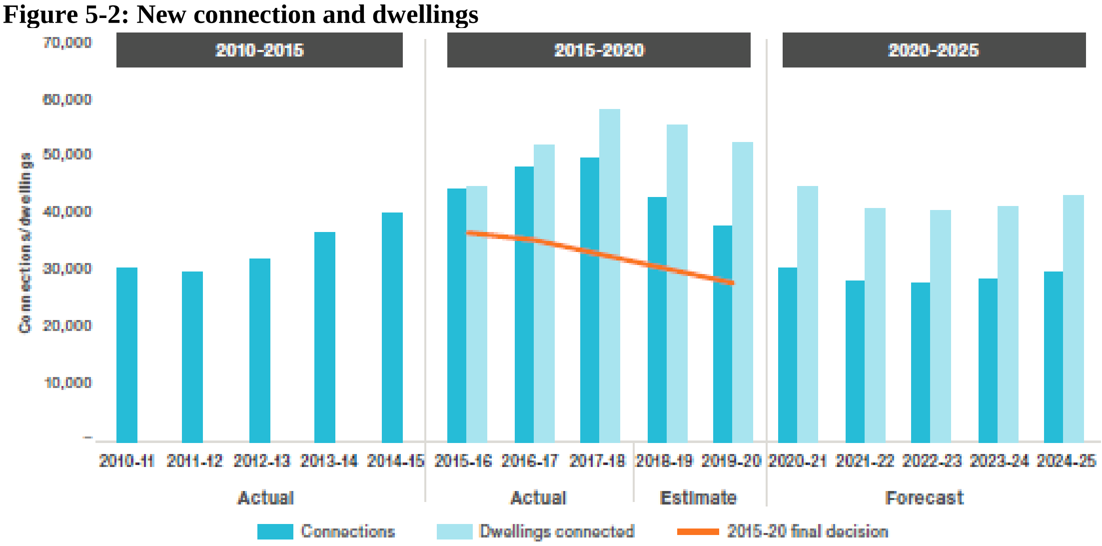
Figure 5-1: Connections Capex and expenditure per net dwelling connected ($2020, million)



(Source: 2020 Plan: Figure: 5.3)

For comparison purposes the following figure shows the number of connections and also the number of dwellings connected, by adding the number of units behind a volume boundary meter.

Figure 5-2: New connection and dwellings



(Source: 2020 Plan: Figure 8.4)

During the current period (2015-2020) connection costs and AER allowance diverged, partly due to the unprecedented building boom in Sydney particularly with respect to high-rise buildings, and partly due to unit rates in the AER's allowance being set below JGN costs[8].

[8] 2020 Plan pg.55

The connection capex is based on a top down methodology using revealed unit costs and forecast connection numbers, prepared by Core Energy and Resources (Core).

New Homes makes up more than half of the connections' capex. While there were approximately 23,000 connections in 2017-18, this is expected to fall to around 18,000 per year over the forecast period. The bulk of new home connections occur in new estates where whole estates are reticulated at a time.

Medium density / high-rise covers all multiple dwelling connections, including townhouses, small walk-up unit blocks and large high-rise apartments. Connections[9] have increased from 10,000 – 12,000 dwellings a year to almost 31,000 in 2017-18. For the 2020-25 period this is expected to fall back to just under 20,000. Note: the average connection cost (per dwelling) in Figure 5-1, above, does not appear to demonstrate any reduction as a result of introducing the boundary metering product from around 2015-16, which may reflect the relatively low volumes initially.

Commercial, refers to Commercial and Industrial Volume connections and captures all non-residential volume market connections, ranging from local restaurants up to large users such as manufacturers or food processors. Volumes are typically around 800 per year.

Electricity to Gas connections relate to existing homes which do not have a gas connection. Volumes are typically around 4,000 per year (down from around 7,000 in 2012-13).

I&C demand covers the large commercial and industrial connections (not included in the above figure). There is a relatively smaller volume of connections and the variability in connection cost is considerably higher. Despite this the annual connection capex is relatively steady.

5.2 FORECAST METHODOLOGY

JGN has developed a "Connection and metering forecast methodology" document which provides information on its approach to forecasting connections capital expenditure and is used in conjunction with its "Connection capex forecast model".

In summary, JGN's connections forecasting methodology applies a top-down forecast using actual revealed historical costs and it applies three different forecasting methods to reflect the nature of the market segments, as follows:

- New homes, commercial and electricity to gas:
  - Use average cost per connection method, which calculates the price adjusted unit rates x volume forecast. The price adjusted unit rates reflect recent changes arising from tendering/benchmarking process.

- Medium density / high-rise:
  - Metering costs are split into three sub-segments (medium density, high-rise with instantaneous hot water and high-rise with centralised hot water). The

[9] *Connection and metering forecasting methodology: pg 3*

    - respective price-adjusted sub-segment unit rates are multiplied by the volume forecast of sub-segment connections;
    - Mains and services costs reflect the price adjusted average cost per site multiplied by the site volume forecast.

- I&C demand:
    - Simple average of historical costs

Zincara considers the methodology describes above to be reasonable. Where we consider that the historical data (outliers) have distorted the four-year average, Zincara has adjusted the unit rates. These are noted in the analysis and our conclusion, including the impact on the capex forecast.

5.3 DEMAND FORECAST

JGN engaged Core to prepare an independent forecast for the forecast period. CORE relies on dwelling construction forecast by the Housing Industry Association (HIA) and uses the historical ratio of connections and dwellings construction to estimate the proportion of new dwellings will connect to the network.

The connection volume forecast, including the penetration rate, has a significant impact in the overall capex. While we have used JGN's forecast in our analysis, we recommend that JGN provide updated forecast and penetration rate data for review, before the AER's final decision, using FY2019 actual data and updated HIA and/or other related data.

5.4 NEW HOMES, COMMERCIAL AND ELECTRICITY TO GAS

This section provides unit rate and volume forecast review and analysis. Due to the relative complexity of the forecasting for medium density / high-rise dwellings, that market segment is covered in Section 5.5 of this report. For new homes, commercial and electricity to gas market segments the relationship between costs and the number of connections is relatively steady. For these connections JGN has used historic actuals over four years (2015 to 2018) in forecasting its proposed unit rates and adjusting for changed contractor prices.

In reviewing the historic data and the four-year average results, Zincara considers that some average unit rates may be distorted by particular historic rates and has proposed adjusted rates where it considers these distortions occur. In doing so, we have also considered the earlier historic data to assess longer term trends, using a five-year average as a baseline and where this aligns closely with JGN's four-year average we have accepted JGN's unit rates. Where there has been some variation, we accept the five-year unit rate. In some cases, we have found that a particular year's unit rates impact (distort) the average and in these cases, we have removed that year and applied the balance of the years to determine a unit rate.

5.4.1 Average unit rates

Reviewing the respective data[10] provided in the average unit rate tables, by market segment and also the Connections capex forecast model for historic data[11], we make the following observations:

- New Homes: the four-year average for mains and services appear reasonably steady and a five-year average provides a similar result, so we have accepted JGN's unit rates. However, the meter average is impacted by relatively significant rises in 2017 and 2018, compared to the previous two years. We have applied a five years average and propose an adjusted meter average unit cost of $[redacted].

- Commercial (I&C Volume): the historic data shows a peak average unit cost for mains in 2014-15 and falling in 2017-18, with a four-year average of $[redacted]/m. In this case we have applied the five years average giving a unit rate of *$[redacted]/m*. For services, the data shows a significant step increase from 2015-16. In this case we have applied the five years average giving a unit rate of $[redacted], compared with the four years average unit rate of $[redacted]. For meters, 2015-16 is a relatively high peak which distorts the average. Removing that year from the five-year average give a unit rate of $[redacted], compared with the four-year average unit rate of $[redacted].

- Electricity to Gas: the historic data for mains shows a step change from 2017 compared with the earlier years, with 2017 being a peak year. Removing the peak 2017 year from the five years average gives a unit rate of $[redacted]/m compared with the four years average unit rate of $[redacted]/m. Service costs show an increasing trend. We have compared this with the five-year average and found some variance between the two averages. As a result, we have applied the five-year average giving a unit rate of $[redacted], compared with the four-year average unit rate of $[redacted]. For meters the most recent years are lower than the previous two years and in line with the earlier years. The five-year average shows some variance compared to the four-year average and as a result we have applied the five-year average, giving a unit rate of $[redacted], compared with the four-year average of $[redacted].

Details of the above analysis are provided in Appendix B of this report. Given the above analysis, it is recommended that respective data, as shown in the connections' capex forecast model[12] for the recently completed 2019 be provided by JGN, to enable further analysis.

5.4.2 Price adjusted unit rates

The average unit rates calculated above are then adjusted to reflect price changes such as in JGN's benchmarking/re-tendering processes.

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[10] Connection and metering forecast methodology: Tables 1-2 to 1-4
[11] Tab: AA reset RIN E5
[12] Input: AA reset RIN E5

JGN[13] advised: *"For the 2015-20 period, the AER applied an aggregate price movement (across all of our suppliers). We have expanded our connections capex forecast model to include the calculation of this price adjustment factor, improving the transparency of our calculations".*

Mains and services price movements have occurred as a result of JGN's tendering/benchmarking across all of its contractor regions. It is noted that metering is not covered by any price changes. [redacted] It is also noted that some of the price changes have already been put into place and are partly included in JGN's four-year average unit rates. This is reasonable given the adjustment of the unit rates needs to consider the timing of the application of the price changes and also the variations across regions. The outcome is that there are [redacted] It is noted that the remainder of connection costs associated with restorations, non-routine work, internal labour etc are unaffected by price changes.

Combining the (contractor) price movements, proportion of contractor costs and the proportion of unitised costs to calculate a "price adjustment factor" for mains and services by market segment:

- New homes: mains calculates as [redacted]% price reduction and services is [redacted]% reduction
- Commercial: mains calculates as [redacted]% price reduction and services is [redacted]% reduction
- Electricity to Gas: mains calculates as [redacted]% price reduction and services is [redacted]% reduction

Note that there were no price adjustments for meters.

JGN's four-year average unit rates, adjusted for the contractor price changes are as follows:

Table 5-2: Price adjusted unit rates ($2018)

	New Homes	**Commercial**	**Electricity to Gas**
Mains (per metre)	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]

(Source: Connection and metering forecasting methodology: Tables 2-15, 2-16 and 2-17)

Zincara's recommended unit rates, as noted in section 5.4.1 (average unit rates) above, were also calculated in line with JGN's methodology (using JGN's Connections capex forecast model) to reflect the price adjustments and are shown in the following table, with the revised rates in italics:

Table 5-3: Price adjusted unit rates ($2018)

	New Homes	Commercial	Electricity to Gas
Mains (per metre)	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]

(Source: Zincara's calculation)

[13] *Connections Capex Forecast: 2.2.2 ; pg 10*

5.4.3 Volume forecast

The first stage of the volume forecast is to determine the length of mains and the number of services and meters per connection associated with each market segment. This "volume mix" uses data covering four years (2015 to 2018) to calculate an average for each market segment. Details of the four years data are provided in Appendix B and are summarised below:

- New homes: Mains (metres per connection) for the four-year average is [redacted] metres. The data shows a reducing trend for the length of mains and we consider that this is likely to be consistent with smaller frontages for new estate allotments and also aligns with earlier historic data. We therefore propose that the most recent year is likely to be more representative of the forecast period and recommend using a connection length of [redacted] *metres*. In response to the AER's request for information, JGN provided[14] a draft(unaudited) mains length for 2019 showing [redacted] metres. This further supports our recommendation that there is a decreasing trend on the size of blocks.

  Services and meters are fairly consistent across the four-year period.

- Commercial: The four-year average for mains is [redacted] metres, however 2018 is approximately 40% higher than the next highest year. We have removed this year and applied the remaining years of the five-year average to give a unit length of [redacted] *metres*. Services and meters four-year averages are relatively consistent.

- Electricity to Gas: Four-year averages are relatively consistent.

Zincara recommends that new homes mains average length be [redacted]m and for commercial (I&C Volume) the mains average length is [redacted]m.

The connections forecast volumes have been prepared by Core and summarised in the following table:

Table 5-4: 2020-25 Connections forecast

	2019	2020	2021	2022	2023	2024	2025
New homes	24,201	22,464	18,935	17,742	17,360	17,805	18,945
I&C (tariff)	828	828	828	828	828	828	828
Electricity to gas	4,000	4,000	4,000	4,000	4,000	4,000	4,000

(Source: Connection and metering forecasting methodology: Tables 2-21)
Note: Connections capex forecast model: AA Reset RIN E5 shows historic connection volumes from 2010-11.

As noted above (refer section 5.3) we have used JGN's connections forecast data but recommend that JGN provide updated data for review before the AER's final decision.

[14] IR023

5.4.4 Capex forecast

Applying the price adjusted unit rates and the volume forecast provides the following connections capital expenditure:

Table 5-5: JGN: New homes capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	13,502	12,651	12,379	12,696	13,509
Services	26,826	25,135	24,594	25,225	26,840
Meters	3,695	3,462	3,388	3,474	3,697
Total	**44,023**	**41,248**	**40,360**	**41,396**	**44,046**

(Source: Connection and metering forecasting methodology: Tables 2-25)

Table 5-6: JGN: Commercial capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	1,788	1,788	1,788	1,788	1,788
Services	2,070	2,070	2,070	2,070	2,070
Meters	1,849	1,849	1,849	1,849	1,849
Total	**5,707**	**5,707**	**5,707**	**5,707**	**5,707**

(Source: Connection and metering forecasting methodology: Tables 2-26)

Table 5-7: JGN: Electricity to gas capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	3,679	3,679	3,679	3,679	3,679
Services	10,963	10,963	10,963	10,963	10,963
Meters	1,093	1,093	1,093	1,093	1,093
Total	**15,735**	**15,735**	**15,735**	**15,735**	**15,735**

(Source: Connection and metering forecasting methodology: Tables 2-27)

Applying Zincara's proposed adjustments, the revised capex by market segment are summarised in the following tables.

New homes: adjustment relates to mains length, reduce from [redacted] metres to [redacted] metres and also price adjusted unit rate for meters, reduce from $[redacted] to $[redacted].

Table 5-8: Zincara: New homes capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	11,436	10,715	10,484	10,753	11,442
Services	26,826	25,135	24,594	25,225	26,840
Meters	3,482	3,262	3,192	3,274	3,483
Revised Total	41,743	39,112	38,270	39,252	41,765
JGN total (New Homes) capex =	**211,071**				
Recommended (New Homes) capex =	**200,141**				
Difference =	**- 10,930 (5%)**				

(Source: Connection capex forecast model: revised)

Commercial (I&C Volume): adjustment relates to unitised price for mains (reduce from $[redacted]/m to $[redacted]/m), services (reduce from $[redacted] to $[redacted]), meters (reduce from $[redacted] to $[redacted]), and also length of mains (reduce from [redacted]m to [redacted]m).

Table 5-9: Zincara: Commercial (I&C Volume) capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	1,544	1,544	1,544	1,544	1,544
Services	1,945	1,945	1,945	1,945	1,945

Meters	1,684	1,684	1,684	1,684	1,684
Revised Total	5,174	5,174	5,174	5,174	5,174
JGN total (Commercial) capex =	28,535				
Recommended (Commercial) capex =	25,868				
Difference =	- 2,667 (9%)				

(Source: Connection capex forecast model: revised)

Electricity to Gas: adjustment relates to mains unitised price, reduce from $[redacted]/m to $[redacted]/m; service unitised price reduces from $[redacted] to $[redacted]; meter unitised price reduces from $[redacted] to $[redacted].

Table 5-10: Zincara: Electricity to gas capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	2,912	2,912	2,912	2,912	2,912
Services	10,752	10,752	10,752	10,752	10,752
Meters	1,071	1,071	1,071	1,071	1,071
Total	14,735	14,735	14,735	14,735	14,735
JGN total (Electricity to Gas) capex =	78,673				
Recommended (Electricity to Gas) capex =	73,675				
Difference =	-4,998 (6%)				

(Source: Connection capex forecast model: revised)

The recommended revisions result in a reduced capex of $18,595,683 (5%), to $299,684,298 compared with the JGN capex of $318,279,981 for these market segments.

5.4.5 Conclusion

This section includes:

- New Homes, which make up more than half of the connections' capex. While there were approximately 23,000 connections in 2018, this is expected to fall to around 18,000 per year over the forecast period.
- Commercial and Industrial Volume connections captures all non-residential volume market connections, ranging from local restaurants up to large users such as manufacturers or food processors. Volumes are typically around 800 per year.
- Electricity to Gas connections relate to existing homes which do not have a gas connection. Volumes are typically around 4,000 per year (down from around 7,000 in 2013).

For these market segments the relationship between costs and the number of connections is relatively steady and JGN has used historic actuals over four years (2015 to 2018) in forecasting its proposed unit rates and adjusting for changed contractor prices.

In reviewing the historic data and four-year average results, Zincara considers that some average unit rates may be distorted by particular historic rates and have proposed adjusted rates where we consider these distortions may occur. In doing so, we have also considered the earlier historic data to assess longer term trends, using a five-year average as a baseline and where this aligns closely with JGN's four-year average we have accepted JGN's unit rates. Where there has been some variation, we accept the five-year unit rate. In some cases, we have found that a particular year's unit rate is an outlier and would distort the average. In these cases, we have removed that year and applied the balance of the years to determine a unit rate.

These unit rates were then adjusted to reflect contractor price changes and timing associated with mains and services as a result or a tendering/benchmarking process. Meters were not part of this process and will be subject of a separate review. The resulting "price adjustment factor" for mains and services by market segment are:

- New homes: mains - calculates as [redacted]% price reduction and services is [redacted]% reduction.
- Commercial: mains - calculates as [redacted]% price reduction and services is [redacted]% reduction.
- Electricity to Gas: mains - calculates as [redacted]% price reduction and services is [redacted]% reduction.

The volume forecast is to determine the length of mains and the number of services and meters per connection associated with each market segment. JGN has used a four-year average (2015 to 2018) to determine this "volume mix". As with the unit rates analysis, we have reviewed the volume mix for each market segment and in some cases recommended a revised mix. The volume mix is then applied to the connection volumes. We have not considered any revision to the connection forecast volumes.

The capex forecast is then calculated by multiplying the adjusted unit rates and the volume forecast. Zincara's recommended adjustments to unit rates and /or volumes:

- **New homes**: mains length, reduced from [redacted] metres to [redacted] metres and price adjusted unit rate for meters, reduced from $[redacted] to $[redacted].
- **Commercial & Industrial Volume**: price adjusted unit rate for mains, reduced from $[redacted]/m to $[redacted]/m, services price adjusted unit rate reduced from $[redacted] to $[redacted], meters price adjusted unit rate reduced from $[redacted] to $[redacted], and also the length of mains reduced from [redacted]m to [redacted]m.
- **Electricity to Gas**: price adjusted unit rate for mains reduced from $[redacted]/m to $[redacted]/m, service price adjusted unit rate reduced from $[redacted] to $[redacted], and meter price adjusted unit rate reduced from $[redacted] to $[redacted].

The resulting Zincara recommended capex forecast for these market segments is as follows:

Table 5-11: Zincara: Recommended Connection capex forecast ($2018, 000)

Market segment	JGN 2020 Plan	Zincara Recommendation	Difference
New Homes	211,071	200,141	**- 10,930**
Commercial & Industrial Volume	28,535	25,868	**- 2,667**
Electricity to Gas	78,673	73,675	**-4,998**

(Source: Connection capex forecast model: revised)

5.5 MEDIUM DENSITY / HIGH-RISE

This section provides unit rate and volume forecast review and analysis for the medium density / high-rise dwellings market segment.

From July 2020, JGN will be withdrawing its hot water metering product for new connections and using volume boundary metering. As a result, there will be the following sub-segments:

- Medium density dwellings: townhouses etc. less than three stories. These connections have several metres of main and a service which is shared by each dwelling in the building. Each dwelling has an individual gas meter.

- High-rise dwellings: buildings (or sites) with more than three stories, either fitted with:
    - Instantaneous hot water systems (typically installed on balconies). These connections have several metres of main and a service which is shared by each dwelling in the building. Each dwelling has an individual gas meter.
    - Centralised hot water systems. Historically JGN have installed individual hot water meters for each dwelling to measure hot water consumed and allocate the gas by the centralised hot water plant. These dwellings could also have gas meters installed to measure the gas used by cooktops or space heaters. In 2015-16, JGN introduced its boundary metering product, where a single boundary gas meter is installed, typically supplying a centralised hot water system operated by an embedded network provider.

To account for the above changes, JGN has made two changes to its forecasting method:

- Calculate meter costs on a market sub-segment level, rather than calculate the average meter unit rates for the market segment as a whole. The unit rates are then applied to a connection forecast at the market sub-segment level.
- Calculate mains and services costs on a per site basis (rather than per connection) to better reflect that mains and services costs are driven by the number of sites rather than the number of connections made.

Zincara considers that JGN's methodology with respect to the medium density / high-rise market segment is reasonable.

5.5.1 Unit rates

Metering. With respect to meter costs, the volume boundary tariff was only introduced in 2015-16 and due to the move to SAP system in 2016, JGN has only used data covering 2017 and 2018 to calculate metering cost per connection, as shown below:

Table 5-12: Medium density / high-rise metering 2017 and 2018 ($2018)

Sub-segment	Metering configuration	Expenditure	Connection volume	Cost per connection
Medium density *(ave. 9 dwellings/site)*	Gas meter per dwelling	1,455,804	[redacted]	[redacted]
High-rise with instantaneous hot water *(ave. 21 dwellings/site)*	Gas meter per dwelling	23,729,214	[redacted]	[redacted]
High-rise with centralised hot water *(ave. 88 dwellings/site)*	Hot water meter per dwelling and an optional gas meter per dwelling			
	Hot water meter per dwelling and a boundary meter per site	3,086,409	[redacted]	[redacted]
	Volume boundary meter per site	954,484	[redacted]	[redacted]

(Source: Connection and metering forecasting methodology: Table 2-30)

Note: Boundary meter connections have the highest cost per connection ($[redacted]), due to the larger size of the meter. However, when considered on a per dwelling basis the metering cost equates to $[redacted].

JGN advised[15] that they have been unable to isolate the historical metering costs of high-rise buildings with instantaneous hot water systems as costs have been captured together with the cost of installing individual metering for high-rise buildings with centralised hot water systems. As a result, they have applied the same unit cost used for the medium density sub-segment. The following table shows the metering unit rates used in the forecast.

Table 5-13: Medium density / high-rise forecast metering unit rates ($2018)

Sub-segment	Metering configuration	Cost per connection
Medium density	Gas meter per dwelling (average 9 dwellings per site)	[redacted]
High-rise with instantaneous hot water	Gas meter per dwelling (average 21 dwellings per site)	[redacted]
High-rise with centralised hot water	Hot water meter per dwelling and an optional gas meter per dwelling (average 88 dwellings per site)	Withdrawing product
	Hot water meter per dwelling and a boundary meter per site (average 88 dwellings per site)	Withdrawing product
	Volume boundary meter per site (average 88 dwellings per site)	[redacted]

(Source: Connection and metering forecasting methodology: Tables 2-31)

[15] Connection and metering forecasting methodology (section 2.3.3, pg. 19)

Mains and services unit rates

The cost of laying mains and services is unaffected by the introduction of volume boundary meters and the withdrawal of hot water metering. JGN's forecast methodology is to forecast expenditure on a cost per site basis.

Table 5-14: Medium density / high-rise mains and service unit rates ($2018)

	2015	2016	2017	2018	4-year average
Services					
Services cost	1,756,872	1,970,681	3,327,134	3,806,617	
Volume	[redacted]	[redacted]	[redacted]	[redacted]	
Cost/service	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Mains					
Mains cost	1,537,369	2,516,682	3,007,695	4,452,876	
Volume services	[redacted]	[redacted]	[redacted]	[redacted]	
Cost/service	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Connection and metering forecasting methodology: Tables 2-32, 2-33 and 2-34)

In the above table, the average cost of a service and a main show a step change increase from 2016-17. In response to our information request (IR003: Q2) JGN has clarified the basis for the unit rate increases and we have accepted the explanation.

The average unit rates are then adjusted for price changes as a result of retendering/benchmarking processes. The resulting price adjustment factor is applied to the four-year average unit rate as shown in the following table.

Table 5-15: Medium density / high-rise price adjusted unit rate ($2018)

	4-yr average unit rates	Price adjustment factor	Price adjusted unit rate
Services	[redacted]	[redacted]%	[redacted]
Mains	[redacted]	[redacted]%	[redacted]

(Source: Connection and metering forecasting methodology: Tables 2-39)

5.5.2 Volumes forecast

The above analysis provides meter unit rates on a connection (dwelling basis) and mains and services unit rates on a per site basis. CORE connection forecasts provide the number of dwellings which will connect to JGN's network and also how many sites will be connected in the high-rise sub-segments. For the medium density sub-segment JGN has assumed an average of 10 dwellings per site.

Table 5-16: Medium density / high-rise forecast dwellings

	2021	2022	2023	2024	2025	Total
Medium density	2,838	2,551	2,530	2,584	2,682	**13,185**
High-rise instantaneous hot water	4,352	3,818	3,779	3,881	4,063	**19,893**
High-rise centralised hot water	14,569	12,782	12,652	12,991	13,601	**66,595**

(Source: Connection and metering forecasting methodology: Tables 2-40)

Table 5-17: Medium density / high-rise forecast sites

	2021	2022	2023	2024	2025	Total
Medium density	284	255	253	258	268	**1,318**
High-rise instantaneous hot water	207	182	180	185	193	**947**
High-rise centralised hot water	166	145	144	148	155	**758**

(Source: Connection and metering forecasting methodology: Tables 2-41)

The resulting medium density / high-rise capex forecast combines the forecast volumes and the price adjusted unit rates.

5.5.3 Capex forecast

To forecast medium density / high-rise capex, the forecast volumes are combined with the price-adjusted unit rates. Meter costs are determined by multiplying the unit rate per connection (dwelling) by the number of connections at a sub-segment level. Mains and services costs are determined by multiplying the respective costs per service by the number of sites. The resulting medium density / high-rise capex forecast is shown as follows.

Table 5-18: Medium density / high-rise capex forecast ($2018, 000)

	2021	2022	2023	2024	2025
Mains	2,414	2,140	2,120	2,172	2,265
Services	2,245	1,990	1,972	2,020	2,107
Meters	2,958	2,607	2,581	2,648	2,768
Total	7,616	6,737	6,673	6,840	7,140

(Source: Connection and metering forecasting methodology: Tables 2-48)

5.5.4 Conclusion

Following review of the forecasting methodology and further information provided in response to our information requests, we consider that JGN's forecast is prudent and efficient. Note that we have not reviewed the volume forecast, which we understand is being reviewed by the AER, particularly relating to the penetration rate forecast. However, we recommend that JGN provide updated forecast data for review prior to the AER final decision.

From July 2020 JGN will be withdrawing its hot water metering product for new connections and using volume boundary metering. Zincara's review relates to this changed policy. In the event of the AER rejecting this change, then metering capex will need to be adjusted.

5.6 I&C DEMAND

The volume of I&C demand connections is relatively small and connection costs vary significantly. However, JGN indicate that annual costs are relatively steady and as a result propose a four-year average of historic connection costs as the forecast cost[16]. In reviewing the historic costs, Zincara found that 2017 and 2018 are relatively lower than the earlier two years. However, when considering the four-year average and the five-year average, along

[16] Connection and metering forecasting methodology: Table 2-49

with the variability of this market segment, we have accepted JGN annual connection capex forecast as being reasonable.

5.7 CONCLUSION

Connections capex for the 2021-25 period is forecast to be below the current (2015-20) period in large part due to the unprecedented building activity during the current period and in particular with respect to medium density / high–rise activity. JGN has achieved some price reductions with its contractors through its tendering / benchmarking processes. They will also fully apply its boundary metering product for high-rise market sub-segment and no longer install hot water meters in these situations.

JGN's connection forecast methodology applies a top down forecast using actual revealed historical costs with some variation to suit the respective market segments. They have used a four-year average to determine average unit rates and applied price adjustments to recognise the contractor tender/benchmarking undertaken in recent years.

Zincara considers that some average unit rates may be distorted by particular historic rates and have proposed adjusted rates where we consider these distortions occur. In doing so, we have also considered the earlier historic data to assess longer term trends, using a five-year average as a baseline and where this aligns closely with JGN's four-year average we have accepted JGN's unit rates. Where there has been some variation, we accept the five-year unit rate. In some cases, we have found that a particular year's unit rates impact (distort) the average and in those cases, we have removed that year and applied the balance of the years to determine a unit rate.

It is noted that CORE have developed the volume forecast, covering all market segments and also considering dwelling and site connections where appropriate.

The contractor tendering/benchmarking has resulted in some nominal price reductions for mains and services, although metering is not included. JGN has advised that metering services will be subject to a separate review. There are no internal price adjustments.

Zincara's proposed adjustments, determined during a review of the various market segments, are summarised as follows:

- **New homes**: mains length, reduced from [redacted] metres to [redacted] metres and price adjusted unit rate for meters, reduced from $[redacted] to $[redacted]
- **Commercial & Industrial Volume**: price adjusted unit rate for mains, reduced from $[redacted]/m to $[redacted]/m, services price adjusted unit rate reduced from $[redacted] to $[redacted], meters price adjusted unit rate reduced from $[redacted] to $[redacted], and also the length of mains reduced from [redacted]m to [redacted]m.
- **Electricity to Gas**: price adjusted unit rate for mains reduced from $[redacted]/m to $[redacted]/m, service price adjusted unit rate reduced from $[redacted] to $[redacted] and meter price adjusted unit rate reduced from $[redacted] to $[redacted].
- **Medium Density**: Zincara accepts the unit rates for this market segment are reasonable.
- **I&C Demand**: Zincara accepts that the annual expenditure forecast is reasonable.

The resulting Zincara recommended capex forecast for these market segments is as follows:

Table 5-19: Zincara: Recommended Connection capex forecast ($2018, 000)

Market segment	JGN 2020 Plan	Zincara Recommendation	Difference
New Homes	211,071	200,141	**- 10,930**
Commercial & Industrial Volume	28,535	25,868	**- 2,667**
Electricity to Gas	78,673	73,675	**-4,998**
Medium Density	35,007	35,007	**Nil**
I&C Demand	13,766	13,7665	**Nil**
Total Connection capex	**367,053**	**348,457**	**-18,596**

(Source: Connection capex forecast model: revised)

The resulting difference represents a 5% reduction in the connection capex over the period.

We also note that from July 2020 JGN will be withdrawing its hot water metering product for new connections and using volume boundary metering. Zincara's review relates to this changed policy. In the event of the AER rejecting this change, the medium density capex will need to be adjusted.

Zincara also recommends that JGN provide to the AER its 2020-unit rates and expenditures for each of the market segments, along with further updates of the connection volumes forecast.

6. METER REPLACEMENT

6.1 INTRODUCTION

Meter replacement capex covers all metering types that require replacement either as part of a planned program or when found to be defective.

The capex details used throughout this meter replacement chapter are presented in direct, 2018 dollars (unless noted otherwise). The meter replacement capex total forecast is summarised in the following table.

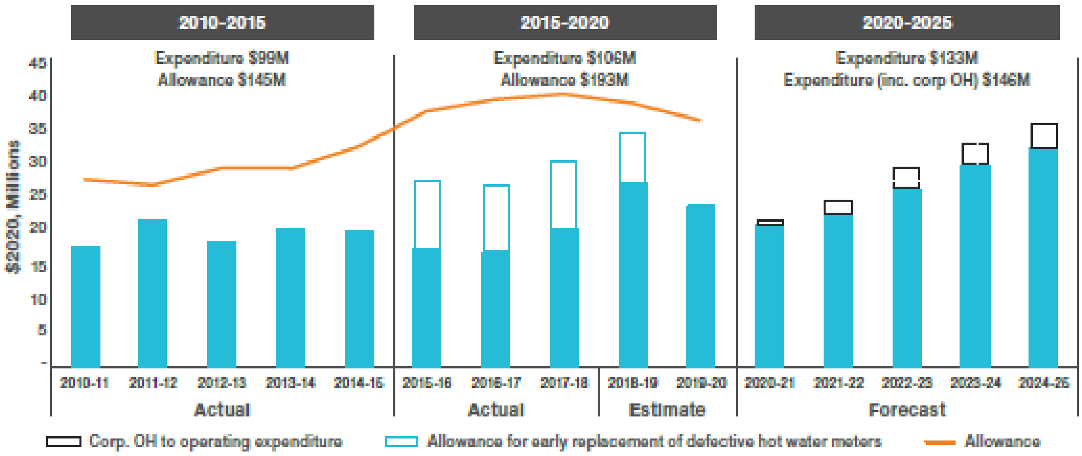
Table 6-1: Meter Replacement Capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Residential gas meters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**52,268**
Hot water meters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**21,709**
Meter data loggers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**6,528**
I&C meters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**26,969**
Metreteks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**1,614**
Testing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**1,532**
Other	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**139**
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**110,760**

(Source: Meter replacement capex forecast model)

The 2020 Plan provides the following figure which shows for the meter replacement programs, the allowance and actual expenditure over the 2010-15 and 2015-20 periods, along with the forecast for the 2020-25 period. In each of the current and previous periods, actual expenditure has been well below the allowance.

Figure 6-1: Meter Replacement Capex ($2020, million)



Source: 2020 Plan: Figure: 5.6

6.2 METERING CAPEX FORECAST METHODOLOGY

Metering capex forecasts are developed as follows:

- Historical unit rates. This method is applied where volume of work varies year to year but the scope of work remains the same. Average unit rates are based on historical data and then applied to a separately derived volume forecast.
- Project cost estimate methodology. This method produces a whole project cost, or unit rate which is then applied to a volume forecast. It is used where the historical unit rates will not provide the best forecast, typically where there is no historical data or the scope of work changes over time.
- Historical yearly spending. This method is a simple average of historical annual costs. It is applied where volumes are not expected to significantly change.
- Calculated using historical data from similar programs. This method is applied for new or relatively small projects.

6.3 RESIDENTIAL GAS METERS

This section gives an overview of the number of residential meters and Zincara's analysis in regard to the meter volume and costs along with any revision recommendations.

6.3.1 Volume Forecast

The volume of gas meters to be replaced is shown in the table below.

Table 6-2: Volume of Residential Gas Meter Replacement

	2021	2022	2023	2024	2025	Total
Planned	27,923	42,613	59,973	71,130	80,079	**281,717**
Statistical	1,693	1,560	1,478	1,525	1,558	**7,813**

Source: Meter replacement capex forecast model – volumes regulatory year

Residential gas meters are tested in accordance with Australian Standards[17] to identify the accuracy and leak tightness of meters. This involves statistical sample testing of meter families (similar characteristics). Meter families are first tested at the age of 13 years to determine whether they need to be replaced at 15 years (Fail), or field life extended to 20 years (Pass). They are tested again two years prior to the end of their extension and the process is repeated until the family fails the testing and is planned for replacement.

JGN has assumed that all meter families that are not due for testing will pass their 15 years and 20 year life extensions and are then expected to fail their following life extension and be replaced at 25 years.

[17] AS/NZS 4944:2006 Gas Meters – In-service compliance testing

Residential gas meter families of 400 or less are replaced at 15 years.

The key drivers for the residential gas meter replacement program are:

- Ensure accurate measurement of gas meters in line with regulatory requirements[18].
- In accordance with this regulation, JGN has a program for in-service testing, based on Australian Standard AS/NZ 4944:2006 Gas Meters – in-service compliance testing.

The gas meters that make up the planned replacement program include:

- Meter populations which have failed statistical sample testing;
- Populations containing <400 meters.
- "Difficult to access" meters which were unable to be replaced from previous years due to meter access issues.

Analysis

During the 2021-2025 period, JGN's planned meter replacement program[19] identifies three age groups of meter families for replacement (15 years, 25 years and 30 years). There are no meter families at 20 years of age that are planned for replacement during the period.

15 years: This includes a family [redacted] planned for replacement at 15 years. It also includes miscellaneous meters that are typically small meter families that are not cost effective to test and therefore are replaced at 15 years.

Zincara considers the volume of meter replacement to be reasonable.

25 years: JGN's methodology assumes that all meters of this age group are not expected to pass the statistical testing and are planned for replacement. Zincara believes that this assumption is too simplistic as JGN's information shows that over [redacted] meters from various families have passed their 25-year field life testing and are now to be extended to 30 years field life.

Zincara's approach is to review the historical performance of each meter family and based on its performance and that of similar families determine the likelihood of whether each family has to be removed when it reaches its field life of 25 years or whether it can extend past the 25-year field life. This methodology is even more relevant given that there are [redacted] meters reaching their 25 years field life during the 2021-2025 period. The capex of such a program is significant.

The outcome of our analysis is that a number of meter families can to extended past the 25-field life which will result in a reduced meter replacement program.

Details of our analysis are provided in Appendix C.

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[18] Gas and Electricity Consumer Safety Regulation 2018 – Schedule 4 Provisions relating to gas meters, Division 3, 7(2)(c), legislated under the Gas Supply Act 1996 No.38.

[19] Meter replacement volumes forecast model

30 years: [redacted]

We have accepted this assumption as there is limited information to justify extending the life of these meters pass 30 years. However, we consider it prudent that the statistical sample testing be undertaken to determine whether any families pass and can be further field life extended.

6.3.2 Recommended Residential Meter Replacement Volume

As a result of our analysis we recommend a reduced planned meter replacement program of 226,250 meters compared with JGN's program of 281,718 meters. This represents a net reduction of 55,468 meters. The following table summarises the recommendation compared with JGN's program:

Table 6-3: Residential gas meter: Planned meter replacement volume

	2021	2022	2023	2024	2025	Total
Recommended	13,300	25,150	56,200	69,250	62,350	**226,250**
JGN 2020 Plan	27,923	42,613	59,973	71,130	80,079	**281,717**
					Difference =	**- 55,468**

Source: Appendix C of this report

JGN advised in their IR004 response that they are able to manage the natural variation in meter volumes with the flexibility to ramp up and down the contractors and suppliers as needed. Zincara accepts JGN's response on its operational capability.

6.3.3 Capex Forecast

JGN's forecast replacement unit cost[20]:

- Planned replacement of residential gas meters: based on four-year average unit rates the calculated unit rate is $[redacted]/meter.
- Planned statistical sampling of residential gas meters: based on four-year average unit rates: $[redacted]/meter
- Defective meters and regulators: the forecast is based on the four year historical average yearly expenditure.

Given that there are no outliers in the actual unit cost, we consider that these rates are reasonable. The residential gas meter replacement capex is shown in the following table:

[20] Meter replacement capex forecast model: Historical data

Table 6-4: Recommended Residential gas meter replacement capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Planned	1,810	3,423	7,649	9,425	8,486	**30,792**
Statistical	260	239	227	234	239	**1,198**
Defective meter	840	840	840	840	840	**4,200**
Defective regulator	1,706	1,706	1,706	1,706	1,706	**8,530**
Total	**4,615**	**6,208**	**10,421**	**12,204**	**11,270**	**44,719**

(Source: Meter replacement capex forecast model, OA documents)

Using Zincara's recommended reduced volume of meter replacements and a unit cost of $[redacted] per meter, the resulting capex for the planned meter replacement program is $30.8 million compared with the JGN 2020 Plan of $38.3 million, a reduction of $7.5 million.

The revised residential meter replacement program capex is $44.7 million.

6.3.4 Conclusion

JGN's planned gas meter replacement program is 281,717 meters during 202120-25. The majority of these meters have successfully passed statistical sample testing to extend their field life to 25 years, with any further field extension testing due during the 2021-2025 regulatory period. For these meters, JGN has assumed that they are expected to "fail" the testing and be replaced during the 2021-2025 period.

Based on our analysis of the volume forecast model, options analysis and responses to further information requests, we consider that a number of meter families will be expected to pass their upcoming sample testing, resulting in a reduction of 55,468 meters, reducing the planned meter replacement program to approximately 226,250 meters. This results in a revised capex for the residential gas meter replacement, as shown in the following table.

Table 6-5: Recommended Residential gas meter replacement volume and capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Planned ($) (recommended)	1,810	3,423	7,649	9,425	8,486	30,792
Statistical ($)	260	239	227	234	239	1,198
Defective meter ($)	840	840	840	840	840	4,200
Defective regulator ($)	1,706	1,706	1,706	1,706	1,706	8,530
Total Capex ($) (recommended)	**4,615**	**6,208**	**10,421**	**12,204**	**11,270**	**44,719**
Planned Volume(#) (recommended)	**13,300**	**25,150**	**56,200**	**69,250**	**62,350**	**226,250**

The resulting capex of $44.7 million compares with JGN's 2020 Plan of $52.3 million a reduction of $7.5 million.

6.4 RESIDENTIAL HOT WATER METERS

There are approximately [redacted] hot water meters in the field. They are generally installed together with a meter data logger to record consumption of each dwelling at a central location. As a result, most hot water meters are powered by a battery to enable communication between the meter and the data logger, with the battery being a limiting factor in terms of field life of the meter.

During the current period, JGN had anticipated a large volume replacement of faulty meters, due to historic failure rates being experienced. However, this did not eventuate suggesting that there had been a batch of faulty meters which were replaced, rather than a larger problem. This resulted in a large volume of meter replacement being deferred[21].

There is also a backlog of meters requiring replacement (about 25,000) due to issues with supply of suitable meters, which JGN propose to work through over 8 years. In addition, there are also mechanical hot water meters due for replacement.

6.4.1 Volume Forecast

The volume of residential hot water replacement meters is shown in the table below.

Table 6-6: Residential hot water meter replacement volumes

	2021	2022	2023	2024	2025	Total
Planned	12,528	13,451	12,311	9,395	7,224	**54,909**

(Source: Meter replacement capex forecast model – volumes regulatory year; OA documents)

Hot water meter replacement volumes are based on field failure information, initial purchase specifications and manufacturer recommendations. JGN's approach is to replace:

- Mechanical hot water meters at 25 years, which reflects the historical field failure data.
- Hot water meters with a Cyble Head at 10 years, due to battery life, field performance and as indicated by manufacturer recommendations.
- All other hot water meters with a battery at 15 years, due to battery life.

Statistical sampling is not used for hot water meters, as the battery life is a limiting factor.

[21] Attachment 5.1 Capital Expenditure: section 3.3 pg 18: defer hot water meter replacement saving $27.3M during 2015-20 period.

6.4.2 Capex forecast

JGN forecast replacement unit cost[22]:

- Planned replacement of residential hot water meters: based on four-year average unit rates: $[redacted] / meter.
- Defective meters: the forecast is based on the four-year historical average yearly spend as shown in the table below.

Table 6-7: Defective replacement hot water meter historic capex ($2018, 000)

	2015	2016	2017	2018
Defective	3,491	1,721	949	2,072

(Source: Meter replacement capex forecast model; OA document)

With respect to defective hot water meter replacement program, JGN's four-year average of the above historical expenditure is $[redacted] per year. However, we consider [redacted] Therefore, Zincara has used [redacted] expenditure giving an average of $[redacted] per year, which results in a reduced capex forecast as shown in the following table.

Table 6-8: JGN Residential hot water meter replacement capex ($2018,000)

	2021	2022	2023	2024	2025	Total
Planned	2,605	2,797	2,560	1,954	1,502	**11,418**
Defective	2,058	2,058	2,058	2,058	2,058	**10,291**
Total	4,663	4,855	4,618	4,012	3,560	**21,709**

(Source: Meter replacement capex forecast model; OA documents)

Our recommended hot water meter replacement capex ($2018):

- Planned: $11,418,190 (no change)
- Defective: $7,903,272 ($1,580,654 per year)
- Total: $19,321,460 (reduction of $2,387,883)

6.4.3 Conclusion

Hot water meters are generally installed together with a meter data logger and as a result most are powered by a battery which is a limiting factor in terms of field life. As a result of issues with supply of a suitable meter during the last few years there is a backlog of meters (around [redacted]) requiring replacement.

The defective hot water meter replacement capex forecast is based on historic four-year average. Zincara considers that [redacted] distorts the historic average compared to the more recent years and therefore recommends

[22] Meter replacement capex forecast model: Historical data

a revised three average annual capex of $1,580,654, resulting in a revised total capex of $7,903,270 for the 2021-2025 period. This reduces the overall hot water replacement capex from $21.7M to $19.3 million, a reduction of $2.4 million, which we consider to be prudent and cost efficient.

Table 6-9: Residential hot water meter replacement capex ($2018, 000)

	JGN Plan	Recommended
Planned	11,418	11,418
Defective	10,291	$7,903
Total	21,709	$19,321
Difference = -$2,388		

6.5 METER DATA LOGGERS

Meter Data Loggers (MDLs) record consumption from each hot water meter in a high-rise building then communicate consumption back to a central server. The system was originally developed in 1997. JGN initially proposed to all MDL during the 2015-20 period due to issues such as single supplier, possible obsolescence of the technology and potential impacts of the NBN rollout. However, it was found that life could be extended by only replacing a single component which reduced cost and allowed upgrade of the communication. While the systems will require replacement at some stage, JGN has not included any costs in its 2021-25 Plan. However, JGN has a program for the planned replacement of MDL batteries, with capex developed using its project estimation method (PEM).

With respect to wireless radio frequency (RF), the program is to install RF technology in meters at apartment buildings that are not currently fitted with an MDL. This will avoid manual meter reading of each individual meter and reduce these costs.

Development of meter data logger capex:

- Planned replacement of MDL batteries: use project estimation model. Forecast proposes [redacted] replacements per year, with a unit rate of $[redacted].
- NBN rollout: use project estimation model. Forecast proposes [redacted] upgrades over two years (2021: [redacted]; 2022: [redacted]), with a unit rate of $[redacted].
- Wireless RF: use Project estimation model. Forecast proposes [redacted] installations, with a unit rate of $[redacted].
- Defective replacement: use average of historical yearly spending model. The yearly spend is shown in the table below.

Table 6-10: Defective replacement MDL historic capex ($2018)

	2015	2016	2017	2018
Defective	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter replacement capex forecast model)

With respect to the defective MDL replacement program, JGN's four-year average of the above historical expenditure is $[redacted] per year. However, we consider that [redacted] distorts the average calculation. Therefore, Zincara has used [redacted] giving an average of $[redacted] per year, which results in a reduced capex forecast as shown in the following table.

Table 6-11: Defective replacement MDL forecast capex ($2018)

	2021	2022	2023	2024	2025	Total
Defective (JGN)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Defective (Zincara)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: JGN Meter replacement capex forecast model and Zincara analysis)

JGN's meter data logger capex forecast is summarised in the following table:

Table 6-12: Meter data loggers capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Planned	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NBN rollout	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Wireless RF	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Defective	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter replacement capex forecast model)

A revised Meter Data Logger (MDL) capex ($2018) would be:

- Planned: $[redacted] (no change)
- NBN rollout: $[redacted] (no change)
- Wireless RF: $[redacted] (no change)
- Defective: $[redacted] ($[redacted] per year)
- Total: $[redacted] (reduction of $[redacted])

6.5.1 Conclusion

Meter data loggers (MDLs) program includes the continuing upgrade of MDLs in line with the NBN rollout and also to install radio frequency technology in [redacted] meters at apartment buildings that are not currently fitted with an MDL, to avoid meter reading of each individual meter. These programs are in addition to the ongoing need to replace MDL batteries and replace defective MDLs.

With respect to the defective MDL replacements, Zincara considers [redacted] distorts the trend average and proposes that an efficient annual average expenditure would be $[redacted], resulting in the Meter data logger replacement program forecast capex

reducing from $[redacted]M to $[redacted]M, a reduction of $[redacted]M. Other forecast capex is considered reasonable.
The meter data logger capex comparison of JGN forecast and Zincara's recommended forecast is shown in the following table.

Table 6-13: Meter data loggers capex ($2018, 000)

	JGN Plan	Recommended
Planned	[redacted]	[redacted]
NBN rollout	[redacted]	[redacted]
Wireless RF	[redacted]	[redacted]
Defective	[redacted]	[redacted]
Total	[redacted]	[redacted]
Difference = [redacted]		

6.6 INDUSTRIAL AND COMMERCIAL METERS

6.6.1 Volume forecast

Replacement of industrial and commercial (I&C) diaphragm meters and meter sets covers two elements:

- Replacement of meters based on statistical sampling, in a similar fashion to that applied with residential gas meters.
- Replacement of meter sets operating at <15kPa based on the results of FEED audit.

The FEED audit not only assesses meter performance, but also the customer's gas usage and meter size requirements to ensure the appropriate metering is installed.

JGN's I&C diaphragm meter replacement volume forecast approach:

- I&C meter families of 15 meters or less are replaced at 15 years.
- The testing approach for I&C diaphragm gas meters is similar to that for residential meters, with meters tested at 13 years (before they reach 15 years). If they pass the testing, they are life extended by five years. They are then subsequently tested again.
- If there are no test results, then:
    - [redacted] and [redacted] meters are assumed to pass the 15-year test and are replaced at 20 years.
    - [redacted] are assumed to be replaced at 15 years, as volumes are small and JGN do not have testing evidence which supports further life extension.

While the forecast replacement volumes are based on assumed statistical sampling results, the actual volumes are determined following the statistical sampling, which is undertaken two years prior to the life extended year. Based on review of the meter families, Zincara found that there weren't any meter families that have passed 18-year test to enable field life extension to 25 years. Only a very small number of meter families had volumes >400 and these were all [redacted] meters (four families totalling approximately [redacted] meters). The volumes proposed for the industrial and commercial diaphragm meter replacement program appear to be reasonable.

Diaphragm and rotary I&C meter sets operating >15kPa are managed through a planned six monthly maintenance schedule to ensure safe and reliable operation.

Rotary and turbine meters are not statistically tested given the relatively high volumes of gas that is measured by these meters. Typically, they are periodically removed from service and refurbished for reuse. JGN replace rotary meters at 10 years and turbine meters at 5 years, in line with manufacturer recommendations and gas industry practice.

Statistical sampling volumes are greater than the forecasted replacement volumes as the meter population replacements are assumed to have their field life extended.

Meter kit change out program forecast volumes are based on the number of planned I&C meter replacements, as customer meter requirements are reviewed at the same time as meters are replaced or refurbished.

The following table shows the volumes of meters forecast for replacement.

Table 6-14: Industrial and Commercial gas meter replacement Volumes

	2021	2022	2023	2024	2025	Total
Planned-diaphragm	90	53	691	1,622	2,228	4,684
Planned - rotary	165	211	132	239	320	1,066
Planned – turbine	11	13	18	24	19	84
Statistical sampling	903	1,120	1,193	1,088	1,005	5,308
Meter kit change	643	835	1,424	1,424	1,296	5,621

(Source: Meter replacement capex forecast model – volumes regulatory year)

6.6.2 Capex forecast

JGN's capex forecast methodology:

- Planned replacement of I&C diaphragm gas meters and regulator sets and FEED: Use Project Estimation Method. The forecast model provides unit rates for each year, although no information is provided as to how these have been derived.

- Planned rotary and turbine meter replacement: Use Project Estimation Method. The forecast model provides unit rates for each year, although no information is provided as to how these have been derived.

- Statistical sampling of I&C diaphragm meters: based on four year historical unit rate. JGN's IR026 response confirmed that there had been an error in the meter replacement capex forecast model and provided a corrected model showing the missing volumes.

- Defective I&C meters: based on four-year average historical expenditure.
- Meter capacity upgrades: based on four-year average historical expenditure.
- Meter kit change out: unit rate is based on four-year average historical expenditure, with the unit rate then applied to the forecast volumes to determine forecast capex.

The rates include the cost to replace both the gas meter and meter sets <15kPa for the diaphragm and rotary meter replacement programs. The annual historic rates can vary given the range of meter sizes replaced during particular years.

A "JGN corrected" capex for Statistical sampling of I&C diaphragm meters, using the corrected unit rate of $[redacted], results in the following capex forecast:

Table 6-15: Industrial and commercial meter capex - corrected ($2018, 000)

	2021	2022	2023	2024	2025	Total
Statistical sampling	498	618	658	600	554	**2,927**
Corrected (JGN)	400	496	528	482	445	**2,351**
Variance:	**98**	**122**	**130**	**128**	**109**	**576**

(Source: Meter replacement capex forecast model)

The corrected industrial and commercial meter capex is shown in the following table:

Table 6-16: Industrial and commercial meter capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Planned-diaphragm	207	153	1,422	3,070	4,151	**9,002**
Planned - rotary	691	865	538	945	1,237	**4,275**
Planned – turbine	98	111	160	209	169	**747**
Statistical sampling	*400*	*496*	*528*	*482*	*445*	***2,351***
Defective	383	383	383	383	383	**1,916**
Capacity upgrades	1,402	1,402	1,402	1,402	1,402	**7,009**
Meter kit change	125	162	277	277	252	**1,094**
Revised I&C Total	**3,306**	**3,572**	**4,709**	**6,767**	**8,039**	**26,393**

(Source: Meter replacement capex forecast model)

6.6.3 Conclusion

Industrial and commercial (I&C) meters forecast volume methodology which has been applied to the various I&C meter replacement categories aims to ensure in service meters remain safe, accurate and reliable, while at the same time maximising their in-service life. In addition, customer requirements in respect to meter sizing is reviewed and if appropriate replacements are resized accordingly. Zincara considers that the methodology is prudent and efficient and in accordance with accepted good gas industry practice.

With respect to capex forecasts, JGN's IR026 response corrected an error in their initial model with respect to the unit rate for statistical sampling of I&C diaphragm meters. The corrected capex forecast is $26.4 million compared with the initial submission of $27.0 million, a reduction of $0.6 million, as shown in the following table.

Table 6-17: Industrial & Commercial meter capex ($2018, 000)

	JGN Plan	Recommended
Planned-diaphragm	9,002	9,002
Planned - rotary	4,275	4,275
Planned – turbine	747	747
Statistical sampling	2,927	*2,351*
Defective	1,916	1,916
Capacity upgrades	7,009	7,009
Meter kit change	1,094	1,094
Total	26,969	26,393
Difference = -$576		

6.7 METRETEKS

Metreteks are communication devices enabling remote reading of consumption for larger customers. They communicate via a dial-up modem through copper telephone lines. There is an ongoing program to ensure ongoing capability with the NBN roll out and subsequent retirement of the old copper telephone wires. Rather than full replacement, an upgrade solution has been developed which also enables the use of solar power where a 240V power supply is not available. Due to the greater variability of scope for each demand site and the shorter period of historic data, JGN has applied the project cost estimation approach.

For defective Metreteks the forecast is based on average annual historic expenditure.

Table 6-17: Metreteks capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Defective	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NBN rollout	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter replacement capex forecast model)

With respect to ensuring ongoing capability of the Metreteks in line with the NBN rollout and routine replacement of defective units, Zincara considers that the methodology and forecast are prudent and efficient.

6.8 TESTING

In addition to the statistical sampling programs, JGN also have testing programs relating to:

- Field failure: defective meters are tested and analysed. This program has been insourced as part of JGN's meter delivery model. Capex forecast is developed using the average of three years historical expenditure (no data available to enable a four-year average).

- Warranty: testing of meters using a risk-based approach, only testing meter models that have shown higher failure rates of similar models. This program is to ensure meters are functioning correctly before the warranty period expires. The capex forecast has been developed using a weighted average of unit costs from the residential testing, I&C diaphragm testing and hot water meter replacement programs. The "corrected" capex model provided by JGN, shows revised forecast capex for this program.

- Quality assurance: testing of new meter models not yet installed in JGN's networks. They are tested at JGN's meter testing centre. A project cost estimate is used to develop the capex, as volumes are not captured in the SAP system.

Table 6-18: Testing capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Field failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Warranty test	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Quality assurance	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter replacement capex forecast model – corrected 20190924: includes revised "warranty test" capex)
(Source: Meter replacement capex forecast model)

Zincara considers that the methodology and forecast are prudent and efficient.

6.9 OTHER METERING

The Wilton hydrocarbon dew point analyser was installed post Bowral loss of gas supply from the MSP in 2010. The analyser is used to detect heavy hydrocarbons within the gas flow from the MSP. Based on manufacturer notifications the analyser will be unsupported after 10 years and as a result is forecast to be replaced in CY2021[23].

The Plumpton water dew point analyser was installed to analyse water dew point upstream of the Colongra compressor facility. Based on manufacturer notifications the analyser will be unsupported after 10 years and as a result is forecast to be replaced in CY2022.

Table 6-19: Other metering capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Dew Point analysers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter replacement capex forecast model)

Zincara acknowledges that these analysers are important in monitoring the gas specification within the networks and as such considers that their replacement, based on manufacturer notifications is prudent and efficient.

6.10 CONCLUSIONS

Meter replacement capex covers all metering types that require replacement either as part of a planned program or when found to be defective. The forecast methodology uses revealed historical costs wherever possible, with average unit rates (typically over four years of historical data) applied to the volume forecast (based on asset age profiles and performance). Where the replacement program is relatively steady then average annual historic expenditure is used. Finally, where these approaches are not possible a bottom up project estimation methodology has been used. Zincara has reviewed the application of these forecasting methodologies for each of the metering programs and consider that they are generally efficient and representative of good gas industry practice.

For residential gas meters and also industrial and commercial (I&C) diaphragm meters, the volume forecast has been developed on the basis of statistical sample testing in accordance with Australian Standards[24], which is effectively a condition-based methodology. In developing the replacement forecast, JGN has applied the outcomes of this testing to determine when a family is to be replaced. Where the testing has not yet occurred then they have made assumptions as to the likely field life based on historic performance. For most residential gas meter families this is assumed as 25 years and for I&C diaphragm meters it is 20 years.

With respect to **residential gas meters**, Zincara agrees with the proposed planned replacement of meters identified at 15 years (failed tests and small miscellaneous families) and also those reaching 30 years of age.

However, we do not agree with JGN's methodology of the planned replacement of meters when they reach [redacted] years of age. Zincara has analysed the available information for each meter type for the relatively large volume of meters approaching [redacted] years of age and based on our analysis, have recommended a program that provides field life extension of some meter families to [redacted] years. This results in a reduced planned replacement program of

[23] Opportunity Brief – Planned replacement of Dew Point Analysers
[24] AS/NZS 4944:2006 Gas Meters – in-service compliance testing

226,250 meters, compared with JGN's program of 281,718 meters, a reduction of 55,468 meters.

The residential gas meter unit rates appear reasonable and the overall residential gas meter replacement program capex forecast is $44.7 million, compared with JGN's program of $52.3 million, a reduction of $7.5 million. We recommend that JGN provide updated information relating to testing of meter families, including results of testing undertaken during CY2019.

Hot water meters are generally installed together with a meter data logger and as a result most are powered by a battery which is a limiting factor in terms of field life. As a result of issues with supply of a suitable meter during the last few years there is a backlog of meters (around [redacted]) requiring replacement. The defective hot water meter replacement forecast is based on historic four-year average. Zincara considers that [redacted] and therefore proposes a revised average which results in a reduced annual capex of $1.6 million and a total of $7.9 million for the 2021-2025 period. This reduces the overall hot water replacement capex from $21.7M to $19.3M a reduction of $2.4M, which Zincara considers to be prudent and cost efficient.

Meter data loggers (MDLs) program includes the continuing upgrade of MDLs in line with the NBN rollout and also to install radio frequency technology in [redacted] meters at apartment buildings that are not currently fitted with an MDL, to avoid meter reading of each individual meter. These programs are in addition to the ongoing need to replace MDL batteries and replace defective MDLs. With respect to the defective MDL replacements, Zincara considers that the 2015 expenditure distorts the trend average and recommends that an efficient annual average expenditure would be $[redacted], resulting in the Meter data logger replacement program forecast capex reducing from $[redacted]M to $[redacted]M, a reduction of $[redacted]M. Other forecast capex appears reasonable and prudent.

Industrial and commercial (I&C) meters forecast volume methodology which has been applied to the various I&C meter replacement categories aims to ensure in service meters remain safe, accurate and reliable, while at the same time maximising their in-service life. In addition, customer requirements in respect to meter sizing is reviewed and if appropriate replacements are resized accordingly. Zincara considers that the methodology is prudent and efficient and in accordance with accepted good gas industry practice. With respect to capex forecasts, JGN's response to the AER's request for information (IR026) corrected an error in their initial model with respect to the unit rate for statistical sampling of I&C diaphragm meters. The corrected capex forecast is $26.4 million compared with the initial submission of $27.0 million, a reduction of $0.6 million

With respect to ensuring ongoing capability of the **Metreteks** in line with the NBN rollout and routine replacement of defective units, Zincara considers that the methodology and forecast are prudent and efficient.

Testing, in addition to the statistical sampling programs, there are also testing programs relating to field failure (defective meters are tested and analysed), warranty (testing of relatively new meter models using a risk-based approach) and quality assurance testing of meter models not yet installed in the networks. Note that in the "meter replacement capex forecast model – corrected 20190924" the capex forecast for planned replacement & warranty testing of gas and water meters at 5 years has revised annual capex. Zincara considers that the programs and methodology used in developing the forecast capex are prudent.

With respect to **Other** metering, Zincara acknowledges that these analysers are important in monitoring the gas specification within the networks and as such considers that their replacement, based on manufacturer notifications is prudent and efficient.

The following table summarises JGN's meter replacement forecast capex, Zincara's suggested revised capex and the resulting variance.

Table 6-20: Meter replacement forecast capex ($2018, 000)

	JGN Plan	Zincara revision	Variance
Residential gas meters	52,268	44,719	**-7,549**
Hot water meters	21,709	19,321	**-2,388**
Meter data loggers	6,528	6,213	**-315**
I&C meters	26,969	26,393	**-576**
Metreteks	1,614	1,614	**-**
Testing	1,532	1,435	**-98***
Other	139	139	**-**
Total	**110,760**	**99,834**	**-10,926**

(Source: (i) Meter replacement capex forecast model and
(ii) Meter replacement capex forecast model – corrected 20190924)
(iii) Options Analysis documents

*Note: "The Meter replacement capex forecast model – corrected 20190924" shows JGN's revised capex for planned replacement & warranty testing of gas and water meters at 5 years.

7. FACILITIES AND PIPES

7.1 INTRODUCTION

This category relates to the capex for high pressure pipelines and facilities. JGN advised that the capex is primarily focused on maintaining the safety of the aging assets. A comparison of the spend over the 2015-2020 AA period (current period) and the 2021-2025 AA period (forecast period) is shown in the table below.

Note: The capex in this section of the report does not include any overheads.

Table 7-1: Facilities and pipe replacement capex ($2020, million)

Project Categories	2015-20		2021-25
	Allowance	Actual/Estimate	Forecast
Facilities country upgrade	14.2	0.0	-
Facilities safety upgrades	28.4	20.4	17.5
Facilities capacity upgrades	2.7	9.1	0.5
Sydney Primary Mains risk reduction	14.2	10.5	28.2
Pigging, validation & integrity digs	26.7	11.7	-
Shallow secondary mains	-	1.2	16.1
Secondary district regulator replacement	12.5	5.1	3.0
Other minor works	8.8	5.9	6.6
Total	**107.1**	**63.8**	**72.2**

Source: JGN attachment 5.1 Capital Expenditure – 20190630 Table 3-12

It is noted that in the current period, there has been an underspend of approximately 43.3m which is equivalent to 40% of the AER approved capex. The main reasons for the underspend are:

- APA not proceeding with its upgrade of the Moomba to Sydney transmission pipeline. Hence the capex of $14.2m for the proposed upgrade of the country facilities was not required.
- Reprioritisation of the projects for the facilities safety upgrade resulting in deferment of a number of projects to free up capex for the surge in new connections.
- The alteration of the Sydney Primary Main section between Horsley Park and Lidcombe to allow for intelligent pigging cost less than estimated.
- Inspection of the secondary district regulators resulted in a reduction in the number of regulators needing replacement.

Our analysis of the capex for the forecast period is detailed below. It should be noted that whilst the above table is in $ 2020, our analysis was carried out in $2018. This is due to the information provided in support of the forecast capex being in $2018. In addition, the analysis was only carried out on the direct costs only.

There are approximately 80 projects in this section. Zincara has had difficulty allocating the projects to the categories shown in Table 7-1 due to the inconsistent naming of projects in the information provided. As such, Zincara has assigned the projects to the various categories in accordance with its understanding of the scope of the project. The capex which Zincara has carried out its analysis is shown in the table below.

Table 7-2: Facilities and Pipes Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Facilities Safety Upgrade	3,084	4,728	4,071	2,249	2,007	**16,139**
Facilities Capacity Upgrade	29	-	-	-	-	**29**
Sydney Primary Mains Risk Reduction	10,301	4,412	980	3,092	8,164	**26,949**
Shallow Secondary Mains	6,307	8,875	-	-	-	**15,182**
Secondary District Regulator Replacement	2,399	527	502	120	120	**3,668**
Other Minor Works	1,592	1,452	1,030	1,030	1,030	**6,133**
Total	**23,713**	**19,994**	**6,583**	**6,491**	**11,321**	**68,101**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Zincara's analysis of project category is detailed in the section below.

7.2 FACILITIES SAFETY UPGRADE

The capex for this category is for the replacement or upgrade of facilities such as Transmission Receiving Station (TRS), Pressure Regulating Station (PRS) and other associated facilities. There are over 40 projects in this section. As such, for ease of analysis, Zincara has grouped some of the like projects together to form a subgrouping. The table below shows the capex for this category.

Table 7-3: Facilities Safety Upgrade Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Minor Capital TRS	200	200	200	200	200	**1,000**
Minor Capital SRS	400	400	400	400	400	**2,000**
Refurbishment of AS 2885 pipework	739	1,397	66	0	0	**2,203**
Appin POTS Upgrade Stage2	455	0	0	0	0	**455**
Facilities Security Upgrade	0	101	1,632	14	0	**1,746**
Facilities Risk Based Safety Upgrade	647	2,147	1,548	1,636	1,407	**7,384**
Refurbishment of Stringybark Creek MLV Pit	269	33	0	0	0	**302**
Installation of	375	450	225	0	0	**1,050**

Secondary Isolation Valve						
Total	**3,084**	**4,728**	**4,071**	**2,249**	**2,007**	**16,139**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Zincara's analysis of each of the categories are detailed below.

7.2.1 Minor Capital TRS

In the case of the TRS, JGN said[25] that the expenditure is for minor Trunk Receiving Station (TRS) projects that are typically less than $100k. The forecast capex shown in Table 7-3 of $200 ($2018, 000) is an average of the actual three year capex from 2016 to 2018.

In its Minor Capital Budgeting and Approval Document[26], the allocation is for aged component replacement due to end of life of individual components rather than the entire TRS and POTS (Packaged Off-take Stations). The replacement is generally initiated by field investigations, generally undertaken to correct an issue or risk, concerning operability or safety. Details of the annual expenditure is shown in the table below.

Table 7-4: Minor Capex TRS

Reset RIN (workings) Direct Costs			Real 2020(end of yr)		
Nominals (mid yr)					
Actuals	Actuals	Actuals	Actuals	Actuals	Actuals
2016	2017	2018	2016	2017	2018
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: JGN-IR036-Capex-Cositng breakdowns for specific projects-20190916

It is noted that in Capex Model spreadsheet[27], its 2019 forecast is $122 ($2018, 000) which shows a declining trend of capex. In addition, the total of JGN's annual allocation for five years is $1 million which would make it a material amount. Zincara considers that further details of the capex are necessary to show why the allocation of the capex is reasonable before it can recommend acceptance of the expenditure.

7.2.2 Minor Capital SRS

JGN said[25] that this capex is an allocation for unplanned expenditure on secondary regulating station (SRS/SDRS). The historical cost incurred per site is in the range of $200k-$400k.

Its' expenditure which is forecast at $400k ($2018) is to provide funds to replace one or two SDRS per future year as these assets age and require replacement. It said that whilst it has typically used a three-year average cost to forecast annual allocation, in this case due to the lumpy nature of the cost, it has based its estimate on one or two SDRS. Details of the expenditure is shown in the table below.

[25] JGN-IR036-Capex-Cositng breakdowns for specific projects-20190916
[26] JGN-2-3.15-3-Minor Capital Budgeting and Project Approval-20190630
[27] JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Table 7-5: Minor Capital SRS

Reset RIN (workings) Direct Costs Nominals (mid yr)			Real 2020(end of yr)		
Actuals	Actuals	Actuals	Actuals	Actuals	Actuals
2016	2017	2018	2016	2017	2018
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: JGN-IR036-Capex-Cositng breakdowns for specific projects-20190916

Given the cost of such replacement, it is unclear why the replacement of SDRS is not part of a managed program to replace aged SDRS. The total of the annual allocation is $2million which is a material amount. Zincara does not consider that the information provided justify recommending the expenditure.

7.2.3 Refurbishment of AS2885 Pipework

The Pipeline Regulation 2003 requires JGN to comply with AS 2885.3 for its operation and maintenance. The Pressure Regulating Stations (PRS) which reduce the pressure from the Primary Main (3500kpa) to Secondary Main (1050kpa) are required to meet the requirements of AS 2885.3. As such the PRS have to be inspected and rectified to ensure the integrity of the pipework and the associated pits.

For the next AA period, JGN propose to upgrade the PRS in Flemington, Mascot and Tempe. These PRS have been in operation since 1976 and are in various conditions due to their age.

For each PRS, JGN has proposed 4 options before deciding on the most cost-effective option. The recommended option is slightly different between the different PRS but the cost is not material.

Details of the capex are provided in the Project Estimation Models which Zincara has examined and considered efficient.

Given the age of the PRS and the requirements of AS2885, Zincara considers it prudent to refurbish the PRS. As such, Zincara recommends acceptance of the project.

Details of the 22 projects in this category are provided in Appendix D.

7.2.4 Appin POTS Upgrade Stage 2

In the initial information provided, there was no information on the Appin POTS upgrade stage 2 project. However, in the Document Index, the project description states that the project is needed to increase reliability of supply to the downstream network as the capacity of one run will be exceeded by 2021. In its response to the AER information request, JGN said[28] that since its AA submission in June 2019, it had decided to defer the project until 2024-2025. This is due to the slower than forecasted growth in the area as reflected in the

[28] JGN-IR036-Capex-Cositng breakdowns for specific projects-20190916

recent network pressure winter monitoring. It will update its capex forecast in its revised submission. There are no other information provided.

In its initial submission, the total cost of the project was shown as $806k (Real $000 2018) spread between FY2020 and FY2021. There are no details on how the costs has been derived.

Given the lack of information on the project and the deferral of the timing, Zincara does not propose to recommend acceptance of the project.

7.2.5 Facility Security Upgrade

JGN advised that a site security assessment conducted in 2016 concluded that the current security measures were inadequate and recommended upgrade of the security of the site. There has no incidence of tempering but there has been threats from disgruntle ex-employee. The TRS sites that have been identified are Hexham, Plumpton and Wyong.

JGN considered two options but concluded that given the criticality of the TRS decided on a more extensive option. The work involves the following:

- Replace entire TRS perimeter fence;
- Install palisade fencing around the pipework and regulator skid;
- Install spotlights and CCTV;
- Install intrusion detection sensor beam system;
- Install security pass swipe access;
- Install lighting at the SCADA building; and
- Install warning signage on the asset.

Zincara notes that the sites have been identified as a result of the 2016 security assessment and as such, concurs that it is prudent to upgrade the security of the sites.

Details of the capex are provided in the Project Estimation Models which Zincara has examined and considered efficient.

Zincara therefore considers the projects to be prudent and efficient and recommends acceptance of the projects.

Details of the projects in this category are provided in Appendix D.

7.2.6 Facilities Risk Based Upgrade

The capex for this category is for refurbishment of high-pressure facilities due to their non-compliance[29] with the Electricity (Consumer Safety) Act 2004 and the Electricity (Consumer Safety) Regulation 2006. JGN advised that the compliance of electrical equipment in hazardous areas are covered by AS/NZS 60079 and for electrical earthing by AS/NZS 3000. In 2018, JGN identified 24 sites for the upgrade due to the following:

- overall number of site defects;
- high risk sites; and
- the viability of long-term risk controls.

Two of the sites will be upgraded in the current AA period with the remainder 22 high pressure facilities to be upgraded in the forecast AA period. The total direct cost of the site upgrades is $7.4 million ($2018) with the cost for each site upgrade ranging from $320 ($000 2018) to $550 ($000 2018).

Zincara has reviewed a number of the Project Estimation Models for the site upgrades and considers them to be efficient.

Given the need to ensure compliance with the Electricity Act and Regulation, Zincara considers the projects to be prudent. Zincara therefore recommends acceptance of the upgrade of the 22 sites.

7.2.7 Refurbishment of Stringybark Creek MLV Pit

JGN is concerned[30] about the structural integrity of the existing Main Line Valve (MLV) due to its corrosion and age. JGN propose to carry out Non-Destructive Examination (NDE) of the MLV and undertake any repair as necessary.

JGN had based the cost of the work on previous work at Horsley Park pit. Zincara therefore considers the cost to be efficient.

Zincara notes JGN's concern on the condition of the MLV and considers it prudent to carry out an investigation and repair as necessary. Zincara therefore recommends acceptance of the project.

7.2.8 Installation of Secondary Isolation Valves

JGN said[31] that need for isolation or throttling of secondary mains for emergency response has been highlighted following the Martin Place incident. This project is to install new

[29] JGN-2-3.15-1-Facilities Risk Based Safety EI Upgrades
[30] JGN-2-3.15-1-10043034-Refurbishment of Stringybark Creek MLV Pit-PM-20190308
[31] JGN-2.3.15-2-R-RAKS-Installation of Secondary Isolation Valves-PM-20190322

secondary valves in the Sydney CBD to enable isolation during an emergency response. JGN has estimated the direct cost of project at $[redacted] million ($2018). There are no further details of how JGN has derived this cost.

Given the material cost of this project, Zincara considers that there needs to further work done to justify the project and its cost. The lack of detail analysis of the need and risk mitigation of the project means that Zincara does not consider the project prudent or efficient. Zincara is therefore unable to recommend the project.

7.2.9 Recommended Capex for Facilities Safety Upgrade

From the analysis above, Zincara's recommended capex for this category is shown in the table below.

Table 7-6: Recommended Facilities Safety Upgrade Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Minor Capital TRS	0	0	0	0	0	**0**
Minor Capital SRS	0	0	0	0	0	**0**
Refurbishment of AS 2885 pipework	739	1,397	66	0	0	**2,203**
Appin POTS Upgrade Stage2	0	0	0	0	0	**0**
Facilities Security Upgrade	0	101	1,632	14	0	**1,746**
Facilities Risk Based Safety Upgrade	647	2,147	1,548	1,636	1,407	**7,384**
Refurbishment of Stringybark Creek MLV Pit	269	33	0	0	0	**302**
Installation of Secondary Isolation Valve	0	0	0	0	0	**0**
Total	**1,655**	**3,678**	**3,246**	**1,650**	**1,407**	**11,636**

7.3 FACILITY CAPACITY UPGRADE

JGN is not proposing any work in this area for the forecast period and the cost shown in Table 7-2 is a carryover from a project in the current AA period, Zincara therefore recommends acceptance of the cost.

7.4 SYDNEY PRIMARY MAINS RISK REDUCTION

The capex for this section is allocated to rectification work on the Sydney Primary Mains (SPM). The list of projects and their capex for the next AA period is shown in the table below.

Table 7-7: Sydney Primary Mains Risk Reduction Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Canada Bay Primary Main Relocation	2,005	40	0	0	0	**2,045**
SPM Risk Mitigation Project Category 1	2,480	1,010	0	0	0	**3,490**
SPM Risk Mitigation Project Category 2	9	0	0	0	0	**9**
SPM Risk Mitigation Project Category 3	9	0	0	0	0	**9**
SPM corrosion failure due to CP shielding (bend verification)	3,875	0	0	0	0	**3,875**
Overall Coating Rehabilitation Program of Exposed Mains on SPM	207	179	536	10	0	**932**
SPM corrosion failure due to CP shielding (Lidcombe – Mortlake)	1,716	3,183	0	0	0	**4,899**
SPM corrosion failure due to CP shielding (Mortlake – Stringybark)	0	0	444	2,668	5,695	**8,807**
SPM corrosion failure due to CP shielding (Mortlake - Botany Bus Depot)	**0**	**0**	**0**	**415**	**2,469**	**2,883**
Total	**10,301**	**4,412**	**980**	**3,092**	**8,164**	**26,949**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Zincara's analysis of the projects are detailed in the sections below.

7.4.1 Canada Bay Primary Relocation

JGN advised[32] that the Sydney Primary Mains (SPM) is located within the Victoria Road School grounds in Concord West and within 5m of the school buildings. The school was opened in early 2005 and JGN had made the decision to relocate the SPM in 2018 due to the safety threat from corrosion or third-party damage. However, there has been a delay due to approvals for easements from the City of Canada Bay Council and the Sydney Olympic Park Authority. The project which was due for completion in 2019 is now scheduled for completion in 2021.

JGN had considered 5 options before deciding on the relocation option from a safety perspective. It also allows this section of the SPM to be pigged in the future which is a requirement of AS 2885.3.

[32] JGN-2-3.15-1-10014644-Canada Bay Primary Mains Relocation-FA-20170329

In its PEM, among other assumptions, JGN had assumed a cost of construction of $2,800 per metre for the cost of constructing the gas main. This cost is not unreasonable and as such, Zincara considers the cost to be efficient.

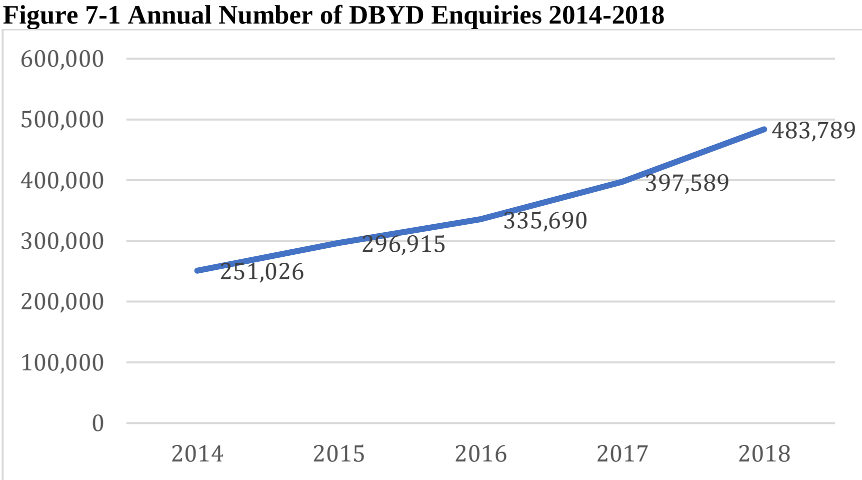
Zincara notes the safety concerns on the SPM in the school grounds and as such, considers it prudent to have the mains relocated. This would also facilitate future pigging of this section of the SPM. Zincara therefore recommends acceptance of the project.

It is also noted that the total direct cost of the project is $3.092million ($2018). As the project runs over the current and the next AA period, the cost shown on Table 7-7 of $2.045million($2018) is for the next AA period only.

7.4.2 Sydney Primary Main Risk Mitigation

JGN said[33] that this project is to mitigate against third-party damage on the Sydney Primary Main (SPM). The SPM was constructed between 1968 and 1976. It is approximately 73km long and supplies gas to over 500,000 domestic and industrial customers. JGN said that the extensive urbanisation of Sydney has reduced the effectiveness of existing controls against third party damage. JGN provided a chart showing the increased number of Dial Before You Dig (DBYD) enquiries to demonstrate the level of construction activities in the area.

Figure 7-1 Annual Number of DBYD Enquiries 2014-2018



Source: JGN-2-3.15-1-SPM Risk Mitigation Project Category 1,2,3 Figure 1

JGN acknowledged that there has not been any recorded asset damage on the SPM but a recent incident in July 2018 in Martin Place where an excavator damaged a Jemena secondary main (<1050kpa pipe) did indicate that such accidents could happen. The incident resulted in the evacuation of the entire Martin Place and rail services around the area were suspended for a number of hours. Jemena's investigation revealed that the gas main was located at a depth of only 300mm.

In addition, due to its maximum operating pressure of 3,500kpa, the SPM has to operate and be maintained in accordance with AS2885-Gas and Liquid Petroleum. Under AS2885.1-2012 the requirement of a pipeline in high consequence areas is:

[33] JGN-2-3.15-1-SPM Risk Mitigation Project Category1,2,3

"No Rupture" pipe requirements stated in Clause 4.7.2 – ensures that pipeline failures result in leaks rather than full bore ruptures, for a given location, assuming ignition of gas, rupture will have far higher consequence when compared to a leak.

To address this concern, JGN commenced a "depth of cover" risk mitigation project and identified a number of affected areas. The affected areas have then been divided into three categories. The table below details the three categories, their physical controls and current risk levels.

Table 7-8 Summary of physical control effectiveness along the SPM

Site Category	Existing Controls Effective Rating	Existing Depth of Cover	Existing Mechanical Protection	Affected SPM Length% of SPM	Third Party Threats causing highest risk Levels	Untreated Risk Level	
						JGN	AS2885
1	Poor	≤ 350mm	√	130m/ 0.2%	Sawcut Auger	High	High
2	Inadeq	≥350mm ≤1200mm	×	4,500m/ 6%	15-20T Excavator Auger	High	High
3	Fair	>350mm	√	65,000m/ 89%	Auger HDD	Sig	Inter

Note: Inter: intermediate, sig: significant; Inadeq: Inadequate
Source: JGN-2-3.15-1-SPM Risk Mitigation Project Category 1,2,3 Table 4

JGN developed a number of options for each of the categories before deciding on the option that addresses the risk

Details of JGN's analysis in regard to the SPM's compliance with AS2885 is covered in Appendix D of JGN-2-3.15-1-SPM Risk Mitigation Project Category 1,2,3 document. Following its analysis, JGN has developed a number of options for the three categories which are summarised in the table below.

Table 7-9: Options Summary

	Category 1			Category 2			Category 3		
	Option Cost $000 2019-2025	**Risk Treatment**		**Option Cost $000 2019-2025**	**Risk Treatment**		**Option Cost $000 2019-2025**	**Risk Treatment**	
		JGM	**2885**		**JGM**	**2885**		**JGM**	**2885**
1	Maintain status quo. Capex Nil Opex Nil	High	High	Maintain Status quo. Capex Nil Opex Nil	High	High	Maintain status quo. Capex Nil Opex Nil	Sig	Inter
2	Add warning signage and increase patrolling frequency. Capex $197 Opex $784	Sig	Inter	Additional procedural control. Capex $335 Opex $784	Sig	Inter	Install signage every 50m. Capex $1,593 Opex Nil	Mod	Low
3	Add warning signage and	Sig	Inter	Replace/ Relocate	Low	Neg	Install extra signage in	Mod	Low

	perform remote pipeline monitoring. Capex $1,059 Opex $56			Capex $18,625 Opex Nil			high activity areas. Capex $887 Opex Nil		
4	Pipe replacement/ relocate gas main. Capex $3,448 Opex Nil	Low	Neg	Mechanical protection. Capex $5,351 Opex Nil	Mod	Low	Install extra signage in high activity areas and increase patrolling. Capex $887 Opex $784	Neg	Low
5				Reduced pressure & mechanical protection. Capex $1,595 Opex Nil	Mod	Low	Replace/ Relocate pipe. Capex $89,691 Opex Nil	Low	Neg

Note: Inter: intermediate, mod: moderate, neg: negligible, sig: significant
Source: JGN-2-3.15-1-SPM Risk Mitigation Project Category 1,2,3 Table 1,2 and 3 combined

The preferred options are shown in bold.

It is noted that the cost shown in Table 7-7 is different to that shown in Table 7-9. Zincara has accepted the cost in Table 7-7 as it is consistent with the PEM provided. Table 7-7 also shows the project costs for Category 2 and Category 3 as $9 ($000 2108) each in 2021. This is due to these projects been carried out in the current AA period.

Category 2- Lane Cove to Willoughby Section of the SPM

Category 2 is essentially the Lane Cove to Willoughby section of the SPM. Approximately 600m of the pipe has less than 750mm cover[34] which would mean that it would not meet the requirement of both AS2885 and AS4645 for high consequence area (HCA). The only option would be de-rate the pipeline to 1,050kpa which would remove the onerous requirements of integrity management required of AS2885. However, the pipeline still needs to meet the requirements of AS4645 for HCA. As such, mechanical protection is required over the 600m to prevent third party damage.

The de-rating of the Lane Cove to Willoughby Section will result in a supply constraint for the North Sydney Network. As such, augmentation of the North Sydney Network is also required as part of the project. To be consistent with JGN submission which describes this augmentation in its Augmentation section, Zincara's analysis of this augmentation is also covered in Zincara's augmentation Section 8.

JGN had provided an ALARP study carried out by GPA[35] on this project. In all cases, the costs of the projects are within the maximum justifiable spend.

[34] JGN-2-3.15-1-Life Cycle Management SPM (Lane Cove to Willooughby)-OA-20190624
[35] 03. SPM Risk Mitigation-Depth of Cover-Risk Cost Report &04. SPM Integrity Management (Lane Cove to Willoughby)-Risk Cover Report

Given the requirement to comply with AS2885.3 and the Martin Place incident, Zincara considers the projects to be prudent and efficient and therefore recommends acceptance of the projects.

7.4.3 SPM corrosion failure due to CP shielding

JGN advised[36] that recent checks on the SPM have identified that a number of heat shrink sleeves have disbonded resulting in active corrosion which has led to the thinning of the pipeline wall. The thinning of the pipeline wall is a potential for metal failure resulting in a high-pressure gas escape.

The Gas Supply Act 1996 and its related Regulation and AS2885.3 require JGN to assess the integrity of the SPM to ensure the pipeline operates safely. JGN as such has considered 5 options from do nothing, reconfiguring the pipeline to enable In-Line Inspection (ILI) to replacing the entire pipeline.

JGN also indicated that currently ILI is the only effective way to measure metal loss in the pipeline. As such it is proposing to reconfigure the pipeline to enable ILi to be carried out.

This option includes all necessary pre-work for performing the ILI, which involves digging up and validating that existing bends / tees would allow passage of modern ILI pigs, modifying existing pipework, installing ILI launcher/receiver infrastructure, detailed selection of an inspection tool, and finally undertaking the ILI inspection.

Capex for the various activities are shown in the table below.

Table 7-10: Capex for Installing Pigging Facilities on the SPM ($2018, 000)

Activities	Direct Cost
Determining SPM Piggability checking on existing bends to ensure ILI	3,875
Install pigging facilities - Lidcombe to Mortlake	4,899
Install pigging facilities - Lidcombe to Stringbark	8,807
Install pigging facilities – Mortlake to Botany Bus Depot	8,024*
Total	24,885

*Note: In Table 7-7, the capex for Mortlake to Botany Bus Depot is shown as $2,883k for the next AA period instead of $8,024k as the project spans the next and the following AA period.
Source: JGN-2-3.15-1-SPM Corrosion failure due to CP shielding.

JGN provided a number of cost estimates (PEM) for these projects. The cost estimate for the project is based on receiving quotations form the approved Jemena pigging vendor and actual costs of similar project.

GPA also carried out an ALARP study on the project and concluded that the maximum likely spend for the project is between $39million to $54million.

Zincara is aware of the safety requirements of AS2885.3 to ensure the safety of the pipeline. Given the threat of the corrosion and disbanding in the pipeline, Zincara concurs that the work needs to be done to determine the extent of corrosion and repair as necessary. In

[36] JGN-2-3.15-1 SPM Corrosion failure due to CP shielding

addition, the cost of the project is within the maximum likely spend calculated by GPA. Zincara therefore considers the project to be prudent and efficient and recommends acceptance of the project.

7.4.4 Overall Coating Rehabilitation Program of Exposed Mains on SPM

In conjunction with the above project described in section 7.4.3, JGN has also identified[37] seven sites that requires recoating due to corrosion as a result of water or moisture ingress. These sites are:

- Timbrell Drive corner of Dobroyd Parade, Haberfield;
- Lyons Road West, Canada Bay – near Marceau Drive, DN550 under footpath bridge;
- Richardson Cres, Marrickville, near Tempe Railway Station;
- Alexandria Canal, Tempe Recreation Reserve, near Airport;
- Mill Pond Rd, Botany, DN550 inside a security fence close to canal under the road bridge;
- Pipeline Section (M-B) Inside Caltex Tunnel under Foreshore Rd, Botany DN150 pipeline; and
- Salt St, Concord – South of Massey Park, DN 550 pipeline exposed across saltwater creek.

JGN proposes to recoat the pipeline through painting and sandblasting.

JGN had provided the cost of the project in the project's PEM[38]. The subcontractor's cost which is the main cost of the project has derived from historical cost for Mill Pond Road, Mascot.

It is noted that the total direct cost of the project is $1,128 ($000 2018). However as the project spans the current and next AA period, the cost for the next AA period is $932 ($000 2018).

Consistent with its recommendation for the project in section 7.4.3, Zincara also recommends acceptance of this project.

7.4.5 Recommended Capex for Sydney Primary Mains Risk Reduction

From the analysis above, Zincara's recommended capex for this category is shown in the table below.

Table 7-11: Recommended SPM Risk Reduction Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Canada Bay Primary Main Relocation	2,005	40	0	0	0	**2,045**
SPM Risk Mitigation	2,480	1,010	0	0	0	**3,490**

[37] JGN 2-3-15-1 -Overall coating rehabilitation program of exposed mains on SPM (File JGN-~8)
[38] JGN-10035435- Overall coating rehabilitation program of exposed mains on SPM

Project Category 1						
SPM Risk Mitigation Project Category 2	9	0	0	0	0	**9**
SPM Risk Mitigation Project Category 3	9	0	0	0	0	**9**
SPM corrosion failure due to CP shielding (bend verification)	3,875	0	0	0	0	**3,875**
Overall Coating Rehabilitation Program of Exposed Mains on SPM	207	179	536	10	0	**932**
SPM corrosion failure due to CP shielding (Lidcombe – Mortlake)	1,716	3,183	0	0	0	**4,899**
SPM corrosion failure due to CP shielding (Mortlake – Stringybark)	0	0	444	2,668	5,695	**8,807**
SPM corrosion failure due to CP shielding (Mortlake - Botany Bus Depot)	0	0	0	415	2,469	**2,883**
Total	**10,301**	**4,412**	**980**	**3,092**	**8,164**	**26,949**

7.5 SYDNEY SECONDARY MAINS SHALLOW MAINS

The capex for this project is related to rectification of the shallow mains in the Sydney Secondary Mains Network. The shallow mains targeted are located in High Density Community Use (HDCU) areas. The capital expenditure is shown in the table below.

Table 7-12: JGN's Sydney Secondary Mains Shallow Mains Capex ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	**Total**
Shallow Secondary Mains	6,307	8,875	-	-	-	**15,182**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

The Sydney Secondary Mains Network supplies[39] directly and indirectly more than 90,000 customers. The maximum allowable pressure (MAOP) for the Sydney Secondary Mains is 1,050kPa. It was constructed in the 1960s and sections of the network pass through HDCU areas.

JGN advised that a Formal Safety Assessment (FSA) was carried out in 2014 and recommended that a number of procedural controls be introduced to manage shallow mains. JGN has since initiated these procedural controls.

In July 2018, an incident occurred at the corner of Castlereagh St and Martin Place, Sydney CBD. A third party rock breaker punctured a secondary gas main causing a large gas escape. The gas main at that location was 300mm below surface level with no mechanical protection. JGN said that this incident highlighted a shortcoming in the effectiveness of its control measures for shallow mains.

[39] JGN-2-3.15-2-10043030-Shallow Secondary Mains Investigation and Rectification

With a MAOP of 1,050kPa, the safety and design of the pipeline is covered by AS/NZS4645. JGN advised that its current legal requirements for the management of gas networks is covered in the NSW Gas Supply Act 1996 and its related Regulation. The suite of technical standards in the Regulation refers to AS/NZS4645 for the relevant technical requirements. AS/NZS4645.2 provides guidance on the depth of cover requirements for HDCU areas and other (general urban) areas. The Standard requires that for gas mains operating at pressures greater than 210kPa should have a depth of cover of 750mm for sandy conditions and a range of 450mm-600mm for rock (depending on operating pressure and size of mains).

As such, JGN commenced an investigation and considered the following alternatives:

1. Maintain status quo
2. Increase operation and maintenance
3. Survey and remediate entire secondary network
4. Survey and remediate secondary mains in HDCU areas (Recommended Option)
5. Rerating the secondary mains in HDCU areas to 210kPa

JGN decided on Option 4 for the following reasons:

(i) Reduces the risk as per the Jemena Risk Manual from Significant to Moderate;
(ii) Aligns with customer expectations–“no compromise on safety”; and
(iii) Conforms to the requirements of the rule 79 of the NGR-79.2, as the proposed capital expenditure is justifiable “to maintain and improve the safety of services”.

The project costs for Option 4 consist of two stages:

Stage 1: Investigation for identifying locations of shallow mains:		$1.10 million
Stage 2: Rectification of shallow mains:		$15.25 million
	Total cost:	$16.35 million

Stage 1 is to be carried out in the current AA period and Stage 2 in the next AA period. Zincara notes that there is a slight difference in the Option 4 cost and that shown in Table 7-12. Zincara does not consider the cost difference to be material and for the purpose of the report has used the cost in Table 7-12 for its analysis.

GPA carried out an ALARP study[40] on the project and concluded that the maximum justifiable spend is in the order of $7million to $20million.

The material cost in the PEM[41] is the subcontractor’s cost and that is dependent on the number of sites for pipe protection, number of sites for pipe relocation and the extent of restoration. Given the project is at its preliminary stage, Zincara considers that JGN has estimated the project cost with the best information available. Zincara therefore considers the cost to be reasonable.

Zincara recognises that the Martin Place incident would have changed the risk profile of the secondary mains and there is a need to find a solution to protect the shallow mains in the

[40] 06.Shallow Secondary Mains -Risk Assessment Report
[41] JGN-10043030-Shallow Secondary Mains Investigation and Rectification-PEM

Secondary Mains network for safety reasons. In addition, the ALARP work carried out by GPA has shown that the cost is within the maximum justifiable spend. Zincara therefore considers the JGN's solution is the most cost-effective solution and recommends acceptance of the project.

7.5.1 Recommended Capex for Shallow Mains

From the analysis above, Zincara's recommended capex for this category is shown in the table below.

Table 7-13: Recommended Capex - Sydney Secondary Mains Shallow Mains ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	**Total**
Shallow Secondary Mains	6,307	8,875	-	-	-	**15,182**

7.6 SECONDARY DISTRICT REGULATOR REPLACEMENT

The capex for this section is related to the upgrade of the pressure regulating stations. Details of the capex are shown in the table below.

Table 7-14: JGN's Secondary District Regulator Replacement Capex ($2018, 000)

Project Categories	**2021**	**2022**	**2023**	**2024**	**2025**	Total
Minor Capital: PRS	120	120	120	120	120	**600**
Auburn PRS Upgrade	660	0	0	0	0	**660**
Goodman Fielder PRS Upgrade	0	0	0	0	0	**0**
Tempe PRS Upgrade	0	0	0	0	0	**0**
Mascot PRS Upgrade	0	0	0	0	0	**0**
Flemington PRS Upgrade	0	0	0	0	0	**0**
Haberfield PRS Upgrade	15	0	0	0	0	**15**
Banksmeadow PRS Upgrade	1,568	0	0	0	0	**1,568**
DRS relocation - Dapto	0	0	0	0	0	**0**
DRS Relocation - Five Dock	36	372	0	0	0	**408**
DRS Relocation - Holson Street Casula	0	35	382	0	0	**417**
Total	**2,399**	**527**	**502**	**120**	**120**	**3,668**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Details of Zincara's analysis are provided in the sections below. It should be noted that the capex for Haberfield PRS is a carry-over from the current AA period. Zincara does not propose to comment further on the project.

7.6.1 Minor Capital: PRS

JGN said[42] that this is an allocation for minor PRS work that are typically less than $100k. The average cost for the last three years is $1,204k ($2020, end of the year). It also said that the actual costs that it had incurred over 2016-2018 were unusually higher as it had to put in place additional controls to manage risks at four PRS's: Mascot, Flemington, Tempe and Auburn. These projects have now been completed. Zincara notes that the Auburn project is actually shown as continuing into the forecast period as shown in Table 7-14.

Given that the above projects are now completed, it has not based the forecast allocation on historical costs but have put forward a significant lower cost estimate.

As can be seen in Table 7-14, the above projects have separately line items which shows zero costs as their actual costs have been accounted for in this current AA period As such, these costs should be not be used for justifying the minor capex for PRS. In addition, JGN had said that it had put forward a significant lower estimate but does not say how it has derived this lower estimate. Zincara also considers that the total cost for the five annual capex is $600k which is material. As such, Zincara is unable to recommend acceptance of this expenditure without further justification.

7.6.2 Auburn PRS

JGN said[43] that the Auburn PRS has 10 small concrete pits containing high pressure pipework and equipment. These pits have limited space and clearances and are difficult to inspect. In addition, the pipework in the pits are subject to wet/dry conditions which can accelerate corrosion. In addition, the PRS was constructed with V-ball control valves which resulted in noise level that exceeded the manufacturer's recommendation. The excess noise has caused vibration which has resulted in pipe failure downstream of the PRS. As such, JGN decided to upgrade the project.

The total cost of the project is $1,292 ($2018, 000). JGN has shown this project to commence in 2019 and completed in 2021. As such, as shown in Table 7-14, the cost of $660 ($2018, 000) is only part of the total project cost. JGN had also provided an Auburn PRS Upgrade Gate 3 certificate[44] to show that the cost had been approved in 2017.

Due to the condition of the PRS, Zincara considers that it is prudent to upgrade the PRS. Zincara therefore recommends acceptance of the project.

[42] JGN-IR036-Capex-Costing breakdowns for specific projects-20190916.
[43] JGN-2-3.15-1-Facilities Asset Class Strategy-20190617
[44] Auburn PRS Upgrade Gate 3 Certificate

7.6.3 Banksmeadow PRS

The Banksmeadow PRS[45] is an above ground facility located in a building and has been classified as a confined space. The facility was commissioned in 1976 and is part of an ageing population of PRS. Its vibration levels are close to the limit of acceptability and at small periods of operation at larger flow rates, the vibration may cause stress cycles above the endurance strength at the pipe welds.

Due to excess noise and the confined space, JGN decided to upgrade the PRS. JGN considered a number of options to address the key drivers before settling on the final solution. The key drivers and the recommended solutions are shown in the table below.

Table 7-15: **Solutions for the Upgrade of Banksmeadow PRS**

Key Drivers	Solution
Vibration and noise leading to integrity failure	Replace active valves
Safe isolation	Install additional buried isolation valves
Gas escape from the expansion joint	Remove expansion joint

JGN also provided the related PEM[46] which showed that the subcontractor's cost had been derived from historical cost from the Tempe PRS. The total cost of the project is $2,239 ($2018, 000). However, the project is to commence in 2019 and completed in 2021. This means that the project spans both current and future AA period. Zincara considers the cost to be reasonable.

Zincara notes the age and condition of the PRS and concurs that it is prudent that the unit be upgraded. Zincara therefore recommends that the cost be accepted.

7.6.4 DRS Relocation

JGN proposes[47] to install two DRS and decommission the existing DRS at:

- Five Dock
- Holson Street Casula

The Five Dock DRS which is located on the corner of Great North Road and Lyon Road is difficult for technicians to access. JGN proposes to install a new Cocon regulator unit and decommission the existing DRS.

The subcontractor's cost in the PEM has been derived using a previous relocation in Goulburn. Zincara considers the cost to be reasonable.

The Holson Street Casula DRS has no regulator bypass which means that to set the pressure, technicians have to manually throttle the value. JGN also proposes to install a new Cocon regulator unit and decommission the existing DRS.

[45] JGN-2-3.15-1-10018572-Banksmeadow PRS Upgrade-OA-20190308
[46] JGN-10018572-Banksmeadow PRS Upgrade-PEM model
[47] JGN-2-315-2-10022019-DRS Relocation – Five Dock & JGN-2-3.15-2-10022512 DRS Relocation - Holson Street Casula

As in the Five Dock PEM, the material cost has been derived from the previous relocation in Goulburn. Zincara considers the cost to be reasonable.

Zincara considers the relocation of the two units prudent and as such recommends acceptance of both relocations.

7.6.5 Recommended Capex for Secondary District Regulator Replacement

From the analysis above, Zincara's recommended capex for this category is shown in the table below.

Table 7-16: Recommended Capex Secondary District Regulator Replacement ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Minor Capital: PRS	0	0	0	0	0	**0**
Auburn PRS Upgrade	660	0	0	0	0	**660**
Goodman Fielder PRS Upgrade	0	0	0	0	0	**0**
Tempe PRS Upgrade	0	0	0	0	0	**0**
Mascot PRS Upgrade	0	0	0	0	0	**0**
Flemington PRS Upgrade	0	0	0	0	0	**0**
Haberfield PRS Upgrade	15	0	0	0	0	**15**
Banksmeadow PRS Upgrade	1,568	0	0	0	0	**1,568**
DRS relocation - Dapto	0	0	0	0	0	**0**
DRS Relocation - Five Dock	36	372	0	0	0	**408**
DRS Relocation - Holson Street Casula	0	35	382	0	0	**417**
Total	**2,279**	**407**	**382**	**0**	**0**	**3,068**

7.7 OTHER MINOR WORKS

The capex for this category is for miscellaneous projects as shown in the table below.

Table 7-17: JGN's Capex for Miscellaneous Projects ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Minor Capital: Pipeworks	250	250	250	250	250	**1,250**
Minor Capital: Washaways works	300	300	300	300	300	**1,500**
Air Compressor Replacement Program	562	422	0	0	0	**983**
Boundary Regulators	300	300	300	300	300	**1,500**
Path Valves - Low, Medium and Secondary Pressure	180	180	180	180	180	**900**
Total	**1,592**	**1,452**	**1,030**	**1,030**	**1,030**	**6,133**

Source: Zincara's analysis derived from JGN-IR006-Attachment5.2-Capex Model (resubmitted)-20190814

Zincara's analysis of the projects is discussed below.

7.7.1 Minor Capital Pipeworks

JGN said[48] that this capex allocation is for minor pipeworks projects that are typically related to rectifying integrity issues for pipes such as cathodic protection for steel pipes. It also said that in RY2016, it had created a separate project to install a new Corrosion Protection (CP) system for buried steel pipes. In the forecast period, this minor capital allocation is intended to also cover these costs.

It also said that the last three years average cost is $377 ($000 2020, end of year) which is higher than its forecast of $250 ($000 2020, end of year). JGN provided a table showing its costs:

Table 7-18: Minor Capital Works Capex

Reset RIN (workings) Direct Costs			Real 2020 (end of yr)		
Nominals (mid yr)					
Actuals	Actuals	Actuals	Actuals	Actuals	Actuals
RY16	RY17	RY18	RY16	RY17	RY18
696,691	-	(2,282)	762,093	-	(2,404)
167,897	77,469	100,865	183,133	83,269	106,284

Source: JGN-IR036-Capex-Costing breakdowns for specific projects-20190916

Zincara assumes that the first line capex is that of the CP system and the capex on the second line is for pipeworks. It is unclear how the costs shown in the table above, lines up with JGN average annual capex of $250 ($000 2018) shown in Table 7-17. In addition, the annual allocation of $250 ($000 2018) adds up to a total cost for the forecast period of $1,250 ($000 2018) which is a material cost.

It is also unclear why such work has been capitalised and not part of opex. Given the lack of information and justification for the capex, Zincara is unable to recommend acceptance of the capex.

7.7.2 Minor Capital: Washaway Works

JGN said[48] that this is an allocation for minor projects to rectify exposed pipelines due to washaway issues. It also said that the past costs were for washaway sites at Canoelands, West Gosford, Hexham, Wyee Creek. Details of the capex for the last three years are shown in the table below.

Table 7-19: Minor Capital: Washaway Works

Reset RIN (workings) Direct Costs			Real 2020(end of yr)		
Nominals (mid yr)					
Actuals	Actuals	Actuals	Actuals	Actuals	Actuals
2016	2017	2018	2016	2017	2018
246,995	67,502	418,253	269,409	72,555	440,725

Source: JGN-IR036-Capex-Costing breakdowns for specific projects-20190916

As in Section 7.7.1, there is no information on why this is an ongoing issue and why the last three years cost is representative of the forecast period cost. At $300 ($000 2018) per

[48] JGN-IR036-Capex-Costing breakdowns for specific projects-20190916

annum, the total cost for the five years forecast period is $1,500 ($000 2018). It is also unclear why this is not an opex item. Zincara is therefore unable to recommend acceptance of the work.

7.7.3 Air Compressor Replacement Program

This capex is for the replacement of obsolete air compressors[49] at various JGN facilities. JGN advised that there are no spare parts for these units and any failure of these units will affect the gas supply at the PRS. JGN propose to replace 12 of these units at various PRS.

The work includes decommissioning the obsolete units and installing the new units outside the hazardous areas with new power supply. The estimated cost has been derived from the historical cost for the Banksmeadow unit.

Zincara considers it prudent to upgrade the units due to their obsolescence. The cost is considered efficient as it has been derived from the historical cost. Zincara therefore recommends acceptance of the capex.

7.7.4 Boundary Regulators

JGN advised[50] that it believes that there are several thousand boundary regulators which are currently not captured by its SAP system. A significant number of these boundary regulators have no overpressure protection which means that a regulator failure could result in medium pressure gas from the gas main in the street entering a building causing an unsafe situation.

The original contractor’s price of replacing a boundary regulator was $25,000 which made the project not cost effective. However, JGN carried out an in-house replacement of these regulators in CY17 and CY18 and have reduced the cost to $5k per regulator which has made the replacement program feasible. JGN now proposes to replace 60 regulators per annum resulting in a cost of $300,000 per annum.

Zincara concurs that there could be a safety issue if the boundary regulator does not have overpressure protection and considers the replacement program to be prudent. The in-house replacement has reduced the cost significantly which makes the program cost effective. Zincara therefore recommends acceptance of the project.

7.7.5 Path Valves - Low, Medium and Secondary Pressures

JGN advised[51] that a path valve is an isolating valve for an industrial or commercial service. It is a safety device to isolate the gas supply in case of emergency. An investigation into the condition and operation of path valves (Haymarket and Kings Cross) has identified a number of operational issues such as:

- Valve or valve cover may be damage;

[49] JGN-2-315-1-100422333-Air Compressor Replacement Program
[50] JGN-2-3.15-RFSB-Boundary Regulators
[51] JGN-2-3.15-2-R-RAKV-Path Valves – Low Medium and Secondary Pressure

- Unable to locate a valve; and
- Unable to operate a valve

These issues have limit JGN's ability to isolate the downstream gas supply.

JGN has therefore planned to replace 10 path valves at a cost of $10 ($000 2018) per unit, giving a total of $100 ($000 2018) per annum

Zincara accepts that it is prudent to replace such valves if they are no longer functional. However, as shown in Table 7-17, JGN proposes to incur a capex of $180 ($000 2018) per annum. As JGN is only proposing to replace 10 per annum, Zincara recommends a capex $100 ($000 2018) per annum.

7.7.6 Recommended Capex for Minor Capital Works

From the analysis above, Zincara's recommended capex for this category is shown in the table below.

Table 7-20: Recommended Capex for Minor Capital Works ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Minor Capital: Pipeworks	0	0	0	0	0	**0**
Minor Capital: Washaways works	0	0	0	0	0	**0**
Air Compressor Replacement Program	562	422	0	0	0	**983**
Boundary Regulators	300	300	300	300	300	**1,500**
Path Valves - Low, Medium and Secondary Pressure	100	100	100	100	100	**500**
Total	**962**	**822**	**400**	**400**	**400**	**2,984**

7.8 CONCLUSION

This category relates to the capex for high pressure pipelines and facilities. JGN advised that the capex is primarily focused on maintaining the safety of the aging assets.

Zincara generally concurs with the need to replace ageing assets and also to ensure that facilities and pipes meet the requirement of industry standards and safety regulations. However, Zincara considers that there is inadequate information on the capex provision for a number of items such as the replacement of minor TRS, SRS and PRS. In addition, Zincara also considers that the capex for the installation of secondary isolation valves on JGN's secondary mains in Sydney CBD needs further justification before it can be recommended.

From the analysis above, Zincara recommended capex for the section "Facilities and Pipes" is shown in the table below.

Table 7-21: Recommended Capex for Facilities and Pipes ($2018, 000)

Project Categories	2021	2022	2023	2024	2025	Total
Facilities Safety	1,655	3,678	3,246	1,650	1,407	**11,636**

Upgrade						
Facilities Capacity Upgrade	29	-	-	-	-	**29**
Sydney Primary Mains Risk Reduction	10,301	4,412	980	3,092	8,164	**26,949**
Shallow Secondary Mains	6,307	8,875	-	-	-	**15,182**
Secondary District Regulator Replacement	2,279	407	382	0	0	**3,068**
Other Minor Works	962	822	400	400	400	**2,984**
Total	**21,533**	**18,194**	**5,008**	**5,142**	**9,971**	**59,848**

Zincara's capex is $8,253 ($2018,000) less than JGN's submission capex of $68,101 ($2018,000) as shown in Table 7-2.

A summary of JGN's capex versus Zincara's recommended capex is shown in the table below.

Table 7-22: Summary of Zincara's recommended capex ($2018,000)

	JGN Plan	Zincara revision	Variance
Facilities Safety Upgrade	16,139	11,636	**-4,503**
Facilities Capacity Upgrade	29	29	**-**
Sydney Primary Mains Risk Reduction	26,949	26,949	**-**
Shallow Secondary Mains	15,182	15,182	**-**
Secondary District Regulator Replacement	3,668	3,068	**-600**
Other Minor Works	6,133	2,984	**-3,149**
Total	68,101	59,848	**-8,253**

8. AUGMENTATION

8.1 INTRODUCTION

Augmentation capex covers network infrastructure required to continue to supply existing demand growth and new connections.

With slowing peak consumption demand, JGN has implemented a revised strategy (changing minimum pressure requirements for its various networks and installing additional monitoring) that has resulted in fewer augmentation projects from pressure constraints.

Connection driven augmentation is related to new estates and high rise developments, requiring networks to be strengthened or extended. Included in this category is the Western Sydney Aerotropolis development which is approximately 50% of the connections augmentation program.

Finally, as part of a major project relating to the Sydney Primary Main (SPM), JGN has proposed a reduction of the operating pressure for the Lane Cove to Willoughby section of the SPM, requiring two mains augmentation projects.

The capex details used throughout this Augmentation chapter are presented in 2018 dollars (unless noted otherwise). The augmentation capex total forecast is summarised in the following table.

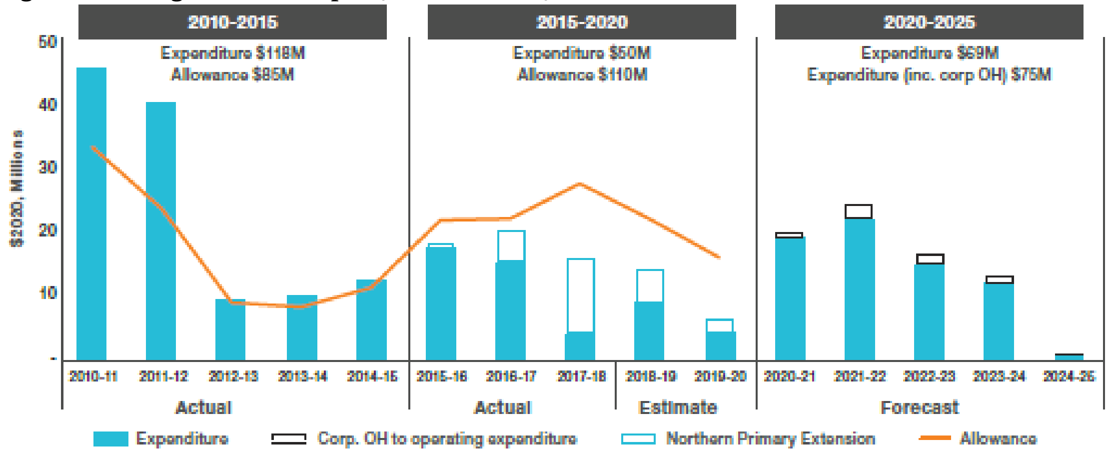
Table 8-1: Augmentation capex forecast ($2018, 000)

	2021	2022	2023	2024	2025	Total
Aerotropolis	1,144	9,911	342	2,965	-	**14,362**
New estate	8,078	1,750	2,713	2,196	-	**14,737**
Medium density	1,755	132	62	538	-	**2,488**
Minor: ME and CD projects	550	550	550	550	550	**2,750**
SPM augmentation	4,071	6,469	8,802	3,853	-	**23,194**
Total	**15,598**	**18,813**	**12,469**	**10,102**	**550**	**57,531**

(Source: Capex model: Augmentation "Forecast")
Note: rounding

Over the current 2015-20 period peak consumption growth has slowed, likely to be due to saturation of instantaneous hot water and a shift to using electricity for heating. As a result a number of augmentation projects were cancelled.

Figure 9-1: Augmentation capex ($2020, million)



(Source: 2020 Plan: Figure 5.10)

For augmentation projects, JGN has adopted the following approach where there is more than one option:

- Long term approach when the likelihood of further development in the future is high and when costs of providing additional capacity now is relatively low.
- Medium term approach where the chance or additional development is low or future costs are not expected to be high.

The Capacity Augmentation Plan discusses the assumptions used in developing forecast peak loads, including penetration rates and gas loads arising from new estates and medium density / high-rise developments. NPV calculations are to 2050 and 2070. The distribution operating pressures are shown in Table 2 of the Plan, including the minimum operating system pressures which are a major driver for the timing of capacity augmentation projects which are grouped as:

- Existing customer demand growth
- Medium density and high-rise developments
- New estate growth areas

8.2 WESTERN SYDNEY AEROTROPOLIS

A third city for Sydney is being developed with the Western Sydney airport at its centre. The airport is proposed to open in 2026 and will be surrounded by industrial, agricultural and residential development. By 2036, the population is expected to grow by 464,000 and an additional 180,000 dwellings will be constructed. JGN anticipate that this area will be the largest development for gas infrastructure over the next 20 years and beyond.

The initial precincts are the Aerotropolis Core, Western Sydney Airport and Northern Gateway (Sydney Science Park) and these will be the main focus for the next five to seven years. All precincts within the Aerotropolis will be subject to more detailed planning before the release and rezoning of land. JGN provided an overview[52] of the range of regular

[52] Meeting with AER, JGN and Zincara, dated 15 August 2019

communication and coordination relating to the Aerotropolis project. Details of the project are not yet sufficiently developed to enable certainty for route selection and preparation of detailed project cost estimates.

The proposed augmentation capex is summarised in the following table and covers the construction of new secondary steel mains (MAOP 1050kPa).

Table 8-2: Western Sydney Aerotropolis Augmentation capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
Aerotropolis Core	557	4,818				**5,375**
Sydney Science Park	588	5,093				**5,680**
Western Sydney Airport			342	2,965		**3,307**
Total	**1,144**	**9,911**	**342**	**2,965**		**14,362**

(Source: Capex Model)

The Aerotropolis Core will be a 24 hour global centre to provide a variety of commercial and housing options for the workers, residents and visitors coming to and from the Western Sydney Airport. The current forecasts for the area include 8,000 new dwellings and a mix of commercial use developments. The current timing for the initial development of the area is approximately 2022.

[redacted].

The Western Sydney Airport will feature an airport freight and logistics precinct, an airport commercial precinct and the passenger terminal precinct.

The Augmentation Plan shows tables of new connections for the above three precincts with augmentation required as follows:

- Aerotropolis Core – augmentation required in 2022
- Sydney Science Park – augmentation required in 2022
- Airport terminal – augmentation required in 2024

For each of these precincts, "*timing of proposed augmentation required up front, at start of development, due to shortage of gas infrastructure*[53]." The Augmentation Plan[54] shows the extent of current infrastructure, which is limited with much of the precinct area currently being semi-rural. It is noted that the augmentation plan assumes 94.3% penetration rate[55] for new homes connections and expected initial network pressures >700kPa (Synergi Gas

[53] Discused and confirmed at meeting with AER, JGN and Zincara, dated 15 August 2019
[54] Augmentation Plan: Figure 20, page 46
[55] Capacity augmentation plan: section 2.3.3 penetration rate; pg. 5

software network models). The augmentation plan[56] provides results of a sensitivity analysis for each project, whereby penetration rates were varied between 80% and 100% (using 5% increments) which changed connection numbers and NPV analysis (both 2050 medium term and 2070 long term). For the three Aerotropolis projects the NPV analysis remained positive.

Medium-term options and long-term options have been considered for each of the precincts, with the medium-term options requiring less capex initially and potentially further augmentation capex in later years.

Aerotropolis Core. Two options have been considered with both providing for construction of a 4km secondary main (ie. MAOP of 1050kPa). The long-term option provides for interconnection between two existing secondary sub-systems. The medium-term option uses a 150mm steel main with a cost estimate of $3.75 million, while the long-term option uses a 250mm steel main with a cost estimate of $5.37 million, a difference of $1.62 million.

NPV analysis of the medium-term option includes further augmentation, with construction of another 4km of 150mm steel main in 2029-2030. The cost estimate is the same as for the initial feeder main. There is no information relating to pressure modelling that supports the timing of this work. The relatively short timeframe between the augmentation projects suggests that possibly the initial augmentation capacity is inadequate.

Airport. Both of the options considered provide for construction of a 2.5km secondary main. The medium-term option uses 150mm steel main with a cost of $2.36 million, while the long- term option uses a 250mm steel main with a cost of $3.31 million, a difference of $0.95 million. Again, the NPV analysis of the medium-term option includes further augmentation, with construction of another 2.5km of 150mm steel main in RY29-30. The cost estimate is the same as for the initial feeder main. There is no information relating to pressure modelling that supports the timing of this work. The relatively short timeframe between the augmentation projects suggests that possibly the initial augmentation capacity is inadequate.

In each case the longer-term options include larger capacity mains. JGN proposes the longer term options for the Aerotropolis Core and Western Sydney Airport, and the medium term option for the Northern Gateway (Sydney Science Park) as they have less confidence regarding future gas load requirements for this area (due to the proposed staging approach and ambitious gas loads post year 2040 proposed by the developers). The resulting augmentation projects interconnect with the existing 1050kPa network and include:

- Aerotropolis Core: construct 4km of 250mm steel main interconnecting with two secondary sub-systems, with MAOP of 1050kPa.
- Western Sydney Airport: construct 2.5km of 250mm steel main, with MAOP of 1050kPa.
- Sydney Science Park: construct 5.5km of 150mm steel main, with MAOP of 1050kPa.

These augmentation projects do not include mains reticulation from these mains into the various Aerotropolis precincts, customer services or metering. The following summary shows these additional capex activities.

[56] Capacity augmentation plan: section 7.2: pg. 61

Table 8-3: Western Sydney Aerotropolis capex ($2018)

	Augmentation	Additional infrastructure Mains, Services & Meters	NPV – 2050 94% penetration
Aerotropolis Core	$5.37 M	$11.49 M (by RY2033)	$2.57 M
Sydney Science Park	$5.68 M	$12.23 M (by RY2033)	$5.44 M
Western Sydney Airport	$3.31 M	$1.57 M	$3.10 M
Total	$14.36 M	$25.29 M	$11.11 M

(Source: Capacity Augmentation Plan: Table 17 and revised in IR028 response)

8.2.1 Cost Breakdown Analysis

Project cost estimates for these augmentation projects have been developed using completed projects with similar infrastructure and are summarised in the following table.

Table 8-4: Western Sydney Aerotropolis project cost estimates ($2018, 000)

Capex – component	Aerotropolis Core	Sydney Science Park	Airport
Labour	188	566	116
Project Management	128	312	79
Material	628	918	387
Subcontract	4,037	2,213	2,484
Risk	393	1,437*	242
Total	**5,375**	**5,446***	**3,307**

(Source: Capacity augmentation plan: appendix C)
Note: Estimate for Sydney Science Park differs from capex model of $5.68 million
Note: IR024 response "forecast capex risk component", for Sydney Science Park, shows risk as $1.209 million and capex of $5.68 million.

At a meeting to discuss these projects[57] it was noted that risk mainly relates to scope risk, with route selection not yet possible. JGN advised that the risk relating to the Science Park (shown in the above table) is an error (see "note" above for a revised risk provision). Also note that the capex model shows this project as $5.68 million. As the precincts are effectively greenfield sites, JGN have selected similar projects for the current level of cost estimation. Route selection is currently not possible. The Aerotropolis Core and Airport project estimates are based on Rouse Hill which has been subject to tender and hence lower level of scope risk.

No PEM models have been developed for the Aerotropolis projects. Following the above meeting JGN provided supplementary information to outline its cost estimation approach.

[57] Meeting with JGN, AER and Zincara held on 15 August 2019

They advise that currently there is no firm scope for each augmentation project making it difficult to accurately forecast the project costs.

8.2.2 Conclusion

A third city for Sydney is being developed with the Western Sydney airport at its centre. The airport is proposed to open in 2026 and will be surrounded by industrial, agricultural and residential development. The initial precincts are the Aerotropolis Core, Western Sydney Airport and Northern Gateway (Sydney Science Park) and these will be the main focus for the next five to seven years. All precincts within the Aerotropolis will be subject to more detailed planning before the release and rezoning of land.

There is a high level of confidence that the Aerotropolis will proceed, based on the future plans announced and commitment from all three levels of government and discussions with developers. However, we see the following issues with the current proposal, based on information provided and discussed to date:

- Uncertainty with respect to timing for the mains augmentation projects.
- Uncertainty with respect to gas load requirements, including levels of penetration.
- Uncertainty with respect to feeder mains design including route selection, sizing, impact of other infrastructure, creeks/road crossings and other unknown siting or construction issues.
- No current visibility of modelling analysis to justify 250 mm steel Feeder mains versus smaller sizes, including the medium-term option of 150mm steel. NPV analysis of the medium-term options includes further augmentation in 2029-2030, which appears to be a relatively short timeframe given the fact that these augmentations are estimated to be the same size and length.

We agree that it would be prudent to have gas supply infrastructure available at the various precincts during early stages of construction. We believe that around 18 months would be reasonable from initiation to completion of the gas feeder mains (with MAOP of 1050 kPa).

Based on the uncertainties currently relating to the Aerotropolis augmentation, we consider that it would be prudent to allow initial funding for JGN to develop its detailed design and approvals processes (effectively Gate 1-3), followed by a further submission for delivery funding by JGN, once there is more certainty not only of the detailed scope but also capital expenditure. As no PEM model has been prepared for these projects, we have reviewed other projects and estimated that approximately 15% of project costs occurs at Gate 1, 2 and 3 and therefore recommend initial funding of $2.0 million to initiate the project.

8.3 NEW ESTATE DEVELOPMENT

New estate developments are generally greenfield or infill areas with minimal or no infrastructure and primarily require gas feeder mains and/or regulators to extend the gas network to service the proposed new estate. In each of these developments, JGN is assuming around 95% penetration rates, with notes indicating that +/- 5% change will not affect timing of augmentations.

Table 8-5: New Estates development augmentation capex ($2018, 000)

	2021	2022	2023	2024	2025	Total
[redacted]	6,886					**6,886**
Cecil Park	1,192					**1,192**
Largs		787				**787**
Edmondson Park		718				**718**
Wilton North		245	2,247			**2,493**
Bathurst			212	2		**214**
Box Hill			254	2,193		**2,447**
Total:	**8,078**	**1,750**	**2,713**	**2,196**	**-**	**14,737**

(Source: Capex model: Augmentation "Forecast")

8.3.1 [redacted]

[redacted].

[redacted].

[redacted].

8.3.2 Cecil Park

The Cecil Park growth area also encompasses the neighbouring suburbs and is supplied from the medium pressure 210kPa network. New homes growth is around 84 per year. Based on its development forecast, the network minimum pressure will drop below 40kPa in 2021, requiring augmentation.

The Plan proposes one option which is to construct a new secondary feeder main (310 metres of 150mm steel), install a new Cocon regulator on the end of the secondary feeder main and then constructing a new medium pressure feeder main (480 metres of 160mm PE) connecting to the existing network. The PEM model provides details of the cost estimate.

With this augmentation project required during the first year of the 2021-2025 regulatory period, we recommend that JGN provide an update of their project cost estimate.

8.3.3 Largs

The Largs growth area also encompasses the neighbouring suburb of Bolwarra Heights and is supplied from the medium pressure 210kPa network. New homes growth is around 67 per year. Growth Based on its development forecast, the network minimum pressure will drop to around 36kPa in 2022, requiring augmentation.

The Plan considers a long-term option and a medium-term option and proposes the medium-term option on the basis of the difference in cost and the uncertainty as to future load requirements. This option is to construct a new medium pressure feeder main (1.9 kilometres of 110mm PE). The PEM model provides details of the cost estimate.

8.3.4 Edmondson Park

The Capacity Augmentation Plan[58] shows this growth area has around 3,500 dwellings already connected. JGN's overall plan for this area is to provide another source of supply by constructing a new secondary main operating at 1,050kPa and constructed in a staged approach in conjunction with other infrastructure works. New homes growth is around 380 homes per year. The Plan indicates that network minimum pressures will fall below 40kPa in 2022, requiring augmentation. The proposal is for completion of the secondary main and a source of supply.

The Plan considers one option, which is to continue construction of the secondary feeder main, which commenced in 2013 and 2014, in two stages. The first is to extend the main (185 metres of 150mm steel) in conjunction with Roads and Maritime Services (RMS) works (reducing construction costs) in 2020 and a second stage to construct another 500 metres of 150mm steel main and install a Cocon regulator in 2023, subject to ongoing liaison with the developer due to land access issues. The PEM model provides details of the cost estimate.

8.3.5 Wilton North

The Wilton North growth area is located entirely in a greenfield area with no existing gas infrastructure and would require a feeder main to be laid at the start of estate construction and as a result augmentation would be required in 2023 to supply gas to the first homes

[58] Section 5.2.1, pg. 23

built. New homes growth is forecast around 266 per year, with an overall estimated total of almost 5,600 dwellings, not including other proposed developments around Wilton.

The Plan considers a long-term option and a medium-term option and proposes the medium-term option of the basis of the difference in cost and the uncertainty as to future load requirements. This option is to construct a new medium pressure feeder main (3.2 kilometres of 160mm PE) operating at 300 kPa.

8.3.6 Bathurst

The Eglinton growth area is already servicing customers off the medium pressure 210kPa network. An augmentation was completed in 2014 to provide initial supply to the area. New homes growth is around 57-76 homes per year, with an estimated total of 500 dwellings proposed to the west of Eglinton. The Plan indicates that network minimum pressures will fall below 40kPa in 2023 requiring augmentation.

The Plan proposes duplication of an existing low capacity feeder main with a new medium pressure feeder main (600 metres of 160 PE), which is stage two of the overall plan.

8.3.7 Box hill

The Box Hill and Vineyard growth areas are adjoining developments, where Vineyard is located entirely in a greenfield area with no existing gas infrastructure and Box Hill already supplying customers off the medium pressure 210kPa network. New homes growth is around 380 homes per year, with an estimated total of 11,800 dwellings in the area. The Plan indicates that network minimum pressures will fall below 40kPa in 2024 requiring augmentation.

The Plan considers a long-term option and a medium-term option and proposes the medium-term option of the basis of the difference in cost and the uncertainty as to future load requirements. This option is to install a Cocon regulator and construct 2.7 kilometres of 160mm PE medium pressure main.

8.4 MEDIUM / HIGH DENSITY DEVELOPMENTS

These new developments are concentrated gas loads with single service connections and can impact the peak demand of gas networks. The Augmentation Plan[59] indicates that the penetration rate for these connections is 100%, as consumers within each building are committed to connect.

[59] Section 5.3 Medium / High Density Developments, pg.38

Table 8-6: Medium / High Rise development augmentation capex ($2018, 000)

Capex	2021	2022	2023	2024	2025	Total
Lidcombe CBD	1,702					**1,702**
Bankstown	53	132				**185**
Campsie			62	538		**601**
Total	**1,755**	**132**	**62**	**538**	**-**	**2,488**

(Source: Business Case V13)

8.4.1 Lidcombe CBD

The Lidcombe growth area is located in an existing gas supply area, but the Plan indicates there is insufficient network capacity to supply the proposed developments which require augmentation in 2021. The Plan estimates a total of 1,000 dwellings are proposed. Notes indicate that augmentation is required once network pressures fall below 3.5kPa minimum pressures, suggesting that it is a low pressure 7kPa network, but there is no further information provided to support the statement as to lack of capacity.

The Plan[60] considers a long term and medium-term option and on the basis of a material cost difference, along with uncertainty around future load requirements, proposes the medium-term approach. This requires construction of a new feeder main (1.3 kilometres of 150mm steel) and installation of a new Cocon regulator connecting to a nearby secondary main. The total project cost is $1,902k (with expenditure of $200k during 2020).

With this augmentation project required during the first year of the 2021-2025 regulatory period, and with expenditure occurring in 2020, we recommend that JGN provide an updated project cost estimate.

8.4.2 Bankstown

The Bankstown growth area is located in an existing gas supply area, around the train station and town centre. There is an estimated 3,000 dwellings proposed in the area and the Plan indicates that the low pressure 7kPa network does not have the required capacity to supply these developments, with minimum pressures falling below 3.5kPa in 2022, requiring augmentation.

The Plan considers a long term and medium-term option and on the basis of a material cost difference and uncertainty of future load requirements, proposes the medium-term approach. This requires construction of 150 metres of 160mm PE main.

[60] Section 6: Augmentation scope details

8.4.3 Campsie

The Campsie growth area is located in an existing gas supply area, around a train station and town centre with new medium and high-rise density dwellings. There is an estimated 1,500 dwellings proposed for the area. Notes indicate that augmentation is required once network pressures fall below 3.5kPa minimum pressures, suggesting that it is a low pressure 7kPa network. The Plan notes that augmentation is required in 2024, however there is no further information provided to support a lack of capacity.

The Plan considers a long term and medium-term option and on the basis of a material cost difference and uncertainty of future load requirements, proposes the medium term approach. This requires construction of a new feeder main (750 metres of 11mm PE) and installing a new Cocon regulator.

8.5 MINOR ME AND CD PROJECTS

Includes minor augmentation for small capacity development projects identified each year, usually after winter gauging (R-DAA). For example, adding a small crossing interconnection or installing a new district regulator set to ensure that capacity can be maintained. The expenditure is based on a top-down forecast based on recent historical costs from similar projects, and not specific augmentation projects. As a result, JGN cannot provide any pressure modelling[61] .

Table 8-7: Minor ME and CD projects capex ($2018, 000)

Capex	2018	2019	2020	2021	2022	Total
Total	550	550	550	550	550	**2,750**

(Source: Capex Model)

8.6 SYDNEY PRIMARY MAIN – AUGMENTATION PROJECTS

The capex for this project is to augment the North Sydney network at the same time as the derating of the Lane Cove to Willoughby SPM to a secondary main.

Table 8-8: Sydney Primary Main augmentation capex ($2018, 000)

Capex	2021	2022	2023	2024	2025	Total
SPM (L-W) Stage 1	3,983	5,297				**9,281**
SPM (L-W) Stage 2	88	1,171	8,802	3,853		**13,914**
Total	4,071	6,469	8,802	3,853	-	**23,194**

(Source: Capex Model)

JGN advised[62] that the Northern Sydney Secondary Network (NSS) Network supplies 220,000 customers and is supplied by the North Ryde Primary Receiving Station, Lane Cove PRS and

[61] IR007 response to question 5.
[62] JGN-Northern Sydney Secondary Network Capacity Assessment

Willoughby PRS. The network performance and its capacity are limited by the Primary and Secondary Network Pressures in the region. In particular, the Primary Network constraints are:

- Putney to Lane Cove section of 6.9km of 250mm steel pipeline; and
- Lane Cove to Willoughby section of 7km of 150mm steel pipeline.

Since 2012, the annual consumption in North Sydney has decreased by 0.3% with the number of customers growing at about 1.5% per annum. This has resulted in a decrease in gas demand of 0.4% from 2012-2018. Irrespective of the trend, the NSS peak pressures continue to reduce possible due to the increase number of customers and the peak usage per customer.

In 2018, after receiving its winter network performance results, JGN reviewed the timing of its Northern Secondary Supply Reliability Enhancement project and concluded that further augmentation to the supply of the NSS Network is only required for the winter 2031.

The proposed augmentation[63] are:

- Stage 1 – construct 3,000m of DN350mm secondary steel mains in North Ryde; and
- Stage 2 – construct 6,000m of DN250mm secondary steel mains in Frenchs Forest.

However, with the proposed derating of the pressure of the Lane Cove to Willoughby Sydney Primary Main to 1050kpa secondary main, the proposed augmentation has to be brought forward to be completed prior to the derating.

In Section 7.4.2, on the Sydney Primary Main Risk Mitigation, Zincara recommends acceptance of the derating of the SPM section between Lane Cove to Willoughby and installation of extra mechanical protection on the de-rated pipeline. Given that the Lane Cove to Willoughby pipeline is an integral supply to the NSS Network, Zincara recommends the proposed Stage 1 and Stage 2 augmentation.

The subcontractors' cost which is the most material cost in the PEM have been derived from the historical costs from similar projects and quoted price form contractors. Zincara therefore recommends acceptance of the costs.

8.7 CONCLUSION

Aerotropolis: A third city for Sydney is being developed with the Western Sydney airport at its centre. The airport is proposed to open in 2026. The initial precincts are the Aerotropolis Core, Western Sydney Airport and Northern Gateway (Sydney Science Park). All precincts within the Aerotropolis will be subject to more detailed planning before the release and rezoning of land.

[63] JGN-2-3.15-1-Life Cycle Management SPM (Lane Cove to Willoughby)

There is a high level of confidence that the Aerotropolis will proceed, based on the future plans announced and commitment from all three levels of government and discussions with developers. However, we see a number of issues with the current proposal, based on information provided and discussed. Most of the issues relate to the current lack of detail available to JGN to enable them to undertake detailed investigation, route selection, design and project estimation for the proposed augmentation projects.

We do agree that it would be prudent to have gas supply infrastructure available at the various precincts during early stages of construction and anticipate that approximately 18 months would be reasonable from initiation to completion of the gas feeder mains.

Based on the uncertainties currently relating to the Aerotropolis augmentation, we consider that it would be prudent to allow initial funding for JGN to develop its detailed design and approvals processes (effectively Gate 1-3), followed by a further submission for delivery funding by JGN, once there is more certainty not only of the detailed scope but also capital expenditure. As no PEM model has been prepared for these projects, we have reviewed other projects and estimated that approximately 15% of project costs occurs at Gate 1, 2 and 3 and therefore recommend initial funding of $2.0 million to initiate the project.

New estates development projects comprise a mix of greenfields and existing network augmentations. The **medium density / high rise** developments are in existing supply areas. In each case the Plan applies the medium-term option on the basis of cost and uncertainty of future load requirements. The projects indicate when the minimum supply pressure will be reached and propose augmentation in that year. This approach is prudent and efficient and in accordance with good industry practice.

While there is some uncertainty as to whether all of the development projects will proceed in their current form and timeframes, we consider that JGN has used best endeavours to develop its forecast, having consulted with NSW Government Department of Planning and the Environment (DPE), developers and local councils. JGN acknowledges that actual infrastructure and timing can be expected to change. In particular, [redacted] requires a contribution to become viable and a number of projects are proposed late into the 2021-2025 period.

It is also uncertain as to whether the penetration rates (94%) will be achieved and in this regard the Plan provides a sensitivity analysis with respect to penetration rates, by considering rates from 80% through to 100%. The analysis indicates that all augmentation projects, apart from [redacted], provide positive NPV both at year 2050 and year 2070.

On the basis of the above we consider the new estate and medium density / high rise augmentation program has been arrived at on a reasonable basis and the best available at this time. With respect to [redacted] we agree with the project but with a negative NPV, JGN will need to seek contribution from the developer/ customers to ensure that it is financially beneficial.

With respect to the augmentation projects required during the first year of the 2021-2025 regulatory period and which have expenditures occurring prior to the period (eg. [redacted], Cecil Park and Lidcombe CBD), we recommend that JGN provide updated project cost estimates. In addition, we recommend that JGN provide an update on its capital contribution negotiations with the developer of [redacted].

Sydney Primary Main – Augmentation projects: The North Sydney Secondary Networks which supplies 220,000 customers is supplied from a number of regulating station including that connected to the Lane Cove to Willoughby Sydney Primary Mains. JGN network planning had assessed that the North Sydney Secondary Networks will need further augmentation in 2031 to ensure there is adequate pressures in the network. However, the de-rating of the Lane Cove to Willoughby Sydney Primary Mains will constraint the network which means that the augmentation has to be brought forward.

Zincara has recommended acceptance of the de-rating project as a risk mitigation strategy for the Sydney Primary Main. Zincara therefore recommends acceptance of this augmentation project as well.

The recommended Augmentation capex forecast is summarised in the following table.

Table 8-9: Augmentation recommended capex forecast ($2018, 000)

	JGN Plan	Recommended	Difference
Aerotropolis	14,362	2,000	-12,362
New estate	14,737	14,737	Nil
Medium density	2,488	2,488	Nil
Minor: ME and CD projects	2,750	2,750	Nil
SPM augmentation	23,194	23,194	Nil
Total	57,531	45,169	-12,362

In the above summary, we recommend funding of $2.0 million for the Aerotropolis augmentation projects to enable detailed scoping, design and cost estimation to be undertaken (effectively Gate 1 – 3) as more information becomes available, with JGN to make a further submission for construction activities once there is certainty with the project.

9. MAINS REPLACEMENT

9.1 INTRODUCTION

Mains replacement relates to the replacement of mains (and associated services) that have significantly deteriorated with an increasing number of reported gas leaks. Generally, they are old cast iron and unprotected steel mains.

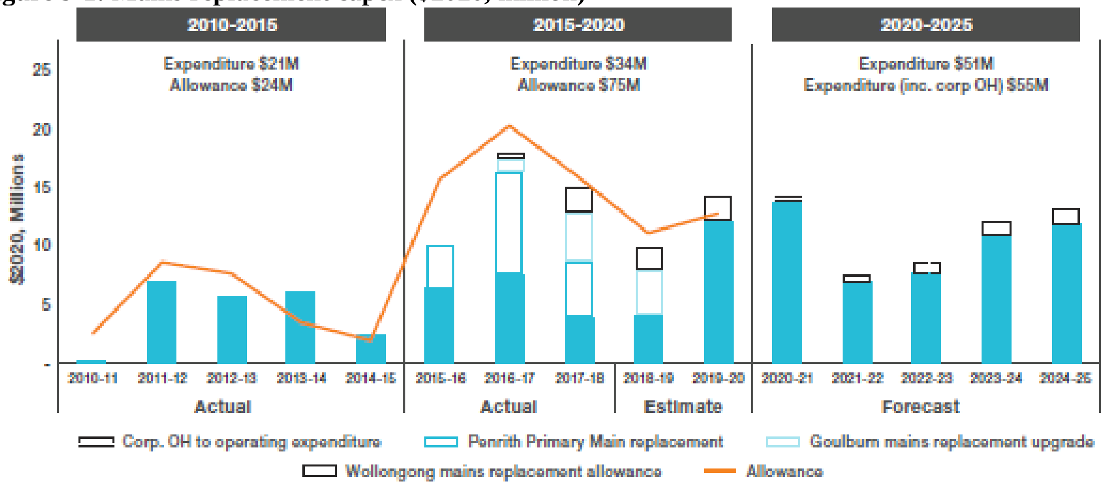
The capex details used throughout this mains replacement chapter are presented in 2018 dollars (unless noted otherwise), to align with JGN's capex model.

Table 9-1: Mains replacement capex forecast ($2018, 000)

	2021	2022	2023	2024	2025	Total
Kurri Kurri	3,470					**3,470**
Matraville	5,156	4,251				**9,408**
Mittagong	1,219	18				**1,237**
Newcastle		300	5,158	7,894	7,954	**21,307**
Bankstown*					326	**326**
Haberfield*					341	**341**
Minor mains renewal	300	300	300	300	300	**1,500**
Minor connection renewal	950	950	950	950	950	**4,750**
Total	**11,096**	**5,820**	**6,408**	**9,144**	**9,872**	**42,340**

(Source: Capex model: "Forecast")
Note: summation of capex totals may align due to rounding
Note: Bankstown* includes Bankstown, Chullora and Greenacre
Note: Haberfield* includes Haberfield, Strathfield and Campsie

Figure 9-1: Mains replacement capex ($2020, million)



(Source: 2020 Plan: Figure 5.11)

JGN has adopted a risk based medium term approach[64], which they say balances the cost of each piece of work against the customer benefits to prioritise and then rank which areas are replaced and when. Assessments are based on information from publicly reported leaks, condition assessments and, where possible, leak surveys. JGN says[65] that its investment approach aims to get as much use as possible from the older mains before they are replaced. JGN's Asset Management Plan (pg: 44) says "we prioritise these sections from replacement based on risk. Our aim is to maintain these ferrous mains to ALARP until they can be completely removed from service as part of the ongoing mains rehabilitation program".

Taking into account the results of recent leakage surveys, JGN is planning to complete the mains replacement works in Matraville and replace deteriorating mains in Newcastle, Mittagong and Kurri Kurri, during the 2021-2025 period.

While 85 kilometres are anticipated to be replaced during the current 2016-2020 period, JGN are planning to replace 146 kilometres during the RY21-RY25 period, the majority of which will be in Newcastle where 104 kilometres will be replaced. During the 2016-2020 period JGN reprioritised its capex investments to offset the increase in connections. More recently, the program for 2021-2025 period has also been reduced, following ongoing assessment of the asset condition within the networks. The following table shows the extent to which the program was revised.

Table 9-2: Mains replacement capex ($2020, Millions, excluding overheads)

	2016-2020		2021-2025	
	Allowance	**Actual/Estimate**	**Draft Plan**	**2020 Plan**
Mains replacement	64.5	27.3	54.3	44.8

(Source: Attachment 5.1 Capital expenditure: table 3-1)

JGN says[66] it has experience in replacing all of the mains to be replaced over the 2021-2025 period and recent cost information has been used in preparing the expenditure forecasts.

JGN's IR025 response included a Rehabilitation Plan which considers safety risks, leakage rates, cost benefits of rehabilitation versus repair, incidents and reliability. The Plan provides a prioritisation of projects and an overall timeframe. The current prioritisation relates mainly to cast iron and unprotected steel mains which the Plan shows will be mostly rehabilitated by around CY2040. There is also an increasing level of rehabilitation projects addressing old generation PE and nylon mains extending the Plan out to CY2049.

[64] 2020 Plan: pg. 64
[65] 2020 Plan: pg. 66
[66] Attachment 5.1 Capital expenditure: 3.7.2; pg 43

9.2 KURRI KURRI

The network currently operates at 100kPa and supplies gas to approximately 2,900 customers in the suburbs of Kurri Kurri, Pelaw Main, Stanford Merthyr, Weston, Abermain, Neath and a small pocket of Cessnock.

Table 9-3: Summary of Kurri Kurri network

Material	Total Length	Approximate Age
200mm Steel	11km	60-70 years
<200mm Steel	24km	60-70 years
Plastic	45km	30-35 years

(Source: Options Analysis: Table 2-1)

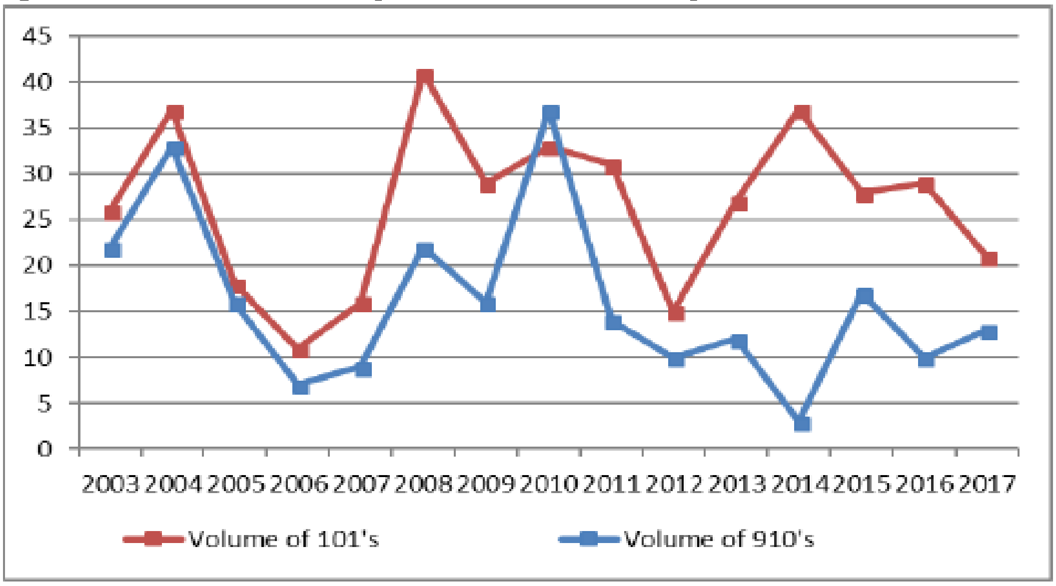
9.2.1 Asset condition analysis

The 200mm steel main forms the backbone of the network and was the original supply main between Maitland and Cessnock. Sections of this main have been replaced with 110mm NY or 160mm PE. There is also an absence of isolation valves, so it is not possible to isolate the supply main within a short period of time. The original steel mains were not installed with any form of corrosion protection. The condition of the mains is such that JGN operates the network at 100kPa instead of the common network pressure of 210kPa.

Leak surveys for the network were conducted in 2005/06 and 2011/12, with very few leaks on mains recorded. JGN’s response to the AER (IR025) provides leakage survey results of Kurri Kurri in 2015 and Heddon Greta in 2017.

There were 291 Public reported leaks over the last ten years, with the majority on the steel mains. The following graph shows the number of Public Reported Leaks (work code “101”) and the number of mains repairs (work code “910”).

Figure 9-2: Number of Public Reported Leaks and Mains Repairs



(Source: Options Analysis: Figure 2-3)
Note: “101” means Public Reported Leak; “910” means Mains Repair

There have been 230 mains repairs between 2003 and 2017. The graph shows that mains repairs were relatively higher between 2003 and 2010, and have been relatively steady over the last seven years. The graph does not indicate whether the leaks were on the 200mm steel main or the smaller 25mm and 50mm steel mains.

In response[67] to an information request regarding leaks on the feeder main and remaining network reticulation, JGN provided a table of publicly reported leaks split between the two types of mains. The data indicates less PRLs than provided in the options analysis[68] and the leaks/km analysis for the reticulation mains does not appear to reflect the 24 kilometres of steel mains reported in the options analysis. However, as this proposal relates to the feeder main we have focussed on the leaks/km for this main, which show a steadily increasing trend with a current rate of 0.5 leaks/km. We agree that it would be prudent to rehabilitate the 200mm steel feeder main in the near future, given its inherent difficulty to repair.

For the reticulation steel mains, JGN proposes to consider their rehabilitation at a later stage. We agree that leaks on these mains could continue to be managed with its maintenance programs for some time.

It had been planned[69] to replace mains in Kurri Kurri in the 2016-2020 period but issues were found during preparations such as exposed mains, creek crossings above mines subsidence areas and coal tar inside pipework, which had to be addressed first. As a result of the preparatory works being completed, JGN has forecast to undertake the mains replacement works across the 2016-2020 and 2021-2025 periods.

9.2.2 Options

The Options Analysis report considers seven options, with the preferred option being to rehabilitate the 200mm steel main (stage 1) and defer rehabilitation of the remaining steel mains (stage 2) for five years (option 7). As stated above, Zincara agrees that this option is prudent and in accordance with good industry practice. We noted that the scope of works outlined in the Options Analysis did not align with the details provided in the PEM model. In IR025 response, JGN advised that the PEM model used an updated scope of works and more in-depth assessment of the project requirements, resulting in a reduced overall cost of the project.

9.2.3 Cost analysis

The capex estimate for works to complete the preferred option during 2021-2025 is summarised in the following table. The completed project NPV is $4.11M over the next 30 years, representing the most attractive of the options considered.

[67] IR008: Mains Replacement
[68] Kurri Kurri Options Analysis: Figure 2-2 PRL
[69] Attachment 5.1: Capital Expenditure: pg.43

Table 9-4: Kurri Kurri rehabilitation (stage 1) ($2018, 000)

Item	Project Estimate for 2021-2025
Materials	29
Contractor Costs	2,230
Internal labour & plant	507
Risk Allocation	704
Total direct costs	3,470

(Source: PEM model: cost estimate & control)
Note: total project estimate (stage 1) is $3,653 ($2018, 000)

9.2.4 Conclusion

The publicly reported leaks on the steel feeder main indicate a steadily increasing trend with the 2019 actual/forecast showing 0.5 leaks/km. Repairs on this main would be more difficult and costly than for smaller reticulation mains. We consider that it would be prudent and in accordance with good industry practice to rehabilitate this main during the RY21-25 period.

9.3 MATRAVILLE

The Matraville 2kPa and 7kPa networks serve approximately 3,200 customers through 45 kilometres of main. With the low operating pressure, customers have experienced poor supply and there is less capacity for additional growth. The networks do not form an integrated network and are divided into three pockets. With restricted metering pressure, customers may not be able to use some types of appliances and may require larger metering and customer piping systems. The following table provides a summary of materials used in the networks.

Table 9-5: Summary of Matraville network

Material	Total Length	Years Laid
Cast iron	32km	1900 - 1960
Unprotected steel	0.2km	1960 - 1970
Old generation Nylon	1.2km	1970 - 1990
Old generation PE	2.3km	1970 - 1990
Nylon	7.2km	1990 - today
PE	1.4km	1990 - today
Total	**44.3km**	

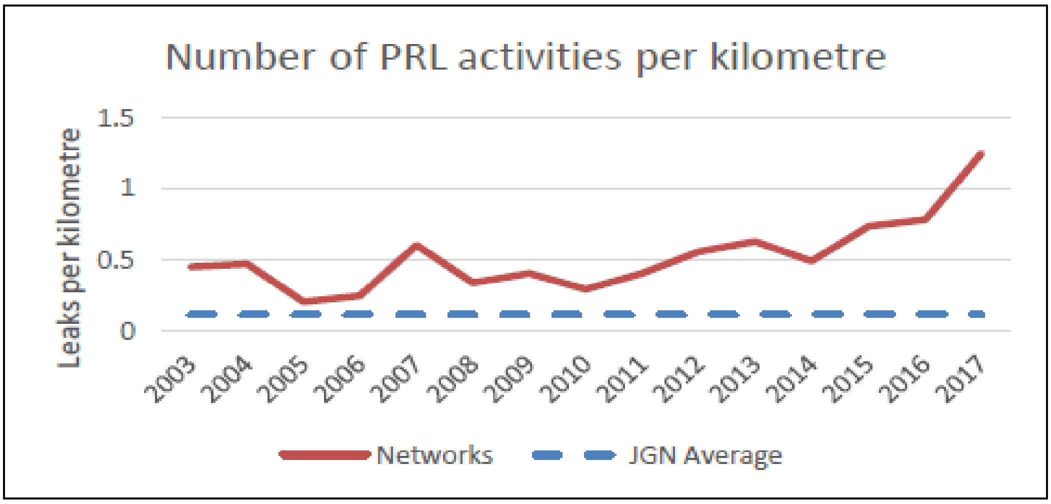
(Source: Options Analysis: Table 2-2)

9.3.1 Asset condition analysis

In addition to the cast iron and unprotected steel there are approximately 3.5 kilometres of early generation nylon and PE, both of which are unsuitable for 210kPa.

Leakage surveys were conducted in 2011 and 2016, with the more recent survey recording 50 class 1 leaks and 10 class 2 leaks, representing approximately 1.3 leaks/km. There were 350 Public Reported Leaks (PRLs) over the 2003 to 2017 period with the following chart showing the PRLs per kilometre.

Figure 9-3: Number of Public Reported Leaks per kilometre



(Source: Options Analysis: Figure 2-2)

Unaccounted for gas (UAG) has been estimated at approximately 46%, based on test results in the suburb of Hillside (part of the 2kPa network).

The analysis indicates that most of the network has aging mains assets which are deteriorating with an increasing trend of leaks being detected. JGN's IR025 response did not provide any specific information as to why the reported leaks in 2017 were higher than earlier years. They did advise that there were 25 publicly reported leaks during 2018, giving a leaks/km rate of 0.6 which represents a drop compared to 2017 and more aligned to the rates over recent years. Zincara agrees that the network is likely to be deteriorating and network pressures unsustainable for reliable supply and use of modern appliances.

9.3.2 Options

The Options Analysis provides four options, with the rehabilitation of all mains and increasing the MAOP to 210kPa being JGN's preferred. The project is proposed to be undertaken from 2020 to 2022.

Scope of works:

- Upgrade the operating pressure of the Networks to 210kPa
- Remove five SRS/DRS and upgrade an SRS to 1050/210kPa
- Insertion of approximately 40 kilometres of mains with plastic
- Laying approximately 1 kilometre of plastic mains
- Pressure test approximately 4 kilometres of existing plastic mains to 210kPa standard and relay where necessary

- Replacing meter sets to 210kPa standard
- Transferring of customers to rehabilitated network

9.3.3 Cost analysis

This project is planned to commence in 2020, with forecast expenditure of $4.34 million in that year. The project cost estimate and cost estimate for the 2021-2025 period is summarised in the following table.

Table 9-6: Matraville rehabilitation ($2018, 000)

Item	Project Estimate	Estimate 2021-2025
Materials	367	367
Contractor Costs	9,540	5,349
Internal labour	907	790
Risk Allocation	2,932	2,901
Total direct costs	**13,746**	**9,407**

(Source: Options Analysis: Table 4-2)

Details of the cost estimate are provided in the PEM model. The model includes details of how items have been costed and where costs have been used from other similar projects. The level of detail supports an efficient cost estimating process. The cost per metre is $[redacted]. The list of benchmark projects, shows that the cost per metre is at the top end of the projects.

In its response (IR008), JGN advised that they are currently carrying out investigation and assessment work to develop a detailed scope, which is scheduled to be completed at the end of 2019.

9.3.4 Conclusion

Low operating pressures in this network result in poor supply, capacity constraints and restraints on some modern types of appliances that customers can use. On this basis and with the reported leakage rate trend showing that the ageing mains are deteriorating, Zincara considers that rehabilitation of the network is prudent.

The cost estimate model details provided support an efficient cost estimate process for the project, although the level of risk component indicates a relatively high uncertainty given the fact that the project is due to commence in 2020 and be completed in 2022.

9.4 MITTAGONG

The Mittagong 210kPa network rehabilitation relates to the 3.5 kilometres of cast iron and steel mains in the network and is proposed to commence in 2020 with completion in 2022. The main reason for the work is the high number of leaks and difficulty in isolating supply on cast iron and steel mains during emergency situations.

A leak survey was conducted in 2011 which recorded 88 leaks, approximating 5 leaks/km and there were 23 publicly reported leaks and 15 mains repairs over the ten-year period. A further leak survey in 2014 resulted in 5 leaks being reported on ferrous mains. Minor rehabilitation works undertaken over the last ten years appear to have replaced a number of poor condition mains, with very few leaks reported in the last few years. The leak repair history shows over 1 leak/km from 2014 to 2017, indicating that the remaining ferrous mains are continuing to deteriorate and likely to be in poor condition.

JGN's IR008 response noted that they have completed an initial assessment of the options and a detailed scope was developed in 2018. A business case for the project is expected to be completed at the beginning of 2020 and construction to begin in 2021. JGN's IR025 response advised that they are currently preparing an Options Analysis.

9.4.1 Cost analysis

The project estimate is summarised in the following table.

Table 9-7: Mittagong rehabilitation ($2018, 000)

Item	Project Estimate
Materials	37
Contractor Costs	996
Internal labour & plant	161
Risk Allocation	151
Total direct costs	**1,345**

(Source: PEM model: cost estimate & control2)

The PEM model includes details of how items have been costed and where costs have been used from other similar projects. The level of detail supports an efficient cost estimating process. The project cost for around 3.5 kilometres of mains indicates a unit rate of approximately $[redacted]/m, which would be relatively high in the benchmarking tables provided for other projects.

9.4.2 Conclusion

While minor rehabilitation works over the last few years have addressed a number of the recorded leaks, the recent repairs indicate that the mains are continuing to deteriorate and it would be prudent to rehabilitate the remaining 3.5 kilometres in the near future. The cost estimate information contained in the PEM model is detailed and supports an efficient estimating process.

9.5 NEWCASTLE

The Newcastle MP1 network currently operates at 30kPa and supplies gas to approximately 12,000 customers in 18 suburbs such as Charlestown, Cardiff, Glendale, Kotara and Windale. The total length of mains is approximately 260 km.

The mains are a mix of ferrous (cast iron and steel) and plastic mains (PE and nylon). There are approximately 136km of cast iron and steel mains that were mainly laid during the 1950's and 1960's. These mains are constructed of mainly 50mm, 100mm and 150mm steel mains, as well as 4 inch and 6 inch cast iron mains. From the 1980's, the network has progressively been laid with plastic mains such as nylon and polyethylene.

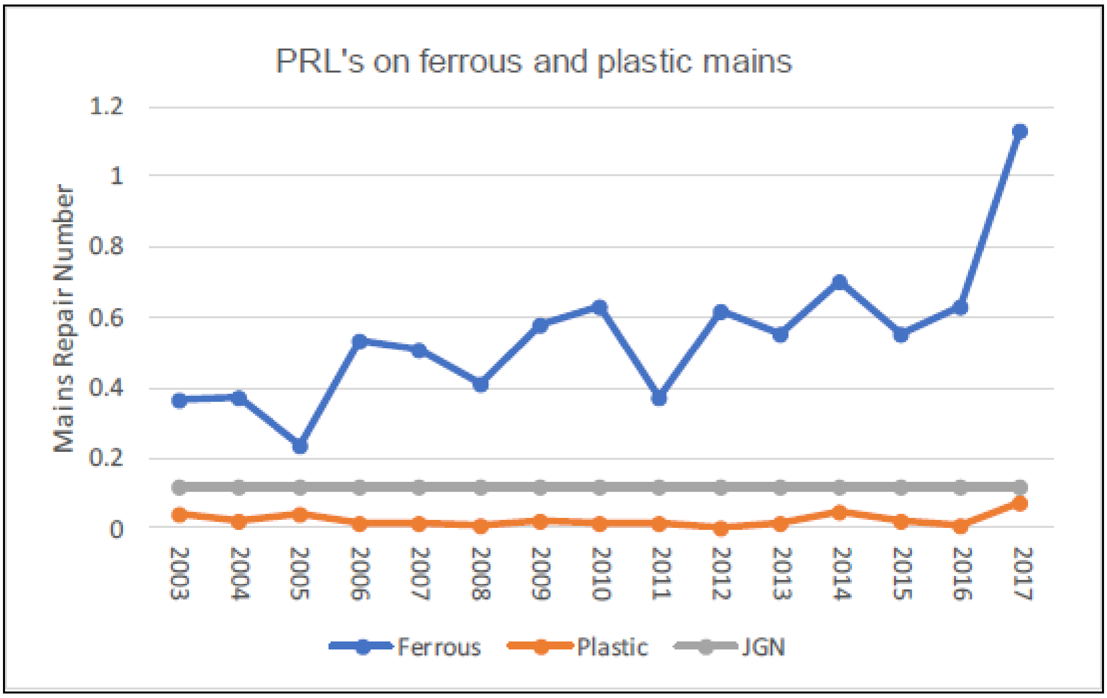
The primary drivers of this rehabilitation project is to address significant corrosion and metal loss on the unprotected ferrous mains, high number of gas leaks which creates a public safety risk and increases in leakage (UAG) losses.

9.5.1 Asset condition analysis

A leakage survey was conducted in 2017 and a further survey is scheduled for 2019 to cover those suburbs not included in the 2017 survey. The 2017 survey found 103 leaks on the steel and cast iron mains, of which 61 were class 1 leaks and a further 14 were class 2 leaks.

The number of public reported leaks per kilometre from 2003 to 2017, shown below, indicates that the networks ferrous mains are deteriorating, with particularly significant increase in 2017.

Figure 9-4: Number of Public Reported Leaks per kilometre



(Source: Options Analysis: Figure 2)

During the 2003 to 2017 period, a total of 788 mains repairs were undertaken on the steel or cast iron mains. It was noted that in 2013 and 2014 some mains rehabilitation was undertaken. Public reported leaks and mains repairs on plastic mains are quite low which indicate that the condition of these mains is satisfactory. A leakage test was performed on part of the network which assessed the unaccounted for gas of approximately 46%.

Analysis of the information provided in the Options Analysis document shows that the steel and cast iron mains are deteriorating, with a significant increase in leaks/km occurring in 2017. In its response (IR008) JGN noted that there were 0.6 leaks/km in both 2018 and the first half of 2019. This indicates leak rates are relatively steady apart from the sharp increase in 2017. JGN noted that there can be variability in leaks from year to year due to repair programs and in particular the weather which impacts the ground conditions.

Considering the historic leakage rates along with the recent information indicates that the networks are in poor condition but not deteriorating at any significant rate. JGN's benchmarking comparisons with some other network companies (refer IR025) shows that the leakage rate for cast iron and unprotected steel in the Newcastle network is not as high as leakage rates experienced in other network companies, which vary between 1.7 to 2.28 leaks/km for cast iron and varying between 0.6 and 6.7 leaks/km for unprotected steel. While we consider that it is prudent to proceed with this project, the timing is more flexible, with JGN currently managing leak repairs and monitoring the networks with its maintenance programs to ensure maximum use of the existing network assets.

9.5.2 Options

The Options Analysis presents five options ranging from maintaining status quo through to full rehabilitation of all mains in the network and increasing pressure to 210kPa. JGN has recommended option three, which involves rehabilitation of all remaining cast iron and steel mains (136km) by inserting new nylon or PE mains and upgrading the pressure to 210kPa and also the transfer of approximately 9,200 customer services to the inserted mains. The 2020 Plan shows that 104 kilometres will be replaced during the 2021-2025 period with the project completing in the following period.

Based on the asset condition analysis, Zincara considers that the rehabilitation project could be reasonably deferred by at least one or two years, as further options.

9.5.3 Cost analysis

The Options Analysis provides a cost estimate summary which it says is benchmarked against similar projects recently completed in Sydney that were subject to competitive tender.

Table 9-8: Newcastle MP1 rehabilitation capex ($2018, 000)

Item	Project Estimate	Estimate 2021-2025
Materials	919	919
Contractor Costs	21,598	16,259
Internal labour	732	732
Risk Allocation	6,601	3,397
Total direct costs	29,850	21,307

(Source: Options Analysis: section 4.3.2)

Details of the cost estimate are provided in the PEM model. The model includes details of how items have been costed and where costs have been used from other similar projects. The level of detail supports an efficient cost estimating process.

A table of benchmarking rates[70] shows a number of recently completed projects within the Sydney area, concluding that the Newcastle rehabilitation project falls "within an acceptable range", with cost/metre of $[redacted]. While the table shows a number of projects there is no information regarding the scope of work undertaken, that would enable comparison with the Newcastle project. However, Zincara's knowledge and experience suggests that the cost per metre rate would appear to be reasonable.

9.5.4 Conclusion

The Newcastle MP1 network rehabilitation project proposes replacement of the remaining 136 kilometres of steel and cast iron mains by way of insertion technique, along with the associated transfer of customer services to the new mains. The project is proposed to commence in 2022 with initial planning, site investigation and FEED study, followed by field works from 2023 through to 2026 in the next regulatory period.

Given the level and trend of leaks, we believe that the mains can continue to be effectively managed for at least one to two years, and thereby maximising the use of existing assets. When considering the overall program and the mains replacement experiences here and around the world, in removing the aging cast iron and unprotected steel, we consider that it would be prudent to defer the project by one year, recognising that there will be ongoing opex and UAG costs during that period. This brings the length of mains rehabilitation program during 2021-2025 to around 105 kilometres (a two year deferral would reduce this period rehabilitation to closer to 60 kilometres, which may be too low). The resulting capex reduction is shown in the following table.

Table 9-9: Mains replacement capex - Newcastle ($2018, 000)

Newcastle	2021	2022	2023	2024	2025	Total
JGN Plan		300	5,158	7,894	7,954	**21,307**
Recommended			300	5,158	7,894	**13,353**
						Difference = -7,954

Details provided in the PEM model indicate that there is an efficient cost estimating process, although the risk allocation of approximately 28% suggests that there is currently a level of uncertainty regarding scope and contractor costs in particular.

9.6 BANKSTOWN / CHULLORA / GREENACRE

The Bankstown / Chullora / Greenacre 7kPa network in south-western Sydney has over 13,000 customers, with approximately 187 kilometres of mains. Rehabilitation works in the mid-1980s replaced large amounts of the existing cast iron, with the remaining cast iron dispersed across the network. The mains comprise a mix of materials and sizes. There are

[70] Newcastel Options Analysis: Appendix D

approximately 22 kilometres of cast iron and unprotected steel mains in the network, with the majority of larger cast iron mains laid in main roads.

A number of Leakage Surveys have been conducted with results shown in the following table. Leaks on cast iron mains account for approximately 30%.

Table 9-10: Leakage survey results

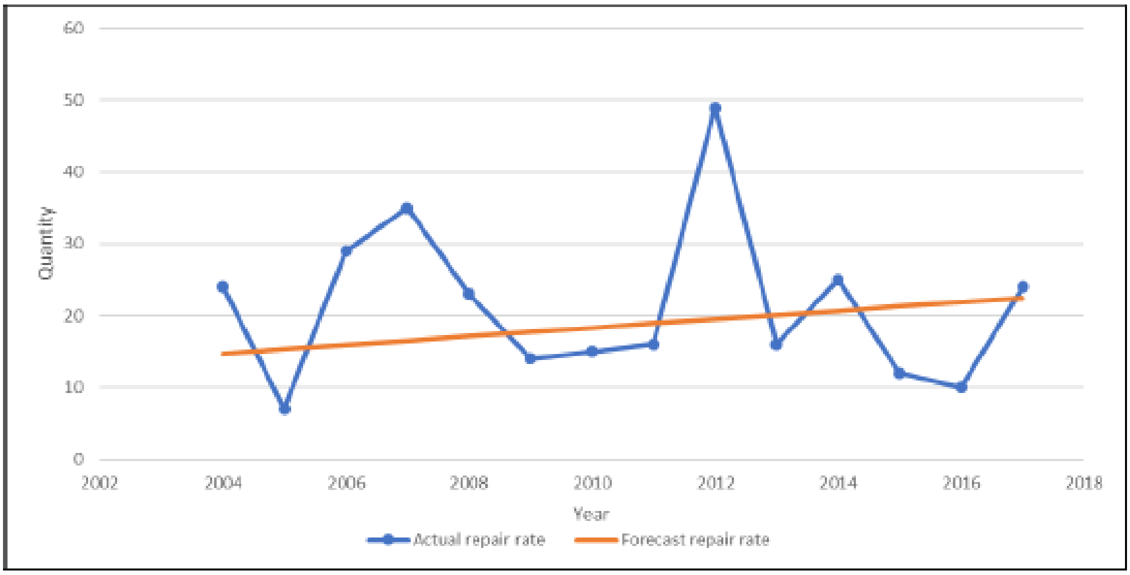
Year	Total number of leaks
2006/07	155
2011/12	113
2016/17	235

(Source: Options Analysis: Table 2)

There have been 745 publicly reported leaks on the network over the last ten years, of which 294 have been on cast iron mains.

The options analysis indicates that the cast iron mains in this network are ranked third highest in terms of repairs per kilometre compared with other networks. In the following figure, the number of mains repairs in 2007 and 2012 were the result of class 1 and class 2 mains repairs identified during the respective leakage surveys of the previous years. Again the number of leak repairs dropped off until the next round of leakage survey was conducted in 2016. While the figure shows an increasing trend in mains repairs it does not indicate how many mains repairs are on cast iron compared to the other mains, nor has there been data provided relating to cast iron mains repairs / kilometre by year. Further information provided (IR008), says there were 3.7 leaks/km in 2018 and 2.8 leaks/km in the first half of 2019, which is a marked increase for the 22 kilometres of remaining cast iron and unprotected steel, compared to the following chart.

Figure 9-5: Number of Mains Repairs



(Source: Options Analysis: Figure 3)

Due to the number of DRS supply points into the network, it has not been possible for JGN to directly measure UAG and they have used rates based on similar networks that have been tested. The resulting UAG of 36% was determined for the network.

The Options Analysis has considered four options, with the preferred option being to rehabilitate all remaining cast iron and steel mains in the network and maintain network pressure at 7kPa. The scope involves:

- Insertion of 22 kilometres of cast iron mains with plastic mains.
- Laying 480m of plastic mains to maintain current network capacity.
- Transfer of up to 1,037 customer services

The project is proposed to commence in 2025 and be completed by 2027.

Cost estimate for the total project and the 2025 component is summarised in the following table:

Table 9-11: Bankstown/Chullora/Greenacre capex ($2018, 000)

Item	Total Project Estimate	Estimate (2021-2025)
Materials	210	119
Contractor Costs	6,486	224
Internal labour	684	203
Risk Allocation	1,984	48
Total direct costs	**9,364**	**594**

(Source: Options Analysis: section 4)

The data provided does not give a clear picture of the condition of the cast iron mains, although with almost 300 leaks on the cast iron mains over the last ten years, it does indicate that these mains are likely to be in poor condition. The recently provided leaks/km data (IR008) for 2018 and first half of 2019 also point to the mains being in poor condition.

The various options all result in negative NPV compared to maintaining the status quo which tends to suggest that the decision to maintain status quo, or proceed with rehabilitation in this case is not driven by cost benefit, but rather safety, reliability and amenity.

JGN's preferred option is to rehabilitate the remaining cast iron mains, with the project commencing in 2025 with a FEED study and site investigation works, followed by delivery in from 2026 through to 2027. Given the leaks/km data, Zincara considers that it would be prudent to commence the study and investigation works as proposed by JGN so that the scope and cost estimate can be more clearly determined.

9.7 HABERFIELD / STRATHFIELD / CAMPSIE

The Haberfield/Strathfield/Campsie network in south-western Sydney has over 30,000 customers, with approximately 430 kilometres of mains. Rehabilitation works in the mid-1980s replaced large amounts of the existing cast iron. There are approximately 27 kilometres of cast iron and unprotected steel mains in the network, with a significant percentage of these mains located in major roads. The network is interconnected to the neighbouring Bankstown/Chullora/Greenacre 7kpa network.

Table 9-12: Leakage survey results (mains only)

Class	Total leaks	Leaks on ferrous mains	JGN average (2012-16)
1	304	80	6%
2	156	20	7%
3	232	73	86%
Total	**672**	**206**	
Leaks/km	**1.56**	**6.40**	**1.33**

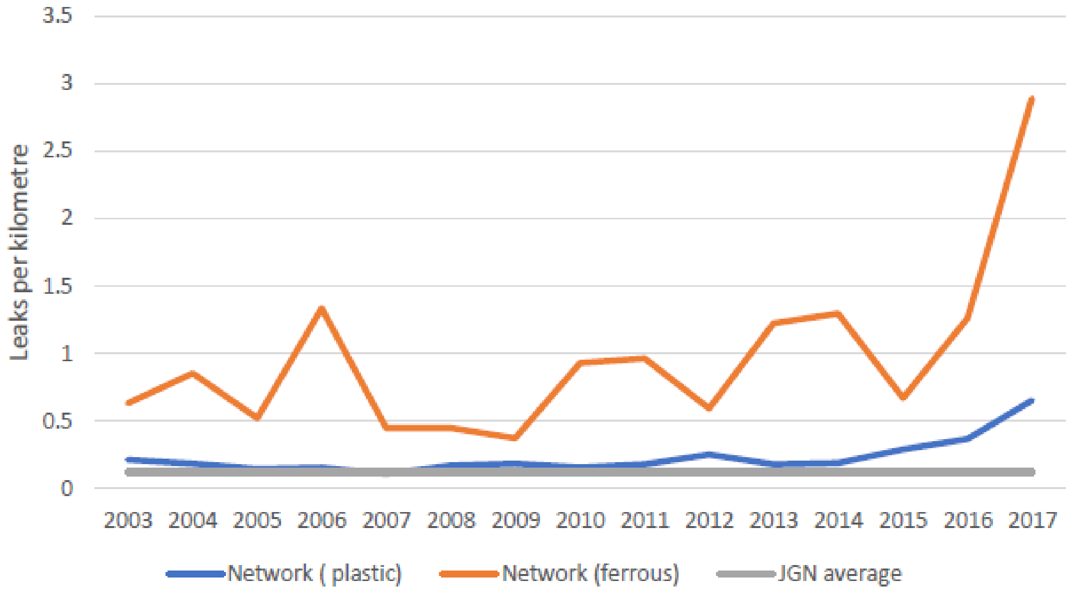
(Source: Options Analysis: Table 2-1)

On the basis of 27 kilometres of ferrous mains, the 100 class 1 and class 2 mains leaks represent a leakage rate of 3.7 leaks/km, which Zincara considers to be high.

The Options Analysis also provides a list of reactive mains replacement projects undertaken from 2010 to 2013, showing expenditure of almost $500k and resulting high cost per metre compared with a planned mains replacement project.

Over the period 2003 to 2017 there were approximately 1,700 public reported leaks, of which 390 occurred on the ferrous mains. Of note is a significant increase in PRLs in 2017. Further information provided (IR008) shows that there were 1.9 leaks/km in 2018 and 0.8 leaks/km in the first six months of 2019. While the most recent data is not quite as high as for 2017, it does indicate that the mains are deteriorating and likely to be in poor condition.

Figure 9-6: Public Reported Leaks per kilometres



(Source: Options Analysis: Figure 2-2)

The mains repairs per kilometre from 2003 to 2017 have been quite variable and around 1 repair per kilometre, with 2017 showing a sharp increase. The information indicates that there is an increasing trend of leaks on ferrous mains.

Each of the considered options result in negative NPV compared to maintaining the status quo which suggests that the decision to maintain status quo or proceed with rehabilitation in this case is not driven by cost benefit, but rather safety, reliability and amenity.

JGN's preferred option is to rehabilitate the cast iron and unprotected steel mains and maintain pressure at 7kPa, with the project proposed to commence in 2025, with a FEED study and site investigation works, and mains replacement commencing in 2026 and be completed by 2028. The proposed scope includes:

- Insertion of approximately 27 kilometres of cast iron mains with plastic mains.
- Laying approximately 1 kilometre of plastic mains to maintain current network capacity.
- Install 3 secondary regulatory sets to augment capacity in the network
- Transfer of up to 1,032 customer services

Cost estimate for the total project and the 2025 component is summarised as follows:

Table 9-13: Haberfield/Strathfield/Campsie capex ($2018, 000)

Item	Total Project Estimate	Estimate (2021-2025)
Materials	324	-
Contractor Costs	7,931	174
Internal labour	684	143
Risk Allocation	2,431	24
Total direct costs	**11,369**	**341**

(Source: Options Analysis: section 4)

Based on the leaks information provided, the remaining cast iron and unprotected steel mains are progressively deteriorating and these mains are likely to be in poor condition. We agree that it would be prudent to commence the study and investigation works as proposed by JGN so that the scope and cost estimate can be more clearly determined.

9.8 MINOR MAINS AND CONNECTION SERVICES RENEWAL

Minor rehabilitation works[71] are required where they pose an unacceptable safety and reliability risk. They are identified from field investigations of high leakage areas or customer complaints and are typically larger than a leak repair activity:

- Mains renewal: Localised renewal of sections of main and associated service and include small areas (greater than twelve metres) of no more than several streets. Project: R-RAC.
- Services renewal: renewal or upgrade of customer service connections. Project: R-RAB.

[71] JGN Minor Capital Allocations – Budgeting and Approval Process

The “Minor Capital Allocations – Budgeting and Approval Process”, says that a three-year average of historic expenditure is applied.

Zincara considers that ad-hoc mains and service connection replacements will occur as a result of reported leaks that may not be satisfactory for repair only. As such we consider that a capex provision is prudent.

9.9 CONCLUSION

JGN’s Rehabilitation Plan shows that the current prioritisation relates mainly to cast iron and unprotected steel mains which will be mostly rehabilitated by around CY2040. The Plan also shows that there is also an increasing level of rehabilitation projects addressing old generation PE and nylon mains extending the Plan out to CY2049.

During the 2016-2020 period, JGN expect to rehabilitate around 85 kilometres of mains, and propose a program to replace 146 kilometres during 2021-2025. Given the types of programs in place for other gas distribution businesses across Australia and around the world, JGN’s program reflects good industry practice.

Our review and analysis of the various mains rehabilitation projects indicate that the condition of the cast iron and unprotected steel mains are deteriorating, with the leakage rate being a key condition indicator. JGN has indicated that it aims to get as much use out of these mains as is possible and we agree that this is a prudent approach. The timing of projects can be somewhat subjective with the ability to extend asset lives through ongoing repairs and maintenance programs. An example being the fact that JGN’s mains replacement program was revised during the 2016-2020 period and the current program further refined between the draft and final 2020 Plan.

With respect to JGN’s current mains replacement program for 2021-2025 period, and based on our asset condition assessments, we consider that there are opportunities to further extend asset lives. With respect to the Newcastle MP1 network rehabilitation project we do see that it can be effectively managed for a further period of time to maximise use of the existing mains.

We propose a one year deferral of the Newcastle MP1 rehabilitation project, which would result in an overall program of mains replacement projects during the 2021-2025 period of approximately 105 kilometres. This is higher, but still somewhat comparable, to the 85 kilometres of mains replacement for the current 2016-2020 period, while expenditure during the two periods would be very similar. As a sensitivity analysis, a two year deferral of the Newcastle project would result in the 2021-2025 program reducing to around 60 kilometres which we believe may not be prudent in terms of the overall program.

Cost estimate details have been provided in the various PEM models. The model includes details of how items have been costed and where costs have been used from other similar projects. The level of detail supports an efficient cost estimating process, however, the risk allocation indicates that there is a level of uncertainty regarding scope details.

Zincara’s recommended mains replacement capex forecast is shown in the following table:

Table 9-14: Mains replacement capex forecast ($2018, 000)

Mains Replacement Project	JGN Plan	Recommended
Kurri Kurri	3,470	3,470
Matraville	9,408	9,408
Mittagong	1,237	1,237
Newcastle	21,307	13,353
Bankstown*	326	326
Haberfield*	341	341
Minor mains renewal	1,500	1,500
Minor connection renewal	4,750	4,750
Total	**42,340**	**34,386**
(deferral of Newcastle MP1 project by one year) Difference = -7,954		

10. CAPITAL EXPENDITURE SHARING SCHEME

10.1 INTRODUCTION

The AER in its 2017 Access Arrangement (AA) Decision for the Gas Distribution Businesses (GDB) in Victoria approved the implementation of a Capital Expenditure Sharing Scheme (CESS). The objective of the CESS is to provide a GDB with an incentive to undertake efficient capital during an AA Period. It achieves this by rewarding a GDB that outperforms its capital allowance and penalizes the GDB that spends more than its capital allowance. CESS provides a mechanism to share efficiency gains and losses between the GDB and Network users. A similar scheme has already been in operation for the electricity network service providers (NSPs).

In its 2019 submission, JGN is proposing a similar CESS mechanism as applied to the Victorian GDB for the AA period 2021-2025 and also under the AER's electricity CESS guidelines.

This chapter does not discuss the merit or otherwise of such a CESS for JGN. If there is a CESS, this chapter examines the factors that should be considered in the operation of a CESS and in particular what are network health indicators (NHI) that will act as a countervailing effect to the CESS. Zincara also considers that the CESS which was implemented for the Victorian GDB should be used as the benchmark test for JGN's CESS except in situations when the NSW circumstances are different to that of Victoria (e.g. extent of low pressure mains in Victoria as compared to NSW which could affect the performance indicators).

JGN's proposal[72] comprises of the same three elements that the AER applied to the Victorian GDB:

1. A CESS mechanism with similar efficiency benefit sharing.

2. A contingent payment index – in a modified fashion more fit for its circumstances.
   a. The term "contingent payment index" has been used instead of "asset performance index" but still continue with the abbreviation API.
   b. A suite of 6 measures chosen for their relevance to the NSW circumstances.

3. A contingent payment factor.

JGN also said that following feedback from its participant workshop early this year, it has decided not to include new connection capex to the total capex under the CESS.

[72] JGN-Attachment 7.11-Incentive Schemes -20190630

10.2 CESS MECHANISM

JGN's proposal for calculating the efficiency gain or efficiency losses is set out as follows:

1. For each year of the AA period, JGN will calculate the NPV of the efficiency gains or losses by subtracting JGN's actual (or estimated, for the final year of the AA period) capex. The gains and losses will be adjusted for the following:

   - Net of any deferrals or capex excluded through ex post reviews from the AER's capex allowance.
   - Pass through amounts or the reopening of capex.

2. Calculate a 30% sharing factor for the total efficiency gains or losses which will be attributed to JGN with the remaining 70% attributed to customers.

3. Calculate the within period financing benefits or costs that accrued through the AA period.

4. Calculating the net CESS reward or penalty by subtracting the within period financing benefit from our share of gains or losses.

5. Applying the contingent payment factor to adjust the net CESS reward or penalty for JGN's service performance.

6. The adjusted CESS reward or penalty would be applied as an additional building block adjustment to JGN's revenue for the AA period.

The proposal is consistent with the CESS proposed for Victorian GDB and as such Zincara recommends acceptance of the proposal.

10.2.1 Deferral Mechanism

JGN proposes that the AER adjust the CESS payment when JGN defers capex in the regulatory period 2020-2025 on the following basis:

- The amount of the deferred capex in the 2021-25 AA period is material;
- The amount of the estimated underspend in capex in the 2021-25 AA period is material; and
- The total approved forecast capex in the 2025-30 AA period is materially higher than it is likely to have been if a material amount of capex was not deferred in the 2021-25 AA period.

Zincara concurs in principle with this approach but believes that the CESS payment should be based on JGN not exceeding any one of the conditions and not on all of the conditions. In addition, the issue of materiality should be sorted out between AER and JGN prior to finalising the CESS mechanism.

10.2.2 Aggregate Capex or Separate Capex Category

JGN proposes that the CESS should apply to the capex in aggregate instead of each expenditure category. The reasons given are:

- Doing so better reflects how JGN actually manages expenditure within an overall allowance (or budget)—changing operating and other factors often require it to rebalance its expenditure to better deliver the service and other outcomes sought by its customers.

- It is simpler with less administrative effort to apply the CESS in aggregate—as only a single set of calculations is needed rather than one for each expenditure category.

- This is the approach applied in Victoria—helping to maintain consistency across jurisdictions.

- The pricing and efficiency outcomes experienced by JGN's customers are a product of the total investment it makes, not the individual category inputs that go into its total program of works.

Zincara believes that this is a reasonable approach. To consider each expenditure category would make the administration of CESS more complicated in terms of how overspent or underspent in each category should be treated. However, Zincara recommends that JGN provides explanations to why the expenditure category is overspent or underspent as it will assist in future review of the effectiveness of the CESS.

10.2.3 Ex-post Capex Review

JGN proposes that any amount that the AER considers non-conforming capex in its ex post review is to be excluded from the actual capex when calculating the annual efficiency gains or losses.

Zincara considers this proposal to be reasonable as the AER would have excluded the capex to be added to the RAB.

10.2.4 Year 5 Treatment

JGN said that it would provide estimate of its capex for its final year (2024-25) for the regulatory period 2020-2025. It also said that when the actual capex differs from the estimate, an adjustment to take into account the difference can be made in the future.

Zincara considers this approach to be reasonable given that at the time of submitting its submission for an AA period, it is unlikely that JGN would have final capex for the last year of the AA period.

10.3 CONTINGENT PAYMENT INDEX

JGN proposes a contingent payment index which is similar to the Asset Performance Index (API). It said that its CESS should take into account its operating environment in NSW as the Victorian CESS has taken into account the operating environment in Victoria.

Following its consultation process, JGN had shortlisted its proposed measures to the following:

- Unplanned SAIFI[73]
- Unplanned SAIDI[74]
- Leaks in mains and services
- Leaks in meters
- Confirmed poor supply
- Estimates of meter reads

JGN proposed that the target setting for its proposed measures be based on the following approach:

- Setting a target for each measure;
- Using five year of historical data when available; and
- Using a simple average to avoid unnecessary complexity.

Based on its historical data, JGN's proposed targets are shown in the table below.

Table 10-1 JGN's Calculated Targets

Measure	Basis	Target	Data Source
Unplanned SAIFI	Outages per 1,000 customers	3.33	RIN response for customer numbers and outage frequency data
Unplanned SAIDI	Hours per 1,000 customers	40.95	RIN response for customer numbers and outage duration reported to NSW Fair Trading for outage that affects 5 or more customers
Mains and services leaks	Leaks per km of mains	0.16	RIN response for mains length and leak data

[73] **Interruption frequency.** The indicator for interruption frequency is called System Average Interruption Frequency Index (**SAIFI**). It measures the number of occasions per year when each customer could, on average, expect to experience an interruption. It is calculated as the total number of customer interruptions, divided by the total number of connected customers averaged over the reporting period. It is reported for Unplanned, Planned and Total.

[74] **Minutes-off-supply.** The indicator for customer minutes-off-supply is called System Average Interruption Index (**SAIDI**). It measures the total minutes, on average, that a customer could expect to be without gas over the reporting period. It is reported for Unplanned, Planned and Total.

Meter leaks	Leaks per 1,000 customers	8.15	RIN response for customer and leak data
Poor quality supply	Events per 1,000 customers	0.92	RIN response for customer numbers and poor quality supply event data
Estimated meter reads	% estimates	5.93%	SAP data.

Source: JGN-Attachment 7.11-Incentive schemes-20190630.
Note1: the basis for SAIDI is shown as hours per 1,000 customers. However, the spreadsheet JGN-Attachment 7.12- Illustrative CESS model shows it as minutes per 1,000 customers. Zincara believes that the basis should be minutes per 1000 customers. However, for the purpose of consistency to the submission, Zincara has retained the same basis.

Note2: JGN had adjusted the meter read data to remove the meter reads that were estimated based on factors outside its control e.g obstructed meters or removed meters and no access.

In regard to weighting the measures to turn the six measures into a single index, JGN proposed the weights to align with the capex program:

- performance is strongly aligned to our capex program – 30% weighting; and
- performance is moderately aligned to our capex program – 10% weighting.

The table below shows the weighting for each of the measure.

Table 10-2 Weightings for the Various Measures

Measure	Weighting %
Unplanned SAIFI	10
Unplanned SAIDI	10
Mains and services leaks	30
Meter leaks	10
Poor quality supply	30
Estimated meter reads	10

Source: JGN-Attachment 7.11-Incentive schemes-20190630.

Zincara's Comments

Zincara concurs with JGN's view that the measures selected should be relevant to the NSW market and not adopt that of the Victorian GDBs due to difference in the operating environment. For the purpose of CESS, Zincara believes that JGN's operational performance should be measured under the following broad categories:

1. Reliability and availability
2. Safety
3. Customer Satisfaction
4. Connection conditions
5. Environmental Impact

Zincara is of the view that the measures should also have some capex relationship. Appendix A provides a raft of KPIs that are used by JGN for its own internal monitoring of its assets. JGN's approach of streamlining the KPIs to six for CESS purposes makes the process manageable and as such is considered reasonable.

JGN has not included its connection capex for CESS and as such category 4 Connection Condition has not been included as part of the assessment of the measures. In relation to the other categories, Zincara considers that the measures proposed in Table 10-1 fall within the broad categories as shown in the table below.

Table 10-3: Categorisation of Measures

Measure	Category
Unplanned SAIFI	Reliability and Availability
Unplanned SAIDI	Reliability and Availability
Mains and services leaks	Safety
Meter leaks	Safety
Poor quality supply	Reliability and Availability
Estimated meter reads	Customer Satisfaction

Zincara therefore recommends acceptance of JGN's measure.

In relation to the targets as shown in Table 10-1, JGN has calculated the targets based on each of the measure's five year actual performance. Zincara considers that these targets should not be less than JGN's own internal targets. As shown in Appendix A, the target for the number of estimated reads is 5%. However, in Table 10-1, JGN is proposing a target of 5.93% which is "lower" than its own internal target.

Zincara believes that where the actual performance targets are below the internal targets, a business will strife to achieve these internal targets which may result in additional expenditure. As such, it will be lowering the performance levels if we accept the actual performance without consideration to the internal targets. In addition, where the business has consistently performed above its internal targets, the new targets should be set at the actual performance as it would be expected that the expenditure occurred would have sustained the improvement.

In addition, Zincara also considers that any outliers should not be included in the setting of targets. As can be seen in the table there is an outlier in 2013-14.

Table 10-4: SAIDI Performance for Five Years

Measure	2014	2015	2016	2017	2018	Average
SAIDI minutes per 1,000 customers	152	6	13	13	21	40.95

Source: JGN-Attachment 7.12-Illustrative CESS model-20190621

Zincara therefore recommends a review of JGN's own internal target for each measure and how that compares with the proposed target before finalizing the targets.

In relation to the weightings of each target, Zincara believes that JGN's approach of aligning the weighting to the extent that it aligns with the capex program is reasonable and the approach is consistent with the Victorian CESS.

10.4 CONTINGENT PAYMENT FACTOR

JGN proposes that a contingent payment factor be applied to scale down rewards where the CPI performance is less than the target level. It proposes to use a similar sliding scale to that of the Victorian GDB's CESS. Details of the sliding scale and the lower performance threshold are:

- JGN will receive a 30% share of the reward of an underspend if its weighted average service performance (as measured by the contingent payment index) is at, or above, target.
- JGN will receive no share of the reward of an underspend if its service performance falls below the lower performance threshold. In this case consumers will receive higher benefit of the underspend.
- JGN will receive a share of the 30% reward of an underspend along a sliding scale if its service performance falls within a range. It receives more of the benefit the closer its service performance is to the top of the range and less of the benefit the closer its service performance is to the bottom of the range.

As in the Victorian CESS, JGN's proposal is that the threshold of performance below which no reward is payable for an underspend is an index score of 80 (compared to a base index score of 100).

Zincara's Comments

Zincara concurs with the use of a sliding scale to determine the contingent payment factor (CPF) which is to be applied to the reward. Zincara also accepts the framework of the scaling scale outlined in the three dot points above. However, Zincara is concern about the range of the performance threshold range of 80 to 100. JGN's justification is that it is consistent with the Victorian CESS. An acceptance of this range would imply that the service level can drop by 20 base points or 20%.

As can be seen from the table below, the actual performance level of each of the measure is relatively constant ecept SAIDI. SAIDI has only a 10% weighting so its overall effect is not that significant.

Table 10-5: Five Year Results of Performance Measures

Measure	2014	2015	2016	2017	2018	Average
SAIFI outages per 1000 customers	2.88	3.50	3.78	3.45	3.06	3.33
SAIDI minutes per 1,000 customers	152	6	13	13	21	40.95
Leaks per km of main and services	0.15	0.17	0.15	0.18	0.15	0.16
Meter leaks per 1000 customers	6.68	7.54	6.89	9.79	9.87	8.15
Supply quality events per 1000 customers	0.88	1.21	1.11	0.83	0.57	0.92
% of reads estimated						5.93%

Source: JGN-Attachment 7.12-Lilustrative CESS model-20190621
Note: The data for average for the estimated reading is from July 2016 – Jan 2019

Zincara therefore considers that a 10 base point drop which gives a range of 90 – 100 would be more acceptable.

10.5 CONCLUSION

Zincara concurs with JGN's CESS proposal for calculating efficiency gains and losses. JGN's proposal consist of three elements:

1. A CESS mechanism with similar efficiency benefit sharing.
2. A contingent payment index – in a modified fashion more fit for its circumstances.

    a. The term "contingent payment index" has been used instead of "asset performance index" but still continue with the abbreviation API.
    b. A suite of 6 measures chosen for their relevance to the NSW circumstances.

3. A contingent payment factor.

CESS Mechanism

Zincara also supports JGN's proposal on the following matters:

- The mechanism for calculating the efficiency gains and loss.
- Capex should be considered in aggregate.
- AER to adjust the CESS payment when JGN has deferred material capex in the 2020-2025 period. However, Zincara recommends the issue of materiality needs to be sorted out before finalizing the CESS mechanism.
- Any capex that the AER considers is non-conforming during its ex-post review should be excluded from the actual capex when calculating the annual efficiency gain.
- The final year of the regulatory period will only be an estimate. Any adjustment can be done in the future following the receipt of actuals.

Contingent Payment Index

The measures and the weightings for the measures are considered reasonable.

However, the targets for the measures based on five year actuals should not be accepted without due consideration of JGN's internal targets or any outliers.

Contingent Payment Factor (CPF)

The use of a sliding scale to determine the contingent payment factor is considered reasonable. However, the performance threshold of 80 to 100 for which JGN will receive its CPF is considered too wide. A range of 90-100 would be more acceptable.

Appendix A

JGN Customer KPIs and Performance at 31 December 2018

Calendar Year (CY)	Measure	CY18		
		Actual	Target	Performance
Monthly (CY)	% of first time resolution of enquiries received	91.93%	80%	
Monthly (CY)	Percentage of meters activated within 5 business days from installation	77%	95%	
Monthly (CY)	Resolution time for customer claims ≤15 days	12	15	
Monthly (CY)	Percentage of standard electricity to gas (E-G) connections completed within 20 days	95.08%	95%	
Monthly (CY)	Reduction of Ombudsman case investigations	9	84	
Monthly (CY)	Percentage of customers who receive more than 2 estimates in a 12-month period	5.42%	4%	
Monthly (CY)	% of estimated reads JGN	3.62%	5%	
Monthly (CY)	Basic connection offers % delivered within time [1]	99.92%	95%	
Monthly (CY)	Negotiated gas connection offers % delivered within 60 business days [1]	99.92%	95%	
Annual (CY)	JGN customer satisfaction (Annual survey) [1]	TBA	64%	
Annual (CY)	Demonstrate improvement in reputation survey results from retails and large customers [1]	TBA	≥Mod /Avg	
Rolling (12 mth)	Planned outage customer notification [1]	100%	99%	

(1) New measure introduced for 2019

Source: Attachment 5.3 Network Asset Management Plan

JGN's Asset Safety and Reliability KPI and Performance at 31 December 2018

Calendar Year (CY)	Measure	CY18		
		Actual	Target	Performance
Monthly (CY)	Network incidents notifiable to technical regulator	70	150	
Monthly (CY)	Type B high pressure pipeline encroachments	4	6	
Monthly (CY)	Agreed actions from internal & external audits (FSA/SMS/NCR) not closed off within 1 month of due date (year-end focus)	0	0	
Rolling (12mth)	GIS outstanding	100%	95%	
Rolling (12mth)	Public reported escapes per 1000 customers	12.94	14	
Monthly (CY)	Percentage of emergency response jobs attended to within 30 minutes	87.40%	85%	
Monthly (CY)	Third party hits (rolling 12 months)	2508	2520	
Monthly (CY)	Type A high pressure pipeline encroachments	0	0	
Monthly (CY)	Pipeline patrol scheduled compliance	100%	99%	
Monthly (CY)	Maintenance plan compliance	97.49%	90%	
Monthly (CY)	High risk valves proving (Completion of maintenance activities for high risk areas)	99.11%	95%	
Monthly (CY)	SCADA availability	99.98%	99.96%	
Monthly (CY)	Customer hours off supply	21409	16000	
Monthly (CY)	Number of odourant level non-conformances to targeted levels	0	4	
Rolling (12 mth)	Unaccounted for gas (UAG)	2.05%	2.53%	
Rolling (12 mth)	Poor supply incidents reported by the public per 1000 customers	0.63	1.40	

Source: Attachment 5.3 Network Asset Management Plan

Appendix B
Connections – Unit Rates and Volume Rates

Unit Rates ($2018): Historic rates and calculation of forecast rates

	2013	2014	2015	2016	2017	2018	JGN	Zincara	Comment
New Homes:									
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Apply 5 year average.
Commercial:									
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Apply 5 year average.
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Apply 5 year average.
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	2016 not reflective of trend. Remove that year and average remaining four years of RY14-RY18.
Electricity to Gas:									
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	2017 not reflective of trend. Remove that year and average remaining four years of RY14-RY18.
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Apply 5 year average.
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Apply 5 year average.

(Source: Connections Capex Forecast: "Input: AA reset E5")

In the above table, JGN applies a four-year average (2015–2018). Zincara has applied five-year average in the first instance. Where the two sets of averages are similar, we have accepted the JGN average unit rate. Where there is an outlier (ie. not reflective of the trend), then that rate is removed and the average of the remaining four years of the 2014-2018 period is applied. Otherwise the five-year average is applied.

The above unit rates are then adjusted to account for price adjustments mainly due to changes in contractor rates. Refer to following table:

Price adjusted unit rates ($2018)

	Unit Rate (Zincara)	Price Adjustment Factor	JGN: price adjusted unit rate	Zincara: price adjusted unit rate
New Homes:				
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]
Commercial:				
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]
Electricity to Gas:				
Mains ($/m)	[redacted]	[redacted]	[redacted]	[redacted]
Services ($/service)	[redacted]	[redacted]	[redacted]	[redacted]
Meters ($/connection)	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Connections Capex Forecast: "Calc: Adjusted rates New Homes, I&C and Electricity to Gas)

Volume Rates ($2018): Historic rates and calculation of forecast rates

	2013	2014	2015	2016	2017	2018	JGN	Zincara	Comment
New Homes:									
Mains (m/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Trend to smaller frontages. Consider 2018 is expected to be representative of forecast period.
Service (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Commercial:									
Mains (m/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	2018 not reflective of trend. Remove that year and average remaining four years of 2014-2018.
Service (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Electricity to Gas:									
Mains (m/connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Service (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Accept JGN (similar to 5 year average)

(Source: Connections Capex Forecast: "Calc: Volumes")

In the above table, JGN applies a four-year average (2015–2018). Zincara has applied five-year average in the first instance. Where the two sets of averages are similar, we have accepted the JGN average unit rate. Where there is an outlier (ie. not reflective of the trend), then that rate is removed and the average of the remaining four years of the RY14-YR18 period is applied. Otherwise the five-year average is applied.

The exception relates to the New Homes average mains length. Zincara considers that 2018 is expected to be representative of the forecast period with trends of smaller frontages in new estates. IR023 response provides a draft (unaudited) mains length for 2019 showing 14.65m, which tends to support our recommendation.

Appendix C

Residential Gas Meter: Planned Replacement: 2021-2025: Analysis

Note: All meter volumes are as at January 2019
Source: Meter Replacement Volume Forecast Model: "Meter Information".
Convert to RY by halving each of the respective CY, then adding accordingly.
Volumes will decrease over time due to meters removed for sample testing, defective meters, difficult access etc, to achieve the final forecast volumes

JGN Metering Forecast Methodology:

1. Tests in accordance with Australian Standards
2. Meters first tested at 13 years to determine whether meters to be replaced at 15 years (Fail), or extend field life to 20 years (Pass). They are tested again two years prior to the end of their extension. The Volume Model (Meter Information) shows test results (at 13yrs, 18yrs and 23yrs) for each family.
3. Where meter families have not yet been tested, then JGN assume that meters will pass their 15 and 20 year life extensions and will be replaced at 25 years, when they are expected to fail the testing. JGN does not account for the proportion of meters which will fail these tests.

Meter families planned for replacement during the 2021-2025 period

Age replaced		Start (CY)	Replace (CY)	Volume (CY)	Volume (RY)	Comment
15 years:	*(all to be removed)*					
[redacted]	[redacted]	2005	2020	[redacted]	[redacted]	Failed 13 yr test, remove at 15 years. 50/50 split to get 2021
Miscellaneous			2020-25	[redacted]	[redacted]	Remove at 15 years. includes 50/50 split of CY20 and CY25
				[redacted]	[redacted]	
30 years:	*(due for test at 28 years)*					
[redacted]	[redacted]	1993	2023	[redacted]	[redacted]	No information in Volume Model as to whether any FLE testing has been conducted of meters at "28-yrs", with potential for field life extension to 35 years.
[redacted]	[redacted]	1993	2023	[redacted]	[redacted]	
[redacted]	[redacted]	1993	2023	[redacted]	[redacted]	
[redacted]	[redacted]	1994	2024	[redacted]	[redacted]	

[redacted]	[redacted]	1994	2024	[redacted]	[redacted]	
[redacted]	[redacted]	1995	2025	[redacted]	[redacted]	
[redacted]	[redacted]	1995	2025	[redacted]	[redacted]	
				[redacted]	[redacted]	
Age replaced		Start (CY)	Replace (CY)	Volume (CY)	Volume (RY)	Comment
25 years:	*(due for test at 23 years)*					
[redacted]	[redacted]	1996	2021	[redacted]	[redacted]	Passed test CY2009 and CY2014.
[redacted]	[redacted]	1996	2021	[redacted]	[redacted]	JGN has assumed to fail next test due CY2019
				[redacted]	[redacted]	
[redacted]	[redacted]	1997	2022	[redacted]	[redacted]	Passed tests CY2010 and CY 2015
[redacted]	[redacted]	1997	2022	[redacted]	[redacted]	JGN has assumed to fail next test due CY2020
[redacted]	[redacted]	1997	2022	[redacted]	[redacted]	Assume don't test below 1,000 meters
[redacted]	[redacted]	1997	2022	[redacted]	[redacted]	
[redacted]	[redacted]	1997	2022	[redacted]	[redacted]	
				[redacted]	[redacted]	
[redacted]	[redacted]	1998	2023	[redacted]	[redacted]	Passed tests in CY2011 and CY2016.
[redacted]	[redacted]	1998	2023	[redacted]	[redacted]	JGN has assumed to fail next test due CY2021
[redacted]	[redacted]	1998	2023	[redacted]	[redacted]	
[redacted]	[redacted]	1998	2023	[redacted]	[redacted]	
				[redacted]	[redacted]	
[redacted]	[redacted]	1999	2024	[redacted]	[redacted]	Passed tests in CY2012 and CY2017.
[redacted]	[redacted]	1999	2024	[redacted]	[redacted]	JGN has assumed to fail next test due 2022.
[redacted]	[redacted]	1999	2024	[redacted]	[redacted]	Assume don't test below 1,000 meters
[redacted]	[redacted]	1999	2024	[redacted]	[redacted]	
				[redacted]	[redacted]	
[redacted]	[redacted]	2000	2025	[redacted]	[redacted]	Split 50/50 for 2026/2026
[redacted]	[redacted]	2000	2025	[redacted]	[redacted]	Passed tests in CY2013 and CY2018

[redacted]	[redacted]	2000	2025	[redacted]	[redacted]	JGN has assumed to fail next test due CY2023
[redacted]	[redacted]	2000	2025	[redacted]	[redacted]	Assume don't test below 1,000 meters
				[redacted]	[redacted]	
			Total 25 year meters =		[redacted]	

From the above table, the total residential gas meters (15, 25 and 30 year) listed for replacement during 2021-2025 = [redacted]. As this volume is at January 2019, there will be some reduction due to replacement of defective meters, meters removed for statistical sample testing and son on. These adjustments are reflected in the volumes shown in the Meter Replacement Capex Forecast Model which shows [redacted] meters planned for replacement.

Analysis: Residential gas meter planned replacement

With reference to the information in the above table, we make the following comments:

1. **15 year meters**: The [redacted] meters have failed their sample testing (at 13 years) and therefore need to be replaced when they reach 15 years. Miscellaneous meters are typically small meter families that are not cost effective to test and therefore are to be replaced at 15 years.
2. **20 year meters**: There are no meter families currently identified to be replaced at 20 years.
3. **25 year meters**: The table shows that there are [redacted] meters that will reach 25 years of age during 2021-2025. JGN methodology assumes that all of these meters are not expected to pass test at 23 years of age and are therefore planned for replacement at 25 years. We consider that a number of meter families, will pass this test and be field life extended to 30 years, thereby reducing the overall planned replacement program for 2021-2025. Our analysis and recommendations are detailed below.
4. **30 year meters**: The table shows around [redacted] meters will reach 30 years of age during 2021-2025 and JGN has planned that they are not expected to pass further testing and therefore will be replaced. While there is no quantified data provided to support this view, for the purposes of our analysis, we have not proposed any of these meter families will be further field life extended. However, we consider it prudent that the statistical sample testing be undertaken to determine whether any families pass and can be further field life extended.
5. **15 and 20 year meters not yet tested at that age**: We note JGN's methodology whereby meter families that have not yet been tested, are assumed to pass their 15 and 20 year life extensions. JGN says[75] that this "reflects the performance we have seen over the last few years where most meters have passed their 15 and 20 year life extensions". We also note that JGN does not account for the proportion of meters which will fail these tests.

[75] IR026 response.

The following analysis relates to the 25 year meters, and our recommendations are based on information provided by JGN in its initial submissions, including Options Analysis, the Meter Replacement Volume Forecast Model and responses to our information requests. The volume forecast model includes "Meter Information" which provides details for planned replacement for CY2019 onwards and therefore does not include any information relating to test outcomes prior to that year.

The above table shows that the following meter types will reach 25 year life during 2021-2025:

- [redacted] [redacted] meters
- [redacted] [redacted] meters
- [redacted] [redacted] meters
- [redacted] [redacted] meters
- [redacted] [redacted] meters
- [redacted] [redacted] meters

[redacted]**:** The meter information shows that there are [redacted] meters that have been field life extended and will reach 30 years during CY2023-25. As there is no information that indicates that the meters due for testing will fail, we consider that they will pass and therefore be extended to 30 years.

[redacted]**:** Meters purchased between CY1996 and CY2005, meaning that the first family to be tested at 23-years will be in CY2019. JGN's response ([redacted]) says that [redacted], noting that [redacted] However, they also say that [redacted]. Given the age profile of these meters, this suggests that the first family to reach the 25 year testing has in fact passed. Over [redacted] meters have passed the earlier (15 and 20 year) tests and are now coming due for the 25 year testing. We have not seen any quantified information to show that the meters will fail this test. Based on our review of the available information, and given the fact that one family of these meters has recently passed the 25 year testing, we believe that it would be prudent to consider that at least some meter families will successfully pass the test and be field life extended to 30 years.

[redacted]**:** JGN's [redacted] response says that [redacted]. The available information indicates these meters were purchased between CY1993 and CY2000, so the first family due for testing at this age was in CY2016. The information shows that [redacted] tested in CY2016 passed ([redacted] meters) and was extended to 30 years, while [redacted] and was scheduled for replacement in CY2019. The next families due for testing will be in CY2020 and CY2021. It is also noted that families due for testing in CY2022 and CY2023 are small and hence are not expected to be tested and are planned for replacement. Based on the information available we consider that at least one of the two families to be tested, will pass the test and be field life extended to 30 years.

[redacted]: [redacted] [redacted]. This meter type were purchased from CY1997 to CY2007, so the first family for 25 year test is due in CY2021 but this is a small family with [redacted] meters, so is not expected to be tested. There are [redacted] that can be tested from CY2021. Based on the information available we consider that some of the families will pass the test and be field life extended to 30 years.

[redacted]: These meters were purchased between CY1997 and CY2002, so the first family due for testing at 23 years will be in CY2020. [redacted] The response does not quantify the volume of [redacted] and with [redacted] meters, we consider it prudent to undertake the testing. With no other information to indicate the failure of the meters, we consider that some families can be expected to pass and be field life extended to 30 years.

Developing the volume of meters that can successfully pass their statistical sample testing and be further extended to 30 years, is complex because each family of meters can have unique performance outcomes, with actual results not known until the testing of each family is performed during the next few years. Based on our analysis, we consider that the following table represents a prudent view of meter families that pass testing and therefore are field life extended to 30 years.

In the following table we have converted CY2025 (Calendar Year) meters to reflect 2025 by halving the volumes. For the other years they are shown in the table as Calendar Years. We have done this to show volumes for the 2021-2025 period.

Also in the table we assume that meter families with less than 1,000 meters will not the tested, but planned to be replaced at the end of their current field life, as they are too small for testing.

Meter Type and associated families: Proposed Pass / Fail volumes

	Year (CY/RY)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Year Total
Meter families	CY2021	[redacted]	[redacted]					[redacted]
	CY2022		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	CY2023		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
	CY2024		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
	RY2025		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
	Total:	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
Pass	CY2021	[redacted]	[redacted]					[redacted]
	CY2022			[redacted]		[redacted]		[redacted]
	CY2023							[redacted]
	CY2024				[redacted]			[redacted]
	RY2025		[redacted]		[redacted]			[redacted]
	Pass Total:	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
	% Pass:	[redacted]%	[redacted]%	[redacted]%	[redacted]%	[redacted]%		[redacted]%
Fail	CY2021							[redacted]
	CY2022		[redacted]		[redacted]		[redacted]	[redacted]
	CY2023		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
	CY2024		[redacted]	[redacted]		[redacted]		[redacted]
	RY2025			[redacted]		[redacted]		[redacted]
	Fail Total:	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]

Reflecting the above results, the following table shows a proposed planned meter replacement program:

Residential gas meter: Planned Meter Replacement (Recommended)

	CY2020	CY2021	CY2022	CY2023	CY2024	CY2025	Total Replace
15 year meters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
30 year meters				[redacted]	[redacted]	[redacted]	
25 year meters			[redacted]	[redacted]	[redacted]	[redacted]	
Total Replace (CY2020 – CY2025):	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
		RY2021	RY2022	RY2023	RY2024	RY2025	
Convert to RY totals:		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Factored RY Totals*		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Proposed Program Volumes (rounded)		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
JGN 2020 Plan volume**		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Volume Difference:							[redacted]
Capex Forecast							
Unit Rate: $[redacted]***							
Proposed Capex		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
JGN 2020 Plan Capex		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Capex Difference:							[redacted]

* To allow for reduced volumes arising from meters removed as defective, statistical testing etc, we have applied a factor calculated by comparing “Meter Information” volumes (per Meter Volume Model) and planned meter replacement volume forecast in the Capex Forecast Model.
** per the planned meter replacement volumes in JGN Meter Capex Model
***Unit Rate: as per Meter Capex Model.

Appendix D

Facilities and Pipes Details

Refurbishment of AS 2885 Pipework in Pits (Real $000 2018)

Project Name	Project ID	2021	2022	2023	2024	2025	Total
Refurbishment of AS2885 pipework's in pits -Auburn PRS	10022451	12	-	-	-	-	12
Refurbishment of AS2885 pipework's in pits -Flemington PRS	10022444	637	33	-	-	-	670
Refurbishment of AS2885 pipework's in pits - Mascot PRS	10022454	45	637	33	-	-	715
Refurbishment of AS2885 pipework's in pits - Tempe PRS	10022455	45	728	33	-	-	806

Source: Zincara's analysis

The refurbishment of the Auburn PRs was carried out in the current AA period. The cost of $12,000 is a carryover from the current AA period.

Facilities Security Upgrade TRS (Real $000 2018)

Project Name	Project ID	2021	2022	2023	2024	2025	Total
Facility Security Upgrade - Hexham TRS	10022601	-	38	632	-	-	670
Facility Security Upgrade - Plumpton TRS	10022605	-	24	460	-	-	484
Facility Security Upgrade - Wyong TRS	10022604	-	38	540	14	-	592

Source: Zincara's analysis

The variation in costs for the sites is due to the different sizes of the sites. The subcontractors' costs have been taken from previous works.

Facilities Risk Based Safety Upgrade (Real $000 2018)

Project Name	Project ID	2021	2022	2023	2024	2025	Total
Facilities Risk Based Safety EI Upgr - Kooragang Island	10018708	164	253	-	-	-	417
Facilities Risk Based Safety EI Upgr - Wilton CTS	10018699	164	253	-	-	-	417
Facilities Risk Based Safety EI Upgr - Auburn PRS	10020150	67	345	5	-	-	417
Facilities Risk Based Safety EI Upgr - Flemington PRS	10020148	67	345	5	-	-	417
Facilities Risk Based Safety EI Upgr - Mascot	10018717	67	330	5	-	-	402

PRS							
Facilities Risk Based Safety EI Upgr - Tempe PRS	10020149	67	303	5	-	-	375
Facilities Risk Based Safety EI Upgr - Bowral TRS	10020157	13	67	345	5	-	430
Facilities Risk Based Safety EI Upgr - Mortlake ALBV	10020152	13	67	238	5	-	323
Facilities Risk Based Safety EI Upgr - Moss Vale TRS	10020159	13	67	312	5	-	397
Facilities Risk Based Safety EI Upgr - Penrith PRS	10020153	13	67	320	5	-	404
Facilities Risk Based Safety EI Upgr - Plumpton TRS	10020151	-	13	67	468	5	553
Facilities Risk Based Safety EI Upgr - Sally's Corner POTs	10020162	-	13	67	299	5	384
Facilities Risk Based Safety EI Upgr - Mt Keira TRS	10020161	-	13	67	345	5	430
Facilities Risk Based Safety EI Upgr - Moorebank PRS	10020176	-	13	67	228	5	313
Facilities Risk Based Safety EI Upgr - Riverwoord PRS	10020175	-	-	13	67	228	308
Facilities Risk Based Safety EI Upgr - West Hoxton TRS (all runs)	10020177	-	-	13	67	468	548
Facilities Risk Based Safety EI Upgr - Bathurst TRS	10020181	-	-	10	49	238	297
Facilities Risk Based Safety EI Upgr - Blayney TRS	10020188	-	-	10	49	238	297
Facilities Risk Based Safety EI Upgr - Cowra TRS	10020189	-	-	-	10	49	59
Facilities Risk Based Safety EI Upgr - Goulburn TRS	10020179	-	-	-	10	49	59
Facilities Risk Based Safety EI Upgr - Lane Cove PRS	10020170	-	-	-	13	67	80
Facilities Risk Based Safety EI Upgr - Marulan TRS	10020180	-	-	-	10	49	59

Source: Zincara's analysis