Gas Distribution
Asset Management Plan
2016 – 2026

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Gas Distribution
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Executive Summary

Summary of the Asset Management Plan

Vector's strategic vision is to:

"Create a new energy future"

with a focus on five strategic pillars:

- **SUSTAINABLE GROWTH**
- **CUSTOMER FOCUS**
- **OPERATIONAL EXCELLENCE**
- **PARTNERSHIPS**
- **SAFETY, PEOPLE AND CULTURE**

This Asset Management Plan (AMP) supports achieving Vector's vision.

Purpose of the Plan

The purpose of this AMP is to comply with the requirements set out in the Commerce Commission's Gas Distribution Information Disclosure Determination (Determination). It covers a ten year planning period starting from 1st July 2016.

The AMP accurately represents asset management practices at Vector as well as the forecasted ten year capital and maintenance expenditure on the Vector gas distribution network. The objectives of the AMP are to:

- Inform stakeholders about how Vector intends to manage its gas distribution network based on information available at preparation;
- Demonstrate alignment between gas network asset management and Vector's vision and goals;
- Demonstrate that safe asset management processes are in place;
- Provide visibility of effective life cycle asset management at Vector;
- Provide visibility of the level of performance of the network;
- Provide guidance of asset management activities to its staff and field service providers (FSPs);
- Provide visibility of forecast gas network investment programmes and forecast medium-term construction activities to external users of the AMP;
- Demonstrate innovation and efficiency improvements;
- Discuss the impact of regulatory settings on future investment decisions;
- Discuss expected technology and consumer developments and the asset investment strategies to deal with a changing environment; and
- Meet Vector's regulatory obligations under the aforementioned Determination.

From an asset manager perspective the AMP:

- Analyses customer trends and expectations;
- Supports continued efficient improvement in Vector's performance;

- Is essential to Vector's goal to continually improve its asset management practices; and
- Will help the Vector Group achieve its overarching vision.

Business Operating Environment

Qualification

This AMP represents Vector's current and best view of the ongoing investment, maintenance and operational requirements of its gas network, in the current operating environment.

Vector follows an annual budget process and the implementation of the works programmes may be modified to reflect any changing operational and economic conditions as they exist or are foreseen at the time of finalising the budget, or to accommodate changes in regulatory or customer requirements that may occur from time to time. Any expenditure must be approved through normal internal governance procedures. This AMP does therefore not commit Vector to any of the individual projects or initiatives or the defined timelines described in the plan.

Regulatory Factors

Vector's gas distribution network is subject to price and quality regulation under Part 4 of the Commerce Act 1986 administered by the Commerce Commission (the Commission).

Vector supports a regulatory framework that provides certainty and the right investment incentives. This is particularly important given technology developments in energy are heightening the risk of asset stranding. Shorter economic asset lives is one way of addressing the uncertainty that technology change may have on investment decision making.

In this respect, the cost of capital needs to continue to recognise the "fuel of choice" position reticulated gas distribution networks have and their lower level of household penetration. The risk faced by distributors is increasing, and this needs to be reflected in the way the cost of capital is set.

Distributors also currently bear growth and CPI forecast risk when the Commission set prices under a weighted average price cap, the current preferred form of control for gas distribution networks. Where the Commission's growth forecasts are exaggerated this will compromise the ability of distributors to realise their regulated return.

MWH review of Vector's previous AMP

Vector notes that its 2013 AMP was subject to a review and rated by engineering consulting firm MWH appointed by the Commission to review gas pipeline business AMPs. For that review Vector's AMP was rated at 2.9 out of a maximum score of three from the range of criteria used by MWH. This AMP broadly follows the same style as the AMP reviewed by MWH. In this AMP Vector has also implemented changes recommend by MWH by including more context and detail on design standards in the form of an additional table setting out this information in a user friendly format.

Factors Specific to the Auckland Region

Vector notes that the significant and sustained growth and the increasing high cost of living expected in the Auckland region is not reflected in the rest of New Zealand. The pressures this places on the existing network infrastructure and the activities Vector must undertake to support this growth must be considered in the regulatory treatment of Vector’s network.

Vector anticipates that Auckland will experience continued population increase and associated growth in business activities and gas demand for the foreseeable future. However, the extent to which this population growth translates into new gas connections varies considerably over years, and network reinforcements are therefore deferred until sufficient certainty of new developments and network demand is obtained.

Future network reinforcement will inevitably involve conventional asset investment, but will also employ emerging technology, (e.g. fuel cells) to enhance utilisation of existing network assets and defer investments where feasible to do so. Underlying all of this, Vector will continue to ensure a safe and reliable gas supply, meeting Vector’s customers’ gas demand requirements.

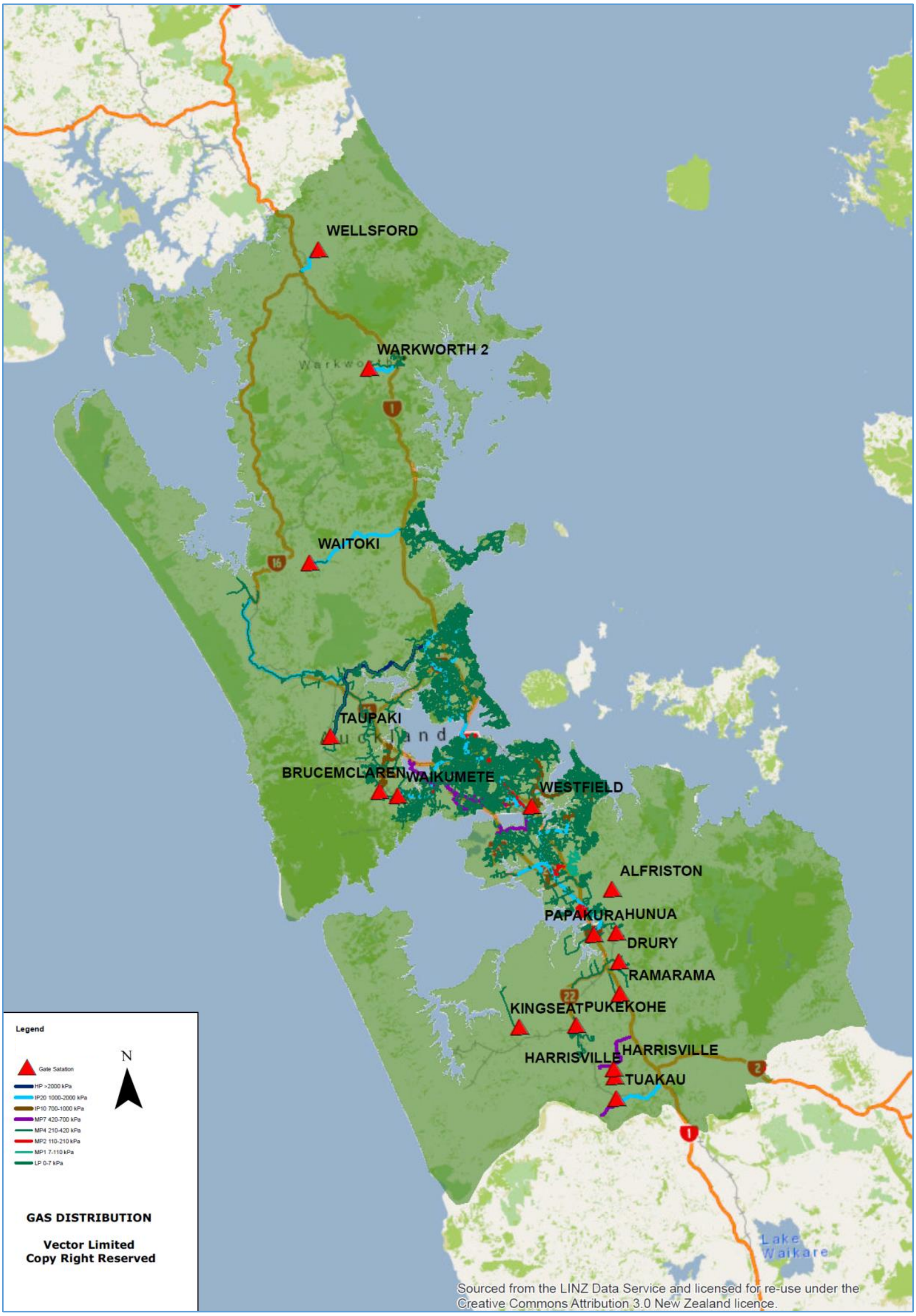
Improvements in the AMP and Asset Management at Vector

This AMP builds on the previous plans and incorporates further developments in Vector’s approach to and thinking on asset management. Important further changes recorded in this AMP include:

- Network augmentation plans have been thoroughly reviewed and updated, reflecting new load forecasts, customer connection and relocation activity.
- The 10 year capex and maintenance forecasts were updated to reflect the sale of the non-Auckland gas distribution assets to First Gas Limited.
- Vector’s updated asset management maturity assessment results are included.

Vector’s Network

Vector’s natural gas distribution network assets are located within the Auckland Council and the northern part of the Waikato District Council areas. The northern limit is defined by the Northland Regional Council and Auckland Council boundary. The southern limit is defined by the Waikato River from the west coast to State Highway 1, and then the boundary separating the Auckland Council and the Waikato District Council towards the East coast. The map below shows the extent of Vector’s gas distribution network supply area.



WELLSFORD
WARKWORTH 2
WAITOKI
TAUPAKI
BRUCEMCLAREN
WAIKUMETE
WESTFIELD
ALFRISTON
PAPAKURA
HUNUA
DRURY
RAMARAMA
KINGSEAT
PUKEKOHE
HARRISVILLE
HARRISVILLE
TUAKAU
Legend
Gate Satation
HP >2000 kPa
IP20 1000-2000 kPa
IP10 700-1000 kPa
MP7 420-700 kPa
MP4 210-420 kPa
MP2 110-210 kPa
MP1 7-110 kPa
LP 0-7 kPa
N
GAS DISTRIBUTION
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Network Summary (Year ending 30 June 2015)

Description	2015
Consumers connected (no.)	101,744
System length (km)	6,274
Consumer density (consumer/km)	16.2
Gate stations	16
District regulating stations (DRS)	305
DRS density (system km/DRS)	20.6
DRS utilisation (consumers/DRS)	334
Peak load (standard cubic meters per hour)	94,900
Gas conveyed (PJ pa)	12.6

Demand Forecasts

Historical trends show gas demand is influenced by: economic activities in an area, consumer preferences, availability of substitute fuels (such as electricity, fuel oil, bottled gas etc.), population / household growth, socio-economic factors and most significantly climate. In the short-term, gas demand is very sensitive to climatic conditions. A cold snap, for example, could cause a momentary sudden and significant increase in demand for gas. Conversely, a warm winter could result in a materially lower demand. Hence on a year–by-year basis, demand can vary significantly.

A more recent trend in energy efficiency of gas appliances and greater choice in energy sources (such as affordable solar PV and battery storage) also means there is a greater risk of more customers seeking out new technology solutions for their energy needs. Alternative energy sources such as solar PV are becoming more prevalent for Auckland network users during "life events" such as home renovations and can result in a dramatic decline in gas usage as users change their heating or water heating to achieve greater "energy independence."

Our forecast of gas demand suggests that overall the network will have modest growth in gas conveyed on an annual basis. The exceptionally high peak demand hours occur due to extreme weather conditions and normally represent only a small percentage of hours in a year.

Network Costs

On 20 April 2016 Vector sold 100% of Vector Gas, which owned the gas transmission network and the gas distribution network outside of Auckland. Approximately 130 staff responsible for operating these networks transferred with the business to the new owner, First Gas.

As a result of the sale, Vector's corporate/shared services costs have reduced, particularly in relation to insurance, information technology and professional services costs that will no longer be incurred. However as at 30 June 2016, Vector was continuing to provide a number of transitional services to the First Gas in respect of network management, information technology, regulatory and finance. Once these transitional services are complete (sometime in the regulatory year ending 30 June 2017), we would expect Vector's corporate cost base will reduce further.

Despite the reduction in Vector's overall corporate cost base, the quantum of this cost allocated to Vector's Auckland gas network has increased directly as a result of the sale. This is due to loss of significant economies of scale that Vector enjoyed in managing multiple networks. A number of the corporate functions undertaken by Vector will not scale as a result of the sale of Vector Gas, for example the Vector board and executive team will remain unchanged and the regulatory compliance burden associated with gas distribution will not change despite the fact that our gas distribution business is now significantly smaller.

Despite the sale of Vector Gas, in some areas the Vector corporate team is increasing in size, as a result of an ever increasing focus on health and safety, increasing demands for improved cyber security, and as a direct result of the significant challenges in responding to unprecedented growth in Auckland. Growth in Auckland over the next 10 years is expected to more than replace the Vector Gas RAB that has been sold to First Gas. As a result, any corporate costs savings as a result of the sale of Vector Gas are unlikely to be sustained in the long term.

Network Development

Planning Criteria

Vector’s approach to network development planning is driven by:

- Ensuring the safety of the public, staff and service providers;
- Meeting network capacity and security requirements in an economically efficient manner;
- Customer needs, which vary by customer segment and are reflected by service level standards and associated pricing;
- Striving for least life-cycle cost solutions (optimum asset utilisation) and optimum timing for capex;
- Maximising capex efficiency in a sustainable manner;
- Outcomes that improve asset utilisation take into account the increased risk trade-off;
- Incorporating enhanced risk management strategies and processes into Vector’s planning philosophy;
- Reference to targets set by industry best practice where economic and practical;
- Ensuring assets are operated within their design rating; and
- Meeting statutory requirements.

Vector’s planning criteria are detailed in Section 5.

Network Development Plan

Vector’s ten-year network development plan is described in Section 5.

Based on these demand forecasts and Vector’s network planning criteria, various projects are planned (and alternatives considered) to ensure that supply capacity and security will be maintained at economic levels. Planning is detailed for the first five years of the plan, but only indicative for the following five years as the nature and timing of disruptive technology and consumer behaviours is difficult to predict.

Service Commitment

Vector contracts with energy retailers for line services, while end users contract with energy retailers for both energy and line services (interposed arrangement).

Vector's gas quality of supply standards are explained in detail in Section 5 of this AMP.

Asset Management Planning

Maintenance Planning Policies and Criteria

Vector's overall philosophy on maintaining network assets is based on four key factors:

- Ensuring the safety of consumers, the public and the network field staff;
- Ensuring reliable and sustainable network operation, in a cost-efficient manner;
- Achieving the optimal trade-off between maintenance and replacement costs. That is, replacing assets only when it becomes more expensive to keep them in service. Vector has adopted, where practicable, condition-based assessments rather than age based replacement programmes; and
- Integration (alignment) of asset management practices given Vector is a multi-utility asset manager.
- Vector has developed maintenance standards for each major class of asset it owns. These detail the required inspection, condition monitoring and maintenance tasks, and the frequency at which these are required. The goal of these standards is to ensure that assets can operate safely and efficiently to their rated capacity for at least their full normal lives. Data and information needs for maintenance purposes are also specified.

Based on these maintenance standards, to ensure that all assets are appropriately inspected and maintained, Vector's maintenance contractors develop an annual maintenance schedule for each class of asset they are responsible for. The asset maintenance schedules are aggregated to form the overall annual maintenance plan which is implemented once it has been signed off by Vector. Progress against the plan is monitored monthly.

Defects identified during the inspections are recorded in the FSPs defect database with an electronic copy being kept by Vector. FSPs prioritise the defects for remedial work based on risk and safety criteria (which are reviewed by Vector's asset specialists).

Root cause analysis is normally undertaken as a result of faulted equipment. This is also supplemented by fault trend analysis. If performance issues with a particular type of asset are identified, and if the risk exposure warrants it, a project will be developed to carry out the appropriate remedial actions. The asset and maintenance standards are also adapted based on learning from such root cause analysis.

The following summarises the different types of maintenance programmes for the gas network assets:

- Preventative maintenance: Asset inspections as per asset management standards, condition testing as specified in asset management standards and inspection intervals based on industry best practice and Vector experience;
- Corrective maintenance: Correction of defects identified through preventative maintenance;
- Reactive maintenance: Correction of asset defects caused by external influences, or asset failure; and
- Third party services: Asset protection (e.g. pipeline location and marking, issuing close-approach consents).

Asset Renewal Planning

Vector's asset renewal plans are discussed in Section 6. The overall asset-condition of various asset categories is discussed in detail, highlighting areas where upgrades or renewal is required (as well as the process and factors to support these decisions). This forms the basis of the ten-year asset renewal programme.

In general Vector replaces assets on a condition-assessment rather than age-basis. Vector strives to achieve the optimal replacement point where the risk associated with asset failure and the likelihood of this occurring becomes unacceptably high, and it is more economically efficient to replace an asset than to continue to maintain it.

Vector is continually monitoring local and international developments in asset maintenance. As part of its ongoing improvement programme, Vector is focusing on improved risk identification and management practices to direct future renewal and maintenance activities.

Risk Management

Risk Management Policies

Managing risk is one of Vector's highest priorities. Risk management is practiced at all levels of the organisation and is overseen by the Board Risk and Assurance Committee, the Executive Risk and Assurance Committee and Vector's Chief Risk Officer.

Vector's risk management policy is designed to ensure that material risks to the business are identified, understood, and reported and that controls to avoid or mitigate the effects of these risks are in place. Detailed contingency plans are also in place to assist Vector in managing high impact events.

The consequences and likelihood of failure or non-performance, current controls to manage these, and required actions to reduce risks, are all documented, understood and evaluated as part of the asset management function. Risks associated with the assets or operations of the network are evaluated, prioritised and dealt with as part of the network development, asset maintenance, refurbishment and replacement programmes, and work practices.

Asset-related risks are managed by a combination of:

- Reducing the probability of failure through the capital and maintenance work programme and enhanced work practices, including design standards, equipment specification and selection, quality monitoring, heightened contractor and public awareness of the proximity of or potential impact of interfering with assets; and
- Reducing the impact of failure through the application of appropriate network security standards and network architecture, selected use of automation, robust contingency planning and performance management of field responses.

The capital and maintenance asset risk management strategies are outlined in the Asset Maintenance and Network Development sections (Section 6 and Section 5 respectively). Vector's contingency and emergency planning is based around procedures for responding to and restoring gas in the event of a fault on the network, and is detailed in Section 8.

Vector also recognises that information technology (IT) systems are a very important part of its business and asset management framework. Vector operates real-time network monitoring systems, deeply integrated with the IT systems of the rest of the business. Potential compromise of the (cyber) security of Vector's IT systems, including real-time control systems, is recognised as a major (and increasing) business and network risk. Over the past three years Vector has implemented several enhancements to its cyber-security systems to manage this risk and create a more robust operating environment. Further security enhancements will be implemented on an ongoing basis.

Health and Safety

At Vector, safety is a fundamental value, not merely a priority. Vector is committed to a goal of zero harm to people, assets and the environment. Vector's Health and Safety Policies can be found in Section 8. In summary, the policies are developed to ensure safety and wellbeing of its staff, contractors and the public at its work sites and around its assets.

To achieve this Vector aims to comply with all relevant health and safety legislation, standards and codes of practices; establish procedures to ensure its safety policies are followed; encourage its staff and service providers to participate in activities that will improve their health, safety and wellbeing; and take all practical steps to ensure its FSPs adhere to Vector's health and safety policies and procedures.

Sustainability

Vector's environmental policy has been developed to monitor and improve Vector's environmental performance and to take preventive action to avoid adverse environmental effects of Vector's operation.

To achieve this Vector will:

- Plan to avoid, remedy or mitigate adverse environment effects of Vector's operations; and
- Focus on responsible energy management and energy efficiency for all Vector's premises, plant and equipment where it is cost effective to do so.

Vector's long term operational objectives with regard to environmental factors are to:

- Utilise energy as efficiently as practicable;
- Plan for the future reduction of emissions and in particular the management of greenhouse gas emissions;
- Wherever practical, use ambient and renewable energy; and
- Influence and work with and within our supply chains to maximise energy efficiency.

Approval of the AMP and Reporting on Progress

Approval of this disclosure AMP was obtained at the August board meeting and published on Vector's website on 1 September 2016. This timing is aligned with the extension granted by the Commerce Commission in their letter dated 20 June 2016.

Progress in implementing Vector's AMP is regularly monitored, and progress against its investment plans and asset performance measured through several metrics, including:

- Health, safety and environmental performance;
- Monthly overall expenditure against budget;
- Progress of key capital projects against project programme and budget;
- Response time to emergencies (RTE); and
- Progress with risk register actions.

Financial Forecasts

The following tables summarise Vector's capital and operations and maintenance expenditure forecast covering the AMP planning period.

2016 AMP	Financial Year ($000)										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Consumer connection	17,245	14,420	14,543	14,812	14,951	15,083	15,135	14,878	15,052	15,236	151,355
System growth	1,018	1,327	1,687	818	1,663	460	530	1,120	1,120	460	10,203
Asset replacement and renewal	1,680	1,300	1,225	1,725	1,725	1,725	1,725	1,725	1,725	1,725	16,280
Asset relocations	2,324	3,020	2,340	2,964	2,096	1,488	1,760	1,760	1,760	1,760	21,272
Quality of supply	263	386	408	527	200	139	0	0	0	0	1,923
Legislative and regulatory	0	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	241	210	210	0	0	0	0	0	0	0	661
Capital Expenditure on network assets	**22,771**	**20,663**	**20,414**	**20,847**	**20,635**	**18,895**	**19,150**	**19,483**	**19,657**	**19,181**	**201,696**
Non Network Assets	1,270	1,735	1,380	1,459	1,743	1,556	1,540	1,773	1,581	1,480	15,517
Capital Expenditure on assets	**24,040**	**22,398**	**21,793**	**22,306**	**22,378**	**20,450**	**20,691**	**21,256**	**21,237**	**20,661**	**217,210**

* Figures are in 2017 real New Zealand dollars

** The forecasts are inclusive of cost of finance and in line with Vector's business practice

Table 1-1 : Capital expenditure forecast

2016 AMP	Financial Year ($000)										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Service interruptions, incidents and emergencies	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	19,910
Routine and corrective maintenance and inspection	2,496	2,499	2,501	2,504	2,507	2,510	2,513	2,515	2,518	2,521	25,084
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0	0
System operations and network support	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	30,740
Business support	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	44,120
Total Operational Expenditure	**11,974**	**11,977**	**11,979**	**11,982**	**11,985**	**11,988**	**11,991**	**11,993**	**11,996**	**11,999**	**119,864**

* Figures are in 2017 real New Zealand dollars

Table 1-2 : Total Operational Expenditure Forecast

Gas Distribution
Asset Management Plan
2016 – 2026

Background and Objectives – Section 2

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2. Background and Objectives

2.1 Introduction

This AMP covers a ten year planning period, from 1 July 2016 through to 30 June 2026[1] and was approved by the board of directors on 23 August 2016[2].

The first five years of the plan is based on detailed analysis of customer, network and asset information and hence provides a high degree of accuracy in the descriptions and forecasts. The capital and maintenance budgets set out in the Plan, particularly for the first year, are important inputs into Vector's annual budgeting cycle.

The latter period of the Plan is based on progressively less certain information and an accordingly less accurate and detailed level of analysis. From year five on, the AMP is only suitable for provisional planning purposes.

2.2 Asset Management Strategy

Asset management is critical for ensuring Vector's gas distribution business provides safe and reliable services which meet the needs and expectations of our consumers, helps to achieve the business's commercial and strategic objectives, and satisfy its regulatory obligations. Effective planning helps ensure Vector maintains and invests appropriately in its network. Vector's ongoing goal is to ensure good industry practice in asset management, given its critical nature to the business and consumers, while reflecting the regulatory and economic environment within which the network operates.

Vector also recognises that providing a network that is safe to customers, the public and operators alike is a top priority. This is reflected in Vector's work processes and standards.

Asset management is strongly influenced by safety and customer needs as well as commercial, financial and regulatory requirements:

- Safety is one of Vector's key priorities. The company's health and safety policy sets out the directives of Vector's health and safety framework to ensure health and safety considerations are part of all business decisions;
- Customer needs and expectations, along with safety and technical regulations, are the key determinants of network design. Network layout and capacity is designed to ensure contracted or reasonably anticipated customer demand can be met during all normal operating circumstances. Quality of supply levels, which relate to the level of redundancy built into a network to avoid or minimise outages under abnormal operating conditions, have been translated into the Vector gas distribution network quality of supply standards. These standards balance customer requirements and the value they place on reliability of supply with the level of service Vector can economically and safely provide;

  Most direct interaction with customers occurs through the Customer Excellence group. Asset management involves close interaction with the Customer Excellence to assist with understanding and addressing customer technical requirements, consumption forecasts and upcoming developments;
- There are technical and commercial regulations around how networks are allowed to be built and operated, how network services are provided and sold, and the limits on

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[1] Vector operates to a June financial year. All asset management and financial reporting is carried out based on its financial calendar. Works programmes and the corresponding expenditures presented in this document align with its financial reporting timeframes. This plan covers the ten financial years from 1st July 2016 to 30th June 2026.

[2] This timing is aligned with the extension granted by the Commerce Commission in their letter dated 20 June 2016.

commercial returns on investments. These regulations directly influence investment decisions. There are also a number of regulatory compliance rules that have an impact on network configuration and operations;

Regulatory certainty and a suitable rate of return on investments are critical to the investment framework, given the long-term nature of the assets and the need for gas distribution businesses to have confidence that they can expect to recover their cost of capital (i.e. earn a sustainable commercial return) from efficient and prudent investment. Importantly, Vector also has to attract capital both locally and from offshore;

Direct contact with the regulators is generally maintained through the Regulatory group, which in turn works with the Asset Manager to provide guidance on regulatory issues and requirements. Setting and executing regulatory strategy is also closely intertwined with asset investment activities;

- Vector operates in a commercial environment where shareholders expect a commercially appropriate return on their investments reflecting the risk of the investment. To maintain commercially sustainable returns, Vector has to ensure it is able to make optimal investment in the network, including maintenance, replacement, upgrades and new assets, while always keeping safety as a priority. This requires demonstration that investment decisions are not only economically efficient, but that realistic alternative options have been investigated to ensure the most beneficial solution – technically and commercially – is applied. This may involve taking a view on likely future technical changes in the energy sector.

  In addition, financial governance has a direct and significant bearing on asset management. Capital allocation and expenditure approvals are carefully managed in accordance with Vector's governance policies. Short and long-term budgeting processes take into account the balance between network needs, construction resources and available funding – requiring careful project prioritisation.

  Asset management, in particular where expenditure is involved, therefore requires close interaction with the Finance and Network Services groups.

In the context described above, an AMP was developed to define and record Vector's asset management policies, responsibilities, targets, investment plans and strategies to deal with the future of the gas distribution network. It describes Vector's asset management policies, responsibilities, targets, investment plans and strategies to provide confidence to its board and regulators that it has considered all options to ensure the gas distribution network is maintained and enhanced to deliver a commercially sustainable return to shareholders and meets the needs of consumers, while ensuring safe and efficient gas distribution network operations. It also reflects feedback obtained from customers on their requirements for the quality and cost of their gas distribution supplies, and the manner in which they interact with Vector. The Plan sets out the forward path for Vector's gas network capital investment and maintenance needs and how we intend to address these.

As such, the AMP, along with associated processes and documents form a key input into the budgeting process. These documents are intended to assist the executive with the budget process, clarifying the gas network priorities and also prioritising these along with other business investment needs.[3] The regulatory regime and economic conditions directly impact on the return Vector is able to make on its assets, which in turn determines the revenue which Vector is able to earn and the extent it is able to invest in its networks.

2.2.1 Purpose of the AMP

The purposes of this AMP are to:

[3] As with all companies, Vector does not have unlimited cash resources, and competing investment needs and commercial opportunities have to be balanced.

- Demonstrate that safe management processes are in place;
- Inform stakeholders how Vector intends to manage and expand its gas distribution network based on information available at preparation;
- Demonstrate the impact of regulatory settings on future investment decisions;
- Demonstrate alignment between gas network asset management and Vector's goals and values;
- Demonstrate innovation and efficiency improvements;
- Provide visibility of effective life cycle asset management at Vector;
- Provide visibility of the level of performance of the network;
- Provide guidance of asset management activities to its staff and FSPs;
- Provide visibility of forecasted gas network investment programmes and upcoming medium-term construction programmes to external users of the AMP;
- Discuss Vector's views on expected technology and consumer developments and the asset investment strategies to deal with a changing environment; and
- Meet Vector's regulatory obligation under the aforementioned Determination.

This AMP does not commit Vector to any of the individual projects or initiatives or the defined timelines described in the Plan. Vector follows an annual budget process and the implementation of the works programmes may be modified to reflect any changing operational and economic conditions as they exist or are foreseen at the time of finalising the budget, or to accommodate changes in regulatory or customer requirements that may occur from time to time. Any expenditure must be approved through normal internal governance procedures.

2.2.2 Alignment with Corporate Vision and Goals

Vector's strategic vision is to:

"**Create a new energy future**" with a focus on five strategic pillars:

SUSTAINABLE GROWTH

Enhancing our financial performance and growth while innovating to deliver shareholder value.

CUSTOMER FOCUS

Engaging with our customers to deliver value and exceed expectations.

OPERATIONAL EXCELLENCE

Excelling at what we do while managing our impact on the environment and the communities in which we operate.

PARTNERSHIPS

Engaging and collaborating with key partners to develop a range of innovative options for creating a new energy future.

SAFETY, PEOPLE AND CULTURE

> Providing a safe and great place to work that values diversity and develops skilled people who can lead our company in to the future.

The group's vision is supported by the strategies of the various Vector business units. Asset management, as captured in this AMP, is a key part of the regulated networks business plan and consequently plays an important part in achieving the overall Vector vision.

Table 2-1 below demonstrates how asset management supports Vector to achieve its strategic objectives.

Group Goal	← Asset Management in support of
Customer Focus	• Providing safe and reliable services • Fit-for-purpose network designs • Understanding and reflecting customer needs in designs • Security and reliability levels adapted to customer needs • Meeting regulatory requirements • Maintaining appropriate price/quality trade-off
Safety, People and Culture	• Safety is a top priority • Health and safety, environmental and risk management principles embedded in asset investment decisions and work practices • Asset management and performance expectations clearly set • Clear roles and responsibilities
Sustainable Growth	• Investigate new technologies and associated opportunities • Optimise capital contributions • Support commercially attractive investments • Innovation and optimal investment efficiency • Economies of scale from long-term view • Strategic scenario planning
Operational Excellence	• Full compliance with health, safety and environmental regulations • Asset and operational needs clearly defined • Understanding risks • Technical excellence • Reliable asset information source • High quality network planning • Effective maintenance planning • Fit-for-purpose network designs • Providing reliable service • Security and reliability levels adapted to customer needs • Easy-to-maintain and operate networks • Investigate new technologies and opportunities offered • Clear prioritisation standards • Clear roles and responsibilities for asset management • Strong, well-documented asset management processes • Clear communication of network standards and designs
Partnerships	• Engaging appropriate business partners to achieve business outcomes efficiently and safely

Table 2-1 : How asset management supports Vector's group goals

The Asset Owner determines the operating context for the Asset Manager, focusing on corporate governance, strategies and goals, and the relationship between regulatory issues and other stakeholder requirements. The Asset Manager interprets these strategies and goals and translates the strategic intentions into an asset investment strategy which is supported by a series of asset management policies. These are documented in the AMP. Technical standards, work practices and equipment specifications support the asset management policies, guiding the capital and operational works programmes.

Performance of the network is monitored against a set of performance indicators that are based on realising customer expectations, meeting regulatory requirements, meeting safety obligations and achieving best-practice network operation. Performance monitoring ensures resources are optimally allocated to the appropriate areas.

The diagram in Figure 2-1 illustrates the relationship between Vector's corporate strategies and goals with its asset management policy framework.

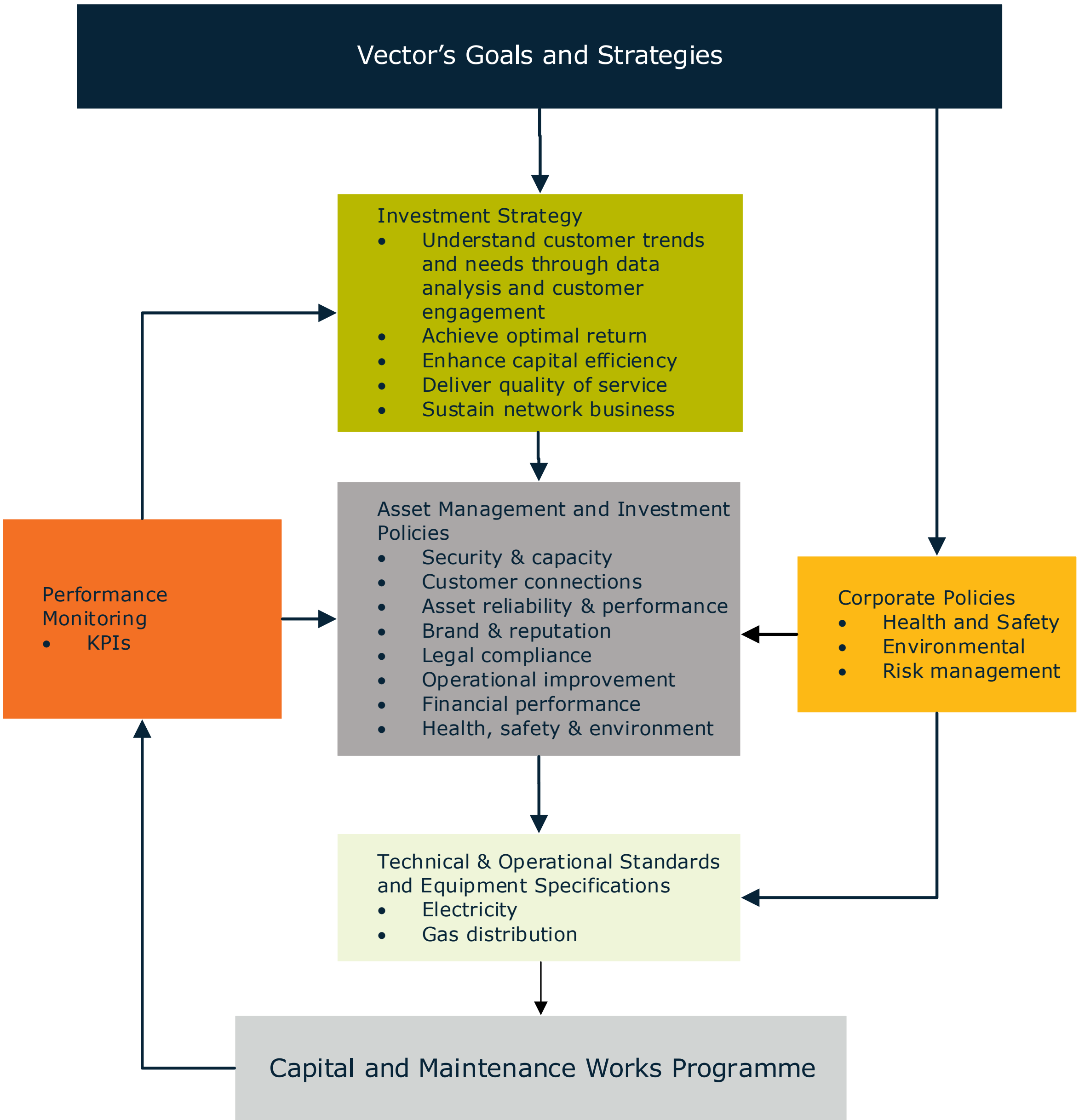


Figure 2-1 : How Vector's asset management strategies relate to the strategic goals

Vector's gas network asset management objective is to efficiently and effectively deliver safe and reliable gas network services to customers at a quality commensurate with their technical and economic preferences.

2.2.3 Aligning Network Investment with Strategy

The diagram in Figure 2-2 shows the high level asset investment process within Vector. This highlights the relationship between the different asset creation and evaluation processes within Vector and how they align with Vector's business objectives and service level targets.

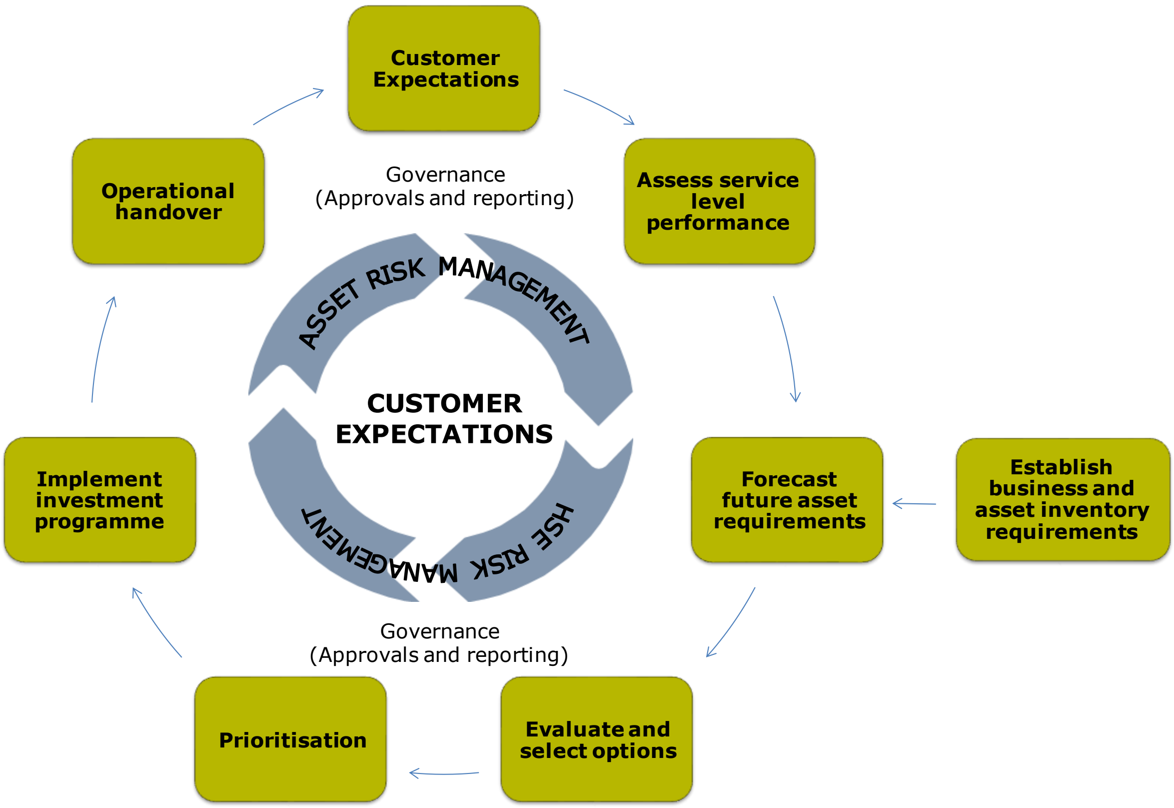


Figure 2-2 : High-level overview of the Vector asset investment process

Information on the performance, utilisation and condition of existing assets and the different parts of the network is needed to forecast future investment, renewal or upgrading requirements and improve service level. This requires ongoing monitoring of asset condition and network performance, the consumption of resources associated with maintaining the assets, and the efficiency and effectiveness with which assets are utilised (including network configuration).

The levels of service required from the gas network are guided by the wider business requirements including the overall asset management strategy. These requirements in turn are determined by Vector's operating environment and reflect corporate, community, environmental, financial, legislative, institutional and regulatory factors together with stakeholder expectations.

The combination of asset condition and performance drivers, load demand and the business requirement drivers form the basis for assessing future asset needs and the resulting network development plans. As Vector operates a gas network in a changing environment, future requirements are likely to differ materially from the situation faced today. Section 5 discusses the anticipated impact of some of these variables, and Vector's development strategies to position for this.

Once the future network or asset requirements are established, options for addressing these needs have to be evaluated and potential solutions have to be identified. Decision tools and systems used to support the evaluation of options include load-flow analysis, effective capital budgeting techniques, optimised renewal modelling, life-cycle costing, risk assessments and geographic information. At the same time, the feasibility of non-network or unconventional solutions to address network requirements is also considered.

Vector broadly categorises asset investment planning in two main streams:

- Network development planning is undertaken to ensure service target levels are met in an environment of increasing load (demand) growth, or increased customer quality expectations. It is based on systematic analysis of maximum demand trends, consumer requests and demographic estimates. Vector’s approach to network development planning is set out in Section 5; and
- Asset maintenance and replacement planning is undertaken to ensure assets remain fully functional for their reasonably expected lifespan when operating within expected design ratings. It also includes activities to prolong asset lives or to enhance asset performance. Maintenance planning addresses both capital investments on renewal or refurbishment, or long, medium and short-term asset maintenance. Vector’s approach to maintenance planning is set out in Section 6.

Prioritisation is a process that ranks all projects identified during the network development and maintenance planning processes. This process ensures only projects that meet Vector’s investment thresholds and strongly align overall strategic requirements are included in the project programme.

Budgets are prepared on a cash-flow basis mirroring expected expenditure based on works programmes. The board approves the overall expenditure on an annual cycle and project expenditure on the larger projects in accordance with DFA governance rules.

2.3 Org Structure and Responsibilities

2.3.1 Senior Level Organisation Structure

The Vector senior level organisation structure related to the gas network is provided below.

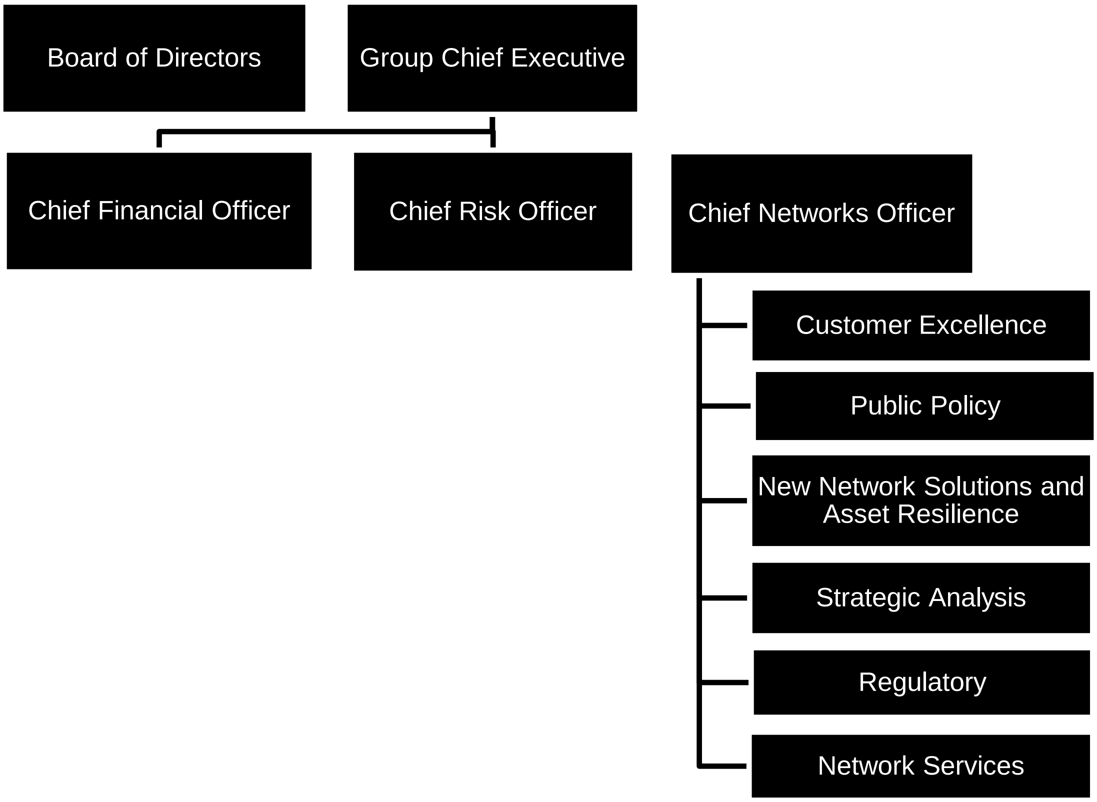


Figure 2-3 : The Vector senior management structure

The primary responsibility for the management of the gas distribution network lies with the Chief Networks Officer. Determining what activities are needed on the network is the responsibility of the New Network Solutions and Asset Resilience Group, and determining how to efficiently and safely perform these activities is the responsibility of Network Services.

In summary, the responsibilities of the groups supporting the gas network are as follows[4]:

- **Office of the CEO**

  Public affairs, company secretary.

- **Chief Risk Officer**

  Human resource management support, training and development, recruitment, health, safety and environmental policies, corporate risk management and payroll services.

- **Finance**

  Financial accounting and reporting, budgeting, treasury, management accounting, investor relations, procurement support, business analytics and insurance.

- **Chief Networks Officer**

  Overall management and operation of the electricity and gas networks, managed through the following functional teams.

[4] Vector functions not directly involved in the operation of the gas network removed for clarity

- **Regulatory**

  Responsible for interaction with the industry regulators, monitoring regulatory compliance, developing regulatory strategies, making regulatory submissions, setting gas pricing, developing pricing strategy.

- **Customer Excellence**

  Key customer relationships, mass market customer relationships, customer connections, commercial strategies.

- **Public Policy**

  General Counsel for regulated activities, policy and strategy guidance.

- **Strategic Analysis**

  Information management, strategic analysis, business scenario modelling and data analytics.

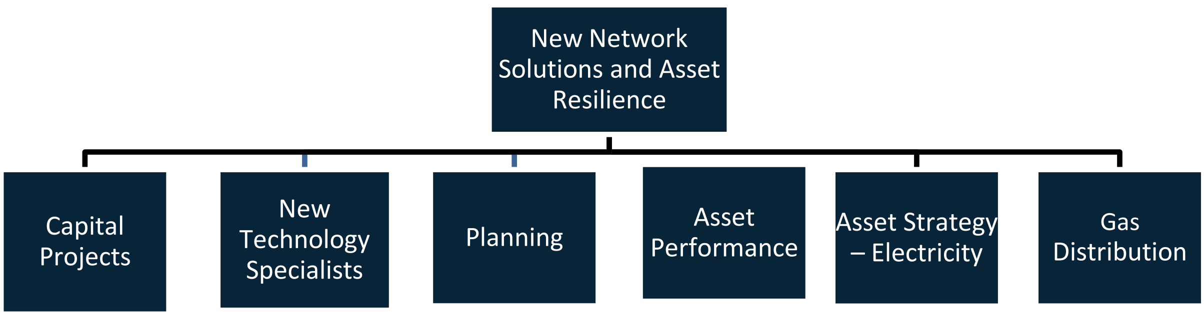
- **New Network Solutions and Asset Resilience**

  Engineering decision making on the maintenance and renewal of existing network assets and planning for future upgrades on the network.

- **Network Services**

  Project and contract management services to deliver all activities on the network, including operation of a 24/7 Control Room function for both networks.

2.3.2 New Network Solutions and Asset Resilience



Capital Projects

This team is responsible for the detailed design of complex electrical projects and confirming any outsourced electrical designs comply with Vector's engineering standards.

New Technology Specialists

Vector has dedicated engineers responsible for monitoring and assessing new technologies against traditional gas and electricity solutions to ensure optimal investment decisions are made for all capital investments.

Planning

This team continually monitor present and future customer energy needs, identify capacity/security constraints on the electricity network and facilitate investments to augment where shortfalls are identified, and provide technical assistance to support new large customers connecting to the network.

Asset Performance

This team monitors the overall performance of the electricity network from a risk and customer service perspective to identify areas for improvement and co-ordinate such projects.

Asset Strategy – Electricity

This team is responsible for asset selection, maintenance and renewal strategies and associated standards for the electrical network.

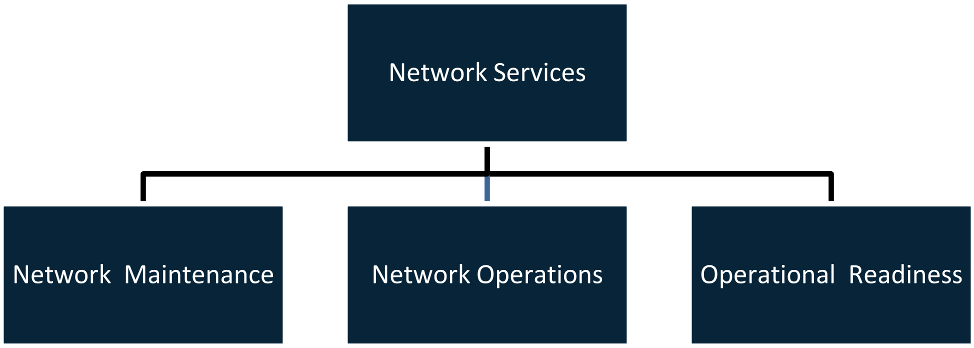
Gas Distribution

This team manages all asset management and planning functions for the gas distribution network. In broad terms, this group is responsible for:

- Setting gas distribution network security standards;
- Supporting Vector's development and implementation of a Safety Management System;
- Ensuring asset investment is efficient and provides an appropriate commercially sustainable return to Vector's shareholders;
- Ensuring the configuration of the gas distribution network is technically and economically efficient, meets customer requirements, and is safe, reliable and practical to operate;
- Planning network developments to cater for increasing gas demand and customer requirements;
- Ensuring the integrity of the existing asset base, through effective renewal, refurbishment and maintenance programmes;
- Preparing detailed engineering design for projects, including engagement of design consultants;
- Keeping abreast of technological and consumption trends, assessing the potential impact thereof and devising strategies to effectively deal with this in the long-term network planning; and
- Maintaining current and accurate information about the extent and performance of the network and assets.

2.3.3 Network Services

In Vector's asset management model, the service provider function is predominantly fulfilled by the Network Services group.



Network Maintenance

The Network Maintenance team is responsible for the maintenance of the electricity network. This is done in conjunction with Vector's service provider partners (Northpower and Electrix), who carry out all physical work in the field.

Network Operations

Network Operations is responsible for the maintenance and day-to-day safe operation of the gas distribution network, including planning network configuration; managing, reporting and investigating incidents and contingency management. Network Operations is also responsible for the delivery of infrastructure projects and customer connections including detailed project engineering and cost estimates, as well as project and contract management services.

Operational Readiness

The Operational Readiness team provides programme and project management expertise to deliver the electricity capital works program.

2.3.4 Customer Excellence

New Customer Solutions

Design and deliver new customer experience (e.g. online journey, outage app, call centre optimisation) to reduce time to serve customers and enable customer self-service.

Commercial Customer Accounts

Manage commercial arrangements with gas and electricity customers and associated projects. Manage retailer and shipper relationships and contracts.

Manage retailer and shipper relationships and associated contracts.

Strategic Customer Relationships

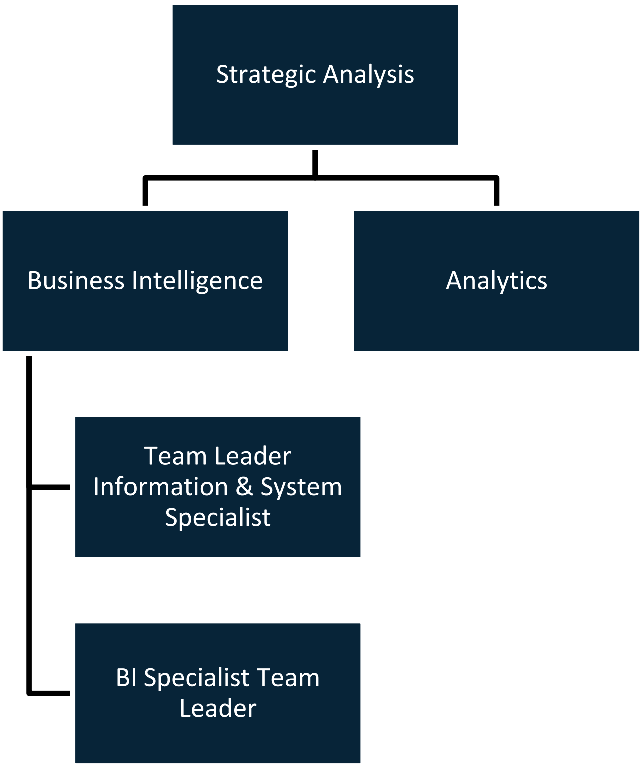
Complaints resolution. Manage strategic customer relationships including Council, Auckland Transport, NZTA. Executing undergrounding project with partners (Water Care, Spark etc).

Customer Communications

Develop, design and execute customer communication strategy, including all touch points (direct and via FSPs).

Standardise pricing for new electricity and gas connections. Provide pricing solutions to commercial customer accounts.

2.3.5 Strategic Analysis



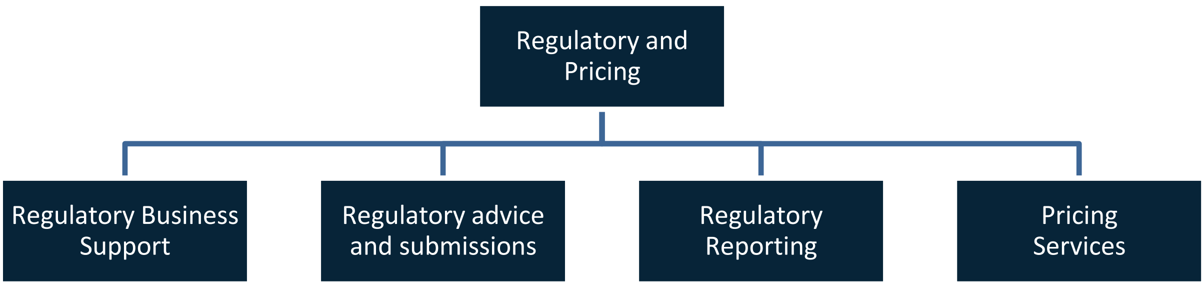
Business Intelligence

The purpose of the Business Intelligence team is to support the Networks business to make more informed decisions through the provision of quality data and business intelligence tools.

Analytics

The purpose of this function is to provide superior analytics to support business objectives and enable data driven decisions.

2.3.6 Regulatory



Regulatory Business Support

The regulatory business support team provides support to the regulated networks business to deliver disclosures to the Commerce Commission and comply with other regulated requirements set by authorities such as the Gas Industry Company (GIC).

Pricing Services

The pricing team sets distribution pricing and ensures compliance with the Default Price Quality Determination as set by the Commerce Commission. The pricing team also ensures compliance with pricing disclosures required by the Information Disclosure Determination 2012 (amended 2015) as set by the Commerce Commission.

Regulatory Reporting Quality

The regulatory reporting quality function ensures financial disclosures are delivered efficiently, to appropriate quality.

Regulatory advice and submissions

The regulatory team delivers regulatory advice to the business with respect to operating in a regulated environment. Submissions are made to the Commerce Commission, the Gas Industry Company, and other bodies as may affect Vector's interests.

2.3.7 Asset Management Activities by Other Groups

While the bulk of gas network asset management activities are performed by the New Network Solutions & Asset Resilience group, supported by the Network Services group, some gas-related assets are directly sourced and incorporated by others.

2.3.7.1 Information Technology

There is increasing overlap in the real-time operation of gas network assets and corporate-wide information technology services. Not only does Asset Management require increasingly sophisticated information systems, but the traditional SCADA networks are, over time, becoming less of a stand-alone gas network application with unique requirements and protocols, and more of an integrated IT network application. Procurement and implementation of Asset Management and IT support systems, and core SCADA equipment, is managed by the Information Technology group.

2.3.7.2 Communications

Vector Communications are engaged to provide asset management and maintenance services on the fibre communications network and associated infrastructure that support the operation of the gas network.

2.3.8 Field Service Model

Vector has, through a competitive process, partnered with Electrix to maintain its gas network.

The maintenance contracts deliver the reactive, preventative and corrective maintenance works programmes, based on the requirements set by the Vector maintenance standards.

FSPs are performance managed by Vector's Network Services group. The maintenance contract defines the responsibilities, obligations and Key Performance Indicators (KPIs) to complete scheduled works. Vector maintains a library of technical standards which contractors must comply with when performing their duties. Figure 2-4 below describes the flow of work when maintaining Vector's assets.

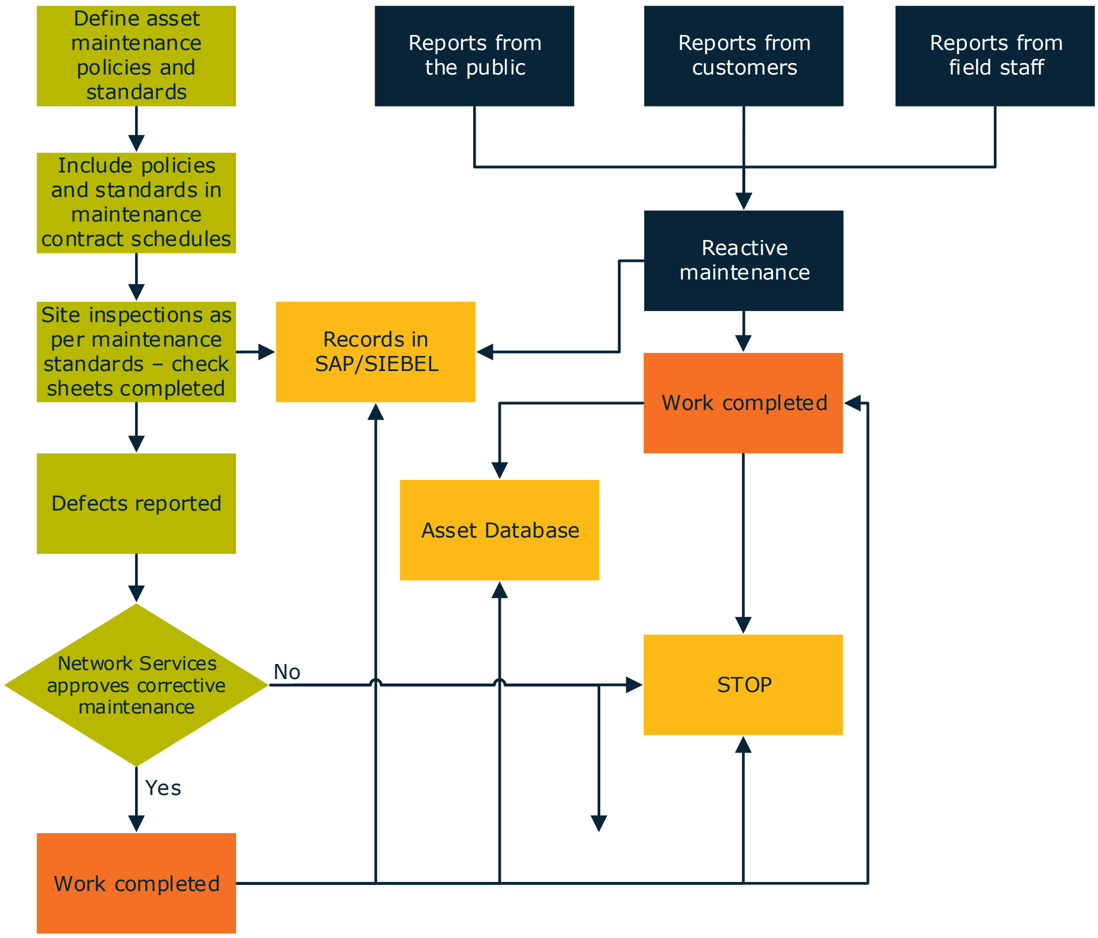


Figure 2-4 : Asset maintenance processes

The delivery of all of these maintenance activities in accordance with prescribed maintenance standards are closely monitored and adjusted by Network Services, on a monthly basis, to ensure the agreed annual target volumes are complied with. Extensive monthly feedback is obtained on actual versus planned progress, KPI performance, causality and issues impacting progress or performance, new risks, action plans and focal points for the coming months.

The overall effectiveness of the programme is evaluated by contract KPI performance and the roll up to Vector's corporate performance metrics, of which environmental compliance, public, and employee and contractor safety are the core measures.

2.3.9 Governance – Reporting and Approvals

Performance against the annual budgets is closely monitored, with formalised change management procedures in place. Regular reports monitor:

- Health, safety and environmental issues;
- Monthly overall expenditure against budget;
- Progress of key capital projects against project programme and budget;
- Response time to emergencies (RTE); and
- Progress with risk register actions (the board has a risk committee with a specific focus on risks to the business).

Implementation of the AMP requires decisions to be made by both the board and management at all levels, reflecting their functional responsibilities and level of delegated financial authorities (DFAs), as set in accordance with the Vector governance rules. Functional responsibilities define the role of each staff member in the organisation. The DFAs specify the level of financial commitment that individuals can make on behalf of the company.

2.4 Stakeholder Interests

Vector has a large number of internal and external stakeholders that have an active interest in how the assets of the company are managed. The essential service nature of the service Vector provides, and its importance to the Auckland well-being and economy, creates a keen interest in how Vector conducts its business.

In Figure 2-5, the important external stakeholders to Vector are highlighted. Understanding of how these stakeholders interact with Vector and the requirements or expectations they have of the company has a major bearing on the manner in which Vector constructs and operates the gas network.

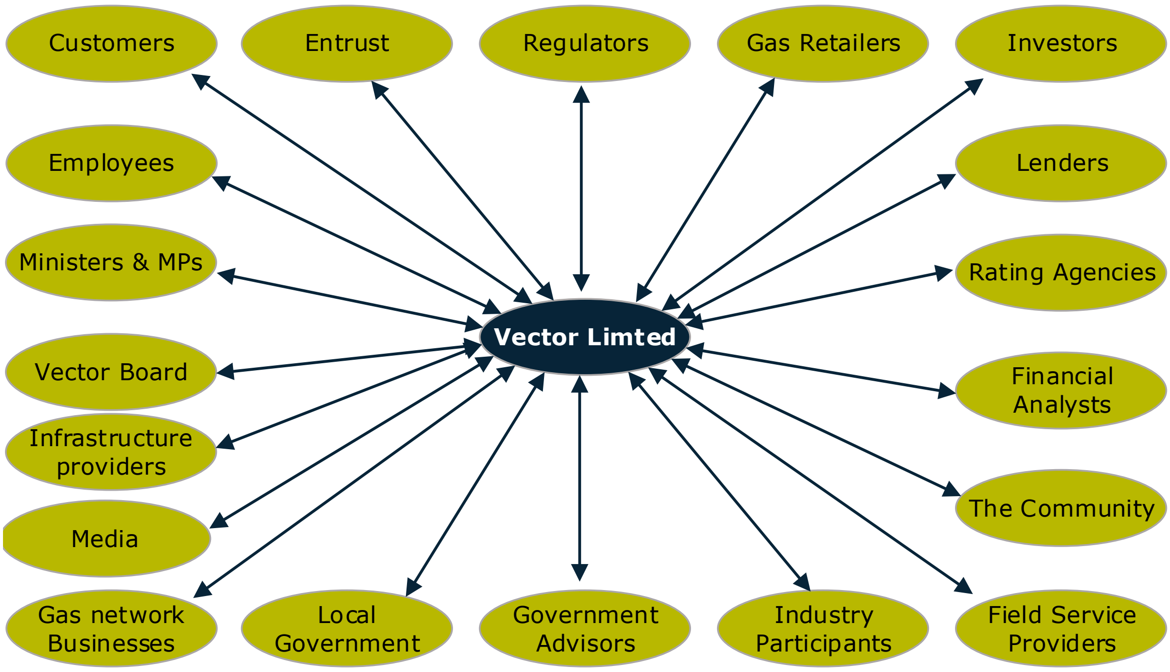


Figure 2-5 : Vector's key external stakeholders

2.4.1 Stakeholder Expectations

Important stakeholder expectations[5] are listed in Table 2-2 below.

Customers (and End-Use Consumers)	
Health and safety	Reliable supply of gas
Quality of supply	Planned outages
Security of supply	Timely response to complaints and queries
Efficiency of operations	Information in fault situations
Reasonable price	Environment

[5] The stakeholders and their expectations are not listed in any order of priority.

Timely response to outages Innovation, solution-focus	Timely connections
Entrust	
Health and safety Sustainable growth Sustainable dividend growth Reliability Confidence in board and management Accurate forecasts	Regulatory and legal compliance Prudent risk management Good reputation Good governance Clear strategic direction Return on investment
Retailers	
Reliability of supply Quality of supply Managing any customer issues	Information in fault situations Ease of doing business Good systems and processes
Regulators	
Statutory requirements Accurate and timely information	Inputs on specific regulatory issues Input into policy proposals and initiatives Fair and efficient behaviour
Vector Board	
Health, safety and the environment Regulatory and legal compliance Good governance Accurate and timely provision of information Expenditure efficiency	Prudent risk management Security and reliability of supply Return on investment Accurate budgeting
Investors	
Compliance with market rules	Good governance
Financial Analysts/Rating Agencies/Lenders	
Transparency of operations Accurate performance information Clear strategic direction Adhering to New Zealand Stock Exchange rules	Prudent risk management Good governance Accurate forecasts Confidence in board and management
Field Service Providers	
Safety of the work place Stable work volumes Quality work standards Maintenance standards Clear forward view on workload	Construction standards Innovation Consistent contracts Clearly defined processes Good working relationships
Government Advisors	
Accurate and timely provision of information Vector's views on specific policy issues Efficient and equitable markets	Innovation Infrastructure investment
Ministers and MPs	
Security of supply Reliable supply of gas Efficient and equitable markets	Investment in infrastructure and technologies Environment Good regulatory outcomes

Industry leadership	Energy and supply outage management
Local Government	
Public safety Environment Coordination between utilities Sustainable business	Support for economic growth in the area Visual and environmental impact Compliance
Community	
Public safety Good corporate citizenship Gas safety programme	Engagement on community-related issues Improvement in neighbourhood environment Visual and environmental impact
Energy Industry	
Health and safety Leadership Innovation Participation in industry forums	Policy inputs Influencing regulators and government Sharing experience and learning
Gas Network Businesses	
Effective relationships Ease of doing business Secured source of supply	Well maintained assets at the networks interface Co-ordinated approach to system planning and operational interfaces Sharing experience and learning
Media	
Effective relationship Access to expertise	Information on company operations

Table 2-2 : Stakeholder expectations

Vector ascertains its stakeholders' expectations by, amongst other things:

- Meetings and discussion forums;
- Consumer engagement surveys;
- Engagement with legislative consultation processes;
- Annual planning sessions;
- Direct liaison with customers;
- Membership on industry working groups;
- Feedback received via complaints and compliments;
- Investor roadshows and annual general meetings;
- Analyst enquiries and presentations;
- Monitoring of analyst reports;
- Media enquiries and meetings with media representatives; and
- Monitoring publications and media releases.

Vector accommodates stakeholders' expectations in its asset management practices by, amongst other things:

- Due consideration of the health, safety and environmental impact of Vector's operations;

- Providing a safe and reliable distribution network;
- Quality of supply performance meeting consumers' needs and expectations;
- Optimisation of capital and operational expenditures (capex and opex);
- Maintaining a sustainable business that caters for consumer growth requirements;
- Comprehensive risk management strategies and contingency planning;
- Compliance with regulatory and legal obligations;
- Network growth and development plans;
- Provision of accurate and timely information;
- Development of innovative solutions; and
- Comprehensive asset replacement strategies.

2.4.2 Addressing Conflicts with Stakeholder Interests

In the operation of any large organisation with numerous stakeholders with diverse interests, situations will inevitably arise where not all stakeholder interests can be accommodated, or where conflicting interests exist. From a Vector asset management perspective, these are managed as follows:

- Clearly identifying and analysing stakeholder conflicts (existing or potential);
- Having a clear set of fundamental principles drawing on Vector's vision and goals, on which compromises will normally not be considered (see Section 2.2.2);
- Effective communication with affected stakeholders to assist them to understand Vector's position, as well as that of other stakeholders that may have different requirements; and
- Where Vector fundamentals are not compromised, seeking an acceptable alternative or commercial solution.

Other aspects considered when assessing aspects impacting on stakeholder interests or resolving conflicts include:

- Health and safety;
- Cost/benefit analysis;
- Central and local government interface and policies;
- Commercial and technical regulation;
- Long-term planning strategy and framework;
- Environmental impacts;
- Societal and community impacts;
- Legal implications;
- Sustainability of solutions (technically and economically);
- Works/projects prioritisation process;
- Security and reliability standards;
- Quality of supply;
- Risks; and
- Work and materials standards and specifications.

At a practical level in relation to asset management, Vector has developed an extensive set of asset management and investment policies, guidelines and standards which implicitly embrace practical solutions to the requirements of stakeholders. These policies and standards provide guidance to the safe operation and maintenance of the gas network assets.

2.5 Asset Management Maturity

The AMMAT set out in Schedule 13 of the Commerce Commission's Information Disclosure Determination is a series of questions against which a business has to assess its asset management maturity level.

The full assessment criteria for the individual questions and how Vector has self-scored against each criteria are included in the Appendices of this AMP. At an overall level, Vector's asset management maturity compares well with generally accepted New Zealand gas network asset management standards, and is considered adequate for ensuring ongoing safe and efficient operation of our network, but with scope for further improvement.

Vector's progress against the AMMAT will be measured in future AMPs – with the goal to progressively achieve a minimum of "3" rating on each criteria.

2.6 Significant Assumptions

On a practical level, incorporating the Vector values and goals in the asset management strategy determines the fundamental assumptions or premise on which the AMP is based. These assumptions[6], listed in Table 2-3 below, reflect the manner in which Vector understands and implements its strategic direction.

Key Premise for the AMP	
Safety will not be compromised	• Safety of the public, staff and contractors is paramount. Safety is a focus across the business. • Current safety regulations place the accountability for public safety on Vector as the owner of the assets. This is not expected to change.[7] • Vector fully complies with New Zealand safety codes, prescribed network operating practices and regulations.
The present industry structure remains	• The Vector gas network will continue to operate as a stand-alone, regulated gas distribution business (not vertically-integrated). Open access of the network will be maintained. • The transmission system will continue to be owned and operated by a separate entity. System development will continue broadly in its current direction and the existing system will be maintained in accordance with good industry practice, ensuring that sufficient capacity, at appropriate reliability levels, will be retained to meet the needs of Vector's customers.
Existing Vector gas network business operation model remains	• Field services will continue to be outsourced. Adequate resources with the relevant skills will be available to implement the works programme to deliver the service to the required level.
Current supply reliability levels remain unchanged	• Under the current regulatory arrangement in New Zealand, there is no significant incentive to improve network reliability from historical levels. However, it is imperative that reliability does not materially deteriorate. Under current price quality regulation Vector will therefore ensure reliability levels are maintained, but not at the expense of safety.

[6] The assumptions are not listed in any priority order.

[7] This does not absolve Vector's service providers from meeting Vector's health & safety obligations, particularly in respect of public safety – Vector requires full compliance with its health and safety policies from all its service providers. Their performance in this regard is audited on a regular basis and managed under performance-based contracts.

Key Premise for the AMP	
	• Customer survey results indicate Vector's customers in general are satisfied with the quality of service they receive, at the level of price they pay for the service. There is no material evidence to support increased service levels with the associated price increases.
A deteriorating asset base will be avoided	• In general, assets will be replaced when economic to do so, which is likely to be before they become obsolete, reach an unacceptable condition, can no longer be maintained or operated, or suffer from poor reliability. In a number of instances (where it is technically and economically optimal and safety is maintained), some assets will be run to failure before being replaced.
Regulatory requirements will be met	• Regulatory requirements with regards to information disclosure or required operating standards will be met accurately and efficiently.
A sustainable, long-term focused network will be maintained	• Asset investment levels will be appropriate to support the effective, safe and reliable operation of the network. • Expenditure will be incurred at the economically optimum investment stage without unduly compromising supply security, safety and reliability. • Vector's ability to forecast future customers energy demands remains sufficiently reliable (with the impact of disruptive technologies) to determine the optimal timing for such investments • New assets will be good quality and full life-cycle costing will be considered rather than short-term factors only. • Networks will be effectively maintained, adhering to international good industry practice asset management principles. • Avoid over design or building excess assets. • Investments must provide an appropriate commercially sustainable return reflecting their risks.
Existing efficiency, reliability and supply quality levels will generally be maintained	• At present there is no regulatory incentive to improve efficiency, reliability and quality of supply.
Under normal operating conditions the full required demand will be met	• Assets will not be unduly stressed or used beyond appropriate short or long-term ratings to avoid damage. This is part of maintaining a long term sustainable gas distribution network.
Network security standards (for delivery) will be met where it is economic to do so	• Where full compliance to target security standards may create uneconomic investment, Vector may accept variations to standards, as long as this is consciously accepted, explicitly acknowledged and contingency plans prepared to cater for asset failure.
Asset-related risks will be managed to appropriate levels	• Network risks will be clearly understood and will be removed or appropriately controlled – and documented as such.
An excessive future "bow-wave" of asset replacement will be avoided	• Although asset replacement is not age-predicated, there is a strong correlation between age and condition. To avoid future replacement capacity constraints or rapid performance deterioration, age-profiles will be monitored and appropriate advance actions taken.
Quality of asset data and information will continue to improve	• Vector's asset management is highly dependent on the quality of asset information. Its information system and data quality improvement programme will continue for the foreseeable future.
New consumer and network technology will progressively influence how the network is operated and utilised	• The rate at which new consumer technologies are developing is accelerating. Demand and consumption patterns are changing and will increasingly impact on how the network is managed. Vector will continue to explore the opportunities that new technologies offer. Subject to economic justification and sufficient regulatory incentives, Vector will continue to invest in its evolution of it gas and electricity networks.

Table 2-3 : Key premises for the AMP

These key premises have a direct and major impact on the quality of service provided by the network, the condition of the assets, the levels of risk accepted and the asset expenditure programmes.

Gas Distribution Asset Management Plan 2016 – 2026

Assets Covered by this Plan– Section 3

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3 Assets Covered by this Plan

3.1 Distribution Area

Vector's natural gas distribution network assets are located within the Auckland Council and the northern part of the Waikato District Council areas. The northern limit is defined by the Northland Regional Council and Auckland Council boundary. The southern limit is defined by the Waikato River from the west coast to State Highway 1, and then the boundary separating the Auckland Council and the Waikato District Council towards the East coast. The map in Figure 3-1 shows the extent of Vector's gas distribution network supply area.

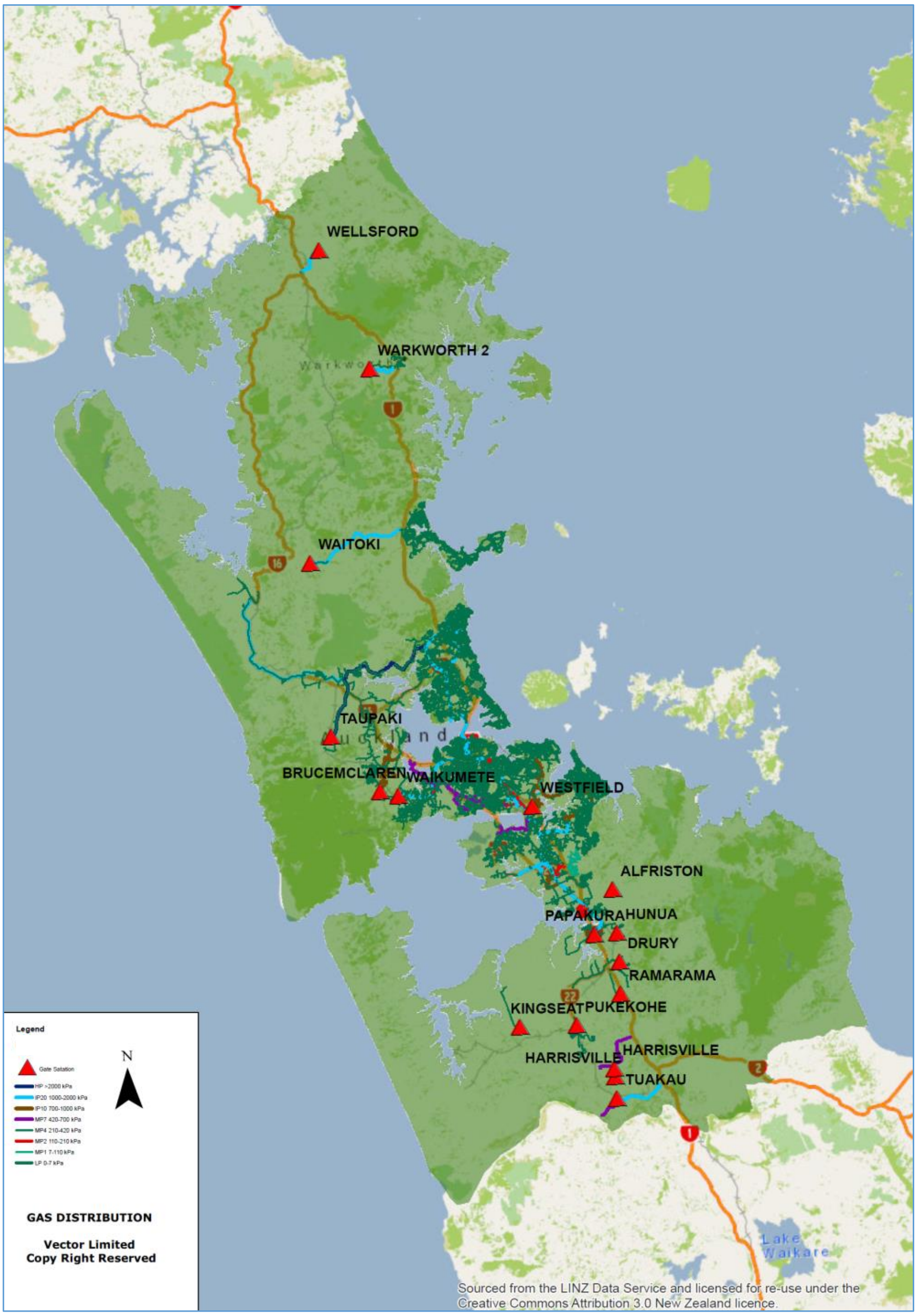

Figure 3-1 : Vector's gas distribution network supply areas

3.2 Key Features

Key features of the gas distribution network for 2015 is presented below (as at 30 June):

Description	2015
Consumers connected[1] (no.)	101,744
System length[2] (km)	6,274
Consumer density (consumer/km)	16.2
Gate stations[3]	16
District regulating stations[4] (DRS)	305
DRS density (system km/DRS)	20.6
DRS utilisation (consumers/DRS)	334
Peak load[5] (standard cubic meters per hour)	94,900
Gas conveyed[6] (PJ pa)	12.6

Table 3-1: Key features of Vector's gas distribution networks

3.3 Load Characteristics

The capacity of an individual pipeline is determined by the operating pressure, the diameter and the allowable pressure difference between inlet and outlet. Meshed distribution networks work on the same principle with the difference that pipelines are interconnected at several points and that such distribution networks can be fed at multiple points.

As the distribution networks expand and demand grows, certain parts of the networks, in particular feeder mains, can develop large pressure drops that constrain delivery in downstream parts of the distribution systems. Each year, Vector prepares network pressure monitoring surveys and carries out distribution network analysis to identify any constraints and to reinforce networks to ensure operating pressures do not become insufficient.

Regulator stations have nominal outlet pressures which supply each discrete pressure system on the distribution network. System pressures in the network drop in accordance with demand and the supply pressure. Under the normal network operating arrangement, Vector's Quality of Supply standard stipulates the pressure at any point on the network shall be no less than 50% of its nominal pressure and no more than 10% above its maximum operating pressure. Further details of Vector's Quality of Supply standard can be found in Section 5.

[1] Source: Vector's Gentrack billing system.

[2] Source: Vector's Geographic Information System (GIS). Includes mains and service pipe lengths.

[3] Source: Vector's GIS.

[4] Source: Information Disclosure 2015 (http://vector.co.nz/disclosures/gas-financial-and-network-information). Includes Vector's district regulating stations and street regulators as described in section 3.6.2.

[5] Calculated by adding the coincident load of each network system for a calendar year. Measured as standard cubic metres per hour (scmh).

[6] Source: Information Disclosure 2015 (http://vector.co.nz/disclosures/gas-financial-and-network-information).

Pressure drops on each pressure system need to be considered separately, due to the meshed nature of the network and the different characteristics, i.e. mix of residential, commercial and industrial customers, each system exhibits.

Vector uses individual system pressure profiles to illustrate the load characteristics of each network. These are based on system pressure data that Vector collects as part of its system pressure monitoring programme and an understanding of the relationship between pressure and flow.

The typical daily winter[7] pressure profile for residential loads and load profile for commercial/industrial customers are illustrated in Figure 3-2 and Figure 3-3. Residential load typically has two peaks whereas the commercial and industrial load is more consistent for the whole day.

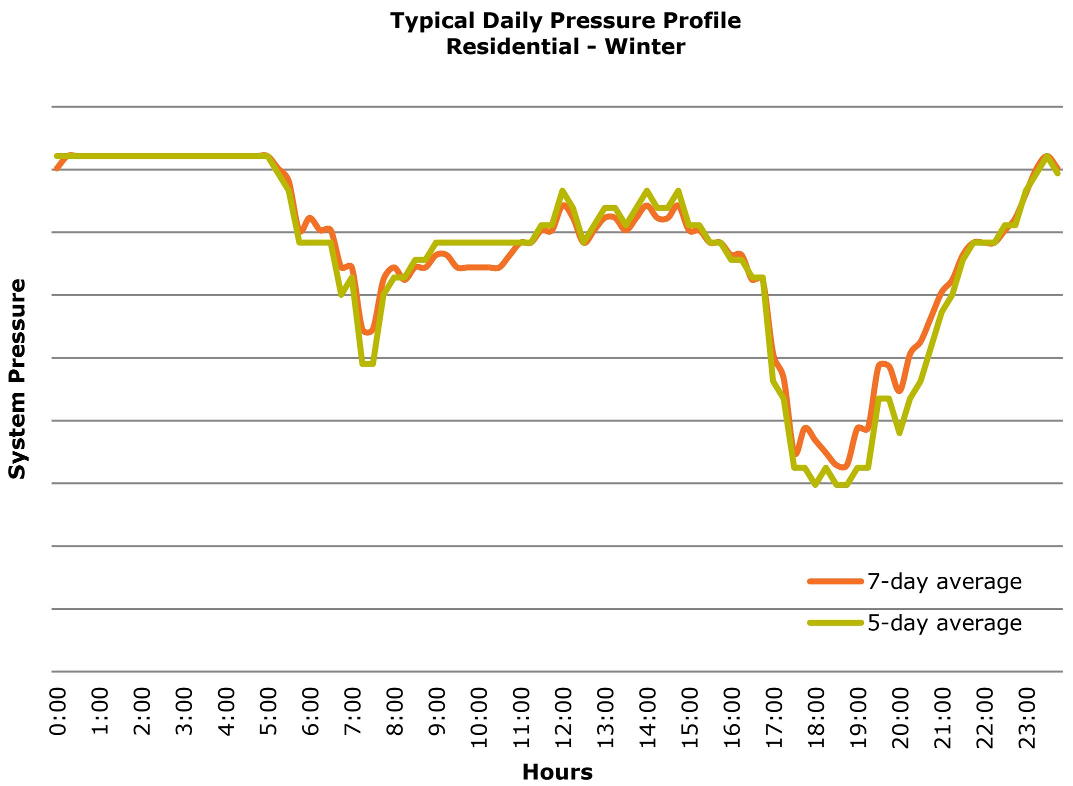

Figure 3-2 : Typical winter system pressure profile for residential customers

[7] The greatest demand on the gas distribution networks occurs during winter

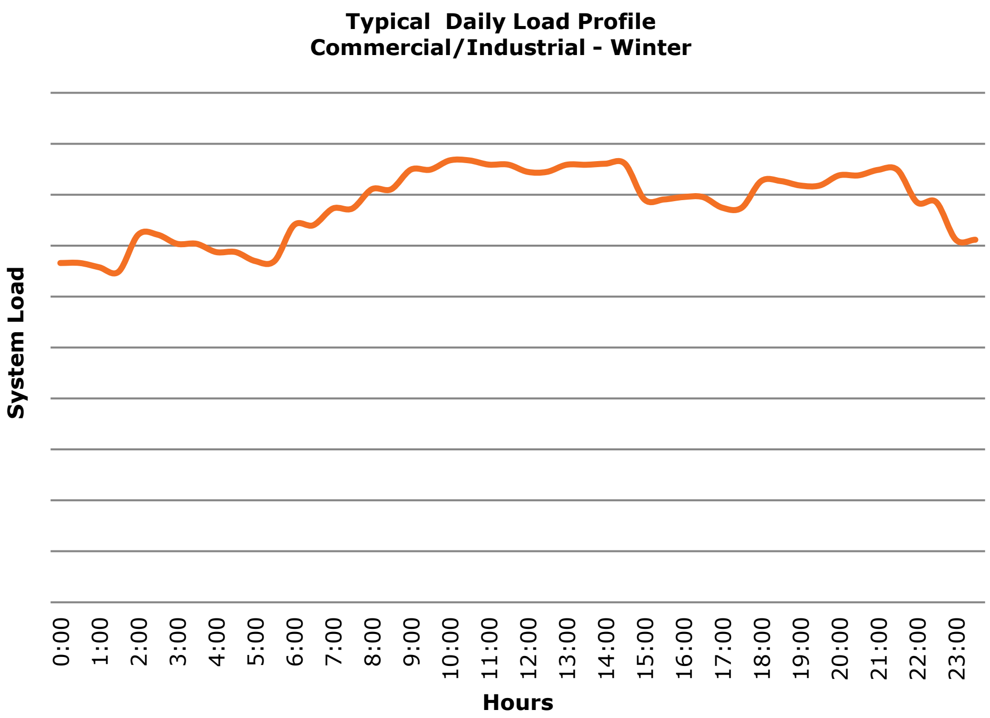

Figure 3-3 : Typical winter load profile for commercial and industrial customers

Demand curves for specific industrial consumers are far more variable – conforming closely to the nature of the customer's business. A typical industrial load curve is therefore not a meaningful concept.

A measure of load diversity is achieved with residential customers providing peaks in the morning and early evening, with the commercial and industrial load filling in the trough between these peaks. The mix of customer types within a distribution network, and their location, influences the size and duration of the peaks.

3.3.1 Peak Demand and Energy Delivered

Historical trends show gas demand (and sales volume) is primarily influenced by economic activities in an area, price and availability of substitute fuels (e.g. electricity, fuel oil etc.), marketing effort, population / household growth, socio-economic factors, climate, and the investment decisions made by large industrial and commercial gas consumers. In the short-term, gas demand is very sensitive to climatic conditions. A cold snap, for example, could drive up the demand for gas significantly. Conversely, a warm winter could result in a materially lower demand. Hence on a year–by-year basis, demand can vary significantly.

Historical information, after normalising for year-on-year variances, shows a reasonably steady demand trend. The exceptionally high peak demand hours occur due to extreme weather conditions and normally represent only a small percentage of hours in a year.

The peak demand[8] on the gas distribution network and the gas conveyed[9] for the past seven years is listed in Table 3-2 (the individual demand forecasts for all gate stations on Vector's network are detailed in Section 5)[10].

Year	Peak Demand[11]		Gas Conveyed[12]	
	Standard cubic meters per hour (scmh)	% change	PJ	% change
2009/10	82,056		11.7	
2010/11	90,222	10.0%	11.8	0.9%
2011/12	83,850	-7.1%	12.4	5.1%
2012/13	84,474	0.7%	12.1	-2.0%
2013/14	91,192	8.0%	12.2	0.5%
2014/15	94,900	4.1%	12.6	3.3%

Table 3-2: Peak hour demand delivered on the gas distribution network

The values reported above are the coincidental peak demands of all gate stations delivering supply to Vector's gas distribution networks.

Vector has a number of large customer sites at various locations in its network. Section 3.8 provides maps which indicate those customer sites with an individual energy demand above 20TJ, and which hence have a significant impact on network operations and asset management.

3.4 Distribution System Design

Vector's gas distribution networks are generally relatively young (built in the late 1980s onwards) and are mostly constructed of steel and polyethylene materials, operating at significantly higher pressures than the original network. Standard operating pressures within the Intermediate Pressure (IP) and Medium Pressure (MP) bands are however not consistent between the individual networks - a legacy of the different operating standards applied by the previous owners of the separate gas networks. Vector intends to rationalise/standardise the design and operating pressure ranges in accordance with future planned improvement programmes.

3.5 Network Configuration

Vector takes bulk gas supply from the High Pressure (HP) transmission systems operating across the North Island. The transmission systems operate at pressures ranging between

[8] The peak demand is calculated by adding the peak load of each network system for a calendar year. Where a network system comprises of more than one gate station or a gate station supplies to more than one network system, the coincident peak load is used.

[9] ibid, footnote 1

[10] The reasons for the variability between the energy delivered and the peak hour demand trends are complex and analysis of this is ongoing. Changes in weather patterns or the timing of gas usage of large industrial consumers has a considerable influence on overall peak gas demand, which partially explains the inconsistent relationship between the annual energy delivered and the total peak hour demand.

[11] Adjusted to reflect the change in Vector's gas distribution Auckland boundary.

[12] Source: Information Disclosure 2015 (http://vector.co.nz/disclosures/gas-financial-and-network-information)

approximately 50 and 80 bar and typically deliver gas to Vector's distribution systems at IP20, IP10, MP7 and MP4 pressure level (20 bar down to 4 bar).

The IP and higher pressure MP systems tend to be radial in design, whereas the design of the majority of MP and Low Pressure (LP) systems tends to be of a mesh nature, providing back-feed security to large numbers of residential and commercial loads. MP and LP systems are often supplied from multiple district regulator stations (DRSs) thereby further increasing the security of supply.

The overall current architecture of the Vector gas distribution network is shown in Figure 3-4.

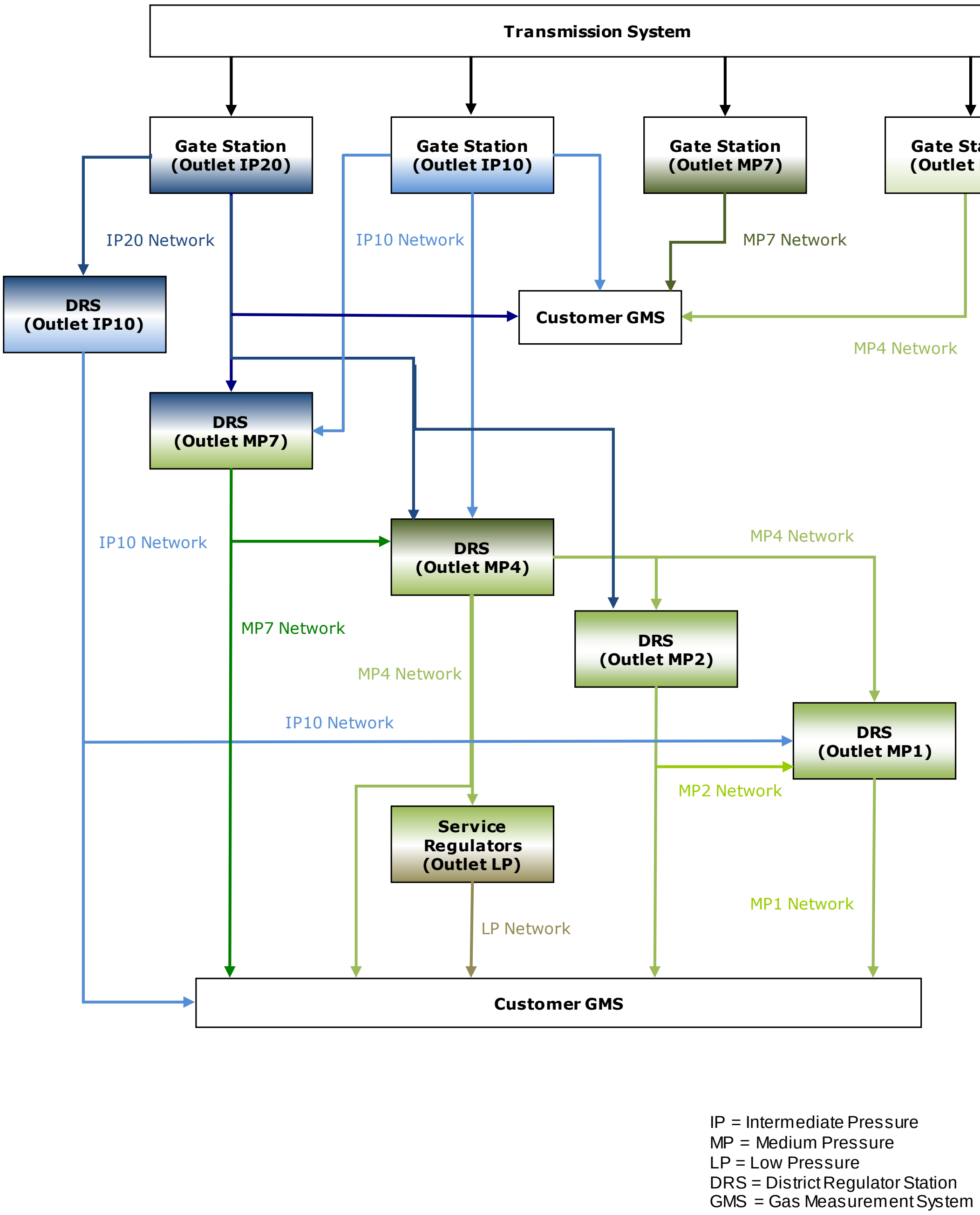

Figure 3-4 : Schematic of Vector's gas distribution network

3.6 Distribution Systems

Distribution networks extend from the outlet valve of the transmission gate station to the inlet valve on a consumer gas measurement system (GMS). Distribution networks broadly contain the following six main categories of assets:

- Distribution pipelines;
- Pressure stations;
- Valves;
- Corrosion protection equipment;
- Telenet/SCADA equipment; and
- Special crossings.

3.6.1 Distribution Pipelines

Vector's distribution networks generally comprise HP, IP, MP and LP systems. Table 3-3 shows the eight pressure levels used by Vector to categorise the gas distribution networks:

Pressure Level	Length (km)	% of Total Network
High Pressure (>2,000kPa)	24	0%
Intermediate Pressure 20 (1,000-2,000kPa)	157	3%
Intermediate Pressure 10 (700-1,000kPa)	60	1%
Medium Pressure 7 (420-700kPa)	69	1%
Medium Pressure 4 (210-420kPa)	5,826	93%
Medium Pressure 2 (110-210kPa)	62	1%
Medium Pressure 1 (7 - 110kPa)	72	1%
Low Pressure (0 - 7kPa)	4	0%

Table 3-3: Pressure levels and corresponding asset length[13]

Vector's bulk gas distribution assets are operated in the IP range of 700 to 2,000kPa. The selection of these pressures has, in the majority of cases, historically been justified on an economic basis (consideration of gas volumes, transmission distances, delivery pressures etc). The IP systems are all constructed to a high technical standard of welded steel with all of them being protected against corrosion by Cathodic Protection (CP), using either a system of sacrificial anodes or an impressed current installation.

The IP systems are generally the principal "backbone" systems of the distribution networks with laterals radiating from them to supply adjacent areas. The distribution assets which are used to directly supply gas consumers are constructed mostly of polyethylene and operate in the MP range.

Vector's gas distribution network includes a high pressure system which is integrated into the gas distribution network. The pipeline is a 200mm steel pipeline running from the Henderson Gate Station (North West of Auckland) to Albany on Auckland's North Shore. The pipeline was constructed and is maintained to high pressure standards, and is rated

[13] Source: Vector's GIS as at 30 June 2015. Includes mains and service pipe lengths.

to operate at 4,600kPa, but is currently only operating at 1,900kPa. The higher design pressure was selected to enable the operating pressure to be increased in the future.

Service connections provide the link between the gas mains in the street and the customer's gas meter and are comprised of a service pipe, riser and a riser valve. The outlet connection of the riser valve designates the end of Vector's distribution system. A service regulator is normally fitted downstream of the riser valve to regulate the gas pressure to the consumer meter-set and to downstream appliances / plant (in these cases the regulator is owned by retailers or Gas Measurement System (GMS) owners).

3.6.2 Pressure Stations

Pressure stations are those parts of a gas system that link two pressure levels in gas networks through pressure regulators. They are the points of input to a pressure level. Vector has three categories of pressure stations: gate stations, district regulating stations and service regulators.

3.6.2.1 Gate Stations

Where the pressure station is the link between the gas transmission system and a gas distribution network, it is known as a gate station[14]. High pressure equipment (i.e. pressure regulating equipment and custody transfer metering etc) within the gate station is operated by First Gas Limited[15], whereas distribution system equipment (i.e. check metering (where installed) and associated valves and pipework etc) within the gate station is operated as part of Vector's gas distribution networks.

3.6.2.2 District Regulating Stations

Where the pressure station is the link between two Vector gas pressure networks it is known as a District Regulating Station (DRS). DRSs are used to reduce the operating pressure from higher operating pressure systems to systems with lower operating pressures.

DRSs are strategically located within the distribution network such that a continuous and safe gas supply of gas is delivered to the maximum number of customers. They are primarily used to reduce the higher pressures associated with 'high volume' mains, (i.e. those with an operating pressure of 1,900kPa, 1,000kPa and 700kPa), down to a more economical distribution pressure level of between 200kPa and 420kPa. They are also used to provide a controlled pressure into the low pressure networks. In this case the DRS may be sited to use an IP or MP system as its source, depending upon which is geographically available.

Generally a DRS converts significant volumes of gas from one pressure to another and they are the source of supply to a significant number of consumers. The importance of DRSs in the supply networks means duplicate assets are often provided in order to deliver a reasonable level of security. This duplication also enables maintenance to take place without a loss of supply to customers.

The lower operating pressures provided by the DRS assets allow modern technology and materials to be used to provide a safe, assured and economical gas supply to the areas where customers are situated.

3.6.2.3 Service Regulators

A service regulator is used to regulate the flow and pressure of gas to individual customer premises. Where for practical reasons a regulator cannot be installed immediately

[14] An alternative name for a gate station is delivery point.

[15] First Gas Limited is the gas high pressure pipeline operator.

adjacent the gas meter (i.e. as part of the GMS) it is installed at a location upstream from the GMS and in some cases is owned and maintained by Vector.

3.6.3 Valves

Distribution system valves are comprised of in-line mains and service valves (to isolate the flow of gas within the system) and blow down valves (to depressurise sections of the system in the event of an emergency). Valve types currently in use include ball valves, plug valves, gate valves and a relatively small number of other valve types.

3.6.4 Corrosion Protection Equipment

Below ground steel plant is protected against corrosion by the provision of protective coatings (e.g. high density polyethylene) and the application of impressed current or sacrificial anode Cathodic Protection (CP) systems. Protective coatings are inspected whenever underground plant is exposed. CP test points are monitored on a periodic basis and maintained to ensure that the levels of protection being provided to the underground plant are kept within prescribed maximum and minimum levels.

Above ground steel or metallic plant is protected against corrosion by the provision of paint or other suitable protective coating e.g. wrapping. Periodic inspections are carried out to monitor the condition of protective coatings.

3.6.5 Telemetry Systems

The telemetry systems used by Vector to monitor its gas distribution networks comprise the Telenet Supervisory Control and Data Acquisition (SCADA) system, and the Cello system.

Access to Telenet data is provided via the PI archiving system, and access to the Cello data is provided via a proprietary PMAC database.

The telemetry systems provide remote monitoring and alarming of critical inlet/outlet pressures, temperatures and flow rates, and corrected and uncorrected metering data. The telemetry system monitors data at gate stations, DRSs and major gas customer sites, and also provides remote control facilities for the operation of the IP20 valves located at either end of the Auckland Harbour Bridge.

3.6.6 Special Crossings

Special crossings are locations where a section of pipeline is installed above ground in order to cross over a roadway, river or railway etc. The above ground crossing enables the gas distribution pipeline route to negotiate obstacles presented by the presence of a roadway, river or railway etc where a below ground crossing is not practical.

3.7 Justification of Assets

Network assets are created for a number of reasons. While asset investment is often the most effective and convenient means of addressing network issues, Vector also considers other solutions to network issues and applies these where practical and economic. Such alternatives may include network reconfiguration, asset maintenance, or adopting non-network solutions such as adjusting gate station and DRS pressure regulator set points or entering into load management arrangements with customers.

The key factors leading to asset investment at Vector are:

- Health and safety: Where health and safety concerns indicate the need for asset investment, this takes priority;

- New developments: Where new building or urban developments occur, or existing developments are extended, this usually requires investment in network assets;
- Legal and regulatory compliance: Ensuring Vector is not in breach of statutory obligations of a gas distributor or regulatory requirements such as satisfying the gas quality and pressure specifications;
- Capacity: Maintaining sufficient network capacity to supply the needs of consumers is a key driver for asset investment;
- Vector's technical standards: Vector is committed to meeting its Quality of Supply standard (refer Section 5 for details), and any potential breaches of these often indicate a need for asset investment;
- Customer requirements: Assets are often installed at the request of customers (who then contribute to the investment cost) for example to provide higher security of supply levels;
- Replacement: Assets are usually replaced before they have deteriorated to the extent that they pose a safety or reliability risk, or when they have reached the end of their useful lives (where maintenance starts to be more expensive than replacing an asset); and
- Obsolete Assets: When assets become obsolete and can no longer fulfil the basic requirements of a modern, effective network, this will lead to replacement.

Vector's network investment is that of a prudent network company, meeting realistic network growth requirements over a reasonable planning window. Several factors influence how assets are selected and the manner in which they are implemented.

- **Network design standards**

  Vector has developed detailed network supply standards, which sets out the basic requirements for network planning for the gas distribution networks (refer to Section 5 of this AMP for details). These standards define largely the stage at which network reinforcement (i.e. new assets) becomes essential, and the capacity to which new installations should be built.

  To manage supply risk, Vector has put in place a system of operational contingency plans (which are regularly updated).

  Capacity and security are not the only criteria for the design of the distribution network. In Section 5 other planning criteria are also described.

- **Optimising installations**

  When a potential network issue or constraint is identified, project options will be developed and the optimal (usually least life cycle cost) solution will be adopted. The optimal solution may not have the lowest initial capital cost or be the lowest capacity solution.

- **Equipment standardisation**

  To minimise cost in the long-term and to ensure that optimally rated equipment is installed to meet a range of possible situations, Vector has a policy of using standardised equipment on its network. Standardisation helps to reduce design and procurement costs during the establishment phase, increase operational flexibility and makes equipment maintenance more effective. It also allows more effective strategic spares management. For example, we have standardised on pipe sizes for polyethylene pipelines which are designed to operate at a standard pressure of 420kPa. Other examples of standardised asset categories, defined in Vector's material specifications, include district regulator station equipment (such as meters, regulators and filters), valves and telemetry equipment.

- **Customer-specific assets**

From time to time, Vector builds dedicated assets to supply customers at their request based on agreed commercial terms.

- **Life-cycle considerations**

  Vector adopts a life-cycle cost approach to choosing network solutions and assets. This implies that the lowest cost short-term solution may not always be adopted. For example, designing and building district pressure stations to accommodate future telemetry equipment.

- **Historical considerations**

  Load growth, load density and historical network architecture and equipment standards resulted in varying types of assets, states of security and asset condition throughout the network. While historical network architectures and equipment standards converge over-time, replacing well-functioning assets to achieve such alignment in the short-term can generally not be economically justified. However, as assets are replaced or new assets are added to the network, these are designed to comply with the present specifications.

3.8 Gas Distribution Maps

Parakai
Helensville
0002376787QT72E
0002376788QT8F0
Riverhead
Waimauku
TAUPAKI
Muriwai Beach
0000353551QT27B
Legend
ICP greater than 20 TJ
Gate Satation
HP >2000 kPa
IP20 1000-2000 kPa
IP10 700-1000 kPa
MP7 420-700 kPa
MP4 210-420 kPa
MP2 110-210 kPa
MP1 7-110 kPa
LP 0-7 kPa
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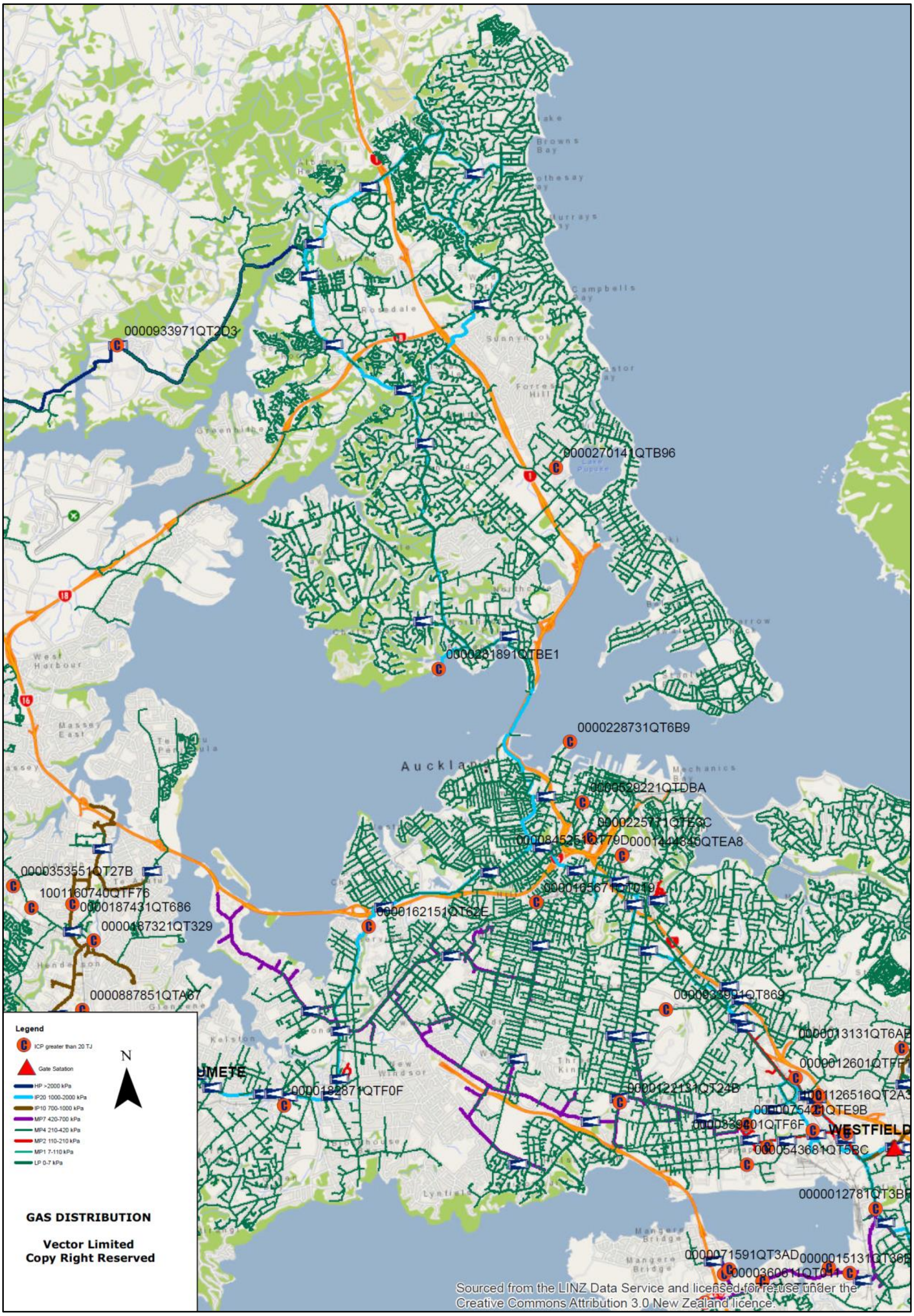
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IP20 1000-2000 kPa
IP10 700-1000 kPa
MP7 420-700 kPa
MP4 210-420 kPa
MP2 110-210 kPa
MP1 7-110 kPa
LP 0-7 kPa
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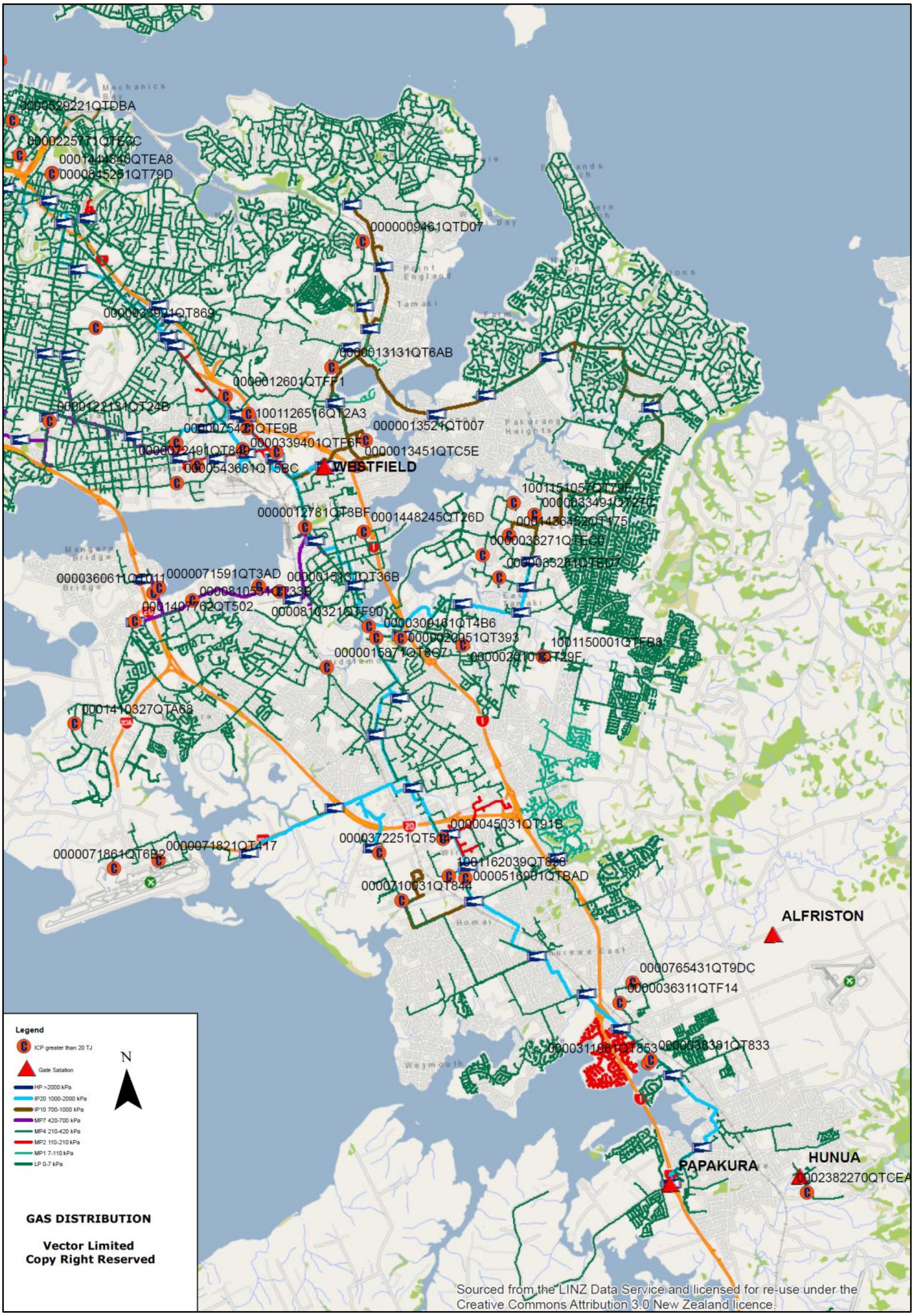

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Legend
ICP greater than 20 TJ
Gate Satation
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IP20 1000-2000 kPa
IP10 700-1000 kPa
MP7 420-700 kPa
MP4 210-420 kPa
MP2 110-210 kPa
MP1 7-110 kPa
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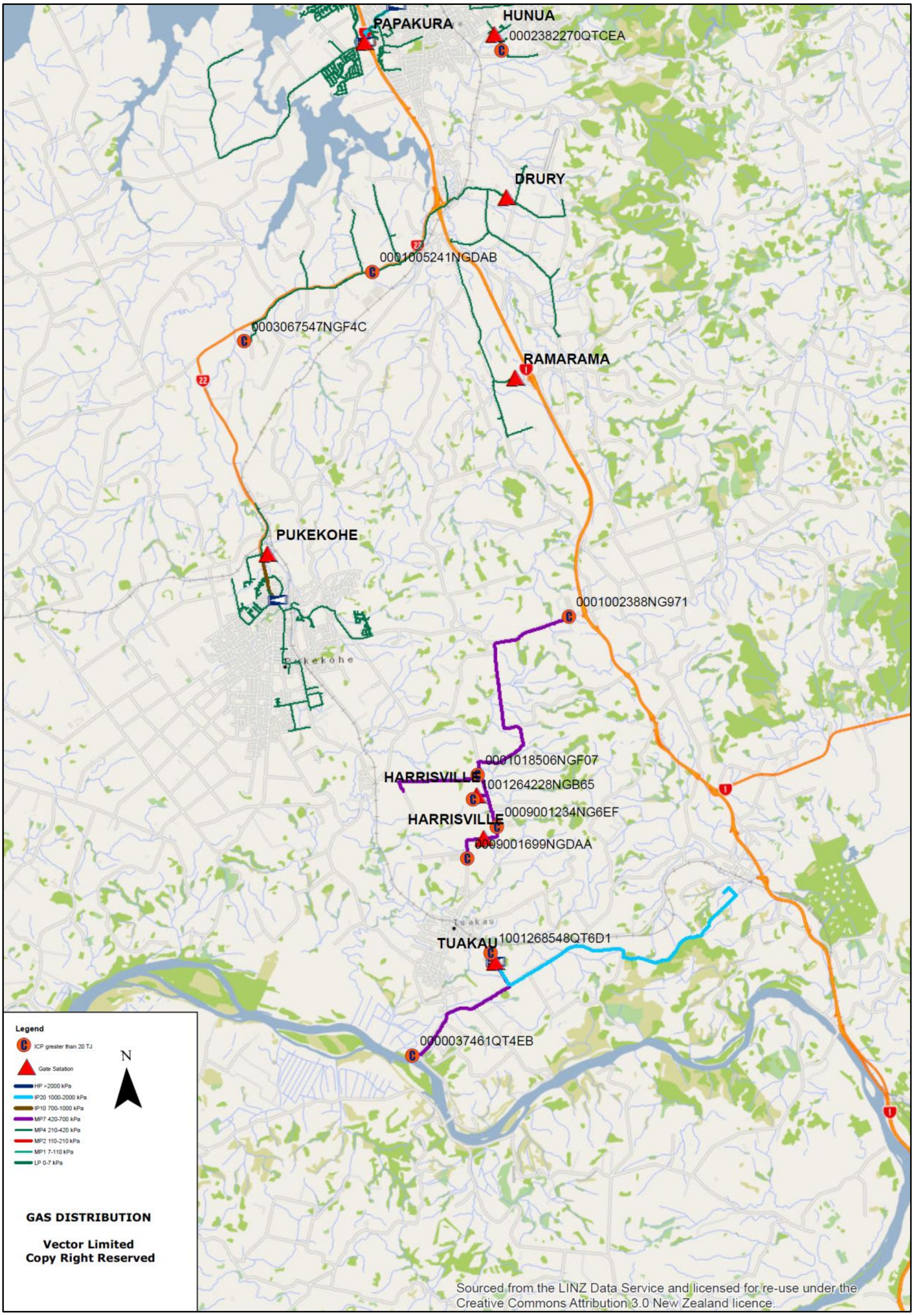
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RAMARAMA
PUKEKOHE
Pukekohe
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0001018506NGF07
HARRISVILLE
1001264228NGB65
HARRISVILLE
0009001234NG6EF
0009001699NGDAA
Tuakau
TUAKAU
1001268548QT6D1
0000037461QT4EB
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ICP greater than 20 TJ
Gate Satation
HP >2000 kPa
IP20 1000-2000 kPa
IP10 700-1000 kPa
MP7 420-700 kPa
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MP1 7-110 kPa
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Gas Distribution
Asset Management Plan
2016 – 2026

Service Levels – Section 4

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4 Service Levels

This section describes the gas distribution business performance indicators and targets set under Vector's asset management strategy. Performance against these targets is also discussed.

4.1 Customer Experience

Vector is committed to delivering customer excellence as we create a new energy future. We will do this by consulting with and listening to our customers, use simple language and developing new tools to reduce their time and effort to be served. Vector recognises customer communication as essential in order to understand, add value and deliver services and products our customers like, want and need.

Keeping engaged, aligned and ahead of changing customer expectations is fundamental to delivering optimal asset investment and asset management practices.

Our intention is to develop easy and fast options for our customers.

Customer interaction, consultation and the outcome experience is part of everyday business encompassed by;

- Call centre representatives;
- Customer service team representatives;
- Operations and project representatives;
- Service contracting representatives;
- Service feedback surveys;
- Lifestyle surveys;
- Digital platforms (website, social media, apps etc);
- Dedicated account management for nominated customers; and
- Vector Customer Advisory Board.

Vector has established a Customer Advisory Board consisting of diverse representation of our customers and key stakeholders to help define and test evolution of our customer relationships, strategies, services and standards. Vector is using this Board, along with results of the surveys conducted, to drive services to meet customer expectation.

Significant individual needs, preferences and expectations are derived through lifestyle surveys. Lifestyle insight providing a sound basis for changing business objectives in alignment with changing customer expectations.

The most recent lifestyle survey, conducted in November 2015, continues to reinforce the strong themes from previous engagement surveys. This survey was designed to draw out customer preferences around network performance, pricing, preferred manner of communication, appliance usage, and energy usage.

Key findings in summary;

- Traditional resistance heaters are still the main method for space and water heating. However, regardless of cost, heat pumps are the first choice for space heating, with solar related appliances being the top preferred method for water heating.
- Intention to take up natural gas remains low. Forty five percent of respondents do not know if natural gas is available in their streets or not. The initial cost of connection is the main reason why the respondents do not install natural gas. When

natural gas is an option, the respondents choose LPG primarily due to the fact that the price is cheaper.

4.1.1 Customer Expectations

Keeping engaged and aligned with changing customer expectations is fundamental to optimal asset investment and asset management practices.

Customer performance targets are normally established through taking into account customer needs on a qualitative basis, due to the complexity and informational requirements of quantifying customer requirements, and relating them to network performance.

At present there is no evidence from the Vector customer-base to support increased (or reduced) levels of supply reliability, especially where these would require increased network charges to recover the additional costs. In the absence of other drivers, Vector's quality targets therefore coincide with the Commerce Commission's regulatory quality targets[1].

4.1.2 Customer Feedback

Vector obtains feedback from regular customer experience surveys, through which we contact a sample of customers[2] who have recently had a residential gas connection completed through Vector's connections process. The survey results report the overall residential customer satisfaction of getting gas installed.

In general, Vector does not vary its customer orientated performance indicators with different consumer types. However, Vector recognises that individual customers have different and diverse needs and expectations when connecting gas at their property. For some, the initial contact and professionalism is a key consideration. For others, the method and level of disruption has real consequences. All aspects of the customer experience are reported through the detailed survey responses.

The results of these surveys provide a basis for setting Vector's customer service levels for connection activities, and guide continuous process and service improvements. The average rating score is expressed as a percentage.

Results for the overall residential gas connection is summarised in the following chart.

[1] The regulatory threshold target is defined in the Commerce Commission Gas Distribution Services Default Price-Quality Path Determination 2013 dated 28 February 2013 (http://www.comcom.govt.nz/assets/Gas/Gas-Default-Price-Quality-Path/Initial-DPP-for-GPB/2013-NZCC-4-Gas-Distribution-Services-Default-Price-Quality-Path-Determination-28-February-2013-.PDF)

[2] The sample size for the customer surveys vary each year but typically range between 620 to 820. Surveys are conducted on an ongoing monthly basis with reporting at quarterly intervals for connections.

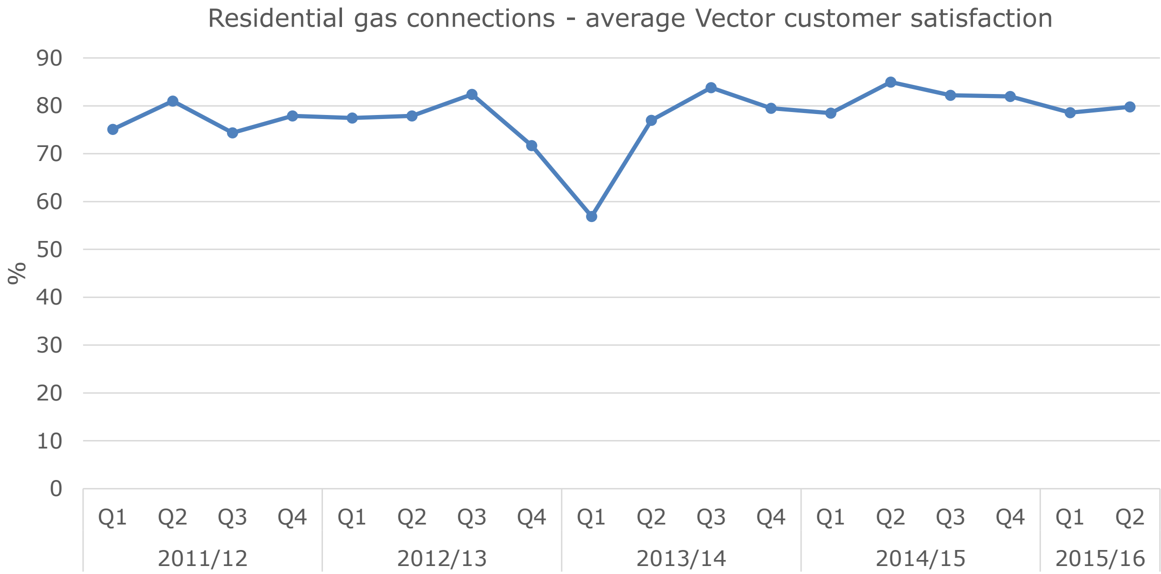

Figure 4-1 Residential customers' overall satisfaction with Vector through the connections process

4.1.3 Customer Resolution

Although Vector seeks to provide a high standard of service and a safe and reliable gas supply, there may be times when customers have concerns with their service. In these instances Vector's customer services team takes appropriate actions to manage these concerns, including:

- Logging all reported complaints in relation to the distribution network;
- Coordinating closely with all appropriate areas of the business in resolving the complaints; and
- Improving the customer experience, where appropriate and reasonable.

If the cause for concern or complaint is not immediately resolved, it is logged as a formal complaint with Vector's customer services team. The customer services team is responsible for complaint resolution, identifying trends and raising issues with the appropriate business units in order to implement permanent solutions and prevent recurrence, where appropriate.

Vector adheres to a formal complaint resolution process. Vector's preference is for proactive, consultative and direct engagement with customers via the customer services team. Vector's formal complaint process is as follows:

- Acknowledgement of receipt of the complaint by Vector;
- Providing the customer with an update and/or working to resolve the complaint; and
- If the complaint is not resolved within the stated timeframe, informing the customer of the reason for the delay and working towards resolution.

If Vector has not resolved the complaint within the timeframes specified by the Electricity and Gas Complaints Commission (EGCC, see below), or to the customer's satisfaction, then Vector notifies the customer of the option of taking the complaint to the EGCC.

The number of complaints performance indicator is calculated from the sum of complaints acknowledged divided by the average total number of customers.

For the year ending 30 June 2015, Vector's total number of complaints per customer was 0.0005, beating Vector's 2015 target of 0.0013. Table 4-1 shows the comparison of the average complaints per customer for the previous three years.

Financial Year	2013	2014	2015	2015 Target
Number of complaints per consumer	0.0013	0.0014	0.0005	0.0013

Table 4-1 : Historical response for customer complaints

Vector's target number of complaints for the next 10 years is (less than) 0.0011 complaints per customer.

4.1.4 Response Time to Emergencies

Targets and measures for Vector's response time to emergencies[3] (RTE) are recorded and reported as follows. For the year ending 30 June 2015, Vector's RTE within one hour and three hours response time is shown in Table 4-2.

Financial Year	2013	2014	2015	2015 Target
Proportion of RTE within one hour	95.4%	94.0%	96.1%	80%
Proportion of RTE within three hours	100%	100%	100%	100%

Table 4-2 : Historical performance of RTE

Vector's target proportion of RTE within one and three hours is 80% and 100%, respectively, which is higher than or equal to the limits set by the Commerce Commission[4].

4.2 Health and Safety

Vector is committed to continual and progressive improvement in its health and safety performance. The building of sustainable health and safety capability at all levels, the delivery of services, and exceptional engagement with all stakeholders on the following fundamental objectives:

- Providing a safe and healthy workplace for all Vector people (including FSPs), the public and visitors;
- Ensuring health and safety considerations are part of all business decisions;
- Monitoring and continuously improving our health and safety performance;
- Communicating with Vector people, customers, and stakeholders on health and safety matters;
- Operating in a manner that manages health and safety hazards and mitigation of the risks;
- Fostering personal commitment to health, safety and wellbeing and encouraging safe and healthy lifestyles, both at work and at home; and
- Supporting the safe and early return to work of injured or ill Vector people.

In addition to the specific performance measures relating to health and safety that have been put in place with the FSPs, Vector monitors gas-related public safety incidents and

[3] An "emergency" is defined as one of the following events: an unplanned escape and/or ignition of gas that requires the active involvement of any emergencies service (i.e. fire service, ambulance); or an unplanned disruption in the supply of gas that affects more than five customers; or the need to evacuate premises as the result of escape or ignition of gas.

[4] The regulatory threshold target is defined in the Commerce Commission Gas Distribution Services Default Price-Quality Path Determination 2013 dated 28 February 2013 (http://www.comcom.govt.nz/assets/Gas/Gas-Default-Price-Quality-Path/Initial-DPP-for-GPB/2013-NZCC-4-Gas-Distribution-Services-Default-Price-Quality-Path-Determination-28-February-2013-.PDF)

incidents arising from its employees. These incidents are reviewed monthly to ensure lessons are captured and where appropriate, corrective actions are implemented.

The primary health and safety performance measure considered by Vector is the total recordable injury frequency rate (TRIFR). TRIFR encompasses all incidents resulting in a medical treatment, restricted work injury, lost time injury or fatality, which impacts Vector people including all contractors and FSPs. The incident count is divided by the number of hours worked for the same measurement timeframe, Vector reports TRIFR as a moving 12 month value which is then normalised to report TRIFR in per million hours worked.

Table 4-3 below shows the trend in total recordable injury frequency rate injuries at Vector (including Vector staff, contractors and FSPs).

Financial Year	**2013**	**2014**	**2015**
TRIFR Total Recordable Injury Frequency Rate	12.29	11.26	9.13

Table 4-3 : Health and Safety Performance 2013–2015 (including the electricity network)

Vector's stated objective for 2016 is a 10% reduction in TRIFR from the previous year, with subsequent annual reductions of 5% out to 2020. The Health and Safety TRIFR targets are presented in Table 4-4.

Financial Year	**2016**	**2017**	**2018**	**2019**	**2020**
TRIFR Total Recordable Injury Frequency Rate	8.22	7.76	7.30	6.85	6.39

Table 4-4 : Health and Safety Targets 2016-2020 (including the electricity network)

Vector is continuing to place a strong focus on: designing out hazards, where ever possible, through our safety in design process, Vector's policies and procedures assist the workforce to deliver the right action at the right time, and to focus on personal behaviours and safety leadership to encourage an individual and team safety culture.

The Health and Safety at Work Act 2015 came into effect on 4 April 2016. Vector has reviewed and updated its Health, Safety and Environment (HSE) management system in line with the new legislation.

4.3 Environment

Vector strives to be recognised as a leading environmentally responsible company, with exceptional emphasis on operating in such a way as to respect and protect the natural environment.

Vector's environmental target is full compliance with all requirements from local and regional councils to have no prosecutions based on breaches, environmental regulations or requirements.

Environmental incidents are also reported, recorded and investigated with any learnings and improvements shared with the FSPs at the HSE leadership forum.

4.4 Supply Reliability

Supply reliability is the outcome of how often the gas supply gets interrupted, and how long it takes to restore supply once interrupted. In the context of average network supply reliability, the following nationally recognised measures are recorded and reported:

- SAIDI (System Average Interruption Duration Index) - the length of time in minutes that the average customer spends without supply over a year, measured in customer minutes per 1000 customers;
- SAIFI (System Average Interruption Frequency Index) - the number of unplanned supply interruptions which the average customer experiences over a year, measured in customer interruptions per 1000 customers;
- CAIDI (Customer Average Interruption Duration Index) – the average length of an unplanned outage that a customer would experience (SAIDI / SAIFI);
- Outage events - the number of unplanned interruptions that affect more than five customers; and
- Outage events caused by third party damage - the number of unplanned interruptions that affect more than five customers which has been caused by third party damage.

4.4.1 SAIDI

SAIDI measures the total time, on average, that a customer could expect to be without gas over the reporting period. It is a measure of interruptions, including third party damage and excludes interruptions directly resulting from interruptions on the transmission system. It is calculated by dividing the product of the number of interrupted customers and the duration of the interruption (in minutes), by the total number of customers connected to the network and further dividing by 1000.

SAIDI is driven by a combination of factors. These include the number of faults on the network, the number of customers affected by each fault, and the time taken to restore supply. These in turn are affected by external factors e.g. third party damages, the network design and construction standards, equipment standards, management and performance of field staff and condition of the network assets.

A significant influence on SAIDI (and SAIFI) is the damage caused to the gas network by non-Vector contractors conducting works not directly related to the gas network. Third party interference damage is a major cause of system interruptions. Though not all events caused by third party works result in interrupted gas supplies, they are potential safety hazards and could project a negative public image of natural gas (and of Vector).

Performance

For the year ending 30 June 2015, Vector's SAIDI performance was 2010 minutes per 1000 customers, above Vector's 2015 target of 988.

The majority of Vector's SAIDI is caused by third party damage or equipment failure. Significant increases in SAIDI (and SAIFI) during the 2015 period include:

- An increase in Vector's unplanned SAIDI (and SAIFI) performance due to two third-party related events in April and May 2015 which resulted in an outage affecting three customers for 13 and 25 days, respectively. Both events related to customer supplies that were inactive at the time of each event. This accounted for 29% of the yearly total unplanned SAIDI result; and
- An improvement in Vector's planned SAIDI (and SAIFI) due a lower number of planned riser valve replacements.

Table 4-5 shows the comparison of SAIDI for the previous three years.

Financial Year	2013	2014	2015	2015 Target
SAIDI (minutes per 1000 customers)	5180	3140	2010	988

Table 4-5 : Historical performance for SAIDI

4.4.2 SAIFI

SAIFI measures the average number of interruptions that a customer could expect over the reporting period, including those due to third party damage, but excluding those directly resulting from interruptions of the transmission system. SAIFI is calculated by dividing the total number of interruptions on the network in the relevant year by the total number of customers connected to the network and further dividing by 1000.

Performance

For the year ending 30 June 2015, Vector's SAIFI performance was 10 interruptions per 1000 customers, above Vector's 2015 target of 5.9. Table 4-6 shows the comparison of SAIFI unplanned for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
SAIFI (interruptions per 1000 customers)	24	15	10	5.9

Table 4-6 : Historical performance for SAIFI

4.4.3 CAIDI

CAIDI measures the average outage duration of an interruption of supply per customer who experienced an interruption in the reporting period.

CAIDI is the sum of the duration of each (excluding transmission) interruption, divided by the total number of (excluding transmission) interruptions.

Performance

For the year ending 30 June 2015, Vector's CAIDI performance was 202 minutes per interruption, above Vector's 2015 target of 152. Table 4-7 shows the comparison of CAIDI for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
CAIDI (minutes per interruption)	212	204	202	152

Table 4-7 : Historical performance for CAIDI unplanned

4.4.4 Outage Events

Outage events are a count of the number of unplanned interruptions which affect more than five customers.

Performance

For the year ending 30 June 2015, Vector's outage events performance was 2 events, below Vector's 2015 target of 11. The outage events caused by third party damage was 1 event, below Vector's 2015 target of 8. Table 4-8 below shows the comparison of outage events (including those caused by third party events) for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Outage events (events)	5	5	2	11

Outage events caused by third party damage (events)	4	5	1	8

Table 4-8 : Historical performance for outage events

4.4.5 Targets

Table 4-9 shows the supply reliability targets for the next 10 years[5].

Financial Year	2016	2017	2018	2019	2020	+5 yrs
SAIDI (minutes per 1000 customers)	3443	3443	3443	3443	3443	3443
SAIFI (interruptions per 1000 customers)	17	17	17	17	17	17
CAIDI (minutes per interruption)	206	206	206	206	206	206
Outage events	4	4	4	4	4	4
Outage events caused by third party damage	3	3	3	3	3	3

Table 4-9 : Vector's supply reliability targets

4.5 System Condition and Integrity

Vector's strategic goal is to ensure system condition and integrity performance targets are achieved in accordance with the Commerce Commission's regulatory thresholds and customer expectations. In the context of average network system condition and integrity, the following measures are recorded and reported:

- Non-compliant odour tests;
- Public reported escapes;
- Third party damage events;
- Leakage survey; and
- Poor pressure due to network causes.

4.5.1 Odorisation

The purpose of this measure is to ensure the odorant levels of gas conveyed through Vector's gas networks are maintained in accordance with the requirements of the Gas Regulations 1993 and the New Zealand standard NZS 5263 Gas detection and odorisation.

Monitoring the number of non-compliant odour tests enables Vector to monitor the level of gas odour in the gas and identify when any corrective action is required. A non-compliant odour test means the odour test result is above 0.9% gas-in-air or where the odorant concentration test result is less than 3 mg/m^3.

Performance

[5] Targets are calculated by Vector using the actual performance results from years 2013 to 2015.

For the year ending 30 June 2015, the number of non-compliant odour tests was 0, below Vector's 2015 target of (less than) 2. Table 4-10 shows the comparison of non-compliant odour tests for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Number of non-compliant odour tests	3	2	0	2

Table 4-10 : Historical performance for non-compliant odour tests

4.5.2 Public Reported Escapes

Vector uses Public Reported Escapes (PRE) as its primary technical network service quality measure for operational purposes. It is a critical safety measure and a reliable indicator of the condition of the network. This measure is impacted by a number of factors, including the effectiveness of renewal strategies, the condition and composition of assets, the level of odorant added (which increases the likelihood of PREs), and the extent and effectiveness of leakage surveys.

PRE is calculated by dividing the total number of confirmed public reported escapes of gas on the network (including mains, service pipes, valves, and pressure stations) in the relevant year by the total length of network (mains and services) and further dividing by 1000.

The monitoring of public reported escapes, the determination of their causes and the implementation of programmes directed at reducing them is internationally recognised as being fundamental to improving the safety and reliability of gas networks.

Performance

For the year ending 30 June 2015, Vector's PRE performance was 43 PRE per 1000 km of system, below Vector's 2015 target of (less than) 53. Table 4-11 below shows the comparison of PRE for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Public reported escapes (events per 1000km)	43	41	43	53

Table 4-11 : Historical performance for PRE

4.5.3 Third Party Damage Events

Third Party Damage (TPD) events to networks are a significant cause of gas escapes and customer supply interruptions. The levels of third party interference damage provide some indication of the network operator's level of success in communicating awareness to those who control and/or are directly engaged in any activities that put gas networks at risk. As described in Section 6, Vector has a number of strategies, such as public safety awareness communications programmes, which are designed to increase public and contractor awareness and reduce the number of third party incidents.

TPD events are calculated by dividing the total number of TPD events on the network in the relevant year by the total length of network (mains and services) and further dividing by 1000.

Performance

For the year ending 30 June 2015, Vector's TPD event performance was 60 TPD events per 1000km of system, below Vector's 2015 target of (less than) 67. Table 4-12 shows the comparison of TPD for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Third party damage (events per 1000km)	56	61	60	67

Table 4-12 : Historical performance for TPD events

4.5.4 Leakage Survey

Leakage surveys are a pro-active maintenance strategy that attempts to locate gas leaks in the network. Leaks detected by system surveys are a clear indicator of the condition of the network and the effectiveness of maintenance strategies. As described in Section 6, renewal strategies play an important role in improving the condition of the gas distribution network and reducing the number of leaks. Vector surveys different parts of its network every year, taking five years to complete an entire network survey. It is therefore not meaningful to compare leak data on a yearly basis; a five year rolling average should be applied to any analysis of overall network condition.

Leak survey is calculated by adding up the number of leaks detected by routine survey and dividing this number into the total length of pipeline and further multiplying by 1000.

Performance

For the year ending 30 June 2015, Vector's leak survey performance was 0.9 leaks per 1000km of system, below Vector's 2015 target of (less than) 1.4. Table 4-13 shows the comparison of leaks detected by survey for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Leakage surveys (leaks per 1000km)	2.3	1.4	1.0	1.4

Table 4-13 : Historical performance for leakage survey

4.5.5 Poor Pressure Due to Network Causes

Poor pressure due to network causes is a count of the number of unplanned incidents where delivery pressure drops below contracted delivery requirements.

Performance

For the year ending 30 June 2015, Vector's poor pressure performance was 4 events, slightly below Vector's 2015 target of (less than) 3 events per annum. Table 4-14 shows the comparison of poor pressure events due to network causes for the previous three years against Vector's target.

Financial Year	2013	2014	2015	2015 Target
Poor pressure due to network causes	2	4	4	3

Table 4-14 : Historical performance for poor pressure due to network causes

4.5.6 Targets

Table 4-15 shows the system condition and integrity targets for the next 10 years[6]:

[6] Targets are calculated by Vector using the actual performance results from years 2013 to 2015.

Financial Year	2016	2017	2018	2019	2020	+5 yrs
Non-compliant odour tests	2	2	2	2	2	2
Public reported escapes per 1000km	42	42	42	42	42	42
Third party damage events per 1000km[7]	59	59	59	59	59	59
Leak survey per 1000km	1.6	1.6	1.6	1.6	1.6	1.6
Poor pressure due to network causes	3	3	3	3	3	3

Table 4-15 : System condition and integrity targets

4.6 Works Performance Measures

4.6.1 Capital Works Delivery

Capital work is scheduled physically and financially from the time a project is in proposal stage. Each project is split into a number of stages that state delivery expectations from defining the solution, through to final commissioning and close out. Project delivery through the stages with an emphasis on cost control is monitored monthly and reported to general manager level, any cost variations from budget being communicated to board level. Project initiators, engineers and contract managers meet on a monthly basis to discuss project progress and issues and roadblocks are quickly escalated.

To ensure focus remains on delivery of the works programme, our FSPs have profit at risk KPIs associated with delivery against forecast.

Monthly forecasts are compiled for the whole programme of work and circulated to executive level. Actual against forecast is also tracked as part of the executive dashboard metrics.

Each month an exceptions report is submitted to the board, which details the number of active projects with a value greater than $500,000 and their status. This report is designed to provide a no surprises environment, where projects with time or budget issues are highlighted at an early stage.

4.6.2 Field Operations Performance Assessment

A performance incentive scheme has been agreed with Vector's FSPs that is intended to:

- Measure the performance of Vector and the FSPs through the establishment of KPIs for both safety and reliability outcomes, and provide appropriate incentives to deliver the required performance by both parties;
- Recognise that the FSPs entitlement to any incentive payment is dependent upon its performance as measured against KPIs, and drive continuous improvement and efficiencies through the annual review of the KPIs and the criteria for those KPIs; and
- Recognise that Vector's performance within key processes is critical to the FSPs' ability to deliver overall results.

Systems have been developed and implemented to provide visibility to both Vector and FSPs on their respective performances against KPIs that employ end-to-end measures.

[7] The third party damage events target is calculated using historical performance and has been adjusted due to the expected level of road corroder activity affecting Vector's assets. Refer to section 6 for further details.

For each KPI there is a “meet” and “outstanding” performance incentive level; in some cases there is an additional “not meet” disincentive criterion. KPIs have been established for Vector’s FSPs in the following areas, which are described in more detail below:

- Network performance;
- Delivery and quality of works;
- Health, safety, environmental and people;
- Cost management and efficiency; and
- Information quality.

4.7 Process for Recording Reactive Fault Information

Vector’s FSPs undertake data capture activities within the gas distribution network. The FSPs manage data in accordance with Vector’s requirements as defined in the Vector standard GNS-0081 (standard for Gas Distribution Network Reliability, Integrity and Consumer Service).

Gas distribution network performance and consumer service data is captured using two methods:

- Electronically via hand-held tablets in the field. Data from the hand-held tablets is automatically uploaded into Vector’s Customer Management System (CMS); and
- Remotely entered (external to Vector) directly into Vector’s CMS, with hard copy paper records scanned and entered as an attachment. This approach is used only if the electronic data capture systems are not available.

Data entered in Vector’s CMS by one of the above methods is then quality checked by the FSP for accuracy, prior to undergoing additional quality assurance checks by Vector personnel. Data is then extracted from Vector’s CMS and the required information is generated for reporting purposes.

The following system integrity and reliability metrics are extracted from the CMS database for disclosure reporting:

- Response Time to Emergencies
- SAIDI Unplanned
- SAIDI Planned
- SAIFI Unplanned
- SAIFI Planned
- CAIDI Unplanned
- CAIDI Planned
- Interruptions by Class
- Outage Events
- Outage Events Caused by Third Party Damage
- Public Reported Escapes
- Third Party Damage Events
- Leakage Survey
- Poor Pressure Due to Network Causes
- Emergency Telephone Calls answered within 30 Seconds
- Product Control – Non Compliance Odour Tests

- Number of Complaints

Figure 4-2 shows how the reactive fault information is recorded and checked for completeness.

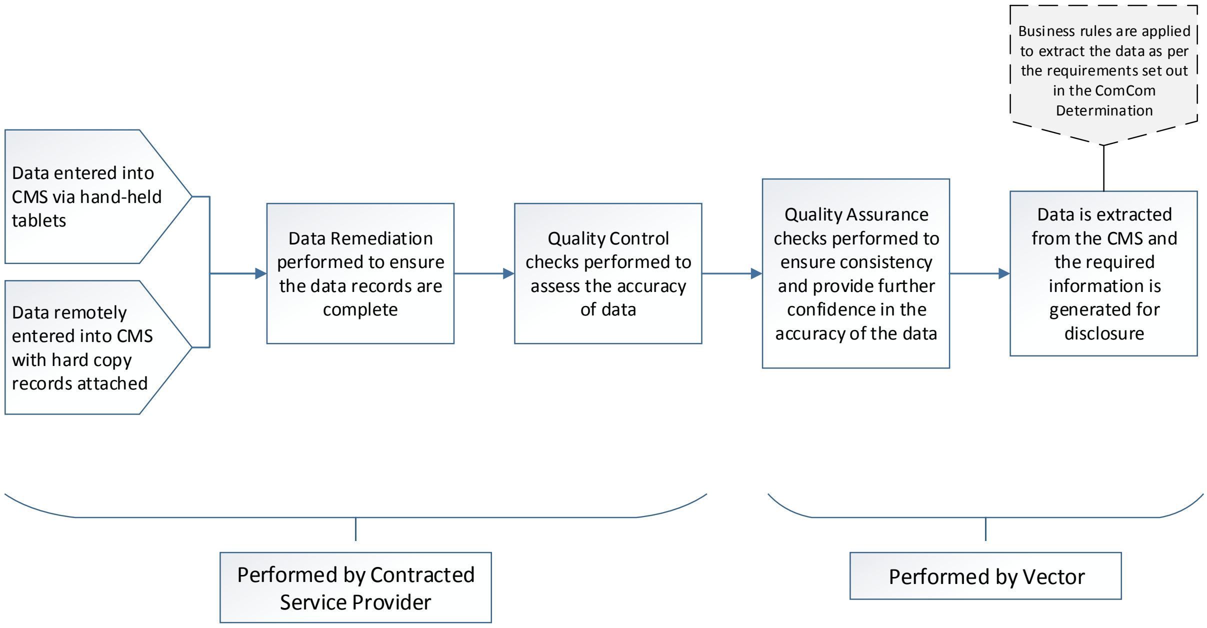

Figure 4-2 : Process for capture and QA of reactive fault information

Gas Distribution
Asset Management Plan
2016 – 2026

Network Development Planning– Section 5

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5 Network Development Planning

Network development refers to growth initiatives which:

- Extend Vector's gas distribution network to developing areas;
- Increase the capacity or supply levels of the existing network to cater for demand growth or changing consumer demand;
- Provide new customer connections; or
- Address the relocation of existing services when requested by customers, utilities or requiring authorities.[1]

5.1 Network Planning Process

Vector's primary objectives in network planning are to identify and prevent foreseeable network related security[2], capacity and quality (system pressure) problems in a safe, technically efficient and cost-effective manner. The planning process involves identifying and resolving:

- Supply quality, security or capacity issues that may prevent Vector from delivering its target service levels;
- Adequacy of supply to new developments or areas requiring gas connections;
- The need to relocate assets, when reasonably required by third parties; and
- Supply quality problems which can be identified from a wide range of sources, including network measurement and monitoring (system pressure), gas flow modelling and customer complaint databases.

Knowledge of asset capacity and capability, together with an accurate demand forecast, enables an accurate assessment of the network's ability to deliver the required level of security and service. Input data comprising past demand trends, anticipated customer growth, technology trends, demographics, population growth, and industry trends are used to produce the demand forecast.

5.2 Planning Criteria and Assumptions

Network development planning is concerned with delivering network performance based on the availability of reserve capacity to a level of risk acceptable to the board, or as agreed with customers. Vector has a number of key policies, standards and guidelines underpinning its network planning approach. These policies, standards and guidelines cover the following areas:

- **Quality of supply standard:** Vector's quality of supply standard specifies the minimum levels of network pressure (including levels of redundancy) to ensure an appropriate level of supply service. Vector has adopted a 1-in-20 year winter incidence (i.e. severity) level, to ensure that distribution capacity shortfalls do not occur at an unacceptably high frequency;
- **Service level:** Established as part of the Use of Network Agreement with retailers and customers;
- **Technical standards:** Ensure optimum asset life and performance is achieved. They ensure that capital cost, asset ratings, maintenance costs and expected life are

[1] The main requiring authorities are local authorities, Kiwi Rail and NZTA.

[2] "Security" as used in a planning context means the security of the gas supply – i.e. the likelihood that supply may be lost.

optimised to achieve lowest overall cost for Vector. Standardisation also reduces design costs and minimises spare equipment holding costs, leading to lower overall project costs; and

- **Network parameters:** Including acceptable operating pressure levels, pipe sizes, flow rates, etc., providing an appropriate operating framework for the network. These will generally be aligned with industry norms.

These policies, standards and guidelines are based on the following principles:

- All network assets will be operated within acceptable standards;
- The design and operation of the network will not present a safety risk to staff, contractors, customers or the public;
- The network is designed to meet statutory requirements including acceptable pressure levels;
- Customers' reasonable gas supply requirements will be met.[3] In addition, the network is designed to include a prudent capacity margin to cater for foreseeable medium term load growth;
- Equipment is purchased and installed in accordance with network standards to ensure optimal asset life and performance; and
- Network investment will provide an appropriate commercial return for the business.

5.2.1 Quality of Supply

Vector recognises the importance of supply quality to its customers. The networks are designed to a supply quality level that ensures most modern gas-driven equipment can operate effectively. Strategies have been adopted to monitor and manage the impact of quality on the network. These include installation of pressure and flow monitoring equipment at gate stations, district pressure stations and customer sites and the application of modelling software and tools to predict the impact of supply quality on customers.

Vector has considered several factors in determining the quality of supply applicable to its gas distribution network. These include the degree of redundancy in different circumstances and supply pressure criteria which, when put together, build the over-arching quality of supply criteria.

Due to historical practices of predecessor organisations, Vector's gas distribution networks have been developed based on different criteria. Steps have been taken to progressively align the different criteria towards a single set of quality of supply and security criteria across all regions.

One of the long-term network development drivers is to increase asset utilisation, while retaining acceptable level of supply and security risks. This can be achieved through a combination of knowledge of the capability of network assets, and accurate network operating information (demand, pressure, etc.).

5.2.2 Supply Pressure Criteria

The capacity of an individual pipeline is determined by the operating pressure, the diameter and the allowable pressure difference between inlet and outlet. Meshed distribution systems work on the same principle, except that the pipelines are interconnected and that such distribution systems can be fed at multiple points.

Regulator stations have nominal outlet pressures which supply each discrete pressure system. As the distribution systems expand and demand grows, certain parts of the

[3] This includes customers with non standard requirements, where special contractual arrangements apply.

distribution systems, mostly particular feeder mains, can develop large pressure drops, thus constraining downstream parts of the distribution systems. Vector therefore prepares regular system pressure monitoring surveys and distribution system analyses to identify such constraints and to reinforce distribution systems before operating pressures become insufficient. It is important to note that each pressure system needs to be considered when examining pressure drops. This is due to the meshed nature of the network and the different characteristics each pressure system exhibits, i.e. mix of residential, commercial and industrial customers. The following sections describe the key points of Vector's quality of supply criteria.

Vector has determined that under standard operating arrangements, pressure at any point on the network shall be no less than 50% of its Nominal Operating Pressure (NOP) and no more than 110% of its MAOP[4].

In some cases non-standard minimum network pressures are used as a result of network configuration, cost efficiency or special agreements with customers. Vector's quality of supply criteria provides the minimum operating pressures that apply at the critical locations where non-standard conditions apply.

During contingency conditions, network pressures may drop below those experienced during standard and non-standard operating conditions. In these situations, maintaining network pressure depends on the type of fault and the network configuration. Contingency provisions such as customer load shedding are used to maintain network pressure to the end users. Upon loss of a critical element in the supply chain, the following minimum network pressures shall be maintained using contingency provisions:

- Intermediate pressure (IP) networks shall be operating at no less than 40% of NOP;
- Medium pressure (MP) networks shall be operating at no less than 30% of NOP; and
- Low pressure (LP) networks shall be operating at no less than 1.2kPa.

Note: Under contingency situations, networks are isolated to maintain safety to customers and the public.

5.3 Planning Methodology

As noted previously, the network planning process involves identifying and resolving:

- Upcoming supply quality, security or capacity issues that may prevent Vector from delivering its target service levels;
- Adequacy of supply to new developments or areas requiring gas connections; and
- The need to relocate assets when reasonably required by third parties.

In all cases, effective design requires consideration of the forecast planning demand, the capacity of equipment and the impact of the environment in which the equipment will operate.

The demand forecast model is aimed at providing an accurate picture of future demand growth (or decline) so investment decisions can be made with confidence. When used in conjunction with equipment ratings, it is possible to plan for the required quality of supply margins within the network. The quality of supply criteria is defined to reflect the levels of acceptable supply risk to Vector and its customers. This ensures that network investments are made on a consistent basis.The methodology used to assess equipment rating reflects the capacity of the equipment under field conditions, independent of the manner in which demand forecasts and quality of supply standards are developed.

[4] Vector's standard operating pressures are in line with international practice.

5.4 Network and Asset Capacity

To enable the capacity of the delivery points (pressure systems) to be assessed, it is necessary to a have a reliable assessment of the capacities of the major network components. Major components include:

- Pipelines;
- Gate stations; and
- District regulating stations (DRS).

Determining the capacities of these network components requires a detailed assessment of each sub-component within the component. For example, in assessing the capacity of a DRS, ratings of the filter, meter, regulator and other accessories are also assessed to ensure the sub-component with the lowest rating – which determines the overall asset rating - is identified.

The following paragraphs describe how the capacities of the network components are assessed. In all cases, asset capacities are assessed at normal full-load ratings.

5.4.1 Pipelines

The analysis of pipeline capacity is complex due to the various pipeline types and network configurations. As mentioned beforehand[5], pipeline capacity can be determined by examining the relationship between system pressures, pipe diameter and the allowable minimum operating pressure (MinOP).

To help in determining the capacity of a pipeline or group of pipelines (pressure system), Vector uses the network modelling tool "SynerGi[6]", a product of GL Noble Denton. SynerGi is designed to model the gas network flow, pressure profile and capacity margins. This software tool is used 1) to determine the minimum pressure a pipeline system can sustain under load conditions, 2) for scenario analysis when considering development options, and 3) to assess the impact of changes to network operating parameters (such as increasing or reducing operating pressure in certain parts of the network) and to assess network risk.

5.4.2 Gate Stations

Vector takes its gas supply from the transmission system via gate stations (which are operated and maintained by First Gas Limited).

Gate station capacity is designed to meet the 10 year forecast load requirements at the station, based on minimum design inlet pressure and design outlet pressure and current load projections.

From a gas distribution perspective, there is a need to obtain a better understanding of the design capacity of most gate stations. Constraints at a gate station can impact on distribution investment decisions. Improved knowledge of the gate station capacities and constraints will lead to improved decisionmaking by offering a wider range of investment solutions.

5.4.3 District Regulating Stations

The purpose of a District Regulating Station (DRS) is to control the pressure in the downstream mains pipeline to which it is connected. Also, a DRS is designed with sufficient

[5] Section 5.2.

[6] SynerGi is the product name provided by GL Noble Denton for gas network modelling and analysis. It features advanced pipeline simulation software along with the ease and familiarity of a windows-based operating system. Licensing add-on modules can extend SynerGEE's functionality. Currently, Vector has two server licences that can run both steady state and unsteady state modules.

capacity to supply the 10 year forecast load, based on minimum design inlet pressure and design outlet pressure, and current load projections.

Vector's gas network distribution quality of supply criteria is based on maintaining an adequate supply pressure across the network.

5.5 Demand Forecasting Methodology

A spreadsheet-based model has been developed for gas demand forecasting. The model covers the winter forecasts for the next 10 years.

Time-series analysis is used to develop a demand forecast at each gate station. Historical monthly flow data is summarised into a quarterly peak flow value. Input into the time-series was taken as the maximum flow of each quarter (Jan-Mar as Q1, Apr-Jun as Q2, etc). Some gate stations are equipped with two or three meters resulting in multiple meter readings. At these sites, the flows were either summed or the maximum value was used. Zero, anomalous or incomplete data has been excluded. In some cases[7], data was not available, and in these cases, Vector relies on its system pressure monitoring programmes to assess the demand on the network.

The time-series quarterly values are analysed for several factors: long-term trend, business cycle effects, seasonality, and unexplained, random variation. Because it is usually very difficult to isolate the business cycle effects, the method described here assumes the trend component has both long-term average and cyclical effects. The multiplicative model calculates the value using the formula:

Value = Trend x Seasonal x Random

The process of analysing time-series comprises two stages. The first stage is called 'decomposition' by applying moving averages to eliminate the irregular and seasonal variation in the data and identifying the long-run growth trend within the time-series. Secondly, historical flow data is seasonally adjusted and the trend of the adjusted quarterly flow values is extrapolated[8] and multiplied by an appropriate seasonal index to obtain the forecasted long-term gas demand at each gate station.

Using actual gate station flow data and providing the results of the updated time series analysis allows the demand forecasts to be developed using maximum values for year 0, and derived values for years during the planning period.

Where a gas network is supplied from two (or more) gate stations, the timing of the network peak gas flow may not coincide with either of the gates stations' flows[9]. In such cases, a co-incidence factor is calculated and applied to the growth trend. It is expressed as the maximum peak flow into the network divided by the sum of the individual peak flows of the two gate stations.

Similarly, a co-incident factor is also applied where two network systems are supplied by one gate station. These networks include the Auckland networks in Drury and Whangaparaoa, respectively.

[7] Gate station flow data for Papakura MP4 and Wellsford is unavailable due to these gate stations having no transmission metering capability.

[8] The extrapolation uses a linear trend except where the trend results in negative values. In these cases, a zero load growth has been applied.

[9] The coincident and non-coincident demand is the same for gas distribution networks with a single gate station supply.

5.5.1 Customer Connections

In 2014, Vector commissioned Covec[10] to independently forecast connection rates on the gas distribution network. In its review, Covec identified drivers for the future increase in new connections could be linked to the Statistics New Zealand 2013 Census data (such as population growth projections and household size) and GDP growth forecasts (as provided by the RBNZ). Housing growth was also an indicator, but less influential.

Covec's review included three forecast scenarios as shown in Figure 5-1. The base case forecasts in this AMP are based on Covec's 'medium' growth forecast.

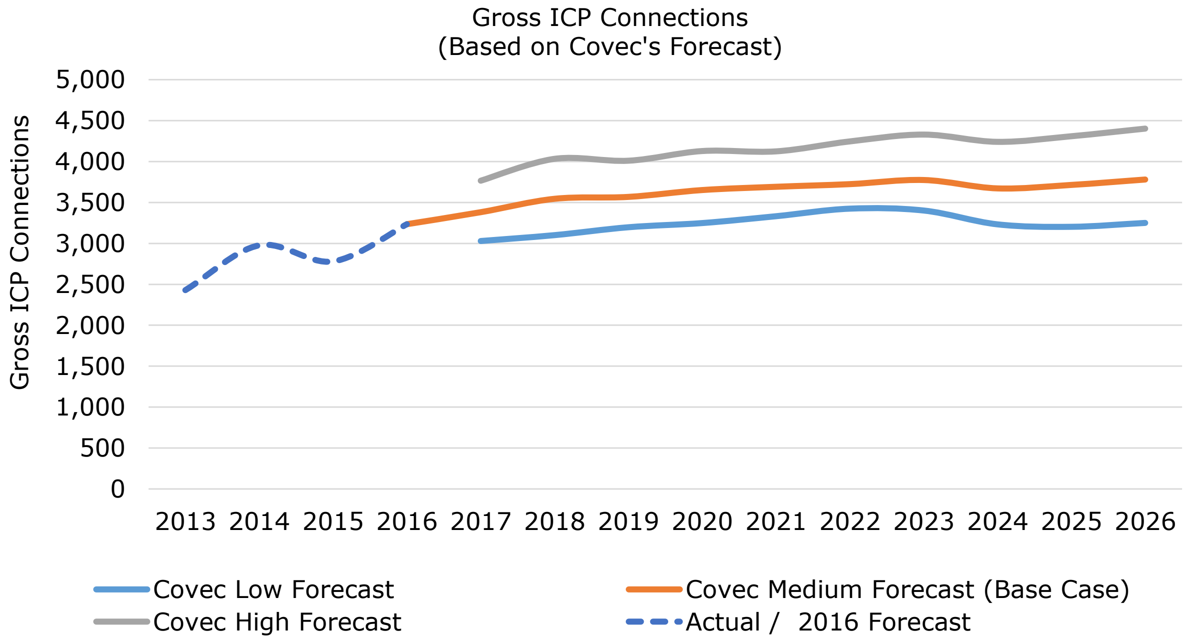

Figure 5-1 : Forecast gross gas connections based on Covec's growth forecasts

5.5.2 Planning Under Uncertainty

A number of precautions are taken to mitigate the risks of making long-term investments in an uncertain environment. Apart from normal business risk avoidance measures, specific actions taken to mitigate the risks associated with investing in networks include the following.

- **Act prudently:** Make small incremental investments and defer large investments for as long as reasonably possible (replace DRS components rather than entire DRS). The small investments must, however, conform to the long-term investment plan for a region and not lead to future asset stranding.
- **Multiple planning timeframes:** Produce plans based on near, medium and long-term views. The near term plan is the most accurate and generally captures load growth for the next three years. This timeframe identifies short-term growth patterns, mainly leveraging off historical trends. It generally allows sufficient time for planning, approval and network construction to be implemented ahead of changing network demand.

  The medium-term plan covers the next ten years, and anticipates regional development trends such as land rezoning, new transport routes and larger infrastructure projects. The medium-term plan also captures behavioural changes

[10] For a description of the analysis behind Covec's forecast refer to Vectors 2014 Gas Distribution Asset Management Plan Update http://vector.co.nz/disclosures/gas/gas-asset-management

such as the adoption of new technologies or global trends (eg. impact of climate change on consumer behaviour, energy conservation, etc).

The Auckland Council has published a draft "Auckland Plan" to guide the development of the city in the next twenty to thirty years to accommodate the anticipated "medium" population growth to two million people by 2031. The "Auckland Plan" will supersede the Regional Growth Strategy (RGS) when it is formalised. A preliminary assessment of the "Auckland Plan" indicated that it is very similar in approach to the RGS with intense developments within the region's urban limits and concentrated growth along transport corridors. A detailed assessment will be made when the "Auckland Plan" is formalised.

The long-term plan looks at growth patterns within the region at the end of the current asset lifecycle, around 40 years out. A top-down approach is used to predict probable network loads within the region, from which the requirement for pressure system upgrades or new gate stations and DRSs are identified. The objective is less about developing accurate load forecasts and more about providing a long-term development plan, identifying likely future network requirements.

- **Review significant replacement projects:** For large network assets, rather than replace existing end-of-life assets with the modern equivalent, a review is carried out to confirm the continued need for the assets, as well as the optimal size and network configuration that will meet Vector's needs for the next asset lifecycle.

5.5.3 Load Forecasts

Table 5-1 shows the projected annual and total growth rates at each of Vector's existing gate stations, which are applied in Vector's network models.

Network system	Gate station / Network system	2010 Actual	2011 Actual	2012 Actual	2013 Actual	2014 Actual	2015 Actual	2016 Forecast	2017 Forecast	2018 Forecast	2019 Forecast	2020 Forecast	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Annual growth	Total growth
Wellsford	Wellsford Gate Station	No data																		
Alfriston	Alfriston Gate Station	194	157	140	141	156	148	156	156	156	156	156	156	156	156	156	156	156	0.0%	0.0%
Auckland Central	Papakura Gate Station (GS0006)	19,444	23,844	20,203	18,632	18,836	24,402	22,040	22,480	22,920	23,360	23,801	24,241	24,681	25,121	25,562	26,002	26,441	1.8%	18.0%
Auckland Central	Westfield Gate Station	43,303	49,938	48,431	42,982	45,227	40,406	40,554	40,554	40,554	40,554	40,554	40,554	40,554	40,554	40,554	40,554	40,554	0.0%	0.0%
Auckland Central	Waikumete Gate Station					11,726	10,510	10,473	10,946	11,418	11,891	12,365	12,837	13,309	13,782	14,256	14,728	15,201	4.1%	40.6%
Auckland Central	Bruce McLaren Gate Station	1,908	1,989	2,142	2,063	2,266	2,253	2,133	2,141	2,150	2,158	2,167	2,175	2,183	2,192	2,200	2,209	2,217	0.4%	3.6%
Auckland Central	Henderson Gate Station	10,635	11,274	10,802	11,657	11,726	10,223	12,355	12,861	13,367	13,873	14,380	14,886	15,392	15,898	16,405	16,911	17,417	3.7%	36.9%
Auckland Central	Central Auckland Network System (non co-incident)	75,290	87,045	81,578	75,334	78,056	87,794	87,555	88,982	90,409	91,836	93,267	94,693	96,119	97,547	98,977	100,404	101,830	1.5%	14.7%
Auckland Central	Auckland Central Network System (co-incident)	70,946	78,660	71,933	72,319	75,482	79,071	74,073	74,928	75,783	76,638	77,496	78,351	79,206	80,061	80,919	81,774	82,629	1.1%	10.4%
Drury CT	Drury CT Network System	373	367	368	315	369	375	264	264	264	264	264	264	264	264	264	264	264	0.0%	0.0%
Drury NC	Drury NC Network System	1,594	1,960	1,877	1,809	2,009	1,849	1,957	1,988	2,018	2,049	2,080	2,111	2,141	2,172	2,203	2,234	2,264	1.4%	14.2%
Drury CT & Drury NC	Drury Gate Station (non co-incident)	1,967	2,327	2,246	2,123	2,378	2,224	2,221	2,252	2,282	2,313	2,344	2,375	2,405	2,436	2,467	2,498	2,528	1.2%	12.5%
Drury CT & Drury NC	Drury Gate Station (Co-incident)	1,786	2,248	2,141	2,053	2,330	2,131	2,195	2,200	2,205	2,209	2,214	2,219	2,223	2,228	2,233	2,238	2,242	0.2%	2.0%
Hunua	Hunua (Vector) Gate Station	858	804	801	771	851	711	665	665	665	665	665	665	665	665	665	665	665	0.0%	0.0%
Kingseat	Kingseat Gate Station	22	22	19	3	4	34	2	2	2	2	2	2	2	2	2	2	2	0.0%	0.0%
Pukekohe	Pukekohe Gate Station	358	375	626	565	432	516	622	640	659	677	696	715	733	752	770	789	807	2.7%	26.8%
Ramarama	Ramarama Gate Station	250	257	255	253	322	322	283	288	292	297	302	306	311	315	320	325	329	1.5%	14.8%
Tuakau	Tuakau Gate Station	1,438	1,494	1,544	1,356	1,499	(Decommissioned in 2014)													
Tuakau	Tuakau Gate Station No.2					3,243	2,961	2,108	2,184	2,260	2,336	2,412	2,488	2,564	2,640	2,717	2,793	2,868	3.2%	32.5%
Warkworth	Warkworth Gate Station	1,899	1,901	1,871	2,016	2,203	2,157	2,405	2,491	2,577	2,663	2,749	2,835	2,921	3,007	3,093	3,179	3,265	3.2%	32.2%
Whangaparaoa CT & Whangaparaoa NC	Waitoki Gate Station (co-incident)	1,191	1,332	1,452	1,409	1,327	3,116	1,927	2,026	2,124	2,223	2,322	2,420	2,519	2,618	2,717	2,815	2,914	4.6%	46.1%
Papakura	Papakura Gate Station (GS1002)	No data																	0.0%	
Harrisville	Harrisville Gate Station	3,114	2,972	3,068	3,588	3,343	3,733	4,016	4,172	4,328	4,484	4,641	4,797	4,953	5,109	5,265	5,421	5,577	3.5%	35.0%

Table 5-1 : Peak demand projection for the gate stations and network systems (in scmh)

5.6 Network Monitoring

Pressure monitoring is undertaken as part of ongoing pressure monitoring programmes. These programmes are designed to provide the necessary system performance data that would enable network modelling analysis to be carried out.

Various methods are utilised to collect the required network performance data, including:

- Manually downloaded or remotely downloaded (e.g. Cello units) portable electronic dataloggers;
- Telemetry data from gate stations, district regulating stations (DRS) or other Telenet installation;
- Gas customer time-of-use data obtained directly or indirectly from retailer gas measurement systems;
- Gas transmission SCADA system data; and
- Isolated readings obtained during peak loading conditions.

Section 6 provides functional and physical descriptions of these systems.

5.7 Network Modelling

Most of Vector's network planning models have been created using data extracted from the GIS and billing systems. These models have been converted for use using the network modelling software Synergi.

Network models are validated by comparing the performance of the computer model to the actual physical performance of the gas distribution network. Where the computer model and actual network performance differs, the computer model is adjusted to reflect the actual conditions recorded from Vector's system pressure surveys[11] and SCADA information.

The total system flow for each network model is then scaled to align with the actual peak flow. This alignment is applied evenly across the network by adjusting the existing loads in the model. This becomes the base model for the network or pressure system.

The network modelling process is an important but time consuming process. Vector has a programme in place to update its network models on a three–yearly cycle.

5.8 Network Development Efficiencies

Significant efficiencies can often be incorporated in growth solutions that could allow conventional network investment to be considerably deferred without compromising capacity or quality of supply. In evaluating possible solutions, the following processes are undertaken to ensure an optimal investment decision:

- Review the asset capacity rating for currency and accuracy of data;
- Consider installing system pressure data loggers to validate actual (rather than theoretical) system pressure data;
- Consider possible load transfer to alternative pipelines or DRSs (adjusting gate station and DRS regulator settings sometimes allows load diversity);
- Look for load diversity opportunities (mixing commercial and residential loads sometimes allows load diversity);

[11] System pressure survey is the process for capturing actual system pressure data and is performed during winter to ensure the system peak flow is considered as far as possible. The underlying assumption is that when the network is operating under its most onerous conditions, the network pressure will be at a minimum.

- Remove capacity constraints caused by individual asset components, to improve the overall capacity of a pipeline;
- Develop short-term solutions that could evolve into longer-term solutions without asset stranding; and
- Leverage off other projects to gain synergies, e.g. asset replacement, road re-alignment or new road construction activities.

5.9 Standardised Assets and Designs

Vector uses standardised design and equipment on its network. This has the advantage of lowering project costs through competitive bulk materials supply agreements, standardised installation drawings and practices, lower stock-holding and emergency spares, standardised maintenance practices, and engaging in a rigorous equipment selection process to ensure fit-for-purpose whilst ensuring appropriate equipment performance over the life of the equipment.

Standardisation has been applied to pipelines, district regulator station equipment and installation practices. Vector may apply differing architectural treatments to its district regulator stationss to better align with local architecture but construction techniques, materials and fit-outs align with well-established standards.

Standard designs are introduced to avoid producing customised solutions for identical network installations. The standard designs ensure rigour and consistency in evaluation, design and application, cost savings over bespoke designs, simplified procurement and reduced stockholding, less rework during construction, safer outcomes and improved mechanism for capturing incremental improvements.

The approach that has been adopted within Vector is that when designs are repeated used on the network, standard designs are developed. As design improvements are identified either by Vector's own staff or as feedback from our Field Services Providers, standard designs are amended and updated.

Table 5-2 below provides a summary of Vector's key design standards.

Asset Class	Standard	Description
District regulating stations	GNS-0001	Design of district regulating stations
Pipelines	GNS-0002	Piping system design
Corrosion protection systems	GNS-0003	Design of above ground corrosion protection systems
Corrosion protection systems	GNS-0004	Design of below ground corrosion protection systems
Telemetry systems	GNS-0005	Design of Telenet systems

Table 5-2 : Design standards by asset class

5.1.1 Safety in Design

Vector takes health and safety very seriously and is committed to ensuring that its operations do not put our employees, contractors or the public at risk. This extends to safety being a key focus of the design phase of the work we do - it is at the design stage of creating assets that the greatest opportunity exists to build in safe operability for the whole life cycle of the asset.

Safety in design is about eliminating or controlling risks to health and safety as early as possible in the planning and design stage, so that whatever is designed will be safe to construct, operate, repair and maintain and ultimately, safe to decommission and dispose of at the end of its life cycle. This concept is implicit in our work practice.

Although we have implicitly always incorporated safety features into our asset designs (though for example adopting reputable international engineering standards and practices), until recently safety in design has not been considered a specific, measurable part of the design process. Vector have now developed a clear policy on safety in design, which is embedded in our Health Safety and Environmental management system. Our policy is to ensure, as far as is reasonably practicable, that all measures are taken during engineering design to avoid injury and ill health to those who construct, operate, maintain, decommission or demolish a Vector asset.

5.10 Project Prioritisation

Once the need for a network development project has been identified, the initial prioritisation is determined by the timing of the system pressure breach. That is, when the demand is expected to exceed remaining asset capacity. Quality of supply standards are developed, balancing reliability risk against premature investment whilst aligning with good industry practice. Where possible projects are initiated on a just-in-time basis, ensuring sufficient lead time for long-lead time procurement and construction timeframes. Where possible, budgets are levelled by adjusting starting dates to allow resource levelling and work continuity.

When levelling budgets, a risk assessment is carried out to determine the impact of the deferral or advancement. This assessment considers growth rates, strength and condition of adjacent networks and potential mitigation measures if the assessment is incorrect. As the projects near approval stage there may be opportunities to exchange projects depending on urgency. This latter option is disruptive to the works programme and is only used as a last resort.

Once the development list is compiled it is combined with projects from other areas (eg asset replacement) and all projects are ranked. The projects are assessed against their ability to deliver the corporate goals, which is determined by evaluating each project against value-weighted questions. A secondary weighting is based on project urgency.

The projects list is selected based on priority ranking to an “affordable” budget based on DPP targets. A review of the deferred lower-ranked projects is carried out to ensure critical projects have not inadvertently been excluded.

The priority ranking process captures network development projects on a bottom-up basis while evaluating all projects against company goals on a top-down basis

The comparison between the demand forecast and the threshold set by equipment capacities and quality of supply standards determines the needs for future network reinforcement. Where the solution involves investment, a project will be initiated. On this basis those projects identified are to address forecast network constraints.

A list of reinforcement projects that are required to address a specific security constraint are included in this AMP. High-level options are presented but are examined with greater scrutiny closer to the target project commencement date.

5.11 Network Development Programme

The Auckland region has a population of around 1.5 million. Latest population projections released by the Auckland Council suggest that the Auckland regional population could increase to 2.5 million by 2041[12].

Auckland is projected to account for 60% of New Zealand's population growth, and the region would be home to 38% of New Zealand's population in 2031, compared with 33% in 2006. Within the region, the highest growth rates between 2006 and 2031 are expected to be in the Manukau and Rodney districts, at 1.7%[13].

5.11.1 Alfriston Network System

The Alfriston network system is supplied from the transmission system at one gate station located in Phillip Road, southeast of Alfriston. This network system comprises one MP4 pressure system. The Alfriston network system supplies one industrial consumer in Philip Road. The gate station winter peak demand statistics are summarised in Table 5-1.

Alfriston MP4

The Alfriston MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 203scmh resulting in a MinOP of 389kPa (97% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.2 Auckland Central Network System

The Auckland Central network system is supplied from the transmission system at five gate stations. This network system consists of one IP20 pressure system, three IP10 pressure systems, two MP7 pressure systems, eighteen MP4 pressure systems, five MP2 pressure systems and four MP1 pressure systems.

The Auckland Central network system is Vector’s largest network system in terms of the number of connections. It is expected that future gas demand will be driven by the population growth and potential industrial and commercial activities in Auckland. The gate station winter peak demand statistics are summarised in Table 5-1.

Auckland IP20

The Auckland IP20 pressure system operates at a NOP of 1,900kPa and provides supply to the greater part of metropolitan Auckland. It transports gas to the urban areas of Manukau, Auckland, North Shore and Waitakere.

Total forecast planning demand during the planning period is estimated to be 78,142scmh, resulting in a MinOP of 1,082kPa (57% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Bruce McLaren IP10

The Bruce McLaren IP10 pressure system operates at a NOP of 1,000kPa. Total forecast planning demand during the planning period is estimated to be 2,209scmh, resulting in a MinOP of 1012kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

[12] Source: The Auckland Plan (http://theplan.theaucklandplan.govt.nz)

[13] Ibid.

Manurewa IP10

The Manurewa IP10 pressure system operates at a NOP of 1,000kPa. Total forecast planning demand during the planning period is estimated to be 631scmh, resulting in a MinOP of 993kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

East Auckland IP10

The East Auckland IP10 pressure system operates at a NOP of 1,000kPa. Total forecast demand within the planning period is estimated to be 10,399scmh, resulting in a MinOP of 707kPa (71% of NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

A preliminary study has been undertaken regarding the provision of gas supply to a housing development project in East Tamaki. This project involves a Housing New Zealand led proposal to develop the Tamaki region, increasing dwellings from 5,000 to 10,000 and population from 17,000 to approximately 25,000 - 27,000 over the next 15-20 years.

Modelling work has confirmed that the East Auckland IP10 pressure system will require reinforcement if the housing project goes ahead. The following IP reinforcement is planned and will be subject to further study once more information is available:

- Construct approximatey 1,000 metres of 200mm IP20 steel main along Gilbert Road and Alexander Crescent to DR0116; and
- Increase the NOP of the IP10 pressure system from 875kpa to 1,000kpa (under investigation).

Central Auckland MP7

The Central Auckland MP7 pressure system operates at a NOP of 700kPa and supplies gas to the southern suburbs of central Auckland City. The maximum flow into the system in the base year was 4,844scmh, resulting in a MinOP of 620kPa 626kPa (89% of the NOP).

Total forecast planning demand during the planning period is estimated to be 4,867scmh, resulting in a MinOP of 622kPa (89% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

The long-term strategic solution for the Central Auckland MP7 network is to elevate the NOP of the pipeline to 1,000kPa.

South Auckland MP7

The South Auckland MP7 pressure system operates at a NOP of 700kPa and supplies gas to an industrial area east of Mt Mangere. Total forecast planning demand during the planning period is estimated to be 4,496scmh, resulting in a MinOP of 606kPa (87% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

In the long-term, it is proposed that the South Auckland MP7 network NOP be elevated to 1,000kPa.

Central Auckland MP4

The Central Auckland MP4 pressure system operates at a NOP of 400kPa and supplies gas to the Auckland central area bounded by the suburbs of Hillsborough, Avondale, St Heliers, and includes the Auckland and Newmarket central business districts. Total forecast planning demand during the planning period is estimated to be 47,950scmh, resulting in a MinOP of 211kPa (53% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to enhance network security, the following projects are planned:

- Construct a new DRS (or upgrade DR-00049-AK) to supply the Auckland CBD.
- Construct approximately 30 metres of 32mm PE MP4 pipeline link in Ruskin Street between 9 and 14 Ruskin Street, Parnell;
- Construct approximately 730 metres of 50mm MP4 PE pipeline link in Motions Road, Pt Chevalier; and
- Construct approximately 1,000 metres of 100mm PE MP4 pipeline link in Kohimarama Rd between Whytehead Crescent and Kepa Road, Kohimarama.

Auckland Airport MP4

The Airport MP4 system provides supply to the Auckland International Airport and domestic terminal complex and is currently supplied with natural gas via a single MP4 pipeline, running from the western end of Puhinui Road and over the Pukaki Creek bridge crossing. The MP4 supply is fed from DR-00107-AK located to the east of the Pukaki Creek bridge crossing, and is comprised predominantly of 100mm diameter pipe with a section of 150mm diameter pipe across Pukaki Creek.

The pipeline crossing the Pukaki Creek is owned by Auckland International Airport Limited (AIAL). Vector is contracted to maintain and operate the pipeline.

The Auckland Airport complex currently includes a number of sizable commercial loads and with the planned expansion of the airport complex, significant additional loads are forecast for the medium term. Potential for additional loads has been identified within the Airport complex and north of the Auckland airport development near the intersection of Ihumatao Road and George Bolt Memorial Drive, and The Landing Precinct Expansion off Landing Drive.

The Auckland Airport MP4 system operates at a nominal pressure of 400kPa. Total forecast planning demand during the planning period is estimated to be 1,040scmh, resulting in a MinOP of 354kPa (89% of NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to enhance network security, the following projects are planned:

- Construct 300 metres of 100mm PE MP4 pipeline in Ray Emery Drive;
- Construct 180 metres of 100mm PE MP4 pipeline in Puhinui Road; and
- Relocate DR-00107-AK and up-rate bridge crossing from MP4 to IP20 at Auckland Airport.

Mangere MP4

The Mangere MP4 pressure system was merged into the East Auckland MP4 pressure system following the completion of the Otahuhu and Papatoetoe LP pipeline replacement projects.

From a network development perspective, recent studies show that the Mangere MP4 system has the potential to provide a second supply to the Auckland International Airport complex. The following MP4 gas main link between the East Auckland MP4 system and the Airport MP4 system is planned:

- Construct a 150mm PE MP4 pipeline along George Bolt Memorial Drive from Landing Drive to Tom Pearce Drive to link the Airport and East Auckland MP4 pressure systems.

Mangere Bridge MP4

The Mangere Bridge MP4 pressure system was merged into the East Auckland MP4 pressure system in FY2014 following the completion of the Otahuhu and Papatoetoe LP pipeline replacement projects.

Glendene MP4

The Glendene MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 91scmh, resulting in a MinOP of 395kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Herd Road MP4

The Herd Road MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 4scmh resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Hingaia Road MP4

The Hingaia Road MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 13scmh, resulting in a MinOP of 399kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Holloway Place MP4

The Holloway Place MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 694scmh, resulting in a MinOP of 397kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Manurewa North MP4

The Manurewa North MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 3,659scmh, resulting in a MinOP of 297kPa (74% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Manurewa South MP4

The Manurewa South MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 568scmh, resulting in a MinOP of 390kPa (98% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

North Harbour MP4

The North harbour MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 441scmh, resulting in a MinOP of 395kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to enhance network security, the following project is planned:

- Construct approximately 180 metres of 100mm PE MP4 pipeline (including a 25 metre bridge crossing) from SH17 to The Avenue, Albany Village. The project will link the North Harbour MP4 pressure system with the North Shore MP4 pressure system.

North Shore MP4

The North Shore MP4 pressure system operates at a NOP of 400kPa and supplies gas to the North Shore area bounded by the suburbs of Beachhaven, Devonport and Torbay. Total forecast demand within the planning period is estimated to be 15,764scmh, resulting in a MinOP of 183kPa (46% of NOP), therefore falling below the minimum system pressure criteria. To address this issue, the following reinforcement projects are planned:

- Install a DRS (IP20/MP4) at the junction of East Coast Road and Glenvar Road, Glenvar;
- Install 200mm PVC duct in conjunction with the SH16 upgrade (future proof) along Royal Road Bridge;
- Construct approximately 2,500 metres of 100mm PE MP4 pipeline from East Coast Road along Glenvar Road to Long Bay development, Long Bay;
- Construct approximately 225 metres of 50mm PE MP4 pipeline from Appleby Road along Albany Highway to house number 286, North Harbour;
- Construct approximately 3,800 metres of 100mm PE MP4 pipeline from East Coast Road along Okura River Road and Vaughans Road to Long Bay development, Long Bay.
- Construct approximately 750 metres of 100mm PE MP4 pipeline from Northcroft Street along Lake Road to Cameron Street, Takapuna; and
- Construct a 50nb PE road crossing at Albert Road / Vauxhall Road, and Albert Road / Victoria Road Devonport.

Nuplex MP4

The Nuplex MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 313scmh, resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Pakuranga MP4

The Pakuranga MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 14scmh, resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Papakura MP4

The Papakura MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 123scmh, resulting in a MinOP of 371kPa (93% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Puhinui Crematorium MP4

The Puhinui Crematorium MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 33scmh, resulting in a MinOP of 399kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

East Auckland MP4

The East Auckland MP4 pressure system operates at a NOP of 400kPa. Total forecast planning demand during the planning period is estimated to be 19,346scmh, resulting in a MinOP of 213kPa (53% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to support future growth opportunities and enhance network security, the following projects are planned:

- Construct approximately 400 metres of 100mm PE MP4 pipeline in Harris Road from Cryers Road to Ti Rakau Drive, Pakuranga;
- Construct approximately 190 metres of 100mm PE MP4 pipeline in Pakuranga Road to the intersection of Bucklands Beach Road, Highland Park; and
- Construct approximately 330 metres of 100mm PE MP4 in Smales Road between 18 and 40 Smales Road, East Tamaki.

Te Atatu MP4

The Te Atatu MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 310scmh, resulting in a MinOP of 390kPa (98% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Universal Drive MP4

The Universal Drive MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 12scmh, resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Wattle Downs MP4

The Wattle Downs MP4 system supplies gas to the suburbs of Manurewa and Mahia Park areas at a NOP of 400kPa. The maximum flow into the system in the base year was 784scmh resulting in a MinOP of 359kPa (90% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Recent information indicates that the gas demand in the Wiri area will increase significantly over the next two of years. To address this, the capacity of two of the three DRSs supplying this system will need increasing. The upgrade of DR-00134-AK was completed in FY2016 and DR-00179-AK is planned for FY2017.

Broadway Park MP2

The Broadway Park MP2 pressure system operates at a NOP of 200kPa. The maximum flow into the system in the base year was 34scmh, resulting in a MinOP of 200kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Conifer Grove MP2

The Conifer Grove MP2 pressure system operates at a NOP of 200kPa. The maximum flow into the system in the base year was 209scmh, resulting in a MinOP of 189kPa (95% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Landsford Crescent MP2

The Landsford Crescent MP2 pressure system operates at a NOP of 200kPa. The maximum flow into the system in the base year was 50scmh, resulting in a MinOP of 199kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Manukau MP2

The Manukau MP2 pressure system operates at a NOP of 200kPa. Total forecast planning demand during the planning period is estimated to be 306scmh, resulting in a MinOP of 143kPa (72% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Penrose MP2

The Penrose MP2 pressure system operates at a NOP of 200kPa. Total forecast planning demand during the planning period is estimated to be 1321scmh, resulting in a MinOP of 77kPa (39% of the NOP), therefore falling below the minimum system pressure criteria. To address this issue, the following reinforcement projects are planned:

- Increase the outlet pressure of the two DRS's supplying the Penrose MP2 pressure system from 180kPa to 200kPa.

Monahan Road MP1

The Monahan MP1 pressure system operates at a NOP of 35kPa. The maximum flow into the system in the base year was 50scmh, resulting in a MinOP of 30kPa (86% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Panmure MP1

The Panmure MP1 pressure system operates at a NOP of 35kPa. The maximum flow into the system in the base year was 34scmh, resulting in a MinOP of 34kPa (97% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Totara Heights MP1

The Totara Heights MP1 pressure system operates at a NOP of 105kPa. Total forecast planning demand during the planning period is estimated to be 503scmh, resulting in a MinOP of 54kPa (51% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Waipuna Road MP1

The Waipuna Road MP1 pressure system operates at a NOP of 35kPa. The maximum flow into the system in the base year was 89scmh, resulting in a MinOP of 30kPa (86% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.3 Drury Network System

The Drury network system is supplied from the transmission system at one gate station located in Waihoehoe Road. This network system consists of two MP4 pressure system. A total of 31 consumers are connected to the Drury network system. Residential consumers comprise more than half of the customer base with the remaining being industrial and commercial users. The gate station winter peak demand statistics are summarised in Table 5-1.

Drury CT MP4

The Drury CT MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 377scmh, resulting in a MinOP of 339kPa (85% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Drury NC MP4

The Drury NC MP4 pressure system operates at a NOP of 400kPa[14]. Total forecast planning demand during the planning period is estimated to be 2,234scmh, resulting in a MinOP of 225kPa (56% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to support future growth opportunities and enhance network security, the following projects are planned (or under investigation):

- Increase the outlet pressure of the Drury gate station from 350kPa to 400kPa (or as far as technically viable when the gate station is upgraded by First Gas Limited);
- Construct 1,220 metres of 100mm PE pipeline to link Drury NC with Drury CT, and ultimately link the Drury MP4 combined network with the Ramarama MP4 pressure system; and
- Construct approximately 5.4km of 160mm PE MP4 pipeline from Tuhimata Road along Paerata Road and Karaka Road to Gellert Road, is underway (under investigation).

5.11.4 Harrisville Network System

The Harrisville network system is supplied from the transmission system at one gate station located in Harrisville Road. This network system consists of one MP7 pressure system. There are six consumers connected to the Harrisville network system. The consumers comprise five industrial/commercial users and one residential consumer. The gate station winter peak demand statistics are summarised in Table 5-1.

Harrisville MP7

The Harrisville MP7 pressure system operates at a NOP of 700kPa. Total forecast planning demand during the planning period is estimated to be 5,421scmh, resulting in a MinOP of 362kPa (52% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period. However, to support future growth and enhance network security, the following projects will be investigated during the planning period:

- Elevate the Harrisville gate station outlet pressure from 550kPa to 650kPa (a request has been made to First Gas Limited at the design stage of the station upgrade project); and
- Install approximately 2,000 metres of 160mm MP7 PE pipeline along Jericho Road between Harrisville Road and 182 Jericho Road.

[14] Due to legacy practices, the current operating pressure of the Drury NC MP4 pressure system is 350kPa.

5.11.5 Hunua Network System

The Hunua network system is supplied from the transmission system at one gate station located in Hunua Road. This network system consists of one MP4 pressure system. The Hunua network system supplies a total of four large commercial/industrial consumers. The gate station winter peak demand statistics are summarised in Table 5-1.

Hunua MP4

The Hunua MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 803scmh, resulting in a MinOP of 396kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.6 Kingseat Network System

The Kingseat network system is supplied from the transmission system at one gate station located in Kingseat Road. This network system consists of one MP4 pressure system; supplying five residential consumers and one commercial gas user. The gate station winter peak demand statistics are summarised in Table 5-1.

Kingseat MP4

The Kingseat system south of Auckland consists of approximately 6km of 100mm steel and PE pipe operating at 400kPa. It was originally designed to supply gas to the Kingseat Hospital which was situated at the end of the pipeline. The hospital has since closed and there are no known significant emerging loads in the region. The system now only supplies a small amount of domestic load.

The Kingseat MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 27scmh, resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Due to limitations of the gate station regulator equipment, First Gas Limited requested to reduce the outlet supply pressure setting to 270kPa. It has been agreed that the proposed pressure setting is considered as a temporary solution and will be restored as and when new regulator equipment is upgraded.

5.11.7 Pukekohe Network System

The Pukekohe network system is supplied from the transmission system at one gate station located in Butcher Road. This network system comprises one IP10 pressure system, MP4 pressure system and one DRS. The Pukekohe network system has approximately 195 consumers. The customers comprise about three quarters residential and the remaining quarter, a mix of commercial/industrial gas users.

The gate station winter peak demand statistics are summarised in Table 5-1.

Pukekohe IP10

The Pukekohe IP10 pressure system operates at a NOP of 1,000kPa. The maximum flow into the system in the base year was 394scmh, resulting in a MinOP of 981kPa (98% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Pukekohe MP4

The Pukekohe MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 394scmh, resulting in a MinOP of 396kPa (99% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.8 Ramarama Network System

The Ramarama network system is supplied from the transmission system at one gate station located near Ararimu Road. This network system consists of one MP4 pressure system and supplies gas to one small commercial customer and two large industrial consumers. The gate station winter peak demand statistics are summarised in Table 5-1.

Ramarama MP4

The Ramarama MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 248scmh, resulting in a MinOP of 307kPa (77% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.9 Tuakau Network System

The Tuakau network system is supplied from the transmission system at one gate station located in Bollard Road. This network system consists of one IP20 pressure system, one MP7 pressure system and one DRS. The Tuakau network system supplies a total of 12 consumers comprising 7 residential and 6 commercial/industrial gas users. The gate station winter peak demand statistics are summarised in Table 5-1.

Pokeno IP20

The Pokeno IP20 system is a new pressure system that consists of a single pipeline operating at a NOP of 1,900kPa. The pipeline was commissioned in 2014 to provide gas to a new major consumer in Tuakau. The maximum flow into the system in the base year was 2,961scmh, resulting in a MinOP of 1,694kPa (89% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Tuakau MP7

The Tuakau MP7 system consists of a single pipeline operating at a NOP of 700kPa that is dominated by a large industrial customer.

The Tuakau MP7 pressure system operates at a NOP of 700kPa. The maximum flow into the system in the base year was 1,389scmh, resulting in a MinOP of 541kPa (77% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.10 Whangaparaoa Network System

The Whangaparaoa network system is supplied from the transmission system from one gate station located in Kahikatea Flat Road. This network system comprises one IP20 pressure system, one MP4 pressure system and one DRS. The gate station winter peak demand statistics are summarised in Table 5-1.

Waitoki IP20

The Waitoki IP20 system supplies gas to the suburbs of Silverdale, Orewa and Whangaparaoa. The network is supplied from a single gate station located west of

Silverdale and operates at a NOP of 1,900kPa, which was up-rated from a NOP of 1,000kPa in 2012.

Total forecast planning demand during the planning period is estimated to be 2,815scmh, resulting in a MinOP of 1,543kPa (81% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Little Manly MP4

The Little Manly MP4 system has been merged with the Whangaparaoa MP4 pressure system.

Whangaparaoa CT MP4

The Whangaparaoa CT MP4 pressure system was merged with the Whangaparaoa NC MP4 pressure system in FY2016 and renamed Whangaparaoa MP4.

Whangaparaoa NC MP4

The Whangaparaoa NC MP4 pressure system was merged with the Whangaparaoa CT MP4 pressure system in FY2015 and renamed Whangaparaoa MP4.

Whangaparaoa MP4

The Whangaparaoa MP4 is an almagamation of the Whangaparaoa CT and Whangaparaoa NC MP4 pressure systems. The combined system takes gas from the interconnection point in Wainui Road and supplies gas to Silverdale, Orewa and the Whangaparaoa Peninsula at a nominal pressure of 400kPa. Total forecast planning demand is estimated to be 2,815scmh, resulting in a MinOP of 179kPa (45% of the NOP), therefore falling below the minimum system pressure criteria. To address this issue, the following projects will be investigated during the planning period:

- Construct approximately 600 metres of 80mm PE MP4 pipeline and approximately 700 metres of 100mm PE MP4 pipeline in Gulf Harbour Drive; or
- Interconnect the stranded Auckland asset at the end of the Whangaparaoa Peninsula into the Whangaparaoa MP4 pressure system.

Waitoki MP4

The Waitoki MP4 pressure system operates at a NOP of 400kPa. The maximum flow into the system in the base year was 3scmh, resulting in a MinOP of 400kPa (100% of the NOP). Total forecast planning demand during the planning period is estimated to be 4scmh, resulting in a MinOP of 400kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.11 Warkworth Network System

The Warkworth network system is supplied from the transmission system at two gate stations, one located at the east end of Woodcocks Road and another at the west end of Woodcocks Road. This network system consists of one MP4 pressure system and one DRS.

About 258 consumers are connected to the Warkworth network system, most of whom are residential consumers. Only around 14% are commercial/industrial consumers, including a large industrial consumer in Woodcocks Road.

The Warkworth network system is fed from one gate station and one DRS which supplies gas to Warkworth MP4 pressure system. The gate station winter peak demand statistics are summarised in Table 5-1.

Warkworth MP4

The Warkworth MP4 pressure system operates at a NOP of 400kPa and is supplied from a single gate station located west of Warkworth and DR-00253-AK.

In 2007, a significant increase in load at Southern Paprika resulted in the Warkworth gate station being relocated further west, adjacent to the transmission pipeline and involved an additional 160mm PE MP4 system reinforcement. The redundant section of transmission pipeline between the two gate stations now operates at 1,400kPa and supplies DR-80075-WW (located at the gate station site at the west end of Woodcocks Road). Formal transfer and approval for the gas transmission pipeline to operate as a gas distribution pipeline was obtained in FY2016.

Total forecast planning demand during the planning period is estimated to be 3,179scmh, resulting in a MinOP of 334kPa (84% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.11.12 Wellsford Network System

The Wellsford network system is supplied from the transmission system at one gate station, located in the northeast of Wellsford. This network system consists of one IP pressure system and one MP4 pressure system. The Wellsford network system has a total of 24 consumers, comprising an even mix of residential and commercial/industrial premises. Flow data for the Wellsford gate station is not available and Vector has no plans at this stage to collect this information. The Wellsford network system has one DRS which supplies gas to Wellsford MP4 pressure system.

Wellsford IP20

The Wellsford IP20 pressure system is supplied from a single gate station located North West of Wellsford with a NOP of 1,900kPa. The IP20 network is capable of operating up to 1,900kPa, but is currently operating at 1,200kPa. The maximum flow into the system in the base year was 9scmh resulting in a MinOP of 1200kPa (100% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

Wellsford MP4

The Wellsford MP4 pressure system is supplied from DR-00252-AK located in Mobil Wellsford Energy Centre and operates at a NOP of 400kPa. The maximum flow into the system in the base year was 9scmh resulting in a MinOP of 349kPa (87% of the NOP). No constraints have been identified and the system pressure is not forecast to fall below the MinOP criteria during the planning period.

5.12 Long-term Development Plans

Traditionally, the method used for developing the network has been a bottom up approach. This has enabled the planner to plan the network in phases from the existing configuration based on projected demand (and other relevant information). The risk of this incremental approach is that the development will be significantly influenced by localised information available for the short term (three to five years) to medium term (five to ten years). This could result in short-term financially attractive solutions being adopted where better economic long-term solutions may be available.

Network modelling and long-term demand forecast information has been used to establish a very long-term vision for Vector's regional intermediate pressure network systems. The vision is presented in the form of a "target" network configuration in year 2050 that reflects the potential security and capacity needs of Vector's customers. This offers guidance to the planner for the ongoing development of the network and enables the planner to take a holistic long-term view to ensure that the network is not developed in a piecemeal fashion. Any duplication and redundancy can be minimised.

The plan takes into account the current and future land use where additional transmission facilities, such as additional gate stations, may be required to reinforce the gas distribution networks.

The long-term load distribution at Auckland shows the potential demand growth can be accommodated by:

- Increasing the capacity of the section of IP20 pipeline between DR-00116-AK and DR-00136-AK or construct a new 200mm IP20 pipeline from the existing Flat Bush gate station (or construct a new gate station) to DR-00117-AK (year 2030);
- Increasing the NOP of the East Auckland IP10 pressure system from 875kPa to 1,900kPa from DR-00136-AK to DR-00160-AK (year 2030);
- Increasing the NOP of the East Auckland IP10 pressure system from 875kPa to 1,000kPa from DR-00244-AK to DR-00160-AK and DR-00164-AK (year 2030);
- Increasing the NOP of the Favona MP7 network from 700kPa to 1,000kPa (year 2030);
- Increasing the NOP of the Central Auckland MP7 network from 700kPa to 1,000kPa (year 2030);
- Increasing the NOP of the high pressure transmission pipeline located in North Harbour from 1,850kPa to 3,000kPa and installing two new DRS's in North Harbour (year 2030);
- Installing an IP20 pipeline between DR-800238 in Silverdale and Glenvar, Torbay (2030);
- Installing a section of IP20 pipeline from the Waikumete gate station to DR-00169-AK (year 2040), and
- Further consideration of increasing the NOP of the entire East Auckland IP10 pipeline is required (year 2040).

Figure 5-2 below shows the proposed long-term plan for the IP networks in the Auckland Central network system.

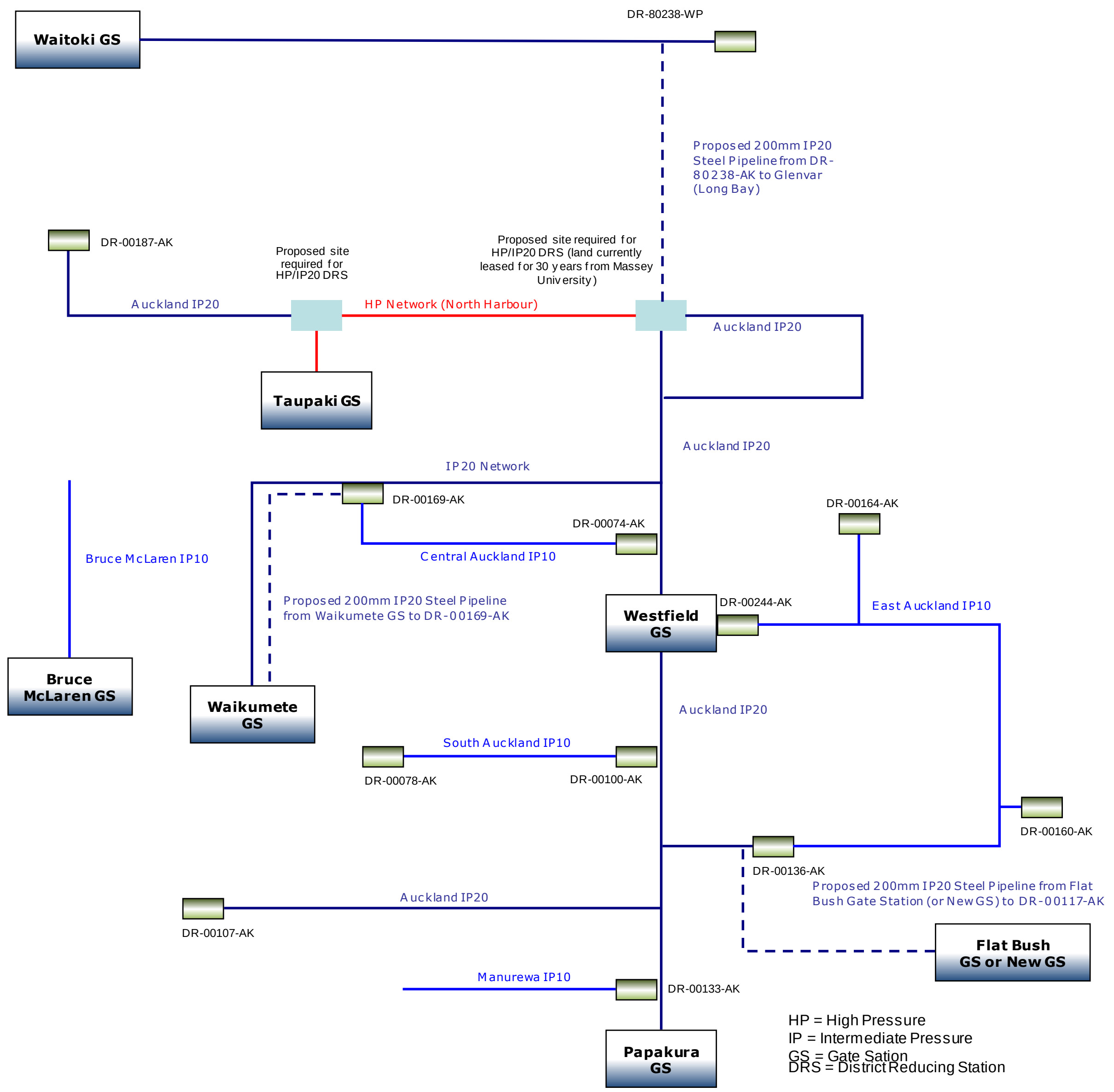

Figure 5-2 : Long-term network architecture: Auckland Central network system

5.13 Significant Variances from Previous AMPs

Table 5-3 summarises the key projects and programmes for development of the gas distribution network. It shows the current target completion dates for these projects, compared with that in the previous plan. If there is a difference the reasons for the change are described (advanced or delayed) in the following tables. Newly identified and completed projects are also highlighted.

Project Description	Previous AMP Date	Current AMP Date	Comments
Construct a 50nb PE road crossing at Albert Road / Vauxhall Road, and Albert Road / Victoria Road Devonport, North Shore	FY20	FY20	No change

Project Description	Previous AMP Date	Current AMP Date	Comments
76 Hillsborough Road to 10 Herd Road (approx. 240m of 50nb PE to integrate into future Central Auckland MP4)	FY19	Removed	No longer required
Construct 180 metres of 100mm PE MP4 pipeline in Puhinui Road	FY22	FY23	Deferred
Construct 300 metres of 100mm PE MP4 pipeline in Ray Emery Drive	FY18	FY19	Deferred
DRS upgrade project to address capacity issue	FY15 to FY24	FY19 to FY26	Ongoing programme
Construct approximately 225 metres of 50mm PE MP4 pipeline from Appleby Road along Albany Highway to house number 286, North Harbour	FY15	FY18	Deferred
Construct approximately 2,500 metres of 100mm PE MP4 pipeline from East Coast Road along Glenvar Road to Long Bay development, Long Bay	FY19	FY18	Rolled forward
Install a DRS (IP20/MP4) at the junction of East Coast Road and Glenvar Road, Glenvar	FY22	FY20	Rolled forward
Construct approximately 3,800 metres of 100mm PE MP4 pipeline from East Coast Road along Okura River Road and Vaughans Road to Long Bay development, Long Bay	FY21	FY21	No change
From Mckenzie Road along Ascot Road, Kirkbride Road and Massey Road (approx. 3900m of 100nb PE MP4 link: to reinforce Auckland Airport and Mangere areas)	FY19	-	New solution identified
Relocate DR-00107-AK and uprate bridge crossing from MP4 to IP20 at Auckland Airport	-	FY19	New project
Construct approximately 750 metres of 100mm PE MP4 pipeline from Northcroft Street along Lake Road to Cameron Street, Takapuna	FY20	FY19	Rolled forward
Construct a 150mm PE MP4 pipeline along George Bolt Memorial Drive from Landing Drive to Tom Pearce Drive to link the Airport and East Auckland MP4 pressure systems	FY17	FY18	Deferred
Construct approximately 400 metres of 100mm PE MP4 pipeline in Harris Road from Cryers Road to Ti Rakau Drive, Pakuranga	FY16	FY21	Deferred
Construct approximately 3km of 150mm IP20 steel pipeline from Westfield gate station along Mt Wellington Highway, Ellerslie-Panmure Highway to DR-00085-AK	FY20 to FY22	-	Removed
Construct approximatey 1,000 metres of 200mm IP20 steel main along Gilbert Road and Alexander Crescent to DR0116	FY24 to FY25	FY24 to FY25	No change
Upgrade the capacity of DR-00244-AK located at the Westfield gate station and DR-00085-AK, and construct an IP20 to IP10/MP4 supply	FY18 to FY19	FY22 to FY23	Deferred
IP Reinforcements: Unknown	FY15 to FY24	Removed	
Construct approximately 1,000 metres of 100mm PE MP4 pipeline link in Kohimarama Rd between Whytehead Crescent and Kepa Road, Kohimarama	FY21	FY21	No change

Project Description	Previous AMP Date	Current AMP Date	Comments
Construct approximately 730 metres of 50mm MP4 PE pipeline link in Motions Road, Pt Chevalier	FY19	FY19	No change
MP Reinforcements: Unknown	FY15 to FY24	-	Removed
Construct a new DRS (or upgrade DR-00049-AK) to supply the Auckland CBD	FY17	FY19	Deferred
NorSGA Development, Hobsonville - Northside Drive Bridge (future proof ducts 200mm PVC x 2)	FY16	Removed	Relocation
Construct approximately 190 metres of 100mm PE MP4 pipeline in Pakuranga Road to the intersection of Bucklands Beach Road, Highland Park	FY22	FY22	No change
Construct approximately 30 metres of 32mm PE MP4 pipeline link in Ruskin Street between 9 and 14 Ruskin Street, Parnell	FY20	FY20	No change
Install 200mm PVC duct in conjunction with the SH16 upgrade (future proof) along Royal Road Bridge	FY19	FY19	No change
Construct approximately 180 metres of 100mm PE MP4 pipeline (including a 25 metre bridge crossing) from SH17 to The Avenue, Albany Village	FY15	FY18	Deferred
SH20A Upgrade - George Road Drive / Kirkbride Road Intersection	FY18	FY17	In progress
Construct approximately 330 metres of 100mm PE MP4 in Smales Road between 18 and 40 Smales Road, East Tamaki	FY22	FY22	No change
Upgrade DR-00163-AK Kerwyn Ave MP	FY18	FY18	No change
Upgrade DR-00179-AK Wiri MP4	FY17	-	Cancelled
Upgrade DR-00183-AK Coronation Road	FY18	FY17	In progress
Drury NC reinforcement - From Drury gate station along Waihoehoe Road, Flanagan Road and Great South Road to the junction of Firth Street - 1.7km of 160mm PE MP4	FY16	Cancelled	New solution identified
Construct 1,220 metres of 100mm PE pipeline to link Drury NC with Drury CT, and ultimately link the Drury MP4 combined network with the Ramarama MP4 pressure system	-	FY17	New project

Table 5-3 : Network development programme update

Gas Distribution
Asset Management Plan
2016 – 2026

Lifecycle Asset Management (Maintenance and Renewal) – Section 6

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6 Lifecycle Asset Management (Maintenance and Renewal)

6.1 Overview

This section covers Vector’s life cycle asset maintenance and renewal plans, and the policies, criteria, assumptions, data and processes used to prepare these.

Vector’s gas distribution network is designed and built to deliver gas safely to the service level standards set out in the connection agreements with its customers. In order to achieve this safety and level of service at optimum cost, the fixed assets have to be kept in good operating condition. This is achieved by way of renewing (replacing), and maintaining assets (regular maintenance).

Safety is the key consideration in the design, construction and maintenance of Vector’s gas networks and accordingly Vector manages its gas distribution networks in accordance with relevant acts, regulations and industry standards. In particular the Gas Act, Gas (Safety and Measurement) Regulations, NZS 5263 Gas Detection and Odorisation, NZS 5258 Gas Distribution Networks, AS2885 High pressure pipelines and AS/NZS 4645 Gas Distribution Networks require Vector to maintain and operate a safe and reliable network.

Although Vector strives to maintain the integrity of its gas networks at levels in line with good industry practice, some leakage and escapes occur on all utility networks (e.g. gas, water and wastewater services etc), including on Vector’s gas networks from time to time. Vector’s networks are subject to ongoing monitoring as part of preventive maintenance programmes that are carried out in accordance with industry code requirements. To provide assurance to government regulators and the general public, Vector is required to monitor and disclose reliability and quality performance measures including public reported escapes (PRE’s) and system interruptions. Additionally Vector is subject to periodic audits by the Energy Safety division of WorkSafe New Zealand.

Vector’s long-term asset maintenance strategy is to achieve the optimal trade-off between capital expenditure (capex) and operational expenditure (opex), while maintaining a safe, efficient and reliable network. Achieving this requires a balance between effective maintenance and judicious asset renewal.

6.1.1 Legislative requirements

Vector's gas distribution assets have been designed and constructed and are operated in accordance with the following principal Acts, Regulations and industry codes:

Gas Act 1992 and Gas Amendment Act;

Health and Safety in Employment Act;

Gas (Safety and Measurement) Regulations;

Civil Defence and Emergency Management Act;

Hazardous Substances and New Organisms Act;

NZS 5258 Gas Distribution Networks;

NZS 7901 Electricity and Gas Industries – Safety Management Systems for Public Safety;

AS/NZS 4645.1 Gas Network Management;

AS/NZS 2885 Pipelines – Gas and liquid petroleum; and

NZS 5263 Gas detection and odorisation.

These Acts, Regulations and industry codes include both prescriptive and performance based requirements which have been embedded into Vector's suite of design, construction, maintenance and material specification technical standards. The purpose of the Vector technical standards is to provide a comprehensive reference source for use by Vector personnel and others involved in the design, construction and maintenance of natural gas networks. Vector has outsourced the construction, operation and maintenance of its gas distribution network to FSPs, and Vector's technical standards form part of the contract with the FSPs.

6.1.2 Vector's Maintenance and Refurbishment Approach

Vector is required by the Gas Act to design, construct, maintain and operate its gas distribution networks in accordance with the Gas (Safety and Measurement) Regulations 2010. This regulation cites both NZS 5258 and AS/NZS 4645 as a means of compliance. Vector has up until now adopted NZS 5258 as its means of compliance, however this standard has not been updated since 2003 and no further updates of this standard are planned. For this reason there is a move within the wider NZ gas industry toward adopting AS/NZS 4645.

In 2013 Vector initiated a review of its suite of technical standards to align them with AS/NZS 4645. The review has seen a progressive adoption of specific requirements of AS/NZS 4645. This will continue until the review is competed in FY2017, at which time the migration from NZS5258 to AS/NZS 4645 will be complete.

Vector has developed a comprehensive suite of asset maintenance standards that describe its approach to maintaining and refurbishing various asset categories. There are clearly significant differences required in the approach to different asset types, but as a broad rule the maintenance standards provide the following:

- The required asset inspection frequency;
- The routine and special maintenance activities required to be carried out during these inspections; and
- Condition testing that needs to be carried out and the required response to the test results.

In general, Vector's philosophy is to keep its assets in use for as long as they can be operated safely, reliably and economically. The maintenance and renewal policies support this goal by intervening to ensure optimal asset performance.

In a small number of cases (such as meters used for network monitoring), assets that have low impact on the gas distribution network's integrity and performance are allowed to exceed their design life.

6.1.3 Vector's Asset Renewal Approach

Assets are only renewed when:

- Assets are irreparably damaged;
- There is an imminent risk of asset-failure;
- The operational and/or maintenance costs over the remaining life of the asset are disproportionate to that of replacement; and/or
- Assets become obsolete and hence impossible or inefficient to operate and maintain.

Asset renewal decisions are therefore in general condition-based rather than age-based.

Optimisation of capital investment and maintenance costs is an important part of Vector's capital investment efficiency drive. This requires comprehensive evaluation of the condition, performance and risk associated with the assets, to provide a clear indication of the optimal time for assets' renewal. Often it may be more efficient to extend the life of asset to beyond normal predicted asset life, by servicing or refurbishing the assets.

Asset condition evaluation is based on Vector’s FSP’s surveys, observations, tests and defect work schedules. The asset performance evaluation is based on asset fault records and reactive maintenance records.

Once an asset is identified for replacement, Vector’s prioritisation methodology is applied to determine the ranking of replacement projects. This methodology is based on assessing the criteria giving rise to the need for replacement, the importance of the asset in question, the impact should the asset fail and the likelihood of such failure. Other important factors considered are the health and safety risk, risk to assets, risk to Vector’s reputation, potential financial impacts and potential effects on the environment. The final project prioritisation list (that incorporates scoring based on conditions and performance as well as risk assessment), along with budgetary estimates forms the basis of the annual renewal budgets for each fiscal year.

It is essential to gain and maintain relevant information on the performance of assets in the field in order to undertake accurate assessments. The field data is currently collected and held by our FSPs. Vector uses a Systems Applications and Processes (SAP) based plant maintenance system. This system enables preventative and corrective maintenance data to be directly fed into Vector’s databases, based on the activities of our FSPs.

The investigation data, field data and fault records collected and maintained in Vector’s databases are increasingly being used to conduct asset condition/performance and risk assessments, informing our renewal programmes.

Asset renewal expenditure forecasts for each expenditure category are based on actual historical costs for similar renewal project types. The majority of asset renewal work is carried out by Vector's contracted FSP’s (refer Section 2), and all major projects are managed through a competitive bid process to ensure that competitive pricing is achieved.

6.2 Maintenance Planning Processes, Policies and Criteria

This section presents the planning processes, policies and criteria for managing Vector’s network assets. Vector’s strategic focus drives the asset integrity strategies:

Operational Excellence

- Ensure gas network assets are in compliant, safe and serviceable order;
- Ensure reliable network performance is sustained;
- Ensure network investments and operating activities are efficient; and
- Drive continual innovation and efficiency improvements in the area of maintenance and operations.

Customer and Regulatory Outcomes

- Ensure high levels of public, staff and service provider safety;
- Ensure assets are designed, operated and maintained to the required standard in order to provide the agreed level of service; and
- Ensure an appropriate level of response to customer concerns, requests and enquiries.

Cost Efficiency and Productivity

- Strive to achieve the optimal life cycle investment considering the balance between capital and operational expenditure;
- Coordinate works and extract efficiency from asset replacement and asset development projects and programmes; and

- Apply innovative approaches to decision making, solutions, and works execution.

6.2.1 Asset Maintenance Standards and Schedules

Vector's asset maintenance standards are prepared by the Asset Resilience (AR) group. Asset inspections and maintenance work is carried out by FSPs, under the direction of Vector's Network Services (NS) group.

Vector has developed maintenance standards for each major class of assets. The standards form a key part of Vector's schedule for planned maintenance. The purpose of these standards, in conjunction with the schedules of maintenance work, is to ensure assets operate safely and deliver their designed outcomes with regard to life and performance.

As part of the asset maintenance standards, the frequency of inspection and reporting per asset category has also been defined. This forms the basis of Vector's asset maintenance schedule.

Vector's maintenance standards are kept on Vector's secure websites and are available to personnel engaged in maintenance activities, as well as for our FSPs. The FSPs must comply with the standards and inspection schedules for each class of assets.

The standards are updated in accordance with an established review cycle and any new findings or updates are incorporated in Vector's standards as soon as they are reviewed by the asset management team, and signed off by all interested parties. Vector's FSPs contribute to and form an integral part of this continual improvement process.

Progress against the maintenance schedules and the associated maintenance costs are monitored on a monthly basis. Any concerns identified during asset inspections are recorded in a database. FSPs recommend the priorities for the remedial works for defects, which are then reviewed by Vector prior to issuing orders for the work. Maintenance priorities are based on costs, risks and safety criteria.

In making decisions on repairing or replacing the assets Vector will consider recommendations submitted by the FSPs, as well as the factors discussed above. The long-term plans supported by trend analysis for an asset will also be taken into account when assessing whether it should be maintained or replaced.

Root cause analysis is normally undertaken as a result of faulty equipment. If this identifies systemic faults or performance issues with a particular type of asset, and if the risk exposure warrants it, a project will be initiated to carry out the appropriate remedial actions on a class of assets. The assets and maintenance standards are also amended to reflect the learning from such root cause analysis.

6.2.2 Maintenance Categories

Maintenance works at Vector are categorised as follows:

Reactive Maintenance

Reactive maintenance is considered to encapsulate all maintenance activities that relate to the repair and restoration of supply, and the safeguarding of life and property (targets and measures for Vector's responses to Emergencies are detailed in Section 4). It primarily involves:

- Safety response and repair or replacement of any part of the network components damaged due to environmental factors or third parties interference; and
- Remediation or isolation of unsafe network situations.

Preventive Maintenance

Preventive maintenance covers activities defined through the maintenance standards, and relates to the following:

- Provision of network patrols, inspection and condition detection tasks, sampling and maintenance service work; and
- The coordination of shutdowns and decommissioning, and re-commissioning and restoration, along with the capture and management of all defined data.

Table 6-1 below provides a summary of preventive maintenance activities by asset class, together with appropriate standards and document references.

Asset Class / Category	Activity Standard	Preventive Maintenance Description
Leakage survey	GNS-0019	Annual - distribution systems adjacent to public buildings, hospitals, schools and business districts; Identified higher risk areas (Auckland International Airport, Auckland Harbour Bridge), steel pipelines without operating cathodic protection systems
Leakage survey	GNS-0019	2 yearly – service pipes located inside or under buildings; Distribution mains systems comprised predominantly of pre-1985 PE
Leakage survey	GNS-0019	4 yearly - all other pipes located under hard-paved surfaces in close proximity to buildings; Shallow IP mains
Leakage survey	GNS-0019	5 yearly - balance of distribution system, including service connections
Above ground steel pipework	GNS-0014	Annual – above ground corrosion inspection
Cathodic protection	GNS-0015	2 monthly – inspection of impressed current transformer/rectifier sites; Inspection of drainage bonds
Cathodic protection	GNS-0015	3 monthly, 6 monthly and annual - inspect & test on and instant-off pipe/soil potential in major urban, urban and rural areas; Electrical test of galvanic anodes in major urban, urban and rural areas; Test electrical isolation at casing test points in major urban, urban and rural areas
Cathodic protection	GNS-0015	3 monthly and 6 monthly – inspect & test "On" pipe/soil potential in rural and urban areas
Gate Station and DRS	GNS-0012	3 monthly - below ground DRS operational check
Gate Station and DRS	GNS-0012	6 monthly - above ground operational check
Gate Station and DRS	GNS-0012	3 yearly – all DRS; full inspection and confirmation of settings and function
Odorant checks	GNS-0020	Monthly - gate station odorant and odorant concentration tests
Odorant checks	GNS-0020	3 monthly – extremity point ICP and designated DRS odorant and odorant concentration tests
Valves	GNS-0013	Annual - full service of emergency and designated valves, and partial service of other designated plug valves
Valves	GNS-0013	2 yearly – full service of other designated ball valves, and partial service of other plug valves; Audit of a sample of service riser valves

Asset Class / Category	Activity Standard	Preventive Maintenance Description
Telenet	GNS-0016	Annual – inspections of master station, field sites and repeater station
Telenet	GNS-0016	4 yearly - intrinsic safety inspections of field sites
Patrols	GNS-0021	3 monthly – visual inspection of above ground pipework, vent pipes and ducted crossings
Patrols	GNS-0021	Annual – visual inspection of service pipes inside/under buildings
Service regulators	GNS-0073	Annual – visual inspection of below ground installations
Service regulators	GNS-0073	2 yearly – visual inspection of above ground installations
Critical spares and equipment	GNS-0078	Monthly – visual inspection
Critical spares and equipment	GNS-0078	Annual – condition assessment of all critical spares and equipment; Review of inventory lists to determine level of inventory held is appropriate
Critical spares and equipment	GNS-0078	5 to 10 yearly - manufacture's check/refurbishment of all major items of equipment

Table 6-1 : Preventive maintenance schedules and standards

Corrective Maintenance

Corrective maintenance catches the follow-up maintenance repair and component replacement requirements resulting from:

- Assets identified from planned inspections or service work to be in poor condition, requiring repair;
- Poor condition or unserviceable assets identified via one-off coordinated network inspections or identified through proximity capital works;
- Removal of graffiti, painting and repair of buildings and asset enclosures, removal of decommissioned assets, one-off type inspection and condition detection tasks outside of planned maintenance standards; and
- Coordination of shutdowns and associated restoration, along with the capture and management of all defined data.

Corrective maintenance activities are managed using SAP Plant Maintenance defect notifications. Defect notifications are assigned a priority ranking (based on risk and asset criticality) which defines the timeframe within which the repair should be completed.

Third Party Services

Third party services maintenance activities describe third party directed requests such as the following:

- Issuing maps and site plans to indicate the location of network assets via the beforeudig service;
- Asset location services, including the marking out of assets, safe work practice site briefings, worksite observer, urgent safety checks, safety disconnections;
- Issuing close approach consents; and

- Disconnection and reconnection associated with customers' property movements and any concerns relating to non-compliance with gas regulations.

6.2.3 Asset Maintenance and Field Services Provider Management Process

Vector has, through a competitive process, engaged an FSP to maintain its gas distribution networks. Electrix Ltd is Vector's maintenance FSP for the gas distribution networks. The maintenance contract drives the preventive, corrective and reactive maintenance works programmes, based on the requirements set by Vector's maintenance standards.

The relationship with Electrix Ltd is managed by Vector's Network Services group. The maintenance contract defines the responsibilities, obligations and key performance indicators (KPIs) to complete scheduled works. Vector's Asset Resilience group works closely with the Network Services group to keep abreast of any issues with regards to the FSP's obligations and performance. The maintenance standards form part of the maintenance contract and FSPs must comply with them when performing their duties.

Vector has a comprehensive preventive maintenance approach across its network asset base. The delivery of all of these maintenance activities in accordance with prescribed maintenance standards (see Table 6-1), is closely monitored and adjusted by NS on a monthly basis, to ensure the agreed annual target volumes are complied with. Extensive monthly feedback is obtained on actual versus planned progress, KPI performance, causality and issues impacting progress or performance, new risks, action plans and focal points for the coming months.

The overall effectiveness of the programme is evaluated by contract KPI performance and the roll up to Vector's corporate performance metrics, of which safety, environmental compliance, public, employee and FSP safety are the core measures.

6.3 Asset Integrity Activities

In this section, the details of Vector's asset inspection, maintenance, testing, refurbishment and renewal programmes are discussed and presented by major asset category. Detailed asset quantities and age profiles for each asset category can be found in Vector's Annual Information Disclosure (Schedules 9a and 9b), with a detailed grading of asset condition per asset category also provided in the Appendices of this AMP (Schedule 12a).

6.3.1 Mains and Service Pipelines

6.3.1.1 Functional Description

Vector's gas distribution mains pipelines are used to transport natural gas from gate station delivery points to the individual service pipes that supply the customer's gas measurement system (GMS).

The majority of Vector's "bulk" gas distribution assets are operated in the IP20 range of 1,000 kPa to 2,000 kPa. The selection of these pressures has, in the majority of cases, been made in historical times and has been justified on an economic basis (consideration of gas volumes, transmission distances, delivery pressures etc.).

The IP systems are used to transport large volumes of gas from gate stations to the areas where it is to be used. The IP system generally forms the principal "backbone" of the distribution networks with laterals radiating from them to supply adjacent areas.

The distribution assets which are used to directly supply the majority of gas consumers operate in the MP4 range of 210 kPa to 420 kPa.

Retailer agreements are in place between Vector and the various gas retailers. These agreements stipulate the maximum and minimum delivery pressures as measured at the inlet valve on the consumer gas measurement system (GMS).

6.3.1.2 Physical Description

Distribution systems are defined as those parts of the gas network that extend from the outlet valve of the gate station delivery point to the inlet valve on the customer GMS. For the purposes of this AMP distribution systems are further stratified into network systems which are defined as discrete systems of interconnected (via DRS installations) pressure systems which are supplied via one or more gate stations.

Pipelines operating at nominal pressures of IP10 and above are constructed of welded steel. Pipelines operating at a nominal pressure of MP7 are predominantly constructed of welded steel, with a small quantity being constructed from PE100 material. Pipelines systems operating at nominal pressures in the range of MP1 to MP4 are predominantly constructed of PE80 with a small quantity being constructed from welded steel. Welded steel pipelines are coated (e.g. extruded high density polyethylene) and typically utilise cathodic protection (CP) systems to provide additional corrosion protection.

The MAOP (maximum allowable operating pressure) of steel pipelines is dependent on pipe and fitting types, and is typically in the region of either 1160 kPa or 1900 kPa. The MAOP of PE pipelines is dependent on the PE type (e.g. PE80 or PE 100) and standard dimension ratio (SDR) rating. Typical MAOP for PE80 pipelines is 420 kPa, and 700 kPa for PE100 pipelines. In some cases the pipeline MAOP may exceed its current nominal operating pressure – e.g. the North Harbour Pipeline section of the Auckland IP20 system was constructed as a HP pipeline and has a MAOP of 4,600 kPa.

The North Harbour Pipeline is operated as part of the IP20 system within Vector’s network. The pipeline is managed and maintained as a HP pipeline under a separate pipeline management plan in accordance with the requirements of the Health and Safety in Employment Regulations (Pipelines) Regulations 1999 and is certified by Lloyds Register.

6.3.1.3 Summary Statistics

Vector’s mains pipeline systems are comprised of the following material types:

88% PE80 pipe;

1% PE100 pipe and

11% steel pipe.

Steel pipelines date from the 1930s with most of it having been installed from the 1970s onward. PE80 pipelines date from the 1970s with the majority of it having been installed since the 1980s. PE100 pipelines date from the late 1990s.

6.3.1.4 Condition, Performance and Risks - Steel Pipes

Condition of Assets

The underground steel pipeline systems in Vector’s network are protected from corrosion by means of pipe coatings and the application of cathodic protection (CP) systems (refer below for non-protected steel pipelines). The average age of these pipelines is approximately 31 years. The standard life for steel pipelines is 60 years for MP pipelines and 70 years for IP pipelines. The overall condition of the pipelines is good and no programmed replacement of these pipelines is envisaged within the standard life of the asset.

Performance of Assets

The replacement of underground steel pipelines is expected to continue to be of a corrective nature, targeting specific locations and addressing localized issues rather than a large scale replacement programme.

Risks

North Harbour Pipeline Operated in Accordance with NZS 5223

The North Harbour Pipeline is managed and maintained as a HP pipeline in accordance with the requirements of the Health and Safety in Employment Regulations (Pipelines) Regulations 1999. These regulations require HP pipelines to be designed, constructed, operated and maintained in accordance with AS 2885, or NZS 5223 or ASME B31.8 When the pipeline was commissioned in the late 1990s NZS 5223 was adopted as the standard to which the pipeline would be certified, and the pipeline has been operated (and certified) in accordance with NZS 5223 ever since.

In the interim period AS 2885 has undergone major reviews and updates and is now considered by the wider gas industry to be best practice. By contrast NZS 5223 has had no changes made to it and there are no plans within the industry to review or update this standard in the future. Vector therefore initiated a review of the pipeline’s design, construction and operation standards in FY2014 with a view to adopt AS 2885.3 as the standard to which this pipeline will be operated and certified to. It is anticipated that the adoption of AS 2885 will be completed prior to the expiry of the current certificate of fitness in 2018.

Steel Systems without Cathodic Protection

Short sections of buried steel pipeline connected to the inlet or outlet riser of a DRS may be at risk of corrosion if the section of pipe is not connected to a CP system; this situation typically arises where a DRS inlet or outlet riser is connected to a PE network. Although Vector's current DRS design standard requires a sacrificial anode to be installed on any section of buried steel pipe that will not be cathodically protected by an existing CP system, the status of CP protection on short sections of buried steel pipeline at a number of legacy DRS installations is unknown. Similarly when some of the older service regulators were installed, they were connected to existing steel service pipes. The status of CP protection on the (now isolated) original steel service pipes at these locations is unknown.

Further research will be undertaken in FY17 to identify sites where on-site testing is required to ascertain the level of CP protection being provided (if any) to an isolated section of steel pipe and determine appropriate risk mitigation measures where required - e.g. installing sacrificial anodes, or bonding to an existing CP system etc.

Electrical hazards on metallic pipelines

The close proximity of high voltage power networks and buried pipelines can result in hazardous voltages on the pipeline. The primary mechanisms involved in the transfer of electrical energy to a buried pipeline include earth potential rise (EPR) and low frequency induction (LFI). AS/NZS 4853 (Electrical hazards on metallic pipelines) requires pipeline owners/operators to reduce the risk to personnel and equipment from identified electrical hazards (including lightning) to an acceptable or tolerable level. AS/NZS 4853 also requires the electrical hazards and their controls be documented in an electrical hazard management plan (EHMP).

AS/NZS 4853 requires the assessment of electrical hazards and associated risks to be carried out over two levels - i.e. Level 1 is a conservative assessment and determines if an electrical hazard exists and, if so, whether the risk level is negligible; Level 2/3 is a detailed risk assessment of locations that are not accepted as low risk by the Level 1 assessment. Because of the nature of the analysis required, it is typically carried out by external consultants who are specialists in this field.

Vector is currently in the process of developing an EHMP for its gas distribution network. It is expected that an interim EHMP (including prioritisation of detailed electrical hazard studies on at-risk sections, and standard mitigation designs) will be ready by the end of FY2016, and the final EHMP implemented by the end of the FY2019.

6.3.1.5 Condition, Performance and Risks - PE pipes

Condition of Assets

The average age of PE mains pipelines on Vector's network is approximately 16 years. The standard life for pre-1985 PE is 40 years and the standard life for modern PE is 60 years.

Although issues have been identified with pre-1985 PE systems (refer below), the majority of the total PE mains systems are comprised of modern PE (i.e. 98% of Vector's PE network). The overall condition of the modern-PE pipelines is good and no programmed replacement of these pipelines is envisaged within the standard life of the assets.

Performance of Assets

PE pipelines have been in use on Vector's networks since the 1970s. Early PE systems (i.e. pre-1985) exhibited premature brittle-like issues (refer below for issues relating to pre-1985 PE), but modern PE has been found to be very durable. Isolated problems have been found with PE butt and saddle tee joints (refer below) used on earlier PE systems and some larger diameter modern PE systems.

Risks

Pre-1985 PE

Vector's network includes approximately 83 km of pre-1985 PE mains of which 39 km (47%) operates at MP4, 29 km (34%) at MP2 and the balance at MP1 and LP.

PE pipe manufactured up to the mid-1980s is known to be susceptible to premature brittle-like issues due to the resin type that was in use at the time of manufacture. The issues occur as a result of stress intensification brought on by the PE pipe being exposed to excessive shear and/or bending forces while in service.

Vector's risk mitigation controls include a targeted leakage survey strategy, the monitoring and regular analysis of faults related to pre-1985 PE pipelines, and targeted pipeline replacement based on the results of the analysis.

This strategy is in line with the recommendations of a report published by the US National Transportation Safety Board in 1998 titled 'Brittle-like cracking in plastic pipe for gas service[1]. The report is recognised internationally and concluded that much of the plastic pipe manufactured and used for gas service from the 1960s through to the early 1980s may have been susceptible to premature brittle-like incidents when subjected to stress intensification. One of the key recommendations made in the report was for gas operators to closely monitor the performance of older plastic piping and to identify and replace in a timely manner any of the piping that indicates poor performance. In the USA the risks associated with pre-85 PE failure have been covered off by a 2009 amendment to the US Federal Pipeline Safety Regulations which requires all US gas distribution pipeline operators to develop and implement integrity management programmes.

[1] http://www.ntsb.gov/safety/safety-studies/Documents/SIR9801.pdf

The most recent analysis of faults relating to pre-1985 PE pipelines was completed in late 2015 and covered the July 2013 to April 2015 period. The results of the analysis highlighted the following key points:

- The PRE rate for Vector's pre-85 PE systems was significantly higher than the average PRE rate for the whole of the Vector network;
- The PRE rate for MP4 pre-1985 PE systems was higher than the PRE rates for MP1 and MP2 pre-1985 PE systems;
- The PRE were geographically evenly spread throughout the pre-85 PE systems and were not grouped in any particular location; and
- Squeeze-off failures accounted for approximately 60% of the pre-1985 PE PRE for the 2013 to 2015 period and this was a similar rate to the 2012 to 2013 period.

The output from the analysis confirms that the strategy adopted by Vector during FY2015 to implement an ongoing pre-1985 PE pipeline replacement programme targeting the replacement of higher risk (i.e. based on operating pressure, failure consequence etc.) sections of the pre-1985 PE system is still appropriate.

Another avenue being explored to reduce the risks associated with pre-1985 PE pipeline is to identify any section of pre-1985 pipeline that has been duplicated with a more recent type of pipe. As these sections are identified, the viability of decommissioning the pre-1985 PE pipeline and transferring any service connections to the adjacent pipeline will be assessed. This strategy will also be augmented by the adoption of other risk mitigating measures - e.g. the avoidance of applying squeeze-offs on pre-1985 PE pipes where possible, and the use of pipe reinforcement fittings at pre-1985 PE squeeze-off locations. The performance of these pipelines will continue to be closely monitored.

Butt Fusion Joints

Butt fusion jointing of PE pipes was the standard method of jointing PE pipe when PE pipe was first introduced on Vector’s networks in the early 1970s. This jointing technique continued until the introduction of electrofusion (EF) jointing in the mid to late 1980s - although butt fusion jointing is still considered viable (using electronic controlled processes) for larger diameter pipes, due to the cost benefits it can provide.

Poor quality control and jointing techniques used in the early 1970s and 1980s has resulted in some butt and saddle tee fusion joint issues. This legacy issue has resulted in a higher risk for PE butt joints.

It is estimated that Vector’s distribution network includes approximately 39 km of MP4, 29 km of MP2 and 15 km of LP/MP1 older PE mains that utilise butt joints.

Vector’s risk mitigation controls include scheduled leakage survey. PE butt joints are currently replaced on an as required basis and no proactive replacement programme is anticipated unless there is a marked change in butt joint incidents.

6.3.1.6 Condition, Performance and Risks - Cast Iron Pipes

Condition

During FY2016 a project to replace approximately 1 km of MP1 cast iron mains pipeline was completed; A small length (approximately 150 m) of MP1 cast iron remains in service within Vector's network. A pipeline replacement project to replace this section of cast iron is programmed for FY2017.

Performance

The remaining sections of cast iron pipeline form parts of two separate small MP1 systems within Vector's network. Results of PRE analysis indicate that the PRE rate for these sections of cast iron pipeline is higher than the average rate of PRE for the entire Auckland network.

Risks

Cast iron pipelines are typically constructed from 3 metre sections of bell and spigot pipe joined via a caulked hemp and lead joint or other mechanical type joints. Although cast iron pipe possesses good resistance to corrosion, joints may fault over time as a result of the different physical characteristics of natural gas (i.e. drier) compared to the original coal gas that was in use when the pipes were first installed. Ground movement (due to subsidence, road works, effects of increased traffic volumes etc.) can also damage the joints and cause fractures in the pipe due to its brittle nature. The incidents can result in gas escapes, water ingress and poor pressure problems.

A pipeline replacement project to replace the remaining sections of MP1 cast iron is programmed for FY2017.

6.3.1.7 Condition, Performance and Risks - Non-Standard Pipe Material

Condition of Assets

All network extensions or alterations are now constructed from approved steel or PE materials. However in the past (particularly before the introduction of natural gas) a range of other materials was used e.g. galvanised steel, asbestos, spiral welded steel etc. Although the presence of these (or similar) materials on the older parts of Vector's networks have not been encountered, there remains a small chance some small quantities remain in operation. Vector will continue to record and improve its asset data information for non-standard pipe materials at the time when new connections or on-site inspections are undertaken.

Performance of Assets

Non-standard material types are not compatible with modern materials, and this has construction implications for pipeline alterations or repair. They also present possible H&S risks due to the integrity of the material.

Risks

Nylon

In the early 1980's nylon pipes were installed in several parts of Vector's distribution network. These systems quickly became obsolete due to the introduction of polyethylene pipe in the mid 1980's. Fittings compatible with the nylon systems can no longer be purchased thereby necessitating the use of water fittings to affect repairs. In most cases these fittings are modified to accommodate the existing nylon and PE pipes. In addition, nylon pipes are brittle and cannot be squeezed off in case of an emergency.

GIS records indicate that Vector's network now includes only a small remaining quantity (140m) of nylon mains pipe, which operates at MP4. GIS records also indicate that there is approximately 2.5 km of nylon service pipe (predominantly 6 mm NB) currently in use for approximately 200 service connections. The nylon service pipes operate at MP4 and are located throughout the suburbs of Ponsonby, St Marys Bay and Freemans Bay and adjacent suburbs, with some located on the North Shore and Epsom and surrounding suburbs.

Vector monitors the performance of nylon pipe through regular analysis of fault data. At-risk sections are prioritised for replacement based on an assessment of the risks associated with the pipeline section.

The level of risk presented by the remaining nylon pipe is considered low. Analysis of fault data has not identified a higher incidence of faults for nylon pipes when compared to PE systems.

Currently no systematic pipeline replacement projects are planned for nylon pipes, and replacement will be carried out on an as required basis.

Stainless Steel

During a period of high growth in the mid to late 1990s, a relatively large number of stainless steel service connections were installed on Vector's distribution network. Subsequent audits of stainless steel service connections installed during this period identified several problems, and in particular the use of stainless steel pipe in non-compliant situations. As a result of these audits, all identified non-compliant installations were either replaced or made compliant.

Periodic audits of stainless steel service connections continue to be carried out to assess the condition of the service connection and to determine if it remains compliant following possible changes to the property since the connection was originally installed; A small project to address any non-compliant stainless steel service connections has been scheduled for FY2017.

With the exception of these legacy installations, the use of stainless steel service pipes on Vector's network is now typically confined to commercial and high-rise building installations, where the use of underground service pipes is not practicable. Currently there are approximately 240 stainless steel service connections in use on Vector's distribution system.

Periodic audits of stainless steel service pipes will continue to be undertaken, and PRE rates for stainless steel service pipes will continue to be monitored on a regular basis to assess whether additional measures are required to mitigate the risks associated with these types of service pipe.

Third Party Strikes

Third party incidents account for a substantial proportion of the total number of reported gas escapes that occur on Vector's networks – in FY2015, third party incidents accounted for approximately 41% of total recorded gas escapes.

Vector has ongoing public safety awareness communications programmes on gas, which are designed to increase public and contractor awareness and reduce the number of third party incidents. These include:

- Promoting safe work practices to external contractors whose work brings them in close proximity to Vector's networks i.e. council and water service contractors; and
- Vector is a founding member of the beforeudig service (www.beforeudig.co.nz) which allows contactors to obtain plans from Vector and a number of other asset owners simply by making a single enquiry.

These programmes are further complemented by programmes operated by Vector's service provider (Electrix) which include:

- A close approach consent system to authorise and control all proposed excavation works within a restriction zone adjacent to pipelines operating at pressures of 700 kPa or greater and all strategic MP and LP pipelines;
- Provision of advice on good work practices and an outline of the hazards to be aware of at the time of issuing a consent;

- Standover works in the vicinity of North Harbour Pipeline assets; and
- Carrying out targeted company visits to take employees through a gas safety presentation.

In order to mitigate the risk of third party damage to critical pipeline assets, pipelines have been classified as "strategic" where the consequence of a third party strike event is considered to be serious or the likelihood of such an event is considered to be high. This classification allows Vector's service provider to review beforeudig service plan-requests that effect strategic pipelines and determine if a close approach permit or on-site supervision will be required.

Pipes Under Buildings

Vector's pipeline design standards prohibit the installation or operation of mains or IP service pipes under buildings. Where the installation of LP or MP service pipe under a building cannot be avoided, special measures (e.g. gas tight conduits) must be employed to mitigate the risk.

Periodically, mains or service pipes located under building are identified. These situations typically result from the property owner not being aware of the existence of the pipeline, or its actual location when undertaking building work.

When these situations are identified, negotiations with the property owner are undertaken to relocate the pipeline. Vector will continue to record and improve its asset data information for potential pipes under buildings at the time when on-site inspections are undertaken.

Mains on Private Land

Gas mains located within private properties are exposed to a higher than normal risk of damage as well as a higher risk of being built over. Pipelines located on private property are typically protected by an easement, or if installed prior to 1992, by the pre-existing rights provisions of the Gas Act 1992.

Incidents of buildings being erected over gas mains (which require the relocation of the main) do occur occasionally, and although incidents of damage to gas mains on private property are rare, there have been some near misses. These risks are typically brought about by the property owner or occupier not being aware of the existence of the gas main, its actual location or their obligations under the provisions of the property easement or the Gas Act 1992.

Vector's risk mitigations include the development of an easement strategy for mains located in private land, and the development of a property occupier notification scheme. The easement strategy and property occupier notification scheme is expected to be finalised and implemented during FY2017.

Inactive Service Pipes

Vector's standard for decommissioning of facilities (GNS-0022) requires all service pipes that have been inactive for a period of 5 years to be physically disconnected where the cost to maintain the service pipe is disproportionate to the cost of disconnecting it or where a risk assessment indicates that the service should be disconnected.

Vector is reviewing and amending its patrolling standard (GNS-0021) to include a periodic inspection of higher-risk inactive service pipes (i.e. based on risk factors such as operating pressure, geographic location etc.) to assess the condition of the service pipe and/or riser and assess the risk of damage from property owners or third parties. Where pipeline damage or the risk of damage is identified appropriate corrective action would be initiated as required. The periodic inspection strategy is expected to be finalised and implemented by the end of FY2016.

These measures are being implemented to meet the formal safety assessment requirements of AS/NZS4645 which requires risk assessment of threats to be undertaken and where necessary controls established to reduce risks to an acceptable level.

There are currently in excess of 3,000 ICP connections on Vector's network that have been inactive for at least 5 years.

Tsunami risk

Various local authorities (e.g. Auckland Council) periodically undertake studies on the risk of tsunami-inundation that face their respective communities. The studies are undertaken in conjunction with environmental research bodies (e.g. National Institute of Water and Atmospheric Research; Institute of Geological and Nuclear Sciences Ltd) and Vector has access to the results of these studies through its participation in the Engineering Lifelines Groups that operate in those areas.

The tsunami studies look at tsunami threats from remote sources (e.g. South American origin) and local/regional sources (i.e. Tonga-Kermadec and Southern New Hebrides tectonic faults). The studies show that tsunami threats from remote sources have a return period of 50-100 years and represent the most probable tsunami risk, while tsunami threats from local/regional sources have a return period 500-2000 years but represent the most devastating tsunami hazard for New Zealand. The studies also show that the tsunami hazard is considerably higher for the east coast of New Zealand than that posed to the west coast.

The largest impact on the Auckland region's east coast is on Great Barrier Island. Omaha, Orewa and surrounding areas also have a high risk of inundation over significant areas. Further into the Hauraki Gulf, this risk lessens as the areas are sheltered by outlying islands. In most other areas, the inundation is confined to narrow coastal strips. There are relatively few gas distribution assets located within the inundation areas, and there are no critical above-ground assets at risk.

Volcanic risk

Any volcanic activity would likely have a devastating effect on parts of the gas distribution network. Evidence from overseas volcanic activity provides clear examples of the magnitude and impact of such activity. Further studies are planned to assess this risk and determine any mitigation measures to protect against such events.

6.3.1.8 Maintenance Programme

Preventive maintenance cycles for mains and service pipelines have been determined based on regulatory and industry code requirements, risk management principles and good industry practice. Preventive maintenance of mains and service pipelines is carried out in accordance with the periodic cycles stipulated in the technical standards listed in Table 6-2.

In 2016, the existing preventive maintenance cycles (as shown in Table 6-2) for leakage survey were modified on a trial basis - i.e. the existing annual survey cycle was left unchanged, but all other leakage survey cycles were reduced to two years. This trial was initiated to assess the efficiency gains that the newly introduced SELMA leak detection equipment could provide, and test the viability of moving the existing 4 and 5 year cycles to a 2 year cycle to improve the overall safety of the network. The trial is expected to be completed during FY2017.

Technical Standard	Periodic Maintenance Activities
GNS-0014 Maintenance of above ground corrosion protection systems	• Annual inspections of all above ground steel pipework

Technical Standard	Periodic Maintenance Activities
GNS-0015 Maintenance of below ground corrosion protection systems	• 2 monthly inspection of impressed current transformer-rectifier installations to record output current and voltage • 2 monthly inspection of drainage bonds to check their satisfactory operation • 3 monthly, 6 monthly and annual inspections of CP test points to measure on and instant-off pipe to soil potentials in major urban, urban and rural areas respectively • 3 monthly and 6 monthly inspections of CP test points to measure "On" pipe to soil potentials in rural and urban areas respectively • 3 monthly, 6 monthly and annual inspections of galvanic anodes to check their satisfactory operation in major urban, urban and rural areas respectively • 3 monthly, 6 monthly and annual inspections of isolation between buried or submerged pipelines and other underground metallic structure (including associated protective casings) in major urban, urban and rural areas respectively
GNS-0019 Leakage survey	• Annual leakage survey of distribution systems adjacent to public buildings, hospitals and schools; All distribution systems in designated central business districts; Identified higher risk areas (e.g. Auckland International Airport, Auckland Harbour Bridge); All steel pipelines without operating cathodic protection systems • 2 yearly leakage survey of all service pipes located inside or under buildings; Distribution mains systems comprised predominantly of pre-1985 PE • 4 yearly leakage survey of all other pipes located under hard-paved surfaces in close proximity to buildings; Shallow IP mains • 5 yearly leakage survey of all remaining portions of the distribution system, including services
GNS-0020 Odourisation system maintenance	• Monthly odorant checks at all gate stations • 3 Monthly odorant checks at ICP risers at key system extremity points and designated DRS
GNS-0021 Patrolling	• 3 monthly inspection of all above ground pipework, vent pipes and ducted crossings • Annual inspection of service pipes located inside or under buildings

Table 6-2 : Maintenance standards for mains and service pipes

Preventive maintenance activities on mains and service pipelines may identify the need for corrective maintenance work including the repair of pipeline mounts, brackets, corrosion, pipeline coating repairs, and civil works (excavation and backfilling) associated with undertaking this work.

6.3.1.9 Replacement Programme

The sections below provide a description of the projects or expenditure planned for the relevant budget nodes for the forecast period.

ARP4 – MP1 Cast Iron Replacement

See discussion in Section 6.3.1.6. Vector's MP1 network includes approximately 150 m of mains cast iron pipeline. A pipeline replacement project to replace these remaining sections of cast iron is programmed for FY2017.

ARP4 – Pre-1985 PE Replacement

See discussion in Section 6.3.1.5. Vector's network includes approximately 83 km of pre-1985 PE mains pipeline. Vector is implementing an ongoing programme to target the replacement of higher risk (i.e. based on operating pressure, failure consequence etc.) sections of the pre-1985 PE system.

ARP4 – Stainless Steel Service Replacement

See discussion in Section 6.3.1.7. A number of non-compliant stainless steel service pipe installations were identified by a recent audit that targeted stainless steel services installed in the late 1990s. These services will be replaced or upgraded as required in FY2017.

ASC1 – Unspecified

Periodically sections of mains and service pipeline will be identified that need to be replaced (on an as required basis) due to safety or compliance issues. Examples include pipes located under buildings, or pipes of non-compliant material specification. The expenditure forecast for this item is based on historical expenditure.

6.3.2 Special Crossings

6.3.2.1 Functional Description

Special crossings are locations where a section of pipeline is installed above ground in order to cross over a roadway, river or railway etc. They are typically installed where the installation of a belowground crossing is not practical.

6.3.2.2 Physical Description

Special crossings are typically attached to road or rail bridge structures, although in a few cases special crossings are attached to dedicated pipe bridge structures. Special crossings are comprised of either a PE or a steel carrier pipe. Where the carrier pipe is PE it is encased in a steel or PVC duct in order to provide physical and ultraviolet protection to the carrier pipe. The duct is typically attached to the bridge structure by means of galvanised or stainless steel fittings. Where the carrier pipe is steel it is typically either painted or wrapped (to provide corrosion protection) and attached directly to the bridge structure by means of galvanised or stainless steel fittings and rollers.

6.3.2.3 Condition of Assets

Detailed condition assessments have been completed for all steel special-crossings on Vector's network. These comprise approximately 60% of the total Auckland special crossings. The results of the assessments indicate that the majority of these crossings are in good or reasonable condition with a small number of sites requiring various levels of upgrade work to address corroded and/or poorly designed pipeline support brackets and damaged and/or loose bracket fixings etc. Detailed assessments of the balance of the special crossings (i.e. non-steel crossings) will be completed during FY2017.

Ensuring adequate access to the special crossing to carry out maintenance inspections is an ongoing challenge at some special crossing sites. This can be due to the physical design of the bridge structure (e.g. the carrier pipe is encased within the structure), or the need to obtain approval (i.e. from the structure owner or operator) to gain access to the bridge structure.

6.3.2.4 Performance of Assets

Detailed condition assessments of special crossings on the Vector's network have identified the need for an increased level of upgrade work over the period ending in FY2017. Additional budget allowances have therefore been included in the capital and operating expenditure forecasts to cover a range of upgrade work including the replacement of damaged or loose bracket fixings and damaged or poorly designed pipeline support brackets, and corrective maintenance work to repair pipeline coating damage and ground to air interfaces etc.

6.3.2.5 Risks

Special crossings installed over waterways (particularly estuaries) and high-volume roads (e.g. motorways) are exposed to a harsh physical environment which can compromise the integrity of pipeline coatings and support brackets. Where above ground crossings are attached to bridges, additional risks are present due to the potential impact on the general public in the event of a pipeline incident or due to corrective maintenance activities. Targeted maintenance inspections are carried out to mitigate the risks associated with these crossings.

In 2012, Vector engaged a seismic specialist to undertake a review of critical gas distribution infrastructure to assess the selected assets for compliance with the seismic provisions of NZS1170. The review included two bridge crossings located in Auckland. The subsequent report indicated that further engineering analysis of the two bridge crossings was required to determine the adequacy of the existing seismic design

Subsequent reviews of the seismic designs of both of the bridge crossings found that the designs were adequate and no further action was required.

6.3.2.6 Maintenance Programme

Preventive maintenance cycles for special crossings have been determined based on industry code requirements, risk management principles and good industry practice. Depending on whether or not a special crossing includes a steel carrier pipe, preventive maintenance is carried out in accordance with the technical standards listed in Table 6-3 below:

Technical Standard	Periodic Maintenance Activities
GNS-0014 Maintenance of above ground corrosion protection systems	• Annual inspections of above ground steel pipework to check for pipeline coating deterioration or disbondment.
GNS-0021 Patrolling	• Three monthly inspections of special crossings to check the condition of pipework and equipment supports.

Table 6-3 : Maintenance standards for special crossings

Preventive maintenance activities on special crossings may identify the need for corrective maintenance work including the repair of pipeline mounts, brackets, corrosion, pipeline coating repairs, and civil works (excavation and backfilling) associated with undertaking this work.

6.3.2.7 Replacement Programme

The following special-crossing projects are planned for the forecast period:

- Upgrade work is planned for the period ending in FY2017 to address specific asset condition issues identified by the recent detailed condition assessments and includes the replacement of damaged or loose bracket fixings and damaged or poorly designed pipeline support brackets.

- A small annual expenditure provision has been made to allow for the replacement of pipe brackets and supports as required due to integrity issues.

6.3.3 Telemetry

6.3.3.1 Functional Description

The telemetry systems used by Vector to monitor its gas distribution networks comprise the Telenet supervisory control and data acquisition (SCADA) system, and the Cello system. The Telenet SCADA and Cello systems are deployed at permanent monitoring sites on Vector's networks.

Access to telemetry data (i.e. Telenet and Cello data) is provided via the PI archiving system.

The telemetry systems provide remote monitoring of critical inlet/outlet pressures, temperatures and flow rates, and corrected and uncorrected metering data. The telemetry systems monitor data at gate stations, DRSs, major gas customer sites, system extremity locations and provides remote control facilities for the operation of IP20 valves located at either end of the Auckland harbour bridge.

The following guidelines are used to determine what type of telemetry monitoring should be considered for DRS and system extremity point monitoring:

- Real time telemetry monitoring will be considered for all DRS that meet the following criteria:
    - The DRS is supplied from an MP7, IP10 or IP20 pressure system; and
    - The position of the DRS relative to the overall configuration of the pressure system provides a key pressure-monitoring location for that pressure system; and/or
    - The DRS has a peak throughput in excess of 500 scmh and/or it supplies 1000 ICPs or more;
- Real time telemetry will be considered for system extremity monitoring points where the ability to monitor real-time system pressure data during a contingency event is considered to be critical; and
- The use of the Cello monitoring will be considered for DRS sites and system extremity monitoring points where the availability of real time load flow and/or system pressure data is not considered to be critical, but where the availability of flow and/or pressure data is considered vital for planning purposes.

Both the Telenet and the Cello systems have the capability to provide additional functionality over what is currently available. Areas of expanded functionality will be investigated where a cost benefit analysis indicates that there are net benefits to be gained. Examples of areas where this functionality could be expanded include:

- Monitoring of a DRS slam-shut sensor (this is being evaluated currently);
- Monitoring of unauthorized entry to DRS station;
- Detection of gas escapes at DRS stations; and
- Remote monitoring of CP sites.

A PI-based gas distribution monitoring system (GDMS) is used to monitor the telemetry data. The GDMS allows alarm thresholds to be set for various conditions (e.g. high/low pressures) for each telemetry site. It provides a graphical interface to display data anomaly and alarm threshold breach alerts and allows real-time and/or historical data trends to be viewed. The GDMS also provides anomaly alert functions (i.e. via SMS text or email) for data anomalies (e.g. data gaps) and alarm threshold breaches (e.g. high/low pressures).

6.3.3.2 Physical Description

Telenet System

There are currently 70 Telenet field sites in operation on Vector's network. The Telenet system was originally commissioned in the late 1990s. The original sites employed a Kingfisher configuration (see below) of which approximately 40 sites are still in use. The balance of the sites employ a GPRS configuration. Telenet installations provide pressure and flow monitoring at DRS and other locations on IP20, IP10, MP7, MP4 and MP2 pressure systems throughout the greater Auckland area.

The Telenet system incorporates two different telemetry configurations which utilise either Kingfisher or GPRS equipment.

Kingfisher System

This configuration utilises Kingfisher RTUs which are polled half-hourly by the Kingfisher master RTU (located at Vector's offices in Newmarket) using radio (via radio repeater stations) and dial-up communications. Data retrieved from the field RTUs is passed from the master RTU to a Foxboro SCADA system and then on to the PI archiving system.

The system utilises three radio repeaters. Co-site agreements are in place for each of the sites which are located at:

- Sky Tower, Hobson St, Auckland;
- Titirangi Tennis & Squash Rackets Club, Titirangi; and
- Pukekohe Hill, Pukekohe Scenic reserve, Pukekohe.

GPRS Modem Configuration

This configuration utilises an electronic gas volume corrector/GPRS router configuration. The router is fitted with dual SIM cards enabling it to choose between the Vodafone and Spark GPRS mobile data network communication services depending on the level of service available at that site. Data is retrieved from the field sites every 5 minutes (nominal) by a SCADA RTU system (located at Vector's offices in Newmarket) from where it is passed to the PI archiving system.

Cello System

Permanent Cello installations currently provide pressure monitoring at approximately 30 DRS and other locations (e.g. system extremity locations) in Vector's network.

The Cello system is comprised of GSM remote data loggers that use SMS messages for communication, and a receiving PC which has proprietary PMAC software and a GSM modem installed. The logger data from permanent Cello sites is uploaded from the PMAC database to the PI archiving system whenever a refresh of the PMAC data is detected.

The Cello is a self-contained (i.e. GSM modem and battery pack) and intrinsically safe unit that can monitor flow and pressure and initiate alarms and is used extensively in the UK. The units log data at a rate set by the operator (typically 15 minutes) and transmit the data at intervals also specified by the operator (typically daily). The rate of data transmission has an impact on battery life, and as a general rule a single pressure Cello unit logging data at a 15 minute interval and sending data on a daily basis (i.e. one SMS message) will yield a battery life of approximately 5 years.

In addition to the Cello units installed at permanent monitoring sites, a further 20 units (approximately) are used as portable data loggers for winter gauging or performance analysis purposes. The data from these units is accessed from the PMAC database - i.e. the data is not archived to the PI archiving system.

6.3.3.3 Condition, Performance and Risks - Cello System

Condition of Assets

The average age of Cello units installed at permanent monitoring locations is approximately 2 years. The equipment is in good working order.

The standard life for telemetry equipment is 7 years.

Performance of Assets

The Cello system performs reliably and adequately.

Risks

Currently there are no significant risks associated with the Cello telemetry system.

6.3.3.4 Condition, Performance and Risks – Telenet System

Condition of Assets

Most of the telemetry equipment installed at Telenet Kingfisher sites was originally purchased and installed in the late 1990s. The average age of the field equipment is approximately 17 years and it is therefore at or near the end of its expected service life. Similarly the original powder coated RTU field cabinets are nearing the end of their service life.

The average age of the GPRS configuration telemetry field equipment is approximately 7 years and it is in good condition. Intermittent performance issues have been encountered at some GPRS sites where a new corrector type has been installed - refer discussion below.

Performance of Assets

The Kingfisher system performs well and reliably. It utilises thirty minute polling (compared to five minute polling for the GPRS configuration), which is at the upper end of the desired polling rate, however this is a limitation of the radio configuration.

The GPRS telemetry configuration provides five minute polling (nominal) which can prove invaluable in fault finding and contingency situations. Previous performance issues with the I/O server unit that received and processed telemetry field data have been addressed by replacing the server with a SCADA RTU system and migrating the existing Telenet sites to the new RTU system - refer Risk section below.

The type of corrector used at new GPRS-configuration Telenet sites has recently been changed due to hazardous-area certification limitations of the previous corrector type. Intermittent performance issues have arisen at some sites following the commissioning of the new type of corrector in conjunction with the new SCADA RTU system. Vector is liaising with the corrector manufacturer to determine if the issues relate to the corrector and/or the telemetry communication system - refer Risk section below.

Risks

RTU Cabinets

The original Telenet Kingfisher RTU cabinets are of a powder-coated-steel type and they are now starting to corrode due to their age and the physical environment in which they are located. Corroded cabinets are replaced (with stainless steel cabinets) as asset replacement projects, and the quantity replaced annually is expected to increase over time.

Aging Telemetry Equipment

The majority of the telemetry equipment (e.g. RTU and radio transceiver equipment etc) installed at the Telenet Kingfisher sites was originally purchased and installed in the late 1990s and is therefore at the end of its expected service life. The frequency of equipment failures at these sites has shown a gradual increase recently, and a 5 year programme to replace the field equipment and master station equipment is therefore planned for FY2017 to FY2021.

I/O Server Replacement

Previous performance issues with the I/O server unit that processed telemetry field data (i.e. from GPRS-configuration Telenet sites) have been addressed by replacing the old server with a new SCADA RTU system. A project to migrate existing GPRS sites to the new RTU system is scheduled for completion during FY2016. The project will include the installation of a protocol converter device at each field site. The project is being carried out in conjunction with the field-testing of a new corrector (see below) to ensure that there are no issues with communications between the corrector and the SACADA RTU system.

Electronic Volume Correctors

The type of corrector used at GPRS-configuration Telenet sites has recently been changed due to hazardous-area certification limitations of the previous corrector type. Although comprehensive field testing of the new corrector was carried out in conjunction with the I/O server replacement project, minor telemetry-data issues still persist. Further testing will be carried out during FY2016 to determine whether these data issues are related to the new corrector type and/or the new SCADA RTU system.

Migration of Telenet Functions from Legacy Foxboro SCADA System

Vector's legacy Foxboro SCADA system is ready to be retired pending the migration of the Kingfisher Telenet functions to another platform. The Foxboro system was previously used to provide SCADA functions for Vector's Northern electricity network and Vector's gas distribution network, however all electricity SCADA functions have now been migrated to another SCADA platform.

The Foxboro SCADA system currently forms part of the data-path between the Kingfisher Telenet system, and the PI archiving system. In addition the Foxboro SCADA system also provides remote control facilities for the operation of IP20 isolation valves located at either end of the Auckland Harbour Bridge.

Before the Foxboro SCADA system can be retired, all Kingfisher Telenet functions (i.e. data link between Kingfisher Telenet and PI archiving system; and Harbour Bridge valve control functions) need to be migrated to alternative platforms. Preliminary planning was undertaken in FY2016, and a technical solution is expected to be implemented in FY2017.

6.3.3.5 Maintenance Programme

Cello units are maintained on an as-required basis in accordance with the manufacturer's recommendation. Cello batteries have a nominal service life of approximately 5 years - the unit initiates a low battery alarm when the battery is reaching the end of its service life allowing a battery change to be scheduled. The Cello unit pressure transducers do not require periodic calibration as they do not drift.

Preventive maintenance cycles for Telenet have been determined based on industry code requirements, risk management principles and good industry practice. Preventive maintenance of the Telenet system is carried out in accordance with the periodic cycles stipulated in the following technical standard:

Technical Standard	Periodic Maintenance Activities
GNS-0016 Telenet maintenance	• Annual maintenance inspections of Telenet master station, field sites and repeater station installations
	• 4 yearly intrinsic safety inspections of Telenet equipment installed in hazardous zones

Table 6-4 : Maintenance standards for Telenet field equipment

Preventive maintenance activities on Telenet field equipment may identify the need for corrective maintenance work, which could typically include the replacement of RTU cabinets (due to corrosion damage), or the replacement of faulty electronic correctors, modems etc.

6.3.3.6 Installation / Replacement Programme

The majority of the telemetry equipment installed at the Telenet Kingfisher sites has reached the end of its expected service life, and the frequency of equipment failures at these sites has shown a gradual increase over time - refer Section 6.3.3.4. A 5 year programme to replace the Kingfisher field equipment and master station equipment is therefore planned for the FY2017 to FY2021 period.

The installation of new Telenet sites is typically carried out in conjunction with major DRS upgrade or installation projects. In addition to telemetry installations carried out as part of DRS installation or upgrade projects, the installation of 8 Cello sites at existing DRS locations (in accordance with the guideline criteria described in Section 6.3.3.1) per year is planned for the period ending FY2021.

A small annual provision for the replacement of telemetry system components (e.g. corroded powder coated RTU cabinets, isolation barriers etc.) has been included in the budget forecast throughout the planning period.

6.3.4 Critical Spares and Equipment

6.3.4.1 Functional Description

A stock of critical spares and equipment is maintained so the repair of a network fault is not hindered by the lack of availability of required parts or equipment. Critical spares and equipment items for Vector's networks are owned by Vector and held on its behalf by its FSP, Electrix. Whenever new equipment is introduced to the network an evaluation is made of the necessary critical spares and equipment items required to be retained to support the repair of any equipment.

The critical spares and equipment items are held in Electrix's main gas division depot in Albany.

A list of critical spares and equipment is maintained for the items held in the FSP's emergency depot. The list has been developed over a period of time and is the result of collaboration between Vector's AR and NS staff and Vector's FSP. When new critical spares and equipment items are required they are typically sourced via Vector's FSP, Electrix. Where the scale of a proposed purchase warrants it (e.g. the purchase of a major equipment item), direct purchase by Vector would be carried out.

6.3.4.2 Physical Description

The critical spares and equipment list includes items that are low volume (turnover) or high cost, or have long lead times for purchase, or are no longer produced (obsolete) or where the level of risk associated with not holding a spare is considered high.

The list is comprised predominantly of fittings and equipment related to steel pipelines (e.g. TDW drilling and stoppling equipment, repair clamps, spherical tees, valves etc), with some critical items for larger diameter PE systems (e.g. 280mm fittings) etc. The list also includes a set of FRIATEC PE drilling and bagging equipment (and storage trailer unit), and a SELMA BMP vehicle-mounted leak detection unit.

6.3.4.3 Condition, Performance and Risks - Critical Spares and Equipment

Condition

The general condition of the critical spares and equipment is adequate. Some of the equipment (e.g. TD Williamson drilling equipment used for hot tap operations on live steel gas mains) is at least 25 years old and its current condition reflects the relatively high level of service. The standard life for critical spares (i.e. excluding critical equipment) is 50 years.

Performance

An appropriate range of critical spares and equipment is held. The performance of the critical equipment items is adequate, although in some cases the type of drilling equipment currently held limits the range of specialized fittings that can be used e.g. completion plugs. The compatibility of equipment with the range of specialized fittings currently available will be considered when planning the replacement of existing, or the acquisition of additional, items of critical equipment.

Risks

A replacement programme for critical spares and equipment has not been formalised. An audit of the condition of critical spares and equipment will be carried out in FY2016 to determine whether a replacement programme for key items is required.

The management of the critical spares and equipment inventory and associated preventive maintenance inspections is carried out within the Electrix data-warehouse system. Vector staff have access to the critical spares and equipment inventory data via a web-based Citrix report, however preventive maintenance inspection records are not currently included in the report. Options to provide Vector visibility to preventive maintenance records will be explored during FY2016.

6.3.4.4 Maintenance Programme

Preventative maintenance inspection and periodic audit cycles have been determined based on risk management principles and good industry practice. Preventive maintenance of critical spares and equipment is carried out in accordance with the periodic cycles stipulated in the following technical standard:

Technical Standard	Periodic Maintenance Activities
GNS-0078 Maintenance of critical spares and equipment	• Monthly – visual inspection
	• Annual – condition assessment of all critical spares and equipment; Review of inventory lists to determine level of inventory held is appropriate

Technical Standard	Periodic Maintenance Activities
	• 5 to 10 yearly - manufacture's check/refurbishment of all major items of equipment

Table 6-5 : Maintenance standards for critical spares and equipment

6.3.4.5 Replacement Programme

The development of a refurbishment/replacement programme for critical spares and equipment is expected to be completed in FY2016. A nominal annual expenditure provision has been made for the replacement of unspecified critical spares and equipment on an as required basis.

6.3.5 Pressure Reducing Stations

6.3.5.1 Functional Description

Pressure reducing stations are those parts of a gas system that link two pressure levels in gas networks, through pressure regulators. They are the points of input to a pressure level and comprise the following three types:

- Gate stations;
- District regulator stations (DRS); and
- Service regulators.

Pressure stations linking the gas transmission system and a gas distribution network are known as gate stations. HP equipment (pressure regulating equipment, custody transfer metering, etc.) within the gate station is operated and maintained by the transmission company (First Gas Limited), whereas distribution system equipment (i.e. check-metering where installed, and associated valves and pipework etc.) within the gate station is operated and maintained as part of Vector's distribution networks.

Where a pressure station links two gas distribution pressure networks, it is known as a district regulating station (DRS). These are operated and maintained as part of Vector's gas distribution networks.

A service regulator is used to regulate the pressure to individual or a small number of consumer premises, and is installed upstream and separate from the customer GMS. Service regulators are owned and maintained by Vector.

The purpose of DRS and gate stations is to automatically control the pressure in the downstream mains, and meet the following service and performance standards:

- Have the capacity to supply the forecast load based on minimum design inlet pressure and design outlet pressure and current load projections;
- Be twin stream with each stream meeting the forecast load capacity;
- Have adequate over-pressure protection – preferably two safety protection devices including an automatic shut off (ASO) device;
- Be accessible at all times and be able to be isolated external to the enclosure;
- Have a 35 year minimum life;
- Pilot loaded regulator DRSs should maintain delivery pressure at ±5% of set point;
- Spring loaded 'direct loading' regulator DRSs should maintain delivery pressure at ±10% of set point;
- Normal operation shall maintain delivery pressure at or below MAOP at all times;

- Under fault conditions, delivery pressure should be maintained at or below 110% MAOP for MP and IP systems;
- Each DRS is to have an inlet and outlet isolation valve located at least 5 metres away from the enclosure; and
- DRSs must comply with Vector standards and legislative requirements.

6.3.5.2 Physical Description

The DRS installations comprise the following elements:

- Remote (fire stop) inlet and outlet isolation valves (in most sites);
- Inlet and outlet valves;
- Filters;
- Regulators;
- Over-protection control – monitor regulators and/or slam shut mechanism and/or relief valves;
- Metering (in some sites);
- Telemetry (in some sites); and
- Enclosure – varies from wire mesh to solid timber/concrete block building.

The average age of the DRS population is 22 years. The standard life for DRS is 35 years.

DRSs are generally twin stream units. DRSs are generally installed above ground, but factory-built underground DRSs are available and to date one of these units has been installed by Vector.

Approximately 195 service regulators remain in service on Vector's network. The average age of the service regulators is 23 years, with the majority installed between the mid-1980s and the mid-1990s. The standard life for service regulators is 35 years. Existing service regulators are mostly installed in small pits below ground, however all new service regulators are installed above ground. Service regulators are typically installed in situations where it is not possible (or considered impractical) to locate the GMS outside of the customer's premises. A service regulator is typically comprised of a small-capacity pressure regulator along with upstream and downstream isolation valves.

6.3.5.3 Condition, Performance and Risks - DRS

Condition of Assets

An initial field audit of all DRS was undertaken during FY2010 to provide a baseline against which ongoing condition assessments could be measured and DRS upgrade priorities could be determined. The audit assessed the condition and status of each DRS and covered the following general areas:

- Enclosure dimensions, amount below ground, enclosure type and ventilation provided;
- Confirmation the reliefs valves vented to a safe location;
- Inlet and outlet fire valves present and accessible;
- The condition of the enclosure and ease of access/egress; and
- The condition of DRS equipment – i.e. regulators, pipework, filter, relief valve, meter and corrector.

A condition assessment rating was assigned for each of the DRS components based on the audit results. The assessment rating was based on a 7 point scale where 1 is very poor condition and 7 is good condition. Since the original audit was undertaken, a DRS integrity register has been updated on an ongoing basis as DRS upgrades are completed. DRS with an average condition assessment rating of 4 or less are considered to be high priority for replacement or refurbishment; currently there are no DRS with an average condition assessment rating of 4 or less.

The relative priority of individual DRS for replacement or refurbishment has been further assessed by considering the relative number of low condition-assessment ratings (i.e. pipework rating, enclosure rating etc.) assigned to each DRS. DRS that have a relatively high number of compliance issues are considered to have the highest priority for replacement or refurbishment. Currently approximately 35% of the total DRS have at least one low condition-assessment rating; these typically relate to inadequate ventilation, or lack of fire valves.

The ongoing condition assessments form the basis of Vector's DRS upgrade programme to address the integrity issues identified. The average integrity score for all stations has shown a steady improvement over the period, and the count of integrity ratings of less than 4 has shown a significant decrease (improvement) over the period.

Performance of Assets

Approximately 59 DRS sites have insufficient ventilation to meet Vector's design standards - i.e. there is insufficient ventilation and/or the ventilation openings are not adequately distributed on the walls of the DRS enclosure. These sites have been assessed and prioritised for upgrading. Ventilation upgrades at these sites will be completed over FY2016 to FY2019.

A risk assessment has been carried out on those sites that do not have both an inlet and outlet fire valve. The high-risk sites will be programmed to have the valves installed. Replacement of the lower risk sites will be programmed with other site works.

There are 7 sites where the DRS enclosure is located within 1 metre of another building. These sites are being evaluated to determine if there are any openings into the building within 1 metre (or directly above) the enclosure, or to determine where the hazardous zones are. If there is a hazardous zone within 1 metre of an opening then options to alter or restrict the hazardous zone are to be considered and implemented.

In 2012, Vector engaged a seismic specialist to undertake a review of critical gas distribution infrastructure to assess the selected assets for compliance with the seismic provisions of NZS1170. The review included two gate stations and three DRS sites in Auckland. The specialist's report recommended seismic reinforcement at one DRS site which has been completed. The report also recommended further assessment of DRS kiosk reinforcing at two sites - this work is expected to be completed during FY2016.

Risks

Inadequate Pressure Relief Capacity

Due to legacy practices, over-pressure protection in Vector's network is sometimes provided by installing full capacity relief valves. With the increase in capacity caused by installing larger regulator orifices/ports, coupled with installing vent pipes on relief valves, a DRS site may no longer have full capacity relief. Currently there is one DRS site with inadequate relief capacity. This site is expected to be upgraded during FY2016. Upgrades typically involve the installation of automatic shut off (ASO) devices.

Over-pressure Protection

Vector's standard DRS design for new DRS installations employs two over-pressure safety devices - e.g. a monitor regulator and a slam-shut ASO device. In certain circumstances Vector's DRS design standard allows a single over-pressure safety device to be used - i.e. where the inlet pressure is IP10 or lower, the outlet pressure is MP4 or lower, and the system demand is less than 500 scmh. This standard was adopted after reviewing the DRS over-pressure protection requirements of relevant industry codes, and exceeds the over-pressure protection requirements of AS/NZS 4645.

There are approximately 11 existing DRS sites that have a single over-pressure safety device only, and don't meet Vector's DRS design criteria. Although these sites are compliant with the over-pressure protection requirements of AS/NZS 4645 (i.e. with regard to the number of over-pressure safety devices), a risk assessment will be carried on these sites to determine if the current level of over-pressure protection is adequate. For those sites which are assessed as high risk, the installations will be bought up to Vector's current standard (for new installations).

Equipotential Bonding and Earthing

Vector is in the process of amending its DRS design standard to require the installation of equipotential bonding on all DRS pipework, the earthing of riser pipework and DRS kiosk (including concrete pad reinforcing and the enclosure structure where appropriate), and the installation of surge diverters (where required) for all new DRS. The amendments to the DRS design standard are being developed in conjunction with the development of an electrical hazard management plan (EHMP) as required by AS/NZS4853 - refer Section 6.3.1.4.

In order to mitigate electrical hazards that could be present at approximately 100 existing DRS installations, a 2-year programme to retrofit equipotential bonding, earthing and surge diverters (where required) to all existing DRS is planned for FY2017 to FY2019.

6.3.5.4 Condition, Performance and Risks – Service Regulators

Condition of Assets

Service regulators are mostly sited underground in small pits close to the main in the street. These pits are vulnerable to filling with water, allowing water ingress into the regulator relief hole.

Since 2000 several service regulator audits and removal projects have been undertaken, and the population of service regulators has been reduced from in excess of 700 to approximately 195 currently. The condition of service regulators is monitored by means of annual (for belowground service regulators) and biennial (for above ground service regulators) preventive maintenance inspections. Service regulator replacement candidates are identified through SAP PM inspection records, fault reports or an assessment of other risk factors – e.g. the service regulator location relative to buildings, roadways etc.

Performance of Assets

In some situations underground service regulators can be affected by the ingress of water, silt or other debris that over time leads to corrosion and impaired regulator performance. This can result in gas escapes from corroded fittings and pipework, and can allow unacceptable over-pressure gas into downstream systems (and venting gas to atmosphere).

Risks

Service regulator pits are vulnerable to water ingress which increases the risk of corrosion of the regulator fittings and the risk of water ingress into the regulator relief hole. This can potentially cause the loss of supply, resulting in a safety issue and a costly maintenance problem.

An ongoing removal programme targets higher risk belowground service regulator sites; the service regulators are removed where possible, or alternatively relocated above ground. Replacement candidates are identified through SAP PM inspection records, fault reports or an assessment of other risk factors - e.g. the service regulator location relative to buildings, roadways etc.

6.3.5.5 Maintenance Programme

DRS and Gate Stations

DRS and gate station maintenance is carried out in accordance with Vector's technical standard GNS-0012 Maintenance of gate and district pressure reducing stations.

All underground sites are inspected quarterly, and all above ground sites are inspected six-monthly. The integrity of the site and enclosure is reviewed and all defects recorded. Operation of equipment is checked and variations outside normal conditions are remedied. Remedial actions are recorded.

In addition to the above, on an annual basis the set points of all equipment are checked and confirmed as within operating parameters. Any variations outside normal conditions are remedied. Remedial actions are recorded and all valves are actuated.

Maintenance records are reviewed on an annual basis. Trends are used to confirm the appropriateness of maintenance cycles and drive replacement programmes.

Service Regulators

All underground sites are inspected annually, and all above ground sites are inspected biennially in accordance with Vector's technical standard GNS-0073 Service regulator maintenance. The integrity of the site and enclosure is reviewed and all defects recorded. Operation of equipment is checked and any variations outside normal conditions are remedied. Remedial actions are recorded.

6.3.5.6 Replacement Programme

The replacement of gate station, DRS and service regulator assets is based on an assessment of the following criteria:

- Condition: Physical deterioration is excessive i.e. beyond economic maintenance. This includes the enclosure;
- Functional changes: Obsolete equipment – spare parts no longer available and equipment is not operating correctly; equipment malfunction leads to replacement; third party interference; inadequate/poor design;
- Site changes: Fire stop valves in carriageway; new/altered surrounding buildings compromising egress, ventilation and access to fire stop valves; vent pipes too close to new/altered buildings; risk consequence/frequency for DRS increased; flooding; and
- Code/standard changes: Legacy plant layout etc. does not meet current codes of practice/Vector standards.

A DRS replacement/refurbishment programme has been implemented based on the criteria described above and the results of ongoing condition assessments. The programme prioritises sites according to condition and risk. An annual provision has been included in the budget forecast throughout the planning period to address specific compliance and integrity issues identified on the DRS integrity register.

Where a DRS replacement or refurbishment candidate is scheduled for removal as part of a pipeline replacement programme or as a result of a system rationalisation study or is scheduled to be relocated as part of a relocation project, the replacement or refurbishment of that DRS is deferred.

The condition assessment rating was based on the following key assessments:

- Compliance assessment:
  - Fire valve rating
  - Relief valve rating
  - Relief venting rating
  - Ventilation rating
- Condition assessment:
  - Regulator obsolescence rating
  - Vector technical standards rating
  - Condition of fittings, equipment and enclosure

Priority is also given to those DRS where the design capacity will be exceeded. The scope of individual upgrades range from the complete rebuilding of a DRS to the replacement of individual DRS components as determined by the latest condition assessment.

The service regulator replacement programme is risk-based and ongoing. Service regulators identified for removal (or replacement above ground) are prioritised based an ALARP risk assessment. Service regulator replacement candidates are identified through SAP PM inspection records, fault reports and other sources. The service regulator replacement programme will target the replacement of 5 to 10 of the highest priority service regulators per annum.

6.3.6 Valves

6.3.6.1 Functional Description

Distribution system valves are comprised of inline mains and service valves (to control the flow of gas within the system) and blow down valves (to depressurise sections of the system in the event of an emergency).

Valve types currently in use include ball valves, plug valves and gate valves. Due to their design, ball valves are relatively maintenance free whereas the other types require some measure of periodic maintenance to prevent issues and to ensure they remain operable.

Specifically valves are expected to achieve the following level of service and performance standards:

- Mains are to have sufficient valves to isolate consumers in blocks of 500 to 1,000;
- Installation at every 2,000 metres in PE systems with MAOP greater than 420 kPa;
- All IP services are to be fitted with an isolation valve;
- All services that enter a building at other than the GMS location, or pass through a space where gas could accumulate and become a hazard, or cross private property to supply another property, or is one of several extending to different floors of a building, are to be fitted with isolation valves;
- Each service shall end with an isolation valve(s) and shall be upstream of the GMS;
- Valves are to be installed to isolate high risk areas, such as CBD areas, bridges and rail crossings (note that these valves may be automatic shutoff valves);

- Valves are easily accessible, operable and leak free; and
- Valves comply with Vector's standards and legislative requirements.

6.3.6.2 Physical Description

Information on valve types (i.e. ball, plug etc.) installed on Vector's network is not currently available as it was not historically held in either the GIS or SAP-PM systems (refer Risk section below). Over 40% of mains valves installed on Vector's network are thought to be plug valves.

Mains and service valves are typically installed below ground. The majority are direct-buried and access to the valve is provided via a valve sleeve. In some cases (e.g. on larger diameter mains) valves are installed in pits or above ground. Below ground valves are generally operated by a purpose-made valve key, whereas above ground valves are typically operated by a hand wheel and gearbox mechanism. Note that the reference to mains valves excludes valves that are installed above ground at gate station and DRS sites; these valves are operated and maintained as part of the station equipment.

6.3.6.3 Condition, Performance and Risks

Condition of Assets

Ball valves are typically in good condition and operate adequately.

Plug valves represent a significant operational and maintenance problem due to:

- The need for continual greasing to overcome seizing problems;
- The grease drying out; and
- Wads of grease contaminating downstream facilities.

Some valve sites are susceptible to the access sleeve filling up with debris. This has to be cleaned out before the valve can be maintained.

In some cases older valves are no longer able to be located. This is typically due to road alterations or re-sealing which result in obscured valve locations. This is an ongoing problem and in order to mitigate the risk, the deployment of electronic locator balls is being trialled.

Performance of Assets

Ball valves have been used since the mid-1980s and are considered to be reliable and relatively maintenance free.

The use of plug valves ceased around the mid-1980s. Plug valves require a higher level of maintenance, because of their design, which includes regular greasing to prevent the valve seizing and/or leaking.

Risks

Valve Activation

The maintenance programme for ball valves requires valves to be partially operated to confirm that the valve is operable, whereas the maintenance programme for plug valves requires only valves that are "designated emergency valves" to be partially operated.

The reason for different maintenance practices for ball and plug valves is that plug valves can be prone to seizing and by limiting the partial movement operation to critical valves only, the risk of a plug valve seizing in a partially closed position is reduced. However this approach does increase the risk of a plug valve that is not subject to a periodic partial movement operation seizing during an emergency operation. International practice is being researched to determine an appropriate maintenance strategy for plug valves.

Riser Plug Valves

Prior to the introduction of ball valves in the early 1990s, a plug type riser valve was used for residential and small commercial connections. Because of its mechanical design, this type of valve is prone to seizing and gas escapes.

In order to mitigate the risks associated with riser plug valves, annual audits of approximately 1000 riser valves are undertaken. The audits target areas known to have relatively high populations of plug type riser valves, and are carried out in accordance with Vector's technical standard GNS-0013 Valve maintenance.

Sectional Isolation Valves

It is an AS/NZS 4645 requirement that sectional isolation valves be installed to facilitate the safe operation of the gas distribution network.

A long-term network isolation study of high risk areas (such as CBD areas) is underway to determine if there are sufficient isolation valves to ensure the safe operation under normal or emergency conditions.

Unknown Valve Types

Information on valve types has historically not been captured in the GIS or SAP-PM systems. This impacts on preventive maintenance scheduling as different valve types (e.g. ball or plug etc.) require different types of maintenance activity. Over 40% of mains valves on Vector's network are thought to be plug valves. A review of available valve data will be undertaken and uploaded into SAP-PM where possible. This will be carried out as part of a larger programme to upload asset data into SAP-PM.

6.3.6.4 Maintenance Programme

Valve maintenance is carried out in accordance with Vector's technical standard GNS-0013 Valve maintenance. Mains, service and service riser valves are inspected as follows:

- 12 Monthly - all designated emergency valves; All other MP and IP mains plug valves; All mains and service valves located within business districts; and
- 24 Monthly - all other HP, MP and IP mains ball valves; All MP and IP service valves not located within business districts; Any LP mains and service valves designated to be included in the valve maintenance programme. A sample of approximately 1,000 service riser valves (in areas known to include higher concentrations of plug type riser valves) are to be inspected.

The integrity of the site and access to the valve is checked, as well as the presence of gas escapes. The operation of the valve (excluding plug valves that are not designated emergency valves) is also tested. All defects are recorded and prioritised for rectification.

6.3.6.5 Installation / Replacement Programme

In general valves are expected to last the lifetime of the network system to which they are connected. However, valves will be replaced on an as required basis where:

- The valve cannot be practically actuated;
- Excessive gas escapes are evident;
- In the case of plug valves, the amount of lubricant being installed is compromising the operation of the downstream network; or
- The cost of maintenance outweighs the cost of replacing/relocating the valve.

The ongoing network isolation study has identified the need for additional valves on key pipeline systems to ensure their safe operation under normal or emergency conditions. The installation of additional isolation valves (including DRS fire valves) on Vector's network is planned for the period ending FY2020.

In order to mitigate the risks associated with riser plug valves, an annual expenditure provision has been made for the audit of approximately 1000 riser valves per year.

6.3.7 Cathodic Protection

6.3.7.1 Functional Description

Underground steel plant is protected against corrosion by the provision of a protective coating (e.g. high density polythene) and the application of either an impressed current or sacrificial anode CP system. CP systems are intended to meet the following level of service and performance standards:

- Provide an instant off potential of more negative than 850 mV;
- Provide an instant off potential less negative than 1,200 mV when measured with a copper/copper sulphate reference electrode; and
- Comply with Vector standards and legislative requirements.

6.3.7.2 Physical Description

The CP systems on Vector's network comprise:

- 9 impressed current CP (IC) systems; and
- Approximately 12 sacrificial anode CP systems.

6.3.7.3 Condition, Performance and Risks

Condition of Assets

Apart from the exceptions noted below, the condition of the overall CP system is considered adequate.

Some CP systems still have inadequate test points to meet the test-point spacing requirements of AS2832.1; Further upgrade work is planned to install additional test points on these CP systems to meet the requirements of AS2832.1.

Performance of Assets

All steel pipelines on Vector's networks now have working CP systems.

The configuration of some sacrificial anode CP systems can make it difficult to undertake instant-off testing due to the inability to synchronously interrupt the CP system - i.e. because the location of the buried anodes is unknown, or because of the anode configuration. In these cases the installation of smart coupons will be considered as a way of upgrading the CP system to allow instant-off testing to be carried out.

Risks

Interference / Stray Currents

Watercare is undertaking a significant upgrade of its trunk water main and associated CP systems in Auckland. Vector is liaising closely with Watercare to facilitate the installation of interference test points to allow joint monitoring of the Vector and Watercare pipelines at points where the pipelines cross or are in close proximity to one another.

Third Party Issues

Short circuits are an ongoing problem in a number of areas in Auckland, particularly the CBD. They are generally due to faulty insulation joints or to the steel pipes touching other utility assets. Due to the nature of the problem and their location they can be difficult and time consuming to identify and expensive to remedy. These short-circuits can take months/years to locate and can cause excessive current drain, which may contribute to early failure of the CP systems.

When GMSs are replaced on steel services, the insulation joints are sometimes not properly reinstated. These can also cause excessive current drain and contribute to early failure of the CP systems. To address this risk a CP insulating joint tag has been developed. The tag is designed to be installed on GMS risers to warn anyone working on the GMS or the riser that an insulating joint is required on the outlet of the riser valve. The requirement to use the tag will be included in the next revision of Vector's technical standard GNS-0059 Construction of below ground corrosion protection systems.

Incomplete Inspection

The configuration of a small number of sacrificial anode CP systems has prevented instant-off measurements being taken due to the inability to synchronously interrupt the CP system. Although "on" readings are being taken and these give an indication of CP protection, they do not meet the requirements of AS/NZS 4645. The majority of these sacrificial anode systems have now been upgraded by means of installing CP coupons which allow instant-off testing to be carried out. There are some short pipeline sections remaining in Auckland, and these will be addressed in conjunction with the programme to improve test point spacing - refer below.

Test Point Spacing

Analysis of Vector's CP test point spacing has shown that on some sections of Vector's network the test point spacing may not meet the requirements of AS2832.1 Cathodic protection of metals. A 6-year (FY2013 to FY2018) programme to install additional CP test points on Vector's network to meet the requirements of AS2832.1 is underway.

Cased Crossings

There are a number of cased crossings of steel pipelines. Cased crossings are typically installed on steel pipelines which cross under railway lines or major roads etc., and consist of a larger diameter steel duct through which the steel carrier pipe has been installed. Rail and road operators sometimes insist on the installation of cased crossings on the basis that the casing will vent gas away from the rail or road crossing in the event of a fault on the steel carrier pipe.

Cased crossings are generally avoided because the casing can shield the pipeline from its CP. In the event that water, or another electrically conducting medium, enters the casing, the steel pipeline may be exposed to risk of corrosion. In some cases the actual casings do not have CP, thus over time they will corrode which may lead to problems with water etc entering the casing.

The current checks made to cased crossings are to confirm that the CP voltage readings are different from the pipeline readings, and that their readings do not alter while an instant on/off potential survey is carried out. This confirms that the casing and the steel pipeline are not touching. A review has confirmed that all known cased sites are being monitored, however further research is being carried out to identify any unrecorded cased sites.

6.3.7.4 Maintenance Programme

CP maintenance is carried out in accordance with Vector's technical standard GNS-0015 Maintenance of below ground corrosion protection systems:

- All impressed current installations are inspected every two months. The output current and voltage are to be recorded;
- All drainage bonds are inspected every two months. Electrical connections are inspected to ensure satisfactory operation;
- All galvanic installations are inspected three monthly, six monthly and annually in major urban, urban and rural areas respectively. Inspect to ensure satisfactory operation;
- All test points are tested three monthly, six monthly and annually in major urban, urban and rural areas respectively. The on and instant off pipe to soil potential measurements with respect to a copper/copper sulphate reference electrode is to be recorded;
- All test points are tested three monthly and six monthly in urban and rural areas respectively. The on pipe to soil potential measurements with respect to a copper/copper sulphate reference electrode is to be recorded;
- Electrical isolation points are tested three monthly, six monthly and annually in major urban, urban and rural areas respectively. Any electrical isolation between buried or submerged pipelines and other underground metallic structure are to be tested to ensure they are electrically isolated from each other; and
- Interference test points are tested every five years. The on and instant-off pipe to soil potential measurements with respect to a copper/copper sulphate reference electrode is to be recorded. The testing is to be carried out in conjunction with the foreign-structure owner with each system being interrupted in turn.

6.3.7.5 Replacement Programme

In general, impressed current systems are expected to last the lifetime of the network system to which they are attached. However, they will be replaced where the cost of maintenance outweighs the cost of replacing them.

Sacrificial anode systems will be replaced when the anodes have been consumed, or when the CP current requirement exceeds the capacity of the anode system. This may be due to coating deterioration (it is usually more cost effective to increase current to protect coating defects than repair coating defects) or an increase in network size which is beyond the capacity of a sacrificial anode system.

The replacement programmes for Vector's networks include an annual provision for the replacement of CP assets as required e.g. installation of surge diverters, installation of new ground beds, upgrade of existing ground beds, replacement of expired sacrificial anodes, relocation of at-risk test points etc.

Further work is planned (in conjunction with the programme to install additional CP test points - refer below) to upgrade some small sacrificial-anode CP systems in Vector's network to enable instant-off testing to be carried out.

A six year programme (FY2013 to FY2018) is underway to install additional CP test points as required to meet the test point spacing requirements of AS2832.1 for "suburban and high-rise" areas.

6.4 Significant Variances from Previous AMPs

Table 6-6 summarises the key integrity projects and programmes for renewal and replacement of the gas distribution network. It shows the current target completion dates for these projects, compared with that in the previous plan. If there is a difference the reasons for the change are described (advanced or delayed) in the following tables. Newly identified and completed projects are also highlighted.

Project Description	Previous AMP Date	Current AMP Date	Comments
DRS earthing and bonding	FY16 to FY17	FY17 to FY19	Rescheduled due to EHMP development
DRS surge diverters	FY16 to FY17	Cancelled	Now included in earthing/bonding project
DRS upgrade project to address compliance (e.g. appropriate over pressure protection) and integrity issues (specific sites identified in accordance with DRS register	FY16 to FY25	FY17 to FY26	Ongoing programme
Installation of additional test points to meet class location requirements of AS2832.1	FY16 to FY17	FY17 to FY18	Additional test points required
Installation of isolation valves	FY15 to FY16	FY15 to FY20	Additional valves required
Telenet upgrades to address integrity issues	FY16 to FY25	FY17 to FY26	Ongoing programme (Project description changed)
Moxa protocol translator (40 sites)	FY16 to FY18	FY16	
Purchase and /or installation of remote pressure monitoring facilities (e.g. Cello units) at nominated sites. FY16 to FY18 additional installs of existing temp winter gauging loggers that will be fixed.	FY16 to FY25	FY17 to FY21	Ongoing programme (shortened)
Replacement of bridge crossing brackets and supports	FY16 to FY25	FY17 to FY26	Ongoing programme
Replacement of CP assets as required - e.g. installation of new ground beds, upgrade of existing ground beds, replacement of expired sacrificial anodes, CP interference-monitoring test points (in conjunction with Watercare, relocation of at-risk test points etc	FY16 to FY25	FY17 to FY26	Ongoing programme
Replacement of MP1 cast iron pipeline in Mt Wellington	FY16	FY17	Extended due to construction complexity
Installation of new CP interference-monitoring test points (in conjunction with Watercare 4 year starting FY11))	FY15 to FY24	Cancelled	Included in annual provision for CP replacement
Riser valve replacements	FY16 to FY25	FY17 to FY26	Ongoing programme
Strategic Spares (leakage survey and valves)	FY16 to FY25	FY17 to FY26	Ongoing programme
Street regulator removal	FY16 to FY25	FY17 to FY26	Ongoing programme
Targeted replacement of high priority MP pre-1985 PE pipe	FY16 to FY25	FY17 to FY26	Ongoing programme
Unknown asset safety and compliance issues	FY16 to FY25	FY17 to FY26	Ongoing programme

Project Description	Previous AMP Date	Current AMP Date	Comments
Kingfisher RTU replacement (40 sites) and Master station replacement (5 year)	New Project	FY17 to FY21	
Stainless steel service pipe replacement	New Project	FY17	

Table 6-6 : Project programme update for network integrity

Vector Gas Distribution Asset Management Plan 2016 – 2026

Non-Network Assets – Section 7

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7. Non-Network Assets

7.1 IT Technical Reference Architecture

Vector implements and manages all its Information Systems and their related infrastructure components according to an overall IT Technical Reference Architecture. This ensures that each Information Technology component has clear boundaries, which ensures that the technology used to support these components are “fit-for-purpose”. It also helps make sure that Vector’s Information Systems environment maintains a “separation of concerns” between its information systems and infrastructure. The Vector IT Technical Reference Architecture is shown in the following diagram.

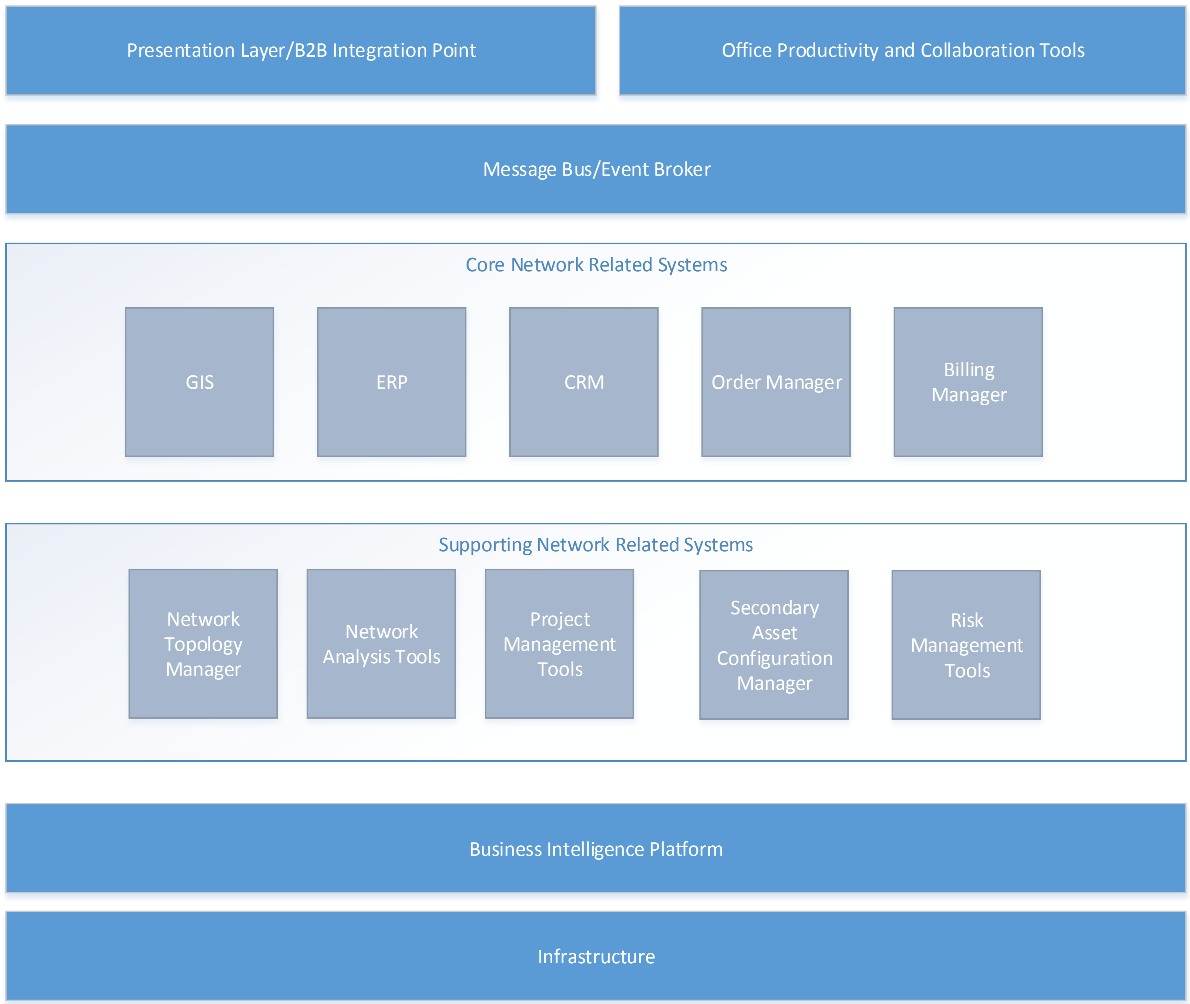

Figure 7-1 : Vector’s IT Technical Reference Architecture

7.2 Information Systems

The components within the IT Technical Reference Architecture are made up of information technology and information systems. These can be divided into three categories relating to the type of business capabilities that they support:

- **Core Network Related Systems:** These systems support capabilities that manage information directly relating to Vector's network assets and their operation and management;
- **Supporting Network Related Systems:** These are smaller systems that support capabilities that manage information that also directly relates to Vector's network assets and their operation and management; and
- **Supporting IT Infrastructure Systems:** These are systems that support the integration and operation of both the Core Network Related Systems and the Supporting Network Related Systems.

The following diagram illustrates the relationship between Vector's business functions and processes, hereafter referred to as business capabilities, and its Core Network Related Systems.

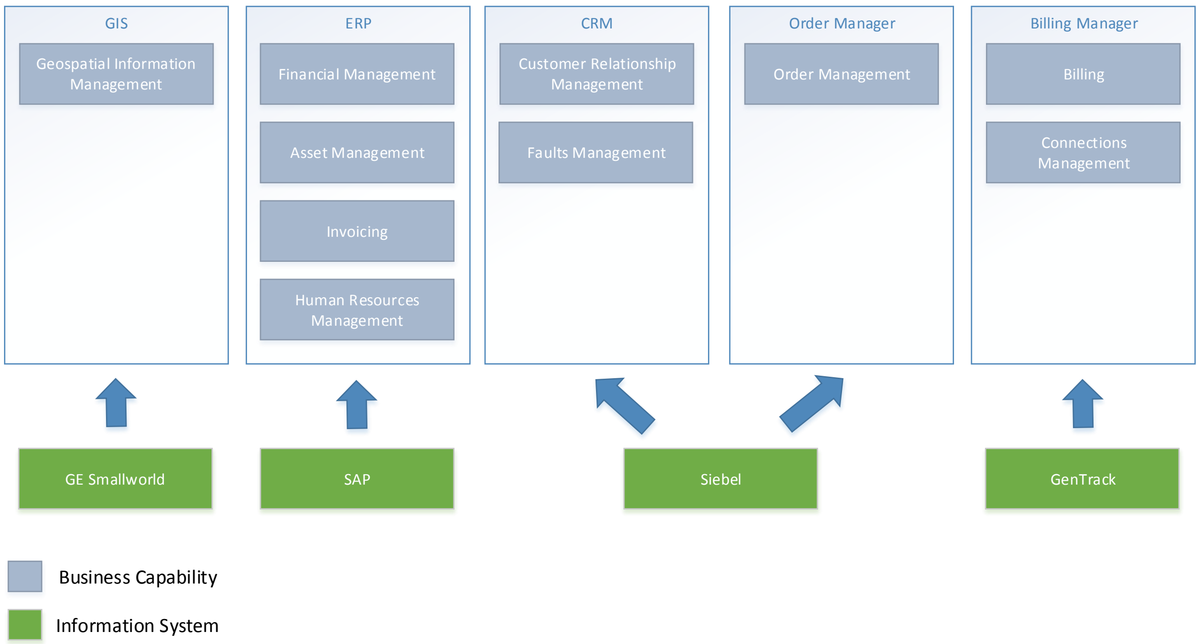

Figure 7-2 : Business Capabilities and Core Network Related Systems

The following diagram illustrates the relationship between Vector's business functions and processes, hereafter referred to as business capabilities, and its Supporting Network Related Systems.

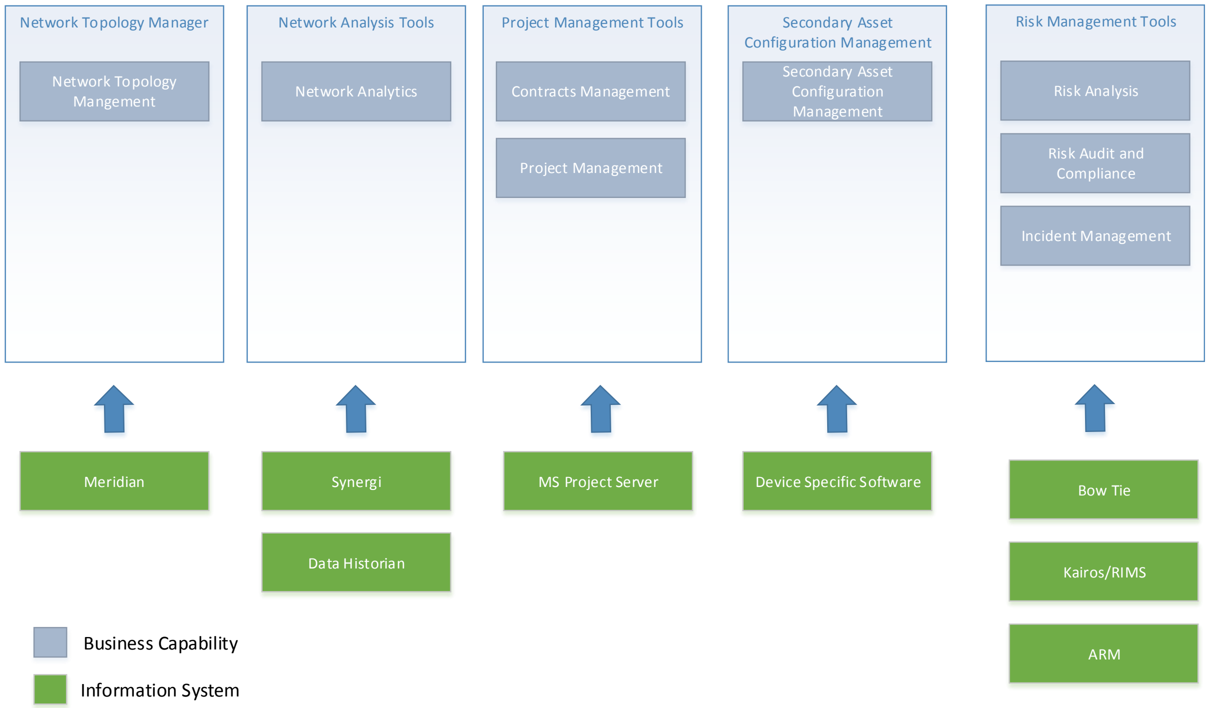

Figure 7-3 : Business Capabilities and Supporting Network Related Information Systems

Vector also manages and maintains other information systems in addition to its Core Network and Supporting Network Related systems. These Supporting IT Infrastructure systems support other Business capabilities that supplement the other main systems basic functionality. These systems are shown in the following diagram along with the additional features that they provide.

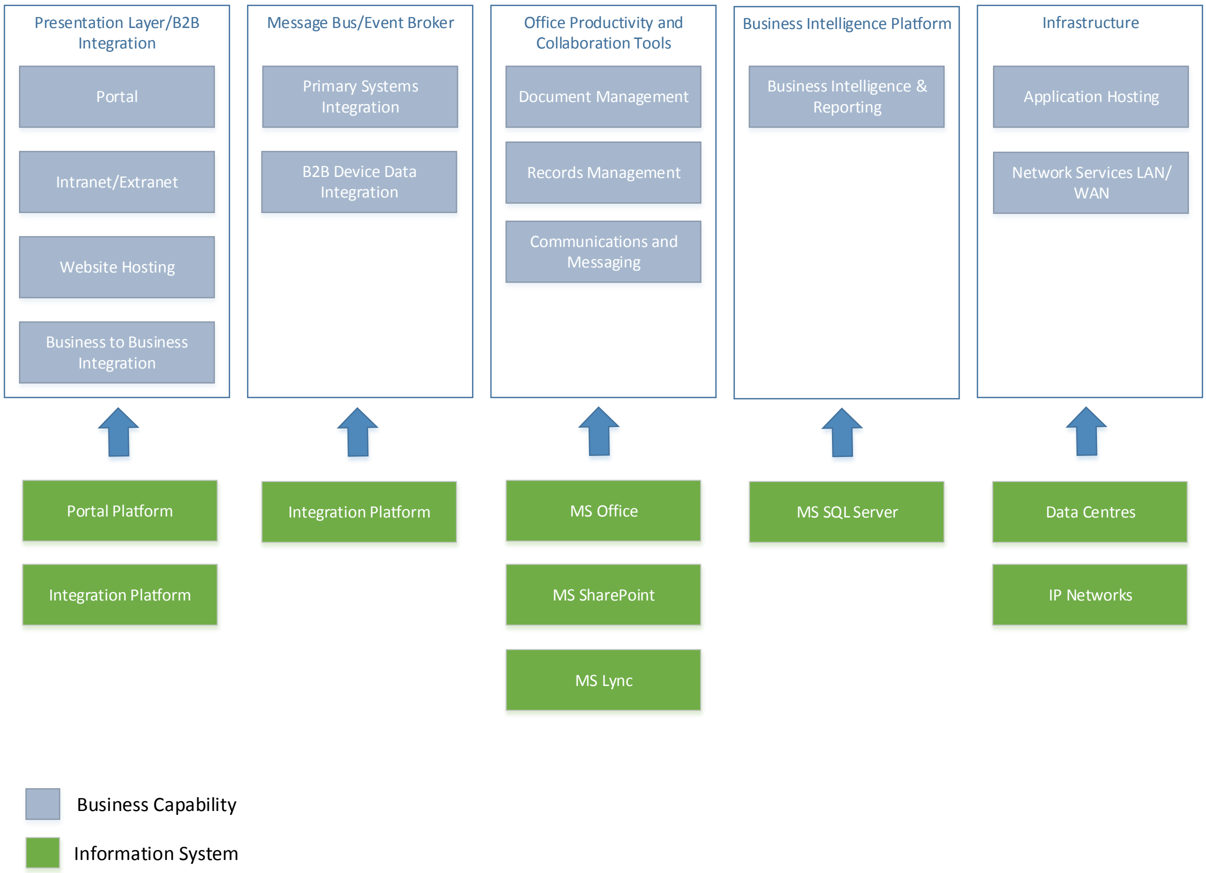

Figure 7-4 : Business Capabilities and Supporting IT Infrastructure Systems

7.3 Information and Data

Vector's Core Network and Supporting Network Information systems are used to manage data that is necessary for the effective day-to-day operation of its network assets and the ongoing planning activities relating to those assets.

The information can be divided into several categories;

- Asset
- Location
- Customer
- Order
- Financial
- Faults and Maintenance
- Real-time Data and Measurements

These information categories are managed by Vector's information systems as shown in the following diagram.

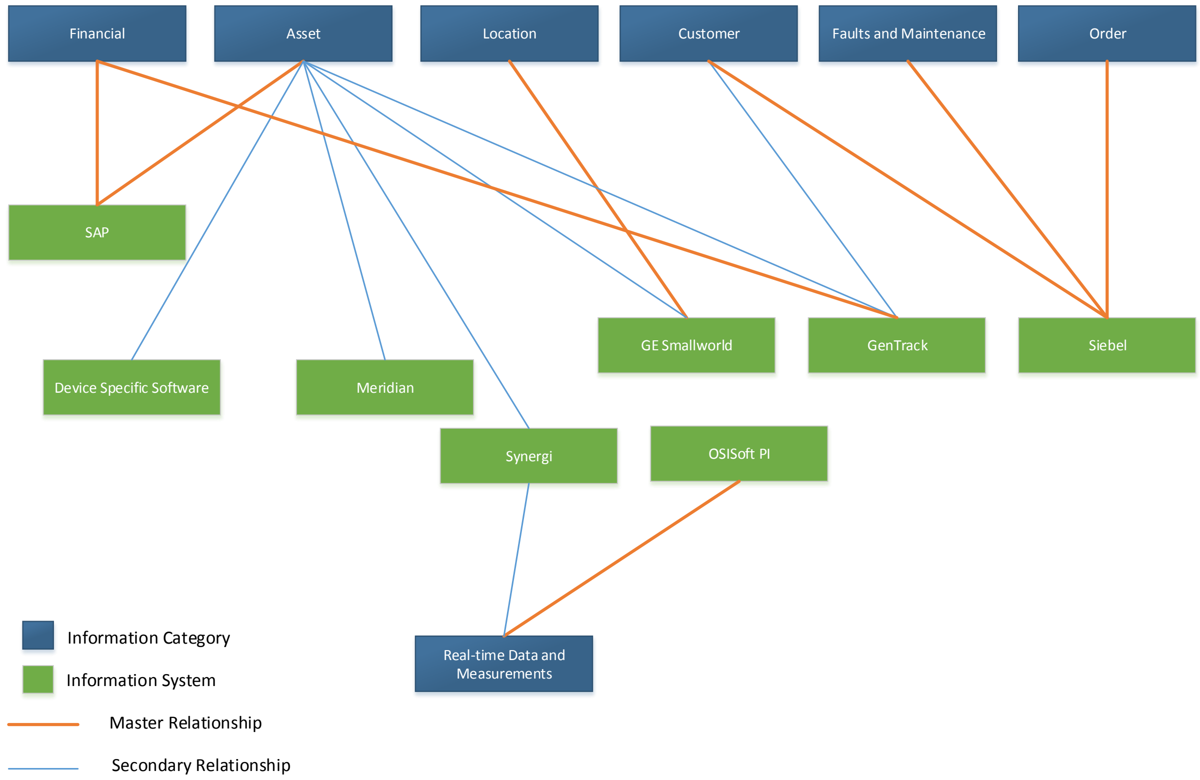

Figure 7-5 : Information and Systems Relationships

7.4 Information Systems Planning

Each component within the Vector IT Technical Reference Architecture has a collection of supporting architecture documents. These documents are referred to as "Architecture Artefacts". They are used to define the strategy, roadmap, and detailed reference architecture specific to each component.

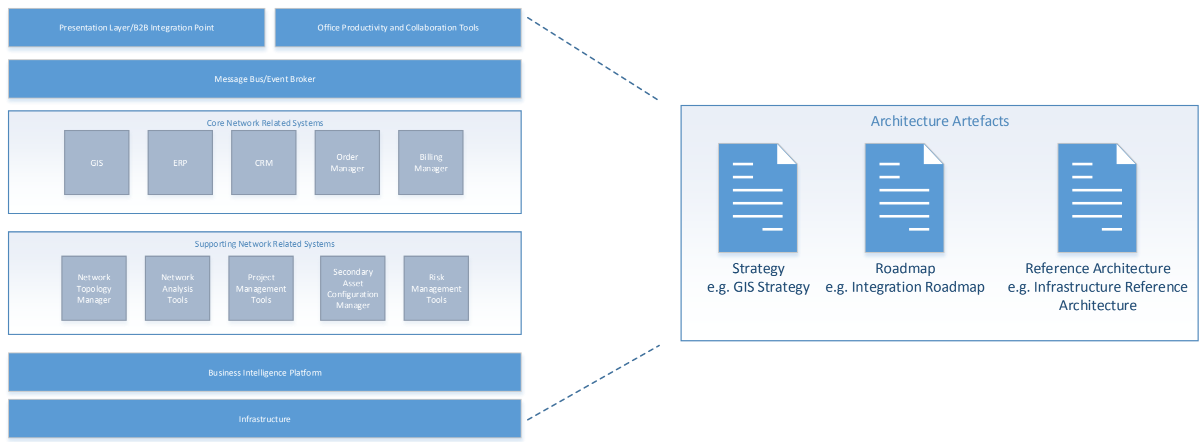

Figure 7-6 : Architecture Artefacts

These "Architecture Artefacts" are used to inform the investment planning for each Information Technology System and Infrastructure Component.

Financial modelling is also used in addition to these artefacts to ensure that IT investment decision making takes into account financial constraints such as total cost of ownership and IT asset depreciation.

7.5 Core Network Related Systems Planning

7.5.1 GIS

Vector's Geospatial Information (GIS) Systems Strategy is to ensure that all GIS solutions are fit for purpose and cost effective to maintain. Fit for Purpose GIS Solutions will allow Vector to leverage its spatial information assets without the systems becoming overly complex and costly. It will enable Vector to use its spatial information assets to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for GIS in the context of Gas Distribution is to maintain the current platform, GE Smallworld, whilst investing in supporting technology components that will enable Vector to leverage its spatial information, for example integration and web viewing.

7.5.2 ERP

Vector's Enterprise Resource Planning (ERP) Systems Strategy is to ensure that all ERP solutions are fit for purpose and cost effective to maintain. Fit for Purpose ERP Solutions will allow Vector to leverage its asset information without the systems becoming overly complex and costly. It will enable Vector to use its asset information to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for ERP in the context of Gas Distribution is to maintain the current platform, SAP (Plant Maintenance), whilst investing in supporting integration components.

7.5.3 CRM

Vector's Customer Relationship Management (CRM) Systems Strategy is to ensure that all CRM solutions are used "as designed" with the minimal amount of customisation. "As Designed" CRM Solutions will allow Vector to better serve its customers without the systems becoming overly complex and costly. It will enable Vector to interact with its customers effectively and efficiently so as to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for CRM in the context of Gas Distribution is to instigate a review of the way the Siebel is used throughout the business and based on that review identify opportunities to improve the way the system used, and upgrade/replace components and customisations as required.

7.5.4 Order Manager

Vector's Order Manager Systems Strategy is to ensure that all Order Management solutions are used "as designed" with the minimal amount of customisation. "As Designed" Order Management Solutions will allow Vector to better fulfil its customers' requirements without the systems becoming overly complex and costly. It will enable Vector to interact with its customers effectively and efficiently so as to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Order Manager in the context of Gas Distribution is to instigate a review of the way the Siebel is used throughout the business and based on that review identify opportunities to improve the way the system used, and upgrade/replace components and customisations as required.

7.5.5 Billing Manager

Vector's Billing Manager Systems Strategy is to ensure that all Billing Management solutions are used "Fit for Purpose" for the billing requirements of the business. "Fit for Purpose" Billing Management Solutions will allow Vector to better control its billing processes without the systems becoming overly complex and costly. It will enable Vector execute its billing processes effectively and efficiently so as to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Billing Manager in the context of Gas Distribution is to instigate a review of the way the Gentrack is used throughout the business and based on that review identify opportunities to improve the way the system used, and upgrade/replace components and customisations as required.

7.6 Supporting Network Related Systems Planning

7.6.1 Network Topology Manager

Vector's Network Topology Manager Systems Strategy is to ensure that all Network Topology Management solutions are "Fit for Purpose" and governable. "Fit for Purpose" Network Topology Management Solutions will allow Vector to optimise its network planning and operation processes. It will enable Vector to maintain its high standards of network planning and management so as to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Network Topology Manager in the context of Gas Distribution is to complete the current review of the systems and processes that are used throughout the business and based on that review identify opportunities to improve the way these systems used, and upgrade/replace components as required.

7.6.2 Network Analysis Tools

Vector's Network Analysis Tools Strategy is to ensure that all Network Analysis solutions are "Fit for Purpose". "Fit for Purpose" Network Analysis Solutions will allow Vector to optimise its network planning and operation processes. It will enable Vector to maintain its high standards of network planning and management so as to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Network Analysis Tools in the context of Gas Distribution continue to use the current Network Analysis Tools and processes. There will be a "fit-for-purpose" Data Historian solution that will be selected as part of the next steps in the planning process.

7.6.3 Project Management Tools

Vector's Project Management Tools Strategy is to continue to use the current toolset, that is, MS Project Server while ensureing that it is still "fit-for-purpose" through regular reviews and upgrades.

7.6.4 Secondary Asset Configuration Manager

Vector's Secondary Asset Configuration Manager Strategy is to maintain the current fit for purpose toolset, that is, the current Device specific software tools.

7.6.5 Risk Management Tools

Vector's Risk Management Tools Strategy is to maintain the current toolset for Risk Analysis and Incident Management and implement a new platform for Risk, Audit and Compliance. The current toolset for Risk Analysis is Bow Tie, the current platform for Incident Management is Kairos/RIMS. The new toolset for Risk, Audit and Compliance is ARM which is under implementation.

7.7 Supporting IT Infrastructure Systems

7.7.1 Presentation Layer/B2B Integration

Vector's Presentation Layer/B2B Integration Strategy is to implement a consistent, cost effective, and supportable Portal and B2B technology set that will allow the Vector to expose the functionality of its systems to the appropriate stakeholders.

The roadmap for Presentation Layer/B2B Integration in the context of Gas Distribution is to migrate from our existing Portal Platform based on Liferay, to a CMS based portal solution. Vector will then migrate all relevant Intranet and Extranet sites onto the new platform. Alongside this Vector will continue to extend our B2B platform based on UltraESB and the migration of its current B2B interfaces onto that new platform.

7.7.2 Message Bus/Event Broker

Vector's Integration Strategy is to ensure that all systems integration solutions are user requirements lead, cost effective, and maintainable. User Requirements Lead Integration Solutions will allow Vector to leverage its information assets across its systems without the integration component becoming overly complex and costly. It will enable Vector to leverage the benefits of an integrated systems environment to achieve our customer & regulatory outcomes, increase our operational efficiency, to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Integration in the context of Gas Distribution is to continue to use the current UltraESB platform. All current integration points between corporate systems will continue to be migrated to this platform over time. The Real-time Integration Bus used in the operational technology environment will continue to be maintained as the strategic integration platform for network device integration.

7.7.3 Office Productivity and Collaboration Tools

Vector's Office Productivity and Collaboration Tools Strategy is to maintain the current fit for purpose toolset, that is, MS Office and MS SharePoint. Vector will migrate all Records Management functionality and information off EMC Documentum over the next year and onto MS SharePoint. EMC Documentum will be retired once this migration is complete. Cloud options are currently being assessed and it is possible that some of the minor office productivity solutions may be migrated into a cloud solution.

7.7.4 Business Intelligence

Vector's Business Intelligence Strategy is to ensure that all Business Intelligence solutions are business requirements lead, cost effective, and maintainable. Requirements Lead Business Intelligence Solutions will allow Vector to report on its day to day operations effective and optimise the mechanisms that it uses to fulfil its compliance reporting obligations. It will enable Vector to understand the details of its operations and inform decision making relating to the achievement of our customer & regulatory outcomes, improvements in operational efficiency, and enable Vector to identify opportunities for disciplined growth and improvements in our cost efficiency.

The roadmap for Business Intelligence in the context of Gas Distribution is maintain and extend the use of the MS SQL Server platform and toolset. Visualisation tools will also be introduced over time as the tools and platform become embedded in the way reporting is performed by the business.

7.7.5 IT Infrastructure Strategy

Vector's IT Infrastructure Strategy is to maintain the current fit for purpose IT infrastructure environment which includes servers, network hardware, security specific hardware/software, operating systems, and other supporting infrastructure tools. The infrastructure will be invested in to ensure that it is able to support the growth of Vector but not exceed the actual infrastructure requirements. It is likely that Vector may need to assess its data centre investments at the 5 year point and decide whether or not investing in another data centre is necessary.

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Risk Management– Section 8

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8 Risk Management

Vector's goal is to maintain robust and innovative risk management practices, consistent with the ISO31000 standard and implement those practices in a manner appropriate for a leading New Zealand publicly-listed company that supplies critical infrastructure and manages potentially hazardous products.

Risk and assurance management also underpins Vector's ability to meet its compliance obligations. Vector takes this responsibility seriously and has effective risk management processes in place covering hazard identification, risk assessment and the monitoring and review of hazards.

8.1 Enterprise Risk Management

Risk management is integral to Vector's asset management process and core operational capabilities. Vector's risk management policy sets out the company's intentions and directions with respect to risk management, including its objectives and rationale around decision making.

Vector's Enterprise Risk Management (ERM) framework provides the method and processes to be applied Vector-wide to manage risk and assess opportunities against the company's objectives. The framework is based on AS/NZS ISO31000:2009 and is illustrated in Figure 8-1 below.

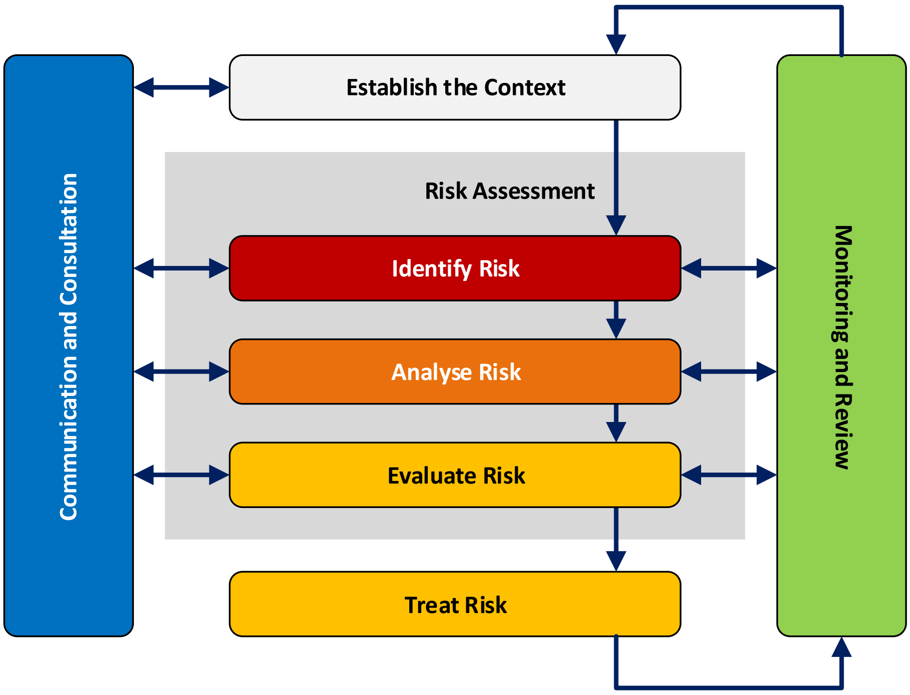

Figure 8-1 : Vector's risk management process (based on ISO31000: 2009)

The level of a risk is determined by considering the combination of the "likelihood" (i.e. rare, unlikely, likely or almost certain) and "consequences" (i.e. minor, moderate, major or catastrophic) of the risk occurring, given its existing controls, and applying the risk matrix assessment (a 4x4 heat map) in Figure 8-2, below.

	Minor	Moderate	Major	Catastrophic
Almost Certain	M	H	VH	VH
Likely	L	M	H	VH
Unlikely	L	M	H	VH
Rare	L	L	M	H

Very High	Risks significantly exceed Vector's risk appetite; immediate escalation for Board attention along with detailed treatment plans to reduce overall risk
High	Risks exceed Vector's risk appetite; escalation for Board attention along with detailed treatment plans to reduce overall risk
Medium	Risks within Vector's risk appetite; but active monitoring required by Management
Low	Risks that can be managed as part of business as usual

Figure 8-2 : Vector's risk assessment matrix

Best practice with respect to setting risk appetite starts with a top-down view from the board (which has an enterprise-wide perspective) in order to set the cultural context for the organisation. As the board holds the ultimate accountability for risk governance and oversight, this approach enables the board to facilitate the alignment of risk management to the group strategy.

Vector has controls in place to manage key risks and has internal review processes associated with these controls. A key component of the assurance process is Vector's internal audit programme which provides assurance around significant controls in the business including organisation-wide 'risk management' – for example, business continuity management. The Internal Audit programme is overseen by the BRAC (Board Risk and Assurance Committee).

8.1.1 Key Operational and Network Risks

Table 8-1 below outlines the most significant gas distribution risks Vector has identified in its asset management risk register. While control and mitigation measures are in place to address these (through various programmes of work and capital projects), work is always ongoing to improve the controls and to ensure they remain effective. Sections 5 and 6 of this AMP provides details on Vector's key operational and network risk mitigation measures, and further discussion on high impact low probability risks, such as tsunami and volcanic risks.

Risk Type	Summary Risk Description	Original Risk	Current Risk	Target Risk
Operational	Serious harm to customers, public or staff	Very High	High	High
Operational	Network disruption	Very High	High	High

Network	Pre 1985 polyethylene pipelines	Very High	High	Medium
Network	Steel systems without cathodic protection	High	High	Medium
Network	Touch voltages on steel pipelines due to the close proximity of pipelines to power transmission equipment	High	High	Medium
Network	Gas pipes into and/or under buildings	Very High	Medium	Medium
Network	Regulator station failure	Very High	High	Medium
Network	System pressure drop below acceptable levels	Very High	High	High
Network	Inability to isolate gas supply	Very High	Medium	Medium
Network	System pressure above acceptable levels	High	Medium	Medium
Network	Stainless steel pipelines	High	Medium	Medium
Network	Service regulator failure	High	High	Medium
Network	Nylon pipelines	High	Medium	Medium

Table 8-1 : Vector's key operational and network risks

8.1.2 Projects & Initiatives

Vector continues to look to enhance the integration of the risk management process into its core planning and prioritisation activities. It is recognised that many of the risk control or mitigation measures require capital investments that is largely driven by risk-associated factors.

Anticipated asset and infrastructure risks identified in the risk register that can be treated by capital investment are included in the 10 year capital works programme (capital expenditure forecasts). Other residual risks are controlled / mitigated through a maintenance programme of works. These projects are part of the corrective or reactive maintenance programme.

8.2 Emergency Response and Contingency Plans

Vector has a number of plans to cover emergency situations. These plans are reviewed and updated regularly to ensure they are current. The more pertinent of these plans are further described below.

8.2.1 Emergency Response Plan

The purpose of the emergency response plan is to ensure Vector is prepared for, and responds quickly to, any major incident that occurs or may occur on the gas distribution network. The plan describes the actions required and the responsibilities of staff during a major incident.

A key component of the plan is the formation of the emergency response team. This team includes senior staff who are required to oversee the management of potential loss (and restoration) of supply following a significant event. The team undertakes exercises periodically, at least biennially.

This plan will be reviewed biennially to ensure there is continuous improvement and a standardised approach to all operational incidents across the group.

8.2.2 Business Continuity Management

Business continuity management (BCM) is integral to Vector's risk management framework. BCM provides the support the organisation needs to respond to, and be prepared for, any disruptive or critical incidents that might otherwise prevent Vector from achieving its objectives.

To achieve this, Vector strives to ensure that its BCM aims to:

- Ensure the continuity of critical business functions;
- Establish controls, processes and procedures to improve business continuity and to deliver results;
- Monitor and review performance against the policy objectives so that any necessary remedial actions can take place;
- Provide testing and training on a cyclical basis to help keep staff, roles and responsibilities up to date and prepared;
- Integrate BCM within wider corporate risk management approaches, policies, and procedures; and
- Ensure that Vector's approach is consistent with the following:
  - Australian / New Zealand Standard AS/NZ 5050/2010 Business Continuity – Managing disruption-related risk;
  - Civil Defence and Emergency Management (CDEM) Act 2002
  - AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines.

The overall BCM framework and plan is developed and monitored by the Chief Risk Officer. Vector's overall BCM capability and programme activities are overseen by the ERAC.

The head of each business and functional unit is responsible for maintaining the appropriate BCM capability and compliance requirements for their areas. All employees are responsible for contributing to the maintenance of the BCM capability and to assist with the emergency/crisis response and recovery efforts in a real situation.

With respect to individual Business Continuity Plans (BCP) Vector's policies require appropriate governance aspects to be in place as well as each plan to have certain components.

Call Centre Business Continuity Plan

Vector's call centre provider is Telnet Services. Telnet's business relies heavily on various computer and telephony technologies that, by their very nature, have the potential to fail.

The purpose of the call centre BCP is to assess the potential risks and planned workarounds for those risks in order that Telnet's core business can continue in the event of any failure or disaster. In addition to the general BCP strategy employed at Telnet, there are a number of specific provisions as part of Telnet's relationship with Vector to provide additional services to ensure the continuity of service is maintained, specifically the handling of safety critical and emergency calls.

8.2.3 Crisis Management Plan

The crisis management plan (CMP) identifies procedures for a crisis affecting Vector, its customers and/or its employees, contractors and other stakeholders. The plan and procedures outlined in this document identify how Vector will manage the consequences of a crisis. It is designed to establish clear lines of communication and reporting, as well as action guidelines for the Vector Group.

The CMP is an “all hazards” plan as it encompasses the management of all possible crisis events. While the CMP procedures have been developed to cover a broad set of circumstances, Vector is mindful that every crisis has its own unique set of circumstances. Thus, each crisis relies on the good judgement of Vector employees to tailor the response and management to what is most appropriate given the circumstances at hand.

The CMP is not intended to cover operational emergency response requirements, as these are covered by the relevant emergency response plans – Vector has individual emergency response plans for major events. Together the CMP plan and emergency response plans better enable staff to fulfil their roles as efficiently and safely as possible, and to ensure the wider public implications of an emergency are identified and addressed.

Crisis Communication Plan

Vector’s crisis communications plan aims to ensure that it is prepared to manage unforeseen events and gain, or retain, public confidence in its management of the situation and is part of the overarching CMP.

The Plan seeks to achieve this by ensuring that in any emergency, crisis or business continuity event affecting Vector, Vector's customers, the affected community and other stakeholders are kept well-informed and up-to-date of:

- The status of the crisis;
- Any actions they can or should take to mitigate the effect or consequences of the emergency / crisis;
- When the situation is expected to be (or is) resolved;
- Updates to the above to reflect any changes to the situation; and
- Post-crisis debriefs or any follow up information.

The plan is designed as a template that can be tailored to the management response requirements determined by the particular nature of the emergency, crisis or business continuity event. It is designed to provide a consistent, robust and scalable approach to communications.

8.2.4 Civil Defence and Emergency Management

As a “lifeline utility” under the Civil Defence and Emergency Management Act 2002 (CDEM), Vector is required to be “able to function to the fullest possible extent, even if this may be at a reduced level, during and after an emergency”. Vector also is required to have plans regarding how it will function during and after an emergency and to participate in the development of a CDEM strategy and BCPs.

As discussed above, Vector has a number of BCPs in place as well as an overall crisis plan. Vector participates in CDEM emergency exercises on a regular basis to ensure CDEM protocols are understood, as well as to test aspects of Vector emergency and BCP plans.

Vector is a member of the Auckland Lifelines Group (ALG). Membership in the ALG helps ensure Vector keeps abreast of developments in the CDEM area and that it is fully prepared for emergencies arising from identified threats including volcanic eruption, tsunami, earthquake, tropical cyclones and storms, both in general and in particular as they relate to Auckland where it has network assets.

A key area of focus for Vector is to better utilise information from the ALG.

Vector is also a member of the National Engineering Lifelines Committee and keeps abreast of national issues and initiatives through this forum.

Gas Distribution
Asset Management Plan
2016 – 2026

Summary of Expenditure Forecast –
Section 9

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9 Financial Performance and Forecasts

This section describes the capital and operational expenditure forecasts for the gas distribution network assets for the next 10 year planning period (2016-2026), and provides a comparison with the 10 year forecast prepared and disclosed in the 2015 AMP (disclosed in June 2015).

9.1 Capital Expenditure

Vector's gas distribution capital expenditure forecast for the next ten financial years (ending 30th June) is presented in Table 9-1. The figures are presented in 2017 prices to reflect the expenditure level of this works programme to be implemented during the planning period. Table 9-2 below shows the difference between the 2015 AMP and the 2016 AMP expenditure forecasts by expenditure categories. The 2015 forecast has been inflation adjusted (using a PPI of 1.8%[1]) to enable comparison with the 2016 figures.

[1] Refer to Table 9-5: Inflation factors

2016 AMP	Financial Year ($000)										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Consumer connection	17,245	14,420	14,543	14,812	14,951	15,083	15,135	14,878	15,052	15,236	151,355
System growth	1,018	1,327	1,687	818	1,663	460	530	1,120	1,120	460	10,203
Asset replacement and renewal	1,680	1,300	1,225	1,725	1,725	1,725	1,725	1,725	1,725	1,725	16,280
Asset relocations	2,324	3,020	2,340	2,964	2,096	1,488	1,760	1,760	1,760	1,760	21,272
Quality of supply	263	386	408	527	200	139	0	0	0	0	1,923
Legislative and regulatory	0	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	241	210	210	0	0	0	0	0	0	0	661
Capital Expenditure on network assets	**22,771**	**20,663**	**20,414**	**20,847**	**20,635**	**18,895**	**19,150**	**19,483**	**19,657**	**19,181**	**201,696**
Non Network Assets	1,270	1,735	1,380	1,459	1,743	1,556	1,540	1,773	1,581	1,480	15,517
Capital Expenditure on assets	**24,040**	**22,398**	**21,793**	**22,306**	**22,378**	**20,450**	**20,691**	**21,256**	**21,237**	**20,661**	**217,210**

* Figures are in 2017 real New Zealand dollars

Table 9-1 : Capital expenditure forecast for Vector

2015/2016 AMP Variances	Financial Year ($000)									
	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Consumer connection	3,603	915	2,233	2,336	2,467	2,754	2,620	2,123	2,211	21,261
System growth	-658	745	1,059	-2,213	-1,097	-1,660	11	-71	-71	-3,955
Asset replacement and renewal	393	140	65	56	56	56	56	56	56	934
Asset relocations	-335	341	-399	328	-562	-1,170	-982	-982	-982	-4,745
Quality of supply	182	171	232	487	159	2	-41	-41	-41	1,110
Legislative and regulatory	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	-65	210	210	0	0	0	0	0	0	355
Capital Expenditure on network assets	**3,118**	**2,522**	**3,399**	**993**	**1,023**	**-19**	**1,664**	**1,086**	**1,173**	**14,960**
Non Network Assets	52	271	223	237	285	253	246	286	182	2,035
Capital Expenditure on assets	**3,170**	**2,793**	**3,623**	**1,230**	**1,308**	**234**	**1,910**	**1,372**	**1,355**	**16,995**

* Figures are in 2017 real New Zealand dollars

Table 9-2: Variances between 2015 and 2016 capital expenditure forecast

9.1.1 Explanation of Major Variances in Capital Expenditure

This section highlights the significant changes to the 2016 disclosed capital expenditure forecasts. The major changes in the annual capital expenditure for which the 2015 AMP and the 2016 AMP overlap, reflect:

- $2.4 million per annum increase in consumer connection expenditure forecast due to an increase in connection costs (reflecting the latest estimate), and the anticipated new requests for consumer connections in the Auckland region;
- $0.4 million per annum decrease in system growth expenditure due to improved network modelling resulting in a reduction in the provisional expenditure for reinforcement projects, and the deferment of a reinforcement project in East Auckland;
- $0.1 million per annum increase in asset replacement and renewal replacement of a cast iron pipeline in Mt Wellington and an increase in the cost of new district regulator stations (reflecting the latest estimate);
- $0.5 million per annum decrease in asset relocation expenditure reflecting the latest estimate of relocation activity;
- $0.1 million per annum increase in quality of supply expenditure due to additional telemetry replacements and additional valve installations required at a number of district regulators stations; and
- $0.2 million per annum increase in non-network costs due largely to the proportionally greater resources necessary to support the business given the lost economies of scale from the sale of Vector's gas transmission and non-Auckland gas distribution networks.

9.2 Operational Expenditure Forecast

Vector’s gas distribution operational forecast for the next ten financial years (ending 30th June) is presented in Table 9-3. Table 9-4 below shows the difference between the 2015 and 2016 expenditure forecasts by expenditure categories. The 2015 forecast has been inflation adjusted (using a PPI of 1.8%) to enable comparison with the 2016 figures.

2016 AMP	Financial Year ($000)										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Service interruptions, incidents and emergencies	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	1,991	19,910
Routine and corrective maintenance and inspection	2,496	2,499	2,501	2,504	2,507	2,510	2,513	2,515	2,518	2,521	25,084
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0	0
System operations and network support	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	3,074	30,740
Business support	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	4,412	44,120
Total Operational Expenditure	**11,974**	**11,977**	**11,979**	**11,982**	**11,985**	**11,988**	**11,991**	**11,993**	**11,996**	**11,999**	**119,864**

* Figures are in 2017 real New Zealand dollars

Table 9-3: Operational Expenditure Forecast for Vector

2015/2016 AMP Variances	Financial Year ($000)									
	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Service interruptions incidents and emergencies	112	112	112	112	112	112	112	112	112	1,008
Routine and corrective maintenance and inspection	-96	-95	-94	-93	-92	-91	-90	-89	-87	-827
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0
System operations and network support	-4,642	-4,642	-4,642	-4,642	-4,642	-4,642	-4,642	-4,642	-4,642	-41,780
Business support	3,981	3,981	3,981	3,981	3,981	3,981	3,981	3,981	3,981	35,833
Total Operational Expenditure	**-645**	**-644**	**-643**	**-642**	**-641**	**-640**	**-639**	**-637**	**-636**	**-5,766**

* Figures are in 2017 real New Zealand dollars

Table 9-4: Variances between 2015 and 2016 operational expenditure forecast

9.2.1 Explanation of Major Variances in Operational Expenditure

This section highlights the significant changes to the 2016 disclosed operational expenditure forecasts[2]. The major changes in the annual operational expenditure for which the 2015 AMP and the 2016 AMP overlap, reflect:

- $0.1 million per annum increase in service interruption costs due the increase in the geographical boundaries of vector's gas distribution networks, resulting from the sale of the non-Auckland assets to First Gas Limited;
- $0.1 million per annum reduction in routine and corrective maintenance costs due to improved leakage survey methods being adopted across the gas distribution networks;
- On 20 April 2016 Vector sold 100% of Vector Gas, which owned the gas transmission network and the gas distribution network outside of Auckland. Approximately 130 staff responsible for operating these networks transferred with the business to the new owner, First Gas.

  As a result of the sale, Vector's corporate/shared services costs have reduced, particularly in relation to insurance, information technology and professional services costs that will no longer be incurred. However as at 30 June 2016, Vector was continuing to provide a number of transitional services to the First Gas in respect of network management, information technology, regulatory and finance. Once these transitional services are complete (sometime in the regulatory year ending 30 June 2017), we would expect Vector's corporate cost base will reduce further.

  Despite the reduction in Vector's overall corporate cost base, the quantum of this cost allocated to Vector's Auckland gas network has increased directly as a result of the sale. This is due to loss of significant economies of scale that Vector enjoyed in managing multiple networks. A number of the corporate functions undertaken by Vector will not scale as a result of the sale of Vector Gas, for example the Vector board and executive team will remain unchanged and the regulatory compliance burden associated with gas distribution will not change despite the fact that our gas distribution business is now significantly smaller.

  Despite the sale of Vector Gas, in some areas the Vector corporate team is increasing in size, as a result of an ever increasing focus on health and safety, increasing demands for improved cyber security, and as a direct result of the significant challenges in responding to unprecedented growth in Auckland. Growth in Auckland over the next 10 years is expected to more than replace the Vector Gas RAB that has been sold to First Gas. As a result, any corporate costs savings as a result of the sale of Vector Gas are unlikely to be sustained in the long term.

9.3 Price Escalation Factors

Vector is required under Clause 2.6 of the Gas Distribution Information Disclosure Determination 2012 (consolidated in 2015) to disclose its Forecast Capital and Operational Expenditure as set out in Schedules 11a and 11b. Schedules 11a and 11b require the expenditure forecasts to be presented in both constant price and nominal terms.

Clause 3.9 of the Attachment A of the Gas Distribution Information Disclosure Determination 2012 (consolidated in 2015) requires the assumptions used in the price

[2] The figures are inflation adjusted.

inflator to be recorded in the AMP. Table 9-5 below shows the price inflation factors used to convert constant price forecasts to nominal forecasts[3].

Financial Year	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY25	FY26
Inflation Factor	1.3%	1.8%	1.8%	1.9%	2.0%	2.2%	2.2%	2.2%	2.2%	2.2%

Table 9-5: Inflation factors

[3] Source: NZIER (New Zealand Institute of Economic Research) March 2016 PPI (Producer Price Index-inputs)

Gas Distribution Asset Management Plan 2016 – 2026

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Gas Distribution Asset Management Plan 2016 – 2026

Appendix 1

Schedule 11a: Report on Forecast Capital Expenditure

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2016 – 30 June 2026**

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)
GDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
8	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**	**30 Jun 24**	**30 Jun 25**	**30 Jun 26**
9	**11a(i): Expenditure on Assets Forecast**	**$000 (nominal dollars)**										
10	Consumer connection	16,512	17,197	14,640	15,040	15,628	16,119	16,621	17,045	17,124	17,705	18,317
11	System growth	570	1,011	1,342	1,737	860	1,785	505	594	1,284	1,312	551
12	Asset replacement and renewal	1,626	1,673	1,318	1,265	1,817	1,857	1,898	1,940	1,983	2,026	2,071
13	Asset relocations	2,134	2,304	3,048	2,405	3,108	2,247	1,629	1,970	2,013	2,057	2,103
14	Reliability, safety and environment:											
15	Quality of supply	-	263	393	423	558	217	154	-	-	-	-
16	Legislative and regulatory	76	-	-	-	-	-	-	-	-	-	-
17	Other reliability, safety and environment	142	238	211	215	-	-	-	-	-	-	-
18	**Total reliability, safety and environment**	218	501	604	638	558	217	154	-	-	-	-
19	**Expenditure on network assets**	21,060	22,686	20,952	21,085	21,971	22,225	20,807	21,549	22,404	23,100	23,042
20	Expenditure on non-network assets	734	1,256	1,747	1,415	1,527	1,864	1,700	1,720	2,025	1,845	1,764
21	**Expenditure on assets**	21,794	23,942	22,699	22,500	23,498	24,089	22,507	23,269	24,429	24,945	24,806
22												
23	*plus* Cost of financing	86	98	104	98	101	106	91	96	105	105	101
24	*less* Value of capital contributions	3,967	3,975	4,685	4,136	4,864	4,126	3,616	3,991	4,035	4,148	4,270
25	*plus* Value of vested assets	-	-	-	-	-	-	-	-	-	-	-
26	**Capital expenditure forecast**	17,913	20,065	18,118	18,462	18,735	20,069	18,982	19,374	20,499	20,902	20,637
27												
28	Assets commissioned	18,455	20,567	18,119	18,466	18,736	20,070	18,983	19,376	20,499	20,903	20,638
29												
30		*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
31	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**	**30 Jun 24**	**30 Jun 25**	**30 Jun 26**
32		**$000 (in constant prices)**										
33	Consumer connection	16,512	16,900	14,131	14,251	14,516	14,650	14,781	14,832	14,580	14,750	14,931
34	System growth	570	994	1,295	1,646	799	1,623	449	517	1,093	1,093	449
35	Asset replacement and renewal	1,626	1,644	1,272	1,199	1,688	1,688	1,688	1,688	1,688	1,688	1,688
36	Asset relocations	2,134	2,264	2,942	2,279	2,887	2,042	1,449	1,714	1,714	1,714	1,714
37	Reliability, safety and environment:											
38	Quality of supply	-	258	379	401	518	197	137	-	-	-	-
39	Legislative and regulatory	76	-	-	-	-	-	-	-	-	-	-
40	Other reliability, safety and environment	142	234	204	204	-	-	-	-	-	-	-
41	**Total reliability, safety and environment**	218	492	583	605	518	197	137	-	-	-	-
42	**Expenditure on network assets**	21,060	22,294	20,223	19,980	20,408	20,200	18,504	18,751	19,075	19,245	18,782
43	Expenditure on non-network assets	734	1,234	1,686	1,341	1,418	1,694	1,512	1,497	1,724	1,537	1,438
44	**Expenditure on assets**	21,794	23,528	21,909	21,321	21,826	21,894	20,016	20,248	20,799	20,782	20,220
45	**Subcomponents of expenditure on assets (where known)**											
46	Research and development	-	-	-	-	-	-	-	-	-	-	-

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
for year ended	30 Jun 16	30 Jun 17	30 Jun 18	30 Jun 19	30 Jun 20	30 Jun 21	30 Jun 22	30 Jun 23	30 Jun 24	30 Jun 25	30 Jun 26
Difference between nominal and constant price forecasts	**$000**										
Consumer connection	-	297	509	789	1,112	1,469	1,840	2,213	2,544	2,955	3,386
System growth	-	17	47	91	61	162	56	77	191	219	102
Asset replacement and renewal	-	29	46	66	129	169	210	252	295	338	383
Asset relocations	-	40	106	126	221	205	180	256	299	343	389
Reliability, safety and environment:											
Quality of supply	-	5	14	22	40	20	17	-	-	-	-
Legislative and regulatory	-	-	-	-	-	-	-	-	-	-	-
Other reliability, safety and environment	-	4	7	11	-	-	-	-	-	-	-
Total reliability, safety and environment	-	9	21	33	40	20	17	-	-	-	-
Expenditure on network assets	-	392	729	1,105	1,563	2,025	2,303	2,798	3,329	3,855	4,260
Expenditure on non-network assets	-	22	61	74	109	170	188	223	301	308	326
Expenditure on assets	-	414	790	1,179	1,672	2,195	2,491	3,021	3,630	4,163	4,586

11a(ii): Consumer Connection

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	30 Jun 16	30 Jun 17	30 Jun 18	30 Jun 19	30 Jun 20	30 Jun 21
*Consumer types defined by GDB**	**$000 (in constant prices)**					
Mains Extensions/Subdivisions	6,526	7,116	3,955	4,024	4,060	4,087
Service Connections - Residential	8,518	8,525	8,871	8,946	9,178	9,290
Service Connections - Commercial	1,468	1,230	1,276	1,252	1,249	1,244
Customer Easements	-	29	29	29	29	29
** include additional rows if needed*						
Consumer connection expenditure	16,512	16,900	14,131	14,251	14,516	14,650
less Capital contributions funding consumer connection	1,986	1,805	1,792	1,804	1,838	1,855
Consumer connection less capital contributions	14,526	15,095	12,339	12,447	12,678	12,795

11a(iii): System Growth

Intermediate pressure						
Main pipe	-	-	-	-	-	-
Service pipe	-	-	-	-	-	-
Stations	131	234	302	907	605	302
Line valve	-	-	-	-	-	-
Special crossings	-	-	-	188	-	-
Intermediate Pressure total	131	234	302	1,095	605	302
Medium pressure						
Main pipe	438	701	934	443	135	1,262
Service pipe	-	-	-	-	-	-
Stations	1	-	-	-	-	-
Line valve	-	-	-	-	-	-
Special crossings	-	-	-	49	-	-
Medium Pressure total	439	701	934	492	135	1,262

92	**Low Pressure**						
93	Main pipe	-	-	-	-	-	-
94	Service pipe	-	-	-	-	-	-
95	Line valve	-	-	-	-	-	-
96	Special crossings	-	-	-	-	-	-
97	**Low Pressure total**	-	-	-	-	-	-
98	**Other network assets**						
99	Monitoring and control systems	-	59	59	59	59	59
100	Cathodic protection systems	-	-	-	-	-	-
101	Other assets (other than above)	-	-	-	-	-	-
102	**Other network assets total**	-	59	59	59	59	59
103							
104	**System growth expenditure**	570	994	1,295	1,646	799	1,623
105	*less* Capital contributions funding system growth	-	-	-	-	-	-
106	**System growth less capital contributions**	570	994	1,295	1,646	799	1,623
107							
108							
109		*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**
110	**11a(iv): Asset Replacement and Renewal**						
111	**Intermediate pressure**	**$000 (in constant prices)**					
112	Main pipe	-	-	-	-	-	-
113	Service pipe	-	-	-	-	-	-
114	Stations	277	303	303	303	303	303
115	Line valve	-	-	-	-	-	-
116	Special crossings	65	98	49	49	49	49
117	**Intermediate Pressure total**	342	401	352	352	352	352
118	**Medium pressure**						
119	Main pipe	760	822	587	587	1,076	1,076
120	Service pipe	20	88	-	-	-	-
121	Station	53	98	98	98	98	98
122	Line valve	48	-	-	-	-	-
123	Special crossings	-	-	-	-	-	-
124	**Medium Pressure total**	881	1,008	685	685	1,174	1,174
125	**Low Pressure**						
126	Main pipe	-	-	-	-	-	-
127	Service pipe	-	-	-	-	-	-
128	Line valve	-	-	-	-	-	-
129	Special crossings	-	-	-	-	-	-
130	**Low Pressure total**	-	-	-	-	-	-

Other network assets						
Monitoring and control systems	52	-	-	-	-	-
Cathodic protection systems	101	142	142	69	69	69
Other assets (other than above)	250	93	93	93	93	93
Other network assets total	403	235	235	162	162	162
Asset replacement and renewal expenditure	1,626	1,644	1,272	1,199	1,688	1,688
less Capital contributions funding asset replacement and renewal	-	-	-	-	-	-
Asset replacement and renewal less capital contributions	1,626	1,644	1,272	1,199	1,688	1,688

11a(v): Asset Relocations

*Project or programme**						
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
** include additional rows if needed*						
All other projects or programmes - asset relocations	2,134	2,264	2,942	2,279	2,887	2,042
Asset relocations expenditure	2,134	2,264	2,942	2,279	2,887	2,042
less Capital contributions funding asset relocations	1,981	2,138	2,778	2,153	2,727	1,928
Asset relocations less capital contributions	153	126	164	126	160	114

11a(vi): Quality of Supply

	Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**
*Project or programme**	**$000 (in constant prices)**					
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
** include additional rows if needed*						
All other projects or programmes - quality of supply	-	258	379	401	518	197
Quality of supply expenditure	-	258	379	401	518	197
less Capital contributions funding quality of supply	-	-	-	-	-	-
Quality of supply less capital contributions	-	258	379	401	518	197

169	**11a(vii): Legislative and Regulatory**						
170	*Project or programme*						
171		-	-	-	-	-	-
172		-	-	-	-	-	-
173		-	-	-	-	-	-
174		-	-	-	-	-	-
175		-	-	-	-	-	-
176	** include additional rows if needed*						
177	All other projects or programmes - legislative and regulatory	76	-	-	-	-	-
178	**Legislative and regulatory expenditure**	76	-	-	-	-	-
179	*less* Capital contributions funding legislative and regulatory	-	-	-	-	-	-
180	**Legislative and regulatory less capital contributions**	76	-	-	-	-	-
181	**11a(viii): Other Reliability, Safety and Environment**						
182	*Project or programme**						
183		-	-	-	-	-	-
184		-	-	-	-	-	-
185		-	-	-	-	-	-
186		-	-	-	-	-	-
187		-	-	-	-	-	-
188	** include additional rows if needed*						
189	All other projects or programmes - other reliability, safety and environment	142	234	204	204	-	-
190	**Other reliability, safety and environment expenditure**	142	234	204	204	-	-
191	*less* Capital contributions funding other reliability, safety and environment	-	-	-	-	-	-
192	**Other Reliability, safety and environment less capital contributions**	142	234	204	204	-	-
193							
194	**11a(ix): Non-Network Assets**						
195	**Routine expenditure**						
196	*Project or programme**						
197		-	-	-	-	-	-
198		-	-	-	-	-	-
199		-	-	-	-	-	-
200		-	-	-	-	-	-
201		-	-	-	-	-	-
202	** include additional rows if needed*						
203	All other projects or programmes - routine expenditure	552	1,068	1,459	1,160	1,227	1,466
204	**Routine expenditure**	552	1,068	1,459	1,160	1,227	1,466
205	**Atypical expenditure**						
206	*Project or programme**						
207		-	-	-	-	-	-
208		-	-	-	-	-	-
209		-	-	-	-	-	-
210		-	-	-	-	-	-
211		-	-	-	-	-	-
212	** include additional rows if needed*						
213	All other projects or programmes - atypical expenditure	182	166	227	181	191	228
214	**Atypical expenditure**	182	166	227	181	191	228
215							
216	**Expenditure on non-network assets**	734	1,234	1,686	1,341	1,418	1,694

Schedule 11a Explanatory Notes

The box below provides commentary specific to the difference between nominal and constant price capital expenditure for the current disclosure year and the 10 year planning period. It is provided in the same format as required for Box 1, Schedule 14a of the Gas Distribution Information Disclosures, which will be fully disclosed within 6 months of the end of the disclosure year.

Commentary on difference between nominal and constant price capital expenditure forecasts Vector has used the NZIER (New Zealand Institute of Economic Research) March 2016 PPI (Producer Price Index-outputs) forecast from 2016 to 2020. Thereafter we have assumed a long-term inflation rate of 2.20%. The constant price capital expenditure forecast is then inflated by the above mentioned PPI forecast to nominal price capital expenditure forecasts.

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Appendix 2

Schedule 11b: Report on Forecast Operational Expenditure

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2016 – 30 June 2026**

SCHEDULE 11b: REPORT ON FORECAST OPERATIONAL EXPENDITURE

This schedule requires a breakdown of forecast operational expenditure for the disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms.
GDBs must provide explanatory comment on the difference between constant price and nominal dollar operational expenditure forecasts in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref												
7		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
8	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**	**30 Jun 24**	**30 Jun 25**	**30 Jun 26**
9	**Operational Expenditure Forecast**	**$000 (in nominal dollars)**										
10	Service interruptions, incidents and emergencies	1,807	1,991	2,027	2,065	2,107	2,153	2,201	2,249	2,299	2,349	2,401
11	Routine and corrective maintenance and inspection	2,446	2,496	2,544	2,594	2,650	2,711	2,773	2,837	2,903	2,971	3,040
12	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
13	**Network opex**	4,253	4,487	4,571	4,659	4,757	4,864	4,974	5,086	5,202	5,320	5,441
14	System operations and network support	1,974	3,074	3,130	3,188	3,252	3,324	3,397	3,472	3,548	3,626	3,706
15	Business support	3,755	4,412	4,492	4,576	4,668	4,771	4,876	4,983	5,093	5,205	5,319
16	**Non-network opex**	5,729	7,486	7,622	7,764	7,920	8,095	8,273	8,455	8,641	8,831	9,025
17	**Operational expenditure**	9,982	11,973	12,193	12,423	12,677	12,959	13,247	13,541	13,843	14,151	14,466
18		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
19	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**	**30 Jun 24**	**30 Jun 25**	**30 Jun 26**
20		**$000 (in constant prices)**										
21	Service interruptions, incidents and emergencies	1,807	1,957	1,957	1,957	1,957	1,957	1,957	1,957	1,957	1,957	1,957
22	Routine and corrective maintenance and inspection	2,446	2,453	2,456	2,458	2,461	2,464	2,466	2,469	2,472	2,475	2,478
23	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
24	**Network opex**	4,253	4,410	4,413	4,415	4,418	4,421	4,423	4,426	4,429	4,432	4,435
25	System operations and network support	1,974	3,021	3,021	3,021	3,021	3,021	3,021	3,021	3,021	3,021	3,021
26	Business support	3,755	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336
27	**Non-network opex**	5,729	7,357	7,357	7,357	7,357	7,357	7,357	7,357	7,357	7,357	7,357
28	**Operational expenditure**	9,982	11,767	11,770	11,772	11,775	11,778	11,780	11,783	11,786	11,789	11,792
29	**Subcomponents of operational expenditure (where known)**											
30	Research and development	-	-	-	-	-	-	-	-	-	-	-
	Insurance	157	181	184	188	192	196	200	205	209	214	218
32												
33		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
34	for year ended	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**	**30 Jun 24**	**30 Jun 25**	**30 Jun 26**
35	**Difference between nominal and real forecasts**	**$000**										
36	Service interruptions, incidents and emergencies	-	34	70	108	150	196	244	292	342	392	444
37	Routine and corrective maintenance and inspection	-	43	88	136	189	247	307	368	431	496	562
38	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
39	**Network opex**	-	77	158	244	339	443	551	660	773	888	1,006
40	System operations and network support	-	53	109	167	231	303	376	451	527	605	685
41	Business support	-	76	156	240	332	435	540	647	757	869	983
42	**Non-network opex**	-	129	265	407	563	738	916	1,098	1,284	1,474	1,668
43	**Operational expenditure**	-	206	423	651	902	1,181	1,467	1,758	2,057	2,362	2,674

Schedule 11b Explanatory Notes

The box below provides commentary specific to the difference between nominal and constant price operational expenditure for the current disclosure year and the 10 year planning period. It is provided in the same format as required for Box 2, Schedule 14a of the Gas Distribution Information Disclosures, which will be fully disclosed within 6 months of the end of the disclosure year.

Commentary on difference between nominal and constant price operational expenditure forecasts

Vector has used the NZIER (New Zealand Institute of Economic Research) March 2016 PPI (Producer Price Index-outputs) forecast from 2016 to 2020. Thereafter we have assumed a long-term inflation rate of 2.20%. The constant price operational expenditure forecast is then inflated by the above mentioned PPI forecast to nominal price operational expenditure forecasts.

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Appendix 3

Schedule 12a: Report on Asset Condition

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2016 – 30 June 2026**

SCHEDULE 12a: REPORT ON ASSET CONDITION

This schedule requires a breakdown of asset condition by asset class as at the start of the forecast year. The data accuracy assessment relates to the percentage values disclosed in the asset condition columns. Also required is a forecast of the percentage of units to be replaced in the next 5 years. All information should be consistent with the information provided in the AMP and the expenditure on assets forecast in Schedule 11a.

sch ref											
7					**Asset condition at start of planning period (percentage of units by grade)**						
8	**Operating Pressure**	**Asset category**	**Asset class**	**Units**	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade unknown**	**Data accuracy (1–4)**	**% of asset forecast to be replaced in next 5 years**
9	Intermediate Pressure	Main pipe	IP PE main pipe	km	-	-	-	-	-	N/A	-
10	Intermediate Pressure	Main pipe	IP steel main pipe	km	-	-	-	100.00%	-	3	-
11	Intermediate Pressure	Main pipe	IP other main pipe	km	-	-	-	-	-	N/A	-
12	Intermediate Pressure	Service pipe	IP PE service pipe	km	-	-	-	-	-	N/A	-
13	Intermediate Pressure	Service pipe	IP steel service pipe	km	-	-	-	100.00%	-	3	-
14	Intermediate Pressure	Service pipe	IP other service pipe	km	-	-	-	-	-	N/A	-
15	Intermediate Pressure	Stations	Intermediate pressure DRS	No.	-	-	20.73%	79.27%	-	4	7.32
16	Intermediate Pressure	Line valve	IP line valves	No.	-	5.67%	76.31%	7.23%	10.78%	3	-
17	Intermediate Pressure	Special crossings	IP crossings	No.	-	5.88%	76.47%	17.65%	-	3	3.70
18	Medium Pressure	Main pipe	MP PE main pipe	km	-	0.46%	-	99.54%	-	3	0.19
19	Medium Pressure	Main pipe	MP steel main pipe	km	-	-	-	100.00%	-	3	-
20	Medium Pressure	Main pipe	MP other main pipe	km	-	100.00%	-	-	-	3	100.00
21	Medium Pressure	Service pipe	MP PE service pipe	km	-	0.36%	99.64%	-	-	3	0.15
22	Medium Pressure	Service pipe	MP steel service pipe	km	-	-	100.00%	-	-	3	-
23	Medium Pressure	Service pipe	MP other service pipe	km	-	-	100.00%	-	-	3	-
24	Medium Pressure	Stations	Medium pressure DRS	No.	-	-	22.22%	77.78%	-	4	-
25	Medium Pressure	Line valve	MP line valves	No.	-	3.03%	82.12%	3.37%	11.49%	3	-
26	Medium Pressure	Special crossings	MP special crossings	No.	-	7.81%	45.31%	45.31%	1.56%	3	3.70
27	Low Pressure	Main pipe	LP PE main pipe	km	-	-	-	100.00%	-	3	-
28	Low Pressure	Main pipe	LP steel main pipe	km	-	-	-	-	-	N/A	-
29	Low Pressure	Main pipe	LP other main pipe	km	-	-	-	-	-	N/A	-
30	Low Pressure	Service pipe	LP PE service pipe	km	-	-	-	100.00%	-	3	-
31	Low Pressure	Service pipe	LP steel service pipe	km	-	-	100.00%	-	-	3	-
32	Low Pressure	Service pipe	LP other service pipe	km	-	-	-	-	-	N/A	-
33	Low Pressure	Line valve	LP line valves	No.	-	-	54.55%	-	45.45%	3	-
34	Low Pressure	Special crossings	LP special crossings	No.	-	-	-	-	-	N/A	-
35	All	Monitoring and control systems	Remote terminal units	No.	-	1.39%	22.22%	76.39%	-	3	27.08
36	All	Cathodic protection systems	Cathodic protection	No.	-	9.52%	71.43%	19.05%	-	4	7.10

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Appendix 4

Schedule 12b: Report on Forecast Utilisation

Company Name: **Vector Limited**
AMP Planning Period: **1 July 2016 – 30 June 2026**

SCHEDULE 12b: REPORT ON FORECAST UTILISATION

This Schedule requires a breakdown of current and forecast utilisation (for heavily utilised pipelines) consistent with the information provided in the AMP and the demand forecast in schedule S12c.

sch ref

7 **Forecast Utilisation of Heavily Utilised Pipelines**

sch ref	Region	Network	Pressure system	Nominal operating pressure (NOP) (kPa)	Minimum operating pressure (MinOP) (kPa)	Total capacity at MinOP (scmh)	Remaining capacity at MinOP (scmh)	Unit	Utilisation *Current Year CY* y/e 30 Jun 16	*CY+1* y/e 30 Jun 17	*CY+2* y/e 30 Jun 18	*CY+3* y/e 30 Jun 19	*CY+4* y/e 30 Jun 20	*CY+5* y/e 30 Jun 21	Comment
11	Auckland	Auckland Central	AU Auckland IP20	1,900	950	77,356	538	scmh	76818	77041	73633	74480	75329	76176	Remaining capacity at MinOP is available in the East Tamaki area.
12								kPa	1112	1106	1099	1093	1086	1080	
13	Auckland	Auckland Central	AU Penrose MP2	200	100	1,177	1	scmh	1176	1189	1202	1215	1229	1242	Remaining capacity at MinOP is available in the Southdown area.
14								kPa	101	99	96	94	91	89	
15	Auckland	Auckland Central	AU North Shore MP4	400	200	14,053	20	scmh	14033	14189	14346	14506	14667	14829	Remaining capacity at MinOP is available in the Devonport area.
16								kPa	236	232	228	223	218	214	

17 ** Current year utilisation figures may be estimates. Year 1–5 figures show the utilisation forecast to occur given the expected system configuration for each year, including the effect of any new investment in the pressure system.*

19 **Disclaimer for supply enquiries**

20 The information in this table contains modelled estimates of utilisation and capacity. Any interested party seeking to invest in supply from Vector's distribution networks should contact their retailer and confirm availability of capacity.

22 **Notes and assumptions**

1. A 'heavily utilised' pressure system is a pressure system where the modelled flow rate, at system peak during 2015, is greater than or equal to 500 scmh, and its utilisation (pressure drop) is greater than or equal to 40% from the nominal operating pressure (NOP). The utilisation of a pressure system is calculated using the formula: [1 – (system minimum pressure/nominal operating pressure)] *100%.
2. The remaining capacity of a 'heavily utilised' pressure system is obtained by examining the modelled flows at various extremity points in each pressure system, and the level at which the minimum operating pressure (MinOP) is reached. Vector's security standards set the MinOP at 50% of the rated pressure (which equates to approximately 82% of the pipeline capacity) for a pressure system (based on standard operating pressures). The minimum modelled flow rate, analysed at one extremity point, is used to calculate the remaining capacity of the entire pressure system being studied.
3. A forecast model of a pressure system is obtained by applying either its forecast flow rate or an annual growth rate in each forecast year; and scaling its loads evenly to give the system total flow. The resulting minimum system pressure is simulated on this basis.
4. The forecast system flow is populated using the respective network system as tabulated in Table 5.1 of Section 5 - Network Development Planning of Gas Distribution Asset Management Plan 2016 - 2026.
5. The forecast system flow for the Central Auckland network system is based on an annual growth rate of 1.11%, as tabulated in Table 5.1 of Section 5 - Network Development Planning of Gas Distribution Asset Management Plan 2016 - 2026.
6. Stated annual growth rates are averaged across a 10-year planning period. Owing to seasonality factors influencing the forecasting model the discrete forecast system flows may not mirror the 10-year averaged growth rate incrementally.
7. Details of performance, capacity and system reinforcement are described in Section 5 - Network Development Planning of Gas Distribution Asset Management Plan 2016 - 2026.
8. Schedule 12b provides a snapshot in time of the pressure system capacity, at the date of its preparation, and it should be noted that the figures will change over time. Schedule 12b is provided on the basis that it be used for consumer guidance only.
9. The capacity limits specified in Schedule 12b for each 'heavily utilised' pressure system, highlight only the most constrained part of the pressure system. At that specific location the MinOP is lowest; in reality more capacity may be available at other locations within the pressure or network system.
10. Consumers considering using gas or wanting more capacity should always contact Vector to confirm availability. In these cases, Vector will prepare a dedicated model that will provide an accurate assessment of available gas capacity at the specified location.
11. Due to resource constraints, the network models used to compile Schedule 12b are updated on a 3 year rolling cycle, meaning that the model update, forecast and validation of some models may not have been updated since 2013.
12. It has been assumed that the load forecasting documented in the AMP is correct, and that all assumptions and risks associated with this forecasting have been reviewed and approved as part of a separate exercise associated with signing off the AMP.

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Appendix 5

Schedule 12c: Report on Forecast Demand

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2016 – 30 June 2026**

SCHEDULE 12c: REPORT ON FORECAST DEMAND

This schedule requires a forecast of new connections (by consumer type), peak demand and energy volumes for the disclosure year and a 5 year planning period. The forecasts should be consistent with the supporting information set out in the AMP as well as the assumptions used in developing the expenditure forecasts in Schedule 11a and Schedule 11b and the capacity and utilisation forecasts in Schedule 12b.

sch ref

12c(i) Consumer Connections

Number of ICPs connected in year by consumer type

sch ref		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
10	*Consumer types defined by GDB*	**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**
11	Residential	3,068	3,185	3,340	3,367	3,452	3,492
12	Commercial	174	196	205	201	200	200
13							
14							
15							
16	**Total**	3,242	3,381	3,545	3,568	3,652	3,692

12c(ii): Gas Delivered

sch ref		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
19		**30 Jun 16**	**30 Jun 17**	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**
20	Number of ICPs at year end (at year end)	104,344	107,325	110,470	113,610	116,833	120,096
21	Maximum daily load (GJ per day)	60,433	61,306	62,191	63,089	64,000	64,924
22	Maximum monthly load (GJ per month)	1,484,162	1,496,307	1,508,552	1,520,898	1,533,344	1,545,892
23	Number of directly billed ICPs (at year end)	1	1	1	1	1	1
24	Total gas conveyed (GJ per annum)	13,954,111	13,792,297	13,907,274	14,117,459	14,225,679	14,327,232
25	Average daily delivery (GJ per day)	38,126	37,787	38,102	38,678	38,868	39,253
26							
27	Load factor	78.35%	76.81%	76.82%	77.35%	77.31%	77.23%

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Appendix 6

Schedule 13: Report on Asset Management Maturity

Company Name	Vector Limited
AMP Planning Period	1 July 2016 – 30 June 2026
Asset Management Standard Applied	

SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY

This schedule requires information on the GDB'S self-assessment of the maturity of its asset management practices.

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
3	Asset management policy	To what extent has an asset management policy been documented, authorised and communicated?	1			Widely used AM practice standards require an organisation to document, authorise and communicate its asset management policy (eg, as required in PAS 55 para 4.2 i). A key pre-requisite of any robust policy is that the organisation's top management must be seen to endorse and fully support it. Also vital to the effective implementation of the policy, is to tell the appropriate people of its content and their obligations under it. Where an organisation outsources some of its asset-related activities, then these people and their organisations must equally be made aware of the policy's content. Also, there may be other stakeholders, such as regulatory authorities and shareholders who should be made aware of it.	Top management. The management team that has overall responsibility for asset management.	The organisation's asset management policy, its organisational strategic plan, documents indicating how the asset management policy was based upon the needs of the organisation and evidence of communication.
10	Asset management strategy	What has the organisation done to ensure that its asset management strategy is consistent with other appropriate organisational policies and strategies, and the needs of stakeholders?	2			In setting an organisation's asset management strategy, it is important that it is consistent with any other policies and strategies that the organisation has and has taken into account the requirements of relevant stakeholders. This question examines to what extent the asset management strategy is consistent with other organisational policies and strategies (eg, as required by PAS 55 para 4.3.1 b) and has taken account of stakeholder requirements as required by PAS 55 para 4.3.1 c). Generally, this will take into account the same polices, strategies and stakeholder requirements as covered in drafting the asset management policy but at a greater level of detail.	Top management. The organisation's strategic planning team. The management team that has overall responsibility for asset management.	The organisation's asset management strategy document and other related organisational policies and strategies. Other than the organisation's strategic plan, these could include those relating to health and safety, environmental, etc. Results of stakeholder consultation.
11	Asset management strategy	In what way does the organisation's asset management strategy take account of the lifecycle of the assets, asset types and asset systems over which the organisation has stewardship?	3			Good asset stewardship is the hallmark of an organisation compliant with widely used AM standards. A key component of this is the need to take account of the lifecycle of the assets, asset types and asset systems. (For example, this requirement is recognised in 4.3.1 d) of PAS 55). This question explores what an organisation has done to take lifecycle into account in its asset management strategy.	Top management. People in the organisation with expert knowledge of the assets, asset types, asset systems and their associated life-cycles. The management team that has overall responsibility for asset management. Those responsible for developing and adopting methods and processes used in asset management	The organisation's documented asset management strategy and supporting working documents.
26	Asset management plan(s)	How does the organisation establish and document its asset management plan(s) across the life cycle activities of its assets and asset systems?	2			The asset management strategy need to be translated into practical plan(s) so that all parties know how the objectives will be achieved. The development of plan(s) will need to identify the specific tasks and activities required to optimize costs, risks and performance of the assets and/or asset system(s), when they are to be carried out and the resources required.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers.	The organisation's asset management plan(s).

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
27	Asset management plan(s)	How has the organisation communicated its plan(s) to all relevant parties to a level of detail appropriate to the receiver's role in their delivery?	2			Plans will be ineffective unless they are communicated to all those, including contracted suppliers and those who undertake enabling function(s). The plan(s) need to be communicated in a way that is relevant to those who need to use them.	The management team with overall responsibility for the asset management system. Delivery functions and suppliers.	Distribution lists for plan(s). Documents derived from plan(s) which detail the receivers role in plan delivery. Evidence of communication.
29	Asset management plan(s)	How are designated responsibilities for delivery of asset plan actions documented?	3			The implementation of asset management plan(s) relies on (1) actions being clearly identified, (2) an owner allocated and (3) that owner having sufficient delegated responsibility and authority to carry out the work required. It also requires alignment of actions across the organisation. This question explores how well the plan(s) set out responsibility for delivery of asset plan actions.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers. If appropriate, the performance management team.	The organisation's asset management plan(s). Documentation defining roles and responsibilities of individuals and organisational departments.
31	Asset management plan(s)	What has the organisation done to ensure that appropriate arrangements are made available for the efficient and cost effective implementation of the plan(s)? (Note this is about resources and enabling support)	3			It is essential that the plan(s) are realistic and can be implemented, which requires appropriate resources to be available and enabling mechanisms in place. This question explores how well this is achieved. The plan(s) not only need to consider the resources directly required and timescales, but also the enabling activities, including for example, training requirements, supply chain capability and procurement timescales.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers. If appropriate, the performance management team. If appropriate, the performance management team. Where appropriate the procurement team and service providers working on the organisation's asset-related activities.	The organisation's asset management plan(s). Documented processes and procedures for the delivery of the asset management plan.
33	Contingency planning	What plan(s) and procedure(s) does the organisation have for identifying and responding to incidents and emergency situations and ensuring continuity of critical asset management activities?	3			Widely used AM practice standards require that an organisation has plan(s) to identify and respond to emergency situations. Emergency plan(s) should outline the actions to be taken to respond to specified emergency situations and ensure continuity of critical asset management activities including the communication to, and involvement of, external agencies. This question assesses if, and how well, these plan(s) triggered, implemented and resolved in the event of an incident. The plan(s) should be appropriate to the level of risk as determined by the organisation's risk assessment methodology. It is also a requirement that relevant personnel are competent and trained.	The manager with responsibility for developing emergency plan(s). The organisation's risk assessment team. People with designated duties within the plan(s) and procedure(s) for dealing with incidents and emergency situations.	The organisation's plan(s) and procedure(s) for dealing with emergencies. The organisation's risk assessments and risk registers.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
37	Structure, authority and responsibilities	What has the organisation done to appoint member(s) of its management team to be responsible for ensuring that the organisation's assets deliver the requirements of the asset management strategy, objectives and plan(s)?	3			In order to ensure that the organisation's assets and asset systems deliver the requirements of the asset management policy, strategy and objectives responsibilities need to be allocated to appropriate people who have the necessary authority to fulfil their responsibilities. (This question, relates to the organisation's assets eg, para b), s 4.4.1 of PAS 55, making it therefore distinct from the requirement contained in para a), s 4.4.1 of PAS 55).	Top management. People with management responsibility for the delivery of asset management policy, strategy, objectives and plan(s). People working on asset-related activities.	Evidence that managers with responsibility for the delivery of asset management policy, strategy, objectives and plan(s) have been appointed and have assumed their responsibilities. Evidence may include the organisation's documents relating to its asset management system, organisational charts, job descriptions of post-holders, annual targets/objectives and personal development plan(s) of post-holders as appropriate.
40	Structure, authority and responsibilities	What evidence can the organisation's top management provide to demonstrate that sufficient resources are available for asset management?	3			Optimal asset management requires top management to ensure sufficient resources are available. In this context the term 'resources' includes manpower, materials, funding and service provider support.	Top management. The management team that has overall responsibility for asset management. Risk management team. The organisation's managers involved in day-to-day supervision of asset-related activities, such as frontline managers, engineers, foremen and chargehands as appropriate.	Evidence demonstrating that asset management plan(s) and/or the process(es) for asset management plan implementation consider the provision of adequate resources in both the short and long term. Resources include funding, materials, equipment, services provided by third parties and personnel (internal and service providers) with appropriate skills competencies and knowledge.
42	Structure, authority and responsibilities	To what degree does the organisation's top management communicate the importance of meeting its asset management requirements?	3			Widely used AM practice standards require an organisation to communicate the importance of meeting its asset management requirements such that personnel fully understand, take ownership of, and are fully engaged in the delivery of the asset management requirements (eg, PAS 55 s 4.4.1 g).	Top management. The management team that has overall responsibility for asset management. People involved in the delivery of the asset management requirements.	Evidence of such activities as road shows, written bulletins, workshops, team talks and management walk-abouts would assist an organisation to demonstrate it is meeting this requirement of PAS 55.
45	Outsourcing of asset management activities	Where the organisation has outsourced some of its asset management activities, how has it ensured that appropriate controls are in place to ensure the compliant delivery of its organisational strategic plan, and its asset management policy and strategy?	3			Where an organisation chooses to outsource some of its asset management activities, the organisation must ensure that these outsourced process(es) are under appropriate control to ensure that all the requirements of widely used AM standards (eg, PAS 55) are in place, and the asset management policy, strategy objectives and plan(s) are delivered. This includes ensuring capabilities and resources across a time span aligned to life cycle management. The organisation must put arrangements in place to control the outsourced activities, whether it be to external providers or to other in-house departments. This question explores what the organisation does in this regard.	Top management. The management team that has overall responsibility for asset management. The manager(s) responsible for the monitoring and management of the outsourced activities. People involved with the procurement of outsourced activities. The people within the organisations that are performing the outsourced activities. The people impacted by the outsourced activity.	The organisation's arrangements that detail the compliance required of the outsourced activities. For example, this this could form part of a contract or service level agreement between the organisation and the suppliers of its outsourced activities. Evidence that the organisation has demonstrated to itself that it has assurance of compliance of outsourced activities.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
48	Training, awareness and competence	How does the organisation develop plan(s) for the human resources required to undertake asset management activities - including the development and delivery of asset management strategy, process(es), objectives and plan(s)?	2			There is a need for an organisation to demonstrate that it has considered what resources are required to develop and implement its asset management system. There is also a need for the organisation to demonstrate that it has assessed what development plan(s) are required to provide its human resources with the skills and competencies to develop and implement its asset management systems. The timescales over which the plan(s) are relevant should be commensurate with the planning horizons within the asset management strategy considers e.g. if the asset management strategy considers 5, 10 and 15 year time scales then the human resources development plan(s) should align with these. Resources include both 'in house' and external resources who undertake asset management activities.	Senior management responsible for agreement of plan(s). Managers responsible for developing asset management strategy and plan(s). Managers with responsibility for development and recruitment of staff (including HR functions). Staff responsible for training. Procurement officers. Contracted service providers.	Evidence of analysis of future work load plan(s) in terms of human resources. Document(s) containing analysis of the organisation's own direct resources and contractors resource capability over suitable timescales. Evidence, such as minutes of meetings, that suitable management forums are monitoring human resource development plan(s). Training plan(s), personal development plan(s), contract and service level agreements.
49	Training, awareness and competence	How does the organisation identify competency requirements and then plan, provide and record the training necessary to achieve the competencies?	2			Widely used AM standards require that organisations to undertake a systematic identification of the asset management awareness and competencies required at each level and function within the organisation. Once identified the training required to provide the necessary competencies should be planned for delivery in a timely and systematic way. Any training provided must be recorded and maintained in a suitable format. Where an organisation has contracted service providers in place then it should have a means to demonstrate that this requirement is being met for their employees. (eg, PAS 55 refers to frameworks suitable for identifying competency requirements).	Senior management responsible for agreement of plan(s). Managers responsible for developing asset management strategy and plan(s). Managers with responsibility for development and recruitment of staff (including HR functions). Staff responsible for training. Procurement officers. Contracted service providers.	Evidence of an established and applied competency requirements assessment process and plan(s) in place to deliver the required training. Evidence that the training programme is part of a wider, co-ordinated asset management activities training and competency programme. Evidence that training activities are recorded and that records are readily available (for both direct and contracted service provider staff) e.g. via organisation wide information system or local records database.
50	Training, awareness and competence	How does the organization ensure that persons under its direct control undertaking asset management related activities have an appropriate level of competence in terms of education, training or experience?	3			A critical success factor for the effective development and implementation of an asset management system is the competence of persons undertaking these activities. organisations should have effective means in place for ensuring the competence of employees to carry out their designated asset management function(s). Where an organisation has contracted service providers undertaking elements of its asset management system then the organisation shall assure itself that the outsourced service provider also has suitable arrangements in place to manage the competencies of its employees. The organisation should ensure that the individual and corporate competencies it requires are in place and actively monitor, develop and maintain an appropriate balance of these competencies.	Managers, supervisors, persons responsible for developing training programmes. Staff responsible for procurement and service agreements. HR staff and those responsible for recruitment.	Evidence of a competency assessment framework that aligns with established frameworks such as the asset management Competencies Requirements Framework (Version 2.0); National Occupational Standards for Management and Leadership; UK Standard for Professional Engineering Competence, Engineering Council, 2005.
53	Communication, participation and consultation	How does the organisation ensure that pertinent asset management information is effectively communicated to and from employees and other stakeholders, including contracted service providers?	3			Widely used AM practice standards require that pertinent asset management information is effectively communicated to and from employees and other stakeholders including contracted service providers. Pertinent information refers to information required in order to effectively and efficiently comply with and deliver asset management strategy, plan(s) and objectives. This will include for example the communication of the asset management policy, asset performance information, and planning information as appropriate to contractors.	Top management and senior management representative(s), employee's representative(s), employee's trade union representative(s); contracted service provider management and employee representative(s); representative(s) from the organisation's Health, Safety and Environmental team. Key stakeholder representative(s).	Asset management policy statement prominently displayed on notice boards, intranet and internet; use of organisation's website for displaying asset performance data; evidence of formal briefings to employees, stakeholders and contracted service providers; evidence of inclusion of asset management issues in team meetings and contracted service provider contract meetings; newsletters, etc.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
59	Asset Management System documentation	What documentation has the organisation established to describe the main elements of its asset management system and interactions between them?	3			Widely used AM practice standards require an organisation maintain up to date documentation that ensures that its asset management systems (ie, the systems the organisation has in place to meet the standards) can be understood, communicated and operated. (eg, s 4.5 of PAS 55 requires the maintenance of up to date documentation of the asset management system requirements specified throughout s 4 of PAS 55).	The management team that has overall responsibility for asset management. Managers engaged in asset management activities.	The documented information describing the main elements of the asset management system (process(es)) and their interaction.
62	Information management	What has the organisation done to determine what its asset management information system(s) should contain in order to support its asset management system?	2			Effective asset management requires appropriate information to be available. Widely used AM standards therefore require the organisation to identify the asset management information it requires in order to support its asset management system. Some of the information required may be held by suppliers. The maintenance and development of asset management information systems is a poorly understood specialist activity that is akin to IT management but different from IT management. This group of questions provides some indications as to whether the capability is available and applied. Note: To be effective, an asset information management system requires the mobilisation of technology, people and process(es) that create, secure, make available and destroy the information required to support the asset management system.	The organisation's strategic planning team. The management team that has overall responsibility for asset management. Information management team. Operations, maintenance and engineering managers	Details of the process the organisation has employed to determine what its asset information system should contain in order to support its asset management system. Evidence that this has been effectively implemented.
63	Information management	How does the organisation maintain its asset management information system(s) and ensure that the data held within it (them) is of the requisite quality and accuracy and is consistent?	2			The response to the questions is progressive. A higher scale cannot be awarded without achieving the requirements of the lower scale. This question explores how the organisation ensures that information management meets widely used AM practice requirements (eg, s 4.4.6 (a), (c) and (d) of PAS 55).	The management team that has overall responsibility for asset management. Users of the organisational information systems.	The asset management information system, together with the policies, procedure(s), improvement initiatives and audits regarding information controls.
64	Information management	How has the organisation's ensured its asset management information system is relevant to its needs?	3			Widely used AM standards need not be prescriptive about the form of the asset management information system, but simply require that the asset management information system is appropriate to the organisations needs, can be effectively used and can supply information which is consistent and of the requisite quality and accuracy.	The organisation's strategic planning team. The management team that has overall responsibility for asset management. Information management team. Users of the organisational information systems.	The documented process the organisation employs to ensure its asset management information system aligns with its asset management requirements. Minutes of information systems review meetings involving users.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
69	Risk management process(es)	How has the organisation documented process(es) and/or procedure(s) for the identification and assessment of asset and asset management related risks throughout the asset life cycle?	3			Risk management is an important foundation for proactive asset management. Its overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to optimally manage such risks to an acceptable level, and to provide an audit trail for the management of risks. Widely used standards require the organisation to have process(es) and/or procedure(s) in place that set out how the organisation identifies and assesses asset and asset management related risks. The risks have to be considered across the four phases of the asset lifecycle (eg, para 4.3.3 of PAS 55).	The top management team in conjunction with the organisation's senior risk management representatives. There may also be input from the organisation's Safety, Health and Environment team. Staff who carry out risk identification and assessment.	The organisation's risk management framework and/or evidence of specific process(es) and/ or procedure(s) that deal with risk control mechanisms. Evidence that the process(es) and/or procedure(s) are implemented across the business and maintained. Evidence of agendas and minutes from risk management meetings. Evidence of feedback in to process(es) and/or procedure(s) as a result of incident investigation(s). Risk registers and assessments.
79	Use and maintenance of asset risk information	How does the organisation ensure that the results of risk assessments provide input into the identification of adequate resources and training and competency needs?	3			Widely used AM standards require that the output from risk assessments are considered and that adequate resource (including staff) and training is identified to match the requirements. It is a further requirement that the effects of the control measures are considered, as there may be implications in resources and training required to achieve other objectives.	Staff responsible for risk assessment and those responsible for developing and approving resource and training plan(s). There may also be input from the organisation's Safety, Health and Environment team.	The organisations risk management framework. The organisation's resourcing plan(s) and training and competency plan(s). The organisation should be able to demonstrate appropriate linkages between the content of resource plan(s) and training and competency plan(s) to the risk assessments and risk control measures that have been developed.
82	Legal and other requirements	What procedure does the organisation have to identify and provide access to its legal, regulatory, statutory and other asset management requirements, and how is requirements incorporated into the asset management system?	3			In order for an organisation to comply with its legal, regulatory, statutory and other asset management requirements, the organisation first needs to ensure that it knows what they are (eg, PAS 55 specifies this in s 4.4.8). It is necessary to have systematic and auditable mechanisms in place to identify new and changing requirements. Widely used AM standards also require that requirements are incorporated into the asset management system (e.g. procedure(s) and process(es))	Top management. The organisations regulatory team. The organisation's legal team or advisors. The management team with overall responsibility for the asset management system. The organisation's health and safety team or advisors. The organisation's policy making team.	The organisational processes and procedures for ensuring information of this type is identified, made accessible to those requiring the information and is incorporated into asset management strategy and objectives
88	Life Cycle Activities	How does the organisation establish implement and maintain process(es) for the implementation of its asset management plan(s) and control of activities across the creation, acquisition or enhancement of assets. This includes design, modification, procurement, construction and commissioning activities?	3			Life cycle activities are about the implementation of asset management plan(s) i.e. they are the "doing" phase. They need to be done effectively and well in order for asset management to have any practical meaning. As a consequence, widely used standards (eg, PAS 55 s 4.5.1) require organisations to have in place appropriate process(es) and procedure(s) for the implementation of asset management plan(s) and control of lifecycle activities. This question explores those aspects relevant to asset creation.	Asset managers, design staff, construction staff and project managers from other impacted areas of the business, e.g. Procurement	Documented process(es) and procedure(s) which are relevant to demonstrating the effective management and control of life cycle activities during asset creation, acquisition, enhancement including design, modification, procurement, construction and commissioning.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
91	Life Cycle Activities	How does the organisation ensure that process(es) and/or procedure(s) for the implementation of asset management plan(s) and control of activities during maintenance (and inspection) of assets are sufficient to ensure activities are carried out under specified conditions, are consistent with asset management strategy and control cost, risk and performance?	3			Having documented process(es) which ensure the asset management plan(s) are implemented in accordance with any specified conditions, in a manner consistent with the asset management policy, strategy and objectives and in such a way that cost, risk and asset system performance are appropriately controlled is critical. They are an essential part of turning intention into action (eg, as required by PAS 55 s 4.5.1).	Asset managers, operations managers, maintenance managers and project managers from other impacted areas of the business	Documented procedure for review. Documented procedure for audit of process delivery. Records of previous audits, improvement actions and documented confirmation that actions have been carried out.
95	Performance and condition monitoring	How does the organisation measure the performance and condition of its assets?	3			Widely used AM standards require that organisations establish implement and maintain procedure(s) to monitor and measure the performance and/or condition of assets and asset systems. They further set out requirements in some detail for reactive and proactive monitoring, and leading/lagging performance indicators together with the monitoring or results to provide input to corrective actions and continual improvement. There is an expectation that performance and condition monitoring will provide input to improving asset management strategy, objectives and plan(s).	A broad cross-section of the people involved in the organisation's asset-related activities from data input to decision-makers, i.e. an end-to end assessment. This should include contactors and other relevant third parties as appropriate.	Functional policy and/or strategy documents for performance or condition monitoring and measurement. The organisation's performance monitoring frameworks, balanced scorecards etc. Evidence of the reviews of any appropriate performance indicators and the action lists resulting from these reviews. Reports and trend analysis using performance and condition information. Evidence of the use of performance and condition information shaping improvements and supporting asset management strategy, objectives and plan(s).
99	Investigation of asset-related failures, incidents and nonconformities	How does the organisation ensure responsibility and the authority for the handling, investigation and mitigation of asset-related failures, incidents and emergency situations and non conformances is clear, unambiguous, understood and communicated?	3			Widely used AM standards require that the organisation establishes implements and maintains process(es) for the handling and investigation of failures incidents and non-conformities for assets and sets down a number of expectations. Specifically this question examines the requirement to define clearly responsibilities and authorities for these activities, and communicate these unambiguously to relevant people including external stakeholders if appropriate.	The organisation's safety and environment management team. The team with overall responsibility for the management of the assets. People who have appointed roles within the asset-related investigation procedure, from those who carry out the investigations to senior management who review the recommendations. Operational controllers responsible for managing the asset base under fault conditions and maintaining services to consumers. Contractors and other third parties as appropriate.	Process(es) and procedure(s) for the handling, investigation and mitigation of asset-related failures, incidents and emergency situations and non conformances. Documentation of assigned responsibilities and authority to employees. Job Descriptions, Audit reports. Common communication systems i.e. all Job Descriptions on Internet etc.
105	Audit	What has the organisation done to establish procedure(s) for the audit of its asset management system (process(es))?	2			This question seeks to explore what the organisation has done to comply with the standard practice AM audit requirements (eg, the associated requirements of PAS 55 s 4.6.4 and its linkages to s 4.7).	The management team responsible for its asset management procedure(s). The team with overall responsibility for the management of the assets. Audit teams, together with key staff responsible for asset management. For example, Asset Management Director, Engineering Director. People with responsibility for carrying out risk assessments	The organisation's asset-related audit procedure(s). The organisation's methodology(s) by which it determined the scope and frequency of the audits and the criteria by which it identified the appropriate audit personnel. Audit schedules, reports etc. Evidence of the procedure(s) by which the audit results are presented, together with any subsequent communications. The risk assessment schedule or risk registers.

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SCHEDULE 13: REPORT ON ASSET MANAGEMENT MATURITY (cont)

Question No.	Function	Question	Score	Evidence—Summary	User Guidance	Why	Who	Record/documented Information
109	Corrective & Preventative action	How does the organisation instigate appropriate corrective and/or preventive actions to eliminate or prevent the causes of identified poor performance and non conformance?	2			Having investigated asset related failures, incidents and non-conformances, and taken action to mitigate their consequences, an organisation is required to implement preventative and corrective actions to address root causes. Incident and failure investigations are only useful if appropriate actions are taken as a result to assess changes to a businesses risk profile and ensure that appropriate arrangements are in place should a recurrence of the incident happen. Widely used AM standards also require that necessary changes arising from preventive or corrective action are made to the asset management system.	The management team responsible for its asset management procedure(s). The team with overall responsibility for the management of the assets. Audit and incident investigation teams. Staff responsible for planning and managing corrective and preventive actions.	Analysis records, meeting notes and minutes, modification records. Asset management plan(s), investigation reports, audit reports, improvement programmes and projects. Recorded changes to asset management procedure(s) and process(es). Condition and performance reviews. Maintenance reviews
113	Continual Improvement	How does the organisation achieve continual improvement in the optimal combination of costs, asset related risks and the performance and condition of assets and asset systems across the whole life cycle?	2			Widely used AM standards have requirements to establish, implement and maintain process(es)/procedure(s) for identifying, assessing, prioritising and implementing actions to achieve continual improvement. Specifically there is a requirement to demonstrate continual improvement in optimisation of cost risk and performance/condition of assets across the life cycle. This question explores an organisation's capabilities in this area—looking for systematic improvement mechanisms rather that reviews and audit (which are separately examined).	The top management of the organisation. The manager/team responsible for managing the organisation's asset management system, including its continual improvement. Managers responsible for policy development and implementation.	Records showing systematic exploration of improvement. Evidence of new techniques being explored and implemented. Changes in procedure(s) and process(es) reflecting improved use of optimisation tools/techniques and available information. Evidence of working parties and research.
115	Continual Improvement	How does the organisation seek and acquire knowledge about new asset management related technology and practices, and evaluate their potential benefit to the organisation?	3			One important aspect of continual improvement is where an organisation looks beyond its existing boundaries and knowledge base to look at what 'new things are on the market'. These new things can include equipment, process(es), tools, etc. An organisation which does this (eg, by the PAS 55 s 4.6 standards) will be able to demonstrate that it continually seeks to expand its knowledge of all things affecting its asset management approach and capabilities. The organisation will be able to demonstrate that it identifies any such opportunities to improve, evaluates them for suitability to its own organisation and implements them as appropriate. This question explores an organisation's approach to this activity.	The top management of the organisation. The manager/team responsible for managing the organisation's asset management system, including its continual improvement. People who monitor the various items that require monitoring for 'change'. People that implement changes to the organisation's policy, strategy, etc. People within an organisation with responsibility for investigating, evaluating, recommending and implementing new tools and techniques, etc.	Research and development projects and records, benchmarking and participation knowledge exchange professional forums. Evidence of correspondence relating to knowledge acquisition. Examples of change implementation and evaluation of new tools, and techniques linked to asset management strategy and objectives.

Gas Distribution Asset Management Plan 2016 – 2026

Appendix 7

Schedule 17 Certification for Year-beginning Disclosures

Clause 2.9.1

We, Robert William Thomson and

Jonathan Parker Mason, being directors of Vector Limited certify that, having made all reasonable enquiry, to the best of our knowledge:

a) the following attached information of Vector Limited prepared for the purposes of clauses 2.6.1, 2.6.3, 2.6.6 and 2.7.2 of the Gas Distribution Information Disclosure Determination 2012 (consolidated in 2015) in all material respects complies with that determination.

b) The prospective financial or non-financial information included in the attached information has been measured on a basis consistent with regulatory requirements or recognised industry standards.

c) The forecasts in Schedules 11a, 11b, 12a, 12b and 12c are based on objective and reasonable assumptions which both align with Vector Limited's corporate vision and strategy and are documented in retained records.

[signature]

Director

[signature]

Director

23 August 2016

Date