GAS DISTRIBUTION ASSET MANAGEMENT PLAN

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EXECUTIVE SUMMARY WHAT IS THE AMP?

The Asset Management Plan (AMP) is a document which outlines Vector's investments, strategies, and approach for managing our gas network assets for the benefit of the Auckland energy consumer, for the period 1 July 2018 to 30 June 2028.

The investments we plan to make, set out in this 2018 edition, are essential to achieving our vision to help create a new energy future for Aucklanders. They are borne from Vector's need to ensure we:

- Provide customers with affordable, accessible choices in meeting their energy needs;
- Take account of the potential for churn between energy sources, largely driven from increasingly disruptive accelerating electricity technologies;
- Preserve our ability to respond quickly should significant technological, environmental, or behavioural trends point to the need to adapt or repurpose our network;
- Meet the ever-changing needs and demands of our customers;
- Provide a safe, reliable and secure service for distributing gas throughout Auckland; and
- Ensure our assets and infrastructure are fit-for-purpose in a rapidly-changing operating environment.

PURPOSE OF THE AMP

As a leading infrastructure company, Vector recognises that how we plan, upgrade, and manage both our network and our capability to provide a reticulated gas network impacts the people and businesses we serve.

This 2018 AMP provides the context and details of our investments, and asset management strategies for our gas network, taking into account the potential for rapid shifts in utilisation trends as the energy sector is disrupted by new technology.

It explains how we will maintain our assets, and ensure the network remains nimble and responsive to future technological and environmental changes that will enable a new energy future.

The objectives of our AMP are to:

- Be transparent with our customers and stakeholders about our plans and investments for the network;
- Detail the projects, improvements, and trials already underway for our network;
- Foster understanding of how our asset management approach works, by providing details about our assets, Vector's plans for them, and the company's objectives; and
- Explain how these plans and strategies align with our corporate vision to bring about a new energy future for Auckland

AMP PLANNING PERIOD

The AMP covers the 10-year planning period as prescribed by the Commerce Commission's Information Disclosure Determination to meet our obligations as a regulated business.

Vector provides a greater level of detail on the company's strategies and investments for the first five years of this period. The reasoning for this approach is as follows.

Today's energy environment is more uncertain than at any other point in time since mass consumer electrification. The rate of Auckland's growth, the exponential impact of maturing alternative energy technologies, new breakthrough energy innovations both in technical capability and cost of production, changing consumer preferences and behaviours, the need to upgrade or maintain older network assets, and the impact of climate change on weather conditions are all creating more uncertainty for previously settled energy infrastructure asset management strategies.

We believe our planning horizon must be shortened, with more regular planning interventions and smaller-scale investment required to pre-empt and respond to scenarios as they emerge. This is the best way to avoid sub-optimal or over-investment and poor consumer outcomes.

We won't answer the energy issues of tomorrow by relying on asset management strategies looking to what has been done before. Meeting the future needs of Auckland is not about continuing to invest in more traditional assets. A more effective approach requires us to preserve our ability to respond quickly should significant technological, environmental, or behavioural trends manifest that enable us to act as facilitators of integration.

Advanced energy technologies and smarter analytics, together with the democratisation of the energy sector as a whole, will increasingly give consumers the power to access new options and choices. The challenges of tomorrow lie in how we build revolutionary energy systems that are highly effective, complementary with each other, highly efficient, faster, more economical, and provide environmental and social benefits.

This AMP was certified and approved by our Board of Directors on 29 June 2018.

AMP STRUCTURE

Vector's 2018 AMP has been developed in accordance with good asset management principles. We have structured and simplified our AMP to tell the story of how Vector is maintaining customer service levels and creating a new energy future. There are six primary sections and supporting details in the appendices that contribute to our asset management story. As described in Table 1-1, the six primary sections of the AMP include:

SECTION	OVERVIEW
1 – Introduction	• Provides the context and summaries for the AMP; • Presents an overview of Vector; who we are, what we do, our vision; and • Considers the purpose, objectives and the operating environment that shapes the AMP.
2 – Customers, Stakeholders and Service Levels	• Identifies Vector's primary stakeholder's interest; • Presents the service level metrics and sets our performance targets to meet their interests; and • Discusses the performance of our network against these service level metrics, along with the primary causes of performance deviation from the service level targets.
3 – Asset Management System	• Provides insight into Vector's asset management practices; • The asset management objectives, scope and governance are presented here; and • Discusses how Vector intends to improve its asset management practices over time.
4 – Our Assets	• Presents an overview and lifecycle management strategies of our gas distribution assets; • Provide insights in to the types, volumes and functional role of assets we manage in the network; and • Summarises our primary asset management strategies that inform and/or drive our expenditure.
5 – Managing Our Asset's Lifecycle	• Provides an overview by asset category, of the plans we have to manage our distribution network assets over the 2018-2028 planning horizon.
6 – Delivering Our Plan	• Outlines how we develop an optimal portfolio of works from our plans and how we will deliver these works to maintain service levels, and deliver our strategic outcomes; • Provide insights into how prioritisation of the plans results in a work portfolio that optimises the outcomes from our network investment; and • Presents a summary of the CAPEX and OPEX required to deliver our gas network AMP for the 2018-2028 period.
7 – Appendices	• Contains supporting and supplementary information for Sections 1 to 6; • Lists the key standards that inform our asset management practices; and • Presents a compliance table showing how our AMP meets the Commerce Commission's Information Disclosure requirements.

Table 1-1 Overview of AMP Structure

SECTION

01. INTRODUCTION

SECTION 1. INTRODUCTION

1.1 OVERVIEW

The energy sector is being increasingly disrupted by a number of forces. In the context of this AMP, Vector's core business is to manage Auckland's reticulated gas network safely, reliably, and efficiently. This responsibility is unlikely to ever change. But the way people and businesses in Auckland want to use and interact with that network may change, with evolving technology, pricing and preferences.

Feedback from our customers clearly underscores the need for us to move forward with flexibility and careful investment. Reticulated gas networks continue to hold their position within the energy mix when it comes to customers making discretionary choices about fuel sources.

However, Auckland is one of the fastest growing and most diverse cities in the developed world. As a consequence of this population growth we also experience growth in the number of new connections to the reticulated gas network. This is largely driven by developers of new-build housing, where reticulated gas infrastructure, whilst remaining a discretionary choice, can be installed economically when sharing resources and costs with essential infrastructure during the construction phase.

We account for this organic growth through our investment approach, and our engagement with developers which is aimed at ensuring customers have access to gas as a fuel, should they desire it. Yet our investment approach cannot ignore the technology advances bringing disruption across the sector as power shifts towards consumers and the need to remove carbon from the energy sector continues to gain urgency. A rising cost of carbon over the ten year term of this plan will become more and more of a factor in driving disruption across the energy sector.

Consumer expectations around choice, control, and experience are rapidly increasing and moving beyond being passive users of energy. This will be a strongly disruptive force in the energy sector as a whole for many years to come, and their impacts on the way Auckland's gas network is utilised could be significant.

On the electricity side of the energy supply equation, there is accelerating take-up of new technologies like solar panels, electricity storage and electric vehicles. These sorts of distributed generation and storage technologies may help reduce peak electricity demand, or even displace some demand for reticulated gas.

On the other hand, greater penetration of electric vehicles could raise peak electricity demand through domestic, peak-time battery charging, reversing the trend seen in the electricity sector of a steady decline in average household electricity consumption. This scenario could lead to reticulated gas, particularly as an alternative fuel source for hot water, heating and cooking, becoming a lever to manage demand for energy from various sources.

Other technologies such as fuel cells, which convert gas to electricity without combustion, could change the way gas delivered through the network is used, with resultant changes on demand. Or, in the case of hydrogen as a transport fuel, engineering solutions could be required to repurpose the gas network to facilitate this.

Taking account of the potential for technology change to impact the way Aucklanders want to use their reticulated gas network means preserving our options for the future. But as we maintain our ability to respond quickly to customer demand, we recognise that in the more immediate term, concerns over power bills and convenience are likely to remain high on consumers' agenda, and many will continue to choose reticulated gas to answer those concerns. Our gas network must remain safe, reliable, efficient and accessible.

While we have a modern network in place, with the historical replacement of legacy systems complete, ongoing replacement and maintenance work on our network is essential to ensure they remain safe and fit for purpose.

In such an uncertain and rapidly changing environment, Vector's approach to planning must now allow for shorter horizons, greater uncertainty, and the flexibility to respond to changes quickly and efficiently. This will aid Vector in avoiding poor investment decisions and worst-case performance outcomes, as well as maximising the benefits and options available to consumers.

To meet the current needs of our customers without compromising future generations, it is imperative for Vector to strike the right balance between the environment, society, and the economy. Vector has established a robust sustainability framework which includes:

- Clear minimum expectations for all of Vector's activities, based on the United Nations Global Compact;
- Activities that work towards the Company achieving the Paris Climate Commitments;
- Identifying opportunities to contribute to the United Nations Sustainable Development Goals;
- The completion of a detailed assessment of the impact of climate change on our network; and
- The adoption of several management actions to prepare the Company for change.

Climate change forms a significant component of our sustainability commitment. Vector is committed to achieving net zero emissions by 2030 for its own emissions, as well to support the energy and transport sectors to reduce emissions. Several aspects of our AMP work together to allow Vector to implement strategies that will deliver a more sustainable, energy efficient, and resilient network.

In short, we find ourselves increasingly planning for a world that is more carbon-aware, and based on probabilities, rather than the traditional working environment we have come from. A new approach is required. We explore the trends that are driving the need for a new approach in the following sections.

1.2 CUSTOMER & COMMUNITY GROWTH

Vector plays an integral part in fostering economic growth and social prosperity in the Auckland region. Auckland has experienced high and sustained levels of population and economic growth in recent years. This has translated into an organic increase in demand for reticulated gas connections as the population grows. With growth forecast to continue, and new-build housing firmly on the agenda, we see this trend continuing.

Our network must manage customer growth in a responsible manner without compromising resilience where the pockets of growth could cause strain. To meet this growth, Vector has plans to:

- Be transparent with our customers and stakeholders about our plans and investments for the network;
- Maintain the network's topology and functionality; and
- Increase capacity to maintain and enhance network reliability.

We further set out our planning and strategy to support our growing region in SECTION 3 of this AMP.

1.3 NEW & EMERGING TECHNOLOGIES

New and exciting technologies are reshaping and restructuring the entire energy sector and we recognise that in a fast-changing world there are many uncertainties particularly when looking towards the end of the AMP period. New Zealand has committed to decarbonise heat, transport and power and on the electricity side, we expect the usage of these technologies to rise over the next few years as prices reduce and they become more accessible and available to our customers. These technologies include:

- Electric and autonomous vehicles (EV and AV);
- Solar panels;
- Power storage batteries;
- Energy management solutions in the home; and
- Fuel cells and hydrogen.

These technologies provide benefits for our customers and the community, and may prove to be significant impactors on reticulated gas as a discretionary fuel choice.

Changing power flows, higher demands for electricity at busy times, network security and resilience, will all compete with reticulated gas for the attention of the increasing number of consumers who choose to take control of meeting their energy needs. We need to better understand the impact these technologies may have on consumer preferences in respect of gas, and how we can respond to the benefit of those we serve.

On the reticulated gas side, new developments include:

- Development of new technologies like fuel cells or bio-gas;
- A shift towards reticulated supply of hydrogen in addition to natural gas; and
- Re-purposing of the gas network to accommodate hydrogen in order to dramatically reduce carbon emissions from gas energy supply.

We need to preserve our ability to facilitate the adoption of these technologies, should Aucklanders choose them in the future.

In this AMP are included the plans, strategies, and proof-of-concept trials Vector will conduct to better understand and accommodate technological change on and around our network. Taking this action now, rather than adopting a reactive approach to their integration, compliments Vector's vision of helping foster a new energy future.

1.4 RESILIENCE & SAFETY

We have committed to minimising the risks associated with operating our gas distribution network. Vector provides critical infrastructure for a functioning modern city and it is imperative that we continue to invest in assets such as our pipes, District Regulating Stations (DRS), valves, supporting Information Technology (IT) and digital infrastructure, and more to ensure that they perform reliably, safely and resiliently in the future.

We responsibly manage our assets over their full lifecycle to avoid failures causing interruptions in the supply of gas to our customers, and pose hazards to our workers, contractors and the public, or harm the environment. A challenge going forward is to ensure that our core systems are developed to enable they capture additional required data. This will require enhanced incident data (i.e. fault and failure records) and improved asset inspection records to support improvements to our Condition Based Asset Risk Management (CBARM). One of our challenges is also to protect pipelines from damage by third parties. The expertise of our workforce is a great asset but we also face a big challenge to maintain competence levels over time.

We have a modern gas network, acknowledging the successful completion of a historical replacement programme of legacy systems, yet ongoing maintenance is required to ensure it remains fit for purpose.

As Vector is also the operator of Auckland's electricity network too, in addition to its gas network, Vector is in a good position to learn and evolve network resilience strategies based on outcomes experienced in the gas and electricity networks. For example, where network infrastructure damage has occurred as a result of significant weather events, learnings from the electricity network that are also applicable to gas can be implemented.

Further details of how Vector will administer a safe, secure, and resilient network is described in SECTION 3 of this AMP.

1.5 SUSTAINABILITY

Vector has established a sustainability framework underpinning how we manage our network equipment over its entire lifecycle, and considers the impacts of climate change.

Responding to climate change requires infrastructure providers needing to tackle a dual approach of reducing their emissions as well as adapting to the inevitable physical impacts. Coupled with this is the economic transition to a low emission economy which will inevitably drive prices up for products like gas that have a carbon content.

Vector has undertaken scenario analysis to better understand the climate change driven transition to a net zero emission economy. This will help inform our understanding of how emission pricing will affect the uptake of reticulated gas into the future.

In terms of physical effects of climate change on the Auckland electricity and gas network modelled climate data suggests that wind speeds are projected to significantly increase in the near future. Summer and winter temperatures are expected to increase by almost 1°C by 2050. Other causes for concern include rising sea levels, storm surges, flooding, and erosion. We expect climate change will lead to: increased risks for erosion-prone land, potentially where underground gas assets are located; and increases in flooding events that can impact gas regulator stations.

Vector's assessments are a starting point in improving the business' understanding of the impact climate change will have on our network. Areas of the network that are deemed to be at higher risk will be assessed in more detail over the period of this AMP.

There is no single identifiable plan in this AMP that directly addresses sustainability or climate change. However, there are aspects of our plans and strategies that work together to deliver a more sustainable, energy efficient, and resilient network. Where our asset management plans contribute to Vector's sustainability commitments, we have noted this against the plans in SECTION 5.

1.6 EXPENDITURE FORECASTS

The investments being made into the projects and programmes are planned with the considerations described above to deliver benefit to our customers and improve network reliability, performance, and safety in an efficient manner. Our planned capital (CAPEX) and operational (OPEX) expenditures are set out in detail in SECTION 5 of this AMP, and summarised in Table 1-1 and Table 1-2 respectively.

Of note, we do not see any material impact on our gas supplies from recent Government policy on offshore oil and gas exploration.

FINANCIAL YEAR ($000)

AMP18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Consumer connection	17,358	18,454	16,744	15,891	18,030	15,604	15,740	15,960	16,127	16,330	166,237
System growth	2,195	1,674	1,322	5,502	6,614	1,466	855	327	327	327	20,609
Asset replacement and renewal	1,620	2,096	2,096	2,096	1,885	1,885	1,885	1,885	1,885	1,885	19,217
Asset relocations	3,828	3,507	2,932	3,139	3,108	3,108	3,108	3,108	3,108	3,108	32,058
Quality of supply	431	557	264	200	53	53	53	53	53	53	1,768
Legislative and regulatory	0	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	325	104	0	0	0	0	0	0	0	0	429
Non Network Asset	1,429	1,494	1,905	1,866	1,953	2,034	1,736	1,598	1,408	1,382	16,805
Total CAPEX	**27,186**	**27,944**	**25,263**	**28,636**	**31,642**	**24,150**	**23,377**	**22,931**	**22,909**	**23,086**	**257,123**

Table 1-1 CAPEX for FY19 to FY28

FINANCIAL YEAR ($000)

2018 AMP	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Service interruptions and emergencies	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	21,789
Routine and corrective maintenance and inspection	2,656	2,658	2,660	2,661	2,663	2,665	2,667	2,668	2,670	2,672	26,641
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0	0
System operations and network support	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	25,187
Business support	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	47,256
Total OPEX	**12,080**	**12,081**	**12,083**	**12,085**	**12,086**	**12,088**	**12,090**	**12,092**	**12,093**	**12,095**	**120,873**

Table 1-2 OPEX for FY19 to FY28

VECTOR OVERVIEW

1.7 COMPANY OVERVIEW

Vector owns and operates the gas distribution network in Auckland, New Zealand, supplying gas to over 106,000 installed connection points across the Auckland region from north of Wellsford to Tuakau in the south. Our network has 6,535 Kilometre (km) of underground pipes, and supplied our customers with 14.3 Petajoules (PJ) of natural gas energy in Regulatory year 17 (year ending 31st March) (RY17).

Vector is the country's largest distributor of electricity and gas, owning the lines and pipes to households and businesses across Auckland. It is working innovatively to create a smarter and more affordable energy future. Vector is listed on the New Zealand Stock Exchange with ticker symbol VCT. Our majority shareholder, with voting rights of 75.1%, is Entrust (formerly Auckland Energy Consumer Trust).

STAKEHOLDER	MAIN INTERESTS
Customers	Service quality and reliability, price, health, safety, environment, customer service, customer experience
Central and Local Government & Community	Sustainability, public safety, environment
Retailers	Business processes, price, customer service
Commerce Commission	Quality and standards, governance, pricing levels
Regulators	Health, safety, environment, market, performance
Employees	Health, safety, environment, training, remuneration
FirstGas	Health, safety, environment, performance, compliance
Entrust and Investors	Efficient management, financial performance, governance

Table 1-3 Vector's Stakeholders

1.8 OUR VISION

Vector's vision is to lead the transformation of the energy sector to create a new energy future; identifying and developing options that will provide value, choice, and service for our customers throughout New Zealand.

The future of power will be driven by brilliant new infrastructure that will see true on-demand energy delivered in bold new ways. Unprecedented integration and storage capacities will redefine how consumers generate, source, store, and trade energy, no matter how that energy is produced.

Vector is challenging and transforming how customers connect to infrastructure, which is changing how cities work. We aspire for networks to become smaller, more agile, and more responsive, and will influence so many aspects of how we live.

To help bring about the new energy future, Vector has moved beyond the investment mindset of a traditional infrastructure company. Our focus is less on building more long-life assets that risk becoming obsolete in a changing energy future, and more on shaping our network to deliver a safe, secure, reliable, resilient and cost-effective service.

Vector is forward-thinking, and we have invested in the delivery of an intelligent, connected, open, aware, and powered network platform that enables the delivery of solutions to multiple markets and segments delivering lower cost, greener and more flexible customer energy outcomes. We will deploy this platform first as an intelligent layer on top of traditional electricity networks, but the same technology can be adapted for any network infrastructure environment, including reticulated gas.

1.9 OUR OPERATING ENVIRONMENT

The plans, investments, and strategies outlined in this AMP will help Vector prepare for and take advantage of the complex and rapidly changing environment the energy sector is facing.

In developing these plans, considerable focus has been placed on identifying the key macro-economic trends which are expected to heavily influence business operations, create risks and opportunities, and shape Vector's operating environment.

These key trends and how they influence our operating environment are shown in Figure 1-1.

Figure 1-1 Key macro-economic external trends shaping Vector's operating environment

These trends mean the outlook for our operating environment is one of continued change. The region we serve is continuing to grow; customer behaviour, choice, and participation with Vector is changing; new technologies are impacting our network and how we operate; and increasing global threats and climate change make sustainability an imperative for the business.

Each of these external factors will shape our network's development over the timeframe of this AMP. In the following sections, we consider each of these factors, assess their implications for our network, and detail at how we are responding through our strategies and plans.

SECTION

02. CUSTOMERS, STAKEHOLDERS AND SERVICE LEVELS

SECTION 2. CUSTOMERS, STAKEHOLDERS AND SERVICE LEVELS

Stakeholder requirements form the basis of Vector's asset management practices. They define the level of service required of Vector's assets, and underpin the need for investment. In this section, the primary stakeholders and their requirements are identified from an asset management perspective. Service level metrics and target performance levels are defined and the performance of Vector's assets against the service level metrics is summarised. Where actual or expected performance gaps are found, consideration is given to the underlying root causes that then inform the development of potential investments required to address asset performance and meet or maintain our stakeholder's service level requirements. SECTION 5 sets out our plans to manage asset performance.

2.1 STAKEHOLDER REQUIREMENTS

The essential nature of the services provided by Vector's gas distribution network, and its importance to the Auckland community and economy, creates considerable interest in Vector's asset management practices, and there are a large number of stakeholders. Figure 2-1 identifies the primary internal and external stakeholders that have an interest in how Vector manages its assets.

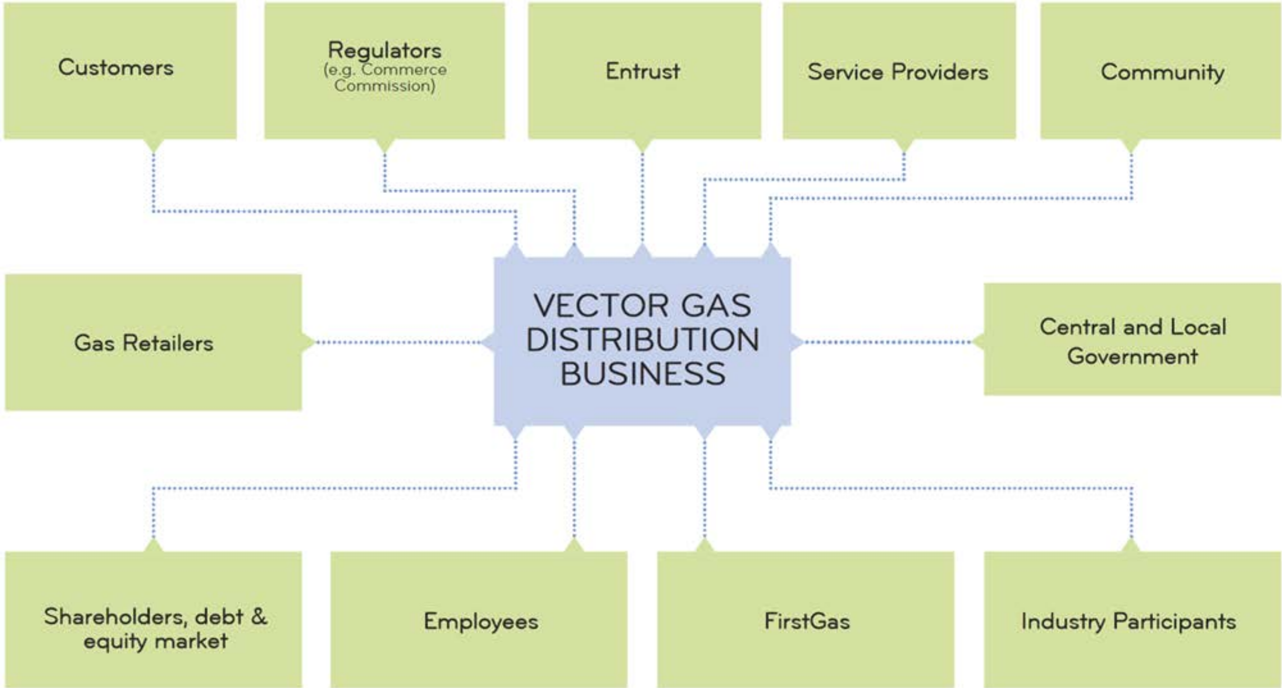

Figure 2-1 Primary stakeholders

To ascertain the service metrics and performance targets that are relevant to managing our gas distribution assets, Vector engages with its stakeholders through a range of channels. These include meetings, discussion forums, political engagement and direct liaison to understand stakeholder needs. Other means of interacting with stakeholders includes surveys, working group memberships, media and publication monitoring, as well as active engagement in the legislative and regulatory consultation processes.

Vector's stakeholders have a broad range of requirements. Table 2-1 provides some insight into some of the stakeholder requirements that impact our business operations. As relevant, Vector's board and management translate our stakeholders' requirements into specific business requirements that influence our asset management practice, through guiding values, shaping objectives and informing service level requirements. This includes the need to prioritise when differing stakeholder requirements conflict.

Public Safety e.g. public and worker health and safety risk management	Confidence in board and management	Participation in policy proposals, and regulatory issues
Sound management of customer issues and information including timely outage management	Good governance, reputation, and fair behaviour	Ensure service providers have stable forward work volumes, and quality work, maintenance, and construction standards.
Quality, Security, and Reliability of supply of gas	Maintain legal and regulatory compliance	Maintain effective relationships and ensure ease of doing business
Sustainability and environmental impact	Prudent risk management	Work with stakeholders to Influence regulators and government
Timely network connections and asset relocations	Develop and maintain a clear strategic direction	Sharing experience and learning with the industry
Engage with community and stakeholders on relevant issues	Return on investment and sustainable growth	Ensure effective coordination of planning and operations with other utilities and stakeholders
Provide cost effective and efficient operations	Accurate and timely information and reporting	Ensure transmission network interface is well maintained.

Table 2-1 Examples of the broad set of stakeholder requirements

From an asset management perspective, stakeholder requirements are translated into objectives that guide asset management practice and into required asset service levels that inform the investment needed to meet and maintain these requirements. Vector has assessed our stakeholder's requirements and formed a set of asset management objectives that are the basis of our asset management policy. SECTION 3 sets out these objectives and provides insight into how they inform our asset management governance and practices.

We have also assessed our stakeholders' requirements and defined a set of service level metrics and associated performance targets that reflect our stakeholders' requirements for the performance of our assets. These metrics have been developed to be meaningful to our stakeholders in terms of the services our assets provide, appropriate to managing our assets and relevant to the investments required to meet and maintain service level performance. Section 2.2 provides details of the service level metrics that we use to assess asset performance and establishes the performance targets that reflect the price quality trade-off that our stakeholders require.

Vector also uses a wide range of asset management metrics (refer Appendix 3) that inform our asset experts about the detailed behaviour and performance of various types of network equipment.

2.2 SERVICE LEVELS

The service level metrics that Vector uses to assess performance of the network against the asset management objectives are described in this section. The service levels include those that are required for regulatory purposes through the Information Disclosure requirements[1] . Further service levels are also measured that inform Vector's asset management practices.

The following sections detail each service level metric, the methodology of measurement and where applicable, the target level set.

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1 Commerce Commission, Gas Distribution Information Disclosure Amendments Determination No.2 2017 21 December 2017.

2.2.1 NUMBER OF CUSTOMER CONNECTIONS

DEFINITION

This service level metric is used to detail the number of new customer connections on the Vector network in the Vector financial year (year ending 30th June) (FY). It includes both actual historical customer connections and forecast numbers for the next 10 years.

MEASUREMENT

The actual number of customer connections in each year is recorded in Gentrack[2] . The net connection number considers decommissioned ICPs, reconnections, disconnections and movements to embedded networks which are subtracted from the forecast dataset. While Vector has reviewed and updated its Gas Capital Contribution Policy[3] , the likely impact on the forecast connections numbers is yet to be fully materialised, and Vector has maintained the connection forecast as last year's AMP for the near term. Customer connection numbers are disclosed in Schedule 12c (Appendix 14).

The connection numbers provide an important input in the Field Service Provider's (FSP) resource planning to design and execute the connections. This metric is also a critical factor in the network planning process.

TARGET

Figure 2-2 in Section 2.3.1shows the forecast for number of customer connections for the planning period.

2.2.2 NUMBER OF CUSTOMER RELOCATIONS

DEFINITION

This service level metric captures the number of relocations requested by customers in the FY. The relocation projects included in this metric are commercial and residential subdivisions, and minor asset relocations. As with customer connections, this metric includes both actual historical customer relocations and forecast numbers for a further 10 years.

MEASUREMENT

The actual number of customer relocations is recorded in Siebel[4] . Relocation projects are managed by Vector's Customer Excellence team. The forecast number of customer relocations is based on an average of the historic relocations, this is because a small percentage of projects are identified in advance, the majority of projects are identified in the year they commence.

TARGET

Figure 2-3 in Section 2.3.2 shows the forecast for number of customer relocations for the planning period.

2.2.3 RESPONSE TIME TO EMERGENCIES

DEFINITION

Response time to emergencies (RTE) is a measure of the time elapsed from when an emergency is reported to Vector to the time Vector's personnel arrives at the location of the emergency.

MEASUREMENT

The RTE is calculated by adding the number of emergencies responded to within one hour or three hours and dividing this number into the total number of emergencies.

TARGET

The RTE target is set by the Commerce Commissions regulatory determination every five years. The process for setting this target is specified in the DPP[5] . For the Regulatory Period (1 October 2017 to 30 September 2022) Vector's RTE targets have been set at the following limits:

- 80% of RTE are responded to within one hour; and

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2 Gentrack is Vector's billing and revenue system.

3 Updated on the 1st of December 2017

4 Siebel is Vector's Customer Relationship Management (CRM) system.

5 Gas Distribution Services Default Price-Quality Path Determination 2017

- 100% of RTE are responded to within three hours.

2.2.4 NUMBER OF UNPLANNED INTERRUPTIONS

DEFINITION

This service level measures the number of unplanned supply interruptions experienced by customers on Vector's distribution network.

MEASUREMENT

The following formula is used to calculate the number of unplanned interruptions per 1,000 customers:

$$Number\ of\ Interruptions\ per\ 1{,}000\ customer = \frac{Class\ C\ (unplanned\ interruptions\ on\ the\ network) + Class\ I\ (unplanned\ interruptions\ caused\ by\ third\ party\ damage)}{Number\ of\ ICPs\ at\ year\ End\ /1000)}$$

TARGET

Vector's overall target level performance is 2.9 interruptions per 1,000 customers per annum. The target is based on the historical average for reference period FY13-FY17.

2.2.5 NUMBER OF POOR PRESSURE EVENTS

DEFINITION

Poor pressure events are a count of the number of unplanned incidents where delivery pressure drops below contracted delivery requirements. Vector uses this measure as an indicator of network capacity to meet customer demand.

MEASUREMENT

Poor pressure events are recorded where the cause of the poor pressure is related to Vector's assets upstream of, and including, the customer isolation valve (CIV). Vector's Quality of Supply (QoS) criteria for system pressure is described in Section 4.3.7.

TARGET

Vector's overall target level performance is four poor pressure events per annum. This target is based on the historical average for reference period FY13-FY17.

2.2.6 PUBLIC REPORTED ESCAPES

DEFINITION

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.

MEASUREMENT

PRE is calculated by dividing the total number of confirmed PRE 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 1,000. The measurement of PRE excludes third party damage events, leaks detected by routine survey and no trace events, and is limited to Vector's assets upstream of, and including, the customer isolation valve (CIV).

TARGET

Vector's overall target level performance is 38 PRE per 1,000km of distribution network. The target is based on the historical average for reference period FY13-FY17.

2.2.7 ENVIRONMENTAL BREACHES

DEFINITION

The environmental breach metric is an annual count of the number of environmental non-compliances, prosecutions, fines, or breaches of any specific local requirements, regional council requirements, or environmental regulations or requirements. It includes breaches related to exceeding noise limits and the release of oil or sulphur hexafluoride (SF6) gas into the environment, from Vector's gas distribution network.

MEASUREMENT

Compliance breaches are captured, processed and reported in Vector's legal compliance reports. The metric is measured and reported monthly and summed for each FY.

TARGET

The performance target value is for no environmental breaches.

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

2.3 SERVICE LEVEL PERFORMANCE

The following sections shows the analysis of the network assets' historical performance against the service level metrics set out in Section 2.2. As per the definitions, it should be noted that performance against all service level metrics is measured in FYs.

2.3.1 NUMBER OF CUSTOMER CONNECTIONS

Figure 2-2 shows the historical and forecast number of customer connections as defined in Section 2.2.1. FY18 customer connections are expected to be lower due a wetter than normal summer period that resulted in slower residential building activities in Vector's gas reticulated areas, and anticipated impact from Vector's updated Gas Capital Contribution Policy.

MEASURE	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
Number of Customer Connections	2,429	2,977	2,780	3,323	3,515	3,169	3,611	3,654	3,663	3,710	3,757	3,640	3,675	3,729	3,771	3,821

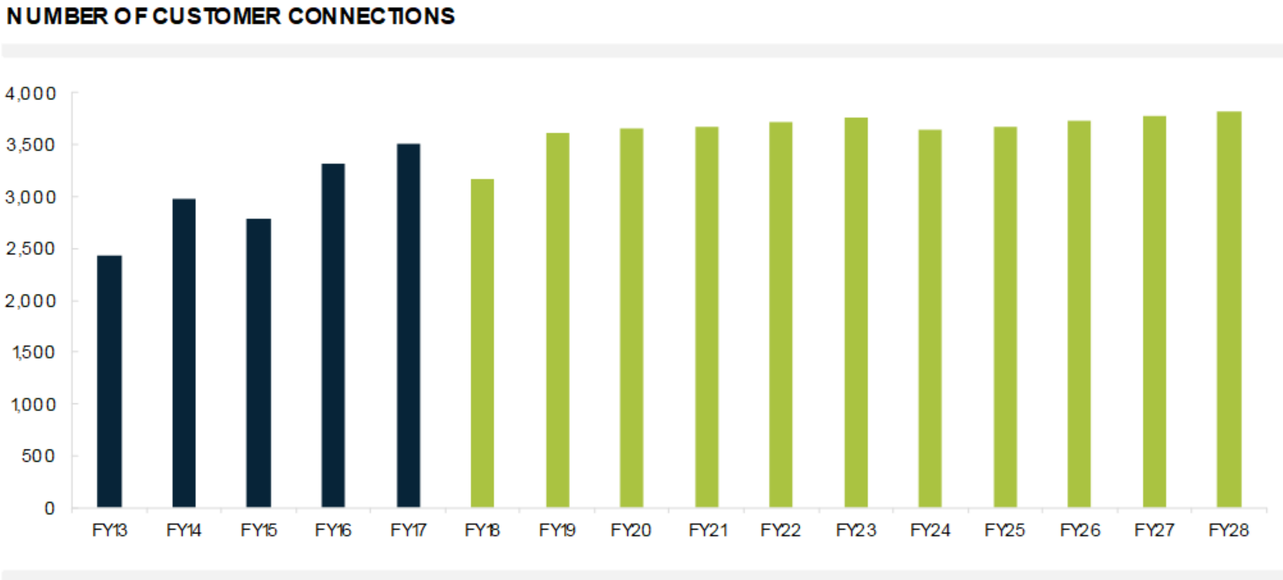

Figure 2-2 Number of customer connections performance

The number of customer connections has been increasing since FY13. This level of new connections is anticipated to continue during the planning period and is in line with growth experienced in the Auckland region, as described in 1.2.

2.3.2 NUMBER OF CUSTOMER RELOCATIONS

Figure 2-3 shows the historical and forecast number of customer relocations as defined in Section 2.2.1.

MEASURE	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
Number of Customer Relocations	5	23	23	23	23	23	23	23	23	23	23	23

NUMBER OF CUSTOMER RELOCATIONS

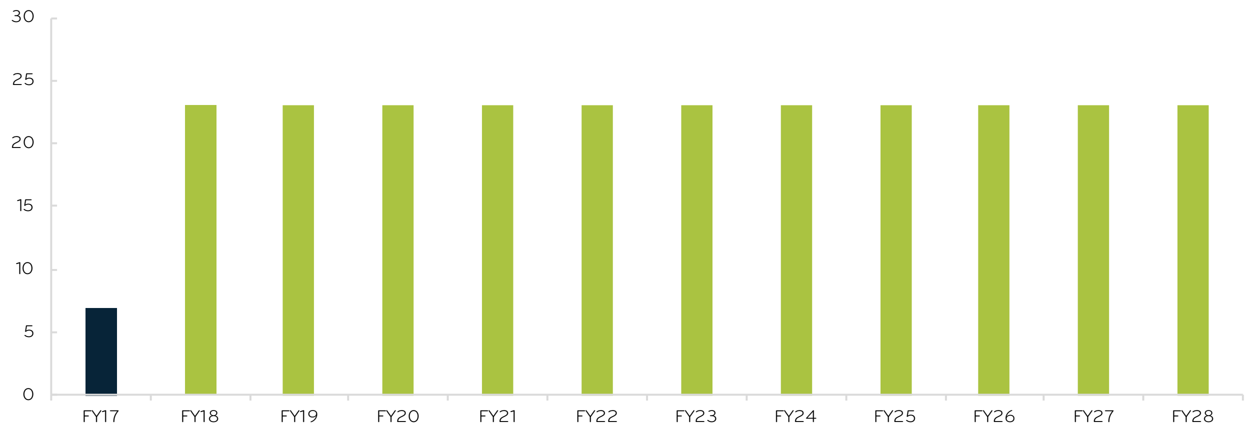

Figure 2-3 Number of customer relocations performance

The number of customer relocations has increased in FY18 due to improved reporting of customer relocation projects. In FY18, there are 23 relocations projects. More recently, there has been an increase in the number of asset relocation projects for road extensions, motorway extensions and subdivision works. However, it is anticipated that future customer relocations will remain constant.

Reference should be made to the asset management plans in Section 5.1 for details of customer relocation projects.

2.3.3 RESPONSE TIME TO EMERGENCIES

For the period ending 30 June 2017, Vector's Response Time to Emergencies (RTE) within one hour and three hours response was 93.8% and 100%, respectively. 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[6] .Table 2-2, Figure 2-4 and Figure 2-5 shows the comparison of RTE for the previous five years against Vector's target.

MEASURE	2013	2014	2015	2016	2017	TARGET
Proportion of RTE within one hour	95.4%	94.0%	96.1%	95.6%	93.8%	80%
Proportion of RTE within three hours	100%	100%	100%	100%	100%	100%

Table 2-2 Response to emergencies performance

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6 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)

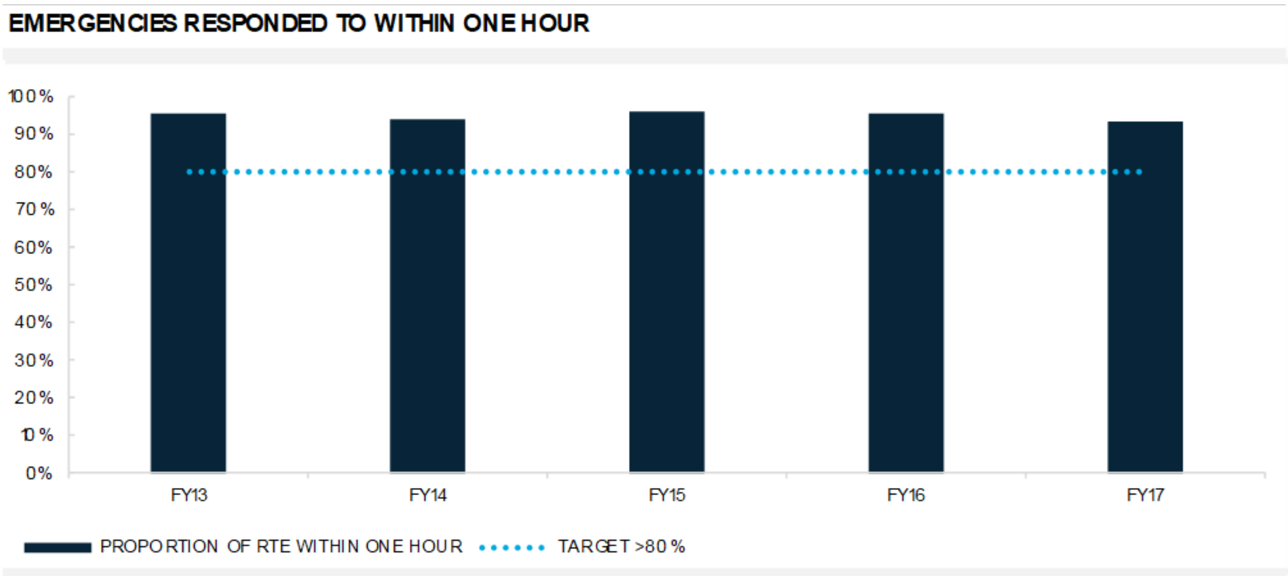

Figure 2-4 Response to emergencies within one hour

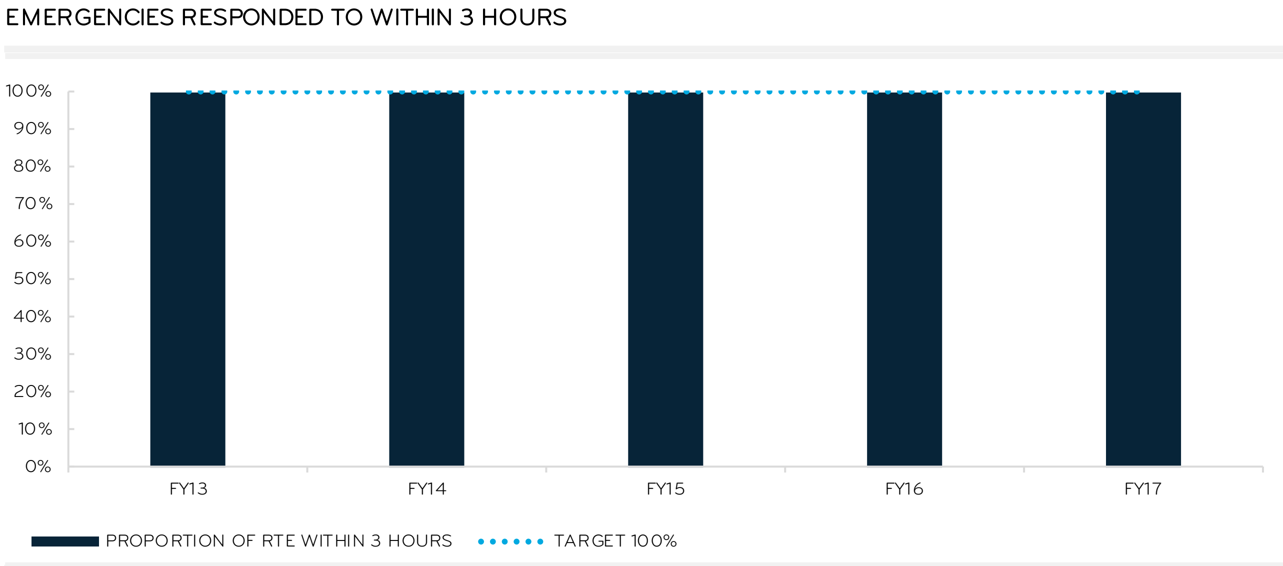

Figure 2-5 Response to emergencies within 3 hours

For the period ending 30 June 2017, Vector's RTE targets were met or exceeded. This demonstrates that Vector's current reactive maintenance programme is effective at ensuring that response times to faults and emergencies are appropriate.

2.3.4 NUMBER OF UNPLANNED INTERRUPTIONS

For the year ending 30 June 2017, Vector's number of unplanned interruptions performance was 2.6 interruptions per 1,000 customers, below Vector's target of (less than) 3.3. Table 2-3 and Figure 2-6 shows the comparison of the number of unplanned interruptions for the previous five years against Vector's target.

MEASURE	2013	2014	2015	2016	2017	TARGET
Number of unplanned interruptions	2.2	3.0	3.7	3.0	2.6	2.9

Table 2-3 Number of unplanned interruptions performance

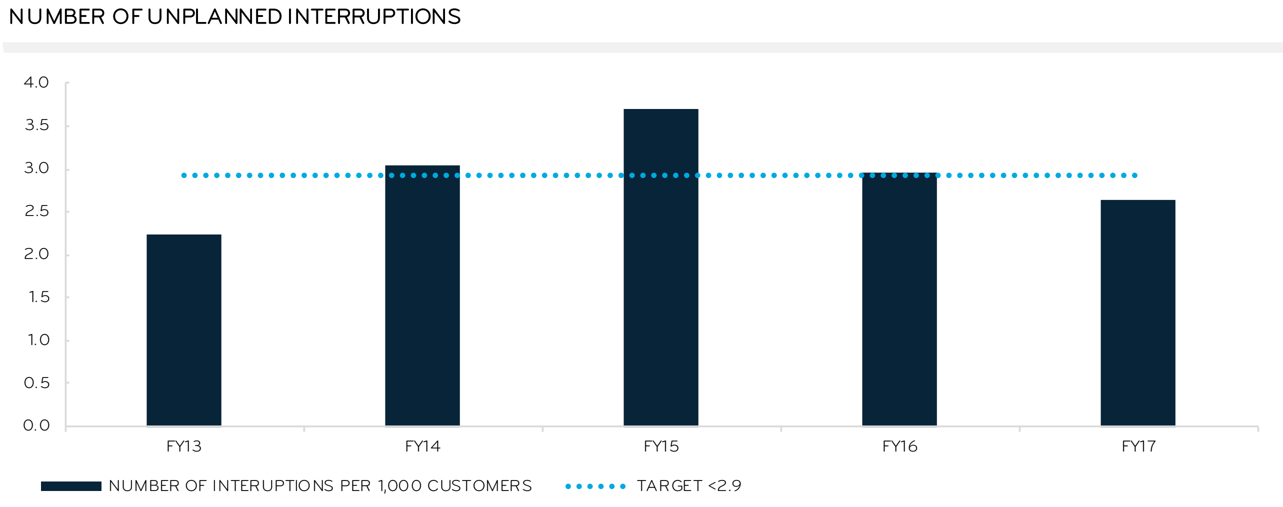

Figure 2-6 Number of unplanned interruptions performance

For the year ending 30 June 2017 approximately 80% of total unplanned interruptions were caused by third party damage, with the majority of the balance being caused by equipment failure; the split between third party damage and equipment-failure related interruptions was similar to that for the preceding year. Over recent years, the total count of unplanned interruptions and the count of interruptions caused by third party damage have trended downwards. This trend demonstrates that Vector's current maintenance programmes (i.e. for reactive maintenance, preventive maintenance, corrective maintenance and third party services) and asset renewal programmes (e.g. service regulator removal, riser valve audits etc.) are appropriate strategies to achieve ongoing network performance improvements.

Vector's unplanned SAIDI result for FY17 was slightly higher than for FY16 and considerably higher than for FY15 and preceding years. The higher than expected unplanned SAIDI result for FY17 was due to two events that each affected 1 customer and resulted in a combined outage of approximately 210 hours, and a third event that affected 12 customers for approximately 19 hours; these 3 events accounted for approximately 70% of the unplanned SAIDI result for FY17.

2.3.5 NUMBER OF POOR PRESSURE EVENTS

For the year ending 30 June 2017, Vector's poor pressure performance was five events, slightly above Vector's target of (less than) four events per annum. Table 2-4 shows the comparison of poor pressure events due to network causes for the previous five years against Vector's target.

MEASURE	2013	2014	2015	2016	2017	TARGET
Number of poor pressure events	2	4	4	4	5	4

Table 2-4 Poor pressure events performance

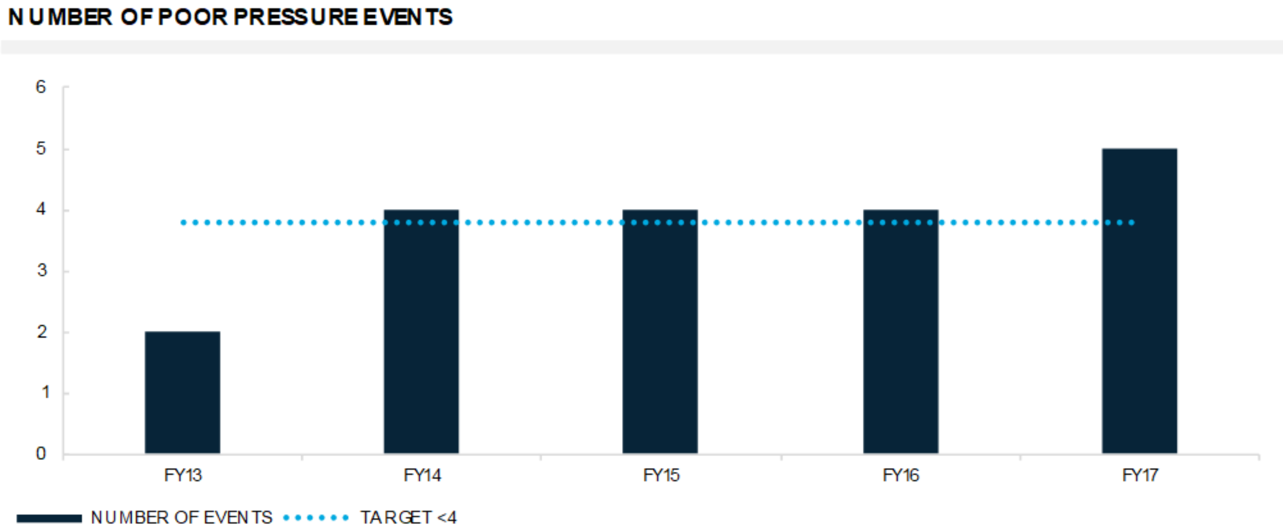

Figure 2-7 Poor pressure events performance

Analysis of poor pressure events for the year ended 30 June 2017 indicates that all of the events were related to either a service pipe fault, a service fitting fault or a service regulator fault; none of the events related to poor pressure on the mains network. Three of the events related to blockages of a service pipe (e.g. due to foreign matter inside the pipe); one event was related to a partially closed service valve and one event was caused by a fault on an upstream service regulator. The absence of poor pressure events on the mains network can be attributed to the level of permanent telemetry monitoring currently installed on the network, and the annual pressure monitoring and network analysis programmes that Vector undertakes to identify constraints on the network.

2.3.6 PUBLIC REPORTED ESCAPES

For the year ending 30 June 2017, Vector's PRE performance was 30 PRE per 1000 km of distribution system, below Vector's target of (less than) 38. Table 2-5 below shows the comparison of PRE for the previous five years against Vector's target.

MEASURE	2013	2014	2015	2016	2017	TARGET
PRE per 1,000 km	43	41	43	32	30	38

Table 2-5 PRE performance

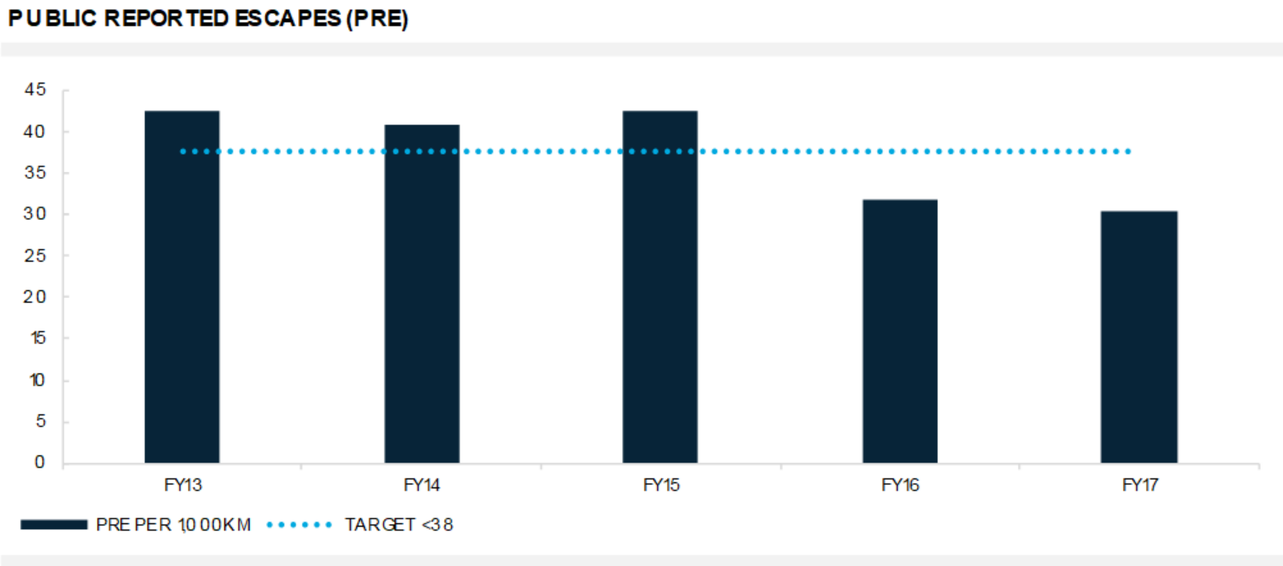

Figure 2-8 PRE performance

For the year ending 30 June 2017 approximately 45% of all PRE related to service riser faults (i.e. riser valve, pipe or crimp joint); a further 20% of PRE related to service pipe faults (i.e. service pipe or fitting) and the balance related to mains pipes and fittings, DRS and service regulators etc. Over recent years the PRE rate has trended downwards; this trend demonstrates that Vector's current maintenance programmes (in particular preventive maintenance and corrective maintenance), and asset renewal programmes (e.g. pre-1985 Polyethylene (PE) pipeline replacement, riser valve audits etc.) are appropriate strategies to achieve ongoing network performance improvements. Further analysis of service riser related faults is planned to identify opportunities to further reduce this type of PRE.

In FY16 Vector modified the preventive maintenance cycles for leakage survey to take advantage of the efficiency gains that the recently introduced SELMA leak detection equipment could provide (this equipment employs laser technology to identify methane releases). The existing annual survey cycle was left unchanged, however all other leakage survey cycles were reduced to two years. This change resulted in a marked increase in the number of leaks detected by leakage survey, and a corresponding decrease in the number of PRE; this result has shown through in the PRE trend described above, and has allowed Vector to take a proactive approach in managing gas leaks to achieve a better public safety outcome.

2.3.7 ENVIRONMENTAL BREACHES

Vector has not breached the environmental target of no environmental breaches, which is defined in Section 2.2.7. Achieving this target requires consistent and effective environmental management. It is expected that there won't be any environmental breaches, provided asset maintenance continues as per their respective maintenance standards, which ensures compliance with our asset management objective.

2.4 PROCESS FOR RECORDING REACTIVE FAULT INFORMATION

Vector's FSP undertakes data capture activities within the gas distribution network. The FSP manages data in accordance with Vector's requirements as defined in the Vector standard Gas Network 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
- System Average Interruption Duration Index (SAIDI) Unplanned
- SAIDI Planned
- System Average Interruption Frequency Index (SAIFI) Unplanned
- SAIFI Planned
- Customer Average Interruption Duration Index (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 2-9 shows how the reactive fault information is recorded and checked for completeness.

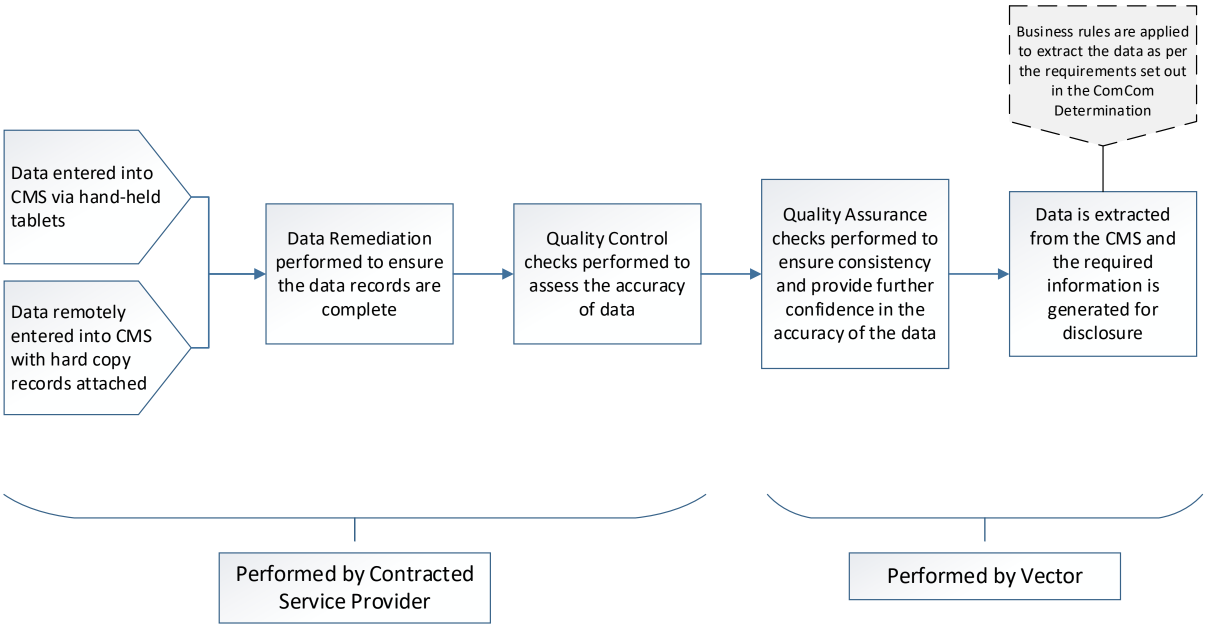

Figure 2-9 Process for capture and QA of reactive fault information

SECTION

03.

ASSET MANAGEMENT SYSTEM

SECTION 3. ASSET MANAGEMENT SYSTEM

This section of our 2018 AMP provides insight into Vector's asset management practice. The objectives and scope of asset management practice are presented along with an outline of the governance arrangements that we apply. An overview of Vector's asset management practices is also provided in this section and the primary policies, standards, information systems and data that support and enable our practice are identified. An assessment of the maturity of our asset management practice is presented along with consideration of how Vector intends to improve its practice over the timeframe of this AMP.

Vector's asset management is a multi-utility practice that includes both gas and electricity distribution assets. While these practices have much in common, the specific nature of each asset type requires differing approaches for some aspects of asset management. In this section, and throughout this AMP, the scope of asset management is limited to Vector's gas distribution network. Vector is also in the process of developing its asset management practice, and accordingly, the way asset management practice is described in this AMP differs from previous AMPs.

3.1 ASSET MANAGEMENT VALUES AND OBJECTIVES

Vector's asset management policy is the overarching governance document that defines the principles and objectives that guide all aspects of our asset management practice. These principles and objectives accord with our corporate values and align with our corporate vision.

Vector is committed to ensuring safe, reliable and cost effective gas distribution services for the benefit of all our customers. This commitment is demonstrated through the principles and objectives that we apply in managing our network assets.

- Safety is our highest priority, and we strive to prevent harm to employees, contractors and the public through the management of our assets over their entire lifecycle;
- We strive to serve our customers by managing our assets to provide a reliable, sustainable, resilient, and efficient distribution network that meets our customer's present and future service expectations;
- Delivering value to our customers and shareholders is at the core of our business and we maximise the value that our assets deliver across their entire lifecycle through good practice asset management, risk management and sound asset investment decisions;
- Our asset management is fact based, drawing on analysis of data to drive understanding and underpin the creative management of our assets in the long-term interests of our customers;
- We care for our natural environment, and so we manage our assets and work with our suppliers to improve energy efficiency, reduce greenhouse gases and minimise the environmental footprint of our distribution network assets;
- We create sustainable value through a long term strategic focus that we leverage to drive an innovative approach to asset management that aligns with Vector's corporate vision and goals as a multi-utility asset manager; and
- As a regulated provider of distribution network services, we aim to comply with all applicable statutory and regulatory obligations and draw on good asset management practice to achieve and maintain this compliance.

In addition to these principles and objectives, Vector's asset management practice seeks to accord with the principles of ISO 55001 and reflects a whole of lifecycle approach.

3.2 ASSET MANAGEMENT SCOPE

Throughout this AMP, the scope of asset management is limited to Vector's gas distribution network, while the scope of our plans covers the period from 1 April 2018 to 31 March 2028. Consistent with Information Disclosure requirements, a greater level of planning detail is provided for the first five years of this period.

The primary asset within this scope is Vector's gas distribution network. This asset is an interconnected network that operates as a geographically distributed machine with many interdependent elements as shown in Figure 3-1. However, for the purposes of this AMP, we have defined asset categories that correspond to the major functional elements of our network. Table 3-1 shows the asset categories we have adopted in this AMP and compares them to the Information Disclosure asset categories[7] .

SCHEDULE 11A(III) ASSET CATEGORIES	AMP ASSET CATEGORIES
Mains pipe Service pipe	Distribution pipelines
Stations	Stations
Line valve	Valves
Special crossings	Special crossings
Other network assets Monitoring and control systems Cathodic protection systems	Monitoring and control systems Corrosion protection systems

Table 3-1 Asset category relationships

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7 Commerce Commission, Gas Distribution Information Disclosure Determination 2012.

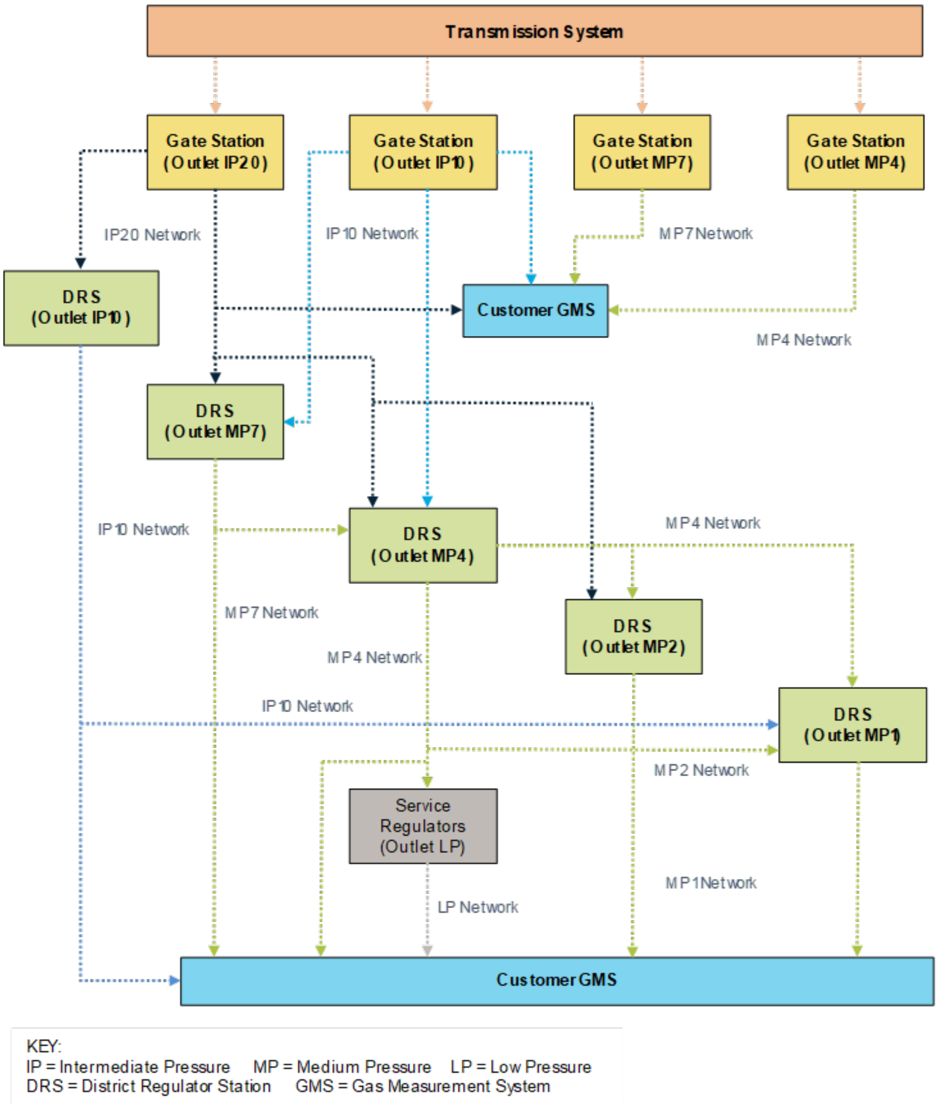

Figure 3-1 Network topology diagram

While Section 4.1 and Appendix 10 provide details that align with the Information Disclosure asset categories, Vector's broader AMP is developed in terms of the AMP asset categories shown in Table 3-1. Vector has developed its AMP based on these asset categories as they better reflect how our network operates.

Further details of Vector's gas distribution network assets, how they are defined and key statistics, is provided in 3.8.

3.3 VECTOR'S ASSET MANAGEMENT ORGANISATION AND GOVERNANCE

Vector's asset management organisation and our governance structure is shown in Figure 3-2. This structure provides oversight and controls all aspects of our asset management practice. An overview of the asset management responsibilities and governance roles within this structure are set out below.

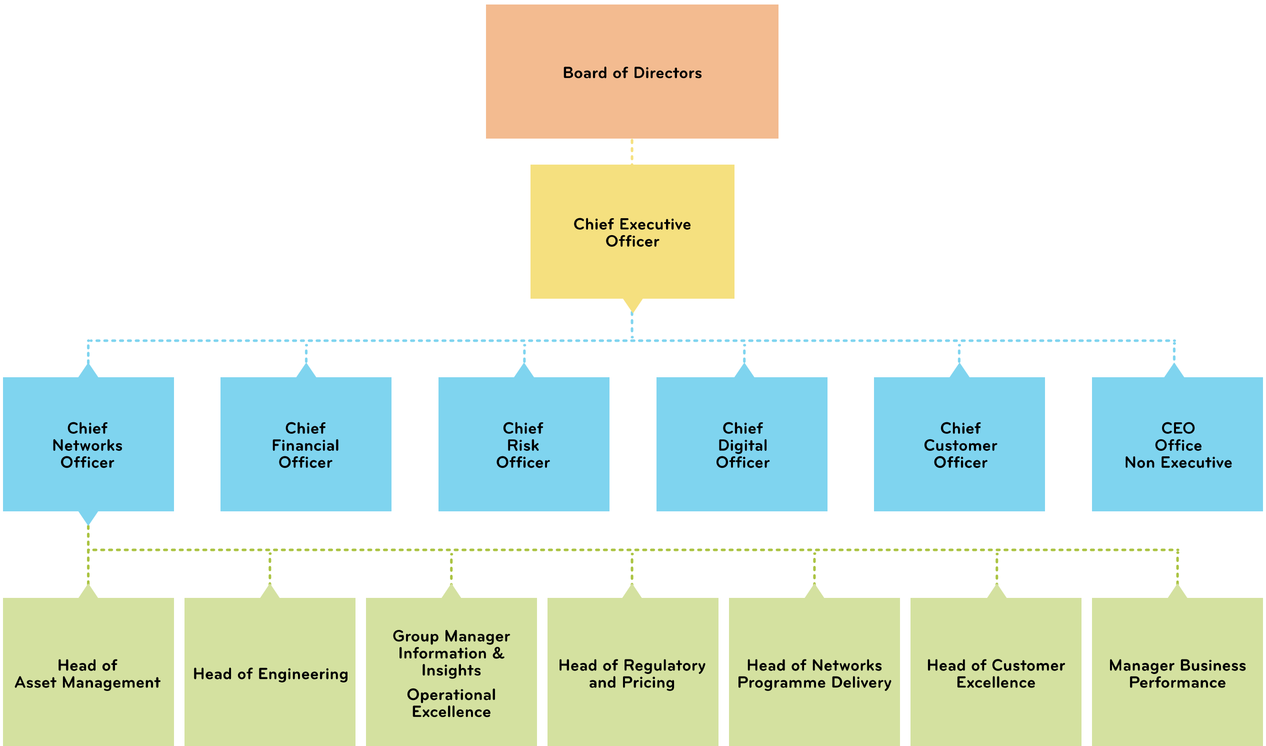

Figure 3-2 Asset management governance structure

3.3.1 BOARD OF DIRECTORS

At the highest level, the Board of Directors operates under the Board Charter, and provides governance over all aspects of Vector's asset management practices on behalf of Vector's owners and the broader stakeholder community. While taking advice from Vector's management, the board exercises oversight of the objectives of asset management, its strategic direction, investment approvals and the customer service level outcomes achieved by Vector's gas distribution network. Overall budgets, significant asset investments and Vector's AMP are reviewed and approved at the board level.

Vector's Board of Directors maintains its asset management oversight through the implementation of governing policy, a Delegated Authorities' Framework (DAF), management reporting and periodic reviews including internal and external operational audits. The Board also receives performance reporting which among other things include reporting against key service levels and regulatory reliability targets.

3.3.2 GROUP CHIEF EXECUTIVE

Under the DAF, the approved strategic plan, approved annual budgets and the day to day operation of the business is the responsibility of the Group Chief Executive (GCE). The GCE maintains oversight of Vector's asset management practices, including service level outcomes, strategic direction and investment approvals. To assist with this oversight the GCE receives performance reporting against key metrics and service levels which include reporting against regulatory reliability targets.

All Vector's activities are governed through the DAF which links approved budgets to the authority to authorise or commit expenditure. Under this structure, the GCE has delegated overall responsibility for the gas distribution business to the Chief Networks Officer (CNO).

3.3.3 CHIEF NETWORKS OFFICER

Under delegation from the Board and GCE, the CNO has full responsibility for Vector's gas distribution business. This includes the establishment and enforcement of Vector's Asset Management Policy, the overall performance of Vector's gas distribution network, development and implementation of the approved AMP, and budgetary control with the DAF.

Within the asset management context, the CNO is supported by the Chief Financial Officer, Chief Risk Officer, Chief Customer Officer and the Chief Digital Officer in ensuring that appropriate systems, policies and procedures are in place that support and enable asset management, as well as implementation of the management and governance practices required by the Board of Directors and GCE. The CNO role is responsible for compliance with the requirements of Vector's risk management framework, delegated financial authorities, and in conjunction with the Chief Digital Officer, for ensuring that Vector's Digital Strategy meets the needs of our asset management practice and enables our network vision (see Section 5.3.1).

3.3.4 HEAD OF ASSET MANAGEMENT

The Head of Asset Management reports to the CNO and has responsibility for the day to day operation of Vector's asset management practice. This position is responsible for ensuring that Vector's Asset Management Policy is implemented, for monitoring the service level performance of our assets, for the development of asset strategy, for the development of Vector's AMPs (including maintenance standards) and for developing asset management practice. This role also has limited budgetary control within the DAF.

3.3.5 HEAD OF ENGINEERING

The Head of Engineering reports to the CNO and is responsible for Network Planning, Engineering and Design Standards, as well as development and integration of new technology options. The primary focus of this role is planning and development of the assets to meet the required service levels and to achieve Vector's network vision (see Section 1.8). In particular, the Head of Engineering is responsible for the service levels associated with the Security of Supply (SoS), quality of supply and for new connection demand associated with large or unusual connections, as well as demand for significant asset relocations (see Section 2.2).

3.3.6 OTHER SENIOR POSITIONS THAT SUPPORT ASSET MANAGEMENT

There are several other senior roles that provide critical support to the CNO role, the Head of Asset Management and the Head of Engineering. Specifically:

- **Head of Customer Excellence:** this role is responsible for ensuring customer expectations are met through the Call Centre Management and Customer Initiated Projects processes. The Head of Customer Excellence also champions the voice of our customers within Vector's asset management practice.
- **Group Manager Information & Insights:** this role is responsible for Networks Analytics, Business Intelligence, as well as Networks Risks and Investigations. This function provides analytical support and information that is essential to understanding asset performance, developing and evaluating asset strategy and managing asset risks.
- **Head of Networks Programme Delivery:** this role manages the day to day networks operations and the Electricity Operations Centre (EOC) as well as delivery of the approved CAPEX and OPEX works programme under Vector's Multi Utility Service Agreement (MUSA) with our FSPs. The works programme is delivered through our Project Delivery Framework (PDF) that ensures compliance with Vector's requirements and in accordance with the AMP. Section 6.3 provides further details of the PDF.
- **Head of Regulatory and Pricing:** this role ensures that Vector's regulatory activities and pricing is managed appropriately. The Head of Regulatory and Pricing provides regulatory compliance oversight as well as expert regulatory advice and support to Vector's asset management practice.

The governance framework overarching each of these roles is defined by Vector's DAF, the Delegated Financial Authorities Policy (DFA) and position descriptions for each role. Vector's Board has delegated specific authorities to the GCE and authorised delegation of certain authorities to other levels of Vector's management. The limits and rules applied to delegations are prescribed in the DAF documentation and govern the authority to commit to transactions or expose Vector to a risk.

Vector's Enterprise Resource Planning (ERP) System (SAP) is the primary management system used to implement the DAF and DFA. Financial delegations for approvals under the DAF for OPEX and CAPEX are set and managed within Vector's ERP system. Periodic audit of the DAF is undertaken to ensure ongoing compliance. The ERP system also provides control of asset management workflows, as well as the management of information that enables our asset management and project management practices. Further details of Vector's asset management practice and our project management practice are provided in Section 3.5 and Section 6.3 respectively.

3.4 KEY DOCUMENTS

3.4.1 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;
- New Zealand Standard (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 asset management documentation. Table 3-2 provides an overview of these governing documents which are used to create 'line-of-sight' in preparing the AMP.

KEY DOCUMENT	DESCRIPTION
Business Plan	The business plan shows Vector's goals and discusses at a strategic level how Vector is going to achieve them. It provides direction to our AMP in managing our assets to achieve the outcome in the business plan.
Organisational Policies and Standards	Vector has many policies and standards that provides a course of action or guidelines for staff. See Section 3.4.2 and 3.4.3 for policies and standards, respectively, that relates to asset management.
AMP	Vector's AMP is a tactical plan for managing the physical assets to deliver an agreed service levels to achieve the objectives and goals outlined in the business plan.
Operational Programme	The output of the AMP is the operational programme which drives OPEX on Vector's gas distribution network. It informs the development of asset maintenance plans.
Capital Programme	The outcome of the AMP is the capital programme which drives CAPEX on Vector's gas distribution network. It informs the business cases prepared for capital investments.

Table 3-2 Key documents that informs asset management

Vector has a robust set of policies and standards that inform our asset management practice, supported by a continuous improvement process to review and update processes and documentation. The following subsections provide insight into these governing documents and how we use them.

3.4.2 MAJOR POLICIES

Vector's major asset management policies are listed in Table 3-3 along with a brief description of how each policy informs our asset management practice.

POLICY DOCUMENT	ROLE IN ASSET MANAGEMENT PRACTICE
Asset Management Policy	This policy is Vector's formative asset management document. It defines the principles and objectives that guide all aspects of our asset management practice. Further details of our asset management policy is provided in Section 3.1.
Delegated Financial Authorities Policy	The DFA has a primary role within Vector governance practices that are defined by Vector's DAF. The DFA governs the level of financial commitment that specific roles can make on behalf of Vector. All decisions within asset management that require expenditure or involve significant risk will be made under this policy and in accordance with Vector's project approval process. Under this policy, projects in the early stages of development are given preliminary approval, while final approval must be provided before expenditure is committed. Further information on Vector's governance practices as they relate to asset management can be found in Section 3.3.

Networks Risk Management Process	This document sits under Vector's Corporate Risk Policy and Risk Management Guideline. The Network's Risk Management Process sets out specific requirements for asset risk management including how risk is to be managed, identified, assessed, and reported. Further information on Vector's network risk management practices are provided in Section 3.5.
Health and Safety Policy	This policy sets out Vector's commitments and requirements for health and safety. Vector will conduct its business activities in such a way as to protect the health and safety of all workers of Vector Limited and its related companies ("Vector People"), the public and visitors in its work environment.
Environmental Policy	This policy sets out Vector's commitment for managing the environmental aspects of its businesses and sets out the standards expected of all workers of Vector Limited and its related companies ("Vector People").
Gas Distribution Safety and Operating Plan	This Safety and Operating Plan (SAOP) has been developed for Vector's gas network to detail the controls in place to mitigate the risks that have been identified under the hazard and risk assessment processes for minimisation of harm to persons, property, the public and the environment, including emergency response.

Table 3-3 Major asset management policies

Appendix 2 provides an overview of other important asset management policies and related documents that inform specific aspects of Vector's asset management practice.

3.4.3 MAJOR STANDARDS

Standards are an integral part of our asset management framework and Vector applies a large number of these standards to the management of our gas distribution assets. Table 3-4 lists the major standards that support the procurement, supply, commissioning. operation and maintenance of existing, new or replacement assets.

ASSET STANDARD	ROLE IN ASSET MANAGEMENT PRACTICE
Planning Standards	These standards guide the planning and development of Vector's overall distribution network. They work in conjunction with the service level metric to ensure that the network has sufficient capacity and capability to provide the required service levels, enable customer connections, and accommodate growth. These standards also set requirements that enable appropriate operation of the network in accordance with the Network Operating Standards (see below). Further information is provided in Section 3.5.
Maintenance Standards	Vector has developed a set of maintenance standards for each major class of asset. These detail the required inspection, condition monitoring, maintenance and data capture requirements. Where a cyclic maintenance strategy is applied, these standards also set out the maximum maintenance cycle frequency. These standards implement compliance with our asset management policy and ensure our assets continue to operate across their design life to provide the required service levels (see SECTION 2).
Network Operating Standards	These standards define protocols and procedures for operating and controlling Vector's gas network, including contingency plans. They also inform minimum requirements for network planning and design practices.
Design and Construction Standards	There are a large number of these standards and they cover the detailed design and installation of Vector's network equipment.
Technical Specifications	Vector has a number of technical specifications which specify the materials and equipment to be used on the gas network.
AS/NZ Standards AIEC Standards	A large number of Australian and NZS, as well as International Electrotechnical Commission (IEC) standards are applied in specifying, developing, and maintaining Vector's gas distribution assets. A full list of these standards is beyond the scope of this AMP.

Table 3-4 Major asset standards

Vector uses a range of other standards and related documents in its asset management practice. A listing of some of the more important standards can be found in Appendix 2.

3.5 ASSET MANAGEMENT PRACTICE

The following sections provide an overview of the practices and principles that Vector applies in the management of its gas distribution assets. These practices are set in the context of our asset management framework that guides implementation, operation and improvement of asset management. Each of the major asset management process elements is described below with attention given to some specialist aspects of our practice.

3.5.1 ASSET MANAGEMENT FRAMEWORK

At the broadest level, Vector's asset management practice reflects an asset lifecycle approach guided by the principles of ISO 55001 and this is reflected in our Asset Management Framework shown in Figure 3-3.

Our framework is grouped into five sections to reflect the major stages of Vector's asset management practice. These five stages are highlighted in Figure 3-3 and described in the following sections.

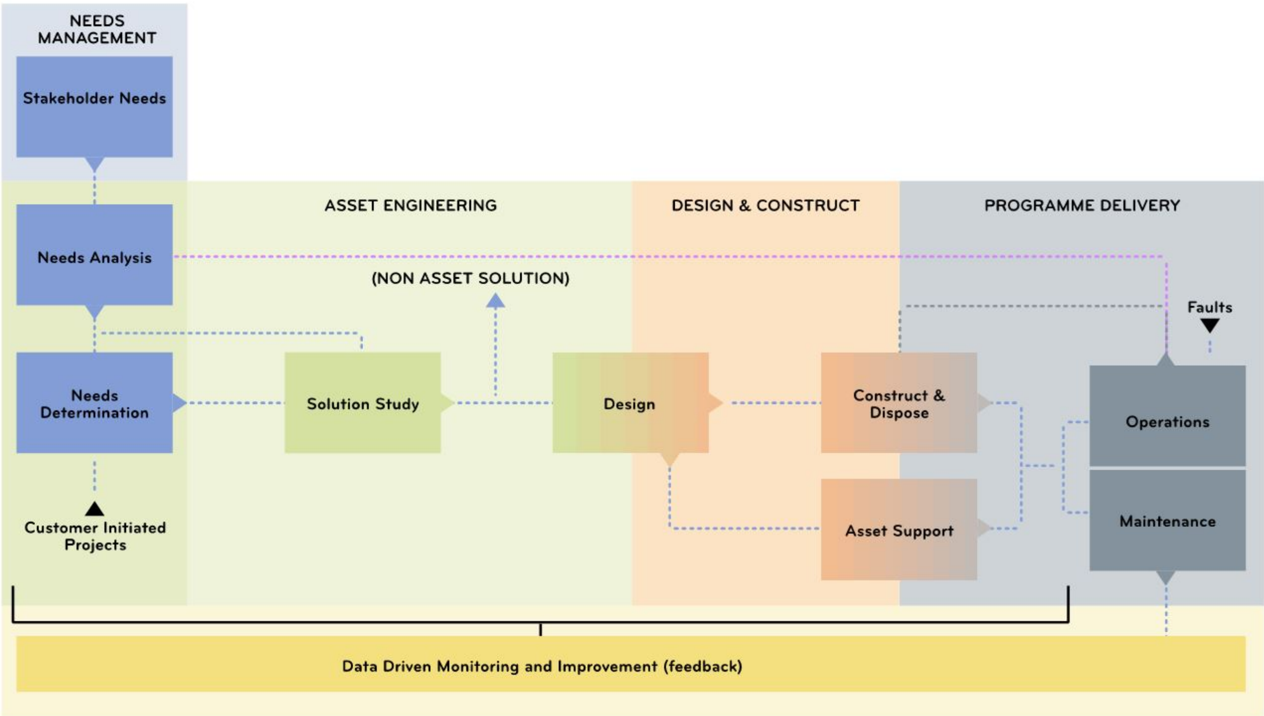

Figure 3-3 Asset management framework

3.5.2 NEEDS MANAGEMENT

This is the formative stage of our asset management practice and involves Stakeholder Needs identification, Needs Analysis and Needs Determination. During this stage, Vector engages with its stakeholders to identify and understand their service needs and requirements. By understanding stakeholders' requirements, Vector is able to develop meaningful service level metrics and associated performance targets that are used to assess asset performance. SECTION 2 provides details of our primary stakeholders and the service levels metrics and targets we use in managing our gas distribution network assets.

On an annual basis, Vector assesses asset performance against the service level targets defined in Section 2.2. Using asset data from SAP and supported by Vector's data analytics layer, analysis of performance volatility and trends are used to identify any significant systemic performance issues. While focus is placed on understanding the assets' historical performance, Vector also considers our assets expected future performance. Any actual or expected performance gaps are identified, and root cause analysis and risks analysis are undertaken to identify the source and significance of any actual or expected service level breaches. Details of the service level gap analysis, root cause analysis and asset needs analysis are provided in Section 2.3.

The result of this analysis is to identify the need for asset related services and network development, or corrective or preventative interventions, that address actual or expected degradation of service performance outcomes. Project proposals are created to address these needs. These proposals specify the need identified, the options considered to address the need and the preferred option. Project proposals are also created through the network planning process (see below), which is responsible for managing the development of the network through a probabilistic planning approach.

All project proposals are approved by Vector's subject matter experts and are then subjected to a portfolio optimisation process as described in Section 6.1. Through the portfolio optimisation process, any conflicting requirements are addressed by trading off requirements to select the option with the greatest overall benefits and least cost. The project proposals for this AMP are provided in SECTION 5 and the trade-off's made through the optimisation process are set out in SECTION 6. The results of the portfolio optimisation process inform the work undertaken in Asset Engineering (see Section 3.5.3).

NETWORK PLANNING PRACTICE

Vector's network planning practice forms an important specialist aspect of Needs Management that applies across the segment, focusing on network development. Our network planning practice involves processes to manage network peak demand (organic growth), and need for asset services initiated directly by customers that may have significant network implications (i.e. major connections, unusual loads and major asset relocations).

The need for asset services initiated directly by customers includes network connection need and asset relocations. Sections 2.2.1 and Section 2.2.2, respectively, describe the service level metrics for connections and asset relocations, and consider the need for these services. In most cases, network connections and asset relocations are managed directly by Vector's FSPs who undertake design, execute project works and maintain associated asset records, in accordance with Vector's standards. Where practical, opportunities to combine network development or asset replacement works with customer initiated works are leveraged to achieve cost savings and other advantages.

Growth in network peak demand (organic growth) is managed under the service level discussed in Section 2.2.5. Section 2.3.5 analyses the performance of the service level against Vector's QoS criteria (GNS-0074). The QoS criteria captures a cost-quality trade-off that reflects the ability of our assets to accommodate gas demand without breaching QoS requirements, and to provide restoration capacity that supports planned and unplanned supply interruption events. Performance against QoS is managed through an annual network planning cycle that involves:

- Development of Vector's annual network load forecast in accordance with the Gas Distribution Forecast Utilisation (GNS-0086). An overview of Vector's load forecasting process is provided later in this section;
- Updating of Vector's network model with asset changes and the latest load forecast in accordance with GNS-0089 Gas distribution model building. To support this practice, data on customer connections is extracted from Gentrack and Smallworld;
- Modelling of the network to identify future capacity or security constraints that breach the QoS service level requirements. Modelling is undertaken using Synergi Gas, our network modelling software, and in accordance with the Gas Distribution Model Building standard (GNS-0089). This model includes the capability of modelling all pressure systems to ensure adequate capacity under contingency conditions or other nominated scenarios including future loads increases, the impact of investment in additional network capacity and effect of seasonal load and asset ratings to meet QoS.
- Where a breach of the QoS service level is identified, a risk assessment is undertaken and options developed as outlined under Asset Engineering (see above). Any proposal to respond to an expected breach will be developed to address the breach on a just-in-time basis, and are developed in accordance with Vector's corporate and asset strategies and with the Piping System Design standard (GNS-0002).

The QoS criteria is also taken into consideration when reviewing asset replacement options, and any synergies with network development works are investigated. Moreover, not all breaches of the QoS criteria are addressed through network investment, as in some cases non-network solutions are practical and more economical.

Further information regarding the standards used in Vector's network planning practice are provided in Section 3.4 and Appendix 2.

NETWORK LOAD FORECASTING PROCESS

A time-series moving average model has been developed for gas demand forecasting. The model delivers steady-state winter peak loads, at gate-station level, forecasted for the ten-year planning period effective from the date of the published AMP. Hourly daily readings from each gate station form the basis of historical data, from which monthly flows are summarised into quarterly peak values, allowing seasonal trends to be observed. Because the gate station meters provide data for upstream network reconciliation and billing a high degree of accuracy is inherent. Input into the time-series was taken as the maximum flow of each quarter (Jan-Mar as Q1, Apr-Jun as Q2, etc).

Various gate stations are comprised of multiple supply streams and therefore are fitted with multiple meters, resulting in multiple simultaneous meter readings. At these sites, hourly flows are summed to account for either parallel supply or switching of supply streams. Graphical presentation of the trends allows easy identification of zero, anomalous or incomplete data, which can then be omitted or corrected.

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-term growth trend within the time-series. Secondly, historical flow data is seasonally adjusted and the trend of the adjusted quarterly flow values is extrapolated 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 "zero", and derived values for successive years during the ten-year 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 any individual gate station peak flow. 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.

Vector's load forecasts can be found in Appendix 14 of this AMP.

RISK MANAGEMENT

Risk management is integral to Vector's asset management process. Vector's Risk Management Policy sets out the objectives and rationale for risk management and governs asset risk management practice in line with the global risk management standard ISO 31000:2009 Risk management – Principles and guidelines.

Vector's risk management framework reflects the nature of our business as a supplier of critical infrastructure, a leading New Zealand-listed company and an operator of high hazard businesses. Accordingly, Vector's risk management practice is audited and certified to NZS 7901 Electricity and Gas industries – Safety management practice for public safety, and incorporates a risk control audit and assurance programme.

Vector's enterprise-wide approach to risk management:

- Provides a single complete view of risk, and ensures a consistent appraisal and treatment is applied across the business;
- Aligns across a number of profiles and contexts (as illustrated in Figure 3-4), to support the achievement of strategic corporate objectives while ensuring key operational activities are appropriately managed and assessed;
- Considers the external trends and drivers which shape Vector's operating environment and creates both risks and opportunities for the business (as outline in SECTION 1); and
- Is integrated into all aspects of our asset management practice.

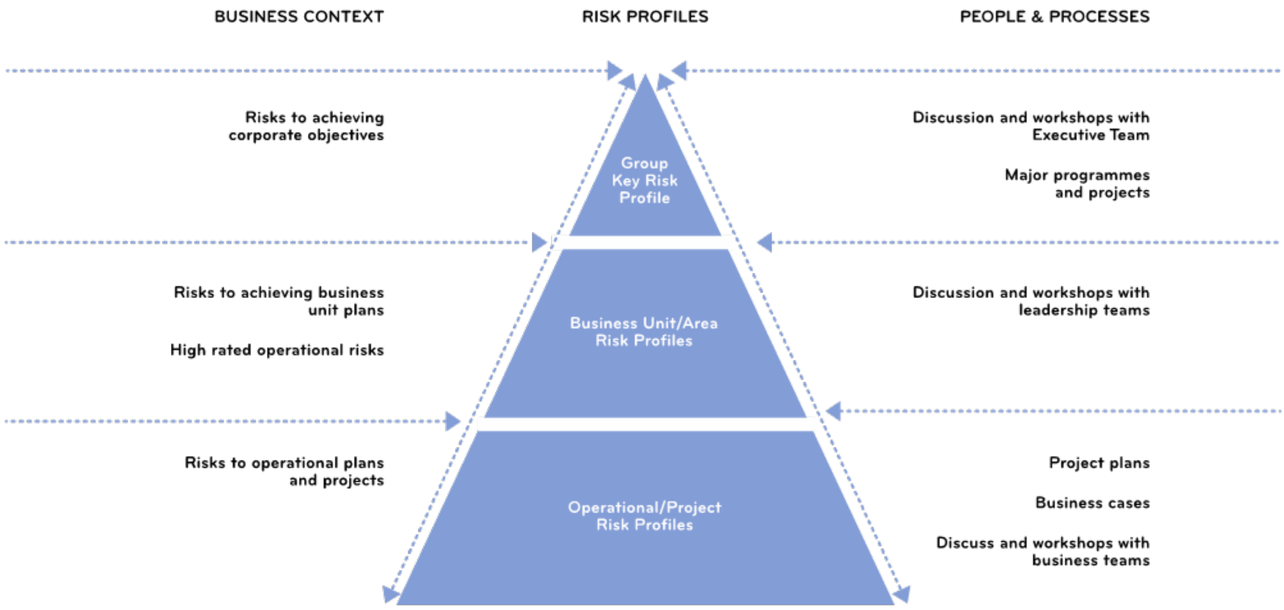

Figure 3-4 Vector's risk profiling structure

Consistent with ISO 31000:2009, our framework supports organisational performance by identifying, assessing and proactively treating uncertainty using the process in Figure 3-5

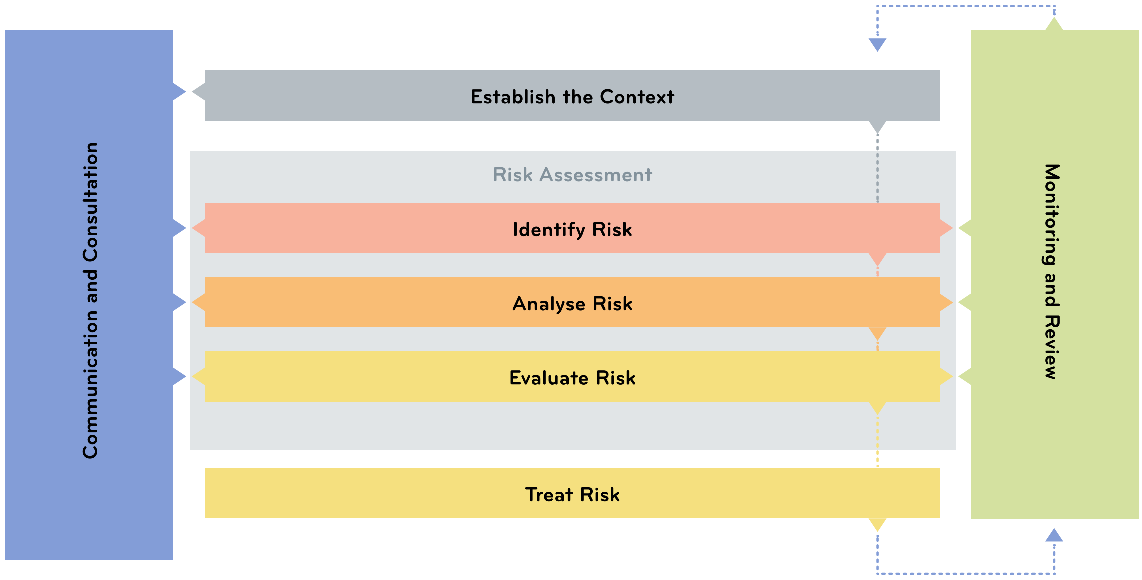

Figure 3-5 Vector's enterprise risk management process

Risks are assessed against Vector's risk assessment matrix, which articulates the Board's risk appetite for the business, and enables risks to be evaluated based on both the likelihood of a risk occurring and the potential impact(s) of a risk. The resulting evaluation informs the development and prioritisation of appropriate treatments plans (which supplement existing controls).

Asset risk management is undertaken using a combination of risk and asset reliability models, including a Failure Mode and Effects Analysis (FMEA), to identify maintenance and other proactive controls, while Bow Tie diagrams enable a comprehensive (and visual) assessment of the causes and consequences of an individual risk and the controls in place to manage the risk. The network-related risk assessment includes identifying potential High Impact Low Probability (HILP) events that could adversely affect the state of the network with specific controls and mitigating activities identified to manage and address the potential consequences. Where appropriate, a visual inspection of the network's health is undertaken post-HILP events to confirm the ongoing resilience of the system.

The management and tracking of identified risks and associated treatment plans is undertaken using Vector's enterprise risk management system, Active Risk Manager (ARM).

3.5.3 ASSET ENGINEERING

Asset Engineering involves a Front-End Engineering Design to develop possible options that address the needs identified during Needs Determination. Options may include traditional network solutions such as asset replacement or renewal, accepting the risks of service level breach (do nothing), non-asset solutions or combinations of these options. Each option is developed and a preferred option selected based on the option's economic value, technical feasibility, risk, strategic alignment and on asset management policy considerations.

Where an asset solution is recommended, functional and performance requirements are specified, lifecycle management plans are developed and a project scope is prepared as the basis of the Design and Construct stage. Where appropriate, Vector also assesses non-traditional solution options to meet the functional or performance requirements expected. A combination of these options may be developed to address a particular functional or performance requirement. Where a non asset solution is recommended, appropriate specialist processes are engaged to progress Vector's response[8] . In some cases, where no technically or economically feasible option is identified, the Front-End Engineering Design may lead to a revaluation of the identified need.

Under Vector's governance practices, approval of the preferred option is required prior to proceeding to the Design and Construct stage or prior to referral to a specialist non asset solution process. Vector's governance process and DAF is discussed further in Section 3.3.

3.5.4 DESIGN AND CONSTRUCT

During the Design and Construct stage, Vector translates the project scope, functional requirements and performance requirements, developed during the Solution Study, into a set of design specifications and plans. For certain types of projects, Vector manages construction as a design and build operation, design overlaps and integrates with construction. The design processes include application of design standards, equipment selection and development of a project specific design if required.

In accordance with our asset management policy, life-cycle cost minimisation is undertaken during design to ensure that ownership and acquisition costs are minimised. Vector also undertakes assessment of safety, constructability, standards compliance, reliability (i.e. failure modes effects analysis), design standardisation, sustainability, environmental impact and operability, during design to ensure that assets can be safely and effectively maintained and operated across the lifecycle. In addition, design is undertaken to align with relevant corporate and asset management strategies. These strategies are discussed in Section 4.3 and Section 4.4.

The outputs of the design process are detailed technical design documentation that is used to guide procurement and construction. During design, essential information is captured in Vector's SAP and Smallworld systems to enable and support the ongoing management of our assets. Section 3.6 provides an overview of the role of these systems in our asset management practice.

Asset Support forms a further essential part of the Design and Construct stage and provides key links with the Programme Delivery stage. Drawing on service level gap and root cause analysis undertaken in the Needs Management stage, Asset Support develops detailed plans for maintenance, spares holding, data systems, finance and resources that maintain asset performance across the lifecycle. All assets are reviewed annually and a comprehensive set of plans are produced that set priorities to maintain asset performance against the required service levels. These plans are approved under Vector's governance practices (see Section 3.3) before being programmed and delivered by Vector's FSPs.

3.5.5 PROGRAMME DELIVERY

Programme Delivery is a process that involves asset acquisition, construction and commissioning, operations, maintenance and disposal. Construct and Dispose links Design and Construct with Programme Delivery. Through this process, the detailed design documentation produced is translated into network assets. Construction of new assets, testing and verification of "as built" assets and disposal of old assets is undertaken through the Construct and Dispose process to

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8 The nature of the process for non-asset solutions, and some new technology solutions tends to be bespoke and highly dependent on the type of solution recommended. These are not addressed further in this AMP.

ensure compliance with design documentation, and Vector's standards (see Section 3.4 and Appendix 2). Critical asset data records are created or updated in SAP, Smallworld and in other systems during this process (see Section 3.6).

Once in service, Operations & Maintenance manages the asset across the operational phase of its lifecycle. This involves maintaining the assets in accordance with Vector's maintenance standards, under the annual plans produced by Asset Support. Asset inspections are also carried out and inspection data is captured in SAP to inform Vector's asset management practices, service level performance analysis and root cause analysis. This inspection data is also used to identify any network components that require replacement due to an unacceptable failure risk. Operations & Maintenance is also responsible for operating the assets to manage system performance, implement planned changes to the network's static configuration and for providing access to undertake planned or emergency works.

Delivery of Operations and Maintenance at Vector is contracted to FSPs and is managed under a contract based performance framework. An overview of Vector's works management practice is provided in SECTION 6.

3.5.6 DATA DRIVEN MONITORING AND IMPROVEMENT

As shown in Figure 3-3, Data Driven Monitoring and Improvement provides feedback into almost every aspect of Vector's asset management practice. This process involves the capture of a wide array of data from the Operations & Maintenance process (and other processes) into Vector's digital systems, and most notably SAP. A Data Analytics layer provides the critical analysis and reporting capabilities that enable our entire asset management practice, governance processes and project management practices. An overview of Vector's primary systems is provided in Section 3.6.

Process audit and review adds to this feedback by monitoring Programme Delivery compliance and outcomes. This ensures that assets are delivered in accordance with design documentation, that Asset Support annual plans are implemented, and that there is ongoing conformance with Vector's specifications and standards. Any process, practice, technical or performance nonconformities identified are addressed through change management processes, which includes engineering change management, processes change management and strategic review.

3.6 ASSET INFORMATION SYSTEMS

Vector has a suite of information systems that support its asset management practice. These, and other critical systems, are described below.

The primary systems used by Vector to manage the operation and performance of its network assets, and the related financial and project management activities are shown in Section 4.2.7.

PRIMARY SYSTEMS

Many of Vector's information systems operate through an integration layer that extends across these systems and enables the reporting and data analytics that support Vector's asset management processes. Table 3-5 provides an overview of the primary systems and provides insight into how they support asset management.

PRIMARY SYSTEM	FUNCTIONAL OVERVIEW
SAP	SAP is Vector's ERP System. It contains records for all assets and is used for managing the asset lifecycle from procurement and operation, to maintenance and disposal, including asset condition data. SAP also provides financial management related to asset management and project management
GE Smallworld	This system provides the geographic, schematic and connectivity information used in managing Vector's network assets
Siebel	Siebel is Vector's Customer Relationship Management system. This system is used for managing customer requests for new connections, quality of supply complaints management, and fault and outage management
Gentrack	Gentrack provides records for all connected ICP's (Installation Connection Points) as well as their regulatory and market attributes. It is used to manage energy consumption, revenue assurance and interfaces with the Gas Industry registry

Data Analytics Layer	This is a bespoke integration layer that provides reporting, monitoring and associated analytics related to network assets, including asset condition data. It is a critical source of information for most of Vector's asset management processes
Siemens Power TG	This is Vector's Supervisory Control and Data Acquisition (SCADA) system and is used to monitor and control operations on the network as well provide data on network loading and other critical asset data
ARM	ARM is Vector's corporate risk management system. Under the Corporate Risk Policy all asset management risks are recorded, prioritised and managed through this system. A supporting system, RIMS (Risk Incident Management System) is used to record any associated incidents

Table 3-5 Overview of primary information systems

OTHER IMPORTANT SYSTEMS

Vector uses a number of other information systems, computer models and computer based tools in the management of is gas distribution assets. In particular:

- **OSIsoft PI:** is a real-time network performance management system that imports data from various corporate systems (e.g. SCADA – see above) and provides a permanent archive of historical network data. Data may be extracted for later analysis in Microsoft EXCEL;
- **Telenet SCADA:** is the telemetry systems used by Vector to monitor its gas distribution networks.
- **Forecast Scenario Model:** this is bespoke load forecasting model used in Vector's load forecasting practice (see Section 3.5). It is implemented in Microsoft EXCEL and draws data from other corporate systems and databases and third party sources; and
- **Synergi:** is a network modelling tool gathering inputs from Smallworld, Gentrack and the PI archiving system to enable modelling of the meshed gas network. Outputs are gas network flow, pressure profile and capacity margins.

3.7 ASSET MANAGEMENT IMPROVEMENT

Periodically, Vector reviews its asset management practices using the Commerce Commission's Asset Management Maturity Assessment Tool (AMMAT). In addition, Entrust, Vector's majority shareholder, biennially conducts an independent review of the state of Vector's network that includes an assessment of asset management. Vector uses these reviews to inform our plans to improve our asset management practice.

At an overall level, Vector's asset management maturity compares well with generally accepted New Zealand gas asset management practices to ensure the ongoing safe and efficient operation of the gas network. Appendix 15 provides details of Vector's latest AMMAT self-assessment, indicating that our practices are adequate. However, this review also suggests areas where improvement is needed for Vector to achieve our target score of three on each AMMAT rating criteria. Set out below is an overview of the primary areas where improvement of our asset management practice is being considered or implemented.

3.7.1 ADOPTING AN ISO 55001 FRAMEWORK

Vector has more recently been consolidating its asset management practice as a basis for improvement. The next step is to revise our key processes so they better accord with an ISO 55001 framework. This will involve further development of our asset management framework, assessment and amendment of some of Vector's asset management processes, training (currently underway) and some documentation redevelopment. Our 2018 AMP is a step in this direction.

It is expected that this initiative will provide benefits through improved skills and more effective and efficient asset management practices. Improvements should become apparent through progressive increases in Vector's self-assessment against the AMMAT model.

3.7.2 ENHANCING STRATEGIC ASSET MANAGEMENT PRACTICE

Adopting an ISO 55001 framework highlights strategic asset management as a core practice. While Vector has a range of asset strategies, their effectiveness can be enhanced through the development of a formal strategy framework that improves their alignment and relationship with service level metrics. This initiative involves the review and mapping of current strategies, service levels and corporate strategies, and the development of an appropriate strategic framework. Development and redevelopment of several asset management strategies may also be required. Further staff training in aspects of strategic asset management will also be undertaken.

This improvement initiative will provide benefits through more effective and efficient asset management practices and greater alignment of asset investment. This will be evidenced through progressive increases in Vector's self-assessment against the AMMAT model.

3.7.3 DEVELOPING DATA AND ANALYTICS

Vector's asset management relies on a wide range of data captured and managed through Vector's Data Driven Monitoring and Improvement practices (see Figure 3-3), and stored, processed and reported on through our primary systems (see above). At the heart of Vector's data and analytics programme is a strong focus on ensuring that appropriate security and governance frameworks are in place and actively monitored to ensure that Vector meets its legal, commercial and ethical obligations with respect to the data that it collects and uses to optimise the business. The Group has established an Information Governance Council who is accountable for setting and enforcing the Information Policy which governs the collection and use of data. The Information Governance Council reports to the CEO and is comprised of the heads of Cyber Security, Information Management, Privacy, Legal, Risk, Regulation & Policy and Digital Architecture.

Vector has created a centre of excellence to combine all data related functions to ensure that the capture, storage and ability to use data meets the business needs now and into the future as the volume and variety of data explodes. Enterprise Information Management, Data Platforms & BI and Advanced Analytics have been centralised into a single group called Information & Insights. This team works with the business to ensure that the data collected meets a minimum set of standards, is quality assured and is available via appropriate platforms for self-service and for more advanced applications such as advanced analytics and machine learning.

While Vector's asset data management practices are relatively mature, and meet the requirements of asset management, there are areas where improved understanding of our assets is required to improve our asset management practices. Specifically, there is a need to improve modelling of the overall condition and risk associated with asset populations. This will require enhanced incident data (i.e. fault and failure records) and improved asset inspection records, to support improvements to our CBARM methods, and enable asset health indices and remnant life model development. Vector is currently developing its CBARM models for the different asset classes.

Vector's corporate Digital Strategy is a core enabler of developing our data and analytics to support asset management practices. Section 4.3.11 provides further details of the key features of our Digital Strategy.

3.7.4 DEVELOPING AN ASSET CARBON REDUCTION STRATEGY

To demonstrate its commitment to sustainability and environmental performance, Vector has committed to achieving zero emissions from its operations by 2030. To achieve this commitment, Vector is implementing a carbon reduction strategy that includes setting annual reduction targets, investment in quality New Zealand based carbon offsets and reviewing opportunities relating to business travel, electricity consumption and waste minimisation.

Vector's carbon emissions are collated by our Environmental team using a software tool 'BraveGen.' Performance is reported to business units on a monthly basis. The most significant carbon emissions relating to Vector's gas distribution assets are defined as Scope 1 emissions (in accordance with the Greenhouse Gas Protocol).

The scope 1 emissions related to gas distribution totalled 32,095 tonnes of carbon dioxide equivalent for our baseline year (FY17).

Vector intends to introduce a service level to assess performance of the network against the asset carbon reduction strategy.

3.8 EMERGENCY RESPONSE AND CONTINGENCY PLANS

Vector as a "lifeline utility" under the Civil Defence and Emergency Management (CDEM) Act 2002 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. In line with its obligations, Vector has a range of plans governing how it will function during and after an emergency. These plans (detailed in Table 3-6) are reviewed and updated regularly.

Furthermore, Vector actively participates in the development of a CDEM strategy and is a member of:

- The Auckland Lifelines Group (ALG);
- The National Engineering Lifelines Committee; and
- Various lifeline groups throughout New Zealand.

TITLE	DESCRIPTION

Business Continuity Management Policy	• Formal representation of Vector's commitment to business continuity management, which forms an essential part of Vector's enterprise risk management framework.
	• Defines key business continuity management roles, responsibilities, accountabilities and reporting requirements.
	• Approved by the Board, it is consistent with the following Standards; and
	• Australian/NZS AS/NZ 5050:2010 "Business Continuity - Managing disruption-related risk";
	    • ISO 22313:2013 "Societal security - Business continuity management systems - Guidance"; and
	    • SAA/SNZ HB 221:2004: "Business Continuity Management"
	    • AS/NZS ISO 31000:2009 "Risk management - Principles and guidelines.

Crisis Management Plan	• Provides the enterprise-wide framework and structure to assess and respond to any crisis-level incident or event affecting Vector, its customers and/or it employees, contractors and other stakeholders. • Includes the Incident Management Guideline, which provides direction on how to categorise incidents - this categorisation determines the appropriate response team, response plan and escalation hierarchy. • Annual crisis management exercises and regular plan reviews are undertaken to ensure usability and understanding and support continuous improvement of the plan.
Issue / Crisis Communications Plan	• Standalone plan governing the communications and external relations approach and processes during a crisis, emergency or business continuity events.
Business Continuity Plans / Incident Response Plans	• Individual business unit / team plans outlining the procedures for responding to any disruptive events or incident (below crisis level) within a specific business area.
Emergency Response Plan	• Ensures Vector is prepared for, and responds quickly to, any major incident that occurs or may occur on the gas distribution network. • Describes the roles and responsibilities for staff during a major incident. • Reviewed annually to ensure continuous improvements and standardised approach to all operational incidents.

Table 3-6 Overview of emergency response and contingency plans

SECTION

04. OUR ASSETS

SECTION 4. OUR ASSETS

This section of the AMP sets out Vector's gas distribution assets; the types and volumes of assets, their functional role and key statistics. The asset management strategies are summarised both at a network wide level and for specific asset classes. These strategies inform when we act and what actions are taken in managing the lifecycles of our network assets. It is these asset management strategies that inform or drive the plans set out in SECTION 5.

4.1 OVERVIEW

Vector's gas network supply area is centred on the Auckland isthmus and extends from north of Wellsford to Tuakau in the south. The supply area is shown in Figure 4-1.

Figure 4-1 Vector's gas distribution supply region

4.1.1 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.

While this can result in large networks the advantage is that failure of one single item does not compromise the entire network. Secondly, the size of the network ensures that organic load increases have minimal impact on the overall immediate impact on the network as the network pressures are continually rebalancing through the connectivity. Changes to network pressure are best identified by long term trending as explained in Section 3.5.2. Significant offtakes, particularly on the smaller networks, are clearly the performance of the network and these are modelled separately.

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.

DRS have nominal outlet pressures which supply each discrete pressure system on the distribution network. System pressures in the network decrease in accordance with demand and the supply pressure. Under normal network operating arrangements, 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 4.3.7.

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 pressure profile for residential loads and load profile for commercial/industrial customers are illustrated in Appendix 4.

4.1.2 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 on the gas distribution network and the gas conveyed for the past seven years is listed in Table 4-1 (the individual demand forecasts for all gate stations on Vector's network are detailed in Appendix 6).

YEAR	PEAK DEMAND		GAS CONVEYED	
	Standard cubic meters per hour (scmh)	% change	PJ	% change
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%
2015/16	90,233	-4.9%	13.9	10.3%
2016/17	87,902	-2.6%	14.3	2.9%

Table 4-1 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. Appendix 9 provides maps which indicate those customer sites with annual energy requirements in excess of 20 Terra Joule (TJ), and which hence have a significant impact on network operations and asset management.

4.2 ASSET OVERVIEW

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 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 HP and Intermediate Pressure (IP) systems tend to be radial in design, whereas the design of the majority of MP systems tends to be of a mesh nature, providing back-feed security to large numbers of residential and commercial loads. Medium Pressure (MP) systems are often supplied from multiple DRSs thereby further increasing the SoS. Typical load profiles of the network and a list of Vector's large customers that have an impact of network operations, can be found in Appendix 3. A single line diagram of the network can be made available on request.

Key statistics of Vector's network are given in the Table 4-2.

Customer connections[9]	106,670
Distribution pipelines – includes mains and service pipes (km)[10]	6,535
Gate stations[11]	16
Pressure stations[12]	305
Peak load (m3/hour)[13]	87,902
Gas conveyed (PJ per annum)[14]	14.3

Table 4-2 Key statistics for FY17

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 (includes mains and service pipes);
- Pressure stations;
- Valves;
- Corrosion protection equipment;
- Monitoring and control equipment; and
- Special crossings.

4.2.1 DISTRIBUTION PIPELINES

Vector's distribution networks generally comprise HP, IP, MP and LP systems. Vector's bulk gas distribution assets are operated in the IP range of 1,000 to 2,000kPa. The selection of these pressures has, in the majority of cases, historically been justified on an economic basis (considering gas volumes, transmission distances, delivery pressures etc). The IP

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9 Source: Information Disclosure 2017 Schedule 9d(ii) (http://vector.co.nz/disclosures/gas-financial-and-network-information).

10 Source: Source: Information Disclosure 2017 Schedule 9c (http://vector.co.nz/disclosures/gas-financial-and-network-information). Includes mains and service pipe lengths.

11 Source: Vector's Geographical Information System (GIS).

12 Source: Information Disclosure 2017 Schedule 9a (http://vector.co.nz/disclosures/gas-financial-and-network-information). Includes Vector's district regulating stations and service regulators as described in section 4.2.2.

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

14 Source: Information Disclosure 2017 Schedule 9d(ii) (http://vector.co.nz/disclosures/gas-financial-and-network-information).

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 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 GMS owners).

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. The inventory of spares and equipment 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).

Key statistics of the distribution pipeline assets are shown in Table 4-3.

PRESSURE LEVEL	MAINS PIPE (KM)	SERVICE PIPE (KM)	TOTAL	% OF TOTAL NETWORK
Intermediate Pressure (700-2,000kPa)	241	6	247	4%
Medium Pressure 1 (7 - 700kPa)	4,089	2,195	6,285	96%
Low Pressure (LP) (0 - 7kPa)	0	3	3	0%
Total	**4,330**	**2,205**	**6,535**	**100%**

Table 4-3 Key statistics for distribution pipelines

Figure 4-2 below depicts the age profile of mains pipelines.

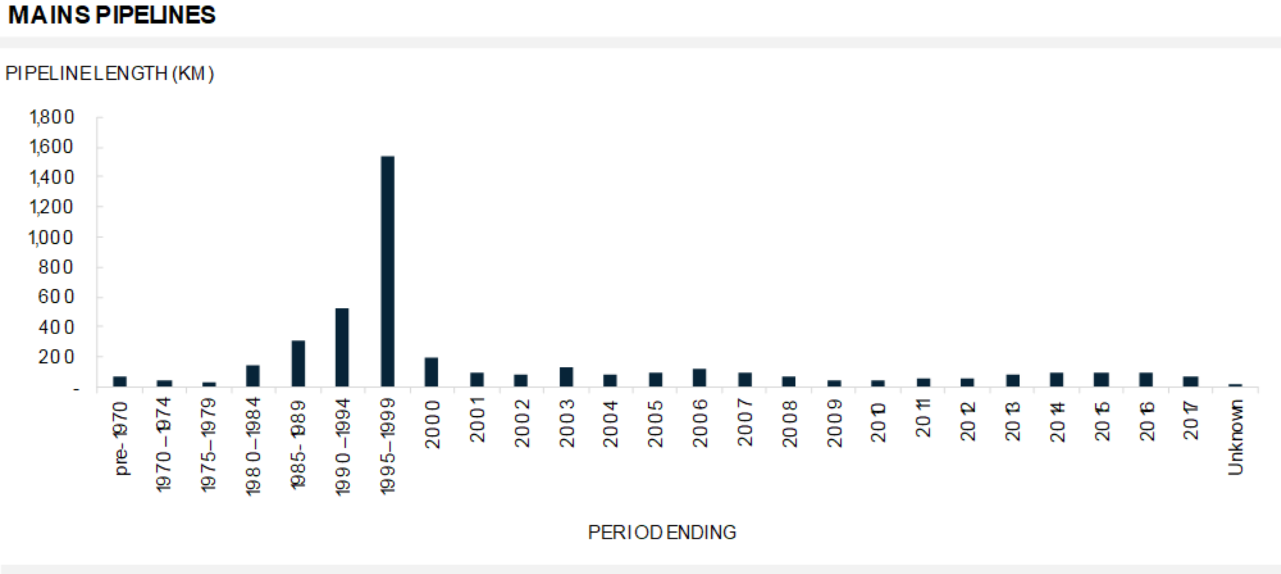


Figure 4-2 Age profile of mains pipelines

Figure 4-3 below depicts the age profile of service pipelines.

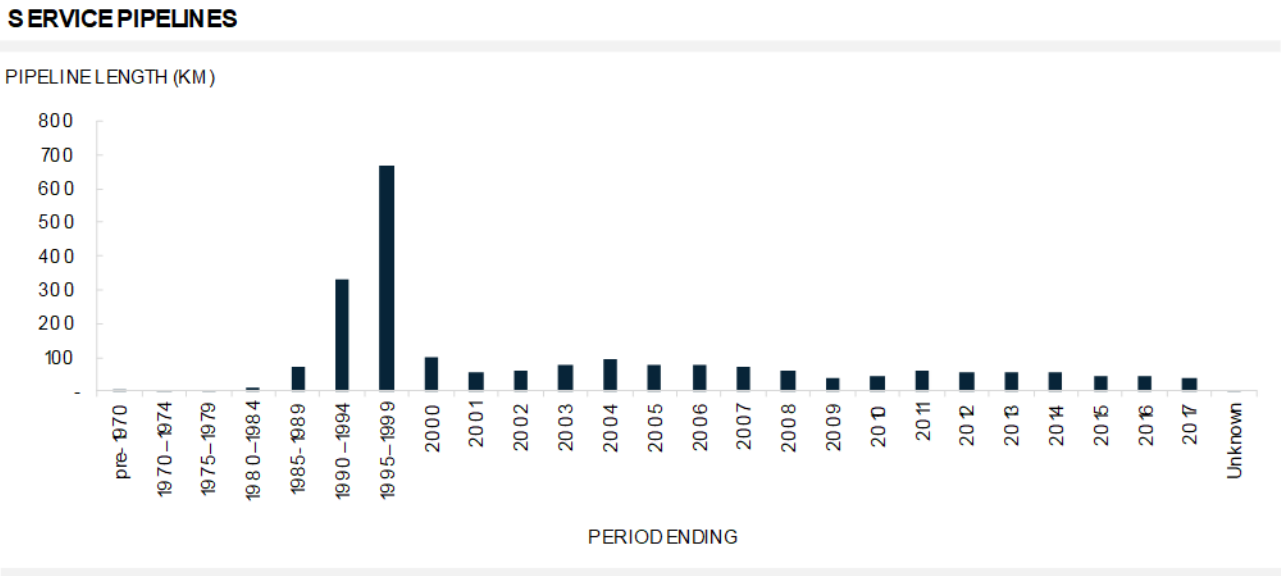


Figure 4-3 Age profile of service pipelines

4.2.2 PRESSURE STATIONS

Pressure stations are those parts of a gas system that link two pipeline systems operating at different pressure levels. The station automatically reduces and regulates the gas pressure being supplied into the downstream pipeline system to which it is connected. Vector has three categories of pressure stations: gate stations, district regulating stations and service regulators.

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. High pressure equipment (i.e. pressure regulating equipment and custody transfer metering etc) within the gate station is operated by 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 as part of Vector's gas distribution networks. Key statistics of equipment owned by Vector but installed at gate stations is listed in Table 4-5.

GATE STATION NAME	ASSETS OWNED BY VECTOR
GS-00001-AK Alfriston	All facilities downstream of the Interconnection Point
GS-00002-AK Bruce McLaren	All facilities downstream of the Interconnection Point, including associated telemetry equipment
GS-00003-AK Drury	All facilities downstream of the Interconnection Point
GS-00004-AK Hunua	All facilities downstream of the Interconnection Point
GS-00005-AK Kingseat	All facilities downstream of the Interconnection Point
GS-00006-AK Papakura	All facilities downstream of the Interconnection Point, including district regulating station DR-00170-AK equipment, structures and downstream distribution outlet pipework, and associated telemetry equipment.
GS-00007-AK Pukekohe	All facilities downstream of the Interconnection Point
GS-00008-AK Ramarama	All facilities downstream of the Interconnection Point
GS-00009-AK Tuakau	All facilities downstream of the Interconnection Point including district regulating station DR-00250-AK equipment, structures and downstream distribution outlet pipework, and associated telemetry equipment
GS-00010-AK Waikumete	All facilities downstream of the Interconnection Point, including associated telemetry equipment
GS-00013-AK Westfield	All facilities downstream of the Interconnection Point including district regulating station DR-00244-AK equipment, structures and downstream distribution outlet pipework, and associated telemetry equipment
GS-00016-AK Henderson	All facilities downstream of the Interconnection Point, including district regulating station DR-00177-AK equipment, structures and downstream distribution outlet pipework, and associated telemetry equipment
GS-00018-AK Wellsford	All facilities downstream of the Interconnection Point
GS-00020-AK Warkworth 2	All facilities downstream of the Interconnection Point
GS-00021-AK Waitoki	All facilities downstream of the Interconnection Point, including district regulating station DR-00254-AK equipment
GS-00023-AK Harrisville	All facilities downstream of the Interconnection Point, including associated telemetry equipment

Table 4-4 Key statistics of equipment owned by Vector installed at gate stations

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 all connected 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.

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.

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 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.

Key statistics of the pressure station assets are shown in Table 4-5

Number of gate stations	16
Number of district regulating stations and service regulators	273

Table 4-5 Key Statistics for pressure stations

Figure 4-4 below depicts the age profile of pressure stations.

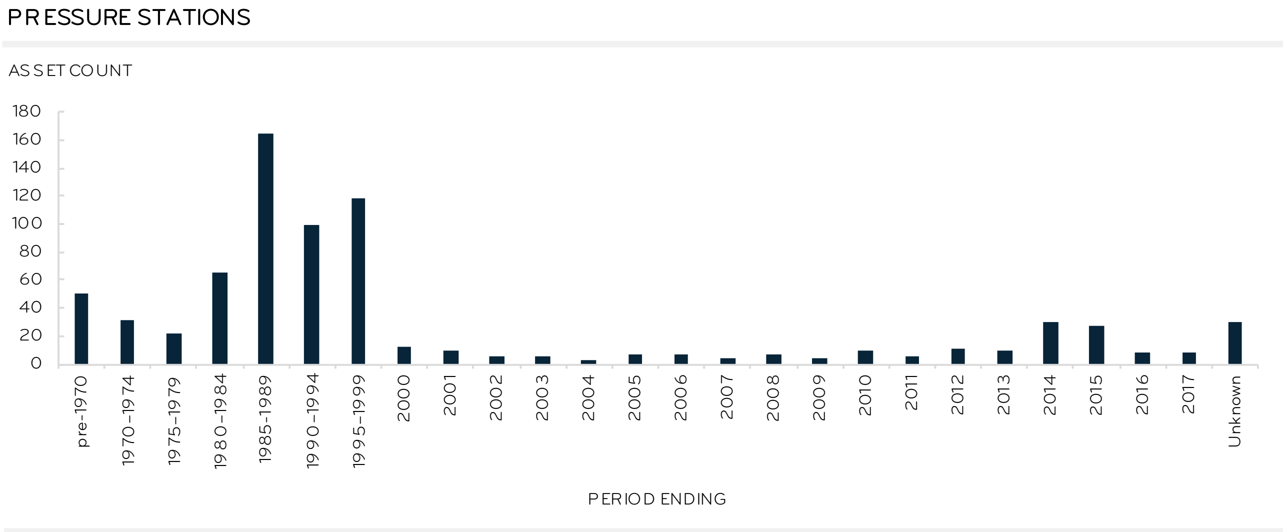


Figure 4-4 Age profile of pressure stations

4.2.3 VALVES

Line valves

Line valves are comprised of buried 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.

Key statistics of the line valves are shown in Table 4-6.

Number of intermediate pressure line valves	660
Number of medium pressure line valves	2,902
Number of LP (low pressure) line valves	4

Table 4-6 Key statistics for line valves

Figure 4-5 below depicts the age profile of line valves.

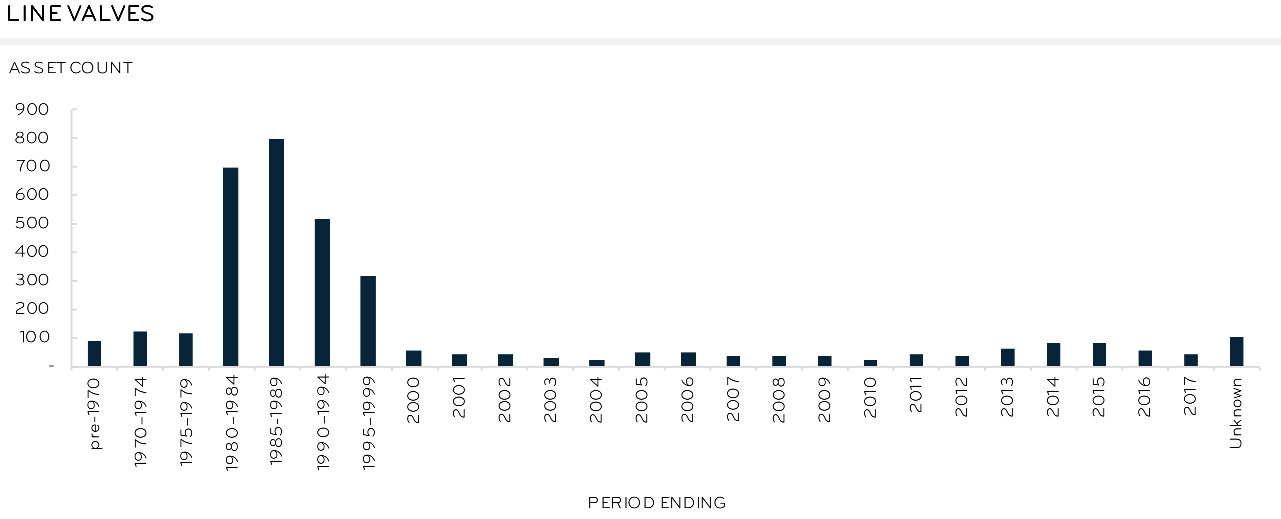


Figure 4-5 Age profile of line valves

Riser valves

Aboveground riser valves are installed at every GMS; they are positioned immediately upstream of the GMS service-regulator to allow the GMS (and downstream pipework) to be isolated from the gas distribution network in the event of an emergency or for maintenance purposes. The riser valve population is comprised of 10mm risers (approximately 92%), 25mm risers (4%), 32mm risers (2%), 50mm risers (1%) and various other riser sizes (1%).

Prior to the introduction of ball valves in the early 1990s, plug type riser valves were used for residential and small commercial connections - i.e. typically 10 mm and 25 mm risers. Due to its mechanical design and the length of time in service, this type of valve has been found to be prone to seizing, leaking or passing gas when in a closed position.

Key statistics of the riser valves are shown in Table 4-6

Number of intermediate pressure riser valves	256
Number of medium pressure riser valves	108,472
Number of LP riser valves	601

Table 4-7 Key statistics for valves

Figure 4-6 below depicts the age profile of riser valves

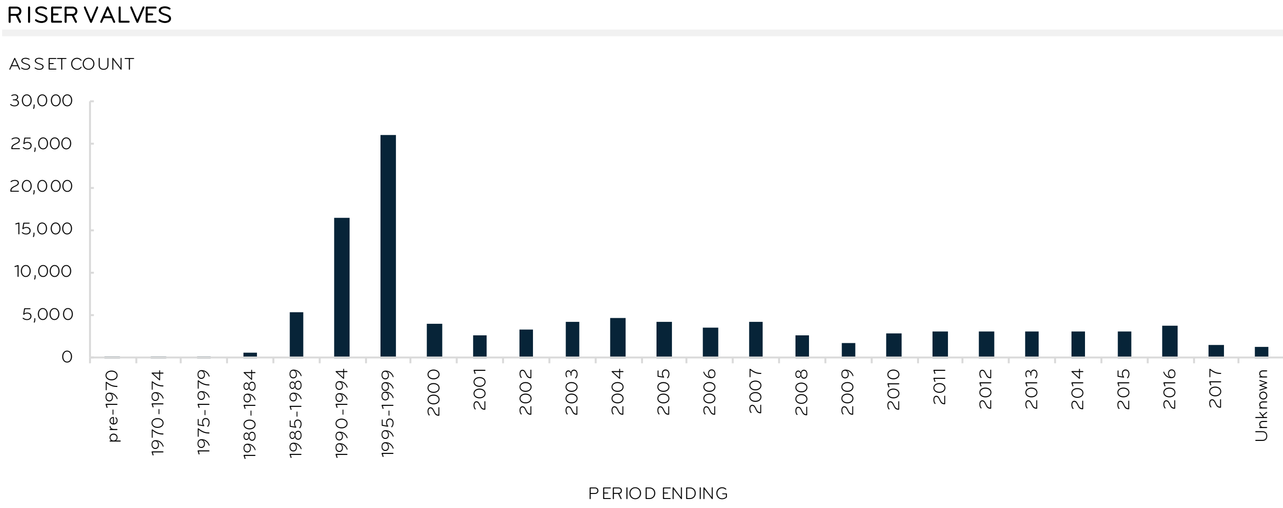


Figure 4-6 Age profile of riser valves

4.2.4 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 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.

The majority of Vector's interconnected steel network is protected by 9 impressed-current CP systems; the balance of the steel network (typically smaller standalone networks) are protected by sacrificial-anode CP systems.

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.

Key statistics of the corrosion protection equipment are shown in Table 4-8.

Number of impressed current cathodic protection systems	9
Number of sacrificial-anode cathodic protection systems	21

Table 4-8 Key statistics for corrosion protection equipment

Figure 4-7 below depicts the age profile of corrosion protection equipment.

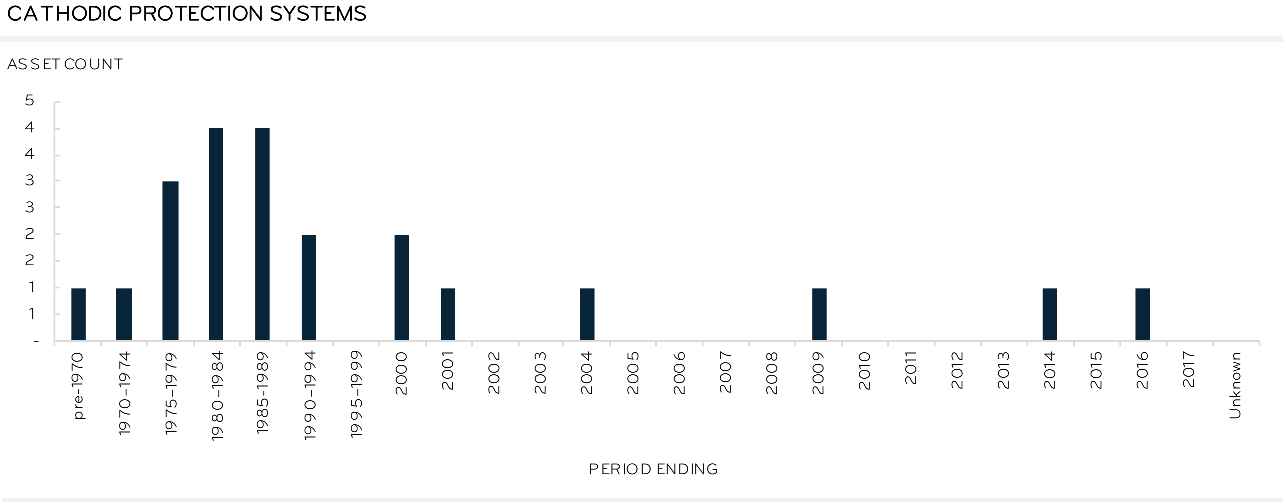


Figure 4-7 Age profile of the corrosion protection equipment

4.2.5 MONITORING AND CONTROL SYSTEMS

The telemetry systems used by Vector to monitor its gas distribution networks comprise the Telenet SCADA system, and the Cello system.

The Telenet system provides near real-time monitoring - i.e. it provides data refresh rates that range between 5 minutes and 30 minutes; approximately half of the Telenet sites utilise an analogue radio communication platform and the balance utilise a General Packet Radio Service (GPRS) communication platform. The Cello system provides 15-minute time-stamped monitoring data (typically pressure only) that is refreshed once a day; communication between the Cello field sites and the base station is via the Global System for Mobile (GSM) communication network using Short Message Service (SMS) communication. Cello equipment is utilised at both permanent and temporary (e.g. winter gauging) monitoring sites.

Access to Telenet and permanent Cello site monitoring-data is provided via the PI archiving system; access to the temporary Cello site monitoring-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 provides remote control facilities for the operation of the IP20 valves located at either end of the Auckland Harbour Bridge.

Key statistics of the telemetry systems are shown in Table 4-9.

Number of telenet monitoring sites	70
Number of permanent Cello monitoring sites	33

Table 4-9 Key Statistics for monitoring and control systems

Figure 4-8 below depicts the age profile of monitoring and control systems.

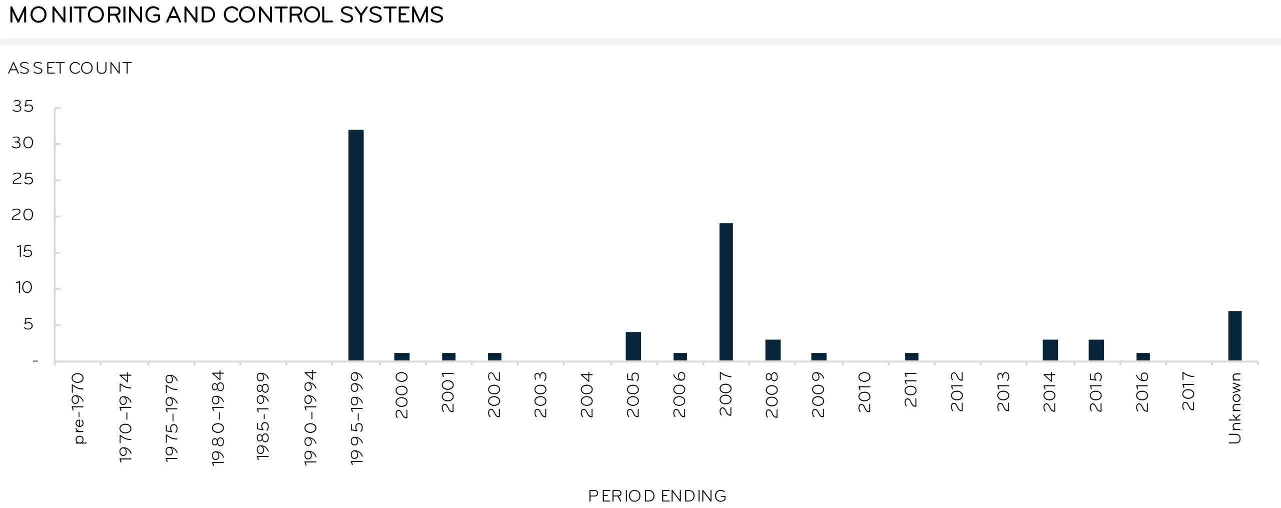


Figure 4-8 Age profile of monitoring and control system

4.2.6 SPECIAL CROSSINGS

Special crossings are locations where a section of pipeline is installed aboveground 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.

Where the carrier pipe is PE it is encased in a steel or Polyvinyl Chloride (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.

Key statistics of the special crossings are shown in Table 4-10.

Number of IP special crossings	20
Number of MP special crossings	69

Table 4-10 Key Statistics for special crossings

Figure 4-9 Age profile of special crossings below depicts the age profile of special crossings.

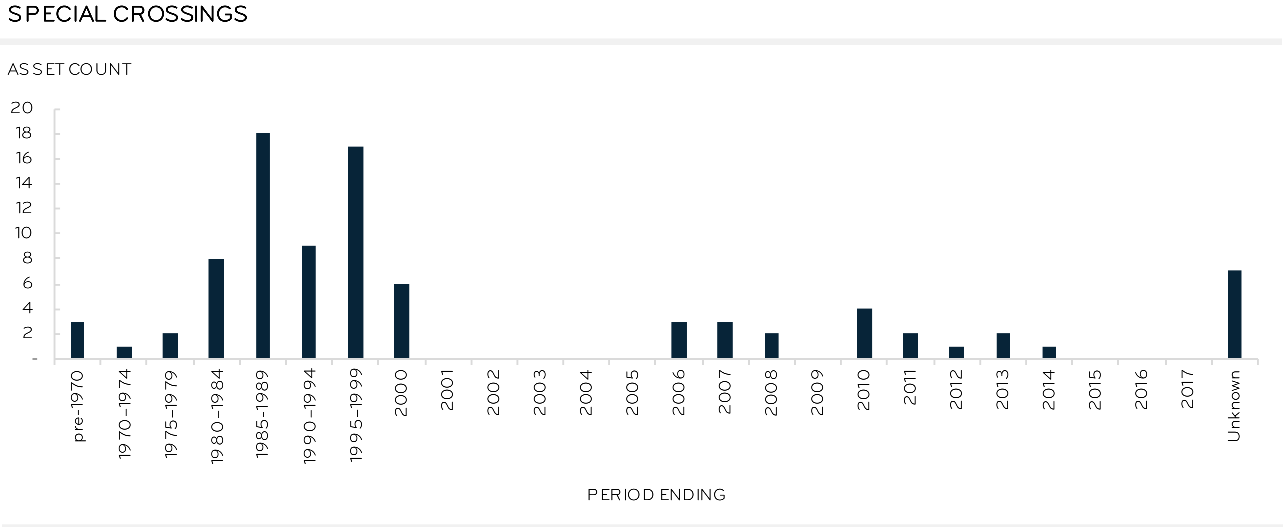


Figure 4-9 Age profile of special crossings

4.2.7 NON-NETWORK ASSETS

Vector implements and manages its information systems and their related infrastructure components according to an overall digital technical reference model. This ensures that each component has clear boundaries, which ensures that the technology used to support these components are "fit-for-purpose". It also helps ensure that Vector's information systems environment maintains a "separation of concerns" between its information systems and infrastructure. The technical reference model is shown in Figure 4-10.

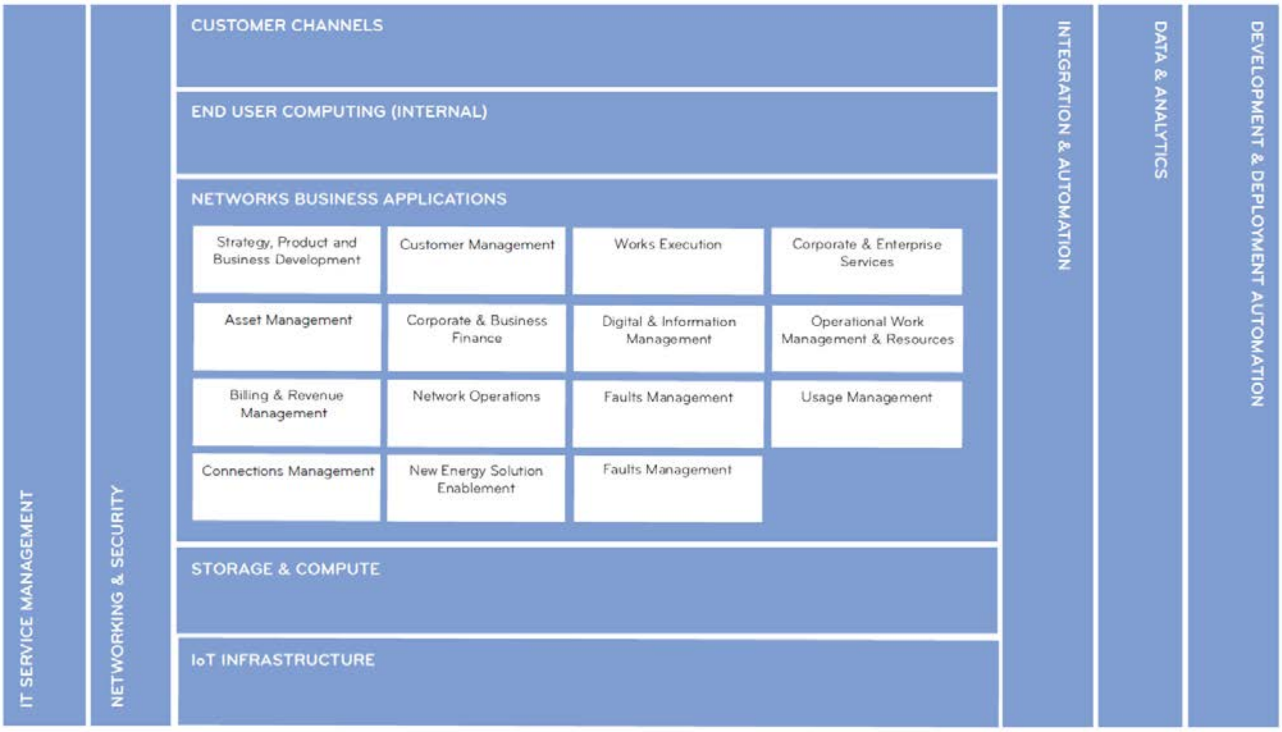


Figure 4-10 Vector's digital technical reference model

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 and customer assets and the ongoing planning activities relating to those assets.

Figure 4-11 illustrates the relationship between Vector's business functions and processes, referred to as business process domains, and its core network related applications.

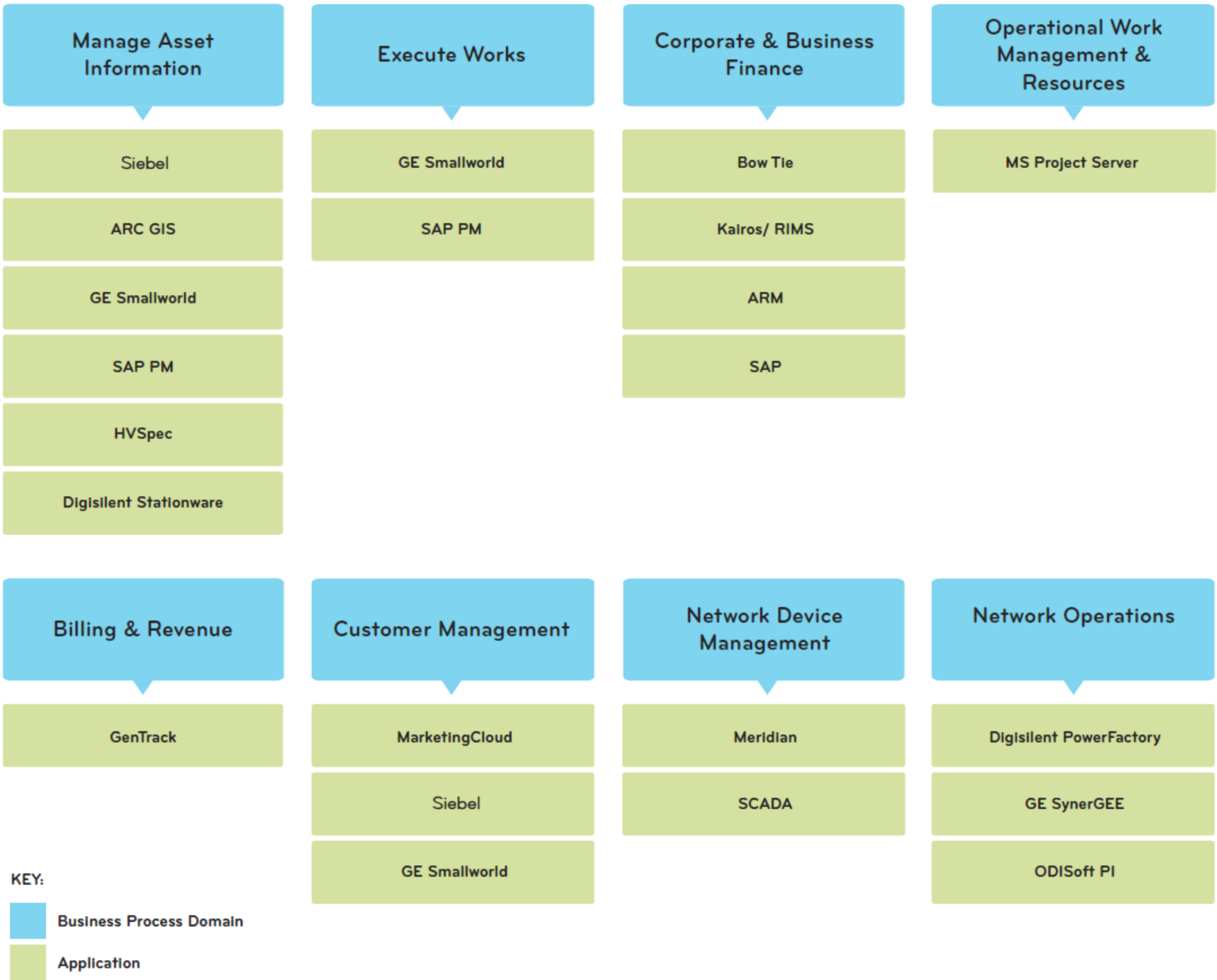


Figure 4-11 Business process domain and core network related systems (non-exhaustive)

INFORMATION AND DATA

Vector's 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 entities as shown in Figure 4-12.

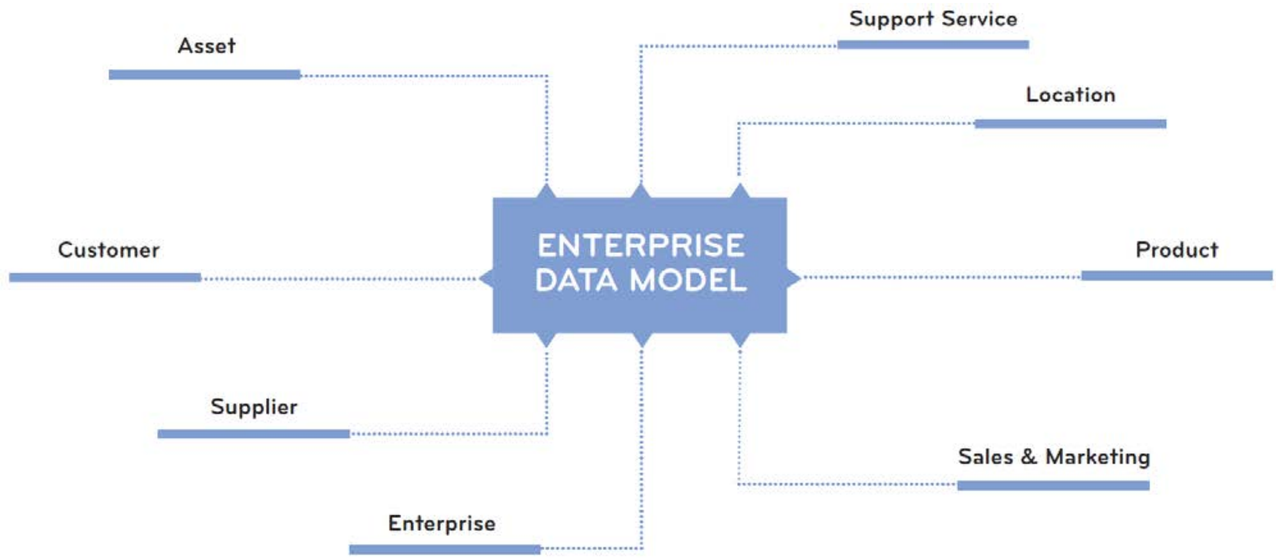


Figure 4-12 Enterprise data model

The information entities above consist of multiple attributes and stored in source systems. The Entity->Attribute->Source System mapping is captured in Vector's Enterprise Data Model.

4.3 MANAGEMENT STRATEGY

4.3.1 OVERVIEW

Management of Vector's network is undertaken in accordance with Vector's asset strategies. These strategies are focused on meeting service level targets. To this end, Vector's assets are managed over their full lifecycle to avoid failures that pose a hazard to workers, public safety or harm to the environment and minimise interruptions of supply to our customers. Strategies are also aligned with statutory and regulatory requirements and design and maintenance standards. A list of key asset strategy documents, design and maintenance standards are provided in Appendix 2.

This section describes the asset management strategies that are in place at Vector that span across all asset classes. These include planning, operation and maintenance strategies as well as specific strategies relating to service level performance i.e. safety, reliability, gas quality and environment. Asset specific strategies are described in Vector's asset strategy documents (see Appendix 2 but have been summarised in Section 4.4).

4.3.2 NETWORK PLANNING STRATEGY

The planning strategy ensures that both Vector's QoS and SoS are maintained across the network. Broadly speaking QoS addresses network pressure issues, both current and forecast, while SoS addresses the level of redundancy or the degree meshing across the network.

Demand for new customer connections outside existing network boundaries is typically supplied through the development of new distribution pipelines and pressure stations. Where forecast demand within an existing network supply area is expected to exceed the nominal capacity of an asset, causing a QoS breach, then solutions are identified to address the constraints. The timing of the solution is scheduled to ensure that the QoS is not compromised. Forecast QoS constraints are reviewed annually or if a significant load is added to the network, to ensure the scheduling of the solution remains valid. Where target forecasts are not achieved, the solution may be deferred.

The SoS criteria determines the level of redundancy required on the network to ensure the risk profile remains within acceptable limits set by Vectors Risk Framework. Key factors include scenario modelling examining the consequences of non-supply through equipment failure or damage on customers and Vector.

Further details on Vector's QoS criteria is provided in Section 4.3.7.

4.3.3 STANDARDISED ASSET DESIGN STRATEGY

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, DRS equipment and installation practices. Vector may apply differing architectural treatments to its DRS 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 repeatedly used on the network, standard designs are developed. As design improvements are identified either by Vector's own staff or as feedback from our FSPs, standard designs are amended and updated.

A list of all of Vector's design standards is provided in Appendix 2.

4.3.4 REFURBISHMENT AND REPLACEMENT STRATEGY

Assets that are no longer able to deliver the level of service that customers require in a safe, efficient and economical way, will be replaced or refurbished. In dealing with distribution assets, where Vector has large populations of low cost assets and associated components, the optimal investment options to repair, replace or refurbish are relatively limited and are readily evaluated.

For DRS assets where replacement costs are typically high, the optimal investment options to repair, replace or refurbish will require more complex multi-criteria evaluation and business case justification. Factors that may be considered include:

- Maintenance costs over the remaining life of the asset will exceed that of replacement;
- The asset has become obsolete, component fabrication is expensive, the asset may be the last of its kind and difficult to maintain;
- Low cost retrofit replacements are available with enhanced ratings and safety features; and
- Associated risk and asset performance history.

Economic asset refurbishment is generally restricted to DRS. This is an efficient way of extending the asset life where appropriate.

The choice to refurbish assets is based on the condition of the asset, accessibility, its age, history of faults, known issues and criticality of the asset. The availability of assets and the safety of assets also play an important part to elect whether refurbishment is an option.

Asset replacement is generally condition based, rather than age based. Vector is moving towards developing CBARM models for its assets, which would support a more risk based approach to replacement. In addition, it is also expected that this approach would support a similar approach for maintenance prioritisation.

4.3.5 MAINTENANCE STRATEGY

Vector's assets are maintained over their whole lifecycle to avoid failures that pose a hazard to workers or public safety. The core that underpins the maintenance strategy is scheduled inspections for equipment in accordance with maintenance standards for each asset class. Maintenance inspections are used to perform maintenance tasks, repairs and identify and record any non-compliances with the maintenance standards.

Vector has a comprehensive suite of in-house developed maintenance standards that define asset inspections, condition testing and associated maintenance tasks by asset class. In general, Vector's philosophy is to keep its assets in use for as long as they can be operated safely, technically and economically. The maintenance standards support this goal to ensure optimal performance. Corrective maintenance for non-compliances will then be undertaken within specified time frames, as stipulated in the maintenance standards.

Each maintenance standard addresses the purpose, content, frequency, record requirements and associated treatment criteria. The treatment criteria and resulting actions generally direct field workers, to repair defects identified.

In addition to the foregoing, Vector has taken a pro-active approach to the management of its gas distribution network and assets. This involves improving overall asset management capability and the ability to monitor the condition of the network as well as the implementation of programmed replacements in circumstances where these are deemed appropriate.

Some capability improvements in train are the transition from AS/NZS5258 to AS/NZS4645 and the proposed use of criticality information developed for CBARM to move to a risk based prioritisation of maintenance.

Improved monitoring initiatives includes scheduled "drive-by" leakage detection surveys, pro-active identification of physical works with the potential to affect the gas distribution network with routine patrols and the regular survey of riser plug valves.

4.3.6 RELIABILITY AND RESILIENCE STRATEGY

The operation of the gas network is focused on safety and reliability. Where network failures occur either through equipment maloperation or third party damage, it must be possible to manage these situations safely. The impact these abnormal situations have on other gas users is dependent on the resilience of the network.

Through scenario modelling, it is possible to remove critical assets from the model to simulate an asset failure, and test the impact the absence these assets has on the performance of the network. Where the resultant network pressure model signals unsafe operating pressures, mitigation measures may be identified and enacted before a real situation arises. The determination of acceptable mitigation measures can be identified through a risk-based approach (consequences x likelihood).

Vector has introduced a number of SoS projects this year to improve the resilience of the network. The intention is to extend this scenario-based approach over the coming year to look more closely at the resilience of the various pressure networks.

Reliability and Resilience can also be impacted by cyber-attacks that target the core control systems with downstream impacts on the physical infrastructure. While the majority of controls will be implemented at a group level, we will continue to investigate and deploy specific tools designed to detect and prevent attacks on the core control systems of the gas network. These will integrate into the broader security monitoring capabilities of the group.

4.3.7 QUALITY OF SUPPLY CRITERIA

The QoS criteria is specified in GNS-0074. The objective is to ensure that the Minimum Operational Pressure (MinOP) is at greater than 50% of the Nominal Operating Pressure (NOP) and no more than 110% of its Maximum Allowable Operating Pressure (MAOP).

Where network modelling forecasts potential QoS issues, closer field monitoring of the pressure at the extremities of the network is carried out to confirm the accuracy of the model. Where forecast QoS breaches are confirmed, solutions are investigated and implemented in a timely manner to ensure the breach does not occur in practice.

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 QoS standard provides the minimum operating pressures that apply at the critical locations where non-standard conditions apply.

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

4.3.8 SECURITY OF SUPPLY STRATEGY

The QoS strategy ensures the local gas networks operate within safe pressure limits, but lacks the wider perspective of managing the network against HILP risks such as ensuring the safe delivery of gas upon the loss of critical components. The widespread application of meshed networks, not only ensures efficient use of the network assets but allows a level of redundancy as a precaution against asset failure. For example, a single IP20 pipeline supplying a network has no redundancy, whereas the downstream MP4 network may have multiple DRS's and interconnected pipelines offering additional levels of redundancy.

The SoS criteria is a risk-based assessment based on the numbers of customers affected by an event, network pressure modelling following a simulated contingent event, and the costs and benefits of mitigation measures. The assessment criteria for a project to be implemented under the SoS category is on a case-by-case basis determined by evaluating the risk-mitigation cost trade-off.

4.3.9 ENVIRONMENTAL STRATEGY

Sustainability lies at the heart of creating a new energy future and Vector strives to be an industry leader in Health, Safety and Environmental performance (see Section 1.5). The Environmental Strategy is to provide sufficient competent resources and effective systems at all levels of the organisation to fulfil this objective. Vector has ISO14001 Environmental Management System certification and will strive to maintain this.

To achieve the above, Vector is committed to:

- Ensuring environmental aspects and impacts are considered as part of all business decisions;
- Meeting and where possible, exceeding the requirements of all relevant environmental compliance obligations;
- Providing environmental leadership through participation in business networks and working with government to create pragmatic laws, regulations, standards and codes of practice to protect the environment;
- Operating in a manner that prevents pollution, minimises environmental impacts and promotes beneficial environmental performance;
- Monitoring and continually improving our environmental footprint;
- Consulting with Vector People, customers and other relevant stakeholders on our environmental performance; and
- Using our knowledge, resources and technology to influence positive environmental outcomes throughout the industries and geographic areas we interact with.

To deliver this strategy Vector will:

- Increase environmental awareness across the business;
- Focus on responsible energy management within our assets;
- Establish environmental goals through our business health, safety and environmental plans and continually monitor, review and improve the effectiveness of our Health, Safety and Environmental Management System;
- Improve environmental capability of all Vector People;
- Set environmental criteria through our purchasing processes; and
- Deliver services and technology to our customers that displace carbon emissions and other forms of pollution.

4.3.10 SAFETY IN DESIGN STRATEGY

The distribution of natural gas involves managing significant hazards, and the Health and Safety in the Work Act 2015 places greater accountability on designers to achieve safe outcomes for works. Safety in Design means the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise the risks to health and safety throughout the life of the structure being designed. Safety in design applies to any plant, substance or structure that is constructed whether fixed or movable.

It is the fundamental of getting Asset Management practices right and forces us to take a collaborative, well considered, risk based multidisciplinary approach across the lifecycle of the asset.

This strategy is covered by Vector's Corporate HSEMS Key Requirement 12.1, Safety in Design.

4.3.11 DIGITAL STRATEGY

Vector has revised its technology strategies to better reflect the changing nature of our business due to digital technologies. The Digital Strategy has been grouped into three themes:

Customer Engagement Platform - Using digital platforms and technology to improve the customer's experience by providing a frictionless multi-channel, bi-directional and secure method of engagement with Vector across all of their interactions and touchpoints throughout the end to end customer lifecycle.

Business Enablement Platform - The development of microservices and fit for purpose core business enablement platforms will reduce complexity and risk on legacy platforms. The existing legacy, monolithic enterprise platforms will result in significant cost and risk to migrate when they start to reach end of life and the Business Enablement Platform will provide Vector the ability to complete lifecycle migration activity and improve our capability to meet changing customer and technology demands.

OT / Energy Internet Of Thing (IoT) Platform - Using digital platforms and technology to improve how Vector collects data and operates the network. The increasing instances of new technology demand improved ability to optimise and manage data collected from our assets. So, this is especially focussed around the areas of network management and data collection where increasing information from the network delivered in a secure way improves our ability to effectively and safely deliver our services.

4.4 ASSET SPECIFIC STRATEGIES

Vector's Asset Strategies for each of its asset classes describe in detail Vector's long-term actions and plans required to deliver specific objectives and network outcomes based on stakeholder requirements and long-term service level performance criteria. A list of all of Vector's Asset Strategies is provided in Appendix 2.

Each asset strategy provides an overview of the class of asset, its purpose and information about its population, asset class replacement considerations, its maintenance requirements, failure modes, specific known issues, risks and asset health indicators and refurbishment requirements. A high-level summary of these strategies is given below.

4.4.1 DISTRIBUTION PIPELINES

Our asset strategy for distribution pipelines is described in GAA001 Distribution Pipelines. The strategies cover distribution mains and services pipelines.

Vector's distribution pipelines are comprised of PE pipe (92%), steel pipe (7%) and nylon and cast iron pipe (1%).

PE PIPELINES

The average age of Vector's mains and service PE pipelines is approximately 18 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 (i.e. over 98% of Vector's PE network) are comprised of modern PE. 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.

PE pipelines have been in use on Vector's networks since the 1970s. PE pipe manufactured up to the mid-1980s is known to be susceptible to premature brittle-like failure 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.

Analysis carried out for the 2015 to 2017 period shows that the PRE rate for pre-1985 PE systems was significantly higher than the average PRE rate for the whole of the Vector network, and had worsened slightly when compared to the 2013 to 2015 period. The analysis also indicated that PRE the rate for MP4 pre-1985 PE systems was significantly higher than that for MP1 and MP2 pre-1985 PE systems and that all PRE that occurred over the period were caused by either a squeeze-off failure or a manual-fusion joint failure. The results of the analysis support Vector's risk mitigation controls which include a targeted leakage survey strategy, the monitoring and regular analysis of faults related to pre-1985 PE pipelines, and an ongoing programme of targeted pipeline replacement based on the results of the analysis.

Vector's design standards currently stipulate that all Series 3 pipe (i.e. imperial size) installed on the PE network must be yellow PE80 material. However, the international supply of yellow PE80 resin is now becoming constrained (i.e. most overseas gas utilities now use PE100 pipe) and Vector is therefore planning on adopting yellow jacketed black PE100 pipe as the standard; it is anticipated that this will avoid pipe shortages and result in improved price stability going forward. As part of this move, the minimum pipe size for service connections will be increased from 10 Nominal Bore (NB) to 15NB;

the key driver for this change is the substantially larger wall thickness that the 15NB pipe offers over the 10NB pipe which will make new service pipes more resilient to 3rd party damage.

STEEL PIPELINES

Underground steel pipelines are protected from corrosion by means of pipe coatings and the use of CP systems. The average age of Vector's steel pipelines is approximately 34 years; the standard life for steel pipe is 60 years for MP pipelines and 70 years for IP pipelines. The overall condition of buried steel pipelines is good and no programmed replacement of these pipelines is envisaged within the standard life of the asset; the replacement of steel pipelines is expected to continue to be of a corrective nature, targeting specific locations and addressing localized issues.

Where a steel pipeline is located in close proximity to a high voltage power network, hazardous voltages can occur on the pipeline in the event of a fault on the power network. The electrical hazards can be caused by Earth Potential Rise (EPR) where the pipeline is located in proximity to a power system earthing-current discharge point, or by Low Frequency Induction (LFI) where a steel pipeline runs parallel with a high voltage power line. Vector is developing an Electrical Hazard Management Plan (in accordance with the requirements of AS/NZS 4853) to identify and assess the risk of electrical hazards on steel pipeline systems and develop hazard mitigation designs (e.g. insulated joint protectors and pipeline earth electrodes) where appropriate.

The North Harbour Pipeline is currently operated as part of Vector's IP20 network but is managed and maintained as a HP pipeline in accordance with the requirements of the Health and Safety in Employment Regulations (Pipelines) Regulations 1999. The pipeline was commissioned in the late 1990s and the initial and subsequent certificates of fitness cited NZS 5223 as the code of practice to which it was certified. However, AS 2885 is now recognised as industry best-practice and Vector therefore initiated a review of the pipeline's design, construction and operating standards in FY14 to align them with the requirements of AS 2885. This is expected to be completed in 2018 with the issue of the 2018 pipeline certificate of fitness which cites AS 2885 as the adopted code of practice.

An inventory of critical spares and equipment items is held for Vector's networks; the items are owned by Vector and held on its behalf by its FSP, Electrix. The inventory 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 general condition of the critical spares and equipment is adequate, however some of the equipment (e.g. TDW drilling equipment) is at least 25 years old and its current condition reflects the relatively high level of service.

NYLON AND CAST IRON PIPELINES

Small quantities of nylon mains pipe were installed on Vector' network during the early 1980s, however all known sections of nylon mains pipe have since been replaced (with PE) or decommissioned. A small-bore (6NB) nylon piping system known as Flexigas was also used for a short period during the late 1980s however it quickly became obsolete due to the introduction of PE pipe; approximately 2.5 km of 6NB nylon service pipe remains in use. Nylon service pipes are replaced (with PE) whenever any reactive or planned work is carried out on these services.

Approximately 100m of cast iron mains pipe remains in service on the Panmure MP1 system; although the installation date is not known, it's thought to have been installed around the 1960s. Cast iron pipelines are constructed from sections of pipe that are joined with a mechanical joint and are prone to leakage due to damage to the joints and/or fractures in the pipe. The replacement of this section of pipeline will be carried out as part of a mains relocation project associated with a major Auckland Council road-upgrade programme.

4.4.2 PRESSURE STATIONS

Management of our pressure station fleet is undertaken in accordance with Vector's asset strategy GAA201 Pressure stations. The strategies cover equipment at gate stations, DRS and service regulators.

GATE STATIONS

High pressure equipment (pressure regulating equipment, custody transfer metering, etc.) within the gate station is operated and maintained by the transmission company (FirstGas 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.

DRS

Vector has approximately 100 DRS in service on its distribution network. The average age of the DRS population is 20 years; the standard life of a DRS is 35 years. The majority of DRS are installed aboveground and have a twin stream active/monitor/slam-shut (i.e. over-pressure protection) configuration.

DRS condition assessments are carried out on an ongoing basis to allow DRS upgrade priorities to be determined; the condition assessments cover the following general areas:

- Enclosure dimensions, amount below ground, enclosure type and ventilation provided;
- Confirmation that the reliefs valves are 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.

The ongoing DRS condition assessments form the basis of Vector's DRS upgrade programme to address integrity issues, and the overall condition of the DRS population has shown a steady improvement over the period since the condition assessments were initiated in FY10. Although the overall condition of the DRS population is improved, there are ongoing integrity issues that still need to be addressed; some common examples of these issues include:

- Corrosion of pipe spools and/or equipment;
- Presence of relief valve over-pressure protection at a small number of sites;
- Deficiencies in legacy DRS enclosure designs - e.g. inadequate protection against vehicle impact; inadequate access or egress resulting in confined or restricted spaces; inadequate enclosure ventilation; and
- Inadequate inlet and/or outlet fire valves.

In order to mitigate electrical hazards that could be present at DRS installations, Vector has initiated a 3-year programme (FY17 to FY19) to retrofit equipotential bonding, earthing and surge diverters (where required) to all existing DRS. This work is being implemented as part of the development of an Electrical Hazard Management Plan in accordance with the requirements of AS/NZS 4853.

SERVICE REGULATORS

Approximately 170 service regulators remain in service on Vector's network. The average age of the service regulators is 25 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.

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). 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 planned maintenance inspection records, fault reports or an assessment of other risk factors - e.g. the service regulator location relative to buildings, roadways etc.

4.4.3 VALVES

Vector's strategy for underground valves is described in GAA301 Valves.

LINE VALVES

The line-valve population is comprised predominantly of ball valves and plug valves with a small number of gate valves. The average age of the line valve population is 27 years; the standard life of valve assets is 35 years. 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 due to operational issues, leakage etc.

Plug valves were installed on Vector's network up until the mid-1980s; because of their design, plug valves require a higher level of maintenance which includes regular greasing to prevent the valve seizing and/or leaking. Ball valves have been used since the mid-1980s and are considered to be reliable and relatively maintenance free. Exact information on valve types (i.e. ball, plug etc.) installed on the network is not available (i.e. legacy valve information is not complete) however it is estimated that over 40% of mains valves are plug valves.

Mains and service valves are typically installed belowground. 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. Aboveground valves that are installed at gate station and DRS sites are operated and maintained as part of the station equipment.

The principal operational risks for line-valves are lost valves (i.e. a valve cannot be located in the field due to road alterations or re-sealing etc.) and seized plug valves (i.e. corrective maintenance procedures are unable to make a seized valve operable). Where lost valves or seized valves are confirmed, they are identified as such in Vector's asset database and a risk assessment carried out to determine if a replacement valve is required.

AS/NZS 4645 requires 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 (e.g. Central Business District (CBD) areas) is underway to determine if there are sufficient isolation valves to ensure the safe operation under normal or emergency conditions. An ongoing programme to install additional isolation valves (including DRS fire valves) as identified by the isolation study is planned for the duration of the planning period.

RISER VALVES

Prior to the introduction of ball valves in the early 1990s, a plug type riser valve was used for all residential and small commercial connections on Vector's network. 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 have been undertaken over recent years targeting areas known to have relatively high populations of plug type riser valves.

However, feedback received from Vector's FSP indicated that integrity issues were now also being identified with larger sized steel risers. As a result of this feedback, Vector's FY17 riser audit targeted IP10 and IP20 risers. The results of the survey showed that over 5% of the riser valves surveyed required replacement of the riser valve and/or flange due to corrosion; a small number of valves were also replaced due to the valve leaking, passing gas or being seized. Future annual riser valve surveys will continue to target larger sized risers (i.e. >25mm NB) until such time as the full population of this type of riser valve has been surveyed.

The crimped riser assemblies currently used by Vector (and the majority of NZ gas utilities) for 10mm and 15mm PE service connections are deemed to be 'proprietary' fittings under AS/NZS4645 and as such need to be tested to demonstrate that the assembly meets the Formal Safety Assessment (FSA) criteria stipulated in AS/NZS4645. The Gas Association of New Zealand (GANZ) is facilitating the testing on behalf of its members and will share the results when completed which is expected to be mid-2018. It is anticipated that Vector may be required to undertake additional testing to allow alternative crimping tools to be used and meet the requirements of the FSA.

4.4.4 CORROSION PROTECTION EQUIPMENT

Vector's strategy for corrosion protection equipment is described in GAA401 Corosion protection systems.

The majority of Vector's interconnected steel network is protected by impressed-current CP systems; the balance of the steel network (i.e. typically smaller standalone networks) are protected by sacrificial-anode CP systems. The CP systems comprise 10 transformer rectifiers and associated ground beds, 12 sacrificial-anode beds and approximately 1,000 CP test points.

The impressed-current CP systems have an average age of 30 years, and the sacrificial-anode CP systems have an average age of 25 years; the standard life of CP assets is 20 years. The condition of the overall CP system is considered adequate, and the performance requirements of AS 2832 CP of metals are generally being met.

Additional CP test points have been installed over recent years to meet the test-point spacing requirements of AS2832, however it is anticipated there could be a need for a small number of additional test points to address further test-point spacing issues as they are identified. Similarly, there is an ongoing need to install a small number of additional interference test points to allow joint monitoring of Vector's steel pipeline and other steel pipelines (e.g. Watercare's) at points where the pipelines cross or are in close proximity to one another.

Although impressed-current system ground beds are generally expected to last the lifetime of the network system to which they are attached, sacrificial-anode system anodes require replacement when the anodes have been consumed, or when the CP current requirement exceeds the capacity of the anode system. Replacement of the anodes is carried out as required based on an assessment of the performance of the relevant anode system.

The replacement programme for Vector's CP assets comprises an annual provision for the replacement of CP assets as required - e.g. installation of surge diverters, installation of new ground beds or upgrade of existing ground beds, replacement of expired sacrificial anodes, installation or replacement of test points etc.

4.4.5 TELEMETRY EQUIPMENT

Vector's strategy for telemetry equipment is described in GAA501 Telemetry equipment.

The telemetry systems used by Vector to monitor its gas distribution networks comprise the Telenet SCADA system, and the Cello system. Telenet equipment is typically installed at gate station and DRS sites, and Cello equipment is typically installed at system extremity or other critical pressure-monitoring points.

The Telenet system employs two communication platforms - i.e. approximately half of the sites utilise Kingfisher RTUs to monitor pressure, temperature and flow data and communicate with a master RTU by means of an analog radio transceiver; the balance of the Telenet sites utilise an electronic gas volume corrector to monitor pressure, temperature and flow data and communicate with the Vector base station by means of a GPRS router utilising the Vector Communications Wireless Plus service. The Telenet data is passed from the Kingfisher master RTU and the GPRS base station to Vector's Power TG SCADA system from where it is archived in the PI archiving system.

Most of the Kingfisher Telenet equipment was originally purchased and installed in the late 1990s; the average age of the field equipment is approximately 19 years and it is therefore at or near the end of its expected service life. Similarly, the original powder coated RTU field cabinets equipment is nearing the end of its service life. The frequency of equipment failures at these sites has shown a gradual increase recently; a 5 year programme (FY17 to FY21) to replace the field equipment and master station equipment was therefore initiated in FY17. The replacement programme will include the upgrade of the analog radio system to digital radio.

The average age of the GPRS Telenet field equipment is approximately 9 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 however these are expected to be addressed through ongoing corrector-firmware upgrades.

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. In addition to the population of Cello units installed at permanent pressure-monitoring locations, a small population of Cello units is also used for temporary pressure-monitoring - e.g. for winter gauging purposes. The 15 minute time-stamped data is uploaded from the Cello unit to the PMAC base station once a day; data from permanent monitoring sites is then archived in the PI archiving system. The average age of the Cello units is approximately 4 years; the equipment is in good working order.

4.4.6 SPECIAL CROSSINGS

Vector's strategy for special crossings is described in GAA601 Special crossings.

Vectors special crossings utilise either a steel carrier pipe (55%) or a PE carrier pipe (45%).

Detailed condition assessments have been completed for most of the steel special-crossings; the results of these assessments indicate that the majority of the 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 condition assessments are not currently possible at a small number of steel special-crossing sites due to restricted physical access. Condition assessments have also been carried out for all PE special crossings however for the majority of these crossings the PE carrier pipe is either buried in the road carriageway or enclosed within the bridge structure; detailed condition assessments have not been carried out at these sites.

A detailed risk assessment of all special crossing sites was undertaken in FY17 to identify sites that required additional protection measures to improve public safety - i.e. to prevent the public from accessing the pipes attached to the crossing structure. During FY18 additional barrier protection and/or signage was installed at all pipeline crossing sites where the need for additional protection was identified.

Following recent periodic maintenance inspections of the Auckland Harbour Bridge IP20 pipeline support brackets, a small pilot project was undertaken during FY17 to develop appropriate pipeline support-bracket upgrade designs and work methodologies and allow a work programme to be developed for the replacement of all Harbour Bridge pipeline brackets. Following the successful completion of the pilot project, a 5 year programme of work (FY18 to FY22) to replace all pipeline support brackets and recoat the entire pipeline has been initiated.

SECTION

05.

MANAGING OUR ASSET'S LIFECYCLE

SECTION 5. MANAGING OUR ASSET'S LIFECYCLE

This section sets out Vector's project proposals for the next 10-year period. Project proposals are created through the 'Needs Management' process described in Section 3.5.2 and are categorised as either 'Asset Development' or 'Operate, Maintain, Renew, Replace' projects. They comprise both standalone projects, where investment is focused on a specific asset and need, and programmes of work, which may comprise a series of projects to address the same need.

These proposals will assist Vector in achieving service level targets through addressing the current or forecast performance issues (see SECTION 2), and delivering our network vision (see Section 1.8). The proposals are aligned with our asset management strategies (see Section 4.3). It should however be noted that the proposals provided in this section have not been subjected to the optimisation process and thus represent an unconstrained view of Vector's investment plan. For key trade-offs made in the optimisation process refer to SECTION 6.

Each project proposal provided in this section details the following:

Need: The need sets out how the project is aligned with Vector's service level targets (see Section 2.2), particular shortfalls in performance (see Section 2.3) and particular strategies (see Section 4.3). Any risks relating to the ongoing performance of the network are highlighted. By having close alignment with the service levels, this ensures projects are in accordance with the asset management objectives.

Options considered: Viable options to address the need are set out in an options table. Where applicable, options consider non-network solutions and innovations and deferral of investment. The options table includes the expected cost of the option, the reason for choosing or rejecting and the post investment risk.

Preferred option: A brief description of the option selected to address the need is described, which forms the basis of the project. Any inter-dependencies with other investment projects are noted.

Investment summary: An investment summary table gives forecast expenditure on the project for the 10-year period in New Zealand dollars. The forecast annual expenditure is given in financial years and all amounts are shown in millions of dollars nominal to two decimal figures.

5.1 NETWORK DEVELOPMENT

Network Development is driven by network demand exceeding the capacity of existing assets. These are generally caused by increases in new customer connections or increasing demand from existing connections (see Section 2.3.1). Other factors such as pressure rating reappraisal (e.g. pressure de-rating due to changing conditions) or the identification and (partial) mitigation of high-impact low-probability events may also be managed as part of Network Development.

As network demand increases, the capacity of the network needs to be increased to maintain network reliability. The QoS criteria describes the level of redundancy to which the network is designed to deliver the accepted reliability levels. Subject to these levels being delivered network reliability is determined by the performance of the network assets. Vector's approach to asset development is outlined in the Network Planning Strategy (see Section 4.3.2). In addition, a 'system pressure drops below acceptable levels' risk and 'SoS risk, and associated controls and treatment plans have been registered in Vector's risk management system. These risks have been assessed in accordance with Vector's risk management process, described in Section 3.5.

The following sections detail the asset development projects and programmes planned across the network over the next 10 years. A full list of all pressure systems and their performance against Vector's QoS criteria (refer Section 4.3.7) is provided in Appendix 6.

5.1.1 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. Forecast breaches over the next 10 years is shown in Appendix 6 and Appendix 13.

EAST AUCKLAND IP20/MP4

NEED

Network modelling of the East Auckland IP20/MP4 pressure system indicates a forecast QoS breach (886kPa) in Gilbert Rd/Alexander Cres area of Pakuranga within the next ten years. Two smaller SoS projects have been identified in Harris Rd and Smales Rd which will improve both local network pressure and connectivity.

RECOMMENDED SOLUTIONS	REASON TO CHOOSING	POST INVESTMENT RISK
Construct approximately 1,000 metres of 200mm IP20 steel main along Gilbert Road to Alexander Crescent, Otahuhu	Quality of Supply risk	Addresses a forecast IP20 pressure breach at DRS-0116 and DRS - 00163
Construct approximately 400 metres of 100mm PE MP4 pipeline along Harris Road from Cryers Road to Ti Rakau Drive, Pakuranga	Security of Supply risk	Improves network pressure and security of supply
Construct approximately 330 metres of 100mm PE MP4 between #18 and #40 Smales Road, East Tamaki	Security of Supply risk	Improves network pressure and security of supply

OPTIONS

The steel IP20 main reduces from an 8" to a 4" pipeline in Gridco Rd, causing excessive pressure drop to the Alexander Cres DRS (DR-0116). Installing a 200mm steel main in parallel with the 4" pipeline from Gilbert Rd to Alexander Rd increases the minimum pressure inlet pressure at DR-0116 to 1224kPa, addressing the immediate issue. Alternatives include extending the 200mm pipeline to connect into the 8" main. This option will add a further 370m pipeline and additional cost, both of which are unnecessary at this time.

Modelling shows that installing an MP4 connection between Cryers Rd and Ti Rakau Dr, Pakuranga substantially improves the MP4 pressure to the network northwest of Ti Rakau Drive (Botany Rd) and west of Harris Rd. Other options such as Ti Rakau Drive road crossings were either less effective than the proposed solution, more expensive and required private property access to achieve the outcomes.

The MP4 extension in Smales Rd allows the connection between the commercial network supplied by the Kerwyn Ave DRS and the residential areas in Franshell Cres and Redcastle Dr. Apart from the pressure improvement further to the north in Moorestead Ave, the mix of commercial and residential load improves the utilisation of the Kerwyn Ave DRS.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
IP20 upgrade from Gilbert Rd to Alexander Cres, Otahuhu	0.30	1.30									1.60
MP4 pipeline extension in Harris Rd, Pakuranga				0.09							0.09

MP4 pipeline extension in Smales Rd East Tamaki			0.39								0.39
Total	0.30	1.30	0.39	0.09							2.08

CENTRAL AUCKLAND MP4

NEED

The Central Auckland MP4 pressure system 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.

Modelling has identified a forecast pressure-related QoS issue arising in Mission Bay and extending west to include Orakei and lower end of Victoria Ave and Portland Rd areas in Remuera. Pressure improvement projects have been identified in Motions Rd, Pt Chevalier and Ruskin St and St Stephens Ave, Parnell and Remuera Rd, Remuera.

Two DRS's have been identified for upgrades to provide increased capacity.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
Construct approximately 1,000 metres of 100mm PE MP4 pipeline along Kohimarama Rd from Whytehead Crescent to Kepa Road, Kohimarama	Quality of Supply risk	Address pending QoS issues in the Mission Bay area
Construct 1,200 metres of 100mm PE MP4 pipeline along Kepa Road, from Kohimaramara to Coates Ave, Mission Bay.	Quality of Supply risk	Address pending QoS issues in the Orakei area
Construct 1,200 metres of 100mm PE MP4 pipeline along Kepa Road from Coates Ave to Ngapipi Road, Orakei.	Quality of Supply risk	Address pending QoS issues in the Remuera area
Construct approximately 730 metres of 50mm MP4 PE pipeline in Motions Road, Pt Chevalier to link two networks.	Security of Supply risk	Improves network pressure and security of supply
Install approximately 30 metres of 32mm PE MP4 pipeline between 9 and 14 Ruskin Street, Parnell to link two networks.	Security of Supply risk	Improves network pressure and security of supply
Upgrade the Kerwyn Ave DRS (DR-0163) to deliver increased capacity	Quality of Supply risk	Addresses a forecast capacity constraint
Upgrade the Franklin Rd DRS (DR-00049-AK) to deliver increased capacity	Quality of Supply risk	Addresses a forecast capacity constraint

OPTIONS

The proposed solution to the QoS issue is to extend the MP4 pipeline from Whytehead Cres near the IP10 network in Apirana Ave. The installation of this MP4 reinforcement allows connection into the MP4 network at Orakei Lagoon, enabling pressure support north to Orakei towards Mission Bay and south into the Remuera area. Due to the costly nature of this project it will be split over three years. Alternatives include supplying Orakei from Whytehead Cres and upgrading the MP4 network from IP20 network at Ellerslie Racecourse. This option is more expensive than the solution proposed.

The Motions Rd connection joins two separate MP4 networks together in Pt Chevalier offering improved network resilience and a marginal improvement in network pressure.

The Ruskin St, Parnell connection is a minor project comprising an upgrade of an existing short length of 32mm gas pipe and a minor extension to link two MP4 networks together

Franklin Rd, CBD and Kerwyn Ave, East Tamaki DRS's (DR-0163, DR-0049 respectively) have been identified for upgrading to provide increased capacity.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 pipeline extension along Kohimarama Rd from Whytehead Cres to Kepa Road, Kohimarama				0.22							0.22
MP4 pipeline extension along Kepa Road, from Kohimaramara Road to Coates Ave.					0.29						0.29
MP4 pipeline extension along Kepa Road from Coates Ave to Ngapipi Road.						0.29					0.29
MP4 pipeline extension along Motions Rd, Pt Chevalier	0.16										0.16
MP4 pipeline upgrade in Ruskin St, Parnell	0.03										0.03
Upgrade Kerwyn Ave DRS (DR-0163)	0.49										0.49
Upgrade Franklin Rd DRS (DR-00049-AK)	0.34										0.34
Total	1.02	0.00		0.22	0.29	0.29					1.82

AUCKLAND AIRPORT IP20/MP4

NEED

The Airport MP4 system provides supply to the Auckland International Airport and domestic terminal complex and is currently supplied by single MP4 pipeline, running from the western end of Puhinui Road and over the Pukaki Creek bridge crossing.

Auckland Airport includes a number of sizable commercial loads and with the planned expansion of the airport terminal, further load increases are forecast within both the Airport complex and commercial area to the north.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
Construct a 150mm PE MP4 pipeline along George Bolt Memorial Drive from	Quality of Supply risk	Reduces exposure presented by the Airport being on a single gas supply.

Landing Drive to Tom Pearce Drive to link the Airport and East Auckland MP4 pressure systems		Enabling project for the relocation of DRS-00107-AK to improve local pressure
Uprate Pukaki Creek bridge crossing from MP4 to IP20 at Auckland Airport	Quality of Supply risk	Enabling project for the relocation of DRS-00107-AK to improve local pressure
Relocate the IP20/MP4 DRS (DR-00107-AK) in Puhunui Rd to the Airport-side of the Pukaki Creek bridge, Auckland Airport.	Quality of Supply risk	Improves gas pressure at the Airport enabling future growth
Construct 300 metres of 100mm PE MP4 pipeline in Ray Emery Drive in conjunction with Airport terminal expansion	Quality of Supply risk	Increases network capacity to the International Terminal to meet increased gas demand

OPTIONS

To meet the growing demand, the proposed solution is to connect the Puhinui Rd MP4 network into MP4 network from the north. This will support modest load growth at the airport. The second stage is to move the IP20/MP4 DRS in Puhinui Rd (DR-0107) closer to the load centre at the airport to reduce the MP4 pressure drop. The proposed location of the DRS is on the airport side of the Pukaki Creek bridge. Timing will be determined by existing network capacity and uptake of forecast gas demand. While the pipework between the DRS in its present location and the proposed new location has been constructed to IP20 standards it is currently operating at MP4 pressures. Commissioning to IP20 standards will be required. As part of the upgrade the Pukaki Creek crossing will be upgraded. The alternative is to defer the linkage of the two networks. However, the Puhinui supply to the airport has limited remaining capacity and although moving the DRS closer to the airport improves the pressure and therefore available capacity at the airport, the network linkage is required to enable the commissioning of the IP20 pipeline extension.

Ray Emery Drive is the roadway fronting the International Airport Terminal. With the expansion of the International Terminal increased gas usage is forecast. The initiation of project to upgrade the network in Ray Emery Drive will be dependent on Auckland Airport's growth strategy and upgrade plans.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 pipeline extension along George Bolt Memorial Drive from Landing Drive to Tom Pearce Drive, Mangere	0.09										0.09
Upgrade Pukaki Creek bridge crossing, Mangere						0.20					0.20
Relocate Auckland Airport DRS (DR-00107-AK DRS) from Puhunui Rd to the Pukaki Creek bridge, Mangere.					0.32						0.32
MP4 pipeline extension in Ray Emery Drive, Mangere			0.07								0.07
Total	0.09		0.07		0.32	0.20					0.68

NORTH-HARBOUR MP4

NEED

The North Harbour and North Shore MP4 networks form a single, large meshed network. For the purposes of geographically separating the reinforcement projects, the North Harbour MP4 pressure system covers the gas network from Albany north to Torbay/Long Bay in the north. Greenfields residential development in the Long Bay area has initiated network extensions to supply these new customers.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
Construct approximately 2,500 metres of 100mm PE MP4 pipeline from East Coast Road along Glenvar Ridge Road to the Long Bay development, Long Bay	Quality of Supply risk	Addresses a forecast QoS issue at Long Bay
Install a new IP20/MP4 DRS at the junction of East Coast Road and Glenvar Road, Glenvar.	Quality of Supply risk	As above
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	Quality of Supply risk	To supplement the Glenvar Ridge Rd supply and support the growth in the Long Bay area

OPTIONS

Residential developments are driving the installation of the back-bone MP4 network down Glenvar Ridge Rd to Long Bay. This pipeline will be supplied by a new IP20/MP4 DRS located at the top of Glenvar Rd and connected into the 6" IP20 steel main in East Coast Rd. Following Glenvar Ridge Rd the next backbone reticulation between East Coast Rd and Long Bay will be along Okura River Rd and Vaughans Rd. There are no alternatives to these projects.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 pipeline extension along Glenvar Ridge Rd from East Coast Rd to Long Bay				0.38							0.38
Establish a new IP20/MP4 DRS at the junction of East Coast Rd and Glenvar Rd, Glenvar.					0.32						0.32
MP4 pipeline extension along Okura River Rd and Vaughans Rd from East Coast Rd to Long Bay						0.62					0.62
Total				0.38	0.32	0.62					1.32

NORTH SHORE IP20/MP4

NEED

The North Shore MP4 pressure system is bounded by the suburbs of Beachhaven and Devonport, and the North Harbour network in the north. High demand growth is forecast in metropolitan Takapuna which affects the network pressure in

Devonport. The vulnerability of the system is caused by the large distance between Devonport and the Council Terrace DRS (DR-00046-AK), which is its nearest point of supply. Modelling has identified a forecast QoS pressure breach, starting with Devonport and progressively moving along the peninsular towards Takapuna as forecast gas load increases.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
Construct 11 x PE MP4 road crossings in Devonport	Quality of Supply risk	Temporarily alleviates a forecast local pressure in Devonport
Extend the 150mm steel IP20 pipeline 4200m from North Shore IP20 line to Takapuna	Quality of Supply risk	Longer term solution to forecast pressure breaches in the Devonport peninsular
Construct a new IP20/MP4 DRS (10,000scmh) in Takapuna to support the Devonport and Takapuna MP4 network	Quality of Supply risk	As above

OPTION

Two key projects are proposed, the first being to reinforce Devonport's MP4 network to temporarily defer short term pressure beaches. The second project is to extend the IP20 pipeline from Hillcrest/Northcote to a new IP20/MP4 DRS in Takapuna. This will increase the gas capacity into Takapuna and address pressure issues in Devonport.

Modelling shows that the benefits made in the road crossing improvements in Devonport are carried through even when the major upgrade is completed. Alternatives considered included upgrading the MP4 network along Lake Rd, which, apart from the constructional difficulties presented by roadworks on this congested road, did little to improve the pressure of the network. Other MP4 solutions were modelled with similarly disappointing outcomes.

The proposed IP20 solution is costly with construction of the pipeline spread over three years.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 road crossings in Devonport	0.27										0.27
IP20 pipeline extension from the North Shore IP20 pipeline to Takapuna			0.50	4.40	4.40						9.30
Establish a new IP20/MP4 DRS in Takapuna					0.45						0.45
Total	0.27		0.50	4.40	4.85						10.02

5.1.2 NORTH-WESTERN IP20/MP4

NEED

The area supplies West Harbour, Westgate, Whenuapai out to Kumeu and Huapai. This is a rapidly growing area with large residential developments planned for Red Hills, Hobsonville Point/Scotts Point and Whenuapai. To enable the connection of new gas customers in these greenfields areas back-bone infrastructure needs to be installed.

RECOMMENDED SOLUTIONS	REASON TO CHOOSING	POST INVESTMENT RISK
Extend 100mm PE MP4 1.14km along Scott Rd from Ngaroma House Drive to the new housing development, Scotts Point	Opportunity to connect new customers	To provide back-bone infrastructure for future infill development
Establish a new IP20/MP4 DRS off the Helensville IP20 line at Kumeu to support Hobsonville & Whenuapai development & intensification	Quality of Supply risk	To provide capacity for growth in Riverhead, Whenuapai, and Westgate
Install 200mm PVC duct over the Royal Road Bridge in conjunction with the SH16 upgrade (future proof)	Future-proofing opportunity	An opportunity to get the gas network over SH16

OPTION

The Scott Rd MP4 extension is to allow for the connection of new customers at the eastern end of Scotts Point. The installation of this reticulation allows connection of further developments along Scotts Rd.

A new IP20/MP4 DRS is proposed at Kumeu to support the greenfields residential developments extending from Hobsonville and Whenuapai towards Kumeu.

Installation of a duct across SH16 at Royal Rd allows for a future motorway crossing.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 pipeline extension along Scott Rd from Ngaroma House Dr, Scotts Point	0.25										0.25
Establish a new IP20/MP4 DRS off the Helensville IP20 pipeline at Kumeu					0.30						0.30
Install a duct over the Royal Rd Bridge, SH16	0.05										0.05
Total	0.30				0.30						0.60

5.1.3 WARKWORTH MP4

NEED

The Warkworth MP4 network is supplied from the IP20/MP4 DRS in Woodcocks Rd, approximately 4km from Warkworth. The MP4 network only supplies the township of Warkworth. Subdivision growth to the northeast of Matakana and Sandspit Roads requires reinforcement of the existing network to provide back-bone support for these developments.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
Construct 2,040 metres 160mm PE MP4 pipeline from Woodcocks Rd, Auckland Rd Whitaker Rd, Mill Lane, Elizabeth St, to Sandspit Rd, Warkworth	Quality of Supply risk	To support growth on the north-eastern side of Warkworth

OPTION

Extension of the network is necessary to get a gas supply into the areas under development.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
MP4 pipeline extension from Woodcocks Rd to Sandspit Rd, Warkworth							0.51				0.51
Total							0.51				0.51

5.1.4 DRS UPGRADES

NEED

Provision is made for the upgrading of DRS's over the forthcoming year that are unforeseen at the time this AMP is prepared. The provisional budget ensures that DRS's that exceed their design capacity can be upgraded.

RECOMMENDED SOLUTION	REASON TO CHOOSING	POST INVESTMENT RISK
DRS upgrade to address unforeseen capacity issues	Quality of Supply risk	Avoiding mal-operation of DRS's due to operation beyond their design capacity

OPTION

Failure to address the capacity constraint could lead to mal-operation of the DRS and potential local network QoS supply issues.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
DRS upgrade to address unforeseen capacity issues	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.16
Total	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.16

5.1.5 CUSTOMER CONNECTIONS

The interface with the customer is managed by the Customer Excellence Team within Vector. Requests for new connections or changes to existing connections are forwarded to the Customer Excellence Team from our FSP's, for small projects, and from developers or consultants for subdivision and customer substation works. Provisional budgets are then developed.

These are the connection (and disconnection) of smaller customers to Vector's network. This includes extensions to mains pipelines and service pipelines inside the customer's property. For the purposes of estimating the budget the average cost of connection has been applied to the expected connection numbers for the year and regulatory period.

NEW CUSTOMER CONNECTIONS

NEED

Vector is not obligated to provide new customer connections. However, the provision of new customer connections is part of Vector's core business and it is good business practice. As part of the process to establish new connections alternative technology solutions are also considered. The number of new connections on Vector's network for the next 5 years has been forecasted as reflected in the service level metric in SECTION 2. The investment summary below shows the whole spectrum of customer connections that includes subdivision developments and substations for customers

OPTIONS CONSIDERED

The following options are considered for new customer connections

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do not invest in new customer connections	No cost	Rejected:	The risk of reputational damage to Vector's brand
2	Invest in new customer connections	$11m per year on average	Selected: This is in line with Vector's core business	Low risk of reputational damage

PREFERRED OPTION

Invest in new customer connections.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Subdivision and mains extensions	7.41	8.42	6.69	5.73	7.76	5.62	5.68	5.77	5.84	5.92	64.84
Residential connections	8.34	8.46	8.48	8.59	8.71	8.43	8.51	8.65	8.75	8.87	85.80
Commercial connections	1.60	1.58	1.57	1.57	1.56	1.55	1.55	1.54	1.54	1.54	15.60
Total	17.36	18.45	16.74	15.89	18.03	15.60	15.74	15.96	16.13	16.33	166.24

5.1.6 RELOCATIONS

NEED

Vector is obliged to provide customer relocations in accordance with Section 33 of the Gas Act. The number of new customer relocations on Vector's network for the next 10 years has been forecasted, as reflected in the service level metric (see Section 2.3.2).

OPTIONS CONSIDERED

This is an obligatory project so no options are considered.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Invest in customer relocations	$3.2m per year on average	This is an obligatory requirement.	N/A

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

The investment requirements for customer relocations is based on historic relocation costs.

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Asset Relocations	3.83	3.51	2.93	3.14	3.11	3.11	3.11	3.11	3.11	3.11	32.06
Total	3.83	3.51	2.93	3.14	3.11	3.11	3.11	3.11	3.11	3.11	32.06

5.2 OPERATE, MAINTAIN, RENEW AND REPLACE

The safe and reliable operation of the network relies upon renewal and replacement of assets together with a sound maintenance regime. Vector undertakes regular meetings with FSP to discuss the progress of maintenance programmes and proactively discuss potential issues to ensure the maintenance programme is effective in improving or maintaining service levels. Vector's ultimate aim for operations and maintenance is to meet the service level targets set out in Section 2.2 This includes ensuring asset safety and any associated environmental requirements are met.

Projects or programmes are initiated to address gaps in service level targets that are either already apparent or are forecast in the next 5-10 years.

This section provides details on all the renew, replace or maintain projects proposed for the next 10-year period for the continued safe and reliable operation of the network. Programmes of work have been created where expenditure is planned across a number of years.

Vector's forecast expenditure for Routine and Corrective Maintenance and Inspections is set out in Schedule 11b in Appendix 11 as part of the disclosure Report on Forecast OPEX. Asset replacement and renewal is forecast in Schedule 11a in Appendix 10 as part of the disclosure Report on Forecast CAPEX. A typical breakdown of Vector's spend on Routine and Corrective Maintenance and Inspections across the primary asset categories is shown in Table 5-1, reflected as a percentage of the value forecast in Schedule 11b.

ROUTINE AND CORRECTIVE MAINTENANCE AND INSPECTIONS	FY19 – FY28 ($M)	FY19 – FY28 (%)
Distribution pipelines	35.74	71%
Pressure stations	2.05	4%
Valves	6.55	13%
Corrosion protection systems	2.39	5%
Monitoring and control systems	1.47	3%
Special crossings	2.20	4%

Table 5-1 Breakdown of routine and corrective maintenance

NETWORK MAINTENANCE

NEED

Vector's network maintenance programmes are categorised as follows:

- Reactive maintenance
- Preventive maintenance
- Corrective maintenance
- Third party services

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 2.2). It primarily involves:

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

Preventive maintenance covers activities defined through Vector's maintenance standards (see Appendix 2), 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.

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.

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.

Analysis of Vector's asset management service levels in Section 2.2 indicates Vector has met or exceeded the specified target. However, in some cases further improvement is required. As a result, there is a need to invest in maintaining or improving the levels of performance attained. The service levels, gap analysis and root cause of the performance that are influenced by maintenance are described below:

- Number of Poor Pressure Events target has been exceeded by one. The root cause analysis of these doesn't indicate any specific trend that is actionable. Regular reviews are conducted of faults data to identify any trends; and
- The number of PRE, Number of Unplanned Interruptions and Environmental Breaches have all been maintained within target.

The overall performance of Vector's Gas distribution network has remained within the service level and reliability targets set. This indicates that the current maintenance program is effective. As a result, the maintenance strategy for the following period is to continue with the programmes already initiated to ensure this performance endures.

OPTIONS CONSIDERED

Vector has considered the following options:

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do Nothing	$0	Rejected: The network would degrade and the rate of failures would increase over time; Vector would be exposed to increased H&S and compliance risks.	Vector would be exposed to increased H&S and compliance risks.
2	Continue to invest in Planned, Corrective, Reactive and Third Party maintenance	$48.43m	Selected: The rate of failures and associated risk will be maintained. This is also aligned with Vector's best practice approach to managing its assets and their associated risks.	Vector will continue to meet its service level targets and maintain H&S compliance and current levels of risk.

PREFERRED OPTION

The preferred option is a responsible approach to ensure that the network is well maintained and will continue to operate and function safely and reliably into the future. Table 5-2 sets out the forecast network maintenance OPEX broken down by maintenance activity. Table 6-4 provides the forecast network maintenance OPEX broken down into the asset categories defined in the Commerce Commission's Gas Distribution Information Disclosure Determination 2012.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Reactive Maintenance	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	21.79
Preventative Maintenance	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	10.13
Corrective Maintenance	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	9.60
Third Party Services	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	6.91
Total	4.84	4.84	4.84	4.84	4.84	4.84	4.85	4.85	4.85	4.85	48.43

Table 5-2 Breakdown of OPEX expenditure forecast by maintenance activity

5.2.1 DISTRIBUTION PIPELINES

The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA001 Distribution pipelines.

TARGETED REPLACEMENT OF HIGH PRIORITY MP PRE-1985 PE PIPE

NEED

Overseas research indicates that much of the PE pipe manufactured and used for gas service from the 1960s through the early 1980s may be susceptible to premature brittle-like failures when subjected to stress intensification - these failures represent a potential public safety hazard.

Vector's gas distribution network currently includes approximately 82 km of PE mains that were installed in 1984 or before - approximately 47% operate at MP4, 35% at MP2, and 18% at MP1. Incidents of brittle-like failure have occurred on Vector's network and the probability of failure is anticipated to rise with time due to factors such as installation, operating and environmental conditions – e.g. PE squeeze offs.

Recent analysis of pre-85 PE PREs on Vector's network shows that the rate of pre-85 PE failures is significantly higher than the rate of failures on the whole of the Auckland network. The analysis also shows that the PRE rate for MP4 pre-85 PE systems is higher than that for MP1 and MP2 systems. Vector has therefore adopted a strategy of targeted pre-85 PE mains and service pipeline replacement initially targeting higher priority areas. Priorities have been based on risk factors which include PRE history, operating pressure, pipe diameter, pipeline criticality, and proximity to business areas, hospitals etc.

The planned programme of pre-85 PE pipeline replacement work aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle. The work programme also aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of unplanned interruptions and the number of public reported escapes.

A 'Pre-1985 PE pipe' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of pre-85 PE pipeline replacement work forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: The rate of pre-1985 PE failures would increase over time; Vector would be exposed to increased H&S and compliance risks.	Vector would be exposed to increased H&S and compliance risks.
2	A continuation of the previous reactive-replacement strategy where pre-1985 PE replacement targeted pipeline sections with a recent fault history.	Annual provision of $100k	Rejected: This option was discounted due to the increase in the rate of pre-1985 PE failures and the increased likelihood of a failure occurring in a higher risk area.	An increase in the rate of pre-1985 PE failures and an increased likelihood of a failure occurring in a higher risk area.
3	An ongoing programme of pre-1985 PE pipeline replacement targeting higher risk areas based on risk factors including PRE history, operating pressure, pipe diameter, pipeline criticality, and proximity to business areas, public buildings etc.	$9.68m	Selected: This option reduces the risk of a pre-1985 PE failure occurring in a higher risk area; it meets the FSA requirements of AS/NZS4645, and aligns with international best-practice.	A steady decline in pre-1985 PE failures, and a decreased likelihood of a failure occurring in a higher risk area.

PREFERRED OPTION

The preferred option is to continue an ongoing programme of pre-1985 PE pipeline replacement that targets higher risk areas based on risk factors including PRE history, operating pressure, pipe diameter, pipeline criticality, and proximity to business areas, public buildings etc.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Targeted replacement of high priority MP pre-1985 PE pipe	0.51	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	9.68
Total	0.51	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	9.68

PRESSURE UPRATING OF THE PANMURE MP1 SYSTEM TO OPERATE AT MP4

NEED

The Panmure MP1 system includes approximately 100 metres of cast iron mains pipe. This section of pipeline will be replaced (with PE) as part of a mains relocation project associated with a major Auckland Council road-upgrade programme and allow the MP1 system to be pressure-uprated.

The Panmure MP1 system is supplied from a single DRS; it is approximately 2.7km in length and supplies approximately 40 service connections. As the majority of the pipeline system has been constructed and tested to operate at MP4, Vector is planning to pressure uprate the pipeline system to operate at MP4. This will allow this pipeline system to be linked with neighbouring MP4 systems as these systems grow thereby improving security of supply for this system and the adjoining systems.

The planned programme of work to pressure uprate the Panmure MP1 system aligns with Vector's asset management policy and in particular a commitment to manage its assets to provide a reliable, sustainable, resilient, and efficient distribution network that meets its customer's present and future service expectations.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: This option does not allow the Panmure system to be interconnected with adjacent MP4 systems to improve security of supply.	The Panmure MP1 system remains as a small standalone system with limited options to mitigate security of supply or system capacity risks.
2	Pressure uprating of the Panmure MP1 system to operate at MP4.	$0.05m	Selected: This option will allow the Panmure MP4 system to be linked to adjacent MP4 systems as these systems grow thereby improving security of supply.	The Panmure MP4 system can be interconnected with adjacent MP4 systems as these systems grow thereby mitigating security of supply and system capacity risks.

PREFERRED OPTION

The preferred option is to pressure-uprate the Panmure MP1 system to operate at MP4.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Pressure uprating of the Panmure MP1 system to operate at MP4	0.05										0.05
Total	0.05										0.05

DESIGN AND INSTALLATION OF ELECTRICAL HAZARD MITIGATION MEASURES AS IDENTIFIED BY THE EHMP

NEED

AS/NZS 4853 sets out minimum requirements that pipeline owners must comply with to control electrical hazards on metallic pipelines due to the close proximity of high voltage power networks, electrical traction systems or lightning activity; amongst the treatments described for managing electrical hazards is the installation of pipeline earthing and the use of equipotential bonding. AS/NZS 4853 also requires pipeline owners to document the hazards and controls in an Electrical Hazard Management Plan (EHMP).

In 2016 Vector prepared a draft EHMP which includes a Level 1 assessment (in accordance with AS/NZS 4853) of Vector's steel pipelines. The assessment identifies approximately 90 at-risk pipeline sections which meet criteria that indicate that a Level 2/3 assessment is required. Vector is planning on undertaking the Level 2/3 assessments during FY19 and implementing a works programme (FY19 to FY20) to install any necessary hazard mitigation measures (e.g. pipeline earthing, FIK surge protection, solid state decouplers etc) as identified by the Level 2/3 assessment.

The planned programme of work to design and install electrical hazard mitigation measures as identified by the EHMP aligns with Vector's asset management policy and in particular a commitment to prevent harm to employees, contractors and the public through the management of Vector's assets over their entire lifecycle.

A 'Touch voltages on steel pipelines' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work to design and install electrical hazard mitigation measures forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: This is not a viable option - i.e. the implementation of an EHMP and the installation of electrical hazard mitigation measures on Vector's steel pipelines are mandatory requirements of the industry codes that Vector must comply with.	Personnel working on Vector's steel pipelines and associated equipment (e.g. valves) could be at risk of harm in the event of a power system fault in the vicinity of any part of the interconnected steel pipeline system; Vector would also be exposed to a compliance risk.
2	Undertake a programme of work to design and install electrical hazard mitigation measures as identified by the EHMP Level 2/3 assessments	$0.20m	Selected: This option will mitigate the H&S risks (i.e. to Vector personnel and the general public) and compliance risks associated with electrical hazards on steel pipelines.	H&S risks and compliance risks associated with electrical hazards on steel pipelines will be mitigated.

PREFERRED OPTION

The preferred option is to undertake a programme of work to design and install electrical hazard mitigation measures as identified by the EHMP Level 2/3 assessments.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Design and installation of electrical hazard mitigation measures	0.10	0.10									0.20
Total	0.10	0.10									0.20

STRATEGIC SPARES AND EQUIPMENT

NEED

The general condition of the inventory of critical spares and equipment is adequate, however some of the equipment (e.g. TDW drilling equipment) is at least 25 years old and its current condition reflects the relatively high level of service. An appropriate range of critical spares and equipment is held 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.

Regular planned maintenance inspections of critical spares and equipment periodically identify items that need to be replaced due to integrity issues - e.g. damaged, worn or corroded parts. An ongoing programme for the replacement of these assets as they are identified is required to ensure that as far as practicable the response to contingency situations is not compromised by the lack of specialist equipment or critical spares.

The ongoing replacement programme aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle. The work programme also aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the risk of prolonged outages associated with contingency events.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: Vector would be exposed to an increased risk of delays when completing emergency repairs due to the lack of adequate critical spares and equipment.	H&S risks would increase due to the risk of emergency repairs being delayed because of a lack of adequate critical spares and equipment.
2	An ongoing programme to replace critical spares and equipment as required to address integrity issues.	$0.20m	Selected: This option will ensure that H&S risks associated with a lack of adequate critical spares and equipment are minimised.	H&S risks associated with delays in completing emergency repairs will be mitigated.

PREFERRED OPTION

The preferred option is to continue an ongoing programme to replace critical spares and equipment as required to address integrity issues.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Replacement of critical spares and equipment as required	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.20
Total	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.20

UNSPECIFIED ASSET REPLACEMENT AND RENEWAL

NEED

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. An ongoing programme for the replacement of these assets as they are identified is planned to ensure that H&S and compliance risks are mitigated. The projected cost for this programme is based on historical expenditure.

The planned programme of work aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle. The work programme also aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of unplanned interruptions and the number of public reported escapes.

A 'Gas pipes into and/or under buildings' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: The works carried out under this category are required for H&S and/or compliance reasons.	Vector would be exposed to increased H&S and compliance risks.
2	Carry out unspecified asset replacement as required to reduce H&S and/or compliance risks.	$1.02m	Selected: To mitigate H&S and compliance risks	H&S and compliance risks associated with an asset failure will be mitigated.

PREFERRED OPTION

The preferred option is to retain a budget provision to allow assets to be replaced (on an as required basis) to address safety or compliance issues.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Unspecified asset replacement and renewal	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.02
Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.02

5.2.2 PRESSURE STATIONS

The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA201 Pressure stations.

DISTRICT REGULATING STATIONS
DRS UPGRADES TO ADDRESS COMPLIANCE AND INTEGRITY ISSUES
NEED

Periodic DRS condition assessments identify integrity and compliance issues that need to be addressed. Where the number and type of defects warrant it, an upgrade of the DRS will be considered. The scope of the upgrade can range from the replacement of individual components, to the complete refurbishment or rebuild of the DRS. Where an upgrade of a DRS is required for integrity reasons, the design capacity of the DRS will be reviewed to determine if a capacity upgrade is also warranted.

Trends over recent years show that an ongoing programme targeting one major DRS upgrade per year is required to address integrity and/or compliance issues identified by the periodic condition assessments.

A planned programme of work will target one major DRS upgrade per year to address integrity and/or compliance issues. The programme aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the risk of unplanned interruptions and poor pressure events associated with a DRS failure. The work programme also aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle.

A 'Regulator station failure' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work to complete one major DRS upgrade per year to address integrity and/or compliance issues forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing	-	Rejected: The integrity of the DRS population would degrade over time leading to increased corrective maintenance and reactive replacement costs, and an increased risk of a DRS failure leading to a loss of supply.	Increases in corrective maintenance and reactive replacement costs; an increase in reputational risk related to a DRS failure that leads to a loss of supply.
2	An ongoing programme targeting one major DRS upgrade per year to address integrity and/or compliance issues.	$3.16m	Selected: This option will result in reduced DRS corrective-maintenance and reactive replacement costs, and mitigate the risk of a DRS failure that leads to a loss of supply.	Reduced DRS corrective-maintenance and reactive replacement costs, and mitigation of the risk of a DRS failure that leads to a loss of supply.

PREFERRED OPTION

The preferred option is to continue an ongoing programme targeting one major DRS upgrade per year to address integrity and/or compliance issues.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
DRS upgrades to address compliance and integrity issues	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.16
Total	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.16

DRS EARTHING AND BONDING

NEED

AS/NZS 4853 sets out minimum requirements that pipeline owners must comply with to control electrical hazards on metallic pipelines due to the close proximity of high voltage power networks, electrical traction systems or lightning activity; amongst the treatments described for managing electrical hazards is the installation of pipeline earthing and the use of equipotential bonding. AS/NZS 4853 also requires pipeline owners to document the hazards and controls in an Electrical Hazard Management Plan (EHMP).

In 2016 Vector prepared a draft EHMP which includes the specification of earthing and bonding requirements for Vector's DRS sites to mitigate possible electrical interference hazards at DRS sites. A 3-year programme of work (FY17 to FY19) is underway to retrofit earthing and bonding to approximately 80 DRS sites that do not already have earthing and bonding installed. The 3 year programme is on track however the final stage (i.e. FY19) needs to be completed to ensure that the required earthing and bonding protection measures are installed at the remaining DRS sites.

The planned programme of work to install earthing and bonding at all remaining DRS sites aligns with Vector's asset management policy and in particular a commitment to prevent harm to employees, contractors and the public through the management of Vector's assets over their entire lifecycle.

A 'Touch voltages on steel pipelines' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of earthing and bonding work forms part of the treatment plan that has been developed for this risk

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing	-	Rejected: This is not a viable option - i.e. the implementation of an EHMP and the installation of earthing and bonding on aboveground steel pipeline equipment are mandatory requirements of the industry codes that Vector must comply with.	Personnel working on a DRS and members of the public in the vicinity at the time could be at risk of harm in the event of a power system fault close to a DRS; Vector would also be exposed to a compliance risk.
2	Complete a programme of works to install earthing and bonding at all remaining DRS sites	$0.21m	Selected: This option will mitigate the H&S risks (i.e. to Vector personnel and the general public) and compliance risks associated with electrical hazards on steel pipelines.	H&S risks and compliance risks associated with electrical hazards on steel pipelines will be mitigated.

PREFERRED OPTION

The preferred option is to complete a programme of works to install earthing and bonding at all remaining DRS sites.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
DRS earthing and bonding	0.21										0.21
Total	0.21										0.21

SERVICE REGULATOR REMOVAL

NEED

Approximately 90% of the current population of service regulators are installed belowground. In some situations, belowground service regulators can be affected by the ingress of water, silt or other debris which can result in gas escapes from corroded fittings and pipework, and can allow unacceptable over-pressure gas into downstream systems.

To mitigate the risks associated with the relatively large number of belowground service regulators, Vector has implemented an ongoing service regulator removal programme that targets the removal (or relocation aboveground) of a small number of higher priority service regulators annually. Service regulator replacement candidates are identified through planned maintenance inspection records, fault reports or an assessment of other risk factors - e.g. the presence of steel outlet pipework without CP, the service regulator location relative to buildings, roadways etc.

The planned programme of service regulator removal aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of unplanned interruptions, the number of poor pressure events and the number of public reported escapes. The work programme also aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle.

A 'Service regulator failure' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of service regulator removal work forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: Reactive and corrective maintenance costs would increase as the overall condition of the population of belowground SRs deteriorates; H&S risks associated with a service regulator malfunction would increase.	Increased maintenance costs; increased H&S and loss of supply risks associated with a service regulator malfunction.
2	An ongoing programme of belowground service regulator removal targeting higher risk sites.	$1.02m	Selected: This option will mitigate the H&S and loss of supply risks associated with a service regulator malfunction, and progressively reduce service-regulator reactive and corrective maintenance costs.	H&S and loss of supply risks associated with a service regulator malfunction will be reduced.

PREFERRED OPTION

The preferred option is to continue an ongoing programme of belowground service regulator removal targeting higher risk sites.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Service regulator removal	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.02
Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.02

5.2.3 VALVES

The following sections set out the project proposals for distribution valves. The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA301 Valves.

INSTALLATION OF ISOLATION VALVES (INCLUDES DRS FIRE VALVES)

NEED

AS/NZS 4645 requires sectional isolation valves be installed to facilitate the safe operation of the gas distribution network; AS/NZS 4645 also requires fire valves to be installed on all DRS inlet and outlet supply lines.

An ongoing network-isolation study is being undertaken to identify the need for additional isolation valves to improve the safe operation of the network and minimise the severity of outages - e.g. in the event of damage to the network from third party activities. An analysis of the availability of DRS inlet and outlet fire valves has also been undertaken to identify sites where additional fire valves are required to allow the DRS to be isolated in the event of an emergency.

The network isolation study and the DRS fire valve analysis completed to date have identified a number of sites where additional isolation valves are required. These have been prioritised and scheduled according to risk.

The programme of work to install additional isolation valves aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by limiting the severity of outages due to third party damage thereby reducing the number of unplanned interruptions. The work programme also aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle.

An 'Inability to isolate gas supply' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The programme of work to install additional isolation valves forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: This option does not mitigate the H&S and loss of supply risks identified by the network isolation study and DRS fire valve analysis.	H&S and loss of supply risks identified by the network isolation study and DRS fire valve analysis will still persist.
2	An ongoing programme to install additional isolation valves based on the results of the network isolation study and DRS fire valve analysis.	$0.79m	Selected: This option mitigates the H&S and loss of supply risks identified by the network isolation study and DRS fire valve analysis.	H&S and loss of supply risks identified by the network isolation study and DRS fire valve analysis will have been mitigated.

PREFERRED OPTION

The preferred option is to continue a programme to install additional isolation valves based on the results of the network isolation study and DRS fire valve analysis.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Installation of isolation valves (includes DRS fire valves)	0.05	0.33	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.79
Total	0.05	0.33	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.79

RISER VALVE REPLACEMENTS

NEED

Vector undertakes annual audits of approximately 1000 riser valves; the purpose of the audit is to assess the general condition, accessibility and operability of the riser valve and carry out corrective maintenance and asset replacement as required.

The initial driver of the audit programme was to address performance issues related to plug-type riser valves which were prone to leakage and seizing. However recent audits have targeted larger sized steel risers due to the risks associated with corrosion of the riser and/or riser valve.

Recent survey results show that over 5% of the risers required replacement of the riser valve and/or flange due to corrosion, and a small number of valves were replaced due to the valve leaking, passing gas or being seized. The results indicated that ongoing riser valve audits are required to mitigate risks associated with leaking, seized or corroded riser valves.

The planned programme of riser valve audits aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of unplanned interruptions and the number of public reported escapes. The work programme also aligns with Vector's asset management policy and in particular a commitment to prevent harm to the public through the management of its assets over their entire lifecycle.

An 'Inability to isolate gas supply' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of riser valve audits forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED
Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: Reactive and corrective maintenance costs would increase as the overall condition of riser valve assets deteriorates; H&S and loss of supply risks associated with a riser valve failure would increase.	Increased maintenance costs; increased H&S and loss of supply risks associated with riser valve failures.
2	An ongoing programme of riser valve audits to identify and replace valves where required due to condition.	$0.76m	Selected: This option will mitigate H&S and loss of supply risks associated with riser valve failures.	H&S and loss of supply risks associated with riser valve failures will be reduced.

PREFERRED OPTION
The preferred option is to continue an ongoing programme of riser valve audits to identify and replace valves where required due to condition.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Riser valve replacements	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.76
Total	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.76

5.2.4 CORROSION PROTECTION EQUIPMENT

The following sections set out the project proposals for distribution valves. The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA401 Corrosion protection systems.

REPLACEMENT OF CP ASSETS AS REQUIRED
NEED
AS/NZS 4645 requires all buried steel pipelines to be provided with CP to give long term protection against corrosion in accordance with AS 2832 (Cathodic protection of metals). Where CP system assets fail (e.g. sacrificial anodes, CP test points etc) due to age or third-party damage etc, new or upgraded CP assets may be required to ensure that the CP performance criteria of AS 2832 are met.

An ongoing programme of CP asset replacement or upgrade is required to ensure that CP assets can be replaced or upgraded on an as-required basis so that the level of CP protection on Vector's steel pipelines continues to meet the performance criteria of AS 2832. The planned programme of work aligns with Vector's asset management policy and in particular a commitment to maximise the value that Vector's assets deliver across their entire lifecycle through good practice asset management and risk management.

A 'Steel systems without CP' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of CP asset replacement or upgrade forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED
Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: CP protection levels on Vector's steel pipelines would degrade over time and lead to increased CP corrective-maintenance and reactive replacement costs, and an increased risk of pipeline corrosion.	Increases in CP corrective maintenance and reactive replacement costs; and an increased risk of pipeline corrosion.
2	An ongoing programme to replace/upgrade CP assets as required.	$ 0.71m	Selected: This option will reduce the risk of CP protection levels not meeting the CP performance criteria of AS 2832.	The risk of CP protection levels on Vector's steel pipelines not meeting the performance criteria of AS 2832 are mitigated.

PREFERRED OPTION
The preferred option is to continue an ongoing programme to replace/upgrade CP assets as required to ensure the CP performance criteria of AS 2832 are met.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Replacement of CP assets as required	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.71
Total	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.71

5.2.5 TELENET/SCADA EQUIPMENT

The following sections set out the project proposals for distribution valves. The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA501 Telemetry equipment.

KINGFISHER RTU REPLACEMENT
NEED
During FY17 Vector completed the first phase of a programme to upgrade its aging gas distribution Kingfisher RTU telemetry system. The Kingfisher telemetry system was commissioned in the mid-1990s and comprises a master RTU which polls field RTUs at 30 minute intervals to retrieve gas temperature, volume and pressure data from approximately 40 sites throughout the wider Auckland area. The Kingfisher system also provides functionality to allow IP20 isolation-valves located at either end of the Auckland Harbour Bridge to be operated remotely.

To address the remaining issues associated with the Kingfisher telemetry system, Phase 2 of the upgrade program is now planned and will target the following issues:

- Upgrade of the Kingfisher RTUs: The majority of the Kingfisher equipment was installed in the mid-1990s and is now reaching the end of its design life. The vendor has indicated that the Kingfisher RTU module is now classified as being in the "mature" stage of its lifecycle and development is now restricted to bug fixes only; however, they have confirmed that a range of compatible Kingfisher replacement units are available to replace this RTU module.
- Upgrade of communication protocol: The existing communication link between the Kingfisher field RTUs and the SCADA system is based on audio frequency-shift keying (AFSK) and utilises a propriety Kingfisher communications protocol. As interfacing the existing Kingfisher protocol with Vector's standard DNP3 protocol will be difficult if not impossible, the communication link between the field RTUs and the SCADA system will need to be upgraded to support the DNP3 protocol.
- Upgrade of analog radio system: Existing radio communications between the Kingfisher RTUs and SCADA system is currently based on slow speed analog technology. Although data throughput speed is not an issue, the analog system is not capable of handling today's high speed Ethernet digital data communications and it would be difficult (and in some cases not possible) to interface it with a digital system. The existing analog radio system therefore needs to be replaced with a digital system.

The planned programme of work to upgrade the Kingfisher telemetry system aligns with Vector's asset management policy and in particular a commitment to maximise the value that Vector's assets deliver across their entire lifecycle through good practice asset management and risk management.

A 'Gas distribution SCADA system failure' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work to upgrade the Kingfisher telemetry system forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: The rate of equipment failures would continue to increase over time; the ability to enhance the level of monitoring (e.g. data refresh rates) would be limited by legacy technology.	Increased rate of equipment failure and limited ability to enhance the level of monitoring being provided.
2	Upgrade all radio sites to utilise GPRS comms platform	Similar to radio upgrade option	Rejected: Costs would be similar to radio upgrade costs, but overall telemetry system resilience would be reduced by having all monitoring sites utilise a single comms platform.	Resilience of overall telemetry system would be reduced as a result of having all monitoring sites utilise the same (i.e. GPRS) comms platform.
3	Replace Kingfisher RTU equipment	$0.49m	Selected: This option updates the radio system and comms protocol to current industry standards and retains the existing level of telemetry-system resilience.	Improved ability to enhance the level of monitoring provided; existing level of telemetry-system resilience is retained.

PREFERRED OPTION

The preferred option is to complete a programme of works (FY19 to FY21) to upgrade all Kingfisher RTU equipment to the current compatible model, and upgrade the associated communications protocol to DNP3 and the analog radio system to a digital system.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Replace Kingfisher RTU equipment	0.16	0.16	0.16								0.49
Total	0.16	0.16	0.16								0.49

TELENET UPGRADES TO ADDRESS INTEGRITY ISSUES

NEED

Approximately 60% of Telenet Kingfisher sites and 60% of GPRS Telenet sites are at least 20 years old and 10 years old respectively. Although a Kingfisher RTU refurbishment programme is underway to replace aging Kingfisher equipment and upgrade radio communication systems, an ongoing programme for the reactive replacement of failed ancillary equipment (e.g. powder coated steel cabinets, power supplies, transducers etc.) due to age and/or environmental factors is required to ensure that telemetry-system downtime is minimised.

The planned programme of work will reduce Telenet system down-time and improve Vector's ability to monitor and respond to poor pressure events. The programme aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of poor pressure events.

A 'Gas distribution SCADA system failure' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: This option would result in increased telemetry-system downtime, and diminish Vector's ability to monitor the performance of the gas network or operate the Auckland Harbour Bridge isolation valves remotely in the event of an emergency.	The reliability of the telemetry system would degrade over time and compromise Vector's ability to monitor the gas network or remotely operate the Auckland Harbour Bridge isolation valves.
2	An ongoing programme of Telenet upgrades to address integrity issues.	$0.61m	Selected: This option ensures that telemetry system down-time due to equipment failures is minimised.	Telemetry system down-time due to equipment failures is minimised; Vector's ability to monitor the gas network and operate the Auckland Harbour Bridge valves is optimised.

PREFERRED OPTION

The preferred option is to continue an ongoing programme of Telenet upgrades to address integrity issues.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Telenet upgrades to address integrity issues	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.61
Total	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.61

INSTALLATION OF ADDITIONAL PERMANENT CELLO MONITORING SITES

NEED

The availability of real-time and historical system-pressure monitoring data is a valuable resource for both operational and network planning purposes. Approximately 50% of Vector's DRS stations have permanent inlet and outlet pressure-monitoring, and 50% of pressure systems have permanent system-extremity pressure monitoring at one or more locations. However further permanent pressure-monitoring sites are required to ensure that all critical DRS sites and system extremity locations have adequate monitoring for network planning and operational purposes.

Cello data loggers have been identified as a cost-effective pressure monitoring solution where real-time pressure, volume and temperature data is not required. The Cello records 15-minute time-stamped pressure data which is critical for network planning purposes, and provides real-time alarm notifications for threshold breaches which are critical for operational purposes.

A planned programme to install additional permanent Cello pressure-monitoring sites at critical DRS and system extremity locations will improve Vector's ability to monitor and respond to poor pressure events. The programme aligns with Vector's service level objectives and will improve overall network performance (as measured against service level targets) by reducing the number of poor pressure events.

A ' System pressure drop below acceptable levels' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work to install additional permanent Cello pressure-monitoring sites forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: Additional permanent pressure-monitoring sites are required to ensure that all critical DRS sites and system extremity locations have adequate monitoring for network planning and operational purposes.	Accurate network planning data and real-time alarm notifications for threshold breaches are not available for significant parts of the network.
2	A 3-year programme to install additional permanent Cello pressure-monitoring sites at critical DRS and system extremity locations.	$0.12m	Selected: This option ensures that adequate system-pressure monitoring is available to meet network planning and operational requirements.	Risks associated with inaccurate network planning data, and loss of supply due to equipment failure or third-party damage will be mitigated.

PREFERRED OPTION

The preferred option is to undertake a 3-year programme of work to install additional permanent Cello pressure-monitoring sites at critical DRS and system extremity locations.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Installation of additional permanent Cello monitoring sites	0.04	0.04	0.04								0.12
Total	0.04	0.04	0.04								0.12

5.2.6 SPECIAL CROSSINGS

The following sections set out the project proposals for distribution valves. The works programme covered in this needs requirement is in line with Vector's asset strategy for this asset type, strategy document GAA601 Special crossings.

REPLACEMENT OF AUCKLAND HARBOUR BRIDGE IP20 PIPELINE SUPPORT BRACKETS

NEED

Recent preventive maintenance inspections of the IP20 pipeline installed on the Auckland Harbour Bridge have identified integrity issues with a significant proportion of the pipeline supports.

The 200 mm NB steel pipeline was constructed in 1983; when the pipeline was originally installed, heat shrink sleeves were fitted to the pipe at the support bracket locations (approximately 170) to provide a protective barrier between the rollers and the pipeline coating. In addition, the original rollers incorporated a urethane rubber layer on the contact surface of the roller to minimise damage to both the heat-shrink sleeve and the pipeline coating.

Over time the rollers and the rubber heat-shrink sleeves have sustained damage due to the axial-movement of the pipe (e.g. due to thermal expansion) against the rollers; the heat-shrink sleeves have also sustained damage from ongoing bridge maintenance activities. To minimise ongoing damage to the pipeline and the pipeline support brackets, the upgrade of all the original pipeline roller bracket assemblies is now required. Access to the pipeline is restricted, and rope access is necessary for a large number of support-bracket locations.

During FY2017 a pilot project was undertaken to develop and trial a modified pipe bracket design and determine suitable bracket-upgrade methodologies. The pilot project saw the successful development of a new pipe bracket design, and the installation of a small number of new pipe brackets on an over-land section of the harbour bridge pipeline near to the northern abutment.

A 5 year programme (FY18 to FY2022) to replace all the original roller bracket assemblies installed on the Auckland Harbour Bridge is now underway. The work is being undertaken by TBS Farnsworth who are a member of the permanent maintenance and bridge management team of the Auckland Motorway Alliance (AMA) group. All work methodologies, access solutions and HSE controls need to be approved by NZTA and AMA before the necessary WAP (work access permit) is issued allowing physical works to commence.

The bracket upgrade work is being carried out in conjunction with the re-coating of the pipeline which is being managed as Opex work.

The planned programme of work to upgrade the Auckland Harbour Bridge pipeline brackets aligns with Vector's asset management policy and in particular a commitment to maximise the value that Vector's assets deliver across their entire lifecycle through good practice asset management and risk management.

An 'Aboveground gas pipeline crossings' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The planned programme of work to upgrade the Auckland Harbour Bridge pipeline brackets forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: The integrity of the IP20 pipeline crossing would degrade over time leading to increased corrective-maintenance and reactive replacement costs, and an increased risk of a major failure that impacts the operation of the Auckland Harbour Bridge.	Significant increases in corrective-maintenance and reactive replacement costs, and an increase in reputational risk related to a major failure of a Auckland Harbour Bridge pipeline support bracket.
2	Undertake a staged programme of works to replace all IP20 pipeline support brackets on the Auckland Harbour Bridge	$0.82m	Selected: Undertaking a staged replacement of all Auckland Harbour Bridge IP20 pipeline support brackets will result in reduced corrective-maintenance and reactive replacement costs and mitigate the risk of an asset failure that impacts the operation of the Auckland Harbour Bridge.	Reduced corrective-maintenance and reactive replacement costs, and mitigation of the risk of an asset failure that impacts the operation of the Auckland Harbour Bridge.

PREFERRED OPTION

The preferred option is to continue a staged programme of works (FY19 to FY22) to complete the replacement of all IP20 pipeline support brackets on the Auckland Harbour Bridge.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Replacement of Auckland Harbour Bridge IP20 pipeline support brackets	0.20	0.20	0.20	0.20							
Total	0.20	0.20	0.20	0.20							0.82

REPLACEMENT OF BRIDGE CROSSING BRACKETS AND SUPPORTS

NEED

Periodic maintenance inspections of special crossings show that at any given time there are 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.

Vector has a small ongoing programme of work to replace pipeline support brackets and bracket-fixings etc. as identified by the periodic maintenance inspections. This work is required to improve public safety and reduce the risk of an asset failure that disrupts the operation of the bridge facility to which the pipeline is attached.

The planned programme of work to replace bridge crossing brackets and supports where required (due to condition) aligns with Vector's asset management policy and in particular a commitment to maximise the value that Vector's assets deliver across their entire lifecycle through good practice asset management and risk management.

An 'Aboveground gas pipeline crossings' risk and associated controls and treatment plans have been registered in Vector's risk management system and been assessed in accordance with Vector's risk management process described in Section 3.5. The programme of work to replace pipeline support brackets and bracket-fixings etc. forms part of the treatment plan that has been developed for this risk.

OPTIONS CONSIDERED

Options to address the need identified above have been assessed and are summarised in the following table.

NO	OPTION	EXPECTED COST	REASON FOR SELECTING OR REJECTING	POST INVESTMENT RISK
1	Do nothing.	-	Rejected: The integrity of pipeline crossings would degrade over time leading to increased corrective maintenance and reactive replacement costs, and an increased risk of a major asset failure that disrupts the operation of the bridge facility to which the pipeline is attached.	Increases in corrective maintenance and reactive replacement costs; an increase in reputational risk related to a major asset failure that disrupts the operation of the bridge facility to which the pipeline is attached.
2	An ongoing programme for the replacement of bridge crossing brackets and supports where required due to condition.	$0.51m	Selected: This option will result in reduced corrective-maintenance and reactive replacement costs, and mitigate the risk of a major asset failure that disrupts the operation of the bridge facility to which the pipeline is attached.	Reduced corrective-maintenance and reactive replacement costs, and mitigation of the risk of a major asset failure that disrupts the operation of the bridge facility to which the pipeline is attached.

PREFERRED OPTION

The preferred option is to continue an ongoing programme for the replacement of bridge crossing brackets and supports where required due to condition.

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Replacement of bridge crossing brackets and supports	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.51
Total	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.51

5.3 NON NETWORK ASSETS

5.3.1 INFORMATION SYSTEMS, PROCESSES AND DATA

Vector has revised its technology strategies to better reflect the changing nature of our business due to digital technologies. The Digital Strategy has been grouped into three platforms;

- Customer Engagement Platform (CEP);
- Business Enablement Platform (BEP); and
- Operational Technology Platform (OT).

CUSTOMER ENGAGEMENT PLATFORM

The Customer Engagement Platform (CEP) is the first of three platforms to be developed as part of the Digital Strategy. This portfolio is focused on treating the experience Vector provides as a product, enabling the management, optimisation, and innovation of features to deliver exceptional customer experiences through improved transparency, customer choices and options to engage with our services. We intend to use digital technology and platforms to improve the customer's experience by providing them with frictionless multi-channel, bi-directional and secure platforms for engagement with Vector across all of their interactions and touchpoints throughout the end to end customer lifecycle, leading to a significantly reduced cost to serve and improve customer experiences.

This platform will focus on development of the foundational components of customer engagement, utilising customer journey mapping, best in class microservices architecture and agile 'DevOps' delivery methods. Specifically, standard services for customer support and customer operations will be developed, including online and digital-first self-service utilising artificial intelligence, chatbots and guided assistance alongside experienced and skilled service desk agents. These enhanced customer engagement capabilities will ensure that Vector can meet changing customer expectations for service providers and deliver best in class utility services at a lower cost.

BUSINESS ENABLEMENT PLATFORM

The Business Enablement Platform (BEP) is the second of three platforms. The BEP will provide new ways of doing business and is heavily focused on enabling Vector to significantly reduce the cost of complex, customised legacy platform migration and lifecycle maintenance due to the development of best in class micro services and the associated reduction in core system complexity. The platform will not only focus on developing and driving the automation and digitisation of core business processes; it will also develop new capabilities and leverage new technologies while ensuring adherence to 'best in class' cost to serve economics.

This platform will include the development and definition of a standard service catalogue encompassing all key business enablement capabilities. The development of APIs and simplified platforms will enable the rapid iteration of services, scalable and cost-effective delivery and improve Vector's ability to deliver favourable customer outcomes through increased transparency, access and lower cost to serve. The development of these common services will directly support the move away from monolithic and bespoke systems to standardised, scalable and fit for purpose business solutions and ensure that Vector has fit for purpose capabilities that can deliver lower total cost of ownership, faster cycle time and reduced cost of migration of its core platforms.

OPERATIONAL TECHNOLOGY PLATFORM

The Operational Technology (OT) platform is the baseline enabling capability for potential future network management investments across Vector group. The OT platform is focused on delivering increased visibility and control of our infrastructure and distributed energy assets and associated operations. The OT platform will ultimately target efficiency savings and optimisation towards new energy solutions which we expect to increase in scope and customer use over this period.

At a high level, the target is to focus the first three years on developing a base OT layer to enable increased visibility and support the expected changes in customer products associated with new energy solutions in the gas industry, while also investing steadily in maintaining our network management and telemetry assets and SCADA over time.

The scope of investment will be focused on enabling improved insight capability to drive efficiencies and reduce risk exposure and to drive greater control and (near real-time to real time) automation across our energy assets. Increased customer choices due to emerging technologies has the potential to impact our areas of focus and associated investment as we aim to meet rapidly changing customer demand.

5.3.2 PLATFORM ARCHITECTURE

NETWORKS PLATFORM REFERENCE MODEL

Vector implements and manages its digital systems according to an overall Platform Reference Model (refer to Figure 5-1). This is comprised of the business process domains that are in turn supported by the underlying technology components of the technology reference model. Over the 10-year period this platform architecture will be utilised to deliver ongoing enhancements and improvements towards the achievement of our business objectives for our core businesses.

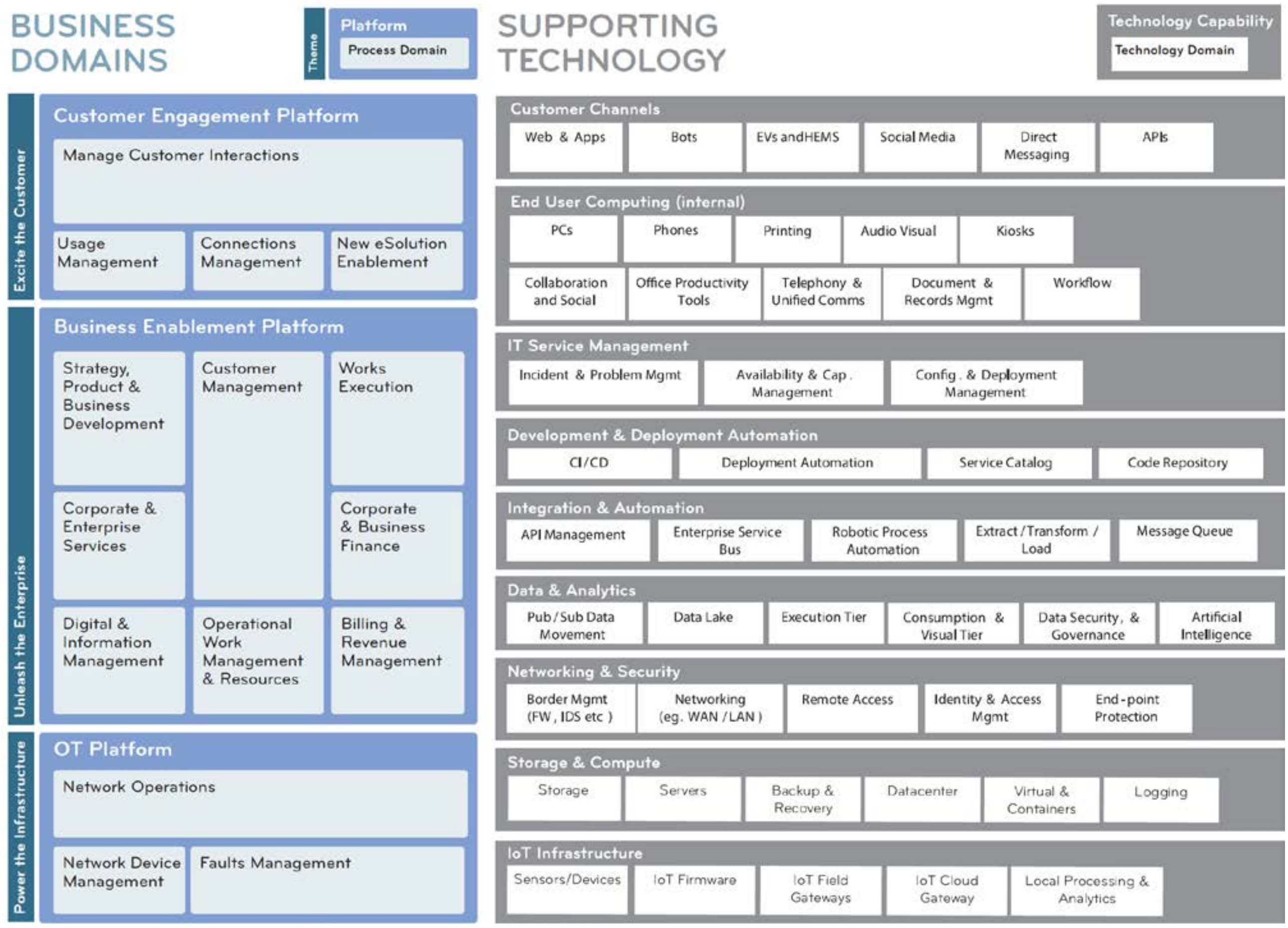


Figure 5-1 Vector's digital platform reference model

PROPOSED INVESTMENT SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Non-network capital expenditure	1.43	1.49	1.91	1.87	1.95	2.03	1.74	1.60	1.41	1.38	16.80
Total	1.43	1.49	1.91	1.87	1.95	2.03	1.74	1.60	1.41	1.38	16.80

5.4 NON NETWORK OPEX

Non-network Opex provides the support services required to ensure the network business can operate as an effective, well-governed business. The networks business benefits from economies of scale with Vector providing shared support services across its group of regulated and non-regulated businesses. Support services include health & safety, finance, legal, human resources, digital and risk management.

PROPOSED EXPENDITURE SUMMARY ($MILLION NOMINAL)

DESCRIPTION	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
System operations and network support	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	25.19
Business support	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	47.26
Total	7.24	7.24	7.24	7.24	7.24	7.24	7.24	7.24	7.24	7.24	72.44

SECTION

06. DELIVERING OUR PLAN

SECTION 6. DELIVERING OUR PLAN

This section of the AMP outlines how we develop an optimal portfolio of works from the plans set out in SECTION 5 and how we will deliver these works to maintain service levels and deliver our strategic outcomes. Our approach to project prioritisation, investment optimisation and resourcing is summarised and the CAPEX and OPEX required to deliver our gas network AMP for the 2018-2028 period is presented

6.1 PORTFOLIO OPTIMISATION

The key objectives of asset management, as stated in Vector's Asset Management Policy, relate to safety, reliability and the environment (see Section 1.4) with performance against these objectives captured by the service level metrics (see Section 2.2). By using a robust portfolio optimisation process, Vector aims to ensure that the investment required to meet these objectives and targeted service levels is efficient, bringing the greatest total benefit to our customers. Portfolio optimisation is also an important step towards achieving best industry practise in asset management as prescribed in ISO55000.

6.1.1 INVESTMENT PROJECTS PROPOSAL AND APPROVAL PROCESS

Vector employs an investment framework that ensures a consistent approach is applied when assessing investment options. This approach considers the initial CAPEX outlay, cost of maintenance, and the benefit in terms of the risk reduction achieved.

The process for Vector's gated investment expenditure proposals is below:

1. **Project proposals**: Once the need for a project has been identified, project proposals are created (see Section 3.5.2). These proposals describe the project need, show the options considered and detail the preferred option (see SECTION 5). Project proposals are prepared by Vector's subject matter experts.
2. **Preliminary investment plan**: Project proposals are peer reviewed to ensure consistency of project proposal before incorporation into the preliminary investment plan. Any synergies and interdependencies between projects are highlighted and incorporated into the preliminary plan.
3. **Portfolio optimisation**: The preliminary investment plan is prioritised and optimised for delivery, with resource and financial constraints applied through the Portfolio Optimisation process. This is an iterative process and is described in more detail in point 6.1 below.
4. **Draft investment plan:** Once projects have been through the Portfolio Optimisation process, the draft investment plan is formed. This plan is reviewed and approved by the executive management team. The risk associated with projects that have not formed part of the draft investment plan following optimisation is highlighted and acknowledged. In particular, the risk associated with sticking to DPP capital constraints is assessed and accepted.
5. **Final Investment Plan**: Following consideration and approval by the executive management team, the final investment plan is reviewed and approved by the Board before it is incorporated into the AMP.

6.1.2 PORTFOLIO OPTIMISATION PROCESS

Vector's portfolio optimisation process is a two-step process. First the project proposals are ranked based on the value of the project to the business. The projects are then prioritised to ensure the highest business value is achieved given the resource and expenditure constraints presented.

PROJECT RANKING

The following points describe Vector's project ranking process:

The 'business value' of a project proposal is usually expressed in terms of improvements to service level metrics or in terms of risk mitigation. In other words, the degree to which the project prevents any foreseen negative impact on Vector's asset management objectives (safety, reliability and the environment).

A risk matrix aligned with the Network Risk Management standards (see to Section 3.5.2) is used to assign a risk score against a project both pre and post project investment. This is used to signal the relative business value between all the proposed projects.

The risk evaluation process considers both the credible event based on the most likely consequences should a risk eventuate, and any catastrophic event that might occur. A multi-dimensional assessment method is then adopted to combine risk scores across multiple business objectives or service levels and the credible / catastrophic scenario.

The ranking process incorporates expert knowledge and experience with the network asset and network system to ensure that the assessed consequences, likelihood and resulting risk score is credible and tested. In addition, an increasingly comprehensive data set is becoming available through condition based monitoring which allows the assessment of the likelihood of failure to become more objective (see Section 3.7.3).

The consistency of this assessment across projects is key to a robust prioritisation and optimisation process that balances risks, performance and costs, and enables Vector to deliver the best outcome for customers.

OPTIMISATION

The following steps set out the optimisation process:

Step 1: Once the business value of project proposals have been assessed, a preliminary plan is formed. In this preliminary plan, projects are staggered to account for the realistic volume of work that can be undertaken in each year. This uses engineering judgement to take into consideration resources available to deliver including the construction and procurement capabilities available.

Step 2: Vector then uses an optimiser algorithm to do more sophisticated planning. The optimiser considers projects, both individually and as combinations, to achieve the optimum cost benefit i.e. the highest accumulative business value for the expenditure constraint set. In simple terms, it considers the option that a combination of smaller projects might have a higher combined business value than one higher cost project. In the multi-year planning process, any change in planning in the preceding year would impact on the planning and optimisation in the subsequent year. The financial constraint applied is based on the DPP, taking into account expected capital contributions and project commission dates.

Obligatory projects (e.g. new connections) and projects that address risks outside of the corporate risk tolerance, are also "forced in" during the optimisation process.

Step 3: Once the optimisation algorithm has been run, a panel of subject matter experts participate in a review to check optimisation outputs. This ensures that the output seems reasonable and is in alignment with industry knowledge and experience, which may not be captured by the qualitative inputs in the modelling process. If required, inputs are adjusted and the optimisation process is rerun.

Step 4: The final investment plan is assessed by the project delivery team for resource availability, as discussed in Section 6.2 and Section 6.3.

6.2 RESOURCE REQUIREMENTS AND CONSTRAINTS

Vector has a MUSA with two key contractors, and they are known as our FSPs. We provide project guidance to our FSPs in monthly meetings where we disclose the upcoming programmes of work. This provides them at least two years of visibility on the upcoming workstream. It is our expectation that the FSPs manage their resource to meet this pipeline of work.

Typically, Vector uses the MUSA as the contract mechanism for delivering projects. However, for civil works depending on the size of the project we directly engage civil contractors using AS/NZS 3910-2013.

Designs for all delivery projects are reviewed and approved by Vector. Further internal engineering support is provided based on the level of effort anticipated. These levels of engineering support are defined as:

- Level 1 – Vector to provide general support to review and approve designs developed by Vector's FSPs
- Level 2 – Vector to provide general support to review and approve designs developed by external consultants.
- Level 3 – detailed design delivered by Vector internal engineering resources

At any time during the delivery of these projects, Vector may engage specialist consultants to assist. For example, consultants are used to:

- Compile, submit and facilitate resource consents
- Define the scope associated with the removal of hazardous material such as asbestos
- Design substations and substation yards as well as electrical designs; and
- Undertake protection studies.

6.3 DELIVERY

Development of Vector's PDF has been based on industry best practises, and the Projects Management Body of Knowledge. Its function is to provide a framework to ensure projects are delivered to minimise Vector's corporate and asset risk profile.

The PDF essentially provides standard procedures and processes that the project manager must comply with, for example safety in design and standard contract templates. It focuses on core corporate obligations associated with health and safety, environment and time, cost and quality. This is achieved through its alignment with corporate policies.

The PDF is reviewed and updated on a regular basis to ensure that it provides flexibility to deliver the range of projects in the capital programme. This flexibility also allows us to manage projects with varying degrees of risk.

The PDF includes seven distinct phases associated with the project delivery lifecycle which includes pipeline, concept, procurement, development, construction, test and commission and project closure. In addition, the PDF provides Vector's project managers with templates, guidelines and tools relevant to each of these phases.

Inception of a project usually follows three distinct stages:

1. Initially project is defined in the AMP.
2. When the project is planned to be delivered a CAPEX Justification (business case) is developed which includes a budget estimate. It is submitted to the business for approval to proceed.
3. Following approval, a project scope is generated and capital expenditure approval is granted and the project handed over to a Vector project manager for delivery.

6.4 INVESTMENT PLAN

This section describes the CAPEX forecasts for the gas distribution network assets for the next 10-year planning period, and provides a comparison with the 10-year forecast prepared and disclosed in the 2017 AMP (disclosed in July 2017).

CAPEX FORECAST

Table 6-1 below shows the forecast CAPEX during the planning period, broken down into the asset categories defined in the Commerce Commission's Gas Distribution Information Disclosure Amendments Determination 2012. The figures are presented in 2019 dollars. For reference purposes, Vector has also included the corresponding CAPEX forecast disclosed in the 2017 AMP escalated to 2019 prices using an inflator of 3.61% (refer to Table 6-2).

FINANCIAL YEAR ($000)

AMP2018	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Consumer connection	17,358	18,454	16,744	15,891	18,030	15,604	15,740	15,960	16,127	16,330	166,237
System growth	2,195	1,674	1,322	5,502	6,614	1,466	855	327	327	327	20,609
Asset replacement and renewal	1,620	2,096	2,096	2,096	1,885	1,885	1,885	1,885	1,885	1,885	19,217
Asset relocations	3,828	3,507	2,932	3,139	3,108	3,108	3,108	3,108	3,108	3,108	32,058
Quality of supply	431	557	264	200	53	53	53	53	53	53	1,768

Legislative and regulatory	0	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	325	104	0	0	0	0	0	0	0	0	429
Non network asset	1,429	1,494	1,905	1,866	1,953	2,034	1,736	1,598	1,408	1,382	16,805
Total CAPEX	**27,186**	**27,944**	**25,263**	**28,636**	**31,642**	**24,150**	**23,377**	**22,931**	**22,909**	**23,086**	**257,123**

Table 6-1 2018 Forecast CAPEX

FINANCIAL YEAR ($000)

AMP2017	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
Consumer connection	14,875	15,082	15,133	15,293	19,114	18,761	18,924	19,141	19,275
System growth	2,003	769	1,661	391	2,774	750	2,376	454	391
Asset replacement and renewal	1,505	2,033	2,033	2,033	1,821	1,821	1,821	1,821	1,821
Asset relocations	3,325	3,541	2,919	2,803	2,610	2,610	2,610	2,610	2,610
Quality of supply	431	557	211	147	0	0	0	0	0
Legislative and regulatory	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	433	0	0	0	0	0	0	0	0
Non network asset	1,721	1,443	1,747	1,441	1,572	1,930	1,804	1,593	1,846
Total CAPEX	**24,293**	**23,424**	**23,704**	**22,107**	**27,891**	**25,872**	**27,535**	**25,620**	**25,944**

Table 6-2 2017 Forecast CAPEX

COMPARISON TO PREVIOUS AMP

The section highlights the significant changes to the 2017 disclosed expenditure forecasts. Figure 6-1 below shows the difference between the 2017 and 2018 AMP expenditure forecasts, with Table 6-3 breaking down the variance by expenditure categories.

AMP MOVEMENT 2017 V 2018

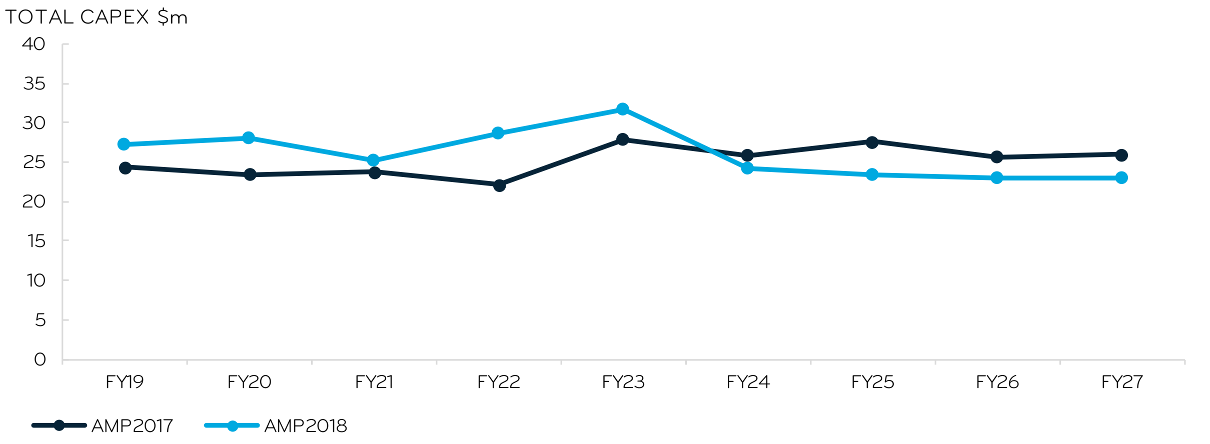


Figure 6-1 CAPEX AMP movement 2017 v 2018

FINANCIAL YEAR ($000)

2017/2018 AMP variance	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	TOTAL
Consumer connection	2,483	3,372	1,611	599	(1,084)	(3,157)	(3,184)	(3,182)	(3,148)	(5,690)
System growth	191	906	(339)	5,111	3,839	716	(1,521)	(127)	(63)	8,713
Asset replacement and renewal	115	63	63	63	63	63	63	63	63	622
Asset relocations	504	(34)	13	337	498	498	498	498	498	3,311
Quality of supply	0	0	53	53	53	53	53	53	53	370
Legislative and regulatory	0	0	0	0	0	0	0	0	0	0
Other reliability, safety and environment	(108)	104	0	0	0	0	0	0	0	(4)
Non network asset	(293)	51	158	424	381	104	(68)	5	(438)	326
Total CAPEX	2,893	4,520	1,559	6,529	3,751	(1,723)	(4,157)	(2,689)	(3,035)	7,648

Table 6-3 2017 and 2018 variance CAPEX

EXPLANATION OF MAJOR CAPEX VARIANCES

This section highlights the significant changes in CAPEX over the 9-year period for which the 2017 AMP and 2018 AMP overlap, reflect the following key changes:

- A $6m reduction in customer connection expenditure resulted from a higher greenfield connection forecast that have a lower cost to connect compared to connections in the established gas network, and alignment of connection forecast in the outer years to the near-term forecast, offset by an increase investment in residential subdivision developments;
- A $9m increase in system growth largely driven by the requirement to reinforce Takapuna/Devonport ($10m) which is anticipated to be in FY22-FY23;

- A $3m increase in relocation expenditure to reflect the sustained growth in Auckland and related infrastructure activities, in particular in transportation and roading; and
- Non network CAPEX forecast is in line with the previous forecast with cost associated with the upgrade of Vector's SCADA system offset by lower cost allocation to the gas network business, resulting in $0.3m increase over the comparable period.

OPERATING EXPENDITURE FORECAST

This section describes the OPEX forecasts for the gas distribution network assets for the next 10-year planning period, and provides a comparison with the 10-year forecast prepared and disclosed in the 2017 AMP (disclosed in July 2017).

OPEX FORECAST

Table 6-4 shows the forecast OPEX during the planning period, broken down into the asset categories defined in the Commerce Commission's Gas Distribution Information Disclosure Determination 2012. The figures are presented in 2019 dollars. For reference, Vector has also included the corresponding OPEX forecast disclosed in the 2017 AMP escalated to 2019 prices using a inflation factor of 3.49% (refer to Table 6-5).

FINANCIAL YEAR ($000)

2018 AMP	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	TOTAL
Service interruptions and emergencies	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	2,179	21,789
Routine and corrective maintenance and inspection	2,656	2,658	2,660	2,661	2,663	2,665	2,667	2,668	2,670	2,672	26,641
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0	0
System operations and network support	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	2,519	25,187
Business support	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	4,726	47,256
Total OPEX	12,080	12,081	12,083	12,085	12,086	12,088	12,090	12,092	12,093	12,095	120,873

Table 6-4 2018 forecast OPEX

FINANCIAL YEAR ($000)

2017 AMP	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
Service interruptions and emergencies	2,173	2,173	2,173	2,173	2,173	2,173	2,173	2,173	2,173
Routine and corrective maintenance and inspection	2,587	2,589	2,591	2,593	2,594	2,596	2,598	2,600	2,602

Asset replacement and renewal	0	0	0	0	0	0	0	0	0
System operations and network support	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736
Business support	4,920	4,920	4,920	4,920	4,920	4,920	4,920	4,920	4,920
Total OPEX	**12,416**	**12,418**	**12,420**	**12,421**	**12,423**	**12,425**	**12,427**	**12,429**	**12,431**

Table 6-5 2017 forecast OPEX

COMPARISON TO PREVIOUS AMP

The section highlights the significant changes to the 2017 disclosed expenditure forecasts. Figure 6-2 below shows the difference between the 2017 and 2018 AMP expenditure forecasts, with Table 6-6 breaking down the variance by expenditure categories.

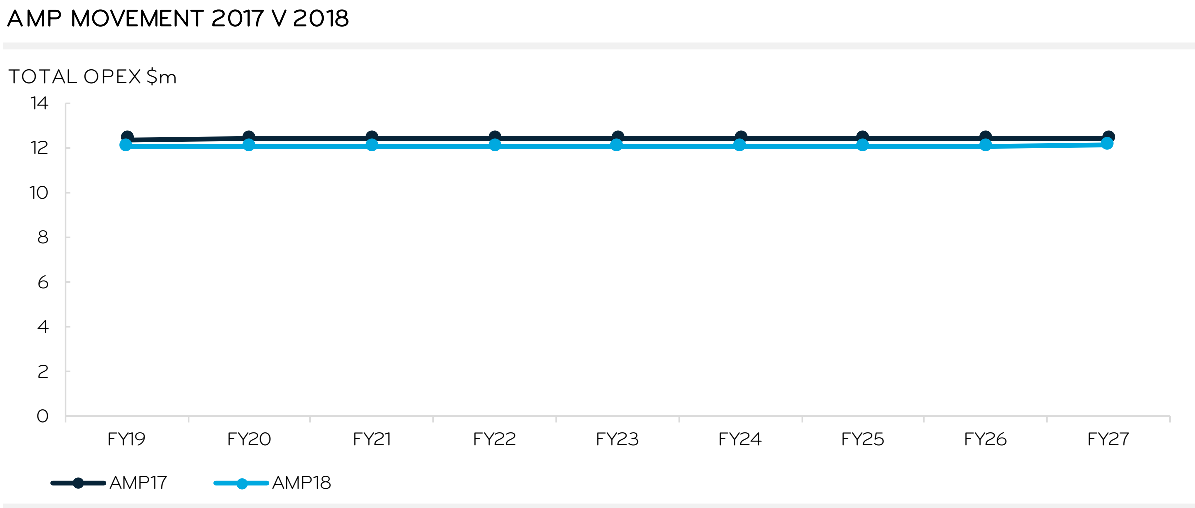


Figure 6-2 OPEX AMP movement 2017 v 2018

FINANCIAL YEAR ($000)

2017/2018 AMP variance	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	Total
Service interruptions and emergencies	6	6	6	6	6	6	6	6	6	54
Routine and corrective maintenance and inspection	69	69	69	69	69	69	69	68	68	618
Asset replacement and renewal	0	0	0	0	0	0	0	0	0	0
System operations and network support	(217)	(217)	(217)	(217)	(217)	(217)	(217)	(217)	(217)	(1,955)

Business support	(194)	(194)	(194)	(194)	(194)	(194)	(194)	(194)	(194)	(1,749)
Total OPEX	(337)	(337)	(337)	(337)	(337)	(337)	(337)	(337)	(337)	(3,032)

Table 6-6 2017 and 2018 variance OPEX

EXPLANATION OF MAJOR OPEX VARIANCES

This section highlights the significant changes in CAPEX over the 9-year period for which the 2017 AMP and 2018 AMP overlap, reflect the following key changes:

- Network OPEX forecast is largely in line with the previous AMP with is an increase of $0.7M over the 9-year comparable period due new expenditure in Auckland Harbour Bridge crossing painting and higher third party service expenditure resulted from a higher number of service disconnections; and
- Non network OPEX is forecast to be $3.7m lower driven by efficiencies realised in personnel costs and professional fees.

SECTION

07. APPENDICES

SECTION 7. APPENDICES

Appendix 1 Glossary of Terms

ALG	Auckland Lifelines Group
AMMAT	Asset management maturity assessment tool
AMP	Asset management plan
ARM	Active risk manager
BCM	Business continuity management
BEP	Business engagement platform
CAIDI	Customer average interruption duration index
CAPEX	Capital expenditure
CBARM	Condition based asset risk management
CBD	Central business district
CDEM	Civil Defence emergency management
CEP	Customer engagement platform
CIV	Customer isolation valve
CMS	Customer management system
CNO	Chief networks officer
CP	Cathodic protection
DAF	Delegated authorities framework
DFA	Delegated financial authority
DPP	Gas distribution services default price-quality price path determination
DRS	District regulating station
EHMP	Electrical hazard management plan
EOC	Electricity operations centre
EPR	Earth potential rise
ERP	Enterprise resource planning
FMEA	Failure mode and effects analysis
FSA	Formal safety assessment
FSP	Field service provider
FY	Vector financial year (year ending 30th June)
GCE	Group chief executive
GIS	Geographical information system
GMS	Gas measurement system
GNS	Gas network standard
GPRS	General packet radio service
GSM	Global system for mobile communication
HILP	High impact low probability
HP	High pressure
ICP	Installation control point
IEC	International electrotechnical commission
IoT	Internet of things
IP	Intermediate pressure
ISO55001	International standard for asset management
IT	Information technology
km	Kilometre

LCI	Labour cost index
LP	Low pressure
LPG	Liquefied petroleum gas
MAOP	Maximum allowable operating pressure
MinOp	Minimum operating pressure
MP	Medium pressure
MUSA	Multi utility service agreement
NB	Nominal bore
NOP	Nominal operating pressure
NZIER	New Zealand Institute of Economic Research
NZS	New Zealand standard
NZX	New Zealand stock exchange
OPEX	Operational expenditure
OT	Operational technology
PDF	Project delivery framework
PE	Polyethylene
PJ	Peta joule
PPI	Producers price index
PRE	Public reported escape
PVC	Polyvinyl chloride
QoS	Quality of supply
Reliability	The ability of the network to deliver gas consistently when demanded.
Resilience	The ability of the network to recover quickly and effectively from an event.
RIMS	Risk and incident management system
RTE	Response time to emergencies
RY	Regulatory year (year ending 31st March)
SAIDI	System average interruption duration index
SAIFI	System average interruption frequency index
SAP	Systems applications and processes (Vector's corporate enterprise resource planning system)
SCADA	Supervisory control and data acquisition system
scmh	Standard cubic metres per hour
SDR	Standard dimension ratio
SoS	Security of supply
SMS	Short message service (communications)
QoS	Quality of Supply
TJ	Terra joule

Appendix 2 Key Asset Strategies and Standards

Vector has a set of asset strategies and standards that together define Vector's approach to Asset Management. An overview of the key policies and standards are set out below.

ASSET CLASS	1XX DISTRIBUTION PIPELINES
Strategies	GAA101 Distribution pipelines
Technical Specifications	GNS-0029 Specification for polyethylene pipe GNS-0030 Specification for polyethylene fittings GNS-0031 Specification for polyethylene to steel transition fittings GNS-0033 Specification for steel pipe GNS-0034 Specification for steel pipe coating GNS-0035 Specification for steel fittings and flange components GNS-0036 Specification for steel punch tees GNS-0037 Specification for stainless steel tube and fittings GNS-0038 Specification for ducts and sleeves GNS-0043 Specification for facility markers warning tape and tracer wire GNS-0048 Specification for repair clamps GNS-0050 Specification for polyethylene to steel transition risers GNS-0055 Specification for under pressure fittings
Maintenance Standards	GNS-0018 Damage prevention and public training GNS-0019 Leakage survey GNS-0020 Odourisation system maintenance GNS-0024 System pressure monitoring GNS-0069 Pressure uprating without decommissioning
Engineering Standards	GNS-0002 Piping system design GNS-0064 Construction of steel pipe systems GNS-0065 Construction of plastic pipe systems GNS-0066 Purging GNS-0067 Hot tapping and flow-stopping GNS-0068 Steel non-destructive testing and inspection GNS-0072 Plastic pipe insertion

ASSET CLASS	2XX PRESSURE STATIONS
Strategies	GAA201 Pressure stations
Technical Specifications	GNS-0039 Specification for filters GNS-0044 Specification for pressure regulators GNS-0045 Specification for meters GNS-0049 Specification for pressure gauges GNS-0076 Specification for below ground district regulating stations
Maintenance Standards	GNS-0012 Maintenance of gate and district regulating stations GNS-0073 Service regulator maintenance
Engineering Standards	GNS-0001 Design of district regulating stations GNS-0056 Construction of district regulating stations

ASSET CLASS	3XX VALVES

Strategies	GAA301 Valves
Technical Specifications	GNS-0032 Specification for polyethylene ball valves GNS-0040 Specification for steel ball valves GNS-0041 Specification for meter valve assembly GNS-0042 Specification for butterfly valves GNS-0047 Specification for valve boxes
Maintenance Standards	GNS-0013 Valve maintenance
Engineering Standards	GNS-0057 Construction of valve installations

ASSET CLASS	4XX CORROSION PROTECTION SYSTEMS
Strategies	GAA401 Corrosion protection systems
Technical Specifications	GNS-0051 Specification for corrosion protection wrapping materials GNS-0052 Specification for anodes GNS-0053 Specification for paint systems GNS-0054 Specification for insulating joints
Maintenance Standards	GNS-0014 Maintenance of above ground corrosion protection systems GNS-0015 Maintenance of below ground corrosion protection systems
Engineering Standards	GNS-0003 Design of above ground corrosion protection systems GNS-0004 Design of below ground corrosion protection systems GNS-0058 Construction of above ground corrosion protection systems GNS-0059 Construction of below ground corrosion protection systems

ASSET CLASS	5XX TELEMETRY EQUIPMENT
Strategies	GAA501 Telemetry equipment
Technical Specifications	GNS-0046 Specification for Telenet equipment
Maintenance Standards	GNS-0016 Telenet maintenance
Engineering Standards	GNS-0005 Design of Telenet systems GNS-0060 Construction of Telenet systems

ASSET CLASS	6XX SPECIAL CROSSINGS
Strategies	GAA601 Special crossings
Technical Specifications	Covered in above asset categories
Maintenance Standards	Covered in above asset categories
Engineering Standards	Covered in above asset categories

ASSET CLASS	GENERAL
Strategies	Not applicable

Technical Specifications	Not applicable
Maintenance Standards	GNS-0017 Defect repair GNS-0021 Patrolling GNS-0022 Decommisioning of facilities GNS-0070 Gas leak investigation GNS-0071 Investigation of failures GNS-0078 Maintenance of critical spares and equipment GNS-0082 Auditing
Engineering Standards	GNS-0007 Class location GNS-0008 Pressure classification and operating ranges GNS-0009 Distribution system analysis GNS-0011 Continuing surveillance GNS-0062 Pressure testing GNS-0063 As-built field recording GNS-0074 Gas distribution quality of supply criteria GNS-0080 Personnel qualification GNS-0084 Technical records management GNS-0085 Management of change GNS-0086 Gas distribution forecast utilisation GNS-0087 Asset condition grading GNS-0089 Gas distribution model building

HEALTH, SAFETY AND ENVIRONMENT KEY REQUIREMENTS

HSEMS01 Management systems framework and HSE policies
HSEMS02 Leadership and Accountability
HSEMS03 Competence and Behaviour
HSEMS04 Engagement, Participation and Consultation
HSEMS05 Contractor HSE Management
HSEMS06 Emergency Management
HSEMS07 Wellness and Fitness to Work
HSEMS08 Risk Management
HSEMS09 Incident Management
HSEMS10 Audits, Reviews and Performance Reporting
HSEMS11 Operational Control
HSEMS12 HSE in Project Management

GAS DISTRIBUTION OPERATING STANDARDS

ERP-SD-001 Emergency Response Plan
GNS-0081 Gas distribution network performance indicator data capture
GNS-0083 Safety and operating plan
GNS-0088 North Harbour pipeline management plan
GNS-0090 Gas emergency response event guide
GNS-0091 North Harbour Pipeline Integrity Management Plan
GNS-0092 North Harbour Pipeline Remaining Life Review

Table 7-1 Key asset strategies and standards

Appendix 3 Asset Management Metrics

CLASSIFICATION	METRIC	FY13	FY14	FY15	FY16	FY17
Reliability	Number of planned interruptions	1762	656	407	440	448
Reliability	Number of unplanned interruptions	147	48	84	64	52
Reliability	Number of unplanned interruptions caused by third party damage	232	238	270	241	226
Reliability	Number of unplanned outage events (interruptions that affect more than 5 ICPs)	5	5	2	9	8
Reliability	Number of unplanned outage events caused by third party damage (interruptions that affect more than 5 ICPs)	4	5	1	7	6
Reliability	SAIDI - Based on the total number of interruptions	5180	3140	2010	1413	1375
Reliability	SAIDI - Based on the number of planned interruptions	4600	2470	564	731	612
Reliability	SAIDI - Based on the number of unplanned interruptions	130	45	151	324	346
Reliability	SAIDI - Based on the number of unplanned interruptions caused by third party damage	430	620	1300	357	417
Reliability	SAIFI - Based on the total number of interruptions	24	15	10	10	9
Reliability	SAIFI - Based on the number of planned interruptions	19.1	11.2	5.4	5.3	5.1
Reliability	SAIFI - Based on the number of unplanned interruptions	1.6	0.6	1.1	1.1	0.8
Reliability	SAIFI - Based on the number of unplanned interruptions caused by third party damage	3.7	3.6	3.5	3.3	2.8
Reliability	CAIDI - Based on the total number of interruptions	212	204	202	147	158
Reliability	CAIDI - Based on the number of planned interruptions	241	221	104	139	119
Reliability	CAIDI - Based on the number of unplanned interruptions	83	75	141	309	451
Reliability	CAIDI - Based on the number of unplanned interruptions caused by third party damage	115	173	371	109	149
Public Safety	Third party damage events per 1000km	56	61	60	56	52
Public Safety	Leak detected by system survey per 1000km	2.3	1.4	1.0	7.4	4.6
Quality	Number of non-compliant odour tests	3	2	0	2	0

Quality	Number of complaints per average total of customers	0.0013	0.0014	0.0005	0.0013	0.0009
Quality	Number of telephone calls to emergency numbers answered within 30 seconds per total number of calls	93%	92%	94%	90%	88%
Public Safety	Average call response time (hours)	0.600	0.600	0.593	0.600	0.650
Public Safety	Number of emergencies	130	116	102	91	96

Table 7-2 Asset management performance metrics

Appendix 4 Typical Load Profiles

The typical daily winter pressure profile for residential loads and load profile for commercial/industrial customers are illustrated in Figure 7-1 and Figure 7-2, respectively. Residential load typically has two peaks whereas the commercial and industrial load is more consistent for the whole day.

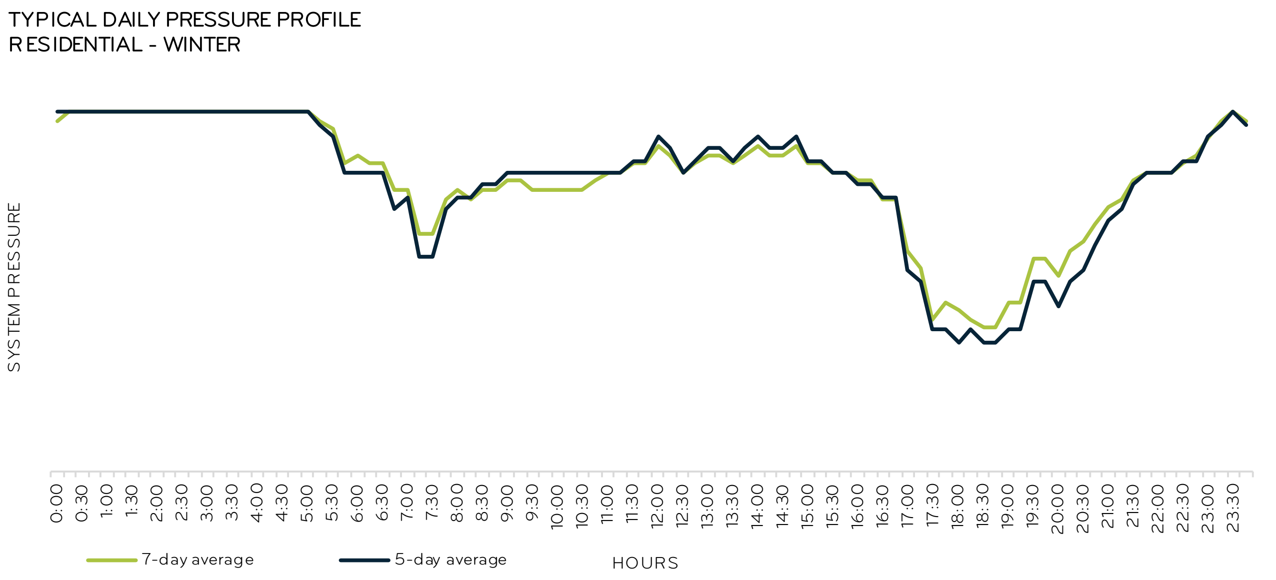


Figure 7-1 Typical winter system pressure profile for residential customers

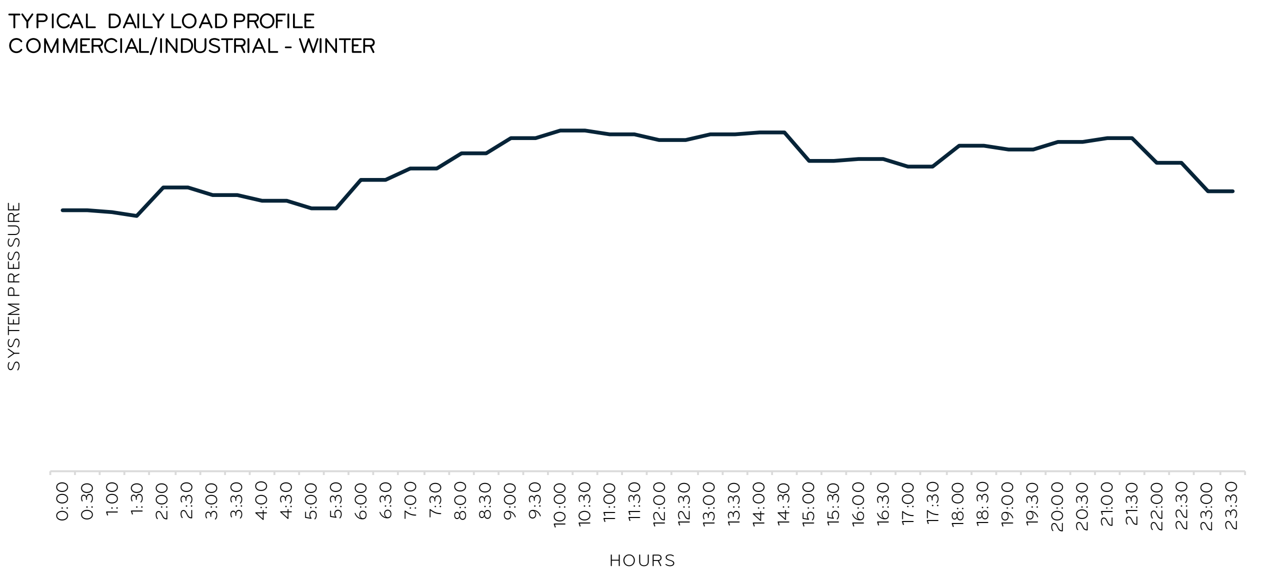


Figure 7-2 Typical winter load profile for commercial and industrial customers

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.

Appendix 5 Load Forecast

NETWORK SYSTEM	GATE STATION / NETWORK SYSTEM	2013 ACTUAL	2014 ACTUAL	2015 ACTUAL	2016 ACTUAL	2017 ACTUAL	2018 FORECAST	2019 FORECAST	2020 FORECAST	2021 FORECAST	2022 FORECAST	2023 FORECAST	2024 FORECAST	2025 FORECAST	2026 FORECAST	2027 FORECAST	2028 FORECAST	ANNUAL GROWTH	TOTAL GROWTH (FORECAST PERIOD 2018 – 2028)
Warkworth	Warkworth Gate Station	2,016	2,203	2,157	2,332	2,287	2,522	2,604	2,686	2,768	2,850	2,932	3,014	3,096	3,178	3,260	3,342	3.0%	32.5%
Wellsford	Wellsford Gate Station	No data																	
Alfriston	Alfriston Gate Station	141	156	148	156	146	146	146	146	146	146	146	146	146	146	146	146	0%	0%
Auckland Central	Papakura Gate Station	18,632	18,836	24,402	22,040	17,616	21,182	21,513	21,844	22,175	22,506	22,836	23,168	23,498	23,829	24,160	24,491	1.4%	15.6%
Auckland Central	Westfield Gate Station	42,982	45,227	40,406	40,554	39,839	39,839	39,839	39,839	39,839	39,839	39,839	39,839	39,839	39,839	39,839	39,839	0%	0%
Auckland Central	Waikumete Gate Station	(Commissioned in 2014)	11,726	10,510	10,473	9,992	12,735	13,397	14,060	14,721	15,383	16,044	16,707	17,369	18,030	18,692	19,355	4.7%	52%
Auckland Central	Bruce McLaren Gate Station	2,063	2,266	2,253	2,133	2,386	2,219	2,234	2,248	2,263	2,277	2,291	2,306	2,320	2,335	2,349	2,364	0.6%	6.5%
Auckland Central	Henderson Gate Station	11,657	11,726	10,223	12,355	10,082	11,771	12,141	12,513	12,884	13,254	13,625	13,997	14,368	14,738	15,109	15,481	2.9%	31.5%
Auckland Central	Central Auckland Network System (non co-incident)	75,334	89,972	87,794	100,275	79,915	87,746	89,123	90,504	91,881	93,259	94,636	96,017	97,394	98,771	100,148	101,529	1.4%	15.7%

Auckland Central	Auckland Central Network System (co-incident)	72,319	75,482	79,071	78,559	77,534	77,653	78,863	80,075	81,284	82,494	83,703	84,916	86,125	87,334	88,543	89,756	1.4%	15.6%
Drury CT	Drury CT Network System	315	369	375	327	430	430	430	430	430	430	430	430	430	430	430	430	0%	0%
Drury NC	Drury NC Network System	1,809	2,009	1,849	2,011	1,826	2,037	2,066	2,095	2,125	2,154	2,184	2,213	2,242	2,272	2,301	2,331	1.3%	14.4%
Drury CT & Drury NC	Drury Gate Station (non co-incident)	2,123	2,378	2,224	2,338	2,256	2,292	2,321	2,350	2,380	2,409	2,439	2,468	2,497	2,527	2,556	2,586	1.2%	12.8%
Drury CT & Drury NC	Drury Gate Station (Co-incident)	2,053	2,330	2,131	2,053	2,330	2,211	2,239	2,268	2,296	2,325	2,353	2,381	2,410	2,438	2,466	2,495	1.2%	12.8%
Hunua	Hunua (Vector) Gate Station	771	851	711	700	625	625	625	625	625	625	625	625	625	625	625	625	0%	0%
Kingseat	Kingseat Gate Station	3	4	34	19	8	8	8	8	8	8	8	8	8	8	88	8	0%	0%
Pukekohe	Pukekohe Gate Station	565	1011	516	888	647	667	686	705	723	742	761	779	798	816	835	854	2.5%	28%
Ramarama	Ramarama Gate Station	253	322	322	264	352	299	304	309	314	319	324	329	334	339	344	349	1.5%	16.7%
Tuakau	Tuakau Gate Station	1,356	(Decommissioned in 2014)																
Tuakau	Tuakau Gate Station No.2	(Commissioned in 2014)	3,243	2,961	3,190	4,066	4,318	4,792	5,268	5,742	6,216	6,691	7,166	7,641	8,115	8,589	9,065	10%	110%

Whangaparaoa CT & Whangaparaoa NC	Waitoki Gate Station (co-incident)	1,409	1,852	3,116	2,433	1,767	1,974	2,061	2,149	2,237	2,325	2,412	2,500	2,588	2,675	2,763	2,851	4%	44.4%
Papakura	Papakura Gate Station (GS1002)	No data																	
Harrisville	Harrisville Gate Station	3,588	3,343	3,733	3,521	3,613	4,039	4,172	4,305	4,437	4,570	4,703	4,836	4,969	5,101	5,234	5,367	3%	32.9%

Table 7-3 Peak demand projection for the gate stations and network systems (in scmh)

Appendix 6 System Pressure Modelling Register

PRESSURE SYSTEM	NOMINAL OPERATING PRESSURE (NOP) (KPA)	BASE YEAR			10 YEAR FORECAST[15]		
		Flow (scmh)	Min. Operating Pressure (kPa)	Proportion of NOP	Flow (scmh)	Min. Operating Pressure (kPa)	Proportion of NOP
East Auckland IP10	1000	6731	781	78%	7675	752	75%
Manurewa IP10	1000	203	874	87%	231	874	87%
Pukekohe IP10 (TBC)	1000	1	995	100%	2	993	99%
Bruce Maclaren IP20	2000	2143	960	96%	3443	956	96%
Central Auckland IP20	2000	59381	1306	65%	67708	1134	57%
Tuakau IP20	2000	1522	1694	85%	4790	1617	81%
Waitoki & Whangaparaoa IP20 (TBC)	2000	0	1670	84%	0	1643	82%
Warkworth IP20 (TBC)	2000	0	1246	62%	0	1144	57%
Monahan MP1	35	59	30	86%	67	30	86%
Panmure MP1	35	43	30	86%	49	30	86%
Totara Heights MP1	100	450	73	73%	513	65	65%
Broadway Park MP2	200	36	199	100%	41	199	100%
Conifer Grove MP2	200	240	163	82%	274	159	80%
Landsford Cres MP2	200	69	180	90%	79	179	90%
Manukau MP2	200	273	151	76%	312	143	72%
Penrose MP2	200	1180	127	64%	1345	103	52%
Auckland Airport MP4	400	954	358	90%	1,103	345	86%
Central Auckland MP4	400	34913	243	61%	39809	219	55%
Drury NC MP4	400	2037	247	62%	2301	216	54%
East Auckland MP4	400	17257	266	67%	19677	223	56%

—

15 System pressure values exclude any future system reinforcements

Glendene MP4	400	195	396	99%	222	395	99%
Herd Road MP4	400	6	400	100%	7	400	100%
Hingaia MP4	400	13	399	100%	15	399	100%
Holloway Place MP4	400	476	398	100%	543	397	99%
Mangere Bridge MP4	400	73	393	98%	83	393	98%
Manurewa North MP4	400	3255	236	59%	3711	181	45%
Manurewa South MP4	400	714	381	95%	815	378	95%
North Shore MP4	400	15122	193	48%	17242	105	26%
Pakuranga MP4	400	11	399	100%	12	399	100%
Papakura MP4	400	254	336	84%	290	318	80%
Puhinui MP4	400	43	398	100%	49	398	100%
Pukekohe MP4	400	666	389	97%	833	384	96%
Ramarama MP4	400	299	293	73%	344	279	70%
Te Atatu MP4	400	419	385	96%	478	381	95%
Universal Drive MP4	400	85	394	99%	91	393	98%
Waitoki MP4	400	0.44	399	100%	0.61	399	100%
Warkworth MP4	400	2522	324	81%	3260	317	79%
Wattle Downs & Wiri MP4	400	822	352	88%	937	338	85%
Whangaparaoa MP4	400	1973	348	87%	2783	298	75%
Central Auckland MP7	700	6424	650	93%	7325	635	91%
Harrisville MP7	700	4039	448	64%	5234	376	54%
South Auckland MP7	700	3792	618	88%	4323	593	85%
Tuakau MP7	700	2796	477	68%	3799	377	54%

Table 7-4 System pressure modelling register

Appendix 7 AMP Information Disclosure Compliance

INFORMATION DISCLOSURE DETERMINATION REQUIREMENT	AMP SECTION REFERENCE
Contents of the AMP	
3. The AMP must include the following:	
3.1 A summary that provides a brief overview of the contents and highlights information that the GDB considers significant;	Executive Summary and SECTION 1
3.2 Details of the background and objectives of the GDB's asset management and planning processes; and	Section 3.1 and SECTION 3
3.3 A purpose statement which:	
(a) makes clear the purpose and status of the AMP in the GDB's asset management practices. The purpose statement must also include a statement of the objectives of the asset management and planning processes;	SECTION 1 and Section 3.1
(b) states the corporate mission or vision as it relates to asset management;	Section 1.8
(c) identifies the documented plans produced as outputs of the annual business planning process adopted by the GDB;	Section 3.5 and SECTION 6
(d) states how the different documented plans relate to one another, with particular reference to any plans specifically dealing with asset management; and	Section 3.4, Section 3.5 and SECTION 6
(e) includes a description of the interaction between the objectives of the AMP and other corporate goals, business planning processes and plans.	SECTION 1 and Section 3.1
3.4 Details of the AMP planning period, which must cover at least a projected period of 10 years commencing with the disclosure year following the date on which the AMP is disclosed.	Executive Summary, SECTION 1 and Section 3.2
3.5 The date that it was approved by the directors.	SECTION 1 and Appendix 17
3.6 A description of each of the legislative requirements directly affecting management of the assets, and details of:	Section 3.4
(a) how the GDB meets the requirements; and	Section 3.4

	(b) the impact on asset management.	Section 3.4
3.7	A description of stakeholder interests (owners, consumers, etc) which identifies important stakeholders and indicates:	Section 2.1
	(a) how the interests of stakeholders are identified;	Section 2.1
	(b) what these interests are;	Section 2.1
	(c) how these interests are accommodated in asset management practices; and	Section 2.1 and 98SECTION 6
	(d) how conflicting interests are managed.	Section 2.1 and SECTION 6
3.8	A description of the accountabilities and responsibilities for asset management on at least 3 levels, including-	Section 3.3
	(a) governance—a description of the extent of director approval required for key asset management decisions and the extent to which asset management outcomes are regularly reported to directors;	Section 3.3
	(b) executive—an indication of how the in-house asset management and planning organisation is structured; and	Section 3.3
	(c) field operations—an overview of how field operations are managed, including a description of the extent to which field work is undertaken in-house and the areas where outsourced contractors are used.	Section 3.3 and Section 6.2
3.9	All significant assumptions-	
	(a) quantified where possible;	SECTION 1
	(b) clearly identified in a manner that makes their significance understandable to interested persons, including-	SECTION 1
	(c) A description of changes proposed where the information is not based on the GDB's existing business;	SECTION 1
	(d) the sources of uncertainty and the potential effect of the uncertainty on the prospective information; and	SECTION 1
	(e) the price inflator assumptions used to prepare the financial information disclosed in nominal New Zealand dollars in the Report on Forecast Capital Expenditure set out in Schedule 11a and the Report on Forecast Operational Expenditure set out in Schedule 11b.	Appendix 16
3.10	A description of the factors that may lead to a material difference between the prospective information disclosed and the corresponding actual information recorded in future disclosures.	SECTION 1
3.11	An overview of asset management strategy and delivery.	Section 4.3, Section 4.4 and SECTION 6

3.12 An overview of systems and information management data.	Section 3.5 and Section 3.6
3.13 A statement covering any limitations in the availability or completeness of asset management data and disclose any initiatives intended to improve the quality of this data.	Section 3.7
3.14 A description of the processes used within the GDB for:	
(a) managing routine asset inspections and network maintenance;	Section 4.3
(b) planning and implementing network development projects; and	Section 4.3
(c) measuring network performance.	Section 2.3
3.15 An overview of asset management documentation, controls and review processes.	Section 3.4 and Section 3.5
3.16 An overview of communication and participation processes.	SECTION 3
3.17 The AMP must present all financial values in constant price New Zealand dollars except where specified otherwise.	Compliant
3.18 The AMP must be structured and presented in a way that the GDB considers will support the purposes of AMP disclosure set out in clause 2.6.2 of the determination.	Compliant
Assets covered	
4. The AMP must provide details of the assets covered, including-	
4.1 A map and high-level description of the areas covered by the GDB, including the region(s) covered; and	Section 4.1, Section 4.2 and Appendix 9
4.2 A description of the network configuration, including-	
(a) A map or maps, with any cross-referenced information contained in an accompanying schedule, showing the physical location of:	Section 4.1 Section 4.2 and Appendix 9
(i) All main pipes, distinguished by operating pressure;	Appendix 9
(ii) All ICPs that have a significant impact on network operations or asset management priorities, and a description of that impact;	Appendix 9 and SECTION 5
(iii) All gate stations;	Appendix 9

(iv) All pressure regulation stations; and	Appendix 9
(b) if applicable, the locations where a significant change has occurred since the previous disclosure of the information referred to in subclause 4.2(a), including-	N/A
(i) a description of the parts of the network that are affected by the change; and	N/A
(ii) a description of the nature of the change.	N/A
Network assets by category	
5. The AMP must describe the network assets by providing the following information for each asset category-	
5.1 pressure;	Section 4.2
5.2 description and quantity of assets;	Section 4.2
5.3 age profiles; and	Section 4.2
5.4 a discussion of the results of formal risk assessments of the assets, further broken down by subcategory as appropriate. Systemic issues leading to the premature replacement of assets or parts of assets should be discussed.	Section 4.4 and SECTION 5
6. The asset categories discussed in clause 5 should include at least the following:	
6.1 the categories listed in the Report on Forecast Capital Expenditure in Schedule 11a(iii); and	Section 5.2
6.2 assets owned by the GDB but installed at gate stations owned by others.	Section 4.2
Service Levels	
7. The AMP must clearly identify or define a set of performance indicators for which annual performance targets have been defined. The annual performance targets must be consistent with business strategies and asset management objectives and be provided for each year of the AMP planning period. The targets should reflect what is practically achievable given the current network configuration, condition and planned expenditure levels. The targets should be disclosed for each year of the AMP planning period.	Section 2.2 and Appendix 3
8. Performance indicators for which targets are defined in clause 7 must include—	
8.1 the DPP requirements required under the price quality path determination applying to the regulatory assessment period in which the next disclosure year falls;	Section 2.2 and Section 2.3

8.2 consumer oriented indicators that preferably differentiate between different consumer types;	Section 2.2 and Section 2.3
8.3 indicators of asset performance, asset efficiency and effectiveness, and service efficiency, such as technical and financial performance indicators related to the efficiency of asset utilisation and operation; and	SECTION 2
8.4 the performance indicators disclosed in Schedule 10b of the determination.	Section 2.2 and Appendix 3
9. The AMP must describe the basis on which the target level for each performance indicator was determined. Justification for target levels of service includes consumer expectations or demands, legislative, regulatory, and other stakeholders' requirements or considerations. The AMP should demonstrate how stakeholder needs were ascertained and translated into service level targets.	Section 2.2 and Section 3.5
10. Targets should be compared to historic values where available to provide context and scale to the reader.	Section 2.3
11. Where forecast expenditure is expected to materially affect performance against a target defined in clause 7, the target should be consistent with the expected change in the level of performance.	N/A
Network Development Planning	
12. AMPs must provide a detailed description of network development plans, including—	
12.1 A description of the planning criteria and assumptions for network development;	Section 3.5 and Section 4.3
12.2 Planning criteria for network developments should be described logically and succinctly. Where probabilistic or scenario-based planning techniques are used, this should be indicated and the methodology briefly described; and	Section 3.5 and Section 4.3
12.3 The use of standardised designs may lead to improved cost efficiencies. This section should discuss:	
(a) the categories of assets and designs that are standardised; and	Section 4.3 and Appendix 2
(b) the approach used to identify standard designs.	Section 4.3
12.4 A description of the criteria used to determine the capacity of equipment for different types of assets or different parts of the network.	Section 3.4, Section 4.1 and Section 4.3
12.5 A description of the process and criteria used to prioritise network development projects and how these processes and criteria align with the overall corporate goals and vision.	Section 6.1
12.6 Details of demand forecasts, the basis on which they are derived, and the specific network locations where constraints are expected due to forecast increases in demand:	Section 3.5, Appendix 5 and Appendix 6

(a) explain the load forecasting methodology and indicate all the factors used in preparing the load estimates;	Section 3.5, Section 4.1 and Section 4.3
(b) provide separate forecasts to at least system level covering at least a minimum five-year forecast period. Discuss how uncertain but substantial individual projects/developments that affect load are taken into account in the forecasts, making clear the extent to which these uncertain increases in demand are reflected in the forecasts; and	Section 4.1 and Appendix 5
(c) identify any network or equipment constraints that may arise due to the anticipated growth in demand during the AMP planning period.	Section 5.1, Appendix 5 and Appendix 6
12.7 Analysis of the significant network level development options identified and details of the decisions made to satisfy and meet target levels of service, including-	
(a) the reasons for choosing a selected option for projects where decisions have been made;	Section 5.1
(b) alternative options considered for projects that are planned to start in the next five years; and	Section 5.1
(c) consideration of planned innovations that improve efficiencies within the network, such as improved utilisation, extended asset lives, and deferred investment.	Section 5.1
12.8 A description and identification of the network development programme and actions to be taken, including associated expenditure projections. The network development plan must include-	
(a) a detailed description of the material projects and a summary description of the non-material projects currently underway or planned to start within the next 12 months;	Section 5.1 and Appendix 8
(b) a summary description of the programmes and projects planned for the following four years (where known); and	Section 5.1
(c) an overview of the material projects being considered for the remainder of the AMP planning period.	Section 5.1
Lifecycle Asset Management Planning (Maintenance and Renewal)	
13. The AMP must provide a detailed description of the lifecycle asset management processes, including—	
13.1 The key drivers for maintenance planning and assumptions;	Section 4.3 and Section 4.4
13.2 Identification of routine and corrective maintenance and inspection policies and programmes and actions to be taken for each asset category, including associated expenditure projections. This must include-	Section 4.3 and Section 5.2

(a) the approach to inspecting and maintaining each category of assets, including a description of the types of inspections, tests and condition monitoring carried out and the intervals at which this is done;	Section 3.4
(b) any systemic problems identified with any particular asset types and the proposed actions to address these problems; and	Section 4.4 and Section 5.2
(c) budgets for maintenance activities broken down by asset category for the AMP planning period;	Section 5.2
13.3 Identification of asset replacement and renewal policies and programmes and actions to be taken for each asset category, including associated expenditure projections. This must include-	
(a) the processes used to decide when and whether an asset is replaced or refurbished, including a description of the factors on which decisions are based, and consideration of future demands on the network and the optimum use of existing network assets;	Section 4.3
(b) a description of innovations that have deferred asset replacements;	Section 5.2
(c) a description of the projects currently underway or planned for the next 12 months;	Section 5.2 and Appendix 8
(d) a summary of the projects planned for the following four years (where known); and	Section 5.2
(e) an overview of other work being considered for the remainder of the AMP planning period; and	Section 5.2
13.4 The asset categories discussed in clauses 13.2 and 13.3 should include at least the categories in clause 6.	Compliant
Non-Network Development, Maintenance and Renewal	
14. AMPs must provide a summary description of material non-network development, maintenance and renewal plans, including—	
14.1 a description of non-network assets;	Section 4.2
14.2 development, maintenance and renewal policies that cover them;	Section 4.2
14.3 a description of material capital expenditure projects (where known) planned for the next five years; and	Section 5.2
14.4 a description of material maintenance and renewal projects planned (where known) for the next five years.	Section 5.3
Risk Management	
15. AMPs must provide details of risk policies, assessment, and mitigation, including—	Section 3.5
15.1 Methods, details and conclusions of risk analysis;	Section 3.5

15.2 Strategies used to identify areas of the network that are vulnerable to high impact low probability events and a description of the resilience of the network and asset management systems to such events;	Section 3.5 and section 4.3
15.3 A description of the policies to mitigate or manage the risks of events identified in clause 15.2; and	Section 3.5 and Section 3.8
15.4 Details of emergency response and contingency plans.	Section 3.8
Evaluation of performance	
16. AMPs must provide details of performance measurement, evaluation, and improvement, including—	
16.1 A review of progress against plan, both physical and financial;	Section 6.4 and Appendix 8
16.2 An evaluation and comparison of actual service level performance against targeted performance-	Section 2.3
16.3 An evaluation and comparison of the results of the asset management maturity assessment disclosed in the Report on Asset Management Maturity set out in Schedule 13 against relevant objectives of the GDB's asset management and planning processes.	Section 3.7
16.4 An analysis of gaps identified in clauses 16.2 and 16.3. Where significant gaps exist (not caused by one-off factors), the AMP must describe any planned initiatives to address the situation.	Section 2.3, Section 3.7 and SECTION 5
Capability to deliver	
17. AMPs must describe the processes used by the GDB to ensure that-	
17.1 The AMP is realistic and the objectives set out in the plan can be achieved; and	Section 6.1 and Section 6.2
17.2 The organisation structure and the processes for authorisation and business capabilities will support the implementation of the AMP plans.	Section 6.3

Table 7-5 AMP Information Disclosure Compliance

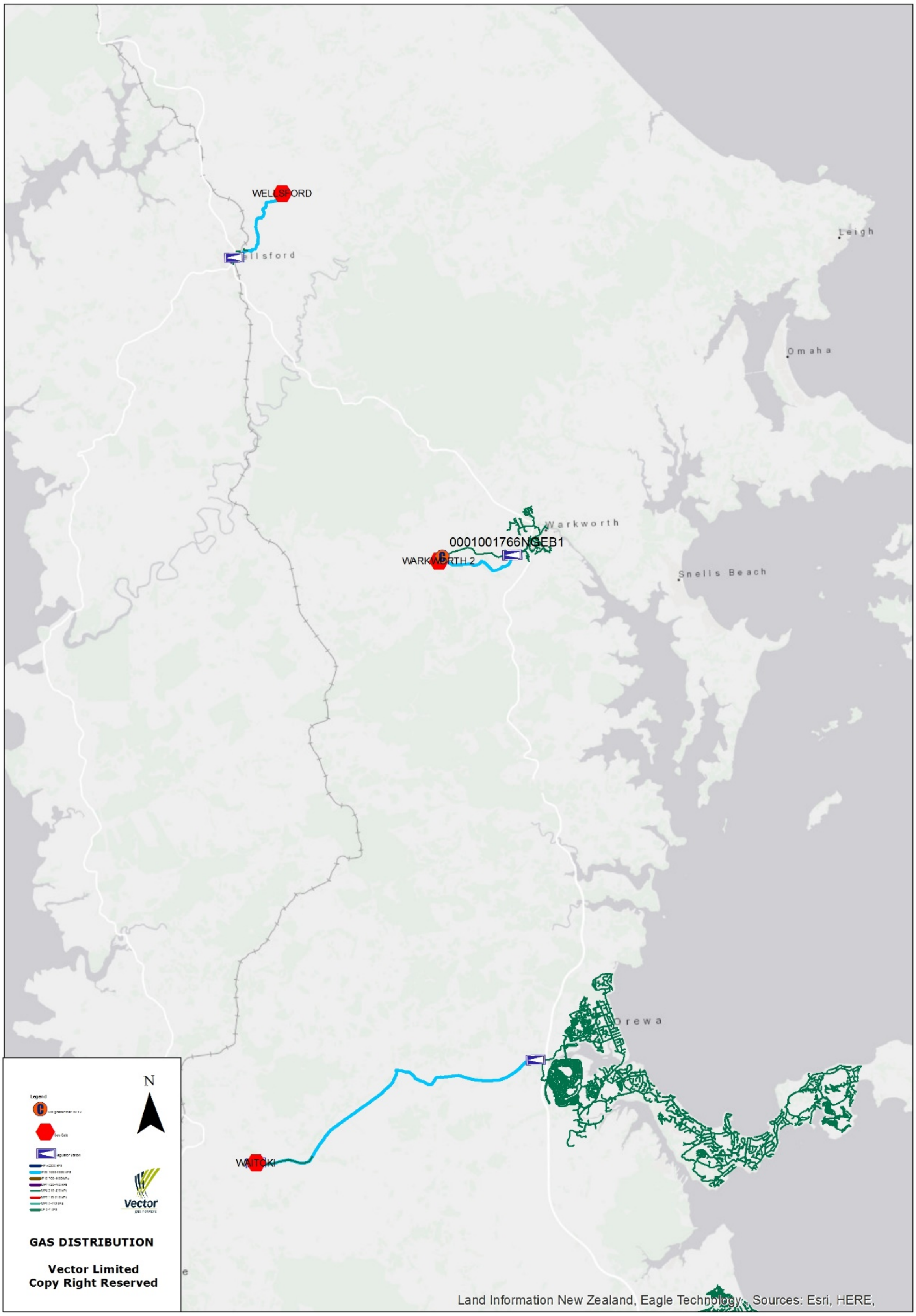
Appendix 8 Significant Changes from 2017 AMP

2018 AMP SCHEDULE DATE	PROJECT AND PROGRAMME DESCRIPTION	2017 AMP SCHEDULE DATE	REASON FOR CHANGE
FY21	Kingfisher RTU replacement	FY21	No change
	New Corrosion protection test points	FY18	Completed
	Wainui DRS Upgrade	FY18	Project reassessed
	SH17 to The Avenue MP4 PE pipe installation SOS	FY18	Project reassessed
FY22	Kohimarama Rd to Kepa Rd MP4 PE pipe installation SOS	FY21	Update in security of supply assessment
FY19	Motions Rd MP4 PE pipe installation SOS	FY19	No change
FY21	Harris Rd MP4 PE pipe installation	FY21	No change
	Northcroft St PE pipe installation	FY19	Alternative solutions
FY19	Franklin Rd DRS upgrade	FY19	No change
FY20	Gilbert Rd to Alexander Cr Steel Main extension	FY25	Revised pressure forecast
FY23	Glenvar Rd new DRS installation SOS	FY20	Update in security of supply assessment
FY19	Kerwyn Ave DR0163 upgrade	FY18	Carry over project
FY22	Auckland Harbour Bridge Support bracket replacement	FY22	No change
	Protective measure to high risk special crossing sites	FY19	Completed
FY24	Auckland Airport bridge crossing pipeline upgrade	FY19	Coordinate with other projects
FY23	Auckland Airport DR00107 relocation	FY19	Coordinate with other projects
FY19	George Bolt Memorial Drive PE pipe installation	FY18	Align with NZTA timing
FY22	Glenvar Rd to Long Bay PE pipe installation	FY18	Revised pressure forecast
FY24	Okura River Rd to Long Bay PE pipe installation	FY21	Revised pressure forecast
FY23	Westgate/Redhills PE pipe installation	FY23	Revised pressure forecast
FY23	Taupaki new HP DRS installation	FY23	No change

FY23	Kumeu new HP DRS installation	FY18	Revised pressure forecast
FY23	Takapuna 150mm steel pipeline reinforcement for Devonport		New Project
FY23	Takapuna new DRS installation for Devonport	FY19	Alternative solutions
	Drury NC to Drury CT PE pipe installation	FY18	Alternative solutions
	Remuera Rd and St Stephens Ave PE pipe crossings	FY26	Alternative solutions
FY23	Kepa Rd to Whytehead Cr PE pipe installation	FY23	No change
FY24	Kepa Rd to Ngapipi Rd PE pipe installation	FY24	No change
FY25	Woodcocks Rd to Sandspitt Rd PE pipe installation	FY25	No change
	Hingaia Rd PE pipe installation	FY18	Completed
FY19	DRS earthing and bonding	FY19	No change
FY20	Electrical Hazard Management Plan mitigation measures		New Project
FY19	Devonport PE pipe crossings		New Project
FY19	Scott Rd MP4 mains extension		New Project
FY20	Main's extension Pokeno		New Project
FY21	Main's extension Drury		New Project

Table 7-6 Significant changes from 2017 AMP

Appendix 9 Gas Distribution Maps




OTEHA VALLEY ROAD
GLENCOE RD MP
ALBANY GATE STATION
PRINCETON RD MP (28)
CONSTELLATION DR
THE PRISON
0000933971QT2D3
NORTH HARBOUR MP
Riverhead
UNSWORTH HEIGHTS MP
HOGANS RD MP
0000270141QTB96
COLONIAL RD MP
COUNCIL TERRACE MP
0000281891QTBE1
Auckland
FRANKLIN RD MP
0000529221QTDBA
DR-00248-AK
0001444840QTEA8
0000845251QT79D
SURREY CRES MP
APIRANA AVE
DR0233
JAEMONT RD
0000353551QT27B
0000187431QT686
DR-00247-AK
EXMOUTH ST MP
CANCER SOCIETY
BROADWAY PARK MP
MOUNTAIN RD MP
BUSCOMB AVE MP
0000162151QT62E
ALBERTON
BURNLEY TCE
POINT ENGLAND RD LP
DIOCESAN SCHOOL
ELLERSLIE RACECOURSE
TAINUI MP
CORBAN AVENUE MP4
0000887851QTA67
VICTOR ST
0000933991QT860
CRAYFORD ST
GOLF RD MP
DULUX
KEYSTONE AVE
BRANDON ROAD
ST GEORGES RD
RANKIN AVE MP
PAH RD
OASIS
19 HERD RD
MAYS RD
WESTFIELD
MONAHAN
MCKINNON MP
0000072491QT849
OTAHUHU YARD
0001448245QT26D
0000012781QT3BF
HASTIE MP
CHURCH ST MP
DR-00257
KAKA ST MP
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INSIDE GATE STATION
Parakai
HELLENSVILLE MP
Helensville
0002376787QT72E
0002376788QT8F0
Riverhead
0000933971QT2D3
THE PRISON
Waimauku
Huapai
Muriwai Beach
HENDERSON MP
DR0233
JAEMONT RD
0000353551QT27B
0000187431QT686
BUSCOMB AVE MP
CORBAN AVENUE MP4
0000887851QTA67
GLENVIEW RD
BRANDON ROAD
KELSTON GIRLS SCHOOL
BRUCE
WAIKUMETE
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APIRANA AVE
POINT ENGLAND RD LP
TAINUI MP
JELLICOE RD MP
ELLERSLIE RACECOURSE
DULUX
FORTUNES ROAD
ACMENA LANE
TI RAKAU
OASIS
GILLET ROAD
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0000013451QTC5E
OTAHUHU YARD
HASTIE MP
DR-00257
HARRIS RD
KERWYN AVE MP
DR-00251-AK
ALEXANDRA MP
CHURCH ST MP
KAKA ST MP
KOLMAR RD MP
DUNNOTAR RD MP
STAFFORD AVE
PUHINUI CREMATORIUM
PUHINUI AIRPORT BOUNDARY
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WIRI ST MP
EVERGLADE MP
VOGLER
DR-00249-AK
DALGETY - BROWNS RD
WEYMOUTH RD MP
ALFRISTON
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0000036311QTF14
GT SOUTH RD MP
BEAUMARIS MP
INLET RD MP
ELLIOTT ST MP
PAPAKURA DISTRICT
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DRURY
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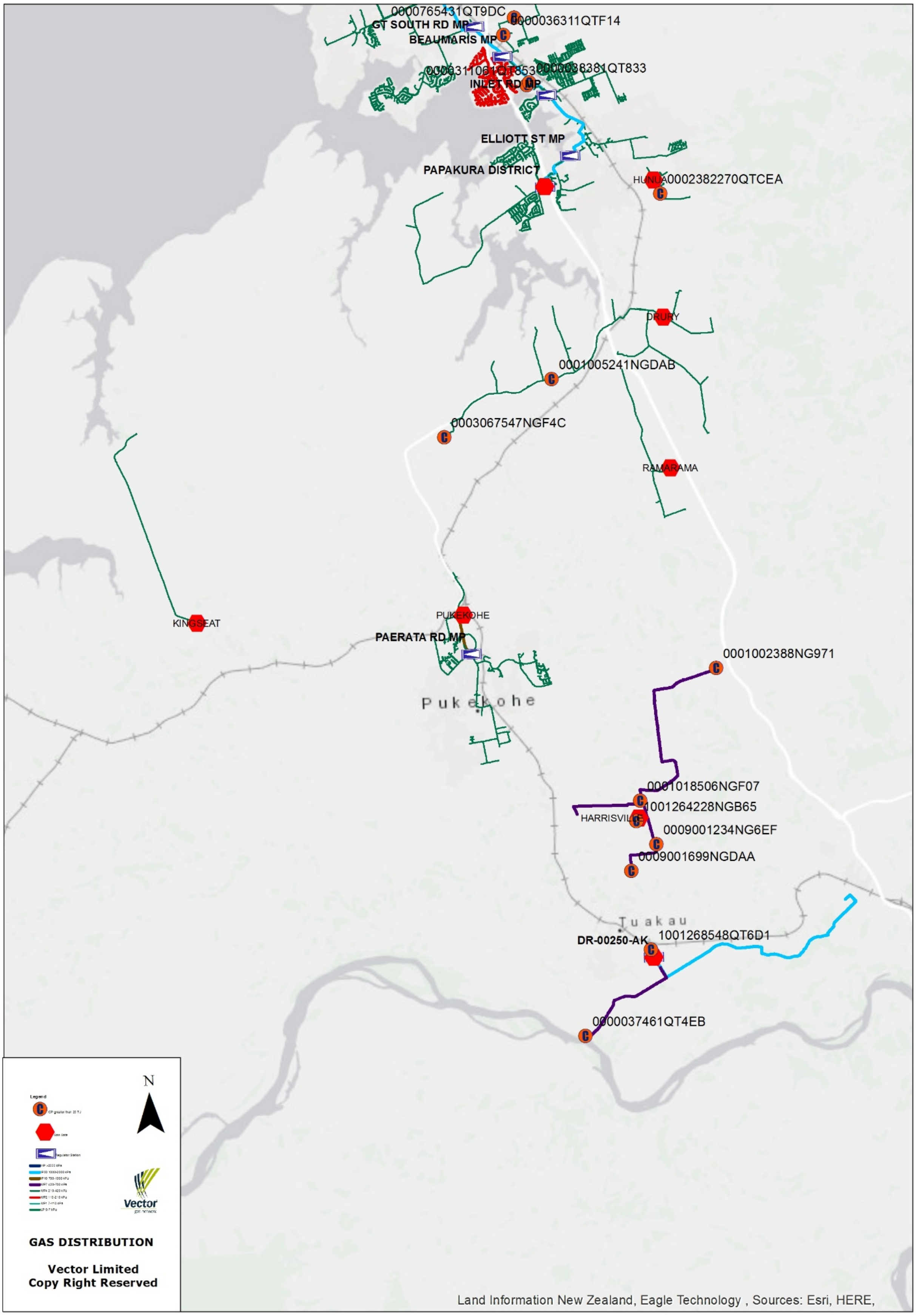
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BEAUMARIS MP
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INLET RD MP
ELLIOTT ST MP
PAPAKURA DISTRICT
HUNUA
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DRURY
0001005241NGDAB
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RAMARAMA
KINGSEAT
PUKEKOHE
PAERATA RD MP
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Pukekohe
0001018506NGF07
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HARRISVILLE
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Appendix 10 Report on Forecast Capital Expenditure (Schedule 11a)

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2018 - 30 June 2028**

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												
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 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**	**30 Jun 27**	**30 Jun 28**
9	**11a(i): Expenditure on Assets Forecast**	**$000 (nominal dollars)**										
10	Consumer connection	19,129	17,135	18,834	17,630	17,237	20,120	17,268	17,899	18,648	19,362	20,144
11	System growth	1,390	2,122	1,674	1,365	5,848	7,232	1,589	953	375	385	396
12	Asset replacement and renewal	1,254	1,593	2,131	2,198	2,264	2,094	2,077	2,134	2,193	2,253	2,315
13	Asset relocations	4,283	3,760	3,562	3,072	3,388	3,452	3,423	3,517	3,614	3,713	3,815
14	Reliability, safety and environment:											
15	Quality of supply	-	431	635	282	156	60	59	61	62	64	66
16	Legislative and regulatory	463	-	-	-	-	-	-	-	-	-	-
17	Other reliability, safety and environment	106	317	105	-	-	-	-	-	-	-	-
18	**Total reliability, safety and environment**	569	748	740	282	156	60	59	61	62	64	66
19	**Expenditure on network assets**	26,625	25,358	26,941	24,547	28,893	32,958	24,416	24,564	24,892	25,777	26,736
20	Non-network assets	1,145	1,417	1,532	2,016	2,033	2,190	2,263	1,984	1,877	1,699	1,713
21	**Expenditure on assets**	27,770	26,775	28,473	26,563	30,926	35,148	26,679	26,547	26,769	27,476	28,449
22												
	plus Cost of financing	421	409	417	385	539	623	394	381	373	384	397
24	*less* Value of capital contributions	7,266	9,261	10,345	8,701	8,091	8,726	8,427	8,704	9,018	9,324	9,653
25	*plus* Value of vested assets	-	-	-	-	-	-	-	-	-	-	-
26	**Capital expenditure forecast**	20,925	17,923	18,545	18,247	23,374	27,045	18,646	18,224	18,124	18,536	19,193
27												
28	Value of commissioned assets	21,006	17,887	18,430	18,065	18,363	32,788	19,625	19,198	19,103	19,543	20,236
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 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**	**30 Jun 27**	**30 Jun 28**
32		**$000 (in constant prices)**										
33	Consumer connection	19,129	16,538	17,583	15,953	15,141	17,177	14,348	14,474	14,676	14,830	15,016
34	System growth	1,390	2,048	1,563	1,235	5,137	6,174	1,320	771	295	295	295
35	Asset replacement and renewal	1,254	1,537	1,989	1,989	1,989	1,788	1,726	1,726	1,726	1,726	1,726
36	Asset relocations	4,283	3,629	3,325	2,780	2,976	2,947	2,844	2,844	2,844	2,844	2,844
37	Reliability, safety and environment:											
38	Quality of supply	-	416	593	255	137	51	49	49	49	49	49
39	Legislative and regulatory	463	-	-	-	-	-	-	-	-	-	-
40	Other reliability, safety and environment	106	306	98	-	-	-	-	-	-	-	-
41	**Total reliability, safety and environment**	569	722	691	255	137	51	49	49	49	49	49
42	**Expenditure on network assets**	26,625	24,474	25,151	22,212	25,380	28,137	20,287	19,864	19,590	19,744	19,930
43	Non-network assets	1,145	1,368	1,430	1,824	1,786	1,870	1,880	1,604	1,477	1,301	1,277
44	**Expenditure on assets**	27,770	25,842	26,581	24,036	27,166	30,007	22,167	21,468	21,067	21,045	21,207
45	**Subcomponents of expenditure on assets (where known)**											
46	Research and development	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
47												

Row		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
49	for year ended	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	30 Jun 27	30 Jun 28
50	**Difference between nominal and constant price forecasts**	$000										
51	Consumer connection	-	597	1,251	1,677	2,096	2,943	2,920	3,425	3,972	4,532	5,128
52	System growth	-	74	111	130	711	1,058	269	182	80	90	101
53	Asset replacement and renewal	-	56	142	209	275	306	351	408	467	527	589
54	Asset relocations	-	131	237	292	412	505	579	673	770	869	971
55	Reliability, safety and environment:											
56	Quality of supply	-	15	42	27	19	9	10	12	13	15	17
57	Legislative and regulatory	-	-	-	-	-	-	-	-	-	-	-
58	Other reliability, safety and environment	-	11	7	-	-	-	-	-	-	-	-
59	**Total reliability, safety and environment**	-	26	49	27	19	9	10	12	13	15	17
60	**Expenditure on network assets**	-	884	1,790	2,335	3,513	4,821	4,129	4,700	5,302	6,033	6,806
61	Non-network assets	-	49	102	192	247	320	383	380	400	398	436
62	**Expenditure on assets**	-	933	1,892	2,527	3,760	5,141	4,512	5,079	5,702	6,431	7,242

70

11a(ii): Consumer Connection

Row		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
72	for year ended	30 Jun 18	30 Jun 19	30 Jun 20	30 Jun 21	30 Jun 22	30 Jun 23
73	*Consumer types defined by GDB**	$000 (in constant prices)					
74	Mains Extensions/Subdivisions	7,637	7,061	8,024	6,378	5,461	7,393
75	Service Connections - Residential	9,643	7,949	8,056	8,078	8,188	8,298
76	Service Connections - Commercial	1,849	1,528	1,503	1,497	1,492	1,486
77	Customer Easements	-	-	-	-	-	-
78							
79	** include additional rows if needed*						
80	**Consumer connection expenditure**	19,129	16,538	17,583	15,953	15,141	17,177
81	*less* Capital contributions funding consumer connection	3,255	5,539	6,543	5,270	4,319	4,690
82	**Consumer connection less capital contributions**	15,874	10,999	11,040	10,683	10,822	12,487

11a(iii): System Growth

Row		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
84	**Intermediate pressure**						
85	Main pipe	-	290	1,257	484	4,256	4,256
86	Service pipe	-	-	-	-	-	-
87	Stations	242	1,103	306	306	306	917
88	Line valve	-	-	-	-	-	-
89	Special crossings	-	-	-	-	-	-
90	**Intermediate Pressure total**	242	1,393	1,563	790	4,562	5,173
91	**Medium pressure**						
92	Main pipe	858	605	-	445	575	276
93	Service pipe	-	-	-	-	-	-
94	Stations	290	-	-	-	-	725
95	Line valve	-	-	-	-	-	-
96	Special crossings	-	50	-	-	-	-
97	**Medium Pressure total**	1,148	655	-	445	575	1,001
98	**Low Pressure**						
99	Main pipe	-	-	-	-	-	-
100	Service pipe	-	-	-	-	-	-
101	Line valve	-	-	-	-	-	-
102	Special crossings	-	-	-	-	-	-
103	**Low Pressure total**	-	-	-	-	-	-
104	**Other assets**						
105	Monitoring and control systems	-	-	-	-	-	-
106	Cathodic protection systems	-	-	-	-	-	-
107	Other assets (other than above)	-	-	-	-	-	-
108	**Other total**	-	-	-	-	-	-
109							
110	**System growth expenditure**	1,390	2,048	1,563	1,235	5,137	6,174
111	*less* Capital contributions funding system growth						
112	**System growth less capital contributions**	1,390	2,048	1,563	1,235	5,137	6,174

11a(iv): Asset Replacement and Renewal

	Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
for year ended	**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**
Intermediate pressure	**$000 (in constant prices)**					
Main pipe	7	-	-	-	-	-
Service pipe	-	-	-	-	-	-
Stations	501	311	311	311	311	311
Line valve	-	-	-	-	-	-
Special crossings	-	251	251	251	251	50
Intermediate Pressure total	508	562	562	562	562	361
Medium pressure						
Main pipe	648	650	1,102	1,102	1,102	1,102
Service pipe	44	-	-	-	-	-
Station	-	100	100	100	100	100
Line valve	-	-	-	-	-	-
Special crossings	-	-	-	-	-	-
Medium Pressure total	692	750	1,202	1,202	1,202	1,202
Low Pressure						
Main pipe	-	-	-	-	-	-
Service pipe	-	-	-	-	-	-
Line valve	-	-	-	-	-	-
Special crossings	-	-	-	-	-	-
Low Pressure total	-	-	-	-	-	-
Other assets						
Monitoring and control systems	-	60	60	60	60	60
Cathodic protection systems	50	70	70	70	70	70
Other assets (other than above)	4	95	95	95	95	95
Other total	54	225	225	225	225	225
Asset replacement and renewal expenditure	1,254	1,537	1,989	1,989	1,989	1,788
less Capital contributions funding asset replacement and renewal						
Asset replacement and renewal less capital contributions	1,254	1,537	1,989	1,989	1,989	1,788

11a(v): Asset Relocations

*Project or programme**						
** include additional rows if needed*						
All other asset relocations projects or programmes	4,283	3,629	3,325	2,780	2,976	2,947
Asset relocations expenditure	4,283	3,629	3,325	2,780	2,976	2,947
less Capital contributions funding asset relocations	4,012	3,399	3,114	2,604	2,788	2,760
Asset relocations less capital contributions	271	230	211	176	188	187

11a(vi): Quality of Supply

		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
	for year ended	30 Jun 18	30 Jun 19	30 Jun 20	30 Jun 21	30 Jun 22	30 Jun 23
*Project or programme**		$000 (in constant prices)					
** include additional rows if needed*							
All other quality of supply projects or programmes		-	416	593	255	137	51
Quality of supply expenditure		-	416	593	255	137	51
less Capital contributions funding quality of supply							
Quality of supply less capital contributions		-	416	593	255	137	51

11a(vii): Legislative and Regulatory

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
Project or programme						
** include additional rows if needed*						
All other legislative and regulatory projects or programmes	463	-	-	-	-	-
Legislative and regulatory expenditure	463	-	-	-	-	-
less Capital contributions funding legislative and regulatory						
Legislative and regulatory less capital contributions	463	-	-	-	-	-

11a(viii): Other Reliability, Safety and Environment

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
*Project or programme**						
** include additional rows if needed*						
All other reliability, safety and environment projects or programmes	106	306	98	-	-	-
Other reliability, safety and environment expenditure	106	306	98	-	-	-
less Capital contributions funding other reliability, safety and environment						
Other Reliability, safety and environment less capital contributions	106	306	98	-	-	-

11a(ix): Non-Network Assets

Routine expenditure

*Project or programme**						
** include additional rows if needed*						
All other routine expenditure projects or programmes	856	1,023	1,069	1,364	1,335	1,398
Routine expenditure	856	1,023	1,069	1,364	1,335	1,398

Atypical expenditure

*Project or programme**						
** include additional rows if needed*						
All other atypical expenditure projects or programmes	289	345	361	460	451	472
Atypical expenditure	289	345	361	460	451	472
Non-network assets expenditure	1,145	1,368	1,430	1,824	1,786	1,870

Appendix 11 Report on Forecast Operational Expenditure (Schedule 11b)

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2018 to 30 Jun 2028**

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		*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 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**	**30 Jun 27**	**30 Jun 28**
9	**Operational Expenditure Forecast**	**$000 (in nominal dollars)**										
10	Service interruptions, incidents and emergencies	2,140	2,178	2,250	2,321	2,391	2,461	2,529	2,600	2,673	2,748	2,825
11	Routine and corrective maintenance and inspection	2,498	2,657	2,745	2,834	2,921	3,008	3,094	3,183	3,274	3,368	3,465
12	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
13	**Network opex**	4,638	4,835	4,995	5,155	5,312	5,469	5,623	5,783	5,947	6,116	6,290
14	System operations and network support	2,389	2,519	2,602	2,684	2,765	2,845	2,925	3,007	3,091	3,177	3,266
15	Business support	4,600	4,725	4,881	5,035	5,186	5,337	5,487	5,640	5,798	5,961	6,127
16	**Non-network opex**	6,989	7,244	7,483	7,719	7,951	8,182	8,412	8,647	8,889	9,138	9,393
17	**Operational expenditure**	11,627	12,079	12,478	12,874	13,263	13,651	14,035	14,430	14,836	15,254	15,683

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 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**	**30 Jun 27**	**30 Jun 28**
20		**$000 (in constant prices)**										
21	Service interruptions, incidents and emergencies	2,140	2,105	2,105	2,105	2,105	2,105	2,105	2,105	2,105	2,105	2,105
22	Routine and corrective maintenance and inspection	2,498	2,567	2,568	2,570	2,572	2,573	2,575	2,577	2,578	2,580	2,582
23	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
24	**Network opex**	4,638	4,672	4,673	4,675	4,677	4,678	4,680	4,682	4,683	4,685	4,687
25	System operations and network support	2,389	2,434	2,434	2,434	2,434	2,434	2,434	2,434	2,434	2,434	2,434
26	Business support	4,600	4,566	4,566	4,566	4,566	4,566	4,566	4,566	4,566	4,566	4,566
27	**Non-network opex**	6,989	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000
28	**Operational expenditure**	11,627	11,672	11,673	11,675	11,677	11,678	11,680	11,682	11,683	11,685	11,687
29	**Subcomponents of operational expenditure (where known)**											
30	Research and development	-	-	-	-	-	-	-	-	-	-	-
	Insurance	64	75	77	80	82	84	87	89	92	94	97
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 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**	**30 Jun 27**	**30 Jun 28**
35	**Difference between nominal and real forecasts**	**$000**										
36	Service interruptions, incidents and emergencies	-	73	145	216	286	356	424	495	568	643	720
37	Routine and corrective maintenance and inspection	-	90	177	264	349	435	519	606	696	788	883
38	Asset replacement and renewal	-	-	-	-	-	-	-	-	-	-	-
39	**Network opex**	-	163	322	480	635	791	943	1,101	1,264	1,431	1,603
40	System operations and network support	-	85	168	250	331	411	491	573	657	743	832
41	Business support	-	159	315	469	620	771	921	1,074	1,232	1,395	1,561
42	**Non-network opex**	-	244	483	719	951	1,182	1,412	1,647	1,889	2,138	2,393
43	**Operational expenditure**	-	407	805	1,199	1,586	1,973	2,355	2,748	3,153	3,569	3,996

Appendix 12 Report on Asset Condition (Schedule 12a)

Company Name **Vector Limited**

AMP Planning Period **1 July 2018 – 30 June 2028**

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.	-	-	81.71%	18.29%	-	4	6.42
16	Intermediate Pressure	Line valve	IP line valves	No.	-	1.54%	76.73%	11.25%	10.48%	3	-
17	Intermediate Pressure	Special crossings	IP crossings	No.	-	10.00%	65.00%	25.00%	-	3	7.87
18	Medium Pressure	Main pipe	MP PE main pipe	km	-	0.50%	1.53%	97.97%	-	3	0.24
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	-	0.27%	99.73%	-	-	3	0.13
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.	-	-	70.59%	29.41%	-	4	-
25	Medium Pressure	Line valve	MP line valves	No.	-	1.03%	75.99%	7.37%	15.62%	3	-
26	Medium Pressure	Special crossings	MP special crossings	No.	-	5.97%	52.24%	41.79%	-	3	2.87
27	Low Pressure	Main pipe	LP PE main pipe	km	-	-	12.89%	87.11%	-	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	-	-	5.59%	94.41%	-	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.	-	-	50.00%	-	50.00%	3	-
34	Low Pressure	Special crossings	LP special crossings	No.	-	-	-	-	-	N/A	-
35	All	Monitoring and control systems	Remote terminal units	No.	-	5.63%	53.52%	40.85%	-	4	25.35
36	All	Cathodic protection systems	Cathodic protection	No.	-	14.29%	61.90%	23.81%	-	3	4.69

Appendix 13 Report on Forecast Utilisation (Schedule 12b)

Company Name **Vector Limited**
AMP Planning Period **1 July 2018 – 30 June 2028**

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 18	*CY+1* y/e 30 Jun 19	*CY+2* y/e 30 Jun 20	*CY+3* y/e 30 Jun 21	*CY+4* y/e 30 Jun 22	*CY+5* y/e 30 Jun 23	Comment
11	Auckland	Auckland Central	AU North Shore MP4	400	200	14,914	11	scmh	14903	15122	15344	15569	15798	16030	Remaining capacity at MinOP is available in the Devonport area. Stated pressure assumes planned MP4 network reinforcements are actioned by 2019, removing constraints in Devonport; MinOP is then observed in the Schnapper Rock area.
12								kPa	213	237	232	226	221	215	

31 * *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.*

33 **Disclaimer for supply enquiries**

34 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.

36 **Notes and assumptions**

37 1. A 'heavily utilised' pressure system is a pressure system where the modelled flow rate, at system peak during 2017, 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%.

38 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.

39 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 for the Central Auckland network system is based on an annual growth rate of 1.47%. The stated growth rate extrapolates trends across historical actuals, which include the flows most recently observed during 2017.

40 5. 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.

6. 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.

41 7. 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.

8. 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.

42 9. It has been assumed that the load forecasting documented in the AMP Update 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 Update.

Appendix 14 Report on Forecast Demand (Schedule 12c)

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2018 – 30 June 2028**

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

7 **12c(i) Consumer Connections**

8 **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 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**
11	Residential	3,023	3,424	3,470	3,479	3,527	3,574
12	Commercial	146	187	184	184	183	182
13							
14							
15							
16	**Total**	3,169	3,611	3,654	3,663	3,710	3,757
17							

18 **12c(ii): Gas Delivered**

sch ref		*Current year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
19		**30 Jun 18**	**30 Jun 19**	**30 Jun 20**	**30 Jun 21**	**30 Jun 22**	**30 Jun 23**
20	Number of ICPs at year end (at year end)	109,634	112,654	115,880	119,114	122,395	125,722
21	Maximum daily load (GJ per day)	61,476	62,541	63,325	64,110	64,895	65,680
22	Maximum monthly load (GJ per month)	1,536,524	1,514,081	1,527,767	1,541,452	1,555,138	1,568,823
23	Number of directly billed ICPs (at year end)	-	-	-	-	-	-
24	Total gas conveyed (GJ per annum)	14,362,790	14,641,313	14,816,610	15,071,587	15,228,539	15,379,637
25	Average daily delivery (GJ per day)	39,350	40,113	40,483	41,292	41,722	42,136
26							
27	Load factor	77.90%	80.58%	80.82%	81.48%	81.60%	81.69%

Appendix 15 Asset Management Maturity (Schedule 13)

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2018 – 30 June 2028**
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?	3	Vector's Asset Management Policy (latest version published August 2017 has been authorised by our Chief Network Officer). The document has been circulated to key stakeholders and is readily available for staff to access. The document is part of the controlled document management system and reviewed periodically.		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	Good asset management is practiced implicitly based on the policies and strategies which are approved by Vector's Board. The Board also approves the asset management plans and associated budget. However, there is room to improve.		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	Specific and more detailed asset management strategies are being developed for all assets. Lifecycle cost and service implications are adequately considered in maintenance and replacement decisions. This is an ongoing program of work with the opportunity to improve and integrate the results of Vector's Condition Based Asset Risk Management (CBARM) models.		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	High level strategies and plans are contained in the Asset Management Plan (AMP). Life cycle activities are documented in the form of standards (maintenance, inspection, testing). Asset condition data, the collection process and specific asset strategies are being improved.		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).

Company Name	Vector Limited
AMP Planning Period	1 July 2018 – 30 June 2028
Asset Management Standard Applied	

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?	3	The AMP is communicated to all stakeholders including employees and Field Service Providers (FSPs). The organisation, end to end process, Vector's Delegated Financial Authorities (DFA) and works programmes are all set up to deliver the works effectively. The AMP is also published on the Vector web site.		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 AMP outlines the key roles responsible for the delivery for the AMP. Vector's delegated authorities framework and policy, and position descriptions for each role define the roles and authorities further.		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	Vector has a process to optimise proposed projects to improve cost effective delivery. Regular meetings with FSPs on capital and maintenance programmes, identfy any potential resource constraints.		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	Contingency plans are in place for business continuity, supply restoration, response to natural disasters, health, safety and environmental events. Supplies to critical areas are duplicated and mobile connection units are available for emergency supplies. Regular reviews of business continuity plans ensure they are current. Incident management processes and Corporate HSE policies ensure that incident and emergency situations are appropriately managed and reported both internally and to external regulators if required.		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.

Company Name	**Vector Limited**
AMP Planning Period	**1 July 2018 – 30 June 2028**
Asset Management Standard Applied	

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	As defined in the AMP, the CNO has overall responsibility for Vector's Network Asset Management. The Heads of Asset Management, Engineering, Customer Excellence and Networks Programme Delivery teams all report to the CNO and are tasked with delivering various parts of the asset management policy and plan. External Field Services Providers have a good understanding of their roles in the delivery of asset management strategy, objectives and plans.		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	Vector utilises external contractors and consultants to supplement internal resources to deliver on its AMP. The successful delivery of the current year development and integrity works programme demonstrates good management of available resources. With the strong growth in Auckland, Vector will continue to focus on resource management initiatives.		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	Service Levels and KPI's are set and monitored across the organisation through readily accessible dashboards. In addition, monthly reporting, quarterly team updates and strong engagement with programme delivery and service providers ensure that there is a strong focus on the delivery of asset management requirements.		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	Maintenance, design and planning standards have been developed which together, with the controls established in the commercial contracts with the service providers, ensure that the KPI's established are being monitored and deficiencies addressed. Maintenance information is collected and stored in SAP-PM. The requirements and performance expectations are communicated through well-established communications mechanisms.		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	An HR strategy is in place to align competencies and human resources with Vector's AMP and strategy, but there is still opportunity to improve. A graduate program is in place and some asset management training is completed.		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	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	The competency requirements and associated training requirements (e.g. Worker Type Competency (WTC) are well established for safety critical activities across both FSP's and Vector. Individuals when recruited have their competency assessed against the job skill requirements. Training needs are identified and agreed. Training achieved is recorded in Vector's learning management system. However, there is room for improvement through ongoing talent development plans and ongoing skills development in asset		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	The competency requirements and associated training requirements are well established for safety critical activities across both FSP's and Vector. These are assessed regularly and the currency monitored. As mentioned above, there is still room for improvement.		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	Readily accessible two-way communication channels are in place for staff and other stakeholders in the form of dashboards, reporting, standards, meetings and additional information on Vector's web site. In addition, the FSPs have direct access to a suite of controlled technical standards and pertinent systems, such as GIS and SAP. The effectiveness of these are reviewed and monitored regularly.		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	The AMP is approved by the Board and widely communicated to internal and external stakeholders, including FSPs. In addition, a comprehensive set of design, maintenance and operating standards have been established.		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	Asset Management Systems have been developed but are evolving further. This includes further collection and analysis of data and improving the utilisation of SAP for asset lifecycle information. A data analytics team has been established to deliver consistent and relevant information needed for quality decision-making. With the review of the asset maintenance standards, a data standard will be developed to ensure the data standards align with the business requirements for information. An Enterprise Information Management team has been established to ensure the requirements for data and data quality improvement are considered.		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	Controls have been developed to govern the data quality in Vector's asset management systems. However, there are still gaps in the data and more work is needed to improve this in time. A comprehensive data standard is being developed to ensure quality and consistency of asset master data throughout its lifecycle.		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?	2	Business requirements such as condition data and updated AS/NZ standards have driven the need for a review of Vector's standards. Condition data requirements are being reviewed to improve the integrity and quality of the data. With the review of the asset maintenance standards, a data standard will be developed to ensure the data standards align with the business requirements for information.		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 processes are documented and managed proactively with the aid of supporting systems such as Active Risk Manager (ARM), Risk and Incident Management System (RIMS), Failure Mode and Effects Analysis (FMEA), HSE Management Systems and Bowtie Analysis. Both the FMEA and Safety Management Systems specifically work to identify risks through the asset lifecycle. These activities and systems are aligned through an established framework. Improvements in the identification of risk controls and assurance activities are ongoing.		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	Risk assessments are used to support high level asset management decisions associated with asset management strategies and plans, and the prioritisation and allocation of resources, budget and activities. These are well established in Vector's risk, incident and investigation processes. However, there is room for further improvements.		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	The business has a regulatory team that advises the business of its obligations. The business utilises "Comply With" software to assist with this. This includes HSE requirements. Regulatory changes are assessed and corresponding changes are made to business operating procedures and practices. In addition, Vectors asset management is also subject to external audit.		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	A suite of technical standards form the basis of Vector's control and management of its network assets. These are supported by the AMP, a maintenance plan and good project and operations management. The effective management of associated projects, budgets and high level work plans are monitored against the expectations established in the AMP.		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	A suite of maintenance standards are in place. In addition, a standards improvement register and assurance (audit) process is in place.		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	Service levels, asset condition and performance information is gathered and reviewed. Vector has also adopted a condition based risk management approach to its asset management together with dashboard KPI's and performance reporting. These are yet to be fully developed and implemented.		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	Vector has an investigation process in place and clear responsibilities defined. This is managed in line with Vector's HSE management system and is supported by our Risk and Incident Management and Active Risk Manager systems. Incidents are reported as defined by Vector's Incident Management Process. Major events are investigated systemically, risk assessed and appropriate mitigation plans are developed. Ownership of the actions are defined and followed up and reported on.		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	Vector has an established audit procedure. External and internal audits, and reviews on asset management practices are carried out on a regular basis. Field work carried out by contractors is sample audited. However, further improvements in the internal audit process and end-to-end capture of audit actions is underway.		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	Actions arising from audits, investigations, risks and legal compliance are captured in various registers. Formal investigation processes are in place for major events. Root cause analysis and condition and performance reviews are being completed when needed but there is room to improve.		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	Continuous improvement processes exist for the ongoing improvements to Vector's technical standards. Internal action registers are also in place to capture improvements associated risks, audits and asset performance reviews. Optimisation improvements across risk, cost and performance will improve with improved data and SAP reporting, currently underway. In addition, further embedded risk thinking and assurance processes will drive continuous improvement in budgeting, strategic thinking and project optimisation.		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	Vector participates in a number of national working groups to identify new asset management technologies and practices. A dedicated team is in place to review new technologies.		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.

Appendix 16 Mandatory Explanatory Notes on Forecast Information (Schedule 14a)

1. This schedule requires GDBs to provide explanatory notes to reports prepared in accordance with clause 2.6.6.
2. This schedule is mandatory-GDBs must provide the explanatory comment specified below, in accordance with clause 2.7.2. This information is not part of the audited disclosure information, and so is not subject to the assurance requirements specified in section 2.8.

Commentary on difference between nominal and constant price capital expenditure forecasts (Schedule 11a)

3. In the box below, comment on the difference between nominal and constant price capital expenditure for the current disclosure year and 10 year planning period, as disclosed in Schedule 11a.

BOX 1: COMMENTARY ON DIFFERENCE BETWEEN NOMINAL AND CONSTANT PRICE CAPITAL EXPENDITURE FORECASTS

Vector has used a CAPEX inflator based on the model used by the Commerce Commission in its DPP price reset on 1 October 2017. We have used an inflator which is a mix of the Producers Price Index (PPI) and Labour Cost Index (LCI). The weighting between PPI (50%) and LCI (50%) is based on Vector 2016/17 year cost structure, i.e. the capital goods component and labour cost component in our capex.

Vector has used the New Zealand Institute of Economic Research (NZIER) December 2017 PPI forecast up to March 2022. Thereafter, we have assumed a long-term inflation rate of 2.50%.

The LCI forecast is 2%, which is based on a 9 year New Zealand average to September 2017. We have then increased the LCI forecast by 1% to account for the higher labour cost observed in Auckland (this is being addressed separately with the Commerce Commission).

The constant price capital expenditure forecast is inflated by the above-mentioned index to convert to a nominal price CAPEX forecast.

Commentary on difference between nominal and constant price operational expenditure forecasts (Schedule 11b)

4. In the box below, comment on the difference between nominal and constant price operational expenditure for the current disclosure year and 10-year planning period, as disclosed in Schedule 11b.

BOX 2: COMMENTARY ON DIFFERENCE BETWEEN NOMINAL AND CONSTANT PRICE OPERATIONAL EXPENDITURE FORECASTS

Vector has used an OPEX inflator based on the model used by the Commerce Commission in its DPP price reset on 1 October 2017. We have used an inflator which is a mix of the PPI and LCI. The weighting between PPI (40%) and LCI (60%) is as per the Commission's model.

Vector has used the NZIER December 2017 PPI forecast up to March 2022. Thereafter, we have assumed a long-term inflation rate of 2.50%.

The LCI forecast is 2%, which is based on a 9 year New Zealand average to September 2017. We have then increased the LCI forecast by 1% to account for the higher labour cost observed in Auckland (this is being addressed separately with the Commerce Commission).

The constant price operational expenditure forecast is inflated by the above-mentioned index to convert to a nominal price OPEX forecast.

Appendix 17 Certificate for Year Beginning Disclosures

Schedule 17 Certification for Year-beginning Disclosures

Clause 2.9.1

We, James Carmichael, and

Karen Sherry, 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, 2.6.6 and 2.7.2 of the Gas Distribution Information Disclosure Determination 2012 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.

Director

Director

29 June 2018

Date