Wellington Electricity

10 Year Asset Management Plan
1st April 2009 – 31st March 2019

Asset Management Plan

10 Year Asset Management Plan - 1 April 2009 – 31 March 2019

Any comments or suggestions regarding the Asset Management Plan can be made to:

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This Asset Management Plan (Plan) has been prepared by Wellington Electricity Lines Limited (Wellington Electricity) for public disclosure in accordance with the requirements of the Electricity Distribution (Information Disclosure) Requirements 2008.

Information, outcomes and statements in this Plan are based on information available to Wellington Electricity at the time of preparation. Some of this information may prove to be incorrect and some of the assumptions and forecasts made may prove inaccurate. Consequently some of the information, outcomes and statements made in this document may not be valid. In addition, with the passage of time, or with impacts from future events, circumstances may change and some of the information, outcomes and statements may need to change.

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Statement from the Chief Executive Officer

Wellington Electricity welcomes the opportunity to submit its first Asset Management Plan (AMP) as a new entrant into the New Zealand electricity distribution industry. We confirm that this AMP has been prepared to meet the Commerce Commissions' "Electricity Distribution (Information Disclosure) Requirements 2008".

Since the purchase of the Wellington network from Vector in July 2008, Wellington Electricity has been transitioning and separating the business from Vector with the key objective of maintaining the existing high levels of safety, reliability, service and performance of the network for its customers. We are employing additional people, installing new business information systems, implementing a new we* brand and effectively creating a new Wellington-based business. The new business is expected to be fully established by June 2009. We are also pleased to report that we have appointed a new CEO, Mr Greg Skelton. Greg has a strong electrical engineering background and over 25 years' experience in the industry and we are confident that Greg will continue the drive to establish Wellington Electricity as the leading electricity distributor in New Zealand. The business's establishment and IT implementation is a significant project involving capital expenditure of almost $20 million.

A number of significant new operational and asset management systems are currently being implemented as part of the transition programme. These systems include remote control and distribution system management applications, maintenance management systems and an upgrade of our geographical information system. A new control room is being established at Haywards with state-of-the-art communication and control systems. It is our belief that this will position Wellington Electricity to become an industry leader in asset management practices. Further synergy will be obtained through collaboration with other electricity distribution businesses in the CKI/HKE group, which will provide us with direct access to international best practice in asset management.

Given we are in the middle of this business transformation, this AMP has predominantly been based on information emanating from the previous business ownership and structure. It is expected that as Wellington Electricity becomes fully separated and undertakes detailed reviews of all its asset management policies and procedures, the AMP will most likely also require some revision. The 2010 AMP will incorporate the findings from this work.

In conjunction with our service companies and in alignment with its business strategy, Wellington Electricity will continue to focus on the development of asset management strategies in parallel with the short to long term planning of the network to ensure that appropriate levels of capital and operational expenditures are made to deliver a safe, reliable and cost effective supply of electricity to consumers within the Wellington region.

We welcome any comments or suggestions regarding this AMP.

Sincerely,

Richard Gross
Interim Chief Executive Officer

Contents

1. Executive Summary

Plan Purpose

Wellington Electricity's distribution network was owned and operated by Vector Ltd (Vector) until it was purchased by Cheung Kong Infrastructure Holdings Limited (CKI) and Hong Kong Electric (HKE). Since the purchase, Vector has continued to provide services to the network under a Transition Services Agreement. Wellington Electricity Lines Limited (Wellington Electricity) is the owner of the network and is owned jointly by CKI and HKE. Wellington Electricity is in the process of migrating the operational systems and the asset management related information currently held by Vector into its own asset management systems and expects to be in a position to manage the network independently of Vector by June 2009.

This asset management plan has been prepared to:

- Inform stakeholders of how Wellington Electricity plans to manage its electricity distribution assets over the period from 1 April 2009 to 31 March 2019 in order to ensure that connected electricity consumers continue to receive a supply of above average quality and reliability at a reasonable price;
- Provide a working plan for use by Wellington Electricity as it takes over the management of the network from Vector and implements its own policies and processes; and
- Satisfy the Commerce Commission's Electricity Distribution (Information Disclosure) Requirements 2008.

The plan covers the 10-year period commencing 1 April 2009 and finishing on 31 March 2019. The plans described in this document for the year ending 31 March 2010 reflect Wellington Electricity's current business plan. Plans for subsequent years of the planning period are likely to be affected by the outcome of an asset management review currently being undertaken as well as by unforeseen changes to the environment in which Wellington Electricity operates.

This asset management plan was approved by the Wellington Electricity Board of Directors on 31 March 2009.

Assets Covered

Wellington Electricity's distribution network supplies the cities of Wellington, Porirua, Lower Hutt and Upper Hutt. A map of the supply area is shown in Figure 1.1.

As of 31 December 2008, there were over 162,000 connected customers. The total system length (excluding streetlight circuits and DC cable) was almost 4,600 km, of which 61% was underground.

Peak demands and energy distributed for the last three years is shown in Table 1.1.

Table 1.1: Peak Demand and Energy Delivery

	Year to 31 March 2007	Year to 31 March 2008	Year to 31 March 2009
Peak Demand (MW)	553	554	573
Energy Injection (GWh)	2,569	2,572	Not available

Figure 1.1: Wellington Electricity Supply Area

Supply Reliability

The reliability of the electricity supply provided to consumers connected to Wellington Electricity's distribution network is high by both New Zealand and international standards. In the absence of severe storms and other rare events, the average consumer connected to the network can expect an outage lasting a little over an hour about once every two years. Wellington Electricity plans to maintain supply reliability at its current high level over the planning period and its asset management strategies and forecast levels of expenditure and investment are designed to achieve this.

Network Development

The growth of electricity consumption and demand in the Wellington Electricity's supply area is relatively low when compared to some parts of New Zealand and this low growth rate is forecast to continue, particularly in view of the prevailing economic conditions in New Zealand. Network infrastructure in most parts of the supply area generally has sufficient capacity to meet the forecast loads through to the end of the planning period.

The exception is the Wellington CBD area, where forecast growth rates are higher than other parts of the supply area and where the derating of some underground subtransmission cables prevents their associated zone substations from being utilised at their full capacity. Wellington Electricity is currently completing a $7 million capital project that will increase the capacity of the incoming cables supplying Terrace and Moore Street zone substations and also significantly increase the security of supply to the CBD. A follow-up project is currently under review that would transfer load from the heavily loaded Frederick Street zone substation to utilise spare capacity at the Nairn Street zone substation. Later in the planning period a new zone substation within the CBD area may be required.

Other areas with potential supply constraints are Whitby and the Johnsonville-Paparangi areas. It is planned to reinforce the 11 kV feeders supplying the Whitby area in 2010 and to install a new feeder in 2014 to provide additional capacity. A new zone substation at Pauatahanui may be required to provide further capacity to supply Whitby and surrounding areas before the end of the planning period. It is also proposed to reinforce the supply to Johnsonville zone substation about 2014 by installing larger incoming cables.

Asset Replacement and Renewal

Much of the existing distribution network infrastructure was installed in the 1960s to meet the high rates of growth in electricity demand experienced over that period. As primary electricity distribution assets typically have a life of around 40-50 years, a significant number of assets are now approaching the end of their expected economic life. In particular, many underground subtransmission cables are gas- or oil-filled, and many high voltage circuit breakers have oil insulation.

Wellington Electricity has programmes in place to regularly monitor the condition of its older assets. This ongoing condition assessment indicates that the existing assets are still serviceable and are generally in good condition for their age. Notwithstanding this, almost 50% of forecast capital expenditure over the planning period is expected to be on the proactive asset replacement and renewal of older assets, or assets with a history of premature failure, before they fail in service. This level of expenditure is designed to mitigate the risk of a significant deterioration in supply reliability as a result of unplanned asset outages.

Asset Management Systems

The migration of asset management data from Vector's asset management systems to Wellington Electricity's asset management and business systems is currently in progress and is a major component of the transition plan that will culminate in the termination of the current Transition Services Agreement with Vector. Wellington Electricity believes that these asset management and business systems it is implementing will lead the use of this technology within New Zealand.

The transition programme includes the establishment of a fully functional and operational network control centre at Transpower, Haywards. This is due for completion by June 2009, at which time Wellington Electricity will separate operational control from Vector and independently control the network. The transition will also include the provision of disaster recovery sites at Transpower Central Park and at the Powercor/Citipower control centre in Melbourne.

Risk Management

Wellington Electricity has risk assessment processes in place that provide input to the planning of network development and maintenance strategies. A major objective of the network development and lifecycle asset management plans is to mitigate the risks inherent in operating an electricity distribution business. Risk assessment therefore plays a major role in the prioritisation of network development and asset replacement projects.

The detailed design and operation of the network is not described in this asset management plan, though is in accordance with industry standard practices and procedures. These practices and procedures have been developed and refined over time to mitigate the risks and hazards associated with high voltage electricity distribution.

Emergency plans are in place to respond to foreseeable high impact low probability events that stress the network beyond its design envelope.

2. Background and Objectives

2.1. Plan Purpose

Wellington Electricity's network was previously owned and operated by Vector Ltd (Vector) until it was purchased by Cheung Kong Infrastructure Holdings Limited (CKI) and Hong Kong Electric (HKE) in July 2008. Since the purchase, Vector has continued to provide services to the network under a Transition Services Agreement. Wellington Electricity Lines Limited (Wellington Electricity), which is jointly owned by CKI and HKE, owns and manages the network. Wellington Electricity is in the process of migrating the asset management related information and other systems currently held by Vector into its own asset management systems. This is discussed in Section 7.

This asset management plan has been prepared to:

- Inform stakeholders of how Wellington Electricity plans to manage its electricity distribution assets over the period from 1 April 2009 to 31 March 2019 in order to ensure that connected electricity consumers continue to receive a supply of above average quality and reliability at a reasonable price;
- Provide a working plan for use by Wellington Electricity as it takes over the management of the network from Vector and implements its own policies and processes; and
- Satisfy the Commerce Commission's Electricity Distribution (Information Disclosure) Requirements 2008.

This asset management plan largely reflects the asset management policies put in place by Vector. Wellington Electricity is reviewing these policies to ensure that they are appropriate in the light of the change in ownership. Hence while the plans outlined in this document reflect Wellington Electricity's firm plans for 2009/10, they should be considered indicative for the following years of the planning period. Notwithstanding this, there is no assurance that any project or programme outlined in this asset management plan for 2009/10 will actually proceed as the Wellington Electricity Board will approve each major capital project before committing capital expenditure. Any changes in asset management strategy resulting from the Wellington Electricity review will be reflected in subsequent asset management plans.

2.2. Interaction between AMP and Other Business Plans

Wellington Electricity is operating to an approved business plan based on transitioning the business from Vector ownership to Wellington Electricity ownership. The transitional business plan has asset management objectives of maintaining the existing high level of safety, reliability, service, and performance according to the standards set by Vector. A Board of Directors is in place and an interim CEO has been responsible for managing the business. A permanent CEO has been appointed to take over the position in April 2009. Detailed business processes will therefore continue to be established during 2009.

Wellington Electricity's internal reporting and asset management planning systems are aligned to a calendar year reporting cycle. This asset management plan therefore represents Wellington Electricity's approved works programme and budget for the nine month period through to 31 December 2009, and unapproved projections based on the best available current information beyond this. Hence, for this document, the information in Wellington Electricity's internal asset management plans has been adjusted as necessary to reflect an annual planning period ending 31 March as required by the Commerce Commission.

2.3. Planning Period

This plan covers the 10-year period commencing 1 April 2009 and finishing on 31 March 2019. As noted in Section 2.1 the plans described in this document for the year ending 31 March 2010 reflect Wellington Electricity's current business plan. Plans for subsequent years of the planning period are likely to be affected by the outcome of the asset management reviews as well as changes to the environment in which Wellington Electricity operates.

This asset management plan was approved by the Wellington Electricity Board of Directors on 31 March 2009.

2.4. Stakeholders

The interests of the major stakeholders in Wellington Electricity's operation are discussed below:

Consumers

The consumers connected to Wellington Electricity's network require a safe and reliable supply of electricity of acceptable quality at a reasonable price. While consumers generally appreciate that delivery of an extremely high quality supply with no interruptions is unrealistic, expectations differ as to the level of reliability and voltage purity that can be considered acceptable.

Retailers

As retailers rely on the network to deliver the energy they sell to consumers, they also require the network to be reliable and electricity distribution services to be provided at a reasonable price. Retailers are reliant on electricity distribution services to conduct their business and therefore want Wellington Electricity to assist them in providing innovative products and services for the benefit of their customers.

Staff and Contractors

Staff and contractors want job satisfaction, a safe working environment and to be fairly rewarded for the services they provide.

Community

Electricity is a public good in that a reliable, reasonably priced supply of electricity will promote the economic and social wellbeing of the Wellington community. The community also requires the network to be designed and operated to a very high level of safety.

Shareholders

Shareholders require a fair economic return for their investment in this critical infrastructure.

The Wellington Electricity Board of Directors

The Wellington Electricity Board of Directors is responsible for developing policies and strategies that reflect stakeholder interests and for managing conflicts between the interests of different stakeholders.

Issues that arise where there is a clear conflict of stakeholder interest will be managed on a case-by-case basis. This will often involve consultation with the affected stakeholders and may involve the development of innovative "win-win" approaches that are acceptable to all affected parties.

2.5. Asset Management Accountability

2.5.1. Wellington Electricity Structure and Asset Management Accountability

The management of network assets is currently in transition from Vector to Wellington Electricity with target completion by June 2009. Prior to this date Vector provides asset management services to Wellington Electricity through a Transition Services Agreement.

Wellington Electricity's organisation structure is shown in Figure 2.1.

The Wellington Electricity Board of Directors is responsible for setting direction and overall governance. The Board has approved capital and operational expenditure budgets and business plans for the 2009 calendar year. Information is provided to the Board as part of a monthly consolidated business report that includes health and safety reports, capital and operational expenditure vs. budget, reliability statistics against targets and customer satisfaction survey results.

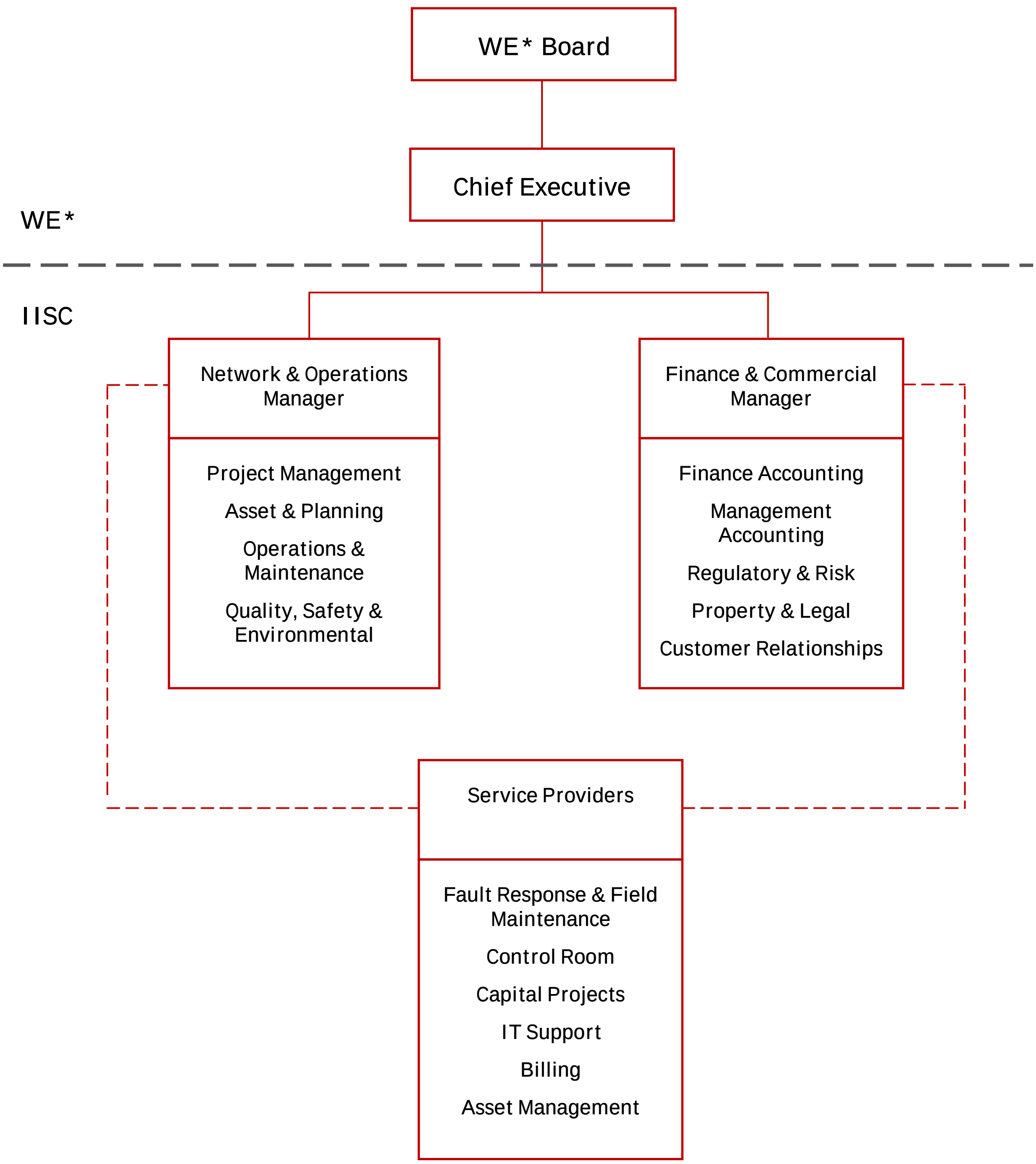
The Wellington Electricity CEO implements the approved policies and business plans and is accountable for business performance.

The International Infrastructure Services Company (IISC) is a separate infrastructure services company owned by CKI/HKE, which provides services to Wellington Electricity Limited.

The Wellington based Network and Operations Manager is responsible for asset management including asset planning, project management, operations and maintenance, and safety, quality and environmental performance.

As Wellington Electricity is part of the CKI group of infrastructure companies, it can access skills and experience from across the world. For example, CKI's Australian group companies (which distribute electricity to over 1.7 million customers) have considerable knowledge and experience in electricity distribution business asset management including strategy and planning. In essence, the CKI group companies provide Wellington Electricity with direct access to international best practice in asset management.

Figure 2.1 Wellington Electricity Organisation Structure



Legend

WE* Wellington Electricity Lines Limited

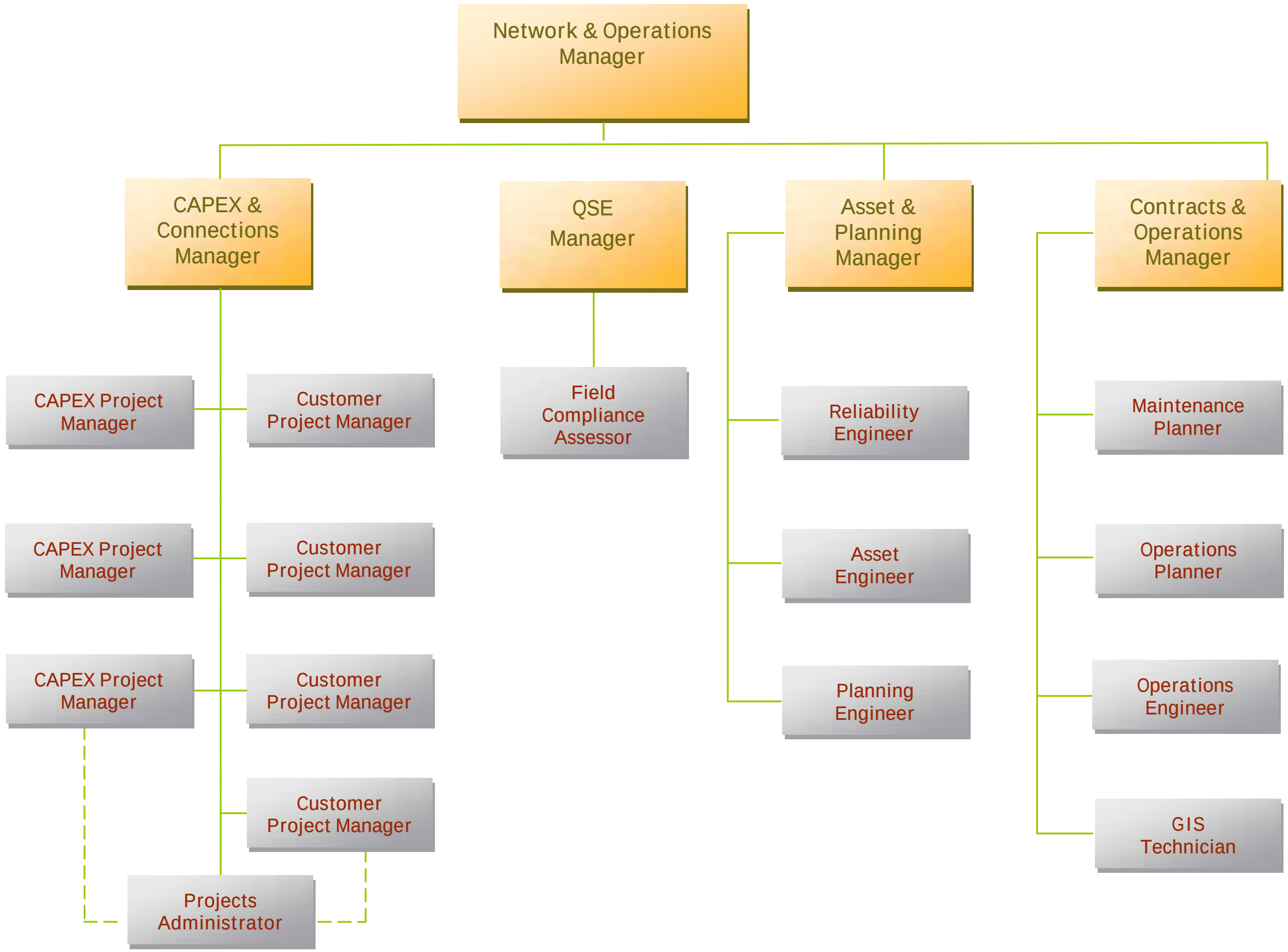
IISC International Infrastructure Services Company

2.5.2. Network & Operations Team Structure and Asset Management Accountability

The asset management function is the responsibility of the IISC Network & Operations team. The structure of this team is shown in Figure 2.2.

This team is based in Wellington and is still being established. All vacant positions are planned to be filled by June 2009, by which time Wellington Electricity will have taken over all asset management functions and operational control from Vector.

Figure 2.2 IISC Network and Operations Organisation Structure



2.5.3. Field Operations

Field operations including asset construction, operation and maintenance are wholly outsourced to contractors. This includes asset condition assessment, asset data management and reporting. As part of its asset management review, Wellington Electricity is reviewing the extent that these activities remain outsourced in order to achieve optimum asset management outcomes.

Currently, Vector manages and audits the contractors, and also collates reports on network operations and maintenance performance and expenditure, and network reliability. The Transition Services Agreement with Vector is scheduled to be terminated by June 2009, after which Wellington Electricity will be totally responsible for all its contract management and performance reporting.

Major capital projects are tendered on a contestable basis to pre-qualified contractors.

A Wellington Electricity control room (and associated offices) with a new SCADA system is being established at Haywards to take over real time operational control from Vector, which currently controls the network from Auckland. This change-over is targeted for completion by June 2009, after which Wellington Electricity will independently control the network. This change will also include the provision of disaster recovery sites at Central Park and at a control centre in Melbourne.

Transpower GXP Substation Supplying Wellington Electricity

3. Assets Covered

3.1. Distribution Area

Wellington Electricity's distribution network supplies the cities of Wellington, Porirua, Lower Hutt and Upper Hutt. Wellington City is one of the major metropolitan centres in the country with high density commercial developments. It is also the seat of government and includes Parliament Buildings and the head offices of most government departments. A map of the supply area is shown in Figure 3.1.

Figure 3.1: Wellington Electricity Supply Area

As of 31 December 2008, there were over 162,000 connected customers. The total system length (excluding streetlight circuits and DC cable) was 4,592 km, of which 61.3% was underground.

Peak demands and energy distributed for the last three years is shown in Table 3.1.

Table 3.1: Peak Demand and Energy Delivery

	Year to 31 March 2007	Year to 31 March 2008	Year to 31 March 2009
Peak Demand (MW)	553	554	573
Energy Injection (GWh)	2,569	2,572	Not available

The Wellington CBD is the business and retail centre for the region, although there are significant retail centres in Lower Hutt, Porirua and Upper Hutt. Apart from the CBD there is widespread residential load throughout the area. This is interspersed with pockets of commercial and light industrial load.

Major customers with significant loads include Parliament, Wellington Airport and Victoria University. Wellington Electricity also supplies the electrified suburban railway network and the trolley bus network. The supply area is notable for the absence of large industrial loads.

The trolley bus network is supplied through Wellington Electricity owned DC assets comprising 15 converter transformers, 19 mercury arc rectifiers, 2 solid state rectifiers and 53 DC circuit breakers. To provide backup supply, in case of faults, there are approximately 53 km of underground DC cables linking various DC substations. These DC assets are managed in accordance with a network connection and services agreement with NZ Bus Limited (the sole customer supplied by these assets) and are therefore not covered by this asset management plan.

3.2. Network Configuration and High Level Asset Description

Any electricity distribution system can be broadly categorised into primary and secondary assets. The primary assets carry the energy that is distributed to consumers. The secondary assets are an integral part of the distribution system and support the operation of the primary assets.

3.2.1. Grid Exit Points and Subtransmission

Wellington Electricity's network is supplied from the grid through nine grid exit points (GXPs), as shown in Figure 3.2. Central Park, Haywards and Melling supply the network at both 33 kV and 11 kV, and Kaiwharawhara supplies it at 11 kV. The remaining GXPs (Gracefield, Pauatahanui, Takapu Rd, Upper Hutt and Wilton) all supply the network at 33 kV.

The 33 kV subtransmission system takes supply from the grid and feeds a total of 28 zone substations, incorporating 54 33/11 kV transformers. This 33 kV system is radial with each feeder supplying its own dedicated power transformer. All 33 kV feeders supplying zone substations in the Wellington area are underground while those in the Porirua and Hutt Valley areas are a combination of overhead and underground. The total length of the 33 kV system is 205 km, of which 146 km is underground.

The 33 kV subtransmission system is also backed up by a limited number of "express" 11 kV circuits that perform a subtransmission function in that they do not supply any directly connected loads. These are used as backups to the 11 kV supply at some zone substations and also to supply a number of 11 kV switching nodes, which in turn are used as the source for 11 kV distribution feeders.

Figure 3.2a: Lower Hutt Subtransmission Network

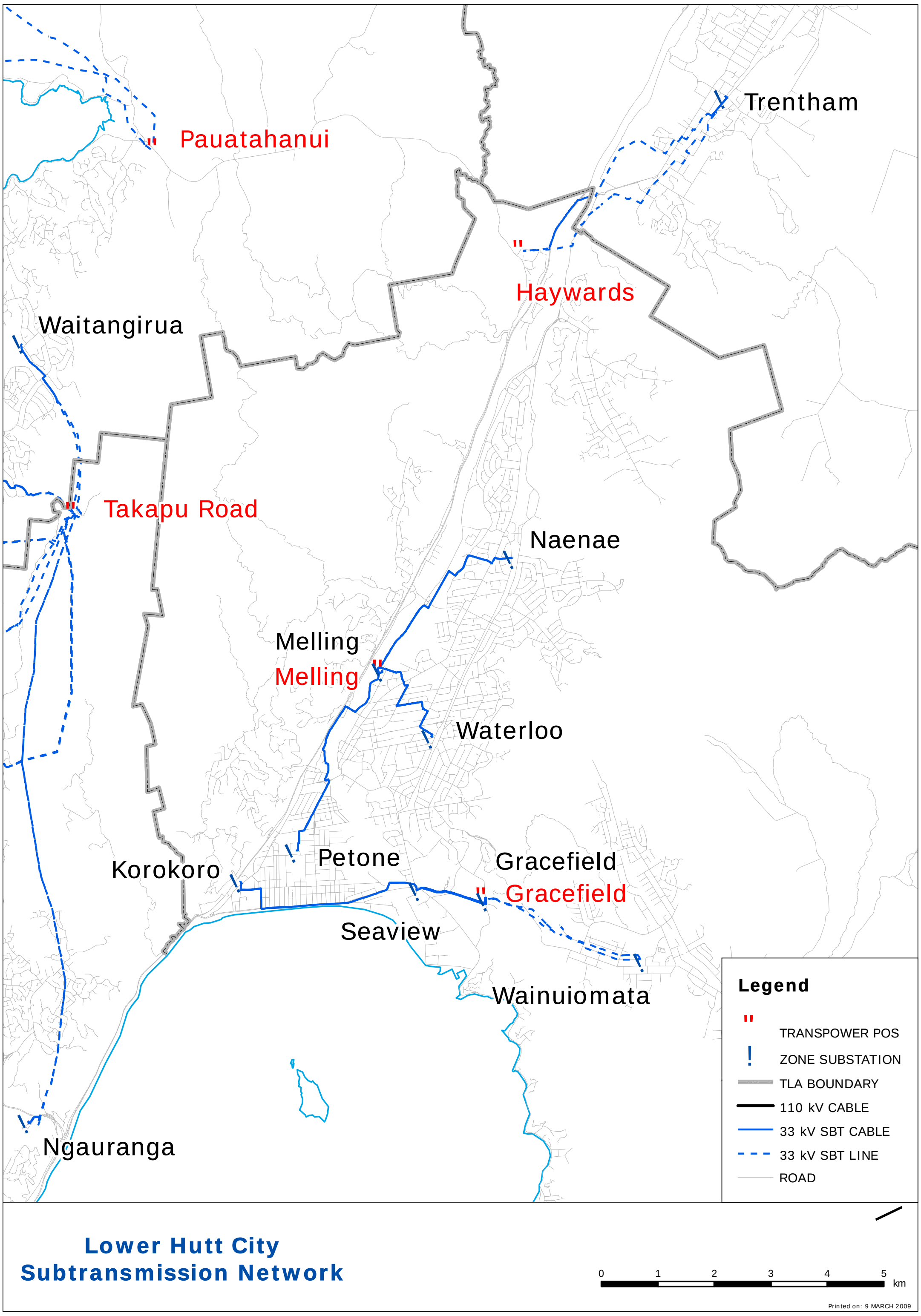


Figure 3.2b: Porirua City Subtransmission Network

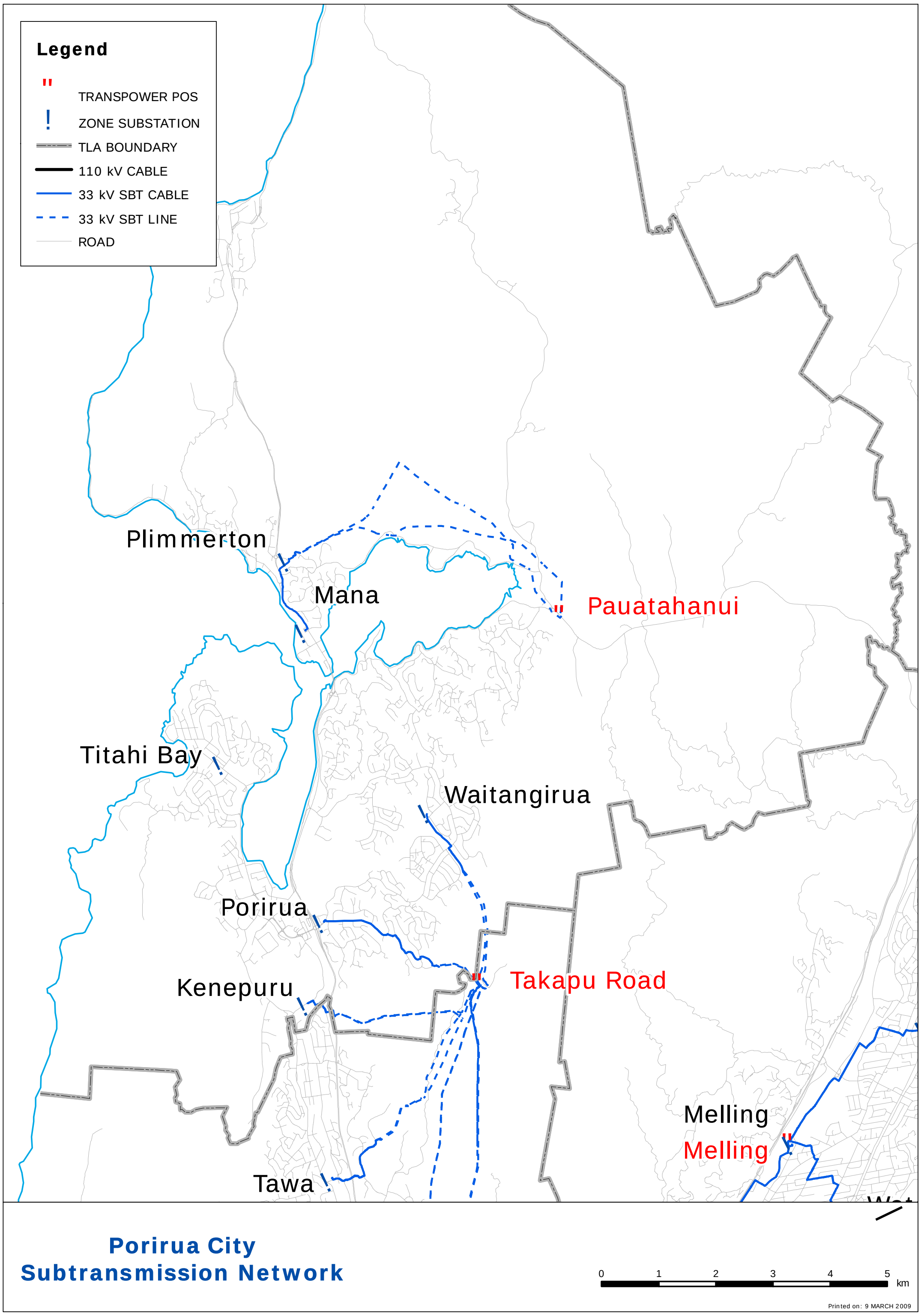


Figure 3.2c: Upper Hut City Subtransmission Network

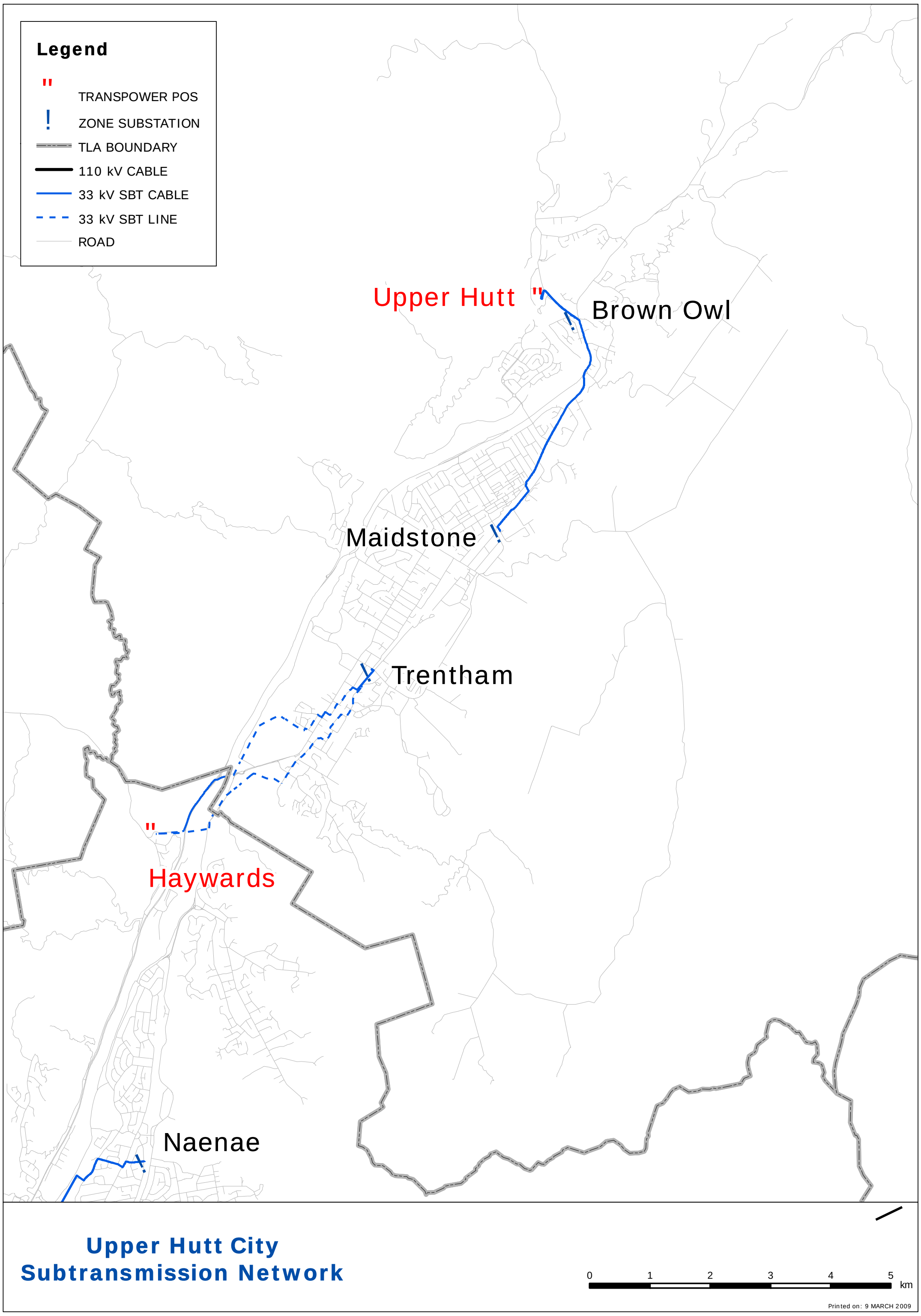
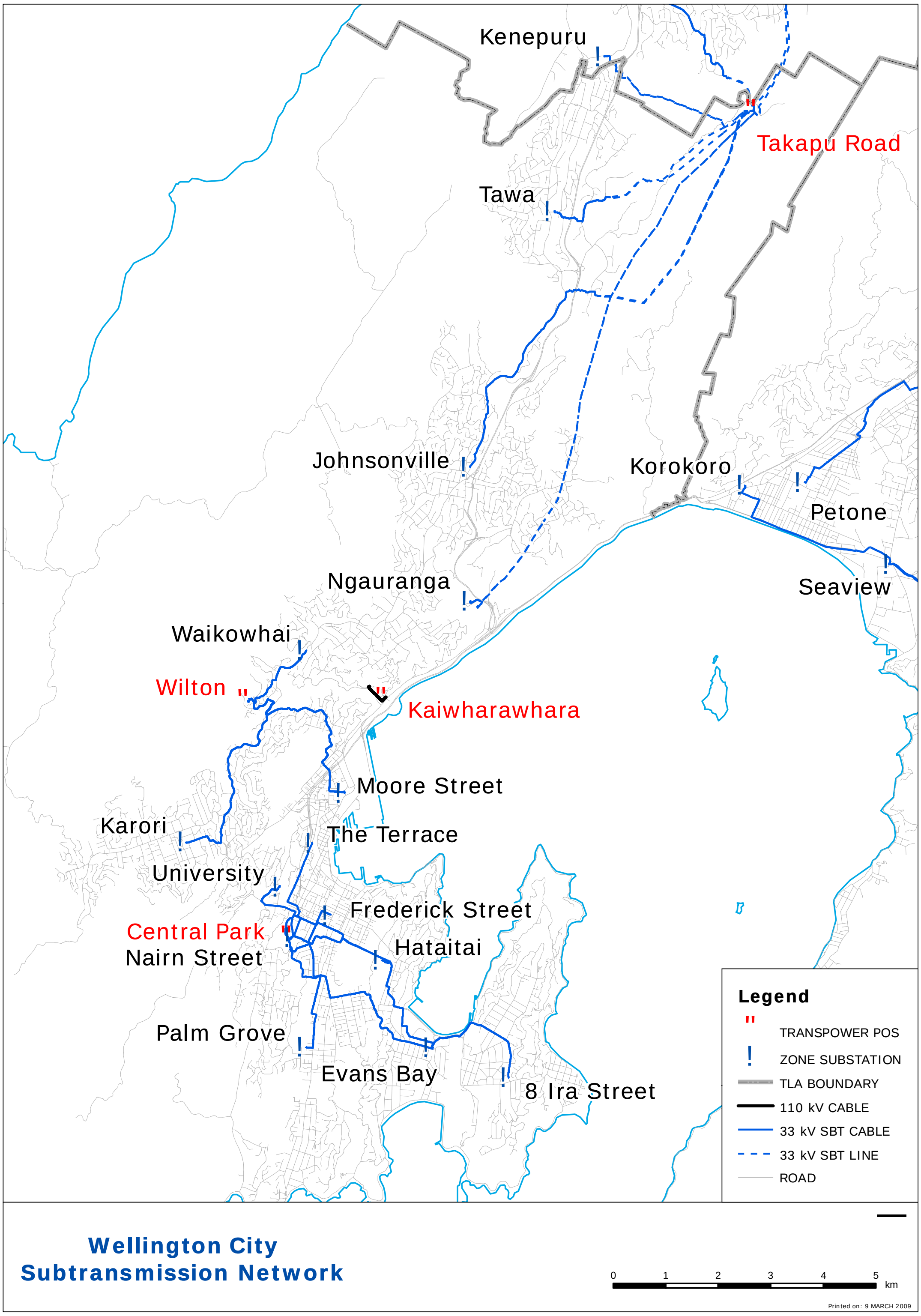


Figure 3.2d: Wellington City Subtransmission Network



3.2.2. Embedded Generation

The network currently has a range of connected embedded generation including several connections of less than 10 kW (typically residential), two landfill sites greater than 1 MW, and a hospital with synchronised generation of approximately 8 MW. In addition, there are a number of customers with standby generation plant of varying sizes (typically less than1 MW), which generally cannot be synchronised to the network.

3.2.3. Distribution System

The 11 kV distribution system is supplied from the zone substations, or directly from the grid in the case of the 11 kV supply points. While some larger customers are fed directly at 11 kV, the system mainly supplies approximately 3,300 Wellington Electricity owned 11/415 kV distribution substations located in commercial buildings, industrial sites, berm-side kiosks and on overhead line poles. The total length of the 11 kV system is approximately 1,695 km, of which about 65% is underground. In Wellington City, the 11 kV network is largely underground whereas in the Hutt Valley and Porirua areas there is a higher proportion of overhead lines. The varying proportions of overhead and underground distribution on the different parts of the system reflect the different design philosophies of earlier network owners.

The 11 kV feeders in the Wellington CBD are operated in a closed ring configuration with radial secondary feeders interconnecting neighbouring rings or zone substations. This arrangement provides a higher level of security and hence a higher level of supply reliability. Most of the 11 kV network outside the Wellington CBD area comprises radial feeders with normally open interconnectors to other feeders so that, in the event of an equipment failure, supply to customers can be switched to neighbouring feeders. To allow for this, distribution feeders are not operated at their full thermal rating under normal system operating conditions.

There are approximately 1,700 circuit breakers operating within the distribution system. Almost 400 of these are located at the zone substations and control the energy being injected into the distribution system. The remainder are located within approximately 250 area substations, mostly situated within or close to the Wellington CBD, and allow the primary feeders in their respective areas to be operated in a closed loop arrangement. These circuit breakers are used to automatically isolate a faulted section of the network and to maintain an uninterrupted supply to all customers not directly connected to the faulted section.

3.2.4. Distribution Substations

Throughout the distribution network there are approximately 3,300 distribution substations with around 4,000 associated distribution transformers in service. Pole-mounted distribution transformers are typically less than 150 kVA and are generally simple platform structures or hanging bracket type arrangements. Ground-mounted distribution substations include a range of designs from the more significant reinforced concrete block buildings that can accommodate single transformers (typically a switch unit and low voltage (LV) distribution panel or frame) up to larger style three-transformer, multiple circuit breaker (CB) switchboards and extensive LV distribution framing. The more compact substations are generally the kiosk style, with an LV frame, transformer and ring main unit enclosed in a metal canopy. Other common styles are stand alone, open fenced enclosures or fully enclosed within customer owned buildings.

In Wellington City the majority of the approximately 800 distribution transformers are ground mounted. The Hutt and Porirua areas are a combination of ground mounted and overhead installations and of these approximately 1,450 are ground mounted. Individual capacities range from 5 kVA to 2,000 kVA, and the weighted average capacity is approximately 300 kVA.

3.2.5. Low Voltage Lines and Cables

Low voltage lines and cables are used to connect individual customers to the low voltage side of the distribution transformers. The total system length is around 2,670 circuit-km, of which approximately 58% is underground.

3.2.6. Secondary Systems

Protection Assets

Protection assets are used to automatically detect equipment faults and to automatically issue control signals to disconnect faulted equipment. This ensures that the system remains safe, that damage is minimised and also limits the number of consumers affected by an equipment failure. There are more than 1,200 protection relays in operation. Around 95% are older electromechanical devices. The remainder are newer relays that use solid state electronic and computer technology.

SCADA

The SCADA system is used to manage the real time operation of the network and can monitor and control the operation of primary equipment at the GXPs, zone substations and larger distribution substations. It is used to:

- Monitor the operation of the network from a single control room by remotely indicating key parameters such as voltage and current at key locations;
- Permit the remote control of selected primary equipment in real time;
- Graphically display equipment outages on a dynamic network schematic; and
- Transmit system alarms to the controller for action.

System information is collected by remote terminal units (RTUs) at each control location and in the main is transmitted to a central master station located in a control room at Haywards substation through dedicated communication links. Control signals travel in the opposite direction over the same communications links.

At the time this AMP was prepared, the master station at Haywards transmits relevant data to and from Vector’s Auckland control room, and the system is controlled remotely from there. Some SCADA data, using newer technology RTU equipment, is transmitted directly between the Auckland control room and the remote Wellington site, bypassing the Haywards master station. Hence, while the Haywards control room can be used as an emergency control room, it cannot currently provide the full functionality available from Auckland.

As noted in Section 2.5.3, Wellington Electricity is currently installing a new stand-alone GE ENMAC master station and outage management system at Haywards, which will be commissioned by June 2009 to enable Wellington Electricity to assume real time control of the network. The SCADA data that currently bypasses the existing Haywards master station will be diverted into the new ENMAC system. Full network control will also be available from the new disaster recovery centre at Central Park, while the functionality of the Citipower/Powercor control centre in Melbourne will be limited to the monitoring of network status.

Load Control

The load control system allows selected loads to be turned on and off from the control centre through the injection of control signals into the primary network. There are a total of 24 injection points situated at zone substations and GXPs and these are operated in response to commands from the SCADA system. The system is used to control street lighting, and also to control hot water cylinders, electric kilns, swimming pool heaters, spa pool heaters, storage heating and air conditioning units operated by consumers who elect to receive supply on a controlled tariff.

Communication

Operation of secondary systems requires the use of high security communication links between the master station and the different control points. Like most distribution businesses, Wellington Electricity operates its own communications system with a small number of communications links being leased from service providers such as Vector Communications and Transpower.

Wellington Electricity's own network comprises mainly copper cable with a small amount of fibre-optic and radio infrastructure. Communications links leased from other service providers are either fibre-optic or radio links.

3.3. Asset Justification

The distribution system is designed to provide an electricity supply of sufficient capacity and reliability to meet the needs of existing customers. In addition, the network is planned and constructed with some excess capacity to cater for forecast load increases. This strategy (which is generally adopted by electricity network businesses) is an efficient approach to network development due to the high cost and long life cycles of electricity distribution assets.

Petone Substation Transformer

4. Service Levels

Wellington Electricity operates its distribution system in accordance with all relevant legal requirements, including the Electricity Act 1992, the Health and Safety in Employment Act 1992, and the Resource Management Act 1991. This legislation and its subsidiary regulations have a significant influence on the way in which Wellington Electricity manages its assets. In the main the legal requirements are non-discretionary and therefore act as a constraint on the way in which the system must be managed (and on the cost of managing the network).

Within these legal constraints Wellington Electricity has discretion in managing its assets to meet the requirements of its stakeholders. It must ensure that the reliability of supply meets or exceeds the reasonable expectations of the retailers and consumers that use the network. Further, it must ensure that the assets that provide distribution service are used efficiently if the conflicting expectations of stakeholders regarding price and profitably are both to be met in a reasonable way. Wellington Electricity measures its performance in these discretionary areas and sets targets that guide its short and medium term asset management planning.

Wellington Electricity has aligned the indicators that it uses to measure the performance of the business with those used by the Commerce Commission in its information disclosure and threshold control regimes. Setting business targets based on these indicators mitigates inefficiencies that might arise from operating in parallel two business management systems, each with a slightly different focus.

4.1. Consumer Orientated Performance Targets

Consumer orientated performance targets measure how well Wellington Electricity is able to "keep the lights on". This is measured using two internationally recognised performance indicators, SAIDI and SAIFI, which taken together are indicators of the availability of an electricity supply to the average customer connected to the network.

- SAIDI[1] is a measure of the total time in a measurement year that an electricity supply is not available to the average consumer connected to the network. It is measured in minutes.
- SAIFI[2] is a measure of the total number of supply interruptions that the average consumer experiences in the measurement period. It is measured in number of interruptions[3].

Consistent with the approach taken by the Commerce Commission the following supply interruptions are not included in the measured performance indicators.

- Interruptions caused by the unavailability of supply at a GXP, or as a result of automatic or manual load shedding directed by the transmission grid operator[4], or as a result of some other event external to the Wellington Electricity network.

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1 System Average Interruption Duration Index
2 System Average Interruption Frequency Index
3 Due to the effect of averaging, SAIFI is reported as a non integer number.

- Interruptions lasting less than one minute. In these cases restoration is usually automatic and sometimes the interruption will not be recorded.
- Interruptions resulting from an outage of the low voltage network or a single phase outage of the 11kV distribution network. The Commerce Commission does not require these interruptions to be recorded for information disclosure or for the operation of the threshold control regime. In practice such interruptions do not have a material impact on measured system reliability and the business processes required to accurately record these interruptions and measure their impact are not cost effective.

The measured historic reliability of Wellington Electricity's network is shown in Figures 4.1 and 4.2. These charts show that the reliability of the network is normally very high, even for a network that supplies only CBD and urban areas. In broad terms it indicates that, under normal circumstances, the average consumer can expect one sustained interruption every two years and that this interruption will last a little over an hour. Wellington Electricity aims to maintain the network reliability at this level and has set reliability targets for the planning period based on the average reliability of the network over the five year period 1 April 2003- 31 March 2008. These targets are shown in Table 4.1.

Table 4.1: Reliability Targets

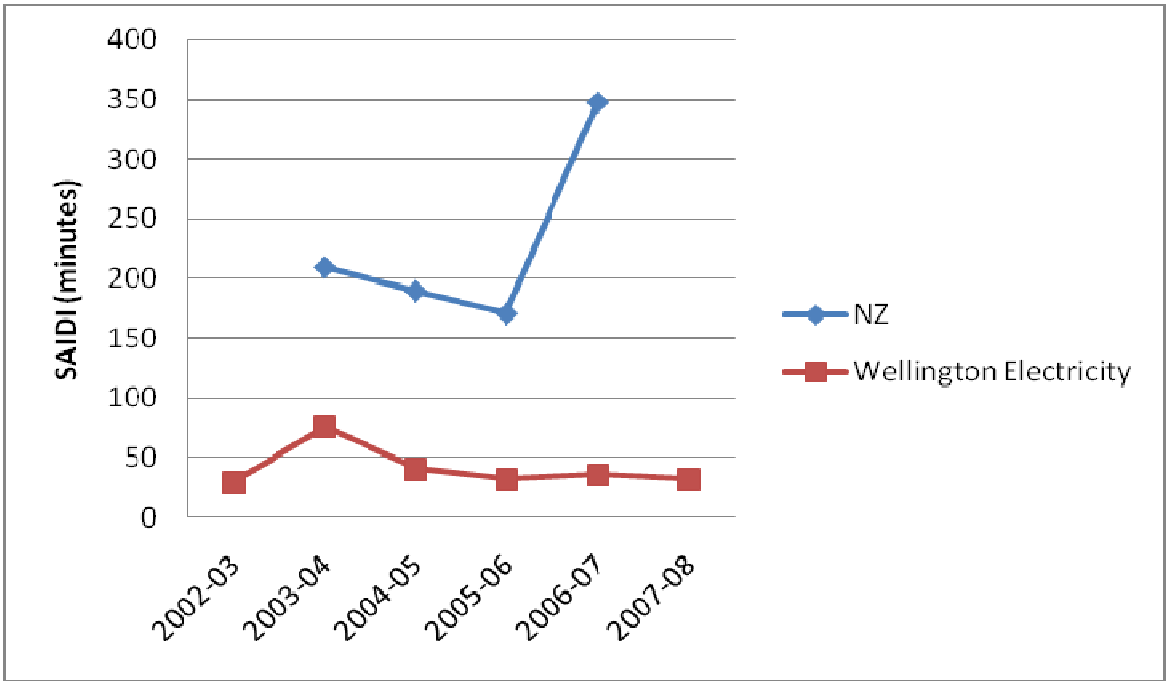
	2009-10	2010-11	2011-12	2012-23	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
SAIDI	42	42	42	42	42	42	42	42	42	42
SAIFI	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Note: SAIDI is measured in minutes and SAIFI in average number of interruptions.

The targets have been designed to align with the Commerce Commission's current requirements for the reporting of reliability and include the impact of major event days when the number of outages exceeded the ability of Wellington Electricity's contractor to respond in a timely manner. The impact of these major event days on the reported reliability can be significant – there were two major event days in 2003-04 when a SAIDI of over twice that recorded in a normal year was experienced.

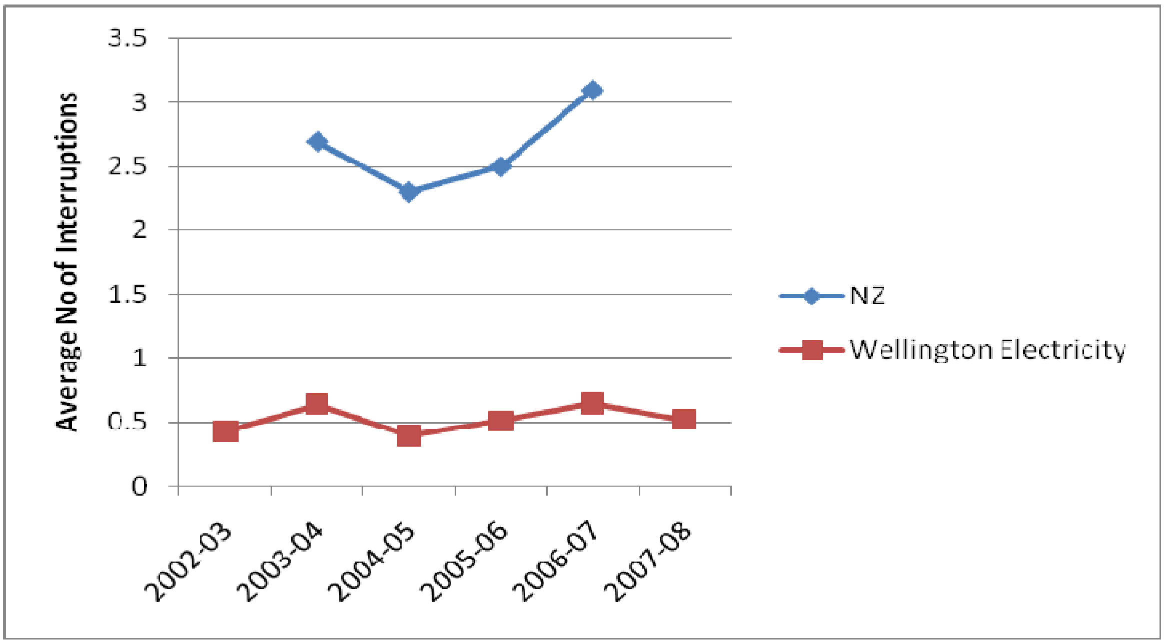
4 The transmission grid operator has the authority to direct electricity distributors to shed load. This is necessary during emergencies to ensure that the power system continues to operate in a secure and stable state.

Figure 4.1: Historic SAIDI of the Wellington Electricity Network



Note: NZ data is average for all New Zealand electricity distribution businesses as disclosed to the Commerce Commission.

Figure 4.2: Historic SAIFI of the Wellington Electricity Network



Note: NZ data is average for all New Zealand electricity distribution businesses as disclosed to the Commerce Commission.

Major event days are usually caused by environmental factors, such as severe storms, that are outside Wellington Electricity's direct control. They are relatively infrequent – Wellington Electricity has experienced only three major event days in the last six years, two in 2003-04 and one in 2004-05. They generally have a much bigger impact on SAIDI than on SAIFI because during such events consumers may only experience one interruption but can be without power for hours or, in extreme situations, days.

International industry practice in measuring and reporting reliability is to identify major event days and to either exclude them from the measurement or to include them with an assumed reliability that better reflects the network reliability in normal circumstances. While standard practices exist for the treatment of this issue, there is some disagreement as to the appropriate treatment at the margins, particularly in respect of whether major event days should be ignored completely or replaced with an assumed reliability[5].

Wellington Electricity understands that the Commerce Commission is reviewing the measurement of reliability as part of work it is undertaking in the design of new regulatory arrangements following the passing of the Commerce Amendment Act 2008, and as a result of this work may allow major event days to be excluded from reported reliability. Should this occur, Wellington Electricity will consider resetting its reliability targets using a measurement approach that aligns with the Commission's revised methodology.

4.2. Asset Management Performance Targets

Other performance targets used by Wellington Electricity relate to the efficiency with which Wellington Electricity manages its fixed distribution assets. The indicators have been selected on the basis that Wellington Electricity considers them particularly relevant to the operation and management of its assets. The selected asset performance targets use indicators that are required to be reported to the Commerce Commission under its information disclosure regime.

4.2.1. Faults per 100 Circuit-km

This is a measure of how well the system is designed and operated from a technical perspective. Wellington Electricity designs its network to withstand the environmental conditions to which it is exposed, particularly the severe Wellington winds and the high level of atmospheric salt contamination. As discussed in Section 6, it also has a preventive maintenance system in place whereby assets are regularly inspected to identify and remedy defects that could potentially cause an asset failure. Further, Wellington Electricity has a vegetation management system in place to reduce the number of faults resulting from trees coming into contact with overhead power lines. This performance indicator is a measure of the effectiveness of these asset management strategies.

For the purpose of this performance indicator a fault is considered an unplanned failure of an in-service line or cable asset on the subtransmission or high voltage distribution systems, irrespective of whether or not it causes a loss of supply to customers. Circuit-km relates to the total circuit length of the subtransmission and high voltage distribution systems, irrespective of whether the circuit is overhead or underground.

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5 The treatment of this issue will have a material impact on the reported SAIDI.

The current target for the planning period is shown in Table 4.2 and has been set on the basis of what is understood to be the current performance of the network. It is unclear whether the historic measurement of this performance indicator fully aligns with the above definition and Wellington Electricity will review the targets in subsequent asset management plans on the basis of its own measurement approach. Notwithstanding this, the intention is to set targets for the planning period that reflect a continuation of the current level of asset performance.

Table 4.2: Performance Targets for Faults per 100 Circuit km / annum

2009-10	2010-11	2011-12	2012-23	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
10	10	10	10	10	10	10	10	10	10

A weakness of this indicator is that it excludes faults on zone substation and area substation assets so the performance of a significant portion of the system asset base is not captured. However these faults occur much less frequently than line faults and often do not cause supply interruptions because of the equipment redundancy built into the substation designs.

4.2.2. Operational Expenditure Ratio

This is a measure of how efficiently Wellington Electricity manages its network on a day-to-day basis. It is the ratio of the operational expenditure on the network to the replacement cost of the system fixed assets at the end of each reporting year. In measuring this performance, the definitions in the Electricity Distribution (Information Disclosure) Requirements 2008 apply[6][7]. The targets shown in Table 4.3 are based on the maintenance expenditure forecasts included in this asset management plan.

Table 4.3: Performance Targets for Operational Expenditure Ratio

2009-10	2010-11	2011-12	2012-23	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%

The target is based on the forecast direct asset maintenance costs shown in Appendix A, the estimated asset replacement cost as at 31 March 2010 and estimated operational expenditures not directly related to asset maintenance. It may need to be reset in the 2010 asset management plan in order to reflect the actual asset replacement cost and operational expenditure as calculated for information disclosures relating to the regulatory year ending 31 March 2009.

6 Operational expenditure means expenditure incurred in the operation of the distribution business that is not capital expenditure. It excludes depreciation, tax, expenditure on transmission and expenditure relating to the financing of the business.

7 System fixed assets include all fixed assets used for the supply or conveyance of electricity, excluding works under construction.

Te Aro Distribution Line

5. Network Planning

5.1. Planning Criteria and Assumptions

The planning criteria on which the design of the system is based is shown in Tables 5.1 and 5.2.

While the reliability of the Wellington Electricity distribution system is high, notwithstanding the difficult physical environment in which the system must operate[8], it is uneconomic to design a network where supply interruptions will never occur. Hence the network is designed to limit the amount of time over a year when it is not possible to restore supply by reconfiguring the network following a single unplanned equipment failure. This approach recognises that the electricity demand on the network varies according to the time of day and season of the year, and that the time over which the system is exposed to its peak demand is very small during the course of a year. It also recognises that equipment must at times be taken out of service for planned maintenance and that, when this occurs, parts of the network are exposed to a higher risk of interruption.

Wellington Electricity's network design and asset management systems also have regard to the time taken to restore supply following an interruption. When an unplanned equipment outage does occur, every effort is made to restore supply to customers not directly affected by the equipment fault by switching load to other parts of the network. However at times of peak demand, or where equipment is out of service for maintenance at the time of the unplanned outage, it may not be possible to switch all load in this way, and in these cases an extended outage may occur with maximum restoration times as shown in Tables 5.1 and 5.2.

Tables 5.1 and 5.2 generally do not apply to the low voltage network or to failures of connection assets used to supply individual customers. In such situations an interruption will last for the time taken to make a repair, which in some circumstances could be longer than three hours.

The tables also do not apply when multiple equipment outages affect the same part of the network or when major storms or other severe events have a high impact on the system and stress the capacity of Wellington Electricity or its contractors to respond in a timely manner. Wellington Electricity has emergency plans in place to mitigate the impact of such situations[9] but when they occur longer supply interruptions than shown in the tables are likely.

8 Much of Wellington Electricity's supply area is renowned for its high winds. There can also be a high concentration of salt in the atmosphere, blown in off the sea.
9 See Section 8.4.

Table 5.1 Subtransmission Network

Type of Load		Planning Criteria (single contingency only)
1	Predominantly residential substations	Risk of supply interruption for up to 5% of the time in a year[1]. Should an interruption occur, supply will be restored within 3 hours.
2	Mixed commercial / industrial / residential substations	Risk of supply interruption for up to 2% of the time in a year[1]. Should an interruption occur, supply will be restored within 3 hours.
3	CBD	Risk of supply interruption for up to 0.5% of the time in a year[1]. Should an interruption occur, supply will be restored within 3 hours.

Note 1 At other times there may be a brief supply interruption of up to one minute following an equipment failure, while the network is automatically reconfigured.

Table 5.2 Distribution Network

Type of Load		Planning Criteria
1	Overhead spurs supplying up to 1MVA urban area	Loss of supply upon failure. Supply restoration upon repair time.
2	Underground spurs supplying up to 400kVA.	Loss of supply upon failure. Supply restoration upon repair time.
3	Predominantly residential feeders	Risk of extended supply interruption due to insufficient backup capacity for up to 5% of the time in a year[1]. When backup capacity is insufficient, supply will be restored within 3 hours.
4	Mixed commercial / industrial / residential feeders	Risk of extended supply interruption due to insufficient backup capacity for up to 2% of the time in a year[1]. When backup capacity is insufficient, supply will be restored within 3 hours.
5	CBD or high density industrial	Risk of extended supply interruption due to insufficient backup capacity for up to 0.5% of the time in a year[1]. When backup capacity is insufficient, supply will be restored within 3 hours.

Note 1 This does not preclude a supply interruption at other times while the network is reconfigured following an unplanned outage. In CBD areas reconfiguration will normally be automatic and the supply interruption will be under a minute. In other areas, an operator may need to travel to the fault location to manually operate network switchgear, in which case the supply interruption could last for up to one hour.

5.2. Capacity of New Plant

When planning an augmentation to the network to increase its existing capacity it is necessary to determine the capacity of the new equipment to be purchased and installed. This often involves a trade-off between cost and the size of the increased capacity because:

- If the capacity is too large either Wellington Electricity or its consumers have to pay the cost of any capacity that will not have been economically utilised before the equipment reaches the end of its economic life; and

- If the capacity is too small then premature asset replacement will be required and this generally increases costs.

The problem of determining the optimum capacity is made more difficult by the fact that the economic life of most primary distribution assets is between 40 and 60 years and the difficulty of forecasting electricity demand over this period into the future.

Wellington Electricity uses the Commerce Commission's planning period as the starting point for making equipment capacity decisions and then takes the following approach:

- On the basis of the current load forecast, determine the maximum potential load on the equipment at the end of the planning period under the most severe operating condition that the network is planned to withstand, based on the security standards set out in Section 5.1 above.
- Select the next highest standard equipment size.

This is the maximum capacity that will avoid the risk of optimisation. It is important to note that this is only a starting point for making capacity decisions. An engineering and economic judgement is then made as to whether this size is appropriate taking other factors into account. Such factors might include the margin between the required capacity and the next highest standard size, the incremental cost of different equipment sizes and the forecast rate of demand growth.

Given the relatively modest demand growth in its supply area, it is unlikely that Wellington Electricity would expose itself to optimisation risk by installing asset capacities greater than indicated by the above approach.

5.3. Prioritisation of Capital Works Projects

A further problem facing distribution network planners is deciding which projects will proceed, given that funding for capital works is generally limited. Wellington Electricity sets its capital works budget based on the following priorities.

- Works necessary to ensure public and employee safety are given the highest priority and will not be deferred.
- Works necessary to meet legal requirements are also accorded a high priority. However, where changes to legal requirements impose significant additional costs it may be necessary to undertake the required works over an extended period of time. This is usually agreed with the authority responsible for monitoring compliance with the changed requirement.
- Other capital works projects, including asset replacements and system augmentations to meet the security criteria set out in Section 5.1 are prioritised on the basis of cost-benefit and risk analyses. Projects that mitigate extreme or high risks to the business and projects with high benefit-cost ratios will be given the highest priority.

5.4. Demand Forecasts

Loads on individual feeders and zone substations are captured by the SCADA system and the load at each GXP is metered through the time of use revenue metering. This information allows Wellington Electricity to trend actual peak demands at the GXP, zone substation and feeder level and to project these trends into the future using a regression analysis model.

At feeder level known changes in load drivers, such as population growth, customer type, economic growth, land usage and district plan changes are factored in and the trended forecast is modified as appropriate to generate a demand projection over the planning period. Individual commercial developments and subdivisions are also factored in. These feeder level growth forecasts are then reflected in the zone substation and GXP forecasts. To verify this bottom up approach, a top-down regional model compares the extrapolated trend-line derived from historical regional loads with the bottom-up trend forecast. Demand forecasts are reviewed annually.

The demand forecast takes into account expected operation of Wellington Electricity's load control and management system. It takes into account large embedded generators only to the extent that commercial agreements to operate the generators at times of peak demand on the network are in place.

Short-term maximum demand on the network is influenced by climate, with the peak demand over a severe winter being materially higher than over a mild or average season. It is therefore necessary to design the network with a small capacity margin over the expected peak demand, in order to cater for forecasting uncertainties and to ensure that the planning criteria described in Section 5.1 is met during an abnormally severe winter.

Detailed forecasts for the planning period are provided in Sections 5.4.1 and 5.4.2. These are recent forecasts that take into account the anticipated impact of the current economic conditions. They indicate that forecast growth in Wellington Electricity's supply area is relatively low when compared to demand growth in many parts of the country. Furthermore the forecast shows that load on the network peaks strongly over the winter. The exception to this is the Wellington CBD area where summer peaks are now experienced. This is thought to be due to air conditioning loads in office buildings, notwithstanding the fact that Wellington Electricity tries to minimise the impact of air conditioning load on peak demand by using its load control system, as discussed in Section 5.5.

5.4.1. GXP Demand Forecast

The forecast demand at each GXP supplying Wellington Electricity's distribution network is shown in Table 5.3. It takes into account the commissioning of the new incoming 33 kV cables supplying the Terrace zone substation in April 2009, which will transfer this substation's load from Wilton GXP to Central Park GXP.

The forecast indicates that the existing assets have sufficient capacity to supply the forecast demand through to the end of the planning period and no major capacity augmentations are envisaged during the period. Notwithstanding this, there is a high level of uncertainty in the forecast, which indicates that the loads at the Melling 11 kV supply point will be approaching firm capacity towards the end of the period.

Wellington Electricity will monitor the situation and take action as necessary to ensure that the security of supply is not compromised.

The Haywards 33 kV and 11 kV supply points each have only a single transformer. However the Haywards 33 kV supply can be backed up from the Upper Hutt GXP and the 11 kV supply points can be backed up from the Melling GXP though Wellington Electricity owned 11 kV subtransmission circuits. Transpower has proposed that a 33/11 kV transformer be installed at Haywards, to serve as a back up to both the 33 kV and 11 kV supply busbars. Wellington Electricity does not believe this to be necessary in the short to medium term, as the backup 11 kV feeders, together with available load transfer capacity in the distribution system, should ensure that the security criteria are met. However the situation will be kept under review[10].

[10] The installation of an interconnecting transformer would not impact the capital expenditure in this asset management plan as the asset would not be owned by Wellington Electricity. It would result in an increase in transmission connection charges, which are not included in any of the forecasts presented in this plan.

Table 5.3: GXP Demand Forecast

GXP	Installed Capacity (MVA)	Firm Capacity[3] (MVA)	Peak Demand (MVA, calendar year)									
			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Central Park 33 kV[1]	2*100, 1*120	228	182	180	179	180	181	182	184	185	186	188
Gracefield 33kV	2*100	89	55	55	55	55	55	55	55	55	55	55
Haywards 33 kV	1*27.5	-	14	15	15	15	15	15	15	15	15	15
Melling 33 kV	2*50	52	44	46	46	46	46	46	46	46	46	46
Pauatahanui 33 kV	2*20	24	19	20	20	20	20	20	20	20	20	20
Takapu Rd 33 kV	2*100	123	78	79	79	80	81	81	82	82	82	83
Upper Hutt 33 kV	2*40	37	32	32	32	32	32	32	32	32	32	32
Wilton 33 kV	2*100	106	57	59	59	60	61	61	62	63	63	64
Kaiwharawhara 11 kV[2]	2*40	41	29	32	32	32	33	33	34	34	35	36
Haywards 11 kV	1*20	-	19	19	19	19	19	19	19	19	19	19
Melling 11 kV	2*25	27	26	26	25	26	26	26	26	26	26	26

Note 1 Includes load of Nairn St zone substation, which is supplied by Transpower at 11 kV through two 25 MVA 33/11 kV transformers. This supply has a firm capacity of 30 MVA. The forecast peak demand at Nairn St substation is 17 MVA in 2018.

Note 2: Kaiwharawhara GXP has a summer peak. All other GXPs have a winter peak

Note 3 As notified by Transpower.

5.4.2. Zone Substation Demand Forecasts

Table 5.4 shows the forecast demand at each zone substation and compares this with the firm capacity of the transformers and incoming circuits. It shows that, while there is sufficient capacity available in most instances, there are a number of situations where the potential peak demand at individual substations either exceeds, or could exceed during the planning period, the firm transformer or incoming circuit capacity at that substation. This is only a problem should an equipment failure occur since under normal operating conditions the load is shared between the two transformer feeders in service at each substation.

The situation shown in Table 5.4 is pessimistic in that it does not take into account the impact of the power factor correction installed at most substations. This acts to reduce the apparent power seen by the substation, effectively increasing the real power transfer capacity. Furthermore, in most cases the potential overload can be reduced by transferring the excess load to adjacent substations using spare capacity available in the distribution system, after an equipment fault occurs[11]. Where there is a potential for equipment to become overloaded following an unplanned equipment failure, Wellington Electricity monitors the ability to offload the affected substation and puts operating plans in place to ensure that this will occur should the need arise.

The table shows an emerging problem in the Wellington CBD. Most of the substations identified as potentially constrained, including Frederick Street, Moore Street, Palm Grove, Terrace and University supply the CBD or surrounding inner city area. Rather than deal with each issue in isolation, Wellington Electricity has taken an area–wide approach and has developed a series of projects to reinforce supply to the Wellington CBD. These are individually discussed in Section 5.6. Taken together, these projects represent a least cost approach to ensuring that the available equipment capacity is efficiently utilised and that the system is reinforced to meet forecast load growth in accordance with the security criteria described in Section 5.1.

Other projects described in Section 5.6 will address the other constraints identified in Table 5.4. The exception is the constraint in the lower Hutt Valley area, as evidenced by the identified constraints at Korokoro and Seaview. These identified constraints are relatively minor and can be managed through operational load shifts as required. These two substations supply the most industrialised part of the supply area and industrial load growth is expected to be low given the current economic outlook. This is reflected in the load forecast.

[11] Both transformers and cables have short term emergency ratings that provide some time for load to be transferred manually after an equipment failure without interrupting supply. These are not shown in Table 5.4.

Table 5.4: Zone Substation Demand Forecast

Zone Substation	Installed Tx Capacity (MVA)	Firm Cyclic Tx Capacity (MVA)	Firm Incoming Cct Capacity (MVA, W/S)	Peak Demand (MVA, calendar year)									
				2009 (W/S)	2010	2011	2012	2013	2014	2015	2016	2017	2018 (W/S)
8 Ira St	2x16/20	24	21/15	16/9	16	16	16	16	16	16	16	16	16/10
Brown Owl	2x11.5/23	23	19/13	16/9	16	16	16	16	16	16	17	17	17/11
Evans Bay	2x20	24	19/15	15/12	15	15	15	15	15	15	15	15	15/14
Frederick St	2x18/36	36	28/20	36/29	37	36	36	36	37	37	38	38	39/33
Hataitai	2x11.5/23	23	20/10	18/7	18	18	18	18	18	18	18	18	18/8
Johnsonville	2x11.5/23	23	19/12	24/13	24	24	24	24	24	24	24	24	25/15
Karori	2x20	24	21/11	19/11	19	19	19	19	19	19	19	19	19/12
Kenepuru	2x11.5/23	23	19/14	14/12	14	15	14	14	14	14	14	14	15/14
Korokoro	2x11.5/23	23	13/10	14/11	14	15	14	14	14	14	14	15	15/12
Maidstone	2x11/22	22	18/10	16/13	16	16	16	16	16	16	16	16	16/14
Mana-Plimmerton	2x10/16	16	27/23	19/8	19	20	20	20	20	20	20	20	20/10
Moore St	2x30	36	33/29	26/29	27	29	29	30	30	31	32	33	33/38
Naenae	2x11.5/23	23	19/14	17/10	18	18	18	18	18	18	18	18	18/12
Nairn St	-	-	-	19/15	19	19	19	19	20	20	20	20	20/17
Ngauranga	2x10	11	20/14	8/5	8	9	9	9	9	9	9	9	9/7
Palm Grove	2x20	24	17/13	27/16	27	27	27	27	27	28	28	28	28/18

Zone Substation	Installed Tx Capacity (MVA)	Firm Cyclic Tx Capacity (MVA)	Firm Incoming Cct Capacity (MVA, W/S)	Peak Demand (MVA, calendar year)									
				2009 (W/S)	2010	2011	2012	2013	2014	2015	2016	2017	2018 (W/S)
Petone	2x10/20	20	19/13	12/8	12	12	12	12	12	12	12	12	12/9
Porirua	2x10/20	20	22/14	17/13	17	17	17	18	18	18	18	19	19/13
Seaview	2x11/22	22	21/13	17/13	17	17	17	17	17	17	17	17	17/14
Tawa	2x10/16	16	21/14	15/10	15	15	15	15	15	15	15	15	15/12
Terrace	2x30	36	50/45	36/41	40	40	39	39	40	40	40	41	41/43
Trentham	2x11.5/23	23	20/14	14/8	14	15	15	15	15	15	15	15	15/10
University	2x20	24	32/28	28/7	26	26	26	26	26	26	27	27	27/8
Waikowhai St	2x16	19	22/15	19/10	18	19	19	19	19	19	19	19	19/13
Wainuiomata	2x11.5/23	23	18/12	18/9	18	18	18	18	17	17	17	17	17/11
Waitangirua	2x10/16	16	22/16	14/8	15	15	15	16	16	16	16	16	16/9
Waterloo	2x11.5/23	23	21/13	19/13	18	19	19	19	19	19	19	19	19/15

Note: W/S = winter / summer

5.5. Embedded Generation and Non-Network Solution Policies

Wellington Electricity's load control system is already used to manage peak demands on the network, and therefore has the effect of deferring demand driven system augmentations. Wellington Electricity also encourages retailers to offer time of use pricing and other supply products that incentivise consumers to shift electricity consumption away from periods of peak network demand.

As noted in Section 3.2.2, there is already a small but significant amount of generation embedded within the network. Wellington Electricity will encourage third parties to invest in initiatives such as the installation of embedded generation that might defer the need for capital investment on the network. However if such investment is to achieve the required outcomes there are a number of issues that need to be managed. In particular:

- The risk of non-provision of service needs to be managed. There is little point in paying a third party for a service such as generation or load reduction if the service cannot be guaranteed at the time that the network demand is at a peak.
- The service must comply with relevant technical codes and not interfere with other consumers.
- Any payments made to third parties must be linked directly to the provision of a service that gives the required technical and commercial outcomes.
- Commercial arrangements must be consistent with avoided cost principles.
- Commercial agreements must be reached on other issues not directly related to any benefit provided to Wellington Electricity. These can include the cost of connection and payment of use of network charges.

5.6. Network Development

5.6.1. Current Projects (2009-10)

Reinforcement of the 33kV Capacity to Terrace & Moore Zone Substations	
Driver: Growth Estimated commissioning: 2009 Status: Committed Estimated cost: $7 million	The ratings of the old 33kV cables to Terrace and Moore St substations were less than the zone substation transformer capacity. To gain full capacity from the transformers the two existing 33kV cables from the Wilton GXP to each zone substation are being run in parallel to supply Moore St. A pair of new 33kV XLPE cables is being installed between Central Park GXP and Terrace zone substation. This project will increase the effective capacity of both substations and mitigate the risk of simultaneous multiple failures occurring in the aging 33kV gas cables feeding the CBD from the Wilton GXP. The project is currently in progress and should be commissioned in April 2009. Once completed, it will transfer the Terrace zone substation load from Wilton GXP to Central Park. This will increase the diversity of supply to the inner CBD area where the load will be shared between Central Park, Wilton and Kaiwharawhara GXPs. The bulk of the expenditure on this project was incurred before the start of the planning period so is not included in the forecast.

Security Reinforcement of the Terrace 11 kV Ring	
Driver: Reliability, safety & environment Commissioning: early 2009 Status: Committed Estimated cost: $1-5 million	Reinforcement of the 11 kV network in order to maintain supply security is required. Terrace feeders are configured in ring form. A fault on one of the circuit breakers will overload the other circuit breakers and will lead to cascaded faults resulting in part of Wellington CBD losing supply.

Reinforcement of Waitangirua 11 kV Network	
Driver: Growth Commissioning: early 2010 Status: Proposed Estimated cost: <$1 million	Load on the feeder supplying the Whitby area (Waitangirua 5) has grown to the point where the feeder supplying the area is loaded at close to capacity. Open point changes have been able to defer this project until now. The existing feeder from Waitangirua is being reinforced to provide additional capacity.

5.6.2. Projects Planned for 2010-2013

Frederick Zone Substation (Te Aro) 11kV Network Reinforcement	
Driver: Growth Timescale: early 2013 Status: Proposed Estimated cost: $1-5 million	Due to load growth of Te Aro, reinforcement of the 11 kV network supplying this area is required to maintain security. Two new 11 kV feeders will be installed from Nairn St substation and the network configured to transfer 12 MVA of Frederick St substation load to Nairn St. This load transfer will reduce the load at Frederick Street to below the firm capacity of the transformers and incoming circuits. Wellington Electricity had planned to uprate the 33 kV incoming cables to Frederick Street but the transfer of load to Nairn Street will defer the need for this. Non-network options were also considered as an alternative to the network expansion, but were not able to provide a satisfactory solution.

5.6.3. Prospective Projects for 2014 – 2019

Projects included in this section are speculative in nature. Whether or not they proceed, and their timing, will depend largely on whether forecast load growth materialises. It is possible that over the period before construction of any project must be committed, Wellington Electricity may identify more cost effective, including non-network, approaches that will supply the required load in accordance with the planning criteria set out in Section 5.1.

New Waitangirua 11 kV Feeder	
Driver: Growth Commissioning: 2014 Status: Proposed Estimated cost: $1-5 million	Notwithstanding the reinforcement of the Waitangirua 5 feeder planned for 2010, it is anticipated that load in the Whitby area will continue to grow and that further capacity reinforcement will be required around 2014. This is likely to be a completely new 11 kV feeder.

33kV Reinforcement of Johnsonville Zone Substation	
Driver: Growth Commissioning: 2014 Status: Proposed Estimated cost: >$5 million	As shown in Table 5.4, the load on Johnsonville zone substation is exceeding the incoming cable ratings by a significant margin, to the extent that it will soon be difficult to manage the situation operationally should an equipment failure occur. This project will reinforce the 33 kV network to overcome this problem.

Reinforcement of Cable Tie Between Mana and Plimmerton Zone Substations	
Driver: Security Commissioning: 2015 Status: Proposed Estimated cost: $1-5 million	The cable tie between Mana and Plimmerton substations is under-rated and needs to be upgraded. Both these zone substations are supplied by a single transformer. The interconnecting 11 kV cable between the two zone substations allows them to be assessed together for contingency planning purposes and security analysis. This project will ensure that the planning criteria described in Section 5.1 are maintained.

Reinforcement of 33 kV Capacity at Palm Grove Zone Substation	
Driver: Growth Commissioning: 2016 Status: Proposed Estimated cost: $1-5 million	As shown in Table 5.4, the current load at Palm Grove zone substation exceeds the capacity of the existing incoming cables. It is proposed to connect the two existing cables in parallel to supply one transformer and to run a new 33 kV XLPE cable to supply the second unit. This will allow the two transformers to be operated up to their full rated capacity. At this stage it is not intended to upgrade the two Palm Grove transformers so that the firm transformer capacity exceeds the current and forecast substation load. Should a transformer fail, the situation will be managed using load transfers. When the new Bond Street substation is constructed, it will allow the loads in all CBD and surrounding areas to be reconfigured and the load on the Palm Grove substation to be reduced.

New Bond Street Zone Substation	
Driver: Growth Commissioning: 2016 Status: Proposed Estimated cost: >$5 million	It is envisaged that a new substation will be required during the planning period to reinforce the supply to the CBD. As is evident from Table 5.4, all substations supplying the CBD are heavily loaded and incremental upgrades can only defer the need for a more substantial reinforcement for a limited time. A consequence of the higher security requirements of the CBD is that network upgrades are triggered sooner than they would be in other parts of Wellington Electricity's supply area.

New Pauatahanui Zone Substation	
Driver: Growth Commissioning: 2017 Status: Proposed Estimated cost: >$5 million	Currently the Waitangirua zone substation is fully loaded to its firm capacity and the Mana-Plimmerton zone substations (which can be considered together for security and contingency planning) are loaded to about 125% of firm capacity. As the load supplied by these two substations increases an unplanned outage will become more difficult to manage using load transfers. Increasing the transformer size at Mana and Plimmerton substations is a possible solution and the incoming circuits have spare capacity. However much of the load growth is expected to be in the Whitby area, which is electrically difficult to serve from Plimmerton. At this stage a new substation at Pauatahanui appears the best technical and economic long term solution. The new substation would be situated close to the Pauatahanui GXP, thus reducing the cost of the incoming 33 kV circuits.

New Lincolnshire Zone Substation	
Driver: Growth Commissioning: 2019 Status: Proposed Estimated cost: >$5 million	By the end of the planning period it is envisaged the subtransmission network will need to be reinforced to support population growth in the Paparangi and Granada Village areas on the eastern side of the Ngauranga Gorge. The relative isolation of this area from its neighbouring suburbs makes reinforcement of the 11 kV distribution network more difficult and a new zone substation at this stage seems the preferred solution. A possible alternative requiring further investigation is transformer upgrades at Johnsonville and Ngauranga substations, which may defer the need for a new substation if there is sufficient power transfer capacity in the 11 kV distribution network.

5.7. Capital Expenditure Forecasts

Wellington Electricity's capital expenditure forecast is shown in Table 5.5 below. It includes the large projects described in Section 5.6 as well as incremental expenditure on other capital works. It can be seen that the line item on which Wellington Electricity proposes to invest the most capital expenditure is asset replacement and renewals. This reflects the increasing age of the asset base, and is discussed in detail in Section 6. In comparison, expenditure on growth projects is relatively modest, reflecting the low growth rates forecast. Expenditure on other line items generally reflects historic expenditure levels.

Table 5.5: Capital Expenditure Forecast ($000 real as at 31 March 2009)

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2019/19
Customer Connections	7,323	5,428	7,412	5,895	5,699	5,633	8,593	8,162	6,332	6,877
Growth	3,276	2,279	3,449	8,368	5,380	4,075	6,191	6,645	2,274	4,852
Replacement and Renewal	10,019	12,951	12,644	11,943	15,195	17,587	13,113	12,836	18,523	16,067
Reliability, Safety and Environment	492	452	606	469	468	463	621	604	492	533
Asset Relocations	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180
TOTAL	22,290	22,290	25,291	27,854	27,922	28,939	29,698	29,427	28,802	29,508

Ngauranga Zone Substation

Thorndon Distribution Substation

6. Lifecycle Asset Management

6.1. Maintenance and Renewal Strategy

This section provides an overview of Wellington Electricity's asset maintenance, refurbishment and replacement strategies over the planning period. The objective of these asset maintenance strategies is to ensure that the network is capable of meeting the service level targets set out in Section 4 and to mitigate the risks inherent in running an electricity distribution network. Risk management is discussed further in Section 8.

Generally, preventative maintenance consists of the following:

- Routine asset inspections, condition assessments and servicing of assets;
- The evaluation of the results in terms of meeting customer service levels, performance expectations and risks; and
- Repair, refurbishment or replacement of assets when required.

Electricity distribution assets do not have an infinite life and must eventually be replaced. Ideally assets should be replaced before they fail. However premature asset replacement is costly since it means that the service potential of the replaced assets is not fully utilised. Hence an asset replacement strategy requires the costs of premature replacement to be balanced against the risks of asset failure and the deterioration of supply reliability that will inevitably occur if an excessive number of assets are allowed to fail in service.

Wellington Electricity uses the following criteria to determine whether an in-service asset should be replaced:

- The asset condition has deteriorated to the extent that there is a high risk that it will fail if left in service and repair or refurbishment is not practical or economic;
- The asset technology is obsolete and spare parts are no longer available;
- The asset presents an unacceptable risk to the environment or to the safety of public or operating and maintenance personnel; or
- The maintenance cost of the asset over its remaining life is expected to be higher than the asset replacement cost.

The remainder of this section focuses on the different asset classes and provides an insight into the condition and maintenance of each class with an overview of the specific asset class, maintenance programs and renewal and refurbishment programmes.

6.2. Overhead Lines

6.2.1. Asset Description

The overhead lines in Wellington Electricity's network consist of 56% wooden and 44% concrete pole lines. Table 6.1 below provides a breakdown of different line types across the different voltages and Figure 6.1 provides an age profile of these lines.

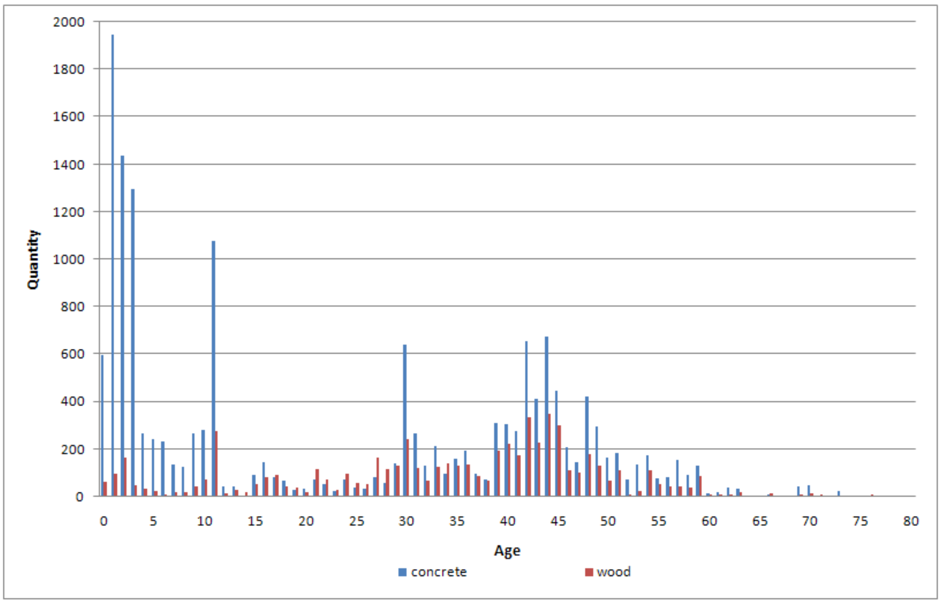
Table 6.1: Breakdown of Line Types

Line Type	Construction	Length (km)
Subtransmission	Wood	49
	Concrete	69
Distribution	Wood	325
	Concrete	273
LV/400V	Wood	646
	Concrete	458
Totals	**Wood**	**1,020**
	Concrete	**800**

Poles

The average age of concrete poles is around 23 years. Although the standard asset life for concrete poles is 60 years, there are a number of concrete poles that have been in service for longer. The average age of wooden poles is around 34 years of age and nearly 50% of all wooden poles are older than 40 years, the standard asset life of wooden poles. An age profile of the poles on the network is shown in Figure 6.1.

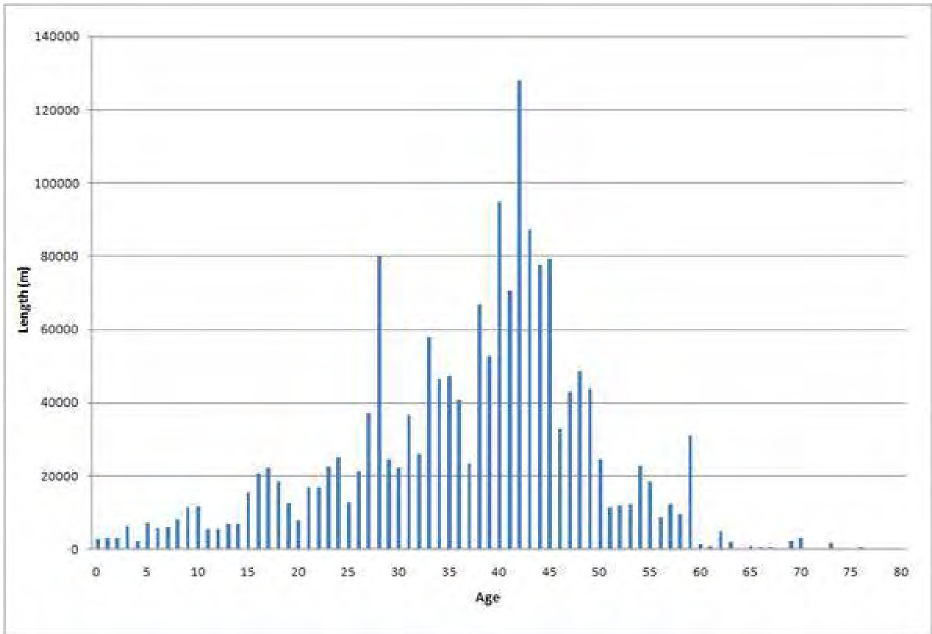
Figure 6.1: Age Profile of Poles



Overhead Conductors

Overhead conductors are predominantly copper (Cu), all aluminium conductor (AAC) and aluminium conductor steel reinforced (ACSR). However, new line reconstruction generally utilises all aluminium alloy conductor (AAAC). Where possible, low voltage aerial bundled conductor (LVABC), and covered conductor thick (CCT) for 11 kV lines are used in areas susceptible to tree damage. Crossarms are predominantly hardwood and are generally in a fair condition. An age profile of overhead line conductors is shown in Figure 6.2.

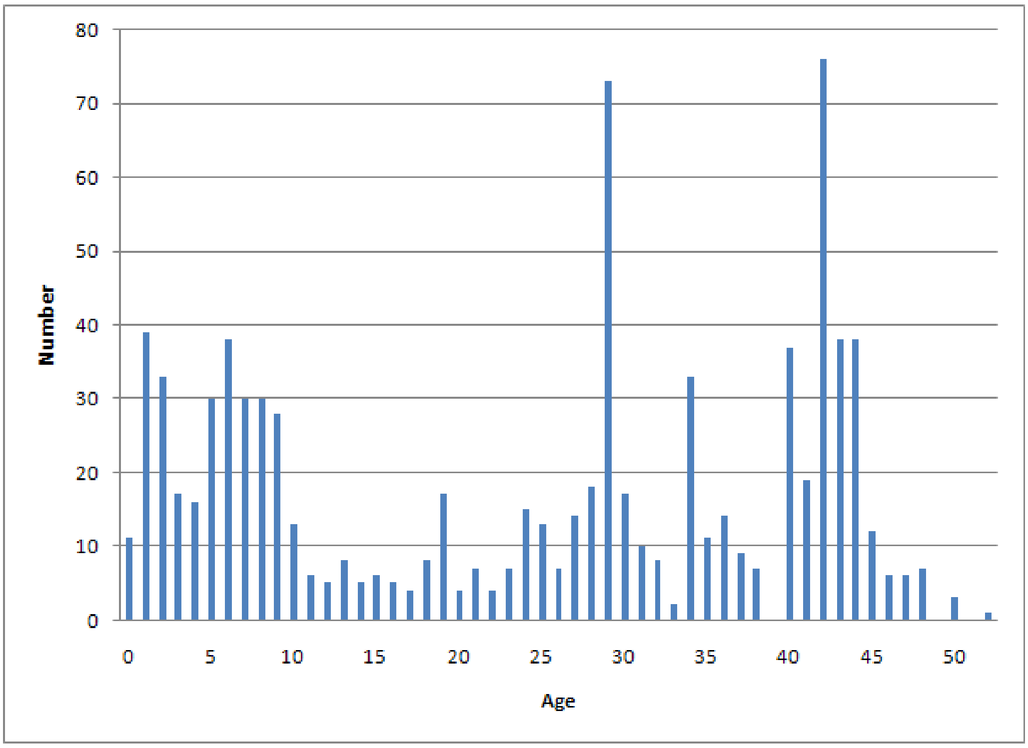
Figure 6.2: Age Profile of Overhead Line Conductors



Overhead Line Devices

There are 376 air break switches (ABS), 27 auto-reclosers, 172 knife links and a mix of expulsion type drop out fuses for breaking the overhead network into sections. Most of the ABSs are more than 20 years old and are not cost effective to refurbish as they are generally in fair to poor condition. An age profile of these overhead line devices is shown in Figure 6.3.

Figure 6.3: Age Profile of Overhead line Devices



Fault passage indicators, both remote and local, have been installed at most major tee offs on the overhead lines. More than 15% of fault indicators in the network are past their economic life and require replacement.

6.2.2. Overhead Line Maintenance

Planned maintenance includes:

- An annual visual line patrol of poles and hardware checking for safety issues and hardware about to fail, including a visual check of ground clearances;
- A five-yearly condition assessment of wood poles using ultrasonic methods and top load analysis;
- A five-yearly detailed visual inspection of all poles, towers and hardware. A top load analysis is carried out on all heavily loaded concrete poles as a serviceability check;
- Proactive vegetation management;
- Five-yearly measurements of earthing sites;
- A three yearly ABS visual inspection including a check of manual operation;

- A nine yearly inspection of SF_6 switches, including operation and gas pressure checks;
- Five yearly inspection and testing of reclosers and sectionalisers; and
- Five-yearly inspection and testing of fault passage indicators, including battery replacement.

A problem has been identified with some types of explosion drop out (EDO) fuses that are overheating, which as a result of the use of different metals is causing the pivot point on the fuse holder to seize and this is preventing the fuse holder from falling as designed. The situation is being monitored and, if warranted, a replacement programme will be put in place.

6.2.3. Asset Renewal and Refurbishment

Many different replacement strategies exist due to the diverse range of assets on the overhead network and also because of different levels of replacement requirements.

Poles

Poles are tested for their serviceability as set out in HB C (b)1:2006 and AS/NZS 4676:2000. Wood poles are also tested using an ultrasound method. Poles that do not meet serviceability criteria are programmed for replacement.

Conductors

Conductors are programmed for replacement based on condition assessments and analysis of fault history. The numbers of joints per span or visible signs of damage are used to determine the need for replacement.

Crossarms and Hardware

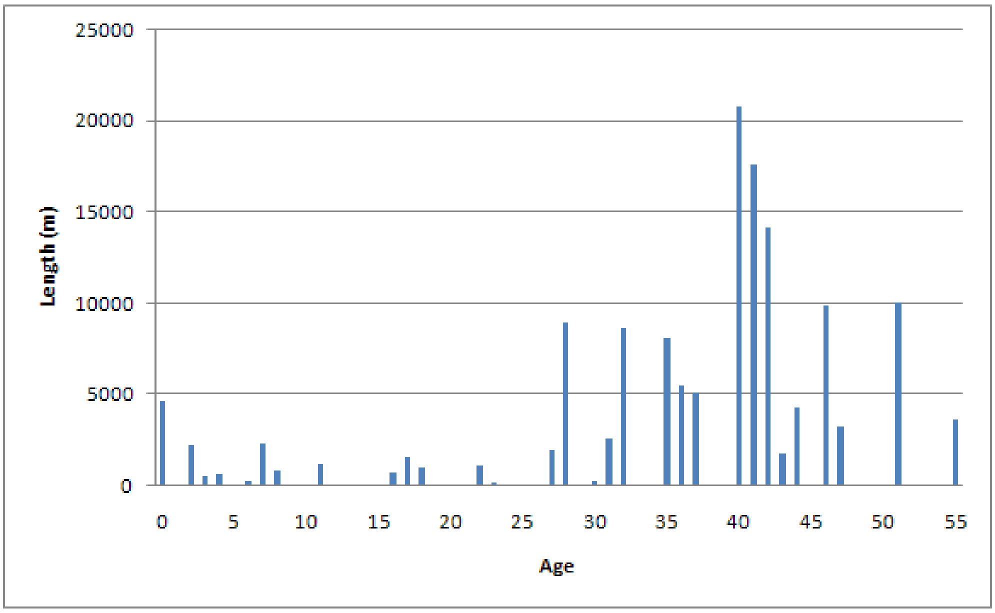
Crossarms are identified for replacement from the detailed line inspections. Pin type insulators are no longer used at 33 kV or 11 kV. All replacement insulators are of the solid core post type as they provide a higher level of reliability in polluted environments and lightning prone areas.

6.3. Subtransmission Cables

6.3.1. Asset Description

Around 5 km of subtransmission cable is of XLPE construction and requires little maintenance. The remainder is of PILC construction, with a significant portion of these cables being relatively old and gas or oil filled. The subtransmission circuits supplying Evans Bay zone substation are fluid filled PIAS cables with copper conductors rated for 110 kV but operating at 33 kV. An age profile of this asset class is shown in Figure 6.4.

Figure 6.4: Age Profile of Subtransmission Cables



A relatively large number of gas filled cables are experiencing leaks and are at risk of failure. Replacement of these cables has been provided for in the capital expenditure forecast.

6.3.2. Asset Maintenance

Due to the importance of these cables to the operation if the network, regular inspection and condition monitoring activities are undertaken. These include:

- Patrolling cable routes on a regular basis;
- Proactive work with external contracting parties to prevent third party damage;
- Annual cable termination inspections and thermographic testing;
- Six-monthly inspection of all gauges and transducers associated with pressurised cables;
- Two yearly serving tests to confirm the integrity of cable outer sheaths; and
- On-line and off-line partial discharge testing on cables with a fault history that indicates potential problems.

In conjunction with the above routine maintenance, all fluid filled and pressurised gas cables are continuously monitored via the centralised SCADA system. This monitoring provides information that identifies cables where pressure is reducing and allows the situation to be promptly investigated.

The historic fault information for each cable is used to assess and prioritise the need for cable replacement.

6.3.3. Asset Renewal and Refurbishment

The need for cable replacement is determined and prioritised by a combination of the consequence of a cable failure, condition and performance assessments, analysis of failure and defect rates, and a comparison of the estimated cost of maintaining the cable in service with the cost of replacement.

The projects listed below are included in the capital expenditure forecasts. However, prioritisation may change as additional condition information becomes available, performance expectations change or changes to the network design and configuration cause a change in overall assessment.

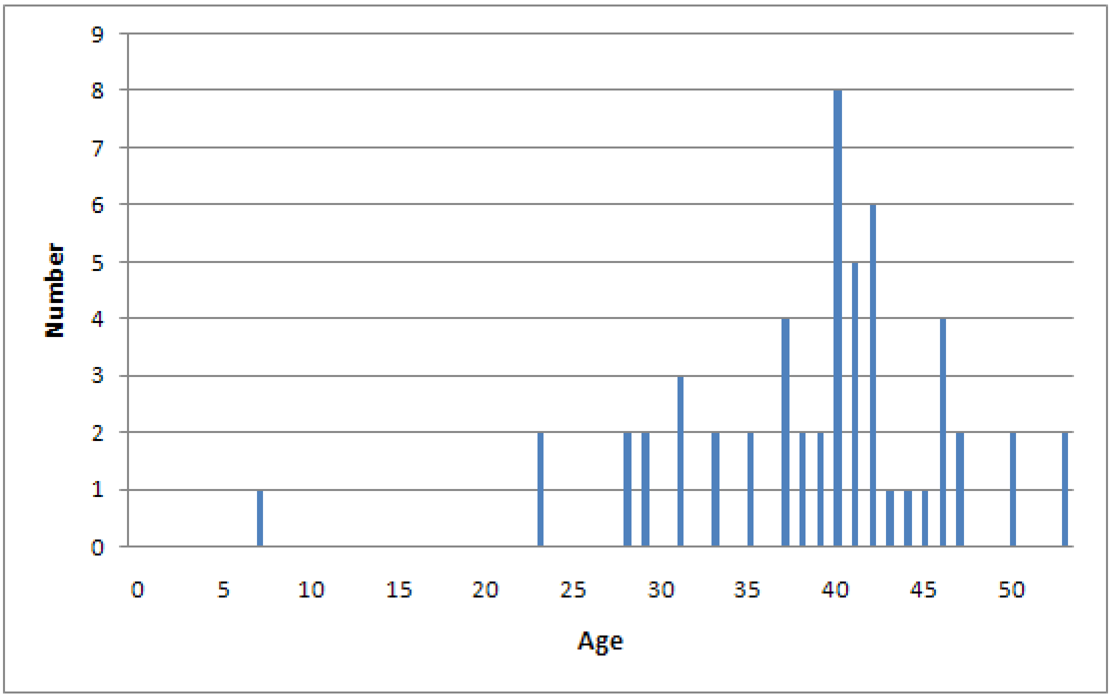
- Upgrading of selected cable joints 2009-10
- Installation of distributed temperature sensing (DTS) 2010-14
- Replacement of gas cables supplying Evans Bay zone substation 2010-14
- Replacement of gas cables supplying Palm Grove zone substation 2010-14
- Replacement of gas cables supplying Maidstone zone substation 2015-19
- Replacement of gas cables supplying Hataitai zone substation 2015-19
- Replacement of gas cables supplying Ira Street zone substation 2015-19
- Replacement of gas cables supplying Karori zone substation 2015-19
- Replacement of gas cables supplying Petone zone substation 2015-19

6.4. Zone Substation Transformers

6.4.1. Asset Description

All zone substation transformers are operated well within their specified ratings and are regularly tested and condition assessments undertaken. Overall the transformer fleet is in a generally sound condition even though a number of transformers are reaching their end of design life. However, based on their operating conditions and maintenance it is expected that most transformers will continue to operate beyond their design life. Nevertheless older transformers require more intensive monitoring to assess and evaluate their condition. The age profile of zone substation transformers is shown in Figure 6.5.

Figure 6.5: Age Profile of Zone Substation Transformers



The age profile indicates that the average age of the transformer fleet is reasonably old (around 39 years). Based on the assumption that zone transformers have an economic life of around 55 years then 95% of the zone transformers have exceeded midlife and around 45% of transformers have exceeded an age of 40 years.

6.4.2. Asset Maintenance

Typical asset maintenance for zone substation transformers includes the following inspections and monitoring:

- Annual dissolved gas analysis (DGA);
- Monthly visual checks for moisture, oil levels and leaks, and fan operation;
- Annual thermal imaging of terminations and connections;
- Annual tap changer activity signature analysis (TASA) condition assessment; and
- As required transformer condition assessment (TCA) to supplement dissolved gas analysis.

When a transformer is identified for relocation, refurbishment is generally performed if it is economic to do so, based on the condition and residual life of the transformer. The PDC method, which is a non-invasive test to determine the moisture content of the winding insulation, is used to aid decisions regarding major transformer refurbishments.

6.4.3. Asset Renewal and Refurbishment

Transformer replacement and life-extending refurbishments are prioritised through a combination of invasive and non-invasive tests and inspections to determine the condition of the transformer. Tests are carried out on the oil and winding insulation to provide an indication of probable remaining life of the transformer. Based on this a decision can be made in conjunction with functional and performance requirements of the transformer on whether to refurbish the transformer or to replace it outright.

The following has been allowed for in the asset maintenance and replacement forecasts for the planning period:

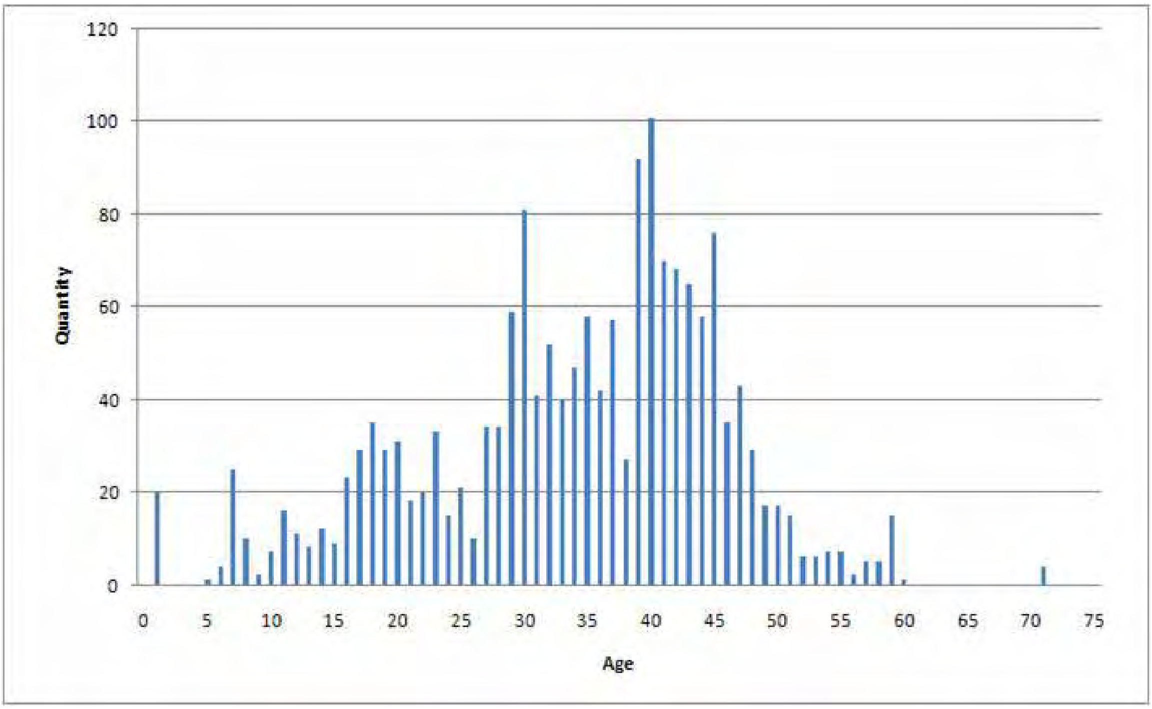
- Transformer replacements at two zone substations;
- Ongoing transformer refurbishment costs; and
- Ongoing preventative maintenance including testing and inspections.

6.5. Circuit Breakers

6.5.1. Asset Description

Circuit breakers are used in zone substations to control the power injected in to the 11 kV distribution network and also within the network to increase the reliability of supply in priority areas such as in and around the CBD. This discussion covers all circuit breakers, irrespective of their function. The majority are Reyrolle Pacific type LMT circuit breakers but other types are also in service. An age profile of the circuit breakers is shown in Figure 6.6. The average age of the circuit breaker fleet is 34 years.

Figure 6.6: Age Profile for Circuit Breakers



The age profile indicates that the average age of circuit breakers in the Wellington Network is around 34 years, with the age of individual breakers ranging from relatively new to more than 50 years. The mix of circuit breaker technologies reflects the age of the equipment. The oil type circuit breakers are the oldest in the network followed by SF6 and vacuum type circuit breakers. Most circuit breakers are oil insulated with relatively intensive maintenance regimes.

The 33 kV air blast breakers at Wainuiomata are approaching 45 years old having been in service since 1965, whilst the 33 kV oil circuit breakers at Ngauranga are around 15 years old having been installed in 1993.

Certain oil-type circuit breakers are approaching the end of their technical life. Inadequate fault level rating, equipment failures, lack of spare parts, and increased maintenance costs compared to newer SF_6 or vacuum equipment are areas of concern for this aging equipment.

6.5.2. Asset Maintenance

Circuit breakers are inspected in a cyclical/rotational manner and these activities are used to highlight any problem areas. There is a good deal of preventative maintenance required, which includes:

- A monthly or quarterly visual inspection for leaks and general condition depending on history and type (i.e. some circuit breaker types require more frequent inspection than others);
- An annual thermographic examination is undertaken on all switchboards;
- Two-yearly Kelman profile testing and non-invasive partial discharge location and monitoring;
- Major maintenance including inspection and testing of circuit breaker contacts on an eight year cycle;
- Condition assessments (either on a scheduled basis or as a result of routine inspection or equipment fault operation).

Based on the condition assessment carried out as part of the preventative maintenance routine, assets are identified for replacement.

Reyrolle Type ‘C’ circuit breakers have been identified as requiring programmed replacement due to age and operational issues.

6.5.3. Asset Renewal and Refurbishment

Condition, performance, ratings and operational history across the industry are considered when determining the timing for replacement of a circuit breaker. However other drivers that influence the decision for replacement include safety, and legal requirements such as fire protection regulations. Circuit breaker replacement projects are prioritised using a risk matrix, as described in Section 8.3.

The following projects have been included in the asset maintenance forecasts:

- Continuing replacement of Reyrolle Type C circuit breakers — ongoing
- Replacement as identified by condition and risk ratings — ongoing
- Security reinforcement of the Terrace 11 kV ring — 2009-10
- Reinforcement of Waitangirua 11 kV network — 2009-10

6.6. Protection Systems

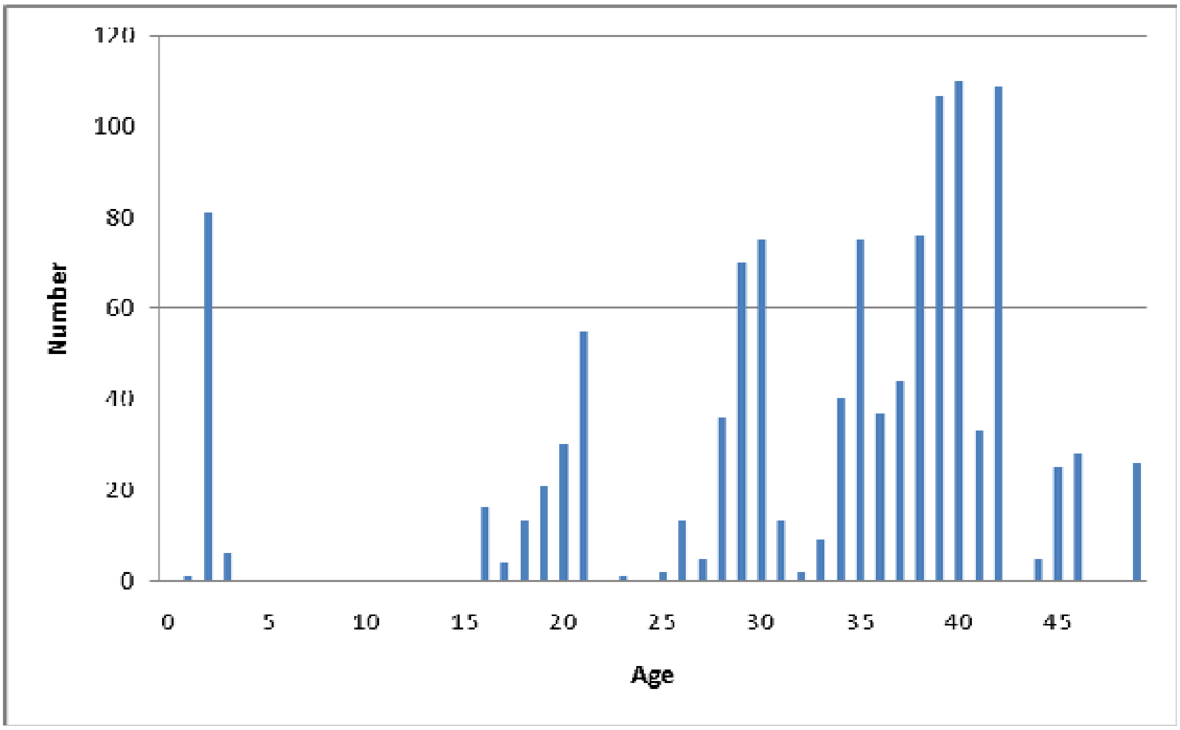
6.6.1. Asset Description

Due to the closed-ring architecture of the central Wellington distribution network there are a large number of protection relays, the vast majority (around 87%) of which are electromechanical type. Numerical type relays are the latest additions to the network but constitute only 9% of the population. Solid state or static type relays ranging in age from around 15 to 25 years represent around 4% of the total number of relays.

Generally all protection relays are in good condition with the exception of Nilstat ITP solid state relays. These relays have performance and functionality issues, which have triggered an ongoing replacement programme. There are around 10 of these relays still in service.

A protection relay age profile is shown in Figure 6.7.

Figure 6.7: Age Profile of Protection Relays



The average age of the protection relays on the Wellington Network is around 32 years and it is estimated that around 400 or 30% of the protection relays are 40 years or over in age[12].

6.6.2. Asset Maintenance

Regular testing of protection relays is undertaken to determine correct operating functionality. Protection relay testing will continue on a regular basis and budgetary provision for this has been made in the maintenance expenditure projections.

The key focus of protection relay maintenance is to identify any equipment that is not operating correctly or has failed. In order to maintain network reliability performance it is necessary to identify these issues before a failed or mal-operating protection relay is required to operate. This is especially relevant with the large number of older electromechanical relays on the network.

Electromechanical relays are tested on a four year basis, whilst the solid state Nilstat ITP relays are tested on an annual basis, to monitor their condition and prioritise replacement.

Numerical relays are equipped with self-diagnostic functions, but international experience has shown that not all protection relay faults can be detected by these functions. Wellington Electricity has adopted the CIGRE Study Committee B5 (Protection and Automation) recommendations for testing numerical protection relays. The testing schedule is shown in Table 6.2.

Table 6.2: Numerical Protection Relay Test Schedule

Test	Test Description	Interval
Function check of the protection (without test equipment)	The function check is to include: ▪ comparison of the quantities "current" and "voltage" with the displays; ▪ tripping test by initiating a trip command; ▪ reading-out and analysis of the event memory; and ▪ Check of the protection local and remote fault indications.	Two years
Protection test (with test equipment)	The protection test is to include: ▪ Check of one measuring point of the input quantities "current" and voltage" both for each phase, neutral and for each measuring range by comparison with the display; ▪ Check of the function of all binary inputs and outputs; Interface test consisting of: ▪ reading out and analysis of the indication and fault recording memory using PC interface; and ▪ reading-out of all setting parameters and comparison with the initially set parameters ▪ check of the protection local and remote fault indications.	Four years

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[12] Figure 6.7 does not show the complete age profile for protection relays (based on installation date) as some installation dates are not known.

Test	Test Description	Interval
Parts replacement	Back-up battery replacement	Ten years

6.6.3. Asset Renewal and Replacement

The majority of electromechanical relays are past their economic life and ideally should be replaced over the next 10 years. However the economic impact of replacement with modern numerical protection relay equivalents is being carefully considered. Therefore, the replacement programmes that are in place generally focus on relay condition and coordination with other replacement programmes or projects especially for assets such as switchgear and transformers. At the time of primary equipment replacement the opportunity is taken to upgrade associated protection schemes to meet the current standards.

The following programmes and projects have been allowed in the asset replacement and maintenance budgets.

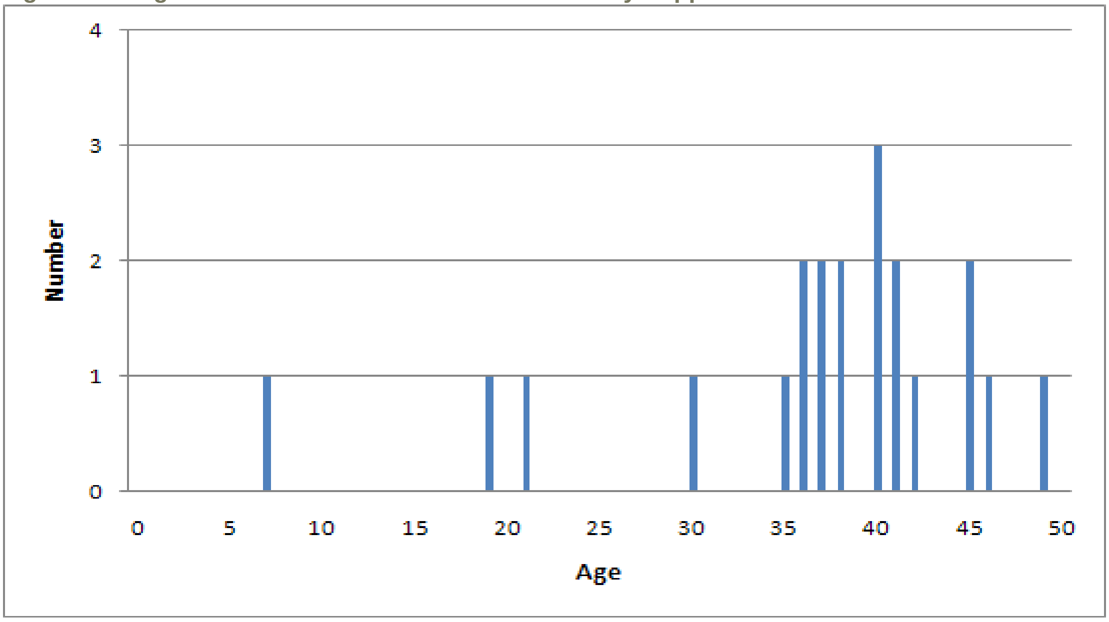
- Ongoing replacement of Nilstat relays;
- Ongoing zone substation and network protection and control replacement/upgrades for assets supplied from GXPs, particularly Takapu Rd, Haywards, Gracefield and Wilton; and
- Ongoing protection and control replacements/upgrades across the network as identified by asset condition monitoring.

6.7. Substation DC Systems

6.7.1. Asset Description

The DC auxiliary systems provide power supply to the substation protection, control, metering, monitoring, automation and communication systems, as well as power circuit breaker tripping and closing mechanisms. An age profile is shown in Figure 6.8.

Figure 6.8: Age Profile of Zone Substation DC Auxiliary Supplies



The standard DC auxiliary system comprises batteries, battery chargers, DC/DC converters and a battery monitoring system.

6.7.2. Asset Maintenance

Valve regulated lead acid (VRLA) batteries are now used. Maintenance is based on the recommendations of IEEE–1188 (IEEE Recommended Practice for Maintenance, Testing and Replacement of Valve Regulated Lead Acid Batteries for Stationary Applications).

6.7.3. Asset Renewal and Refurbishment

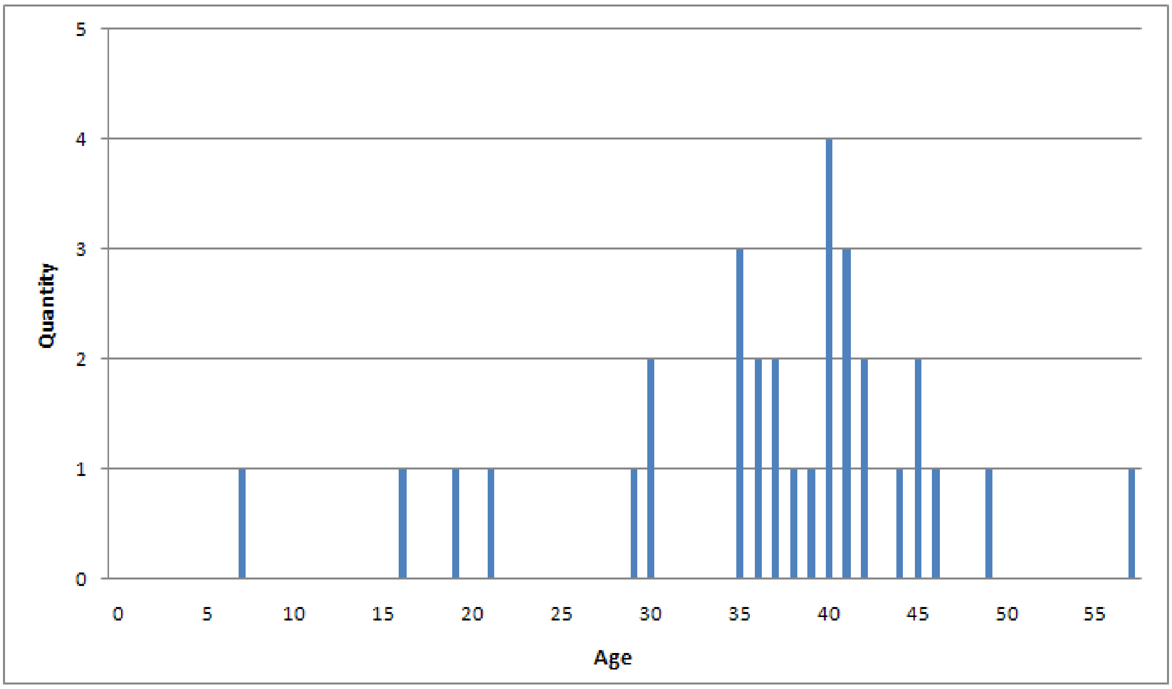
Batteries are replaced, using VRLA batteries, as they fail or based on condition assessment results.

6.8. Zone Substation Buildings

6.8.1. Asset Description

There are 31 substation buildings, 28 of which are located at zone substation sites and 3 at switching stations. The buildings generally stand alone and have switchgear, protection equipment, local AC and DC supplies installed inside. Some buildings also contain transformers and ripple injection plant. An age profile is shown in Figure 6.9.

Figure 6.9: Age Profile of Zone Substation Buildings



The average age of the buildings is 37 years and they are generally in a good condition.

6.8.2. Asset Maintenance

Routine monthly and quarterly zone substation inspections include the building and other assets such as lighting, fire systems, security systems, fans, heaters and safety equipment. The grounds and ripple injection spaces are also maintained to ensure access security, condition and safety.

Where appropriate annual building warrant of fitness inspections are carried out and any defects rectified.

6.8.3. Asset Renewal and Refurbishment

The zone substation building refurbishment program includes tasks such as roof replacement, exterior and interior painting, security and fencing improvements to maintain the assets in good condition on an as-needed basis.

6.9. SCADA

6.9.1. Asset Description

Wellington Electricity's SCADA master station is located at the Transpower-owned Haywards substation. It is a Foxboro (formerly Leeds & Northrup (L&N)) LN2068 system and was initially installed in 1986 and is being replaced with a GE ENMAC system, which is due for commissioning in June 2009.

Data is communicated to the master station by remote terminal units (RTUs) that are located at the different control and monitoring sites. The age and technology of the RTUs vary and many are now obsolete.

6.9.2. Asset Maintenance

Existing RTUs do not have full back up and maintenance is based on failure. First line maintenance on the system is carried out as required by the maintenance contractor, within the scope of its substation maintenance contracts.

6.9.3. Asset Renewal and Refurbishment

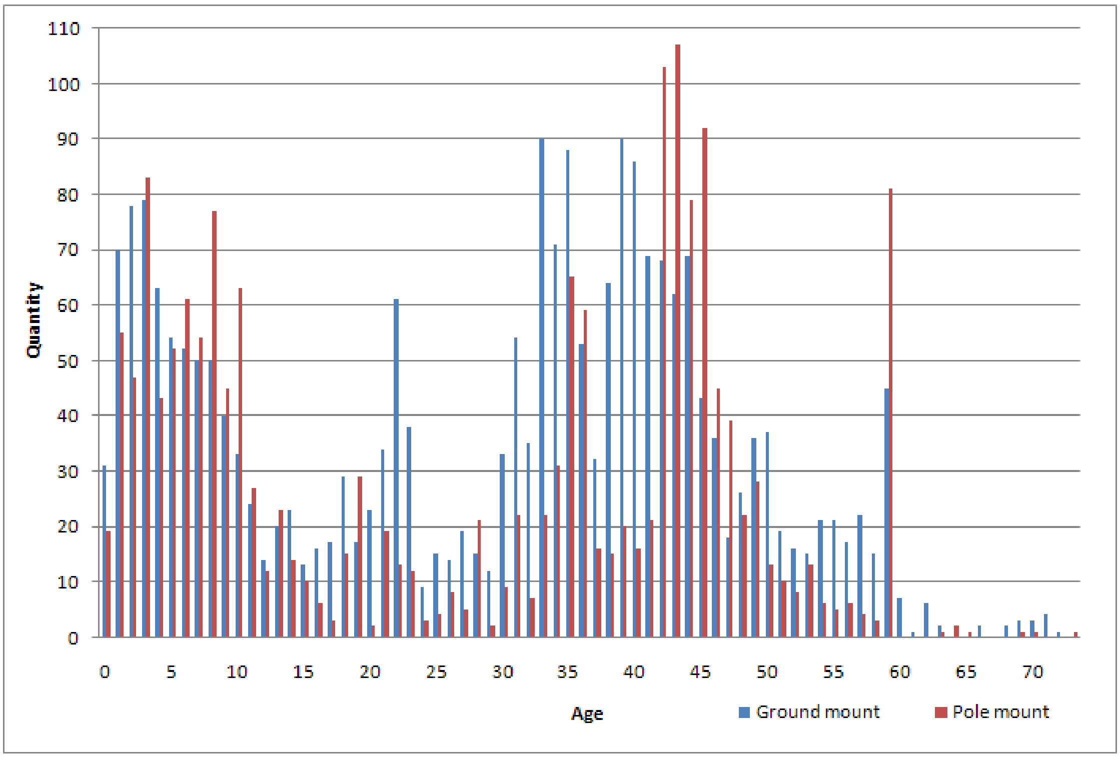
The asset replacement budget also provides for the ongoing replacement of obsolete RTUs throughout the network.

6.10. Distribution Transformers

6.10.1. Asset Description

Approximately 57% of the distribution transformer population is ground mounted and the remaining 43% is pole mounted. The pole mounted units are installed on single and double pole structures and are generally 3 phase units rated between 10 and 200 kVA. The ground mounted units are also generally 3 phase units rated between 100 and 1,500 kVA. An age profile is shown in Figure 6.10.

Figure 6.10: Age Profile of Distribution Transformers



6.10.2. Asset Maintenance

The transformers undergo the followings inspection at the intervals indicated:

- Yearly enclosure and equipment inspection; and
- Five-yearly earthing system inspection and testing.

The transformers also undergo minor onsite repairs. This includes oil top-up, replacement of bolts, minor rust treatment and paint repairs.

6.10.3. Asset Renewal and Refurbishment

If a distribution transformer condition is found to be unsatisfactory during its regular inspection it is replaced. All transformer in-service failures are investigated to determine the cause. Based on this assessment a decision is made to repair, refurbish, or scrap the unit.

The refurbishment and replacement of transformers is an ongoing program, which is provided for in the asset maintenance and replacement budget.

6.11. Distribution Cables

6.11.1. Asset Description

Wellington Electricity's network has a relatively high percentage of underground cables, which contribute to its relatively high level of reliability. The 11 kV underground distribution system has normally open interconnections between feeders and feeders are segmented into small switching zones using locally operated ring main switches. In the event of a cable fault the faulted cable section can be isolated and supply to downstream customers can be switched to neighbouring feeders.

Wellington CBD is operated in a closed ring configuration with radial feeders interconnecting neighbouring rings or zone substations. This part of the network uses automatically operating circuit breakers rather than manually operated ring main switches between switching zones[13].

Approximately 95% of the underground distribution cables are PILC and PIAS and the remaining 5% are newer XLPE insulated cables. PILC cables use a relatively old technology but are in good condition and have proven to be very reliable.

Approximately 28% of low voltage cables are PILC and 72% are newer XLPE insulated cables. In general the low voltage cables are in good condition.

An age profile of distribution cables of both voltages is shown in Figure 6.11.

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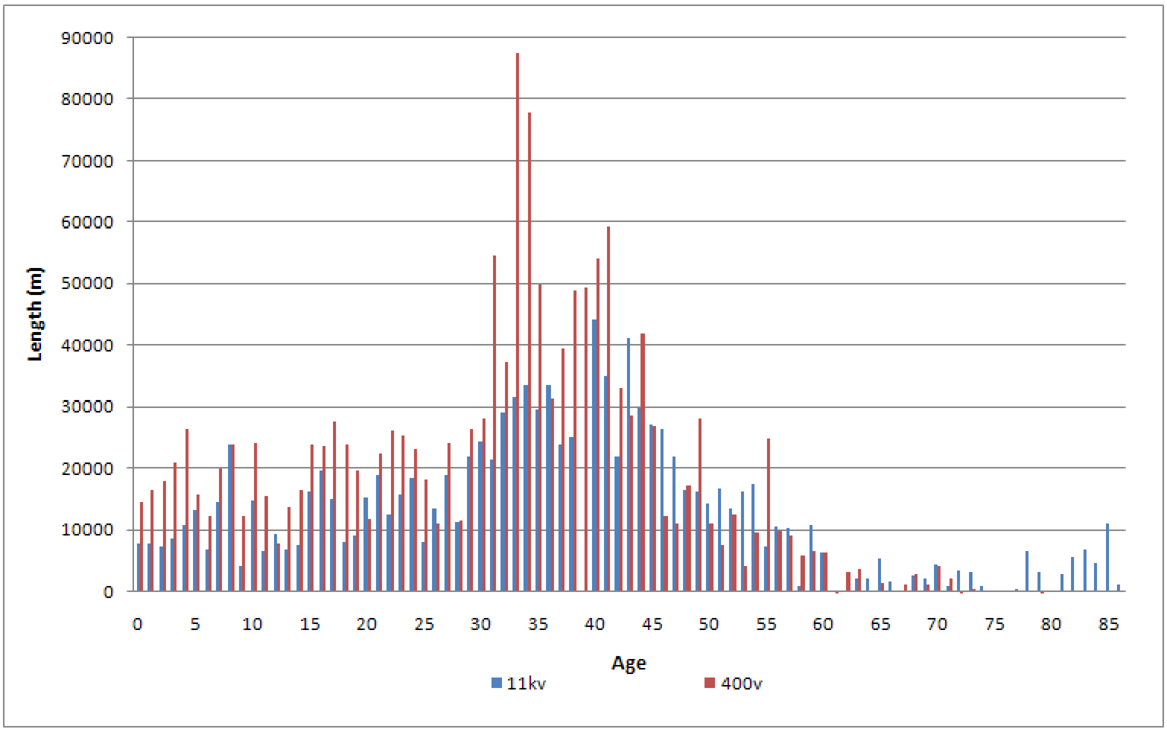
[13] Maintenance of circuit breakers is discussed in Section 6.5.

Figure 6.11: Age Profile of Distribution Cables



Pillars and Pits

Pillars and pits provide the point for the connection of service cables to the underground low voltage reticulation. They contain the fuses necessary to isolate a service cable from the network. Pits are manufactured from polyethylene as are most of the newer pillars. Earlier style pillars were constructed of concrete pipe, steel, or aluminium.

6.11.2. Asset Maintenance

Distribution Cables

Maintenance of the underground distribution cable network is limited to visual inspections of cable terminations. Cables are operated to failure and then either repaired or sections replaced as discussed in Section 6.11.3. A more intensive maintenance regime is not considered cost effective, given that the network is designed so that supply can be maintained while cable repairs are undertaken.

Pillars and Pits

Pillars and pits are visually inspected at three yearly intervals. The pillar inspection includes a loop impedance test to check the condition of the connections from the fuses to the source. Where practical, damaged pillars are repaired but otherwise a new pillar or a pit is installed.

6.11.3. Asset Renewal and Refurbishment

Distribution Cables

Cable replacements are prioritised based on a combination of fault history and frequency together with tests undertaken after earlier cable fault repairs. Cable replacements will be targeted at cables exhibiting high fault rates. The small number of natural polyurethane insulated cables is most likely to show high failure rates and hence this type of cable is more likely to be replaced following a cable fault.

Cable Terminations

Cable termination replacement is driven by visual inspection and analysis of fault rates. The exception to this is 11 kV cast metal terminations, where analysis of fault rates together with a risk assessment has resulted in a decision to replace them with heat shrink terminations.

Pillars and Pits

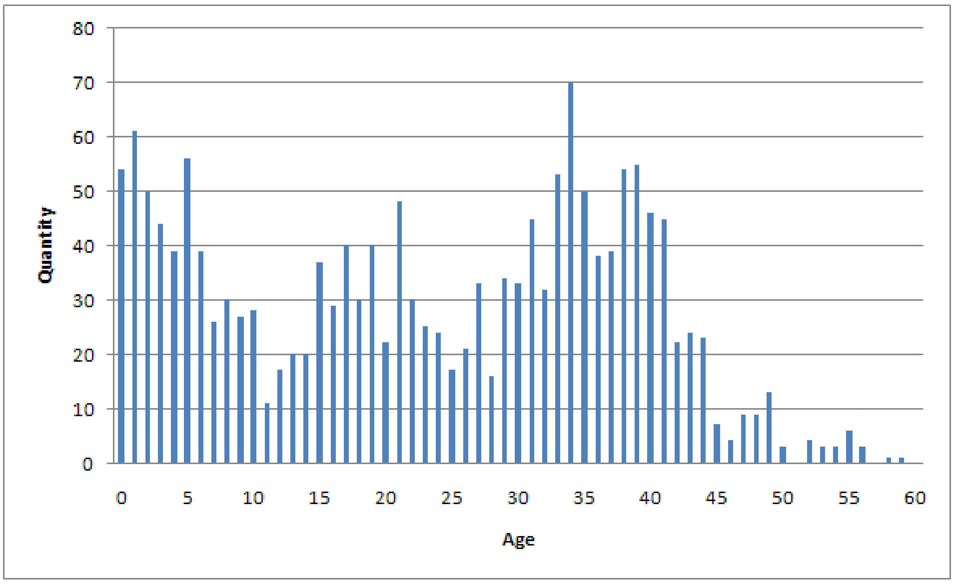
Pillars are generally replaced following faults or reports of damage. Pillars with a high likelihood of future repeat damage by vehicles are replaced with pits. Older pillars are being targeted for planned replacement as repair becomes impractical or uneconomic.

6.12. Ground Mounted Distribution Switchgear

6.12.1. Asset Description

This section covers ring main units and similar switching equipment, which is often mounted outdoors. It does not cover the maintenance of indoor circuit breakers, which is discussed in Section 6.5. There are around 1,700 ground mounted switchgear units in the Wellington Electricity network. Most of the older switchgear is oil insulated; however the newer ones use SF_6 as the main insulating medium. An age profile is shown in Figure 6.12.

Figure 6.12: Age Profile of Ground Mounted Distribution Switchgear



The average age of the ground mounted switchgear is 23 years.

6.12.2. Asset Maintenance

All distribution switchgear undergoes the following inspection and service:

- A visual inspection every three years; and
- A full service, including electrical testing and mechanical servicing, every eight years.

Magnefix switchgear is also cleaned during its three-yearly visual inspection

Any minor defects or maintenance issues are addressed on-site during inspections. This may include such maintenance as topping up oil reservoirs, replacing bolts, rust treatment and paint repairs. Major issues that cannot be addressed on site usually result in replacement of the device. Likewise, replacement of the device is carried out if it is unsafe or if it is uneconomic or impractical to undertake a repair on site.

6.12.3. Asset Renewal and Refurbishment

Wellington Electricity has an ongoing refurbishment and replacement programme for all ground mounted distribution switchgear. Provision is included in the asset replacement forecast to fund this programme.

The drivers for replacement of ground mounted switchgear include:

- The assessed condition of the equipment;
- The availability of spare parts; and
- The switchgear insulating medium.

The continued use of oil insulated switchgear has been reviewed and the decision made to make use of other types such as vacuum or gas (SF_6) insulated types in future. When any switchgear device fails, the reason for the failure is studied and followed up with a cost benefit analysis to determine the best option from repairing, refurbishing, replacing or decommissioning the device.

6.13. Forecast Maintenance Expenditure

The forecast expenditure on network maintenance is shown in Table 6.3. For clarity, the forecast does not include the cost of operating the network from the upgraded control centre at Haywards and does not include other non-maintenance related operational expenditure. Asset replacement and refurbishment costs are included in the capital works forecast in Table 5.5.

Table 6.3: Maintenance Expenditure Forecast ($000 real as at 31 March 2009)

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Routine and preventive maintenance	5,936	5,499	5,485	5,535	5,599	5,603	5,656	5,709	5,762	5,816
Refurbishment and renewal maintenance	614	614	614	614	614	614	614	614	614	614
Fault and emergency maintenance	4,575	4,584	4,630	4,673	4,726	4,771	4,815	4,860	4,906	4,951
Total Maintenance expenditure on asset management	11,125	10,697	10,729	10,822	10,939	10,988	11,085	11,183	11,282	11,382

7. Asset Management Systems and Processes

7.1. Asset Management Systems

Wellington Electricity is currently in the process of migrating the asset management data held by Vector to Wellington Electricity owned systems. Once this migration is complete, Wellington Electricity believes that the asset management systems will provide it with one of the best asset management systems currently used within the Electricity Distribution Industry in New Zealand.

This migration is ongoing and should be completed for all systems by June 2009. The asset management systems and processes described in this and following subsections represent the situation that Wellington Electricity is working towards and are not necessarily the systems and processes currently in place and used by Vector.

The asset management data being provided by Vector is believed to be of good quality with no areas where there are significant gaps or inaccuracies.

SCADA

Wellington Electricity will replace the existing Foxboro system in its Haywards master station with a GE ENMAC system incorporating a fully integrated distribution management system (DMS). In addition to providing an operator interface to allow remote control of primary distribution plant, the ENMAC system will automatically generate switching sheets, which will be used for de-energising and isolating network equipment from the live electricity supply. Advance features in the ENMAC package include a trouble call management system, which will be used to optimise fault response procedures.

Geographic Information System

The geographic information system (GIS) is a representation of the system fixed assets overlaid on a map of the supply area. It will be used throughout the business for planning, designing and operating the distribution system and will be the primary repository of network asset data. In particular it will be used by system operators to identify the location and probable cause of network faults, significantly improving the efficiency of network fault response.

Other specialised asset information systems such as SAP will interface to the GIS and use a unique asset identifier common to all asset information systems. An interface between the GIS and SCADA system will allow the GIS system to show the status of all switching devices monitored by the SCADA system in real time.

Wellington Electricity will use a GE Smallworld GIS, which is the same as currently being used by Vector. Hence the migration of data between the two systems is expected to be seamless.

SAP

SAP will be the central repository for the management of the asset maintenance function within Wellington Electricity. It will contain information on all assets including data on asset type and rating as well as the maintenance history and the required maintenance regime. It will be used for the management of asset inspections and maintenance and for the generation of service and work orders. SAP will also be used as a maintenance planning tool and to generate a range of routine and special maintenance reports.

SAP will be linked to the GIS system to give GIS users direct access to asset data and maintenance history. It will also allow authorised users of the GIS system to directly generate service orders and maintenance works orders. It will also be the main interface between Wellington Electricity and its maintenance contractors as discussed in Section 7.3.

7.2. Planning Processes

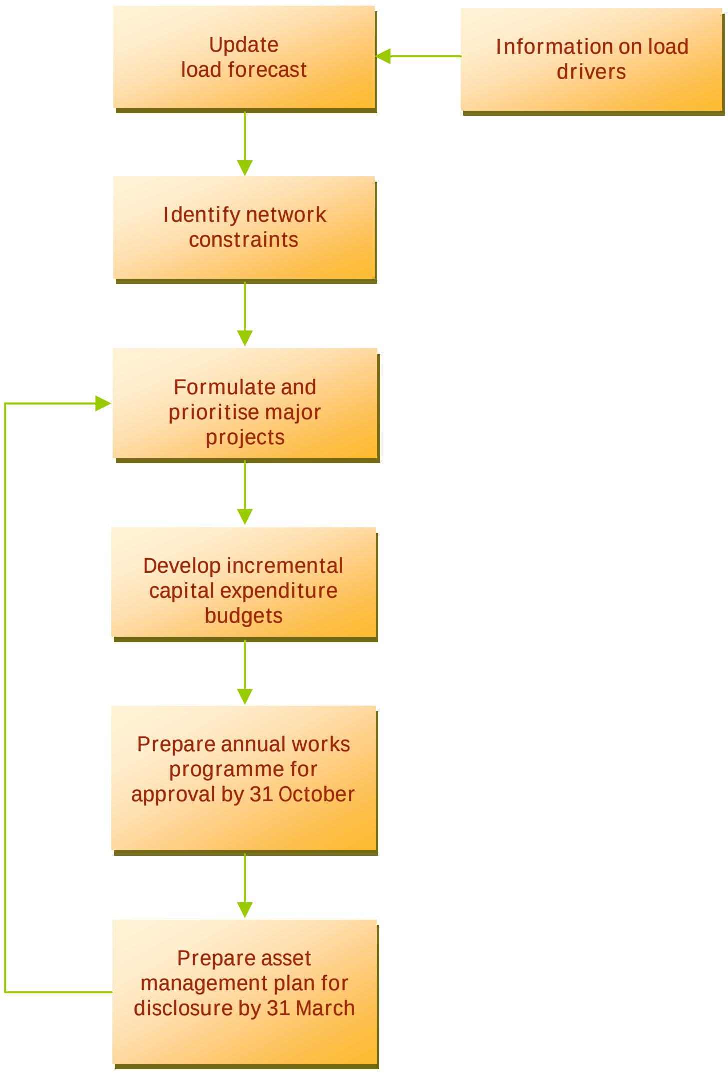
Wellington Electricity's network development planning process is focused on the preparation of a work programme for the approval of the Board prior to the start of the Company's annual work planning year on 1 January. Information on potential and confirmed new connections, new subdivisions and developments and the forecast economic environment is gathered from a range of sources on an ongoing basis and fed though to the system planners. This information is used to update the load forecast, which is prepared annually prior to the development of the capital budget.

Existing loads on all parts of the network are monitored and compared with equipment ratings. This information, together with the updated load forecast, is used to identify network constraints that are likely to occur in the next five years. The current medium term development plan, as outlined in the asset management plan disclosed the previous March, is modified to take account of the updated load forecast and other relevant information. Major projects are prioritised using risk and cost benefit analyses and the highest priority projects are included in the annual work plan. Incremental capital expenditure is not planned in detail, but budgets are developed by extrapolating previous expenditure and modified as necessary in accordance with forecast changes in expenditure drivers and the strategic direction of the company.

The outcome of this detailed planning process is an annual works programme and budget for the following calendar year for the approval of the Board of Directors. Following approval work starts on updating the asset management plan for public publicly disclosure the following March. This reflects the current approved works programme, modified as necessary to reflect the Commerce Commission's required planning period as well as Wellington Electricity's current view on the development over the following nine years. The value of the asset management plan to Wellington Electricity is that, while it is written primarily for information disclosure purposes, it does require the business to plan for the period beyond the current work programme in a structured and disciplined manner. Because of this the disclosed asset management plan is expected to be the key input to the development of the following year's detailed work programme for Board approval.

This annual planning process is shown in Figure 7.1.

Figure 7.1: Annual Planning Process



7.3. Inspection and Maintenance Processes

As discussed in Section 6, Wellington Electricity has developed programmes for regularly inspecting all its assets. The period between inspections and the requirements for each inspection depend on the asset type. Some assets only require a visual inspection while other assets will require either detailed testing or routine maintenance. This information will be loaded into the SAP asset management database, which will prepare schedules of assets due for inspection. This information will be used by the maintenance contractor to develop detailed maintenance schedules and programmes.

The results of testing during these routine maintenance inspections will be entered into SAP. Where defects are found and assets are considered to require replacement or repair prior to the next routine inspection, this information will also be entered into SAP which will automatically generate the necessary contractor service order. Other information on asset condition will be recorded in SAP as appropriate.

Once a defect has been rectified this information will be recorded in SAP and the service order will be cleared.

SAP will be the primary database for managing the maintenance effort. On a day-to-day basis it will be used by the maintenance contractor to manage its routine maintenance activities. It will also be used by Wellington Electricity as a tool for routinely monitoring the contractor's performance. At a higher level the information contained in SAP will assist Wellington Electricity continually improve its maintenance planning and develop strategies that increase the efficiency of its maintenance expenditure. For example it will be used to report on the number of defects found during routine asset inspections and this information could be used to develop targeted maintenance programmes or to determine whether the periods between routine inspections should be increased or reduced. As SAP will have detailed information on the fault and maintenance history of individual assets it will be used to identify the worst performing individual assets and target them for proactive replacement. Wellington Electricity believes that this will ensure that its asset replacement budget is used effectively.

7.4. Performance Measurement

All relevant details of high voltage faults will be entered into the ENMAC trouble call system database, which will calculate the impact of each fault on SAIDI and SAIFI. Where supply is restored progressively through switching over a period of time, the switching sequence will be recorded and used as the basis for accurately recording the actual SAIDI impact on customers. This is substantially more accurate than simply assuming that supply is restored to all affected customers at the time the fault is cleared.

Information on the reliability of the network will be available on an ongoing basis throughout the measurement period and will be regularly reported both within the business and to the Board at its monthly meetings.

The trouble call system database will also be used to measure and monitor the faults per 100 circuit-km performance indicator.

8. Risk Management

8.1. Introduction

Risk management is an integral part of the asset management process. The consequences and likelihood of failure or non-performance, controls to manage this, and required actions to make risks acceptable are all understood and evaluated as part of the asset management function.

Risks associated with network assets are evaluated, prioritised and dealt with as part of the network development and asset maintenance, refurbishment and replacement programmes. They are also taken into account in developing standard work practices. The acceptable level of risk will differ depending upon the level of risk customers and the community are willing to accept and the circumstances and environment in which the risk will occur. This analysis ranges from high frequency but low impact events, such as tree interference, through to low probability events with high impact such as the total loss of a zone substation for an extended period.

Risks associated with system assets are managed through a combination of:

- Reducing the probability of asset failure, through the capital and maintenance work programme and enhanced working practices; and
- Reducing the impact of failure, through contingency and emergency plan development and insurance, and through the development of an efficient fault response capability.

High probability, low impact risks are managed through a combination of Wellington Electricity's network planning and design, asset maintenance and fault response strategies. Sections 5 and 6 of this asset management plan describe the network planning and asset maintenance strategies in some detail. In addition, Wellington Electricity's design standards, which are not described in detail in this plan, are consistent with industry best practice and take due account of the weather and environment conditions in the Wellington area, including the high earthquake risk. Further, Wellington Electricity has industry standard procedures in place to restore power in a timely manner should an asset failure cause a supply interruption.

While it is impractical and uneconomic to design an electricity network that is immune to all risks, low probability high impact events can occur that are either outside the network design envelope or require a response that is beyond the normal capacity of Wellington Electricity, or its contractors. For such events emergency plans have been put in place and are detailed in Section 8.4.

8.2. Risk Accountability and Authority

Board of Directors

Wellington Electricity's Board of Directors oversees risk management as a key part of its corporate governance responsibilities. Specific risk issues are raised with the Board on an ongoing basis through the normal management reporting functions. These include asset management and security of supply issues and capital expenditure approval justifications.

Chief Executive Officer

Wellington Electricity's CEO oversees and monitors the implementation of appropriate and consistent risk management by:

- Developing and maintaining for the Board's review and approval, a risk management policy consistent with the company's objectives.
- Overseeing and monitoring the implementation of risk management processes to ensure compliance with the risk management policy.

In developing and implementing its risk management strategy the CEO meets with senior IISC management regularly to oversee the operation of risk management and assurance within the business. Strategic and operational risk categories are reviewed. High level risks are reported in a strategy register while more detailed operational risks are captured in a second register.

In developing the risk management strategy and process, the senior management team is supported by other CKI group companies. The aim is to migrate the risk management strategy of these utilities into Wellington Electricity's operation so that there will be a common risk management strategy and process across all businesses.

8.3. Risk Management Process

The criticality of any risk is determined on the basis of "likelihood" and "consequences" of the event associated with the risk occurring. The combination of these two is used to prioritise the level of controls to manage the risk

The risk management policy is to ensure that:

- All risks to the business are identified, understood and works prioritised to mitigate the effects are in place; and
- Practices that could cause injury, environment or reputation damage, or financial loss are understood, documented and managed.

Risks are evaluated against the risk matrix shown in Figure 8.1.

Figure 8.1: Risk Prioritisation Matrix

Risk Assessment

	Minor	Moderate	Serious	Major	Catastrophic
Frequent	H	H	VH	E	E
Likely	M	H	VH	VH	E
Possible	L	M	H	VH	VH
Unlikely	L	M	M	H	VH
Rare	L	L	L	M	H

Risk Assessment Using Consequence And Likelihood

L = Low	Red = Board Attention
M = Moderate	Orange = Executive Attention
H = High	Green = Management Attention
VH = Very High	
E = Extreme	

Risks which have *catastrophic* or *major* risk consequences include risks which could lead to loss of life, significant sustained loss of reputation, or financial loss of a magnitude sufficient to impact negatively on the company.

The priority accorded each identified risk, as determined through the prioritisation process, is recorded on the relevant risk register. It determines the level of management attention and resource allocation given to managing that risk. Risk priorities are reviewed regularly and management responses adjusted as necessary.

8.4. Emergency Plans[14]

Wellington Electricity is currently using plans developed by Vector to cover emergency situations. Examples of the plans are:

- Crisis Management Plan
- Major Incident Plan
- Storm Response Plan
- Priority Notification Procedures

[14] Vector's emergency plans are currently being used in accordance with the Transition Services Agreement

- Total Loss of a Zone Substation Plan
- Loss of Transpower Grid Exit Point Plan (Transpower Plan)
- Call Centre Continuance Plan
- Control Room Disaster Recovery Plan.

In addition contingency plans are prepared as necessary detailing special arrangements for major customers.

Vector's plans will progressively be replaced by Wellington Electricity's own emergency response plans as the Vector plans are reviewed and updated to be consistent with Wellington Electricity's new operating environment and other company specific requirements.

8.5. Health and Safety[15]

Wellington Electricity is currently using Vector's health and safety policies and procedures. However these are being reviewed for consistency with Wellington Electricity's own health and safety objectives and its corporate culture.

Like Vector, Wellington Electricity considers that safety is a value, not merely a priority. Its policy is to:

- Provide a safe and healthy work place for all its people, contractors and visitors;
- Ensure health and safety considerations are part of all business decisions;
- Monitor and continuously improve its health and safety performance;
- Communicate with its people, contractors, consumers, and stakeholders on health and safety matters;
- Operate in a manner that minimises health and safety hazards; and
- Encourage safe and healthy lifestyles, both at work and at home.

It aims to achieve this by:

- Complying with all relevant legislation, standards and codes of practice for the management of health and safety;
- Identifying, assessing and controlling workplace hazards;
- Accurately reporting, recording and learning from all incidents and near misses;
- Establishing health and safety goals at all levels within the business, and regularly monitoring and reviewing the effectiveness of its health and safety management system;
- Consulting, supporting and encouraging participation from its people on issues that have the potential to affect their health and safety;
- Promoting its leaders', employees' and contractors' understanding of the health and safety responsibilities relevant to their roles;

[15] Vector's health and safety plans are currently being used in accordance with the Transition Services Agreement

- Providing information and advice on the safe and responsible use of its products and services;
- Suspending activities if safety would be compromised; and
- Taking all practicable steps to ensure its contractors work in line with this policy.

All employees and contractors are responsible for ensuring their own and other's safety by adhering to safe work practices, making appropriate use of plant and equipment (including protective clothing and equipment) and promptly reporting incidents, near misses and hazards.

Wellington Electricity's key health and safety principles in regard to the conduct of its employees and contractors are:

- Everyone is responsible for safety;
- We look out for each other;
- Safety will be planned into our work;
- All injuries are preventable;
- Management is accountable for preventing injuries; and
- Employees must be trained to work safely.

A safe work practices manual defines the essentials necessary to maintain an injury free environment. These practices reflect the basic approach necessary for Wellington Electricity and its contractors to identify and eliminate accident causes.

All contractors working for the company are required, as a minimum, to comply with these safe work practices whilst carrying out any work on the network. Contractors are also required to report all employee accidents/incidents and near misses to Wellington Electricity together with the results of their investigations and intended corrective actions.

Wellington Electricity monitors electricity related public safety and staff/contractor safety incidents. On a regular basis these incidents are reviewed to ensure lessons are captured and where appropriate incorporated into its safety programmes.

With respect to community safety, Wellington Electricity offers cable location and residential isolation services. Public safety awareness and communications programmes on electricity have been undertaken.

8.6. Environmental Practices[16]

Wellington Electricity puts significant emphasis on environmental management and much work has been done in raising the awareness of the field staff on environmental issues.

[16] Vector's environmental plans are currently being used in accordance with the Transition Services Agreement.

8.6.1. Asbestos Management

All asbestos-covered cables and DC circuit breaker arc chutes are located within non-publicly accessible substations and are only accessed by Wellington Electricity approved contractors with the appropriate competencies. The asbestos-covered cables are primarily short lengths used to connect switchgear and transformers. Surveys have been conducted to identify all asbestos cables and all asbestos cables have been tagged on the actual cable itself.

Wellington Electricity has instigated an annual program within the capital expenditure budget to progressively replace the DC mercury arc rectifiers and associated equipment based on the asset condition and age. This will include the asbestos-covered circuit breaker arc chutes.

When asbestos is removed, specialist asbestos removal contractors are used to remove and dispose of the equipment and to ensure the remaining site is free of any asbestos dust or particulates.

8.6.2. Site Contamination Management

The Petone zone substation site in Bouverie St site was previously a gas works and has been identified as having ground contamination. An environmental assessment study has been carried out, which concluded that the risk to general site users from contamination is low and the risk to local groundwater or surface water is also low. Additionally an environmental management plan has been developed to manage the site contamination going forward.

Petone Zone Substation

9. Performance Evaluation

The Wellington distribution network was purchased from Vector in July 2008. Since that time Vector has continued to provide services in accordance with the Transition Services Agreement. However it plans to operate the network as a stand-alone business based in Wellington. This transition is well underway and on schedule for completion in June 2009. The Wellington network performance will be reported separately and will not be integrated with the performance of other networks. This will provide a higher level of transparency to Wellington Electricity's external stakeholders.

In operating as a stand-alone business, Wellington Electricity will continue to outsource its operations and maintenance and many of Vector's Wellington based staff have transferred to the new owners. Hence from the perspective of external stakeholders, the transfer of control from Vector to Wellington Electricity will be relatively seamless.

From an asset management perspective there will be several changes. A transition plan has been prepared and Vector and Wellington Electricity are currently transferring asset management data from the Vector asset management systems to Wellington Electricity asset management systems. This transfer, which is described in Section 7, is progressing well and, once the transfer is completed, Wellington Electricity will no longer rely on Vector for asset management support.

The Wellington Network is very reliable network and Wellington Electricity plans to maintain the current level of reliability. In the year to 31 March 2008, the latest measurement year for which full data is available, the network achieved a SAIDI of 31.6 minutes and a SAIFI of 0.51. This was an improvement in the reliability experienced from the previous year. The improvement was real in that no major event days were experienced in either year, indicating that the influence of weather and environmental conditions on the reported reliability in either year was small. However, severe environmental events, such as major storms do occur and will have an adverse impact on reported reliability. Reliability targets have been set based on historic reliability, in line with the Commerce Commission's current practice, and are therefore influenced by the poor reliability experienced in the 2003/04 and 2004/05 measurement years. Over this period the reported reliability was influenced by three major event days. Wellington Electricity believes that the removal of major event days from the reported reliability would give stakeholders more accurate information on the underlying reliability of the network.

Appendix A Expenditure Forecast and Reconciliation

ASSET MANAGEMENT PLAN REQUIREMENT: EXPENDITURE FORECASTS AND RECONCILIATION For initial forecast year ending 31/03/2010

TEN YEARLY FORECASTS OF EXPNDITURE	Actual	Previous Forecast	Forecast									
Year Ending	31/03/2008	31/03/2009	31/03/2010	31/03/2011	31/03/2012	31/03/2013	31/03/2014	31/03/2015	31/03/2016	31/03/2017	31/03/2018	31/03/2019
Capital Expenditure: Customer Connection			7,323	5,428	7,412	5,895	5,699	5,633	8,593	8,162	6,332	6,877
Capital Expenditure: System Growth			3,276	2,279	3,449	8,368	5,380	4,075	6,191	6,645	2,274	4,852
Capital Expenditure: Asset Replacement and Renewal			10,019	12,951	12,644	11,943	15,195	17,587	13,113	12,836	18,523	16,067
Capital Expenditure: Reliability, Safety and Environment			492	452	606	469	468	463	621	604	492	533
Capital Expenditure: Asset Relocations			1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180
Subtotal: Capital Expenditure on Asset Management (Notes 1 & 2)	**26,368**	**23,219**	**22,290**	**22,290**	**25,291**	**27,854**	**27,922**	**28,939**	**29,698**	**29,427**	**28,802**	**29,508**
Operational Expenditure: Routine and Preventive Maintenance			5,936	5,499	5,485	5,535	5,599	5,603	5,656	5,709	5,762	5,816
Operational Expenditure: Refurbishment and renewal Maintenance (Note 3)			614	614	614	614	614	614	614	614	614	614
Operational Expenditure: Fault and Emergency Maintenance			4,575	4,584	4,630	4,673	4,726	4,771	4,815	4,860	4,906	4,951
Subtotal: Operational Expenditure on Asset Management (Notes 2 & 3)	**9,389**	**11,657**	**11,125**	**10,697**	**10,729**	**10,822**	**10,939**	**10,988**	**11,085**	**11,183**	**11,282**	**11,382**
Total Direct Expenditure on Distribution Network	**35,757**	**34,876**	**33,415**	**32,987**	**36,020**	**38,676**	**38,861**	**39,927**	**40,783**	**40,610**	**40,083**	**40,890**
Overhead to Underground Conversion Expenditure (incl in above)												

VARIANCE ANALYSIS	Actual	Previous Forecast	Variance (%)
Year Ending	31/03/2008	31/03/2008	
Capital Expenditure: Customer Connection			
Capital Expenditure: System Growth			
Capital Expenditure: Asset Replacement and Renewal			
Capital Expenditure: Reliability, Safety and Environment			
Capital Expenditure: Asset Relocations			
Subtotal: Capital Expenditure on Asset Management (Notes 1 & 2)	26,368	28,918	-9.7%
Operational Expenditure: Routine and Preventive Maintenance			
Operational Expenditure: Refurbishment and Renewal Maintenance (Note 3)			
Operational Expenditure: Fault and Emergency Maintenance			
Subtotal: Operational Expenditure on Asset Management (Notes 2 & 3)	9,389	12,788	-36.2%
Total Direct Expenditure on Distribution Network	35,757	41,706	-16.6%

Notes:

1 Actual and forecast data relating to the years ending 31 March 2008 and 31 March 2009 has been provided by Vector. Wellington Electricity is not in a position to comment on variances.

2 Actual and forecast capital expenditures for 2008 year relate to the financial year ending 30 June 2008 rather than the regulatory year ending 31 March 2008.

3 Refurbishment and renewal expenditure assumes a level of reactive and corrective expenditure is provided for within the capital expenditure for asset replacement and renewal.

Appendix B Glossary of Terms

AAC	All Aluminium Conductor
AAAC	All Aluminium Alloy Conductor
ABS	Air Break Switch
ACSR	Aluminium Conductor Steel Reinforced
AMP	Asset Management Plan
CB	Circuit Breaker
CBD	Central Business District
CCT	Covered Conductor Thick
CEO	Chief Executive Officer
CHED Services	Cheung Kong Infrastructure Holdings Limited & Hong Kong Electrical International Electricity Distribution Services Pty Ltd
CIGRE	Conference Internationale des Grands Reseaux Electriques (International Council for Large Electric Systems)
CKI	Cheung Kong Infrastructure Holdings Limited
Cu	Copper
DC	Direct Current
DGA	Dissolved Gas Analysis
DTS	Distributed Temperature Sensing
EDO	Expulsion Drop-out
FPI	Fault Passage Indicators
GWh	Gigawatt Hour
GIS	Geographical Information System
GXP	Grid Exit Point
HEI	Hong Kong Electrical International

HV	High Voltage
IEEE	Institute of Electrical and Electronic Engineers
IISC	International Infrastructure Services Company
km	Kilometre
KPI	Key Performance Indicator
kV	Kilovolt
kVA	Kilovolt Ampere
kW	Kilowatt
LV	Low Voltage
LVABC	Low Voltage Aerial Bundled Conductor
MW	Megawatt
MVA	Mega Volt Ampere
NICAD	Nickel Cadmium Battery
Nilstat ITP	Protection Relay
ODV	Optimised Deprival Value/Valuation
O&M	Operating and Maintenance
PDC	Polarisation Depolarisation Current
PIAS	Paper Insulated Aluminium Sheath Cable
PILC	Paper Insulated Lead Cable
PVC	Polyvinyl Chloride
RTU	Remote Terminal Unit
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAP	Systems Applications and Processes
SCADA	Supervisory Control and Data Acquisition System

SF_6	Sulphur Hexafluoride
TASA	Tap Changer Activity Signature Analysis
TCA	Transformer Condition Assessment
VRLA	Valve Regulated Lead Acid Battery
W/S	Winter / Summer
XLPE	Cross Linked Polyethylene Cable