ASSET MANAGEMENT PLAN

19 December 2011

This document has been prepared by WEL Networks Ltd to meet the "Electricity Information Disclosure Requirements 2004 (Consolidating all amendments to 31 October 2008)".

ASSET MANAGEMENT PLAN

WEL NETWORKS LTD

Planning Period:	1 April 2011 to 31 March 2022
Disclosure Date:	19 December 2011

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WEL Board of Governance Statement
for the 2011-12 Asset Management Plan

This Document, which presents the Asset Management Plan (AMP), has been prepared for the following purposes:

- To enable WEL to provide the required level of services cost effectively through the creation, operation, maintenance, renewal and disposal of assets to meet the needs of existing and future customers.
- To provide a working document for use by WEL in conjunction with other detailed planning and implementation processes and activities as described herein.
- To provide stakeholders with the level of information required to make an informed judgement as to the extent that WEL's asset management processes meet Best Practice criteria.
- To satisfy the "Electricity Information Disclosure Requirements 2004" (Consolidating all amendments to 31 October 2008)

This AMP was approved at the December 2011 Board Meeting by the WEL Board of Directors. It covers a period of 11 years from the financial year beginning 1 April 2011 until the year ending 31 March 2022.

John Spencer
Chairman

Chief Executive's Statement

The primary purpose of WEL Networks Ltd (WEL) is to provide customers in the Waikato with a safe, reliable and cost effective supply of electricity. Our aim is to be responsive to our customers' needs, both for their current electricity supply and meeting their future requirements.

It is imperative that a detailed Asset Management Plan is in place given the long life nature of our assets. By listening to our customers, by benchmarking with other New Zealand lines companies and by learning about trends overseas, WEL has established a number of objectives for the management of our assets and these are detailed in the Plan.

At a high level the following points are important.

1. In compliance with the Disclosure Requirements this plan provides extensive information about WEL's asset planning and management.
2. In recent years we have had an ongoing programme of improving network-wide reliability (measured by SAIDI) and have made significant capital investment to drive our reliability towards a target of achieving a result within the best quartile of lines companies. This Plan recognises a change in emphasis from capital investment to maintenance and fault work improvement, driving improved reliability.
3. A network-wide SAIDI target does not recognise challenges in parts of the network, particularly in some rural areas. We have introduced a new target to ensure that the repeat number of outages per customer is below prescribed levels.
4. This Plan recognises the importance of asset renewal and the methodologies to ensure that the optimal life is achieved from our existing assets.
5. This Plan adheres to a "top down" approach to network planning. This starts at the bulk transmission level. There have been capacity and quality upgrades at the Hamilton Grid Exit Point and a new GXP at Huntly. Continued enhancements include upgrades at the Te Kowhai and Hamilton GXPs. The 2011 AMP shows a strong emphasis on demand management and other commercial arrangements.
6. There is strong ongoing economic growth in the Waikato; this requires careful planning so as to maintain security of supply. We have a programme of meeting with and surveying customers, to ensure that their needs are best met going into the future. WEL is planning to spend $380m during the planning period on capital works which reflects a significant economic investment in the future of the Waikato.
7. This Plan notes WEL's commitment to explore intelligent network technology in order to provide better customer service and manage business risks.

8 There are uncertainties around the projected spend. Cost estimates for the first three years of the plan are based on identified projects, costs will vary as scopes are defined and/or consent conditions prescribed. Overall the cost profile has an increasing level of variance. The first two years reflect certainty of scope and costs, towards the three year milestone, there is an estimated variance of 10%. Over the latter part of the plan the defined projects are still subject to definition and a variance of 20% can be expected. This Plan thus gives an indication of future spend requirements, but there are significant variables associated with it.

Dr Julian Elder

Chief Executive

WEL NETWORKS ASSET MANAGEMENT PLAN

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ASSET MANAGEMENT PLAN 2011

For period 1 Apr 2011 – 31 Mar 2022

Photo 1 33/11kV transformers and building at Avalon Drive substation

1 EXECUTIVE SUMMARY

1.1 Background And Objectives

This Asset Management Plan (AMP) is prepared for the following purposes:

- To enable WEL to provide the required level of services cost effectively through the creation, operation, maintenance, renewal and disposal of assets to meet the needs of existing and future customers.
- To provide a working document for use by WEL in conjunction with other detailed planning and implementation processes and activities as described herein.
- To provide stakeholders with the level of information required to make an informed judgement as to the extent that WEL's asset management processes meet Best Practice criteria.
- To satisfy the *Electricity Information Disclosure Requirements 2004 (Consolidating all amendments to 31 October 2008)*.

WEL seeks to apply international "Best Practice" asset management and planning processes integrated with strategic business plans and goals. The core business drivers for this are derived from WEL's Vision and Mission statements:

Providing best practice, reliable services, valued by customers whilst protecting our community.

Strap Line: Best in Service, Best in Safety

Table 1 WEL's Core Business Key Performance Indicators (KPIs) :

Key Business Areas (Mission)	Objectives	Core Business KPIs
Security of Supply	Operate a safe and sustainable network	Acceptable company risk profile
		Health and Safety - Lost time injury accidents
		Load Factor
Reliable network	Deliver reliability to meet or exceed customer expectations	SAIDI
		Urban Customer Repeated Interruptions
		Rural Customer Repeated Interruptions
Profitability	Grow the underlying profit and create value	Surplus After Tax
		ROI
Lower costs	Deliver costs in line with the three best lines companies in NZ	Costs Per Customer
		Delivery Efficiency
Industry leader	Be progressive	Customer Services Satisfaction
		Capability and Employee engagement index

1.1.1 Asset Management Systems And Processes

The relationship between Corporate Strategic Drivers and Asset Management is shown in Figure 1.

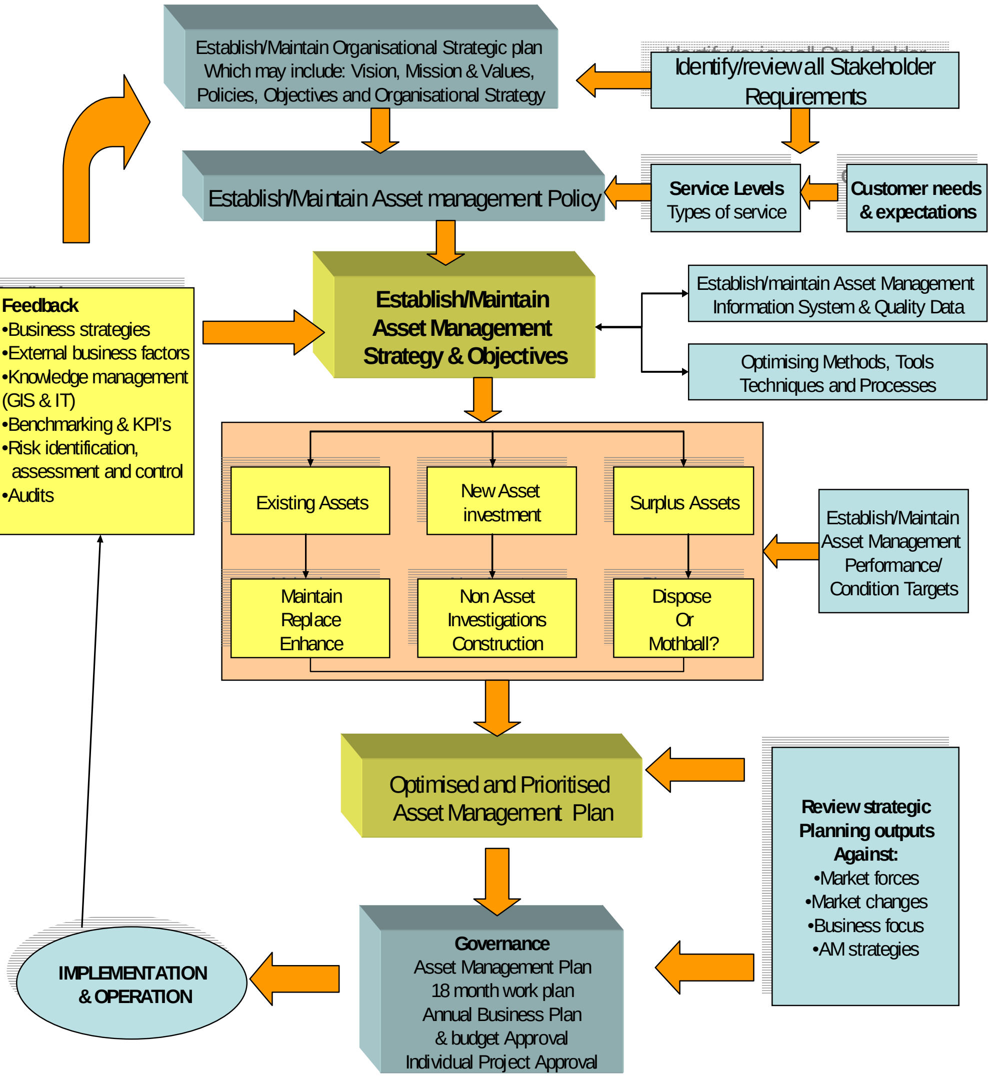


Figure 1. The link between Corporate Strategic Drivers and Asset Management

Key information systems include:

- GIS
- NMS with integrated SCADA and added load management system
- Outage Management System within NMS including Trouble Call System
- Contingency Planning
- ICP Database
- Load Flow and Analysis Software tools
- SAP Enterprise Resource Planning (ERP) system
- Vegetation Management Database

Systems are integrated to provide a cohesive asset management system.

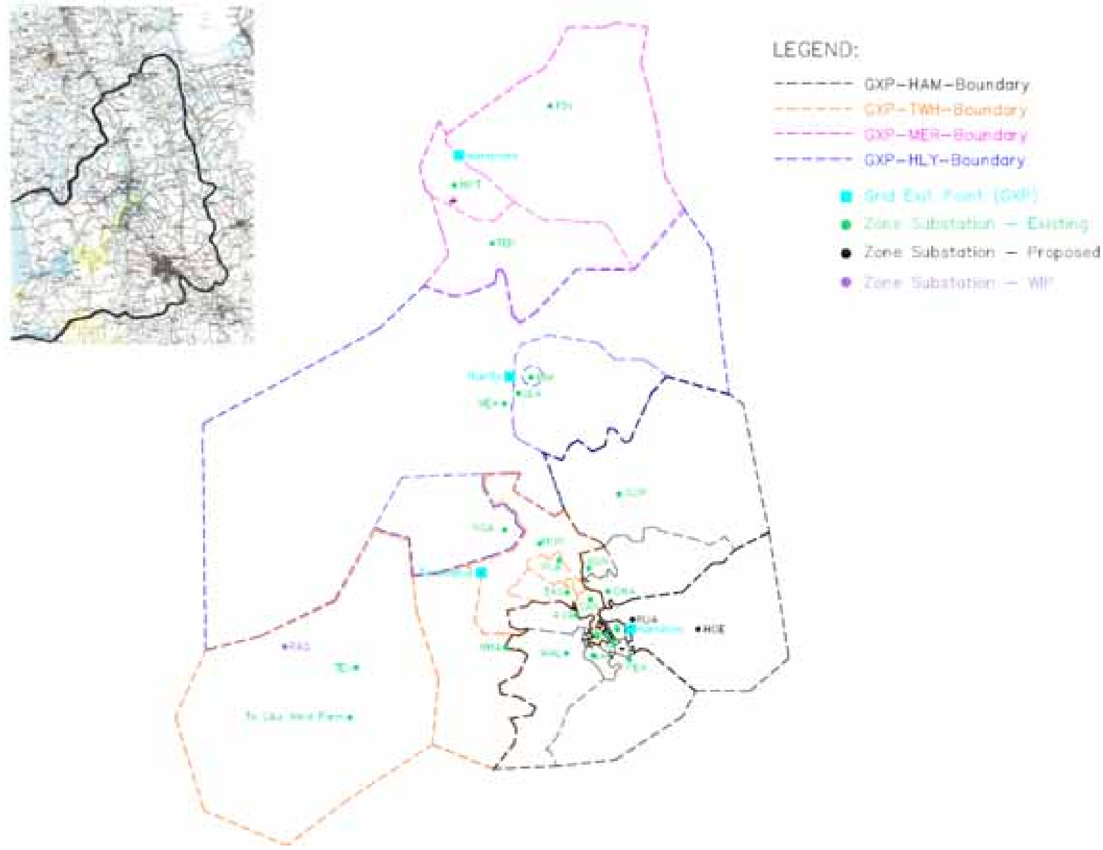
1.2 Assets Covered

1.2.1 WEL Distribution Area Description

WEL supplies power to the North Waikato region which includes the population centres and surrounding rural areas of Hamilton City and the towns of Raglan, Gordonton, Horotiu, Ngaruawahia, Huntly, Te Kauwhata and Maramarua. The WEL supply area is predominantly agricultural in nature and the land is largely flat to rolling with areas of peat and some moderately steep country. Below is a map of the WEL Networks coverage area.

WEL also owns and operates subdivisions in the greater Auckland, Taupo, Wellington and Christchurch regions.

Photo 2 A map of the WEL Network area



1.3 Service Levels

WEL's goal is to provide a quality product to all consumers. WEL defines quality as "providing a network that is safe, reliable and fit for purpose". Quality is measured by the following Safety and Reliability indicators.

1.3.1 Customer Surveys

Regular seminars are held with major industrial and commercial customers. Reliability and other issues are discussed, with a specific focus on the price quality trade-off. In addition to the seminars, top energy consumers are contacted on a regular basis to ascertain their views on supply. The top 50 energy consumers are visited regularly and surveyed at least once a year.

1.3.2 Safety

WEL places primary importance on safety. As such, safety practices are chosen to be consistent with industry best practice.

- Total Injury Rate (TIR) has been used as a measure and the target is for all employees to go home every day safe.
- Key controls are:
  - Design Standards
  - Restricted access to dangerous equipment
  - Field staff and contractors using safe work practices
  - Adequate electrical protection systems to cut the power to potentially dangerous situations

1.3.3 Reliability

Reliability is an essential performance indicator. Appropriate levels of reliability are determined by combining customer survey results with benchmarking studies and by taking implementation costs into account.

Reliability can be measured in a number of ways. WEL uses the following indicators to measure reliability performance.

- Number of Faults per 100km of circuit
- System Average Interruption Duration Index (SAIDI)
- System Average Interruption Frequency Index (SAIFI)
- Customer Average Interruption Duration Index (CAIDI)
- Maximum outage duration for each outage
- Number of interruptions
- Customer Repeated Interruptions

The strategic targets to March 2016 of 70 SAIDI minutes and 1.35 SAIFI meet customer expectations, as derived from customer surveys.

1.3.4 Operating Efficiency – Cost per Customer

Cost per customer (CPC) is applied as the operating efficiency measure. WEL's strategic goal is to deliver costs in line with the best quartile of lines companies in New Zealand. The target for the 2011/12 financial year for CPC is $217. WEL has significantly improved the maintenance programme in the last few years. SAP now records condition assessments, inspection results and maintenance records. This significantly reduces our compliance risks, but has added to our operating spend through increased levels of granularity of asset data.

1.3.5 Delivery Efficiency – Billability and Productivity

WEL has introduced measures of "billability" and "productivity" to ensure that our workforce is effectively and efficiently delivering the approved capital and maintenance programme.

"Billability" is defined as the hours charged to jobs divided by the hours paid to the field staff. Only time spent working on the job is chargeable with non-working time such as annual leave, sick leave, training, meeting attendance, waiting in the yard being excluded.

"Productivity" is defined as the planned labour costs divided by the actual labour costs (including subcontractors' costs).

The target for the 2011/12 financial year for billability and productivity is 80% and 95% respectively. The strategic targets for 2015/16 are 80% and 95% respectively.

1.3.6 Asset Efficiency – Load factor and Asset Utilisation

WEL faces two emerging risks to the business:

- Investment Return Risk

  The return achieved for the large investment in the network could be compromised if certain changes occur within the network. An example of this would be increased use of distributed generation which could significantly change the energy and load flows around the network.

- Risk of a Shrinking Business

  Several trends threaten to divert revenue from us which would reduce income and could strand some assets.

Traditional network planning is based on system peak demand. However, the line revenue is mainly from total energy consumption. Load factor is a measure of the relationship between peak demand and energy used and is an indication of asset utilisation efficiency.

WEL's long term objective is to achieve a load factor above 60% (currently at 56%).

Asset utilisation is defined as the ratio of peak load divided by the installed capacity of the asset and is a measure of effective investment. For example, for a transformer the asset efficiency is the peak load as a percentage of the installed transformer capacity. All assets must be able to carry the transient, daily, weekly and seasonal peak loads hence asset utilisation will always be less than 100%. This measure is known as "capacity utilisation". WEL's long term goal is to deliver asset utilisation within the best three lines companies in New Zealand. WEL has set a capacity utilisation target to maintain or exceed 38.1%

1.3.7 Low Voltage Complaints

WEL records all low voltage complaints (LVCs). The total number of LVCs and the details of each are monitored to determine the quality of supply. A process has been put in place to identify the root cause of each LVC. WEL's aim is to reduce the number of LVCs that WEL is responsible for and to respond to all customer requests promptly. Initiatives include the installation of load monitoring devices on distribution transformers, which will assist in identifying power quality issues before they reach unacceptable levels.

1.4 Network Development Planning

WEL is committing to a high level of Capital Expenditure (CAPEX) to meet growth, maintain security levels, quality of supply and regulatory requirements.

Our network development projects recorded in this document are extensive and include:

- Capacity upgrade at the Transpower Hamilton GXP.
- Integration of the Transpower 33kV and 11kV supplied networks.
- Capacity upgrade at the Transpower Te Kowhai GXP.
- Extensive new 33kV sub-transmission and existing sub-transmission network upgrade
- Northern network development.
- Two new zone substations.
- Extensive distribution 11kV cabling.
- Extensive zone substation upgrade programme (with transformer shifts between them)
- POS and zone substation security.
- Smart networks.
- Safety, LVC, and relocation compliance issues.
- 11kV and LV cable augmentation and interconnections.

- 900 sections of subdivision reticulation and 240 new connections per annum.
- Undergrounding.
- Extensive asset replacement programme.
- Protection and communication upgrades and development.

Demand forecasting, demand-side management, generation and load management form part of the process to develop appropriate network solutions. The deployment of smart grid technology on an advanced metering platform will be central to our plans to defer investment in a new GXP. This opportunity was identified last year; the benefits of deferred investment have been captured in this Plan along with further refinement of the GXP solution (to the extent that a new GXP will not be necessary till well beyond the end of this planning period).

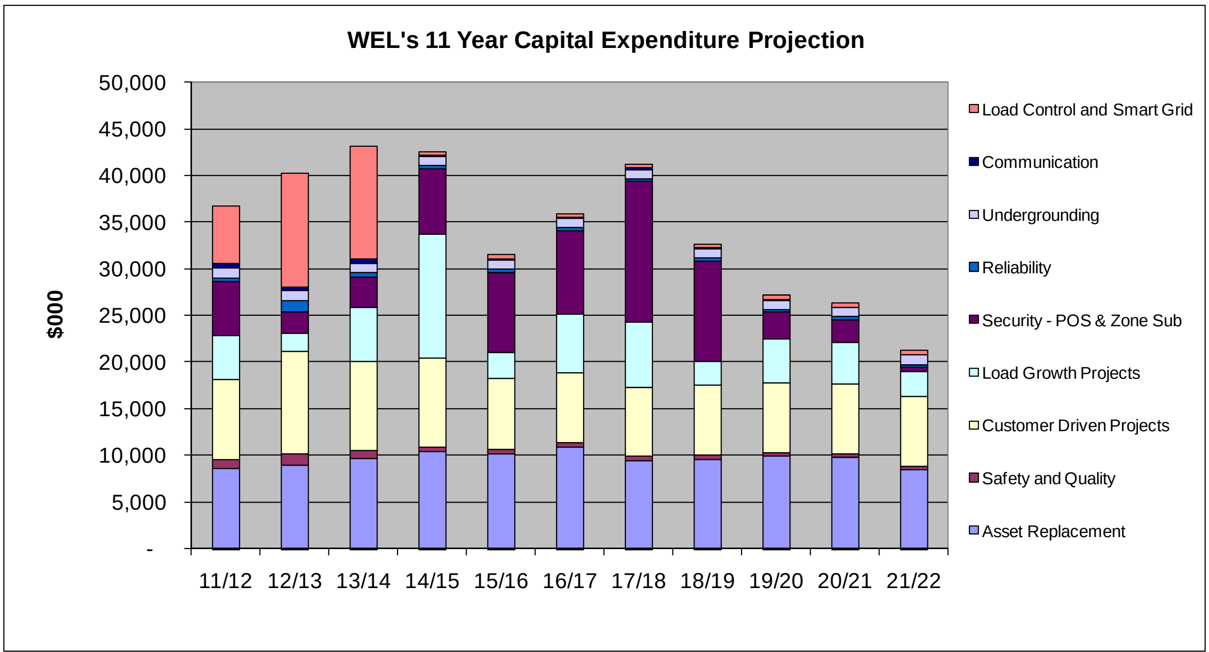


Figure 2. Capital Expenditure Projection for AMP Period

1.5 Life-Cycle Asset Management Planning

WEL's maintenance and renewal expenditure over the next 10 years will ensure the asset base meets customer security requirements and WEL's business objectives.

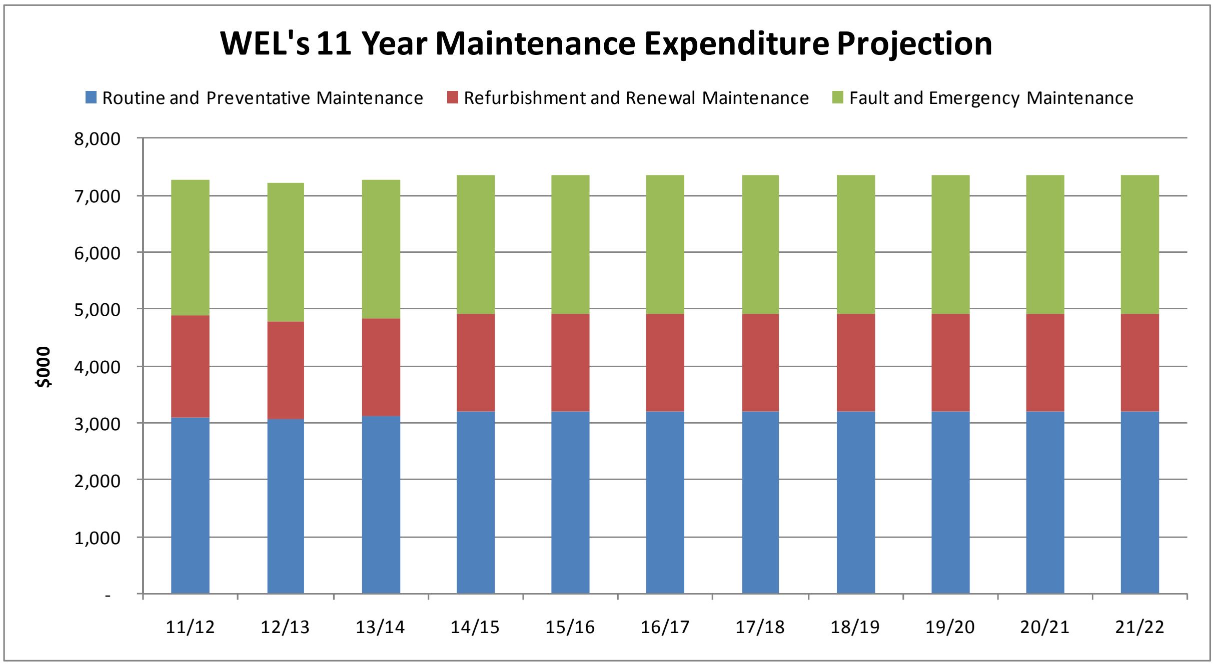


Figure 3. Maintenance Expenditure Projection for AMP period.

Maintenance techniques employed include Root Cause Analysis (RCA) and Failure Mode Effects and Criticality Analysis (FMECA). .

A long term asset renewal strategy has been established with increasing attention being paid to asset replacement management. An asset renewal plan has been developed to ensure the continued high performance of in-service network assets, in particular older assets, through refurbishment and replacement strategies for each class of asset. The programme identifies the need to continue to renew assets to allow service levels and customer expectations to be met.

The decision to undertake replacement of an asset is based on age as well as the following factors:

- Performance evaluation
- Asset condition monitoring
- Level of refurbishment, maintenance and operating cost
- Historical failure statistics
- A risk assessment associated with deferring asset replacement expenditures
- Smooth out costs in consideration of availability of resource
- Optimise the asset replacement spend profile in consideration of overall capital spend profile.

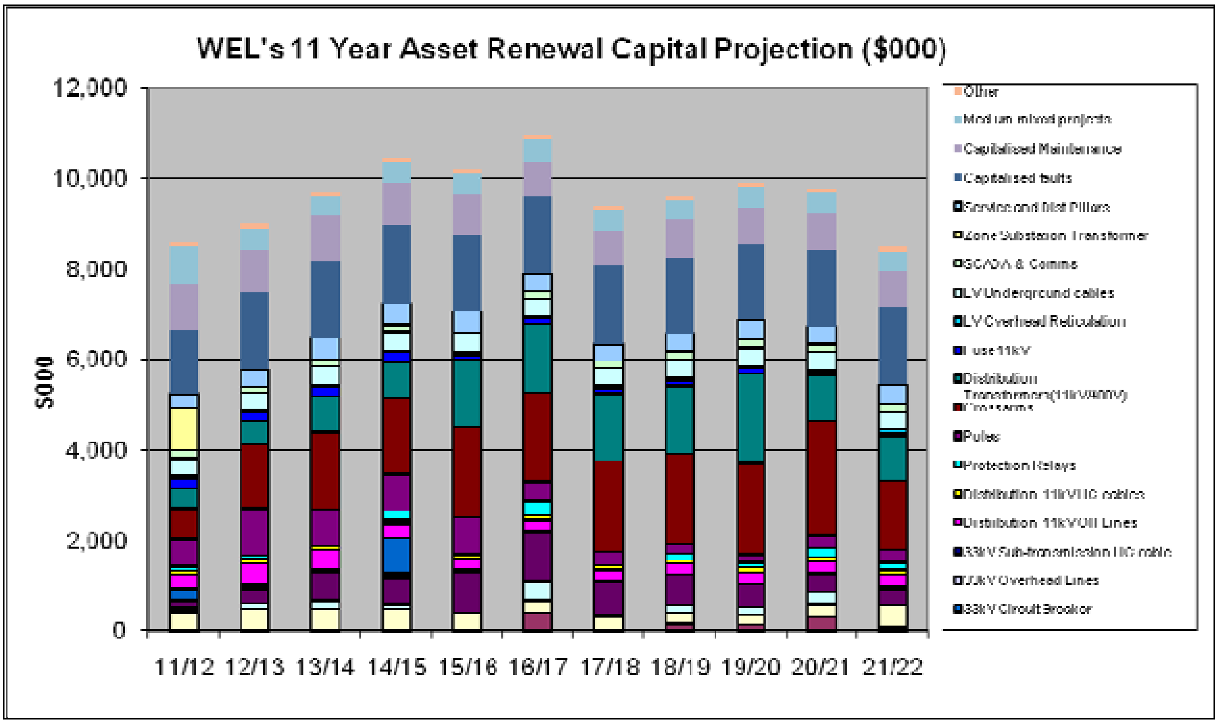


Figure 4. Asset Renewal Expenditure Projection for AMP Period

1.6 Demand Management

In assessing load growth WEL has made the following assumptions about demand management:

- Progressive impact from introduction of network intelligence.
- Future electricity pricing is likely to be structured to influence customer management of demand.
- Home efficiency initiatives by central government are likely but the impact will be incremental over many years.
- Technology will be used increasingly to manage demand (e.g. smart boxes) and also to make plant, equipment, appliances and living space more efficient e.g. increased use of heat pumps.

WEL has initiated a project to introduce smart boxes. These smart boxes provide customers with better information about power consumption and appliance running costs and are expected to gradually bring about modifications to customer behaviour by:

- Encouraging lower power consumption choices
- Encouraging the purchase of more efficient appliances
- Enabling increased use of time-of-use tariffs

The impact of these factors is assumed to be gradual and the demand forecasts have been adjusted, taking into account a newly introduced target to reduce peak demand growth by 10% through the introduction of smart boxes. This reduction will be achieved through development of time of use tariff charges within a year and through incentives to capture additional load control participation.

1.7 Risk Management

WEL has a clearly defined Risk Management Policy, which is published on the company intranet. This Policy and supporting procedure identifies risk management as a core management responsibility and outlines in broad terms the emphasis given to this in both the day-to-day and longer-term facets of managing the assets and overall business. A detailed description of how WEL manages risk is provided in Section 7.

1.8 Performance Evaluation

WEL monitors performance through a variety of measures which include:

- Overall actual Capital Expenditure matched against AMP forecast.
- Maintenance Expenditure matched against budgeted forecast.
- The gap between Network Development Programme targets and delivery.
- Service Levels and Asset Performance for safety, reliability and other performance measures.
- Low Voltage Complaints received and the number proven for comparison.

Performance gap analysis and improvement initiatives have been put in place.

1.9 Best Practice

WEL's asset management practices are aligned with the following industry best practice standards:

- PAS 55 Publicly Available Specification for the Optimised Management of Physical Assets and Infrastructure
- International Infrastructure Management Manual 2006 (IIMM)

Photo 3 33kV and 11kV line termination poles

2 BACKGROUND AND OBJECTIVES

2.1 Purpose Of The Plan

This Asset Management Plan (AMP) is prepared for the following purposes:

- To enable WEL to provide the required level of services cost effectively through the creation, operation, maintenance, renewal and disposal of assets to meet the needs of existing and future customers.
- To provide a working document for use by WEL in conjunction with other detailed planning and implementation processes and activities as described herein.
- To provide stakeholders with the level of information required to make an informed judgement as to the extent that WEL's asset management processes meet Best Practice criteria.
- To satisfy the "Electricity Information Disclosure Requirements 2004 (Consolidating all amendments to 31 October 2008).

WEL seeks to apply international "Best Practice" asset management and planning processes integrated with strategic business plans and goals. The core business drivers for this are derived from WEL's Vision/Mission statement. The following WEL Asset Management Policy reflects WEL's approach:

This Policy is based on WEL Networks Ltd (WEL) Vision/Mission Statement.

The primary purpose of WEL is to meet the needs of existing and future customers by providing a safe, reliable and acceptably priced supply of electricity by means of the creation, operation, maintenance, renewal and disposal of assets. The following are the WEL Asset Management Policy objectives that relate to WEL's primary purpose:

- *The installation, operation and maintenance of network, plant and other assets with the aim of achieving best practice levels of reliability and safety and the efficient long-term utilisation of assets;*
- *The development of the network structure to meet current and future performance expectations;*
- *The establishment of appropriate asset management systems and processes to advance the strategic needs of the Company and;*
- *The generation of sufficient asset based revenue to support the long-term operation of the business.*

The Asset Management Policy requires that WEL assets should be planned, designed, constructed, operated, maintained, renewed and disposed of in an efficient manner which:

- *Complies with regulatory and statutory requirements;*
- *Meets current and future reliability performance expectations cost effectively;*
- *Maintains and renews WEL assets and adopts appropriate methodologies to ensure that optimal benefit continues to be derived from existing assets;*
- *Achieves appropriate financial returns on assets;*
- *Supports Waikato economic growth while still maintaining WEL security standards;*
- *Supports the infrastructure development of the Waikato area by sharing costs with other entities;*
- *Accords with the risk management framework adopted by WEL and:*

- *Bases asset management decisions on the full evaluation of all alternatives - evaluation that takes into account full life cycle costs as well as environmental, sustainability, social and economic benefits and risks.*

This Policy has my full support, as well as that of the Board of Directors.

All WEL staff, suppliers and contractors have a role to play in effectively implementing WEL Asset Management Policy. WEL expects that all staff will give the policy their full support.

Chief Executive, Julian Elder

2.2 Corporate Planning Interaction

2.2.1 WEL's Vision and Mission

Providing best practice high quality reliable services, valued by customers whilst protecting our community.

Best in Service, Best in Safety

2.2.2 WEL's Focus

Our focus is on:

- Secure Supply - operate a safe and sustainable network
- Reliable Network - deliver reliability to meet or exceed customer expectations
- Profitability - grow the underlying profit and create value
- Lower Costs - deliver costs in line with the best quartile of New Zealand lines companies
- Recognition as an industry leader - be progressive

Best practice asset management and planning processes are integrated with strategic business plans and goals. Refer to Section 2.7 for a discussion of Best Practice.

The following core business drivers are derived from WEL's Vision/Mission statement.

2.2.3 WEL's Core Business Performance Drivers

WEL's asset management practices are consistent with the company Vision/Mission statement and are aligned with Public Available Specification (PAS 55) and other best practices. Our aim is to provide the required levels of service at least cost.

WEL seeks to:

- Provide a network that will meet future demands safely and reliably through understanding; electricity volumes, energy demands, asset lifetime requirements, new technology, commercial arrangements, optimal maintenance and replacement programmes, assessment of risk and reliability, safety of network operation, capital improvement, use of skilled labour and appropriate materials, and ensuring an ongoing commercial return.
- Continually improve reliability through a segmented customer approach by understanding and educating customers on the price/quality trade-off, delivery of reliability expectations and targeting the worst performing network components.
- Deliver efficiency and performance through improving processes, operating a performance based organisation and aligning with industry benchmarks.
- Improve customer service.

Table 2 **WEL's Core Business Performance Drivers**

Key Business Areas (Mission)	**Objectives**	**Core Business KPIs**
Secure Supply	Operate a safe and sustainable network	Acceptable company risk profile
		Health and Safety - Lost time injury accidents
		Load Factor
Reliable network	Deliver reliability to meet or exceed customer expectations	SAIDI
		Urban Customer Repeated Interruptions
		Rural Customer Repeated Interruptions
Profitability	Growing the underlying profit and creating value	Surplus After Tax
		ROI
Lower costs	Deliver costs in line with the 3 best lines companies in NZ	Costs Per Customer
		Delivery Efficiency
Industry leader	Be progressive	Customer Services Satisfaction
		Employee capability and engagement index

2.2.4 Relationship between Corporate Strategic Drivers and Asset Management

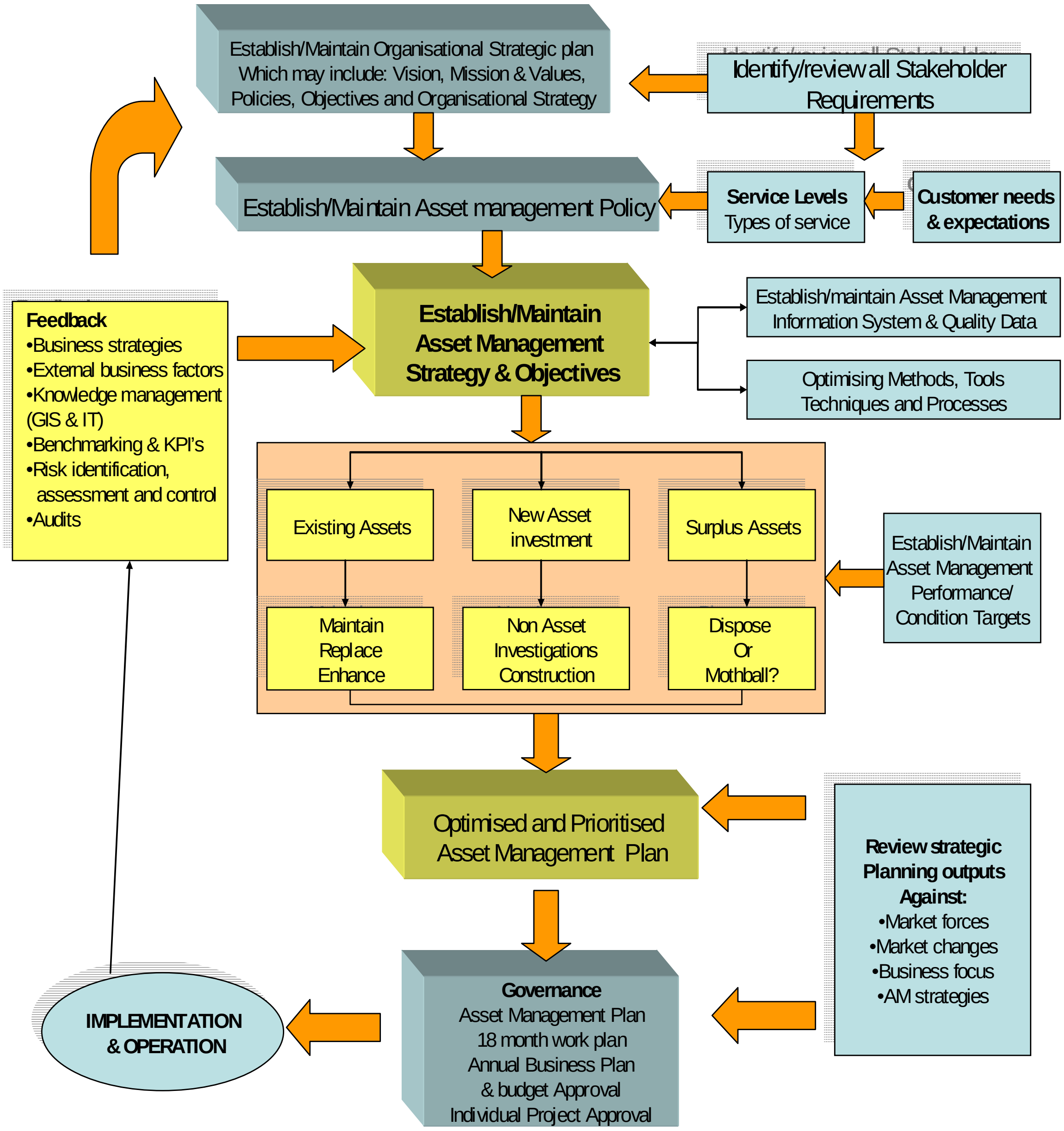


Figure 5. The link between Corporate Strategic Drivers and Asset Management.

- The Company's strategic planning process leads directly to the development of asset management strategies and objectives.
- The objective of asset management strategies and practices is to optimise asset management decisions through a full evaluation of all alternatives - evaluation that takes into account full life cycle costs as well as environmental, sustainability, social and economic benefits and risks while considering "do-nothing" and non-network options.
- Optimised and prioritised asset management decisions are captured in the AMP to set long term network development and maintenance objectives.
- Optimisation requires quality information recorded in effective management systems and appropriate processes to interpret and act on the information in order to make sound decisions.
- The AMP provides the capital and maintenance expenditure projections for the next 11 years. The AMP is a critical input into the Strategic and Business Planning process, the 18 month work plan is produced from this.

- The governance activity and approvals occur prior to implementation and operation.
- Business performance is reported back to the Board each month.

Photo 4 33kV Insulator Replacement

2.3 The Period Covered By The Plan

This AMP was approved at the December 2011 Board Meeting by the WEL Board of Directors. It covers a period of 11 years from the financial year beginning 1 April 2011 until the year ending 31 March 2022.

The AMP provides the capital and maintenance expenditure projections for the next 11 years. The 11 year period covers the current financial year plus a following 10 year horizon. The projects and costs in year 0 (current financial year) have been modified to reflect the up to date forecast. The projects and costs in year 1 and year 2 are very certain, year 3 to year 6 are reasonably certain, whilst years 7 to 10 have a high degree of uncertainty due to unpredicted external factors, particularly new technologies such as embedded generation and smart networks.

2.4 Stakeholder Interests

WEL is owned by a community trust, the WEL Energy Trust. The WEL Energy Trust has a 100% shareholding, on behalf of the community, in WEL Networks Ltd.

The Trust was formed in 1993 and continues to 2073 unless terminated sooner if its purpose is completed. It is a consumer elected body (currently with seven Trustees) and elections are held every three years. The next election will be in June 2014.

The Trust appoints the Board of Directors, who in turn appoints the Chief Executive. Stakeholders and their requirements are formally identified during the annual strategic planning process.

The Trust agrees strategic KPIs with WEL, which includes measures around asset management.

Table 3 Stakeholder Interests.

Strategic Stakeholder Requirements by 2015/16				
SHAREHOLDER	**CUSTOMER**	**BOARD/MANAGEMENT**	**COMMUNITY**	**STAFF**
▪ Enterprise value ▪ Price increases to be in line with inflation ▪ “Keep the lights on” for customers ▪ Long term sustainability of the business ▪ Ensure the company has a good reputation and is seen in a superior light by the community ▪ Invest in growth opportunities and seek increased value ▪ No regulatory breaches ▪ Engage with consumers on discount	▪ Quality and reliability ▪ Customer service ▪ Fair pricing ▪ Price/quality to manage customer expectations	▪ “Keep the lights on” ▪ Increase profit by growth and improving efficiencies ▪ Manage business risk by seeking unregulated opportunities ▪ Minimising regulatory constraints ▪ Efficient operation ▪ Operate within financial capacity ▪ Maintain the integrity of the network with prudent investment ▪ Productive staff ▪ Safe working environment ▪ Adopt appropriate advances in technology ▪ No regulatory breaches ▪ Influence on the regulatory reset ▪ NPAT	▪ Operate our business with due care for the environment ▪ Maintain health and safety of the public ▪ Understand and help meet the needs of the community	▪ Good place to work ▪ Fairly rewarded ▪ Development opportunities ▪ Safe working environment ▪ Seeking to add value

In addition to the stakeholders identified above WEL works closely with other industry participants, namely Transpower and Electricity Retailers, particularly in relation to planning and network development and to ensure quality supply is delivered to customers. WEL also works with local bodies and governmental agencies to meet regulatory requirements.

Stakeholder interests are accommodated by applying the following key tenets to Asset Management:

- Maintaining a clear focus on providing a safe and high quality service to customers
- Achieving levels of reliability which meet customer expectations on reliability and price derived from customer consultation process
- Balancing the needs of Shareholders, Customers, Retailers and Users
- Effectively managing risk
- Achieving excellent returns by improving operating efficiency and optimising investment decisions
- Making WEL the place staff want to be a part of.

2.4.1 Prioritisation of Interest between Stakeholders

WEL has a clear hierarchy of stakeholder requirements which is embedded in various policy, planning, corporate and contractual documents. This hierarchy provides clarity in managing conflicts of interest.

WEL has clear policies and procedures in line with legislative requirements. WEL recognises the importance of public safety as well as staff safety. Safety is not negotiable and all other interests are secondary.

2.4.2 Consumer Requirements

WEL invests considerable effort in establishing what interested parties require in terms of price and quality. Major customers have direct access for any issues or questions they may have, whether this is concerning price versus quality or if they wish to increase their load.

For the "Mass Market", WEL conducts annual customer surveys to assess views on the trade-off between price and quality by the following market segments:

- Urban Residential
- Urban Commercial
- Rural Dairy & Business
- Rural residential / lifestyle

The following list prioritises our response to competing and potentially conflicting demands for lower prices whilst maintaining (or in some cases improving) reliability in this area:

1. Deed of Trust (shareholder requirements) – the requirements of this document provide for the long term protection of the asset for the ultimate beneficiaries and ensuring staff and public safety
2. Contractual requirements – we abide by the terms of contracts we have entered into
3. Consumer requirements for price and quality – we aim to meet our published service levels
4. Company requirements for investment.

Where a conflict arises that is not related to safety, the management team will review the factors and present options to the Board.

Where a conflict cannot easily be resolved expert opinion will be sought and a conflict resolution process entered into.

2.5 Asset Management Accountabilities And Responsibilities

Responsibility for asset management occurs on several key levels: governance by the Board of Directors, executive management, planning and field services implementation.

Governance is provided by the Board of Directors through:

- Annual review of the five yearly strategic plan
- Annual review and approval of the AMP and 18 month work plan
- Annual review and approval of the business plan and budgets
- Individual Project Approval
- Monthly review and decision-making on required actions that vary from original plans.

In addition the Board receives the following information as appropriate at Board meetings:

- A capital project progress report with an overview and detailed information on individual major capital projects
- Project close-out reports
- A detailed reliability report with an explanation of outages that incur more than 0.5 SAIDI minutes
- A report on Transpower peak demand achieved versus budget
- A report on customer complaints
- A report on voltage complaints
- A report on the performance framework for reliability and a corrective action plan for improvement.

All reports are produced by management. WEL has structured its business with the five divisions of Corporate Services, Asset Investment and Growth, Operations and Customer Delivery, Commercial Management and Human Resources shown in Figure 6 - Executive and functional chart.

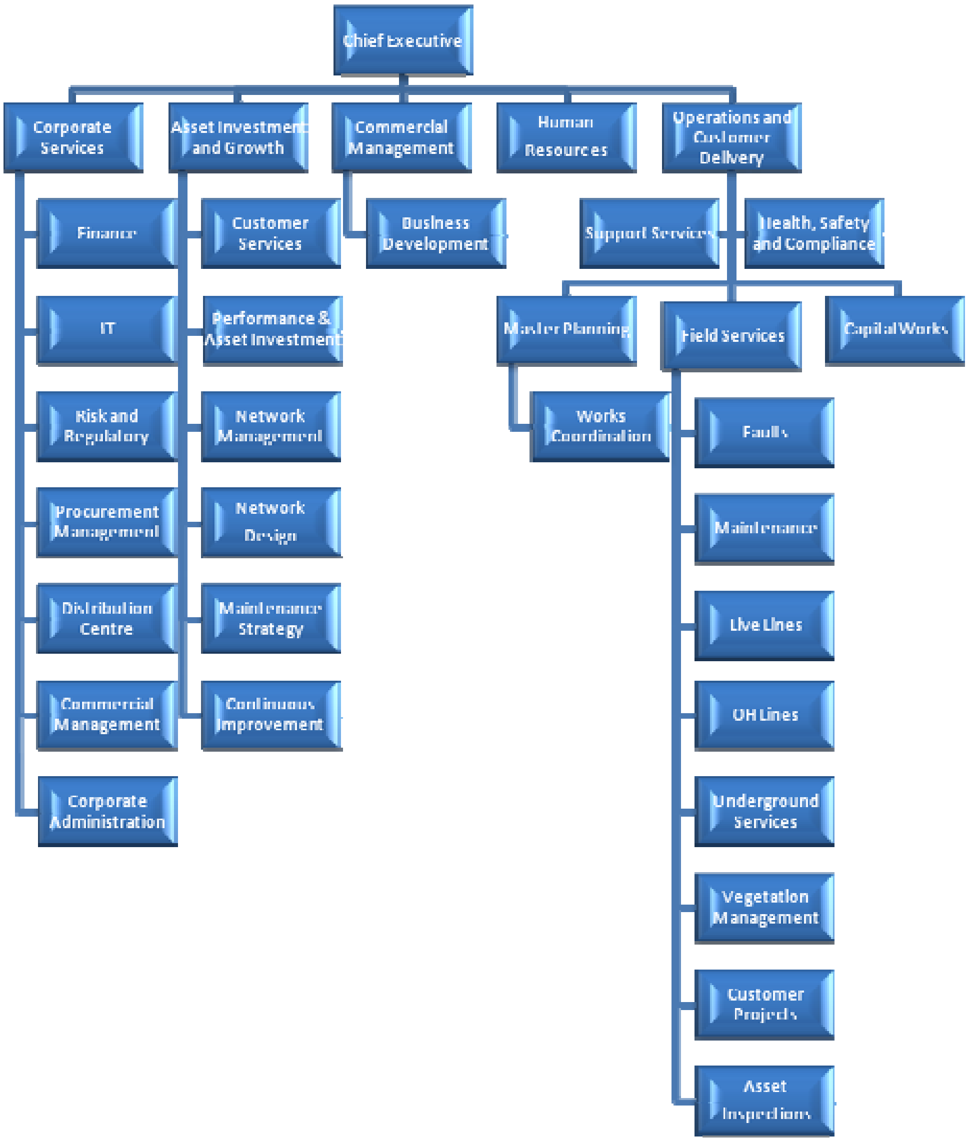


Figure 6. WEL's Executive and Functions

The Asset Investment and Growth team has overall responsibility for management of the network assets. This includes ensuring that the assets are developed, renewed, maintained, operated and used on a long term sustainable basis to meet the needs of all stakeholders. Within the Asset Investment and Growth division there are five teams. Their key responsibilities are summarised below:

Managers	**Key Asset Management Outcomes**
Customer Service	• Customer interface management • Call Centre and Faults Dispatch • New connections and customer project requests • Stakeholder management
Performance and Asset Investment	• Optimised WEL asset management plan and annual work plan • Ensure overall delivery of asset performance outcomes • Direct asset valuation and maximise utilisation of assets • Ensure business management systems are in place including

	process, system and information.
Network Management	• Long term network development to meet network safety, security and reliability standards, including long term load forecast • SCADA/NMS, network automation, Smart Grid and communications • Manages the successful operation of WEL Control Centre • Consenting and Resource Management
Network Design	• Design management to provide a central design service for internal and external customers • Approve designs for design works provided by external contractors • Prioritise the options and provide recommendations to ensure optimal asset investment decision
Maintenance Strategy	• Optimise maintenance strategy, develop and implement maintenance standards, policies and procedures and produce maintenance programs • Optimise asset replacement spend profile and associated works programme

The Operations and Customer Delivery team has overall responsibility for the cost effective delivery of the approved capital and maintenance work plan while meeting customer requirements and safety and quality standards. Within the Operations and Customer Delivery division there are four teams. The main objectives for services delivery are:

Managers	**Key Asset Management Outcomes**
Health, Safety & Compliance	• Ensure staff and public safety and compliance
Field Services	• Effective and efficient fault response and repairs to minimise outage duration • Delivery of the approved maintenance programme and customer driven projects
Capital Project Management including construction services	• Delivery of the approved capital programme and customer driven projects
Planning and Scheduling	• Ensure Quality Customer Services, including fault services • Ensure planning and delivery effectiveness and efficiency • Ensure timely and quality data collection

The approved annual capital and maintenance programmes are used to maintain a work plan for field operations.

The aim of the work plan is to provide enough work volume in advance (ideally three to six months) to ensure resources are used effectively and projects delivered efficiently to time, budget and quality. Materials are supplied by the WEL Distribution Centre. Supply chain management principles have been applied for selection of material supplier, material purchase and Distribution Centre operation.

Detailed design packages and estimated costs are produced using WEL's Comparable Unit Estimation tool. Monthly cross–functional reviews monitor performance against the plan.

WEL has now set up as a largely self sufficient business with in-house consenting and project management and delivery. Maintenance, faults and capital asset replacement works are delivered by WEL's own Field Services staff. Major capital projects and specialised communications work continue to be largely carried out by external contractors. Specialist services such as complex design and architectural services are contracted out as required.

2.6 Asset Management Systems And Processes

2.6.1 WEL Master Process Architecture

WEL uses a number of management systems and processes for complete management of the asset. The relationship between Corporate Strategic Drivers and Asset Management is shown in section 2.2.4.

WEL has been focussed on continuous improvement with a process re-design project starting in 2003, with the following objectives:

- Improved effectiveness and efficiency
- Informed decisions regarding organisation structure
- Formalisation of ad-hoc arrangements
- The development of a common understanding on how WEL works
- The identification of specific gaps and bottlenecks in key processes
- Consistency throughout the organisation.

The result of this project was the establishment of WEL Networks Master Processes – a series of high level processes that describe WEL as a business. The re-design created eleven master processes. The following master processes have been defined:

- Asset Investment Strategy
- Business Development
- Business Support
- Contract Strategy and Management
- Corporate Governance
- Operate and Restore
- Performance Management
- Revenue Management
- Strategy and Business Planning
- Staff Development
- Works Delivery

The overall architecture of the WEL master processes is shown in Figure 7.

Each master process is described by a hierarchy of three levels. It has a set of inputs, a process, which generates a set of outputs. It is demonstrated in Figure 8 and Figure 9 below:

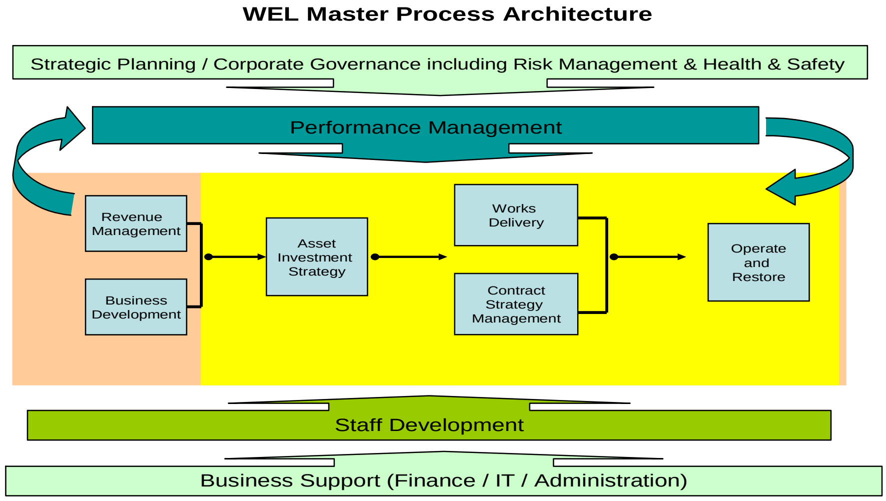


Figure 7. The Master Process Architecture

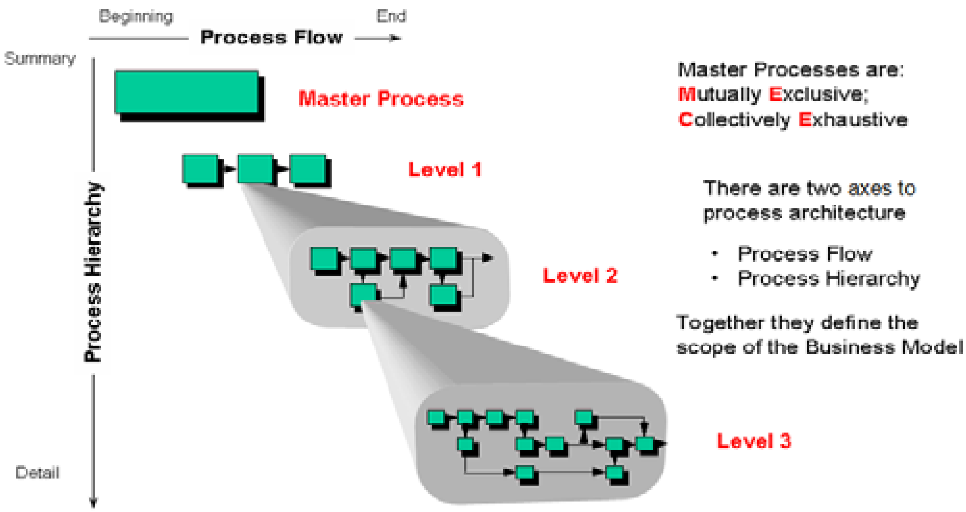


Figure 8. Master Process explanatory diagram

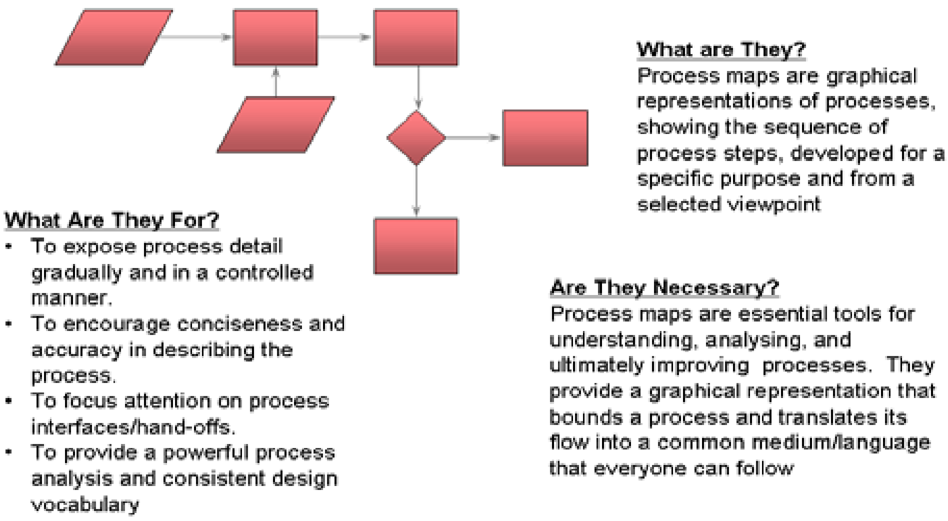


Figure 9. The Master Process Level 1, 2 & 3 Demonstration

2.6.2 High Level Asset Management Planning Process Interaction

The Asset Investment Strategy Process is used for asset management planning. The relationships between the high level processes within the Asset Investment Strategy Process are shown in the following diagram:

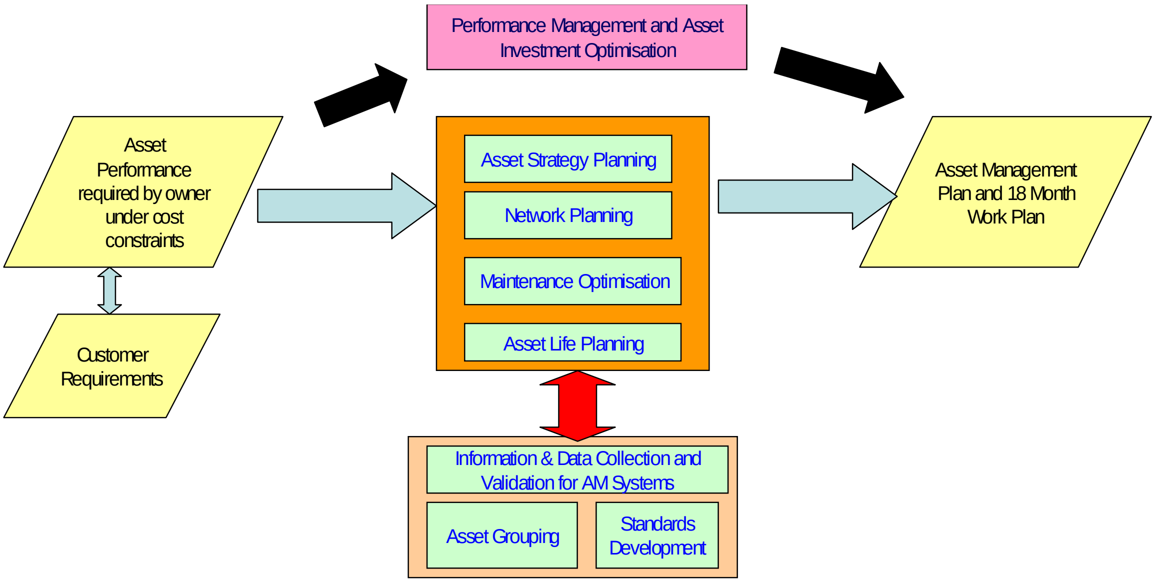


Figure 10. Interaction between high level asset management planning processes

A description of the main sub-processes shown in Figure 10 is given below:

2.6.2.1 Asset Strategy Planning

This process generates and evaluates high-level investment and maintenance strategies, and confirms these strategies with the Asset Owner.

2.6.2.2 Network Planning

This process develops project plans and optimises them with consideration of cost, performance and risk, to produce both the Asset Management Plan and Work Plan.

2.6.2.3 Maintenance Optimisation

This process develops maintenance plans and optimises them with consideration to cost, performance and risk, to produce both the Asset Management Plan and Work Plan.

2.6.2.4 Asset Life Planning

This process pulls asset data together into cohesive plans for the life of a given asset or group of assets, considers the Opex/Capex trade-off and combines these into an overall Asset Life Plan.

2.6.2.5 Information and Data Collection and Validation for AM systems

This describes the process, rules and conventions regarding the definition, capture, storage and validation of asset data.

2.6.2.6 Asset Grouping

This describes the process, rules and conventions regarding the creation and manipulation of assets into groups for efficiency and other purposes.

2.6.2.7 Standards Development

This describes the process, rules and conventions regarding the standards required to manage the network.

Asset Strategy Planning, Network Planning, Maintenance Optimisation and Asset Life Planning form the core decision making components of Asset Investment Strategy. They reflect the planning process by starting at high level strategies and long-term projections that develop through the planning process to specific detailed plans for short-term activities (example Work Plan) and the long term plan (AMP). The Asset Life Plans form the backbone of the planning process.

Asset Grouping, Standards Development and Information and Data Collection and Validation support sub-processes to this planning loop by providing rules and conventions around the asset data and network standards.

Alignment between performance requirements is required to optimise the overall Asset Management Plan and 18 month work plan.

2.6.2.8 Asset Inspections and Network Maintenance

The maintenance strategy for each class of equipment comes from the Maintenance Optimisation process. This process uses RCM techniques and other sources of information to develop possible maintenance strategies. The costs and benefits are evaluated to choose the optimal strategy for the particular class of equipment. The maintenance strategies for all the equipment classes are consolidated and an assessment is made on whether this will deliver the desired level of network performance and reduction of risk.

2.6.2.9 Periodic Maintenance and Condition Assessments

Periodic maintenance activities and condition assessments are developed into Job Plans within WEL's Computerised Maintenance Management System (CMMS) - to be part of SAP from Nov 2011. These job plans specify the maintenance tasks; provide estimates of the cost and resource requirements. The Job Plans are linked in CMMS with individual items of equipment and set the plan execution period for Preventative Maintenance (PM). Work orders are generated at required intervals to perform the maintenance activity. Once the work has been completed the actual costs and condition assessments are recorded back in the system against the jobs.

All these PM tasks in total form the routine maintenance works plan.

2.6.2.10 Faults

Faults are managed within CMMS in a similar way to routine maintenance. Work orders are created automatically from a fault call. A more detailed work order structure may be developed in larger fault situations where multiple items of equipment require repair or replacement. Actual costs are recorded against each equipment item and failure codes are recorded.

2.6.2.11 Root Cause Analysis (RCA)

RCA is used as a reactive (continuous improvement) technique to follow up on all incidents. RCA is compulsory for all faults which have a SAIDI impact of more than 0.3 minutes, any Transpower faults which cause a loss of supply to WEL, any 33kV faults, any defective equipment, or any events due to human error.

A team reviews all incidents regularly (generally weekly) and the root causes identified. The team will investigate the fault and recommend repair work for the immediate problems and also recommend an approach to minimise the class of fault in the future. A risk impact assessment is used to determine the urgency of action. The required actions are set up as work orders in the CMMS against the individual items of equipment and scheduled as required. The work performed and actual costs are recorded against the equipment item.

2.6.2.12 Network Development Projects

The routine monitoring and investigation activities performed by Network Planning staff serve to identify areas of improvement on the network. Those performing the real time operations role and those working in the field are again a good source of ideas for network improvement. WEL has implemented SAP, a software application which allows these and other parties to record new network development opportunities.

Ideas for new capital or maintenance projects are entered into SAP where all technical options, benefits and costs can be analysed.

Projects are ranked according to score. Given the ranking and the importance of each project an assessment is made on which projects should proceed in the next financial year. Those projects are included in the preliminary capital works budget and presented to the Board for approval. For projects that receive final Board approval a detailed project definition document is produced by the Network Design Manager. The project is then handed over to the Capital Projects or Field Services Project Managers to implement the project.

2.6.2.13 Network Performance Measurement

Network reliability affects customers more than any other network performance indicator. WEL has developed an internal process called “Data collection & validation process for reliability performance data”. This process ensures quality and integrity of data used to calculate HV outage performance figures such as SAIDI, SAIFI and CAIDI.

2.6.3 Key Asset Management Systems

WEL strives to excel in the management of its assets. A number of computer based systems support this endeavour, the most significant of which are described below.

Refer to Appendix 1 Glossary of Terms for a definition of acronyms.

2.6.3.1 Geographic Information System (GIS)

The assets managed by WEL are distributed over a large geographical area, so at the most basic level WEL needs to know the geographical location of each asset. The Geographic Information System (GIS) contains this spatial information as well as asset specifications, which is known as attribute data. The GIS also contains data describing the electrical attributes of assets, connectivity, land-base data, which includes property boundaries and owner details, topological maps and aerial photography. Some of this data is transferred to other systems including the ICP Registry, SAP and SINCAL (the network planning tool).

The GIS aims to leverage existing data and present it in a way that decision makers can easily comprehend. One of the strategic focuses for the GIS is to increase the degree to which it leverages existing company data for the benefit of decision makers at all levels.

WEL recognises that the information derived is only as good as the source data it depends upon.

A number of data cleansing projects have been completed in the past and a number are in progress. A data collection programme verifying the conductor size has been completed. Attributes of major equipment items such as transformers, circuit breakers, RMUs and other switches have been verified in the field. Suspected connectivity errors within the low voltage network and street lights are being progressively corrected.

As part of developing an information framework the consistency between the GIS and other systems is improving. The purchase of aerial photography provides cost savings across the company and also is a means of improving the data quality.

Recent data enhancement initiatives include the criticality project, addition of easements, and conversion from NZMG to NZTM and communication features. The criticality project leverages the GIS data to optimise asset replacement decisions. The addition of easements is particularly important for managing the associated legal risks and responsibilities. The communication features allow proper recording of the existing and likely future growth of communication assets. WEL continues to reap the benefits from these initiatives.

The data enhancements planned for the future include, improvements in connectivity, inclusion of photographs, correction of errors in readiness for the next upgrade, faster transfers from the GIS to SINCAL, more aerial photography, electronic capture of field data, and greater system integration.

2.6.3.2 Network Management System

WEL completed a project to replace its network management systems by the end of the 2010 financial year. These systems consist of SCADA (Supervisory Control and Data Acquisition), OMS (Outage Management System), Trouble Call Management functions. The primary functions of the NMS are to provide a real time operator, call, and dispatch interface for the safe management of the network, efficient customer service and to ensure security, reliability and management of system utilisation.

Access to NMS functionality is controlled in a secure authorisation hierarchy. System Management, System Administration, Operator, Call Taker, Dispatcher, Engineering, Report Access or View Only provide different levels of system access. Access can be via a full client installed on a workstation or through a web browser.

Another part of the NMS is load management. Load management is used to minimise WEL's exposure to Transpower peak demand charges as well as assisting in management of network utilisation and improvement in load factor. WEL uses a standalone load management package which interfaces through NMS to provide load control commands to the network. This load management system was implemented in conjunction with the NMS.

All data collected from the field and other operational data is presented to the operator in a clear and concise manner providing critical information and control to the 24 hourly manned control room. The operator is alerted audibly and visually to events important to the operation of the network.

Specific functions performed using NMS include automatic and manual load control, network switching, fault restoration, real-time system monitoring, retrieval of historic load information for planning, retrieval of relay flag information for fault determination and analysis. The TrendSCADA module provides long term storage, retrieval and trending of analogue data for engineering use.

The NMS keeps permanent records of all significant events and selected parameters and provides auditable reports to meet regulatory requirements and performance indicators. Data held includes real-time and historic voltages, currents and power levels for significant items of equipment, system configuration information, alarms, operator action logs, equipment ratings and operating instructions.

DMS (Distribution Management System)

The DMS provides an integration of the Control Centre operational procedures and processes providing one view of SCADA and the OMS analysis and reporting functions sharing one database. The DMS also allows for operators, dispatchers, reliability analysts and managers to each have access to the same pool of real time and historical information.

All switching management steps (preparation, validation and execution) are preformed within the NMS system without the use of printed material and make use of the built in safely logic through all stages.

The DMS provides real time state information to the OMS to allow for the capture and recording of reliability data.

The DMS maintains a connectivity model of the network, but does not include enough information to perform network calculations.

OMS (Outage Management System)

The new OMS was commissioning in the first quarter of this year and is an application designed to aid in the management, prioritisation and administration of outages on the network and individual customers.

OMS automatically associates customer call taker calls and clusters of calls to the one incident and to the respective devices supplying them. To do this OMS relies on the ICP to transformer relationship of the ICP database and the connectivity of the DMS.

The customer calls are automatically updated into the trouble call system which, along with real time events from SCADA, allow for logical prediction or confirmation of the outage area and fault location.

OMS is also used for the capture and recording of reliability data such as SAIDI and is used to assess network performance.

Trouble Call Management System

WEL Networks contracts its call taking and after hours dispatch activities to a remotely located call centre. The call taker function provided in NMS records all incoming customer calls and makes them available to the trouble call system for dispatch of field staff and OMS grouping and fault prediction functions. The call taker and trouble call systems are provided though web browser access to the call centre providing constant updates on outage progress.

Call Taker, through OMS, can be interfaced with an Interactive Voice Recorder (IVR) to automatically update customers with known outage information and predicted restoration

Load Management System

WEL's load management system provides centralised intelligence to monitor regional and network peak demands, calculating and forecasting the half hourly demands, and managing control of interruptible load within service levels to ensure demand does not exceed targets. New RCPD (Regional Coincident Peak Demand) functionality has been developed to coordinate WEL's load control with regional demand. Other controls provided by the load management system include street lighting and meter tariff rate control. The load management system provides its output to NMS which provides the monitoring and load control interface with the network.

NMS Development Planning

Below are listed some of the future developments planned for the system over the next few years –

- Distribution automation support providing for automated switching sequences.
- Continued report development. This is primarily focussed on providing information to support and analysis for improvement to CAIDI and SAIDI.
- A new release upgrade is anticipated to be performed in the 2011/12 year to provide enhanced functionality related to switching management.
- Support for Transpower's implementation of ICCP (Inter-Control Centre Communications Protocol)
- OMS interface for smart networks outage notifications.
- Perform a major upgrade in the 2013/14 year which will incorporate hardware, database and operating system upgrades.

2.6.3.3 Installation Control Point (ICP) Database

The ICP database contains all relevant information on all of WEL's ICPs. The DMS ICP to Transformer connectivity will be for the calculation of reliability performance figures. The ICP database is used directly by the OMS and call centre applications for their operation.

Data stored within the ICP database comes from a variety of sources including the customer, WEL GIS, retailers and electrical inspectors. Much of the data transfer between the parties relies on manual processes. There are therefore checks in place to ensure data integrity. WEL has staff dedicated to identifying, investigating and correcting suspect data. This is an ongoing process.

2.6.3.4 PSS SINCAL (Power Analysis Tool)

PSS SINCAL is an application that uses physical attribute information from GIS to create an electrical model of the network. Load flow calculations can be used by system control staff to assess the feasibility of proposed actions, and by network planning staff in assessing the suitability of proposed asset investments. PSS SINCAL also calculates fault levels used in determining protection settings.

Data held within the application includes construction dictionary information and geographical, physical and electrical information relating to the network. The quality of the network information relates to the quality of data stored within the GIS. Fault levels have been validated using actual fault levels recorded in the field by protection relays. The quality of dictionary information relies on new conductor types being added to the dictionary whenever they are installed on the network.

2.6.3.5 SAP Enterprise Resource Planning (ERP) System

SAP has been implemented to replace the current Navision (Financial), MAXIMO (asset and maintenance management system) and CALIB (Capital Project Library). This allows for full systems integration between the functional areas of finance, asset management, maintenance, capital works and procurement, with the additional functionality of the Prometheus system for works and resource scheduling.

The plant maintenance module in SAP provides a primary database of network equipment and locations where equipment is installed. It is used to manage all maintenance and capital work on the network through the work orders application and further application modules are used for inventory management and purchasing.

For preventative maintenance, a maintenance task is assigned to each equipment item and these then create work orders for the performance of that work at defined intervals. The condition measurements for each item of equipment and the actual costs of the maintenance task are captured.

Faults and corrective maintenance tasks generate work orders and costs, activity and failure codes are recorded against equipment.

Capital works involve work orders being created for the construction of each new equipment item with costs being captured against these.

The system is deployed throughout the company and selected contractors. Comparison of data against other systems and checking by field inspection is continuing to improve the quality and completeness of data. Each asset is assigned a unique number which is used to track an asset when it is moved from one location to another. Where practical these numbers are physically attached to new equipment.

A future enhancement will be the development of the Business Intelligence functionality offered by SAP. A Business Intelligence (BI) Steering Committee has been established to ensure optimal development of this powerful data reporting tool in support of business and operational decision making.

2.6.3.6 Vegetation Management Database (VMD)

This application was commissioned by WEL in order to better manage the tracking of vegetation removal. It has a graphical interface which is derived from a landbase and GIS extract. All vegetation is recorded in the system and registered against a span or sub-span of line. Information includes the priority, owner, species, previous work, previous notifications and other notes as required.

Job cards are created from the system and direct field work. Periodic field patrols are done to update information into the system.

The interface allows tree issues to be visually observed in a spatial mapping environment.

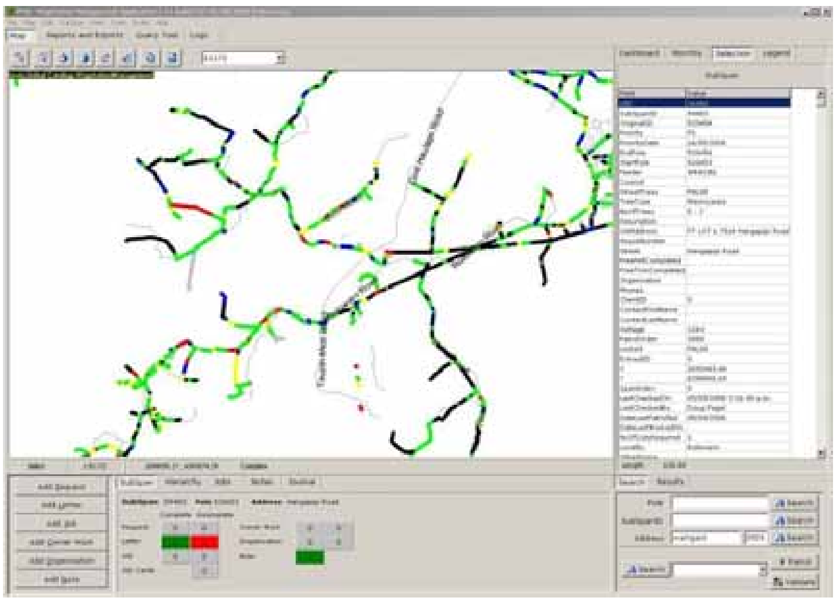


Figure 11. Screen Shot of Vegetation Management Database

2.6.3.7 *Asset Information System (AIS)*

The AIS is designed to provide an accurate, consistent and repeatable source of reporting data. The initial focus is to satisfy the regulatory financial reporting requirements. It is also intended to support ad hoc queries regarding such things as line lengths, classified in a variety of ways. The other important role of the AIS is to provide base data for the pricing model.

The AIS is a data warehouse application, which typically requires consistent data across a number of systems. Much effort was devoted to the establishment of a sound set of base data to support the AIS. As part of the implementation continuous data checking is being implemented to identify any new errors that are detected once the system is operational.

2.6.3.8 *Data Integrity Checking System*

Pervasive Data Profiler was purchased to provide a data integrity check between systems. The initial focus was to satisfy the successful implementation of the Asset Information System (AIS) last year. In addition to the data cross check between the GIS and SAP, the system has been used to ensure data integrity between GIS and ICP, GIS and SCADA, etc.

2.6.4 Systems Data Flow

The flow of data between the applications described above is shown in Figure 12.

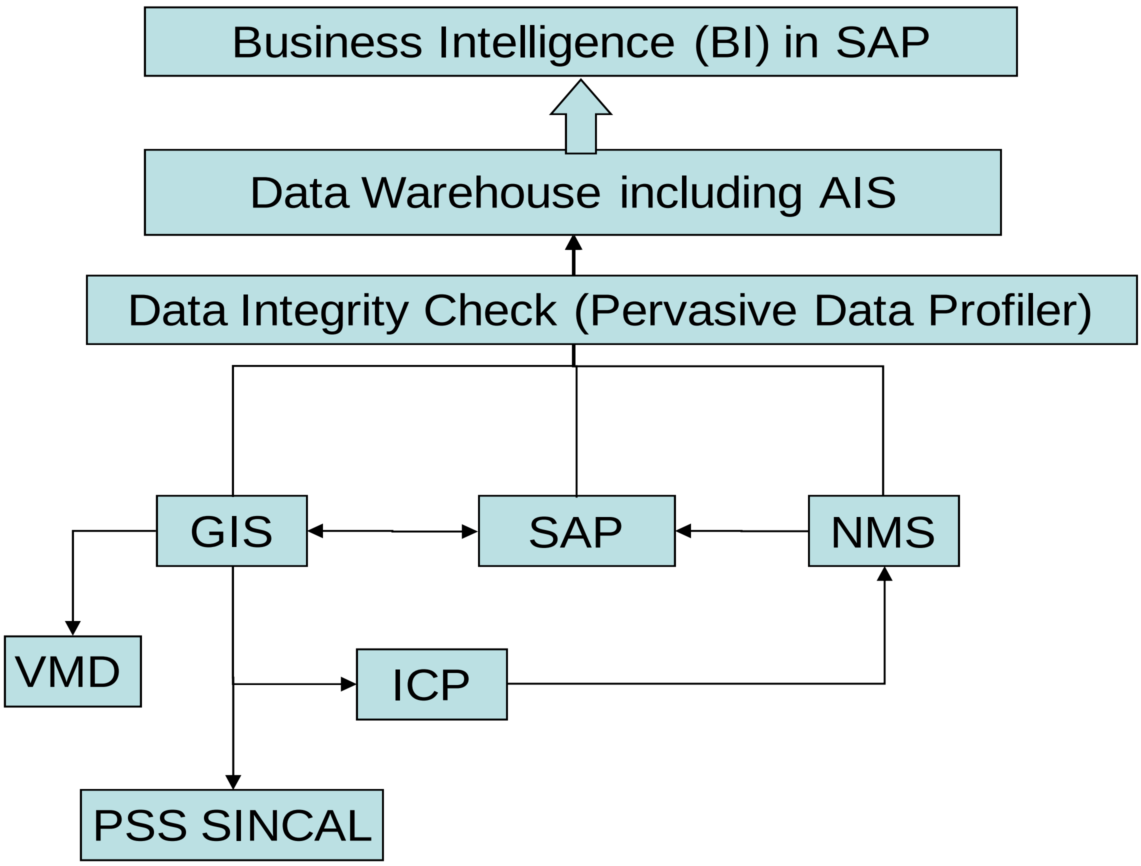


Figure 12. Data flow between applications.

Refer to Appendix 1 for an explanation of acronyms used.

2.6.5 System And Data Ownership

As part of the SAP implementation programme clear ownership of data has been defined. This was done to clearly differentiate between the management of the Information Technology (IT) and associated software, which is a service provided by the IT department, and the ownership of the data which is vested with the primary users of the data and system functionality.

A review of the company's IT and IS strategy has been completed by PricewaterhouseCoopers (PwC). This has resulted in a clearer definition of data ownership and IT/IS accountabilities. Resourcing for ensuring appropriate staffing levels to provide excellent service has also been addressed, including a better focus on service delivery through the implementation of a Help Desk function.

WEL has adopted a policy of allocating Business Process Owners representing the primary users of the system supported by the IT department. The system owners are responsible for the accuracy and timeliness of collection of the data.

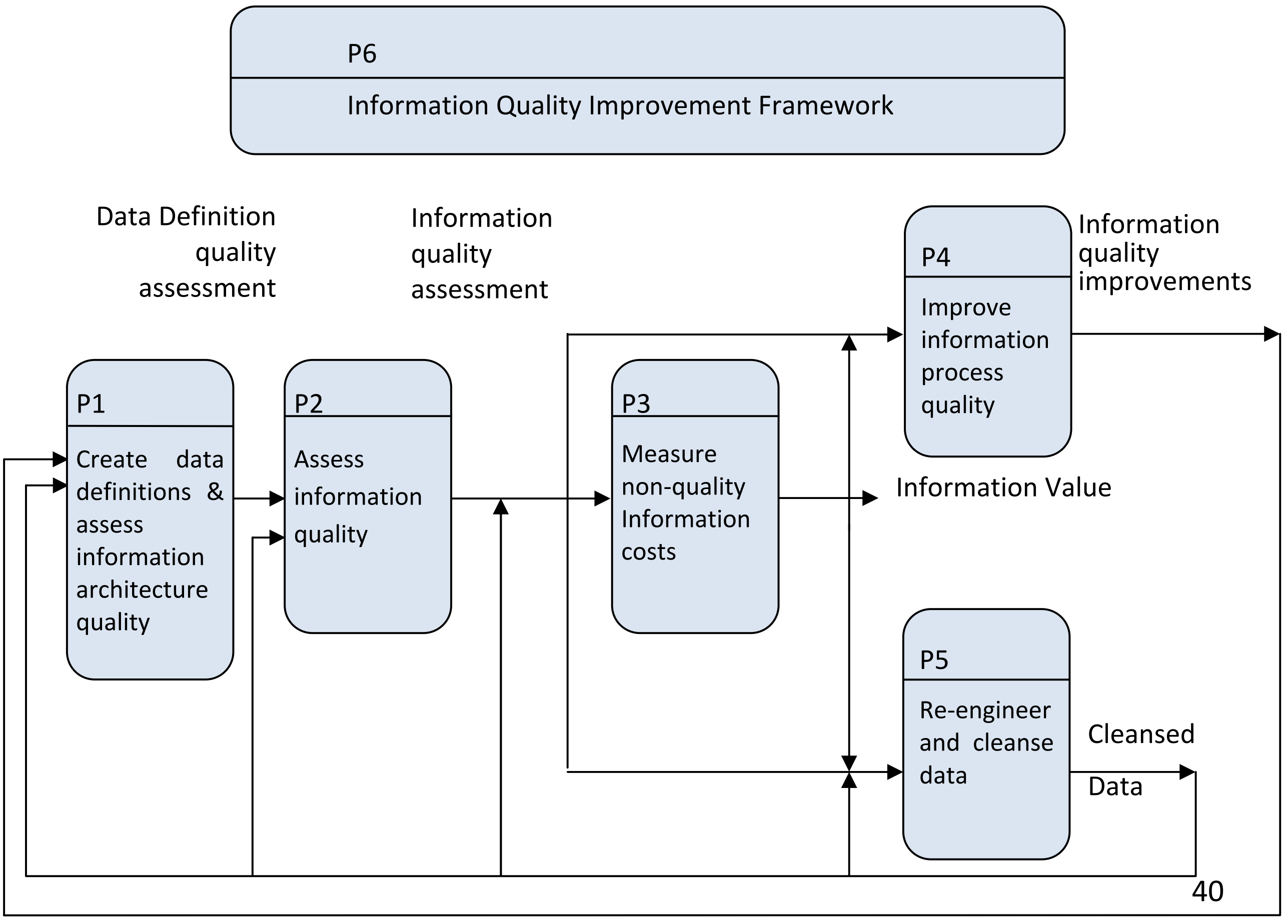
2.6.6 Information Framework And Integrity Assurance

Six years ago a specialist data quality position was created within WEL and since then that role has driven a process of continual data quality improvement. The role has now expanded to cover all asset information across the company. The position is responsible for the overall data quality standards and delivery of quality data.

Recently WEL conducted a data quality assessment across the whole company. This measures the current level of data quality within the company and a framework, which guides systematic, continuous improvement.

WEL adopted an information framework that is shown below:

Figure 13. Generic Information Framework.



2.7 Best Practice

WEL's asset management practices are aligned with the following industry best practice:

PAS 55 Publicly Available Specification for the Optimised Management of Physical Assets and Infrastructure

International Infrastructure Management Manual 2006 (IIMM)

PAS 55 was developed by the Institute of Asset Management (IAM) in the United Kingdom as a standard for carrying out asset management. It is made up of two parts; the first (PAS 55-1) provides the specification for optimised management of physical infrastructure assets while the second (PAS 55-2) provides guidelines for the application of PAS 55-1.

It is based on the business cycle of continuous improvement and covers the following major areas:

- Asset management system
- Policy and strategy
- Asset management information, risk assessment and planning
- Implementation and operation
- Checking and corrective action
- Management review

WEL's asset management practice was independently reviewed by Sinclair Knight Merz (SKM) against PAS 55 in February 2008. The review was completed through an iterative process of identifying the requirements of the various sections in the standard in order to select appropriate WEL documents on processes, followed by discussions leading to the provision of further supporting data as appropriate.

SKM's view on the wider issue of meeting the requirements of PAS 55 -1 is that the present processes and practices adopted by WEL substantially meet the requirements and are clearly focussed to achieve the stated objective of good asset management and are generally in line with good industry practices.

WEL uses regular benchmarking exercises to identify gaps for improvement.

Photo 5 Hampton Downs Substation

3 ASSETS COVERED

3.1 A High Level Description Of The Distribution Area

3.1.1 WEL Distribution Area Description

WEL supplies power to the North Waikato region, which includes the population centres and surrounding rural areas of Hamilton City and the towns of Raglan, Gordonton, Horotiu, Ngaruawahia, Huntly, Te Kauwhata and Maramarua. The WEL supply area is predominantly agricultural in nature and the land is largely flat to rolling with areas of peat and some moderately steep country. Below is a map of the WEL Networks coverage area.

Figure 14. A map of the WEL Networks coverage area

The following Figures outline the areas WEL supplies. The full name for each acronym along with zone substation capacities, capacity utilisation, and number of customers supplied and security class by each zone substation are provided in Section 3.2.3.

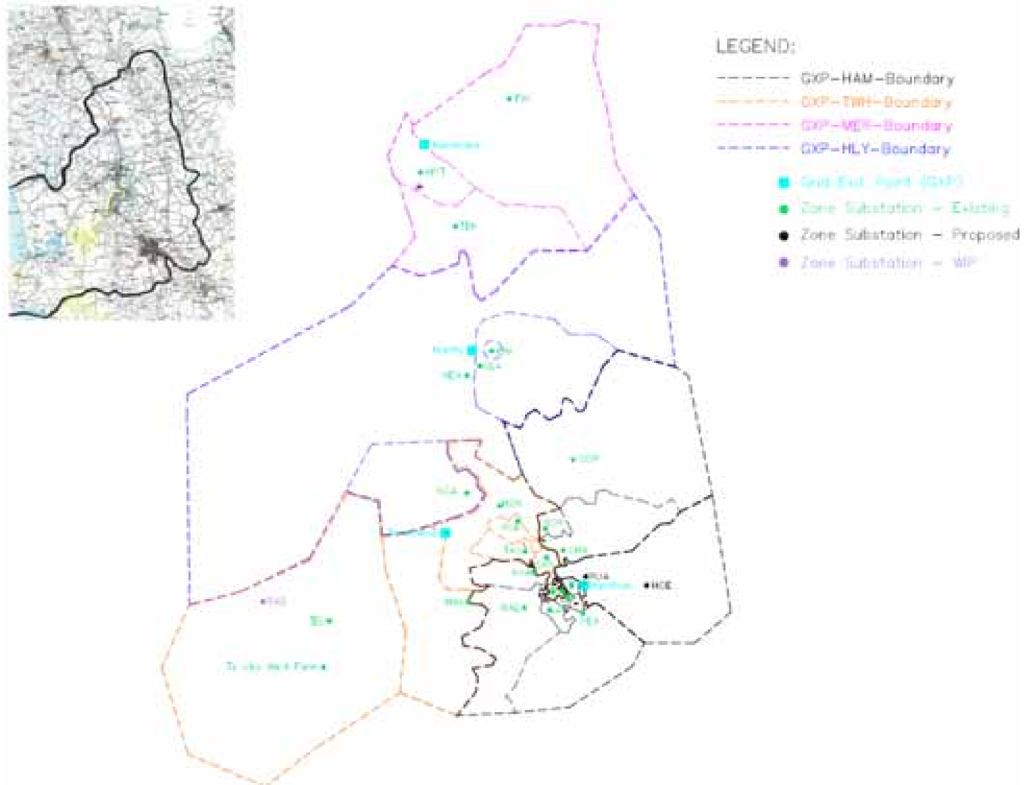


Figure 15. Points of Supply, existing zone substations, associated supply zones and proposed zone substations.

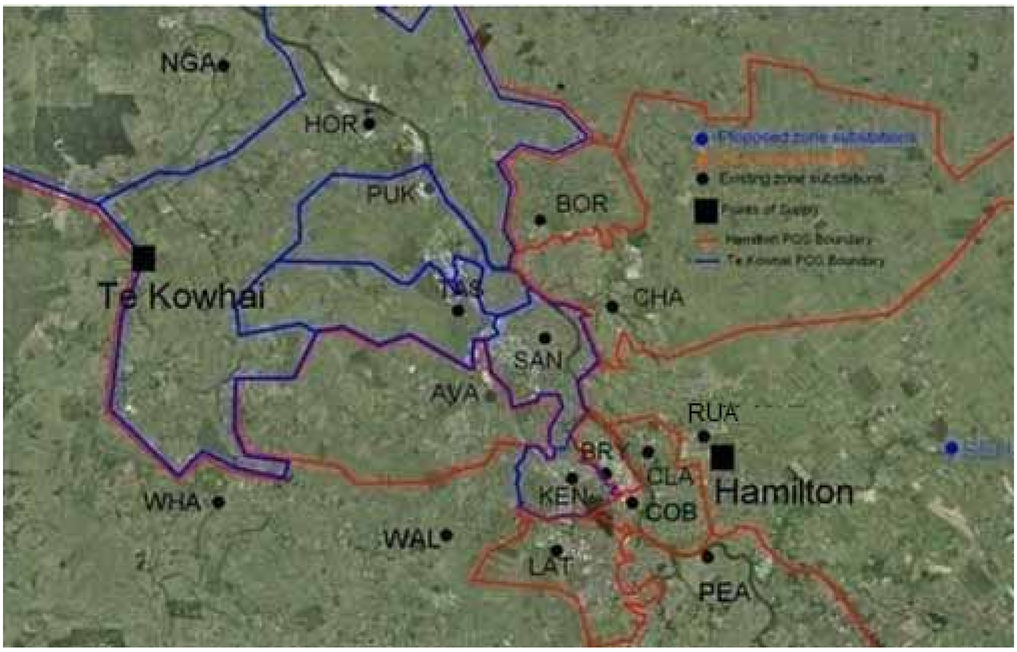


Figure 16. Hamilton City zone substations and associated supply zones.

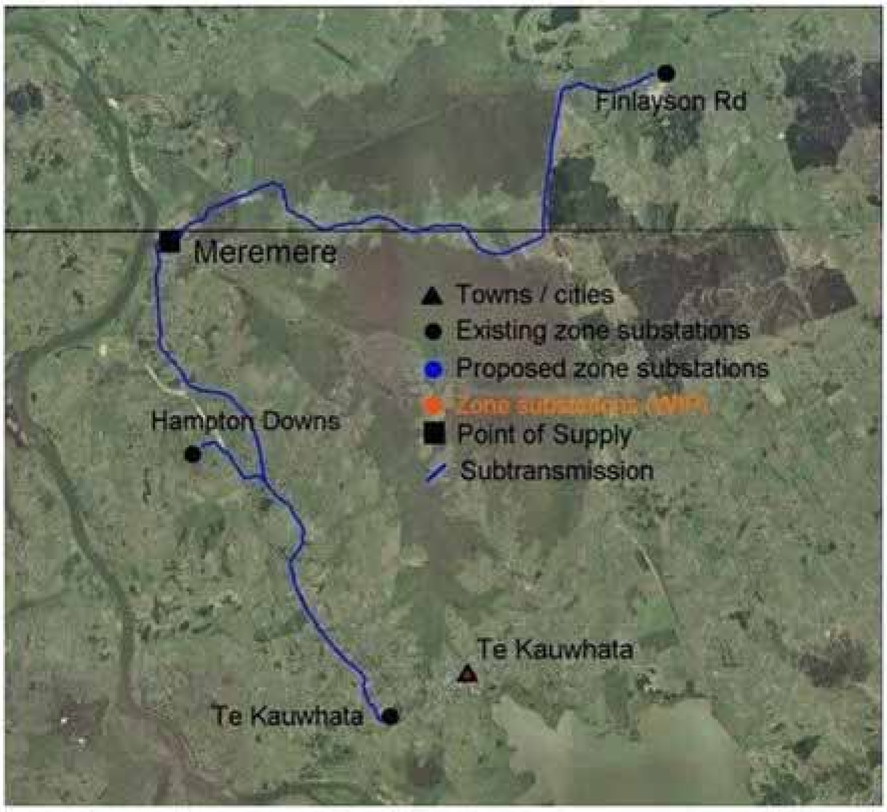


Figure 17. North Waikato Area 33kV Sub-transmission Network

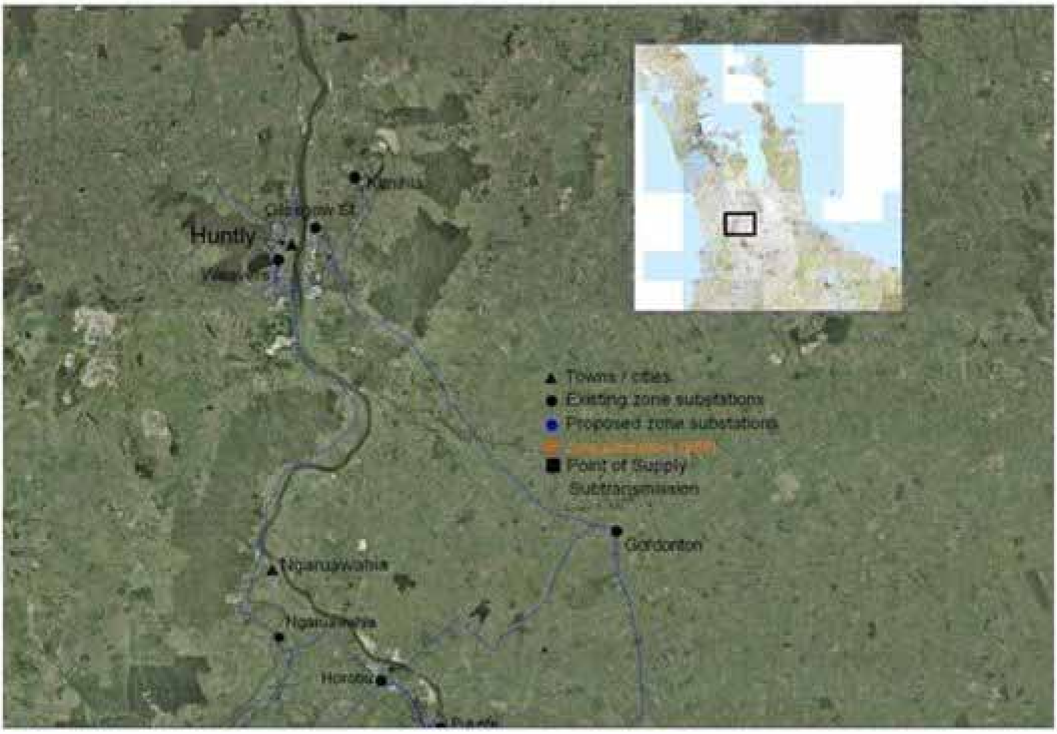


Figure 18. Huntly Area 33kV Sub-transmission Network.

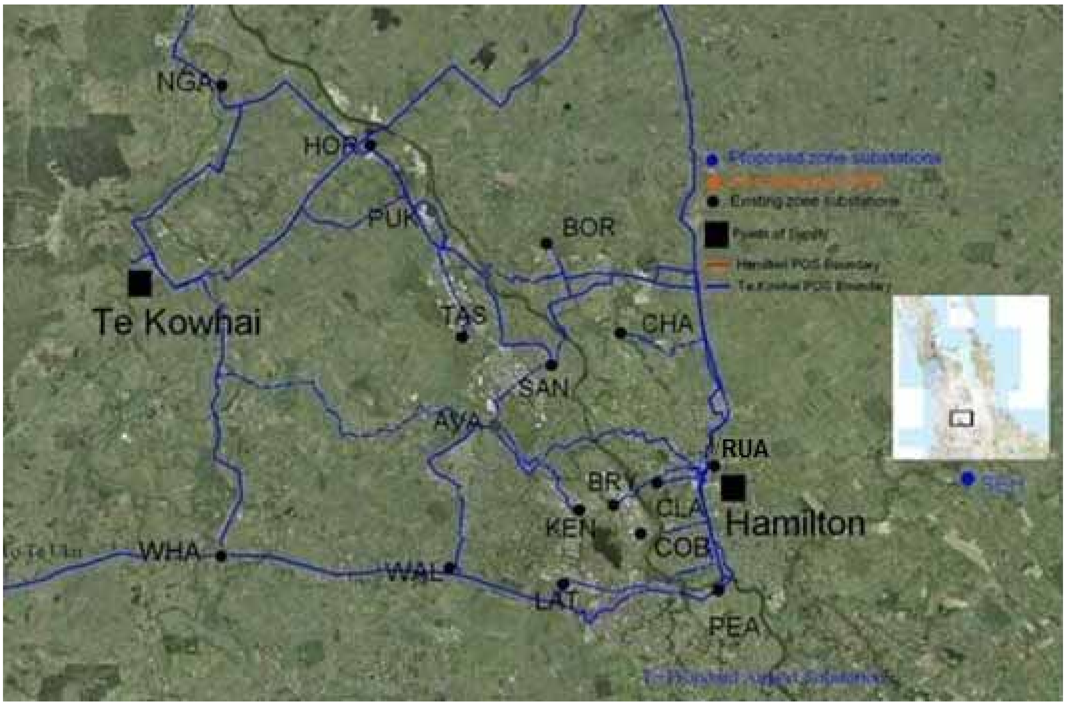


Figure 19. Central Waikato 33kV Sub-transmission Network

3.1.2 Large Customers

The Waikato is a major dairying area and has a number of large dairy based processing facilities. Dairying and pastoral farming contribute approximately $6.8 billion to the regional economy.

The Waikato is also strong in manufacturing, with an economic contribution of $2 billion (primarily plastics, food processing, packaging, light aircraft and small boat manufacture), and education and science with $800 million (the region undertakes 25% of New Zealand's research).

WEL's mass market customer base (residential and small commercial customers) represents 99% of the connections, but takes 60% of total volume conveyed through the network. WEL's top 50 customers represent 20% (approx.) of volume conveyed.

The 600 (approx.) large commercial and industrial customers are time of use metered and a demand based line charge is applied. The line charge includes a monthly peak demand based price signal, which loosely represents a congestion related price signal.

WEL's annual asset planning programme includes a number of initiatives aimed at understanding customer needs and building these into the price/quality trade-off that ensures service levels continue to meet expectations. The interaction also aims to derive growth trends and increases in, or new, point loads around our network.

Initiatives undertaken through the year include:

- supporting specific customer enquiries and assisting regional economic growth initiatives to encourage connections where there is sufficient inherent network capacity to supply
- facilitating access to WEL project staff for load growth investments
- undertaking surveys to better understand the needs of major customers; including future load needs, price versus quality and how this might differ from residential consumers, as well as reliability of supply issues and requirements

- regular meetings/visits/phone or email conversations to keep major customers abreast of electricity industry changes, WEL strategic directions etc.
- staging major customer seminars each year, to help maintain a close relationship and to inform key customers of trends, industry issues and demand management related initiatives.

Over the next few years WEL aims to introduce a number of commercial arrangements with the intent being to improve the network load factor and hence asset utilisation. These initiatives will include stronger demand management incentives and opportunities for customers, as well as contracted emergency load interruptions where the cost of maintaining required levels of security of supply greatly exceeds the value of interruption for selected loads. Opportunities will be investigated in consultation with our larger customers, and the introduction of our smart grid initiatives will help source demand-side responses from mass market customer connections.

3.1.3 Network Load Characteristics

The charts in Appendix 3 and Table 5 for Zone substations show the customer types supplied by each zone substation. There is a clear relationship between customer type and load characteristic. As such it is possible to establish general load characteristics for different parts of WEL's network.

Analysis of the charts reveals that all zones are made up of a high proportion of residential customers. Bryce Street and Finlayson Road have the lowest proportion of residential customers with around 50-60 percent.

Zones with the most agricultural, forestry and mining customers are Weavers, Hamilton 11kV, Gordonton, Wallace Road and Finlayson Road, in that order. Commercial customer categories such as Retail Trade, Accommodation, Cafes and Restaurants, Property and Business Services and Financial and Insurance are most prevalent in Bryce Street and Claudelands. This makes sense as these zone substations supply the Hamilton CBD.

The manufacturing sector is best represented in Kent Street, Latham Court, Sandwich Road and Tasman Road.

3.1.4 Peak Load and Total Electricity Delivered

The highest peak demand over the 2010/2011 financial year for WEL's network was 249 MW. The coincident system peak demand with RCPD was 216MW. The highest peak demand so far for the 2011/12 financial year is 247MW (to end of August 2011).

These figures are derived by summing the total demands incurred at the Transpower Grid Exit Points plus any embedded network generation export. As such, the figures stated represent the peak power consumed by WEL's customers plus WEL's network losses.

The total amount of energy supplied by WEL over the 2010/2011 financial year was 1237 GWh. This figure was derived by summing the energy supplied through Transpower Grid Exit Points plus the energy supplied from embedded network generation export. The figure therefore includes WEL's network losses.

3.2 Description Of Network Configuration

3.2.1 Grid Exit Points and Embedded Generation

WEL takes supply from Transpower Grid Exit Points (GXPs) at Hamilton, Meremere, Huntly and Te Kowhai as well as from embedded generation. Contact operates an embedded 50MVA co-generation plant at Fonterra which connects to the Pukete zone substation. Meridian owns the 65 MW generation at the Te Uku wind farm. Embedded generation is not factored into WEL's firm capacity levels.

Table 4 Grid Exit Point Capacities

Grid Exit Point	Transformers	Installed Capacity	Firm Capacity N-1	Post Contingent Limits	Connections
Hamilton 33kV	100+120 MVA	220 MVA	100 MVA	132 MVA	41,150
Hamilton 11kV	2 x 40 MVA	80 MVA	40 MVA	40 MVA	12,909
Te Kowhai 33kV[1]	2 x 100 MVA	200 MVA	100 MVA	109 MVA*	20,767
Meremere 33kV[2]	Nil	14 MVA	4.5 MVA*	4.5 MVA*	2,703
Huntly 33kV	2 x 60 MVA	120 MVA	60 MVA	82 MVA	5,981

Note 1: Planned to be upgraded to 137MVA.

Note 2: Backfed via 11kV from Huntly GXP.

Hamilton GXP supplies power to WEL at both 33kV and 11kV while Meremere, Huntly and Te Kowhai supply power at 33kV only. Hamilton, Te Kowhai and Huntly GXPs are interconnected through WEL's 33kV sub-transmission network. There is no 33kV connection between the Meremere, and either Huntly or Te Kowhai systems. WEL's 33kV sub-transmission system is a mix of underground cables and overhead lines.

Construction is currently under way for the installation of 33kV cables to connect Huntly to Te Kauwhata, Maramarua and surrounding areas. Once this happens the Meremere GXP may no longer be required in the longer term (will be reviewed after 2016). This will ensure the northern-most area of our network is no longer reliant on a single Transpower 33kV line from Bombay substation.

Schematic diagrams of the GXPs and the WEL 33kV sub-transmission system are included in Appendix 4.

3.2.2 Sub-Transmission System

The supply to the Hamilton CBD is by underground 33kV feeder-transformer circuits with all underground distribution at 11kV.

The 33kV supply to the suburban areas of Hamilton is by a closed 33kV mesh connected system which enhances delivery and reliability and also provides (N-1) security. All zone substations located in Hamilton have dual transformer banks and the 11kV distribution is a radial system with interconnection points.

In rural areas 33kV sub-transmission is primarily radial with limited interconnection capability through the 11kV system.

Both the 33kV sub-transmission and 11kV distribution systems are more of overhead construction except where they traverse the residential areas of Hamilton.

Photo 6 WEL Control Centre

3.2.3 Key Information for Zone Substations

Table 5 Key information for Zone Substations As At 31 August 2011

Code	Full Name	Installed Capacity (MVA)	Firm Capacity N-1 (MVA)	Emergency Capacity 4 hours (MVA)	Capacity Utilisation (2011 Winter)	Customers Supplied	Customer load Type	Security Class required	Security class achieved - 1st interruption
AVA	Avalon Drive	46	23	28	38%	5420	Industrial, Commercial and Residential	C2	C2
BOR	Borman	46	23	28	19%	2762	Residential & light commercial	C3	C3
BRY	Bryce St	46	23	23	40%	2165	Central Business District	C2	C2
CHA	Chartwell	46	23	28	49%	7044	Residential & light commercial	C3	C3
CLA	Claudelands	46	23	28	34%	5595	Residential, light commercial & Central Business District	C2	C2
COB	Cobham	46	23	28	33%	2418	Central Business District and Residential	C2	C2
FIN	Finlayson Road	7.5	7.5	7.5	62%	1088	Residential & light commercial	B2	B3
GLA	Glasgow Street	10	10	15	74%	2492	Residential and commercial	B1	B1
GOR	Gordonton	10	5	7.5	64%	1520	Rural and Residential	B1	B2
HAM 11	Hamilton 11kV	80	40	40	47%	12909	Residential & light commercial	D	D
HOR	Horotiu	20	10	15	45%	2823	Industrial and Rural	B1	C3
HPT	Hampton Downs	10	10	15	17%	334	Rural and commercial	B3	B2
KEN	Kent Street	46	23	23	36%	4254	Industrial, commercial & residential	C2	C2
KIM	Kimihia	10	1.5	1.5	26%	1	Industrial	B2	B1
LAT	Latham Court	30	15	15	59%	4503	Industrial and commercial	C3	C3
NGA	Ngaruawahia	15	7.5	7.5	35%	1830	Residential & light commercial	B1	C3*
PEA	Peacockes Road	20	10	15	71%	4525	Residential & light commercial	C3	C3
PUK	Pukete 11	30	15	15	25%	1498	Residential & light commercial	C3	C3
SAN	Sandwich Road	46	23	28	43%	5059	Residential & light commercial	C3	C3
TAS	Tasman Road	46	23	28	42%	1228	Commercial and industrial	C3	C3
TEK	Te Kauwhata	10	5	7.5	42%	1308	Residential & light	B1	B3

Code	Full Name	Installed Capacity (MVA)	Firm Capacity N-1 (MVA)	Emergency Capacity 4 hours (MVA)	Capacity Utilisation (2011 Winter)	Customers Supplied	Customer load Type	Security Class required	Security class achieved - 1st interruption
							commercial		
TEU	Te Uku	10	5	7.5	71%	3063	Rural	B1	A
WAL	Wallace Road	20	10	15	69%	5198	Residential & light commercial	C3	C3
WEA	Weavers	15	7.5	11.25	60%	3489	Residential & light commercial	B1	C3
WHA	Whatawhata	23	23	28	13%	1012	Residential & light commercial	B2	B2

Note 1: *A brief interruption is necessary to perform switching ("switched" N-1 security)

Note 2: Refer to Table 9 for the meaning of security class from A-D.

To meet the "N-1" security criteria peak load must not exceed emergency rating of remaining banks (Emergency Capacity). Plans have been put in place to address the issues identified. Refer to the Network Development Programme in section 5.9 and Appendix 2 for details. In the case of Glasgow Street there is a robust 11kV backup supply of 10 MVA available from Weavers. For Finlayson Road future installation of cooling fans could raise the continuous capacity of the transformer to 10 MVA if needed with load growth.

3.2.4 11kV Distribution Network

The Hamilton CBD 11kV distribution system is a radial system with 11kV trunk feeders interconnecting and meshing the central zone substations ensuring (N-1) system security. There is redundancy on the 11kV networks, as is typical of high reliability underground networks serving CBD areas.

The general 11kV distribution systems are mostly of overhead construction except where they traverse the residential areas of Hamilton, which are underground cabling networks. All new subdivisions, whether they are rural or urban, are reticulated with underground cables in accordance with District Plan Requirements.

Distribution sub stations are of four main types consisting of, industrial/commercial, residential berm, pole mounted and rural.

Industrial and commercial distribution substations are enclosed, ground mounted transformers with integrated high voltage switchgear enclosed or adjacent to the unit and are site specific or distributed to a small number of customers. Low voltage distribution to the customer from these units is from either fuses or circuit breakers with the unit.

Residential berm type substations are enclosed ground mounted transformers with integrated high voltage switchgear enclosed or adjacent to the unit and with low voltage distribution to the customer from these units via fuses to generally underground cable distribution networks.

Residential pole type substations are mounted on poles with high voltage fuses adjacent to the unit and with low voltage distribution to the customer from these units via fuses to generally overhead distribution networks.

Rural pole type substations are mounted on poles with high voltage fuses adjacent to the unit and with low voltage distribution to a small number of customers or a single customer from these units via fuses into an overhead distribution network.

3.2.5 LV Network

Approximately 50% of the overall low voltage network is reticulated via overhead lines (approximately 90% of the rural and 40% of the urban low voltage network is overhead). All new residential subdivisions, whether they are rural or urban, are reticulated with underground cables.

Underground cables are designed to meet the expected loading with growth and are based on optimised industry standard cabling sizes. The overriding design factors in low voltage networks are to ensure voltage management within the statutory limits and to ensure optimal customers per circuit.

3.2.6 Overview of Secondary Assets

Hot water and streetlight load control is managed with 283Hz and 500Hz mains borne ripple signals. Most of WEL's customers have ripple control relays while a small proportion of customers in some parts of the city are controlled via hard-wired pilot cables.

Pilot cables are generally either overhead or underground in accordance with the LV reticulation or protection element requirements.

Protection signalling, SCADA, and remote control communications are transmitted via a comprehensive radio network; this is being progressively extended to improve communication dependability by a fibre optic cable network. There is a copper pilot network still in use in the CBD.

Smart metering devices and associated mesh radio communications infrastructure are planned to be installed from mid 2011 onwards.

3.3 Age Profiles and Condition Assessments

Age profiles and conditions for each asset category is summarised below. Information is collected through field surveys and is stored in the computerised maintenance management system (MAXIMO). The asset inspection, maintenance and renewal programme for each asset category is detailed in section 6.

3.3.1 Assets Owned by WEL at the Points of Supply (GXP)

At the Hamilton 33kV and 11kV points of supply, and at Te Kowhai, the switchgear is owned by Transpower but WEL owns some ancillary equipment consisting of check meters, power supplies, SCADA and communications equipment.

At the Huntly point of supply WEL owns all the equipment on site including the 33kV switchgear and protection equipment. WEL also owns some ancillary equipment consisting of check meters, power supplies, SCADA and communications equipment.

At Transpower Bombay WEL maintains a Remote Terminal Unit that provides breaker status and check metering. (The Bombay substation connects the Meremere GXP).

The equipment at all sites is in good serviceable condition. The 33kV switch gear at Hamilton is planned to be upgraded to an indoor board and expanded over the next two years.

3.3.2 33kV Sub-Transmission Underground Cables

The 33kV sub-transmission circuits in the Hamilton city area are all underground cables. No weaknesses have been reported with these cables. The sub-transmission system was modelled using the PCORP software from which maximum allowable current flows were determined. For future projects use will be made of the more sophisticated ETAP software.

WEL has standardised the use of XLPE insulated single core aluminium conductor cables with copper wire screens. In the mid 1990s some XLPE cables with aluminium screens were installed and these cables are now subject to failure due to water ingress from corroded screens beneath damaged external sheath. These cables are being monitored more closely.

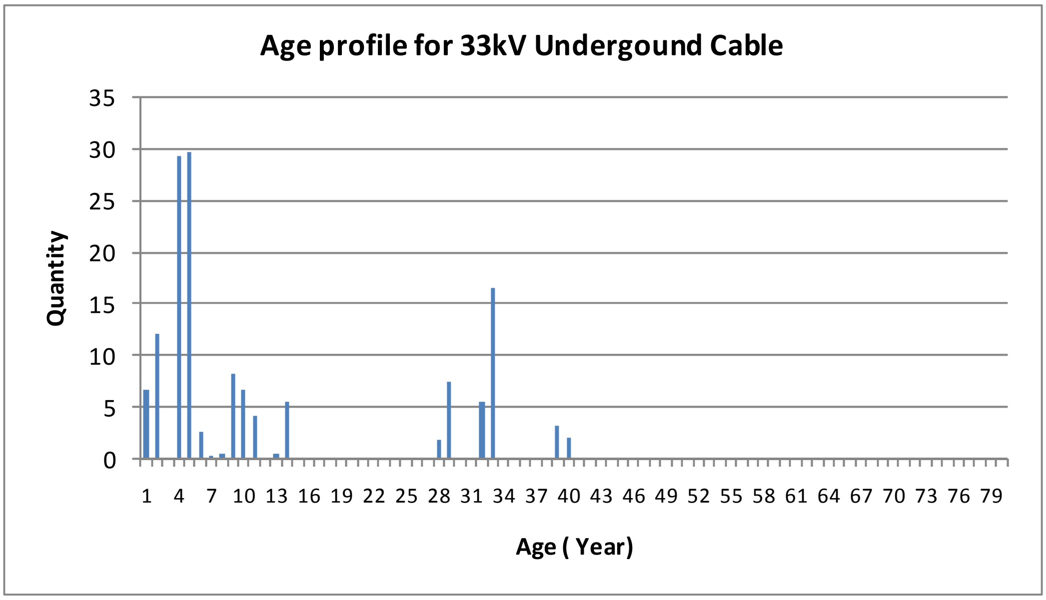


Figure 20. 33kV Sub-transmission Underground Cable – Age Profile

3.3.3 33kV Overhead Lines

In the outer parts of the city and in the outlying areas served by WEL the sub-transmission circuits that were built prior to the last three years are predominantly overhead lines.

Most conductor of this type is still below its nominal lifetime and samples have indicated the condition of the conductor is generally good and better than expected for its age. In some sections where there are high rates of insulator failures, the porcelain insulators are being replaced with polymers to improve reliability.

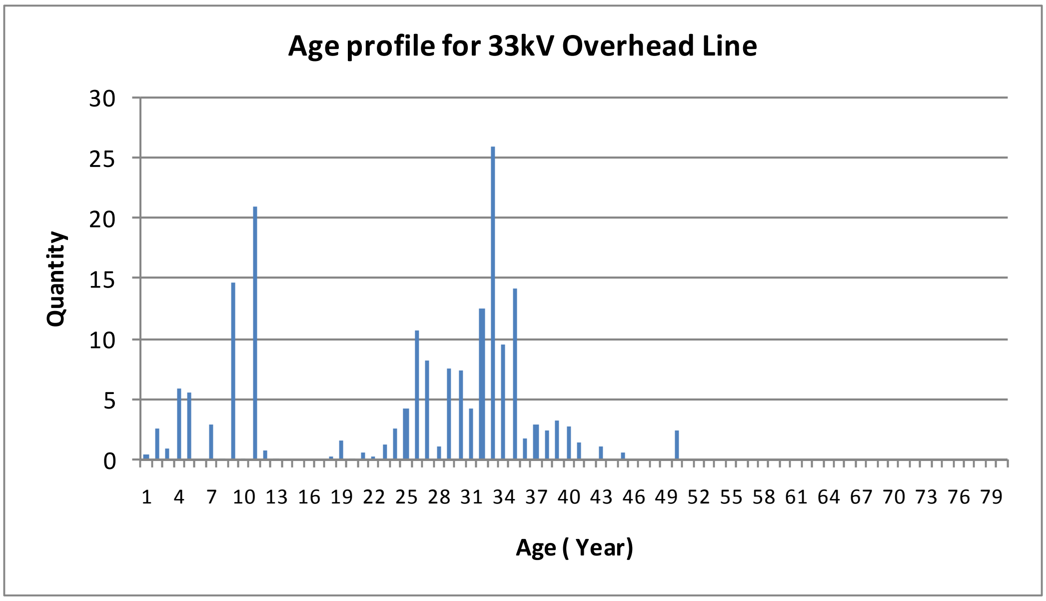


Figure 21. 33kV Overhead Conductors – Age Profile

3.3.4 33kV Circuit Breakers

All 33kV circuit breakers are regularly maintained in accordance with recognised maintenance practices and are in good condition.

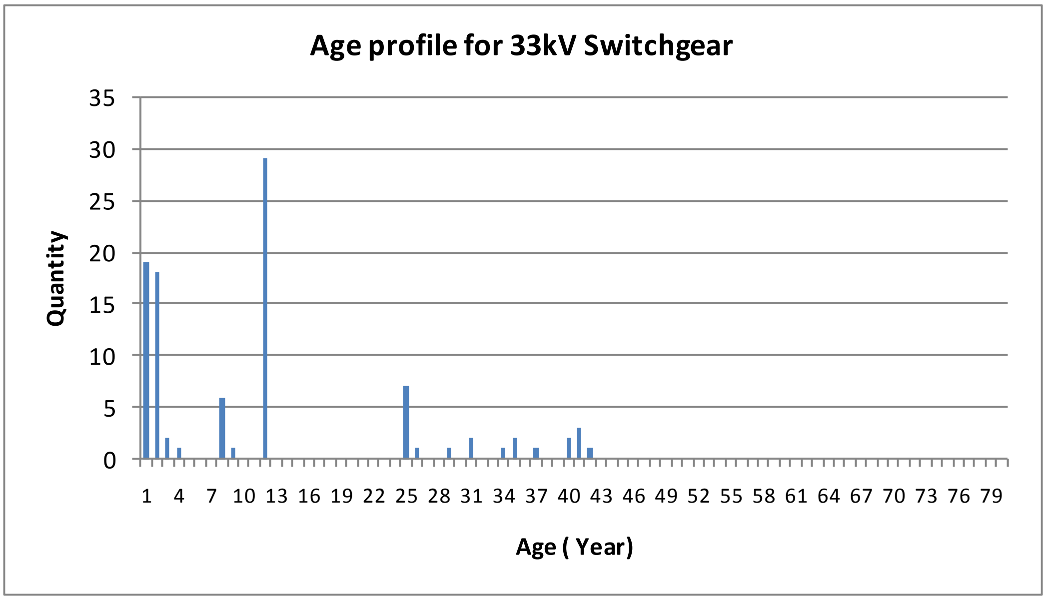


Figure 22. 33kV Circuit Breaker – Age Profile

3.3.5 Zone Substations

Zone substations include the buildings, outdoor structures, foundations, fences, oil interception equipment and auxiliary equipment such as low voltage AC and DC power supplies, that make up the site, but excludes major items of equipment within the zone substation, such as zone transformers and HV circuit breakers which have their own asset categories.

Zone substations are used to transform power from the 33kV sub-transmission voltage to the 11kV distribution voltage. There are 24 zone substations with construction dates ranging from the 1950s to

2011. The zone substations are of varying construction types that reflect the design standards at the time of their construction.

Buildings have been well maintained and are in reasonable condition with some repairs of leaks and painting required. Seismic strengthening has been completed at Sandwich Rd and is in progress at Bryce St substations. Some minor work is required at Glasgow St. Further substations are being evaluated and corrective work will be proposed in the plan.

Risk assessments with respect to public health and safety are undertaken on these assets according to WEL's Public Safety Management System (PSMS). Security fences and other civil works are progressively being upgraded.

All equipment is suitable for its purpose and in a state that is generally aligned to its age.

3.3.6 Zone Substation Transformers

Zone substation transformers are generally in good order. Annual Dissolved Gas Analysis (DGA) has allowed the internal condition of the transformers to be monitored and periodic furans analysis gives an indication of remaining paper life. This has shown that the transformers are in a condition appropriate to their age and there is no evidence of accelerated insulation ageing or deterioration.

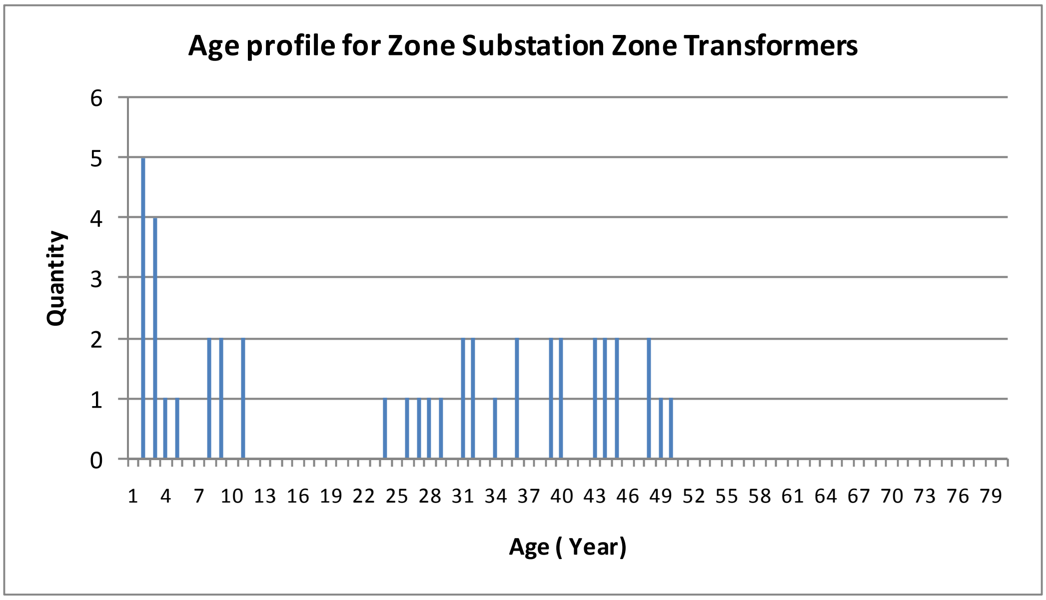


Figure 23. Zone Substation Transformers – Age Profile

3.3.7 11kV Circuit Breakers

Routine condition monitoring so far indicates no significant maintenance problems. Since service operation has been well below operational limits, life expectancy is expected to exceed the standard life of 45 years. Circuit breakers currently being installed are typically of the vacuum type and have low maintenance requirements.

The older switchgear units are of solid construction and remain serviceable. Older items in particular are kept under review through condition monitoring regimes. Switchgear replacement will be arranged where it is found that the condition is unsatisfactory or where equipment fault level capabilities or load ratings are no longer sufficient.

Although a number of electromechanical protection relays will exceed their standard life in the planning period, their condition is still good and they will be replaced in conjunction with the switchgear at these sites as outlined in section 6.4.5

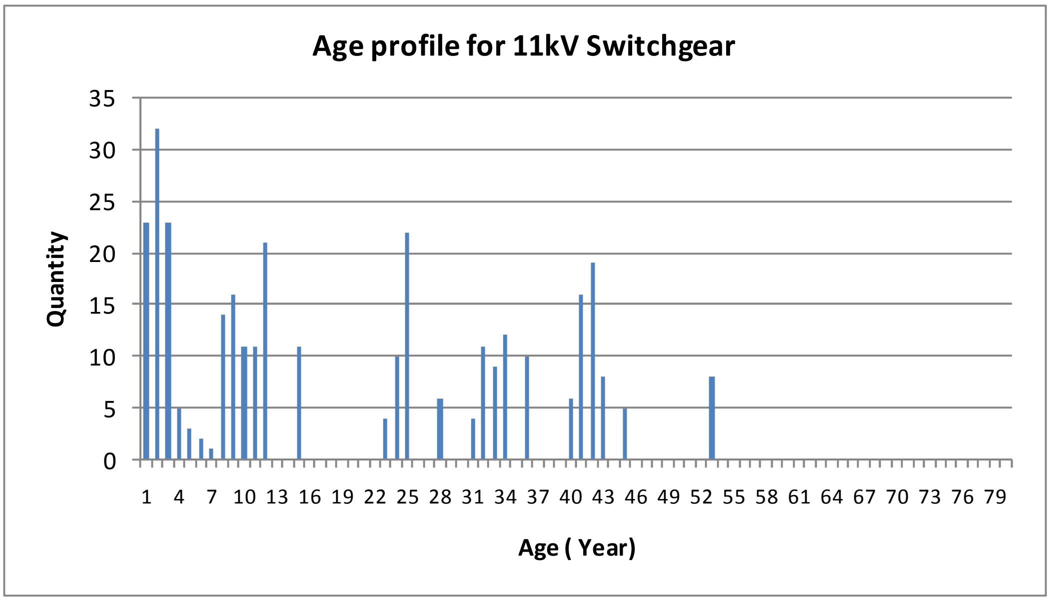


Figure 24. 11kV Switchgear – Age Profile

3.3.8 Distribution 11kV Underground Cables

All of the 11kV cable installed prior to 1976 was PILC. Between 1976 and 1990 XLPE cable was installed in the Hamilton CBD area with predominantly PILC installed in other areas. Since 1990 most cable installations have been XLPE. Though difficult to assess, condition is generally considered to be good. Most faults have occurred at joints and where possible, cable sections are taken for closer examination.

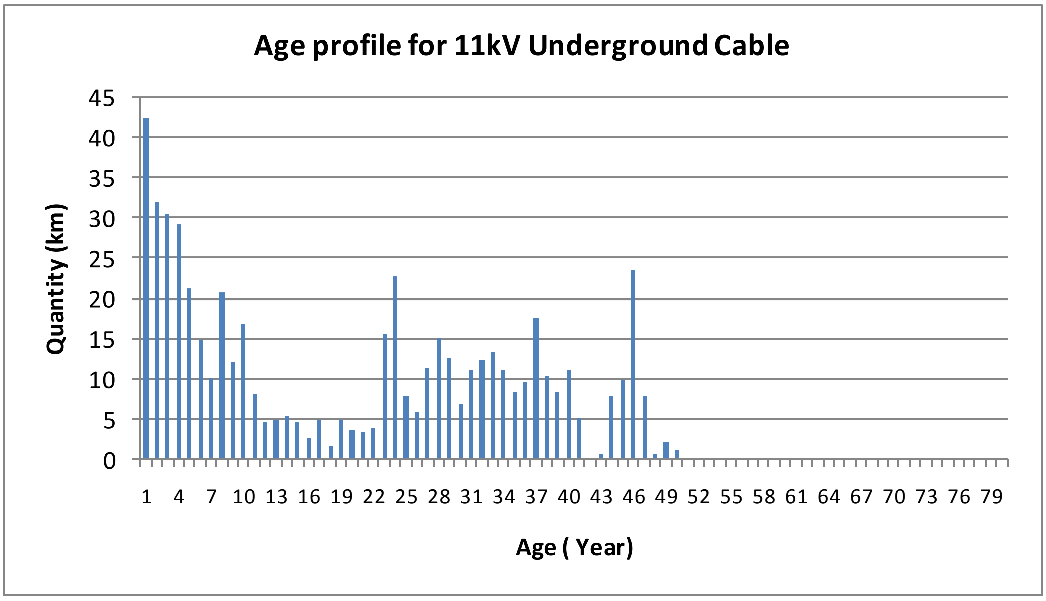


Figure 25. Distribution 11 kV Underground Cables – Age Profile

3.3.9 11kV Overhead Distribution Lines

There are 1,932km of 11kV overhead distribution lines.

The 11kV overhead lines are generally in satisfactory condition, apart from a number of sections of the older 16 mm square copper conductor which is failing due to corrosion. These sections have been identified and an earlier replacement programme will be undertaken. Where practical, any refurbishment is coordinated with the undergrounding plans to avoid unnecessary replacement of overhead lines.

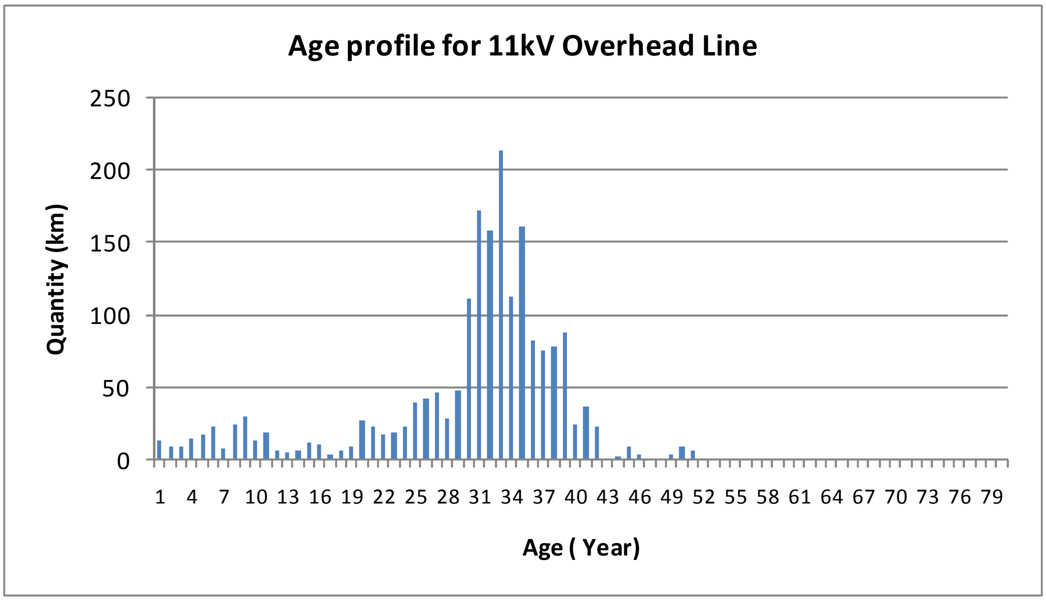


Figure 26. Distribution 11kV Overhead Conductors – Age Profile

3.3.10 Poles Wooden

Given that WEL has approximately 1,200 hardwood poles, most of which will need to be replaced in the 10 year planning period, it has been decided to assess the condition and prioritise the replacement through the use of a radiation backscatter density measurement. It is expected that most of this assessment will be completed in the 2011/12 year. Each pole will be given a replacement date based on the data obtained. Poles found to be in poor condition are programmed for urgent immediate replacement.

Condition assessments, so far, suggest remaining asset life less than initially expected and likely to need replacing before reaching the nominal lifespan. The plan has been updated to reflect this change.

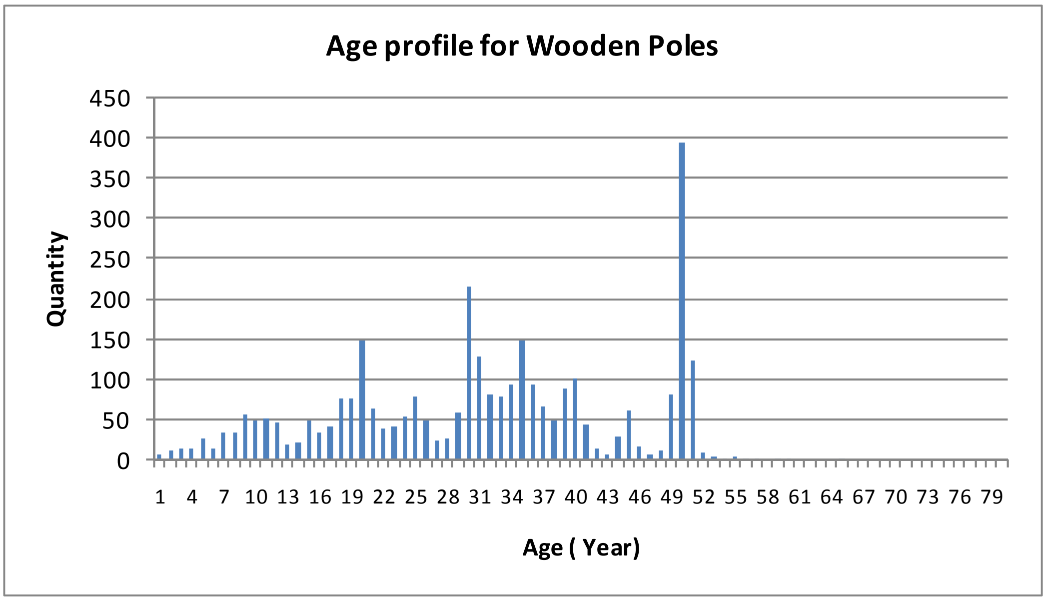


Figure 27. Wooden Poles – Age Profile

3.3.11 Poles Concrete

Concrete poles are generally in good condition and the projected spend on this asset class is minimal over the 11 year planning period. There are however particular types that are more susceptible to concrete spalding and these are being replaced as identified by condition assessment.

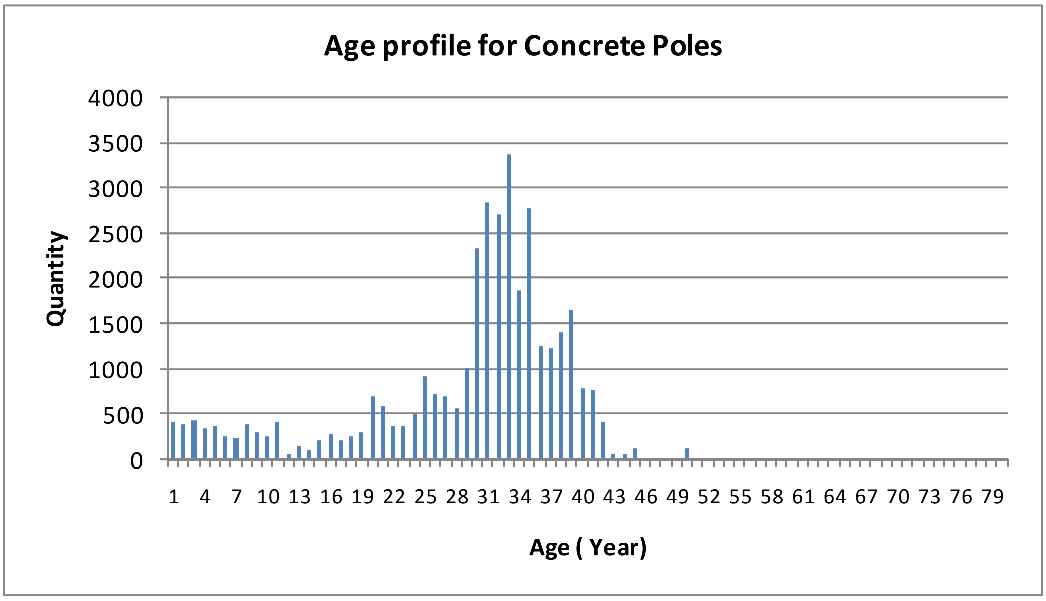


Figure 28. 33kV Concrete Poles – Age Profile

3.3.12 Crossarms

Crossarms are visually inspected as part of the five yearly condition assessments of overhead assets. Those given a poor assessment are then tagged for replacement in the following period's capital programme. Particular insulator types (for example Kidney) are noted and are being progressively replaced. While inspection information suggests crossarm conditions may be slightly better than expected, a full survey has not been completed and there is remaining uncertainty as to exactly when the spend needs to occur within the planning period.

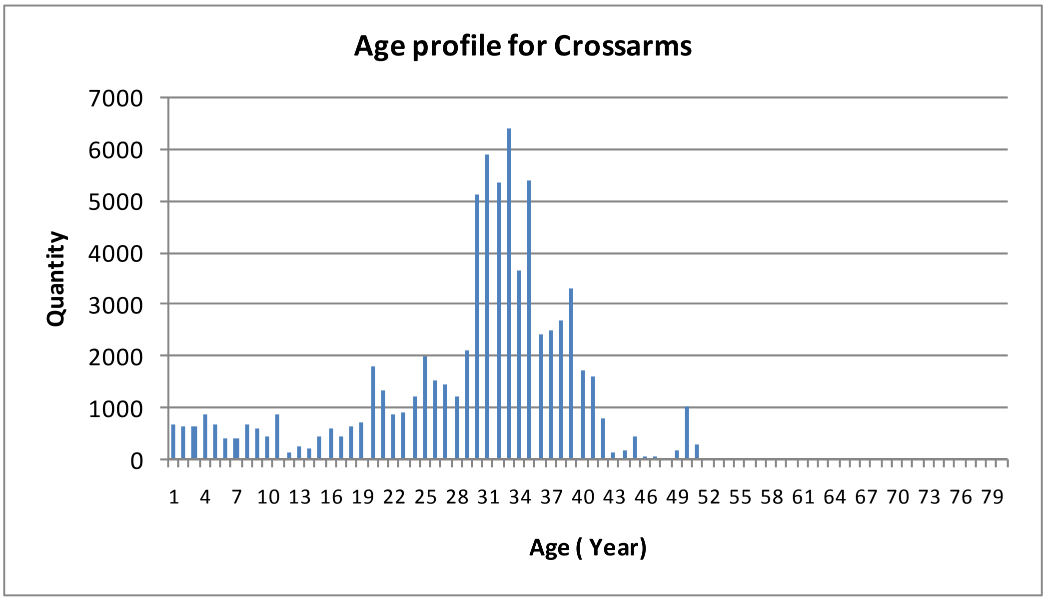


Figure 29. Crossarms – Age Profile

3.3.13 11kV Switching Stations

There are 18 11kV switching station installations.

Condition monitoring is carried out as part of the RCM philosophy. Condition monitoring indicates no major electrical or structural problems.

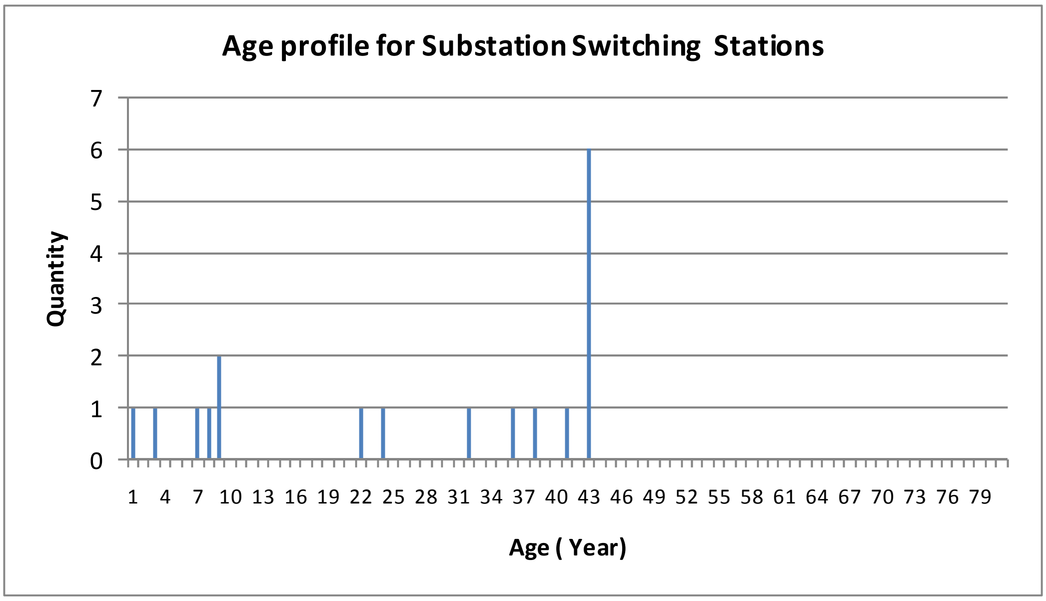


Figure 30. 11kV Switching Stations – Age Profile

3.3.14 11kV Ring Main Units (RMUs)

All new installations are of the SF_6 gas-insulated type because of problems experienced with oil insulated units. We have had a number of instances where oil filled ring mains have failed due to incorrect adjustment of internal contact travel, contact bounce and contact damage. Issues have been identified with Andelect ring mains and particular attention has been paid to the internal inspection of these. Where appropriate they are being replaced. Due to problems encountered with particular models of oil filled ring mains, all oil filled RMUs have been internally inspected and have had the oil changed. This programme was completed at the end of the 2011 financial year.

The condition can vary considerably with the make/model and environmental exposure.

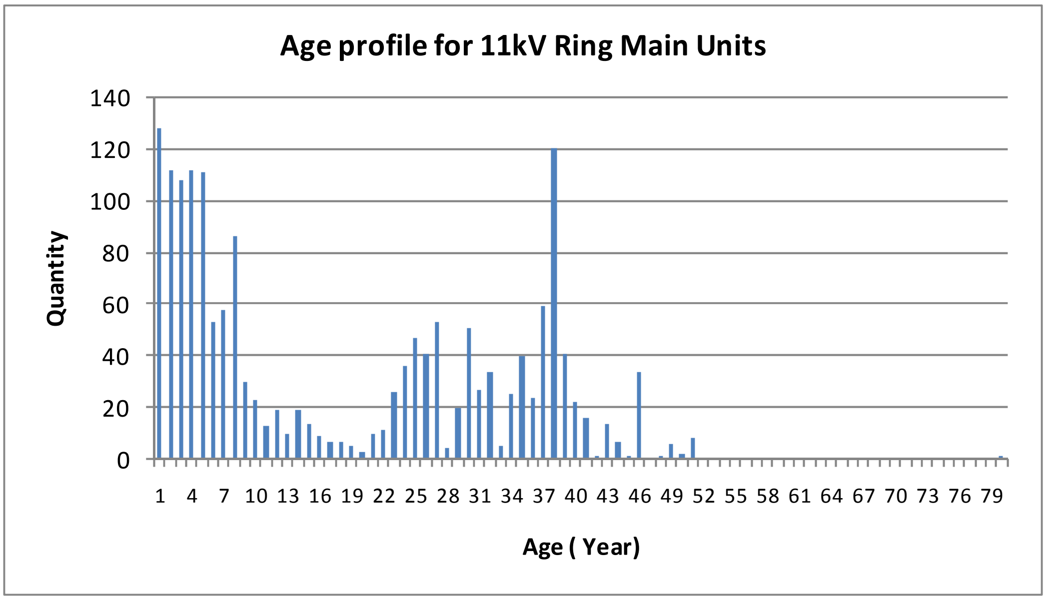


Figure 31. 11kV Ring Main Units – Age Profile

3.3.15 11kV Air Break Switches (ABS)

The age profile indicates a growing number of switches reaching end of life and requiring replacement. The majority of these are non load break switches for isolation on overhead transformer structures. The condition of these is generally poor. Load break line switches are in better condition but are being replaced with sealed gas insulated units.

With appropriate maintenance most of the units are expected to be used to the end of their nominal life, except where their fault level rating is insufficient to meet the growing system fault level.

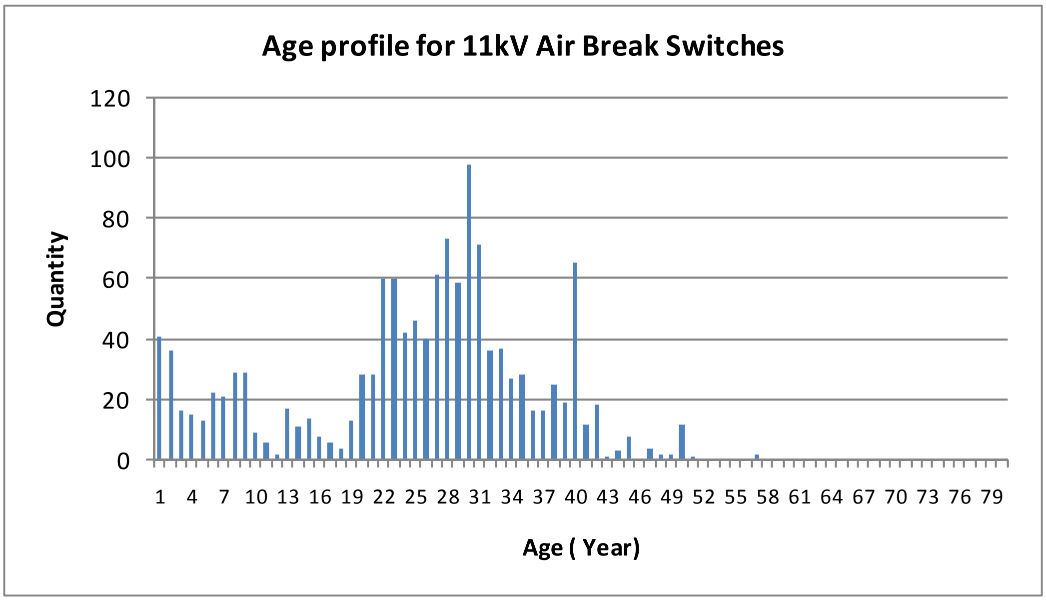


Figure 32. 11kV Air Break Switches (ABS) – Age Profile

3.3.16 11kV Reclosers and Sectionalisers

A large number of units were installed in 2004 and 2005 to achieve reduced SAIDI minutes. Since then the discrepancy in maintenance costs between the older and newer units has become apparent. A life cycle cost analysis has been carried out and as a result the remaining older units will be progressively replaced.

Many of the sectionalisers on the network are old and routine testing has been found to have a detrimental effect on the reliability of their operation. Therefore testing will only be done when there is an indication from SCADA data that an incorrect operation has occurred.

All reclosers are automated, with remote SCADA operation and monitoring.

In the recent years there have been a number of electronic related failures of the more recently installed units. These failures aren't confined to any particular make, and are expensive to repair.

Problems have been experienced with drop-out sectionalisers that were installed in 2004-2005. These do not always operate when expected and moves to correct these problems through maintenance actions have been unsuccessful. Alternatives to the units are being evaluated and the expectation is that these units will be replaced over the following five years of the plan.

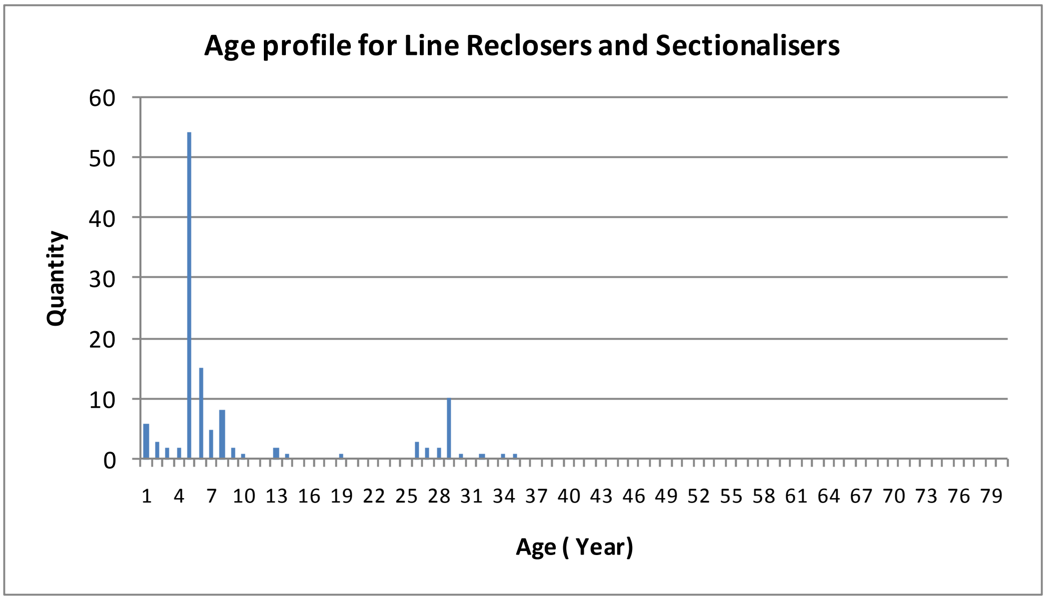


Figure 33. 11kV Reclosers and Sectionalisers – Age Profile

3.3.17 Distribution Transformers

The population of distribution transformers covers a diverse range of sizes, types and ages. Many distribution transformers run well below their rated values for much of their life, resulting in long lives for the cores and windings. Provided that the tanks and oil are well maintained, the units may be kept in service for up to 55 years.

The majority of distribution transformer faults are caused by lightning damage. For the larger pole mounted units surge arrestors are now specified as standard at the time of installation to reduce this cause of failure. Transformers that can be economically repaired will be refurbished and reused. The condition of transformers varies considerably depending on their physical location (pole or ground mount) and make and model. Some relatively new units have been found to have serious rust on their lids.

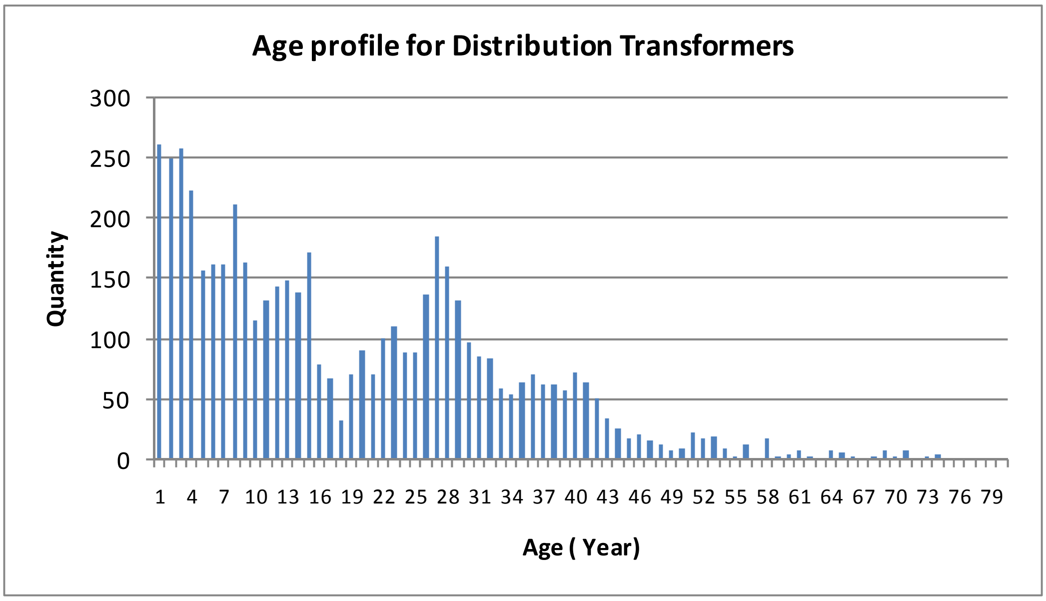


Figure 34. Distribution Transformers – Age Profile

3.3.18 LV underground cables

Underground LV cables are exhibiting only a small number of failures, primarily paper-insulated types, which can be ascribed to age related causes. Most faults are caused by damage from external factors or from poor installation practices. Refer to Section 6.4.16 for details. Condition is difficult to assess and issues only become apparent when faults begin to appear in particular localised areas.

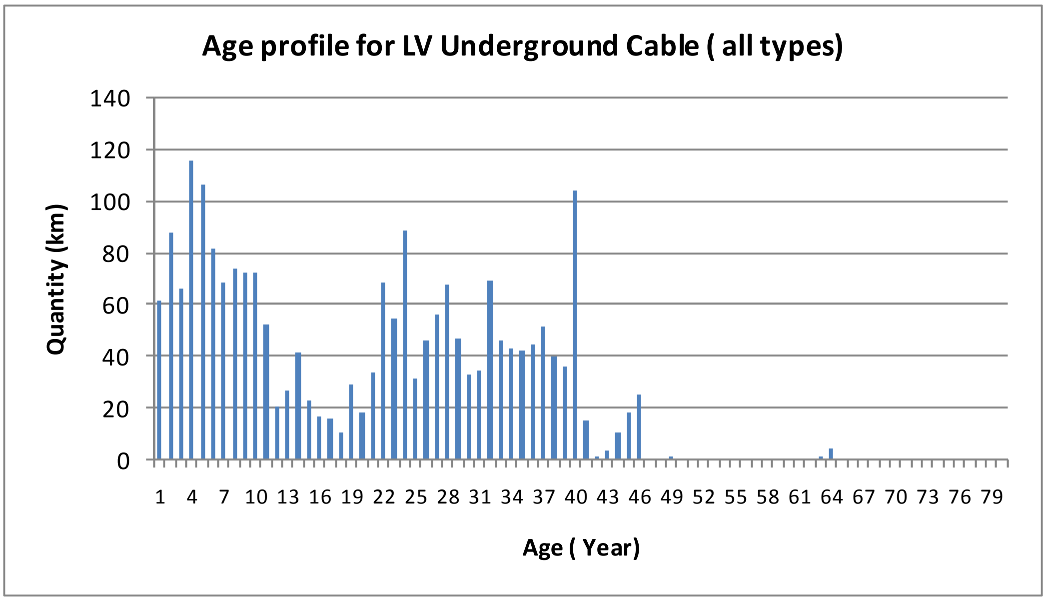


Figure 35. LV Underground Cable – Age Profile

3.3.19 LV Overhead Reticulation

The LV overhead reticulation is generally in a satisfactory condition.

As for other overhead lines, the age profile is based on actual condition assessment rather than from construction dates as many sections have been rebuilt. The LV lines will be replaced with any planned replacement of 11kV overhead lines.

Most lines have yet to reach their expected nominal life so only minor routine maintenance and no significant investment will be required within the planning period.

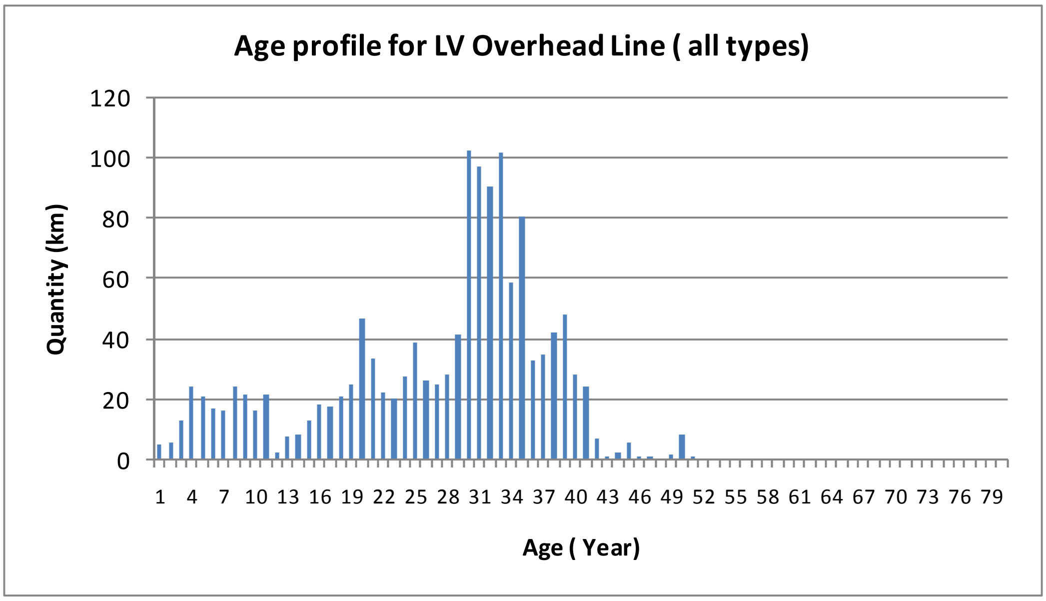


Figure 36. LV Overhead Reticulations – Age Profile

3.3.20 SCADA; Communications and Control Equipment

WEL has recently implemented a new GE PowerOn Fusion Network Management System (NMS) comprising of a master station, data storage systems, alarming and integrated outage management which includes call taking and dispatch functions. A third party load management system has also been integrated to the NMS

Furthermore there is a communications infrastructure, RTU's and substation wiring.

Some of the master station equipment resides at WEL's main office and other parts of the system reside at WEL's disaster recovery site.

Condition and reliability of the Network Management System and communications infrastructure is generally good. Older RTU's, though reliable, are progressively being upgraded or replaced to provide improved functionality and communications capability. Where possible communication is progressively being upgraded to DNP3.0 over IP.

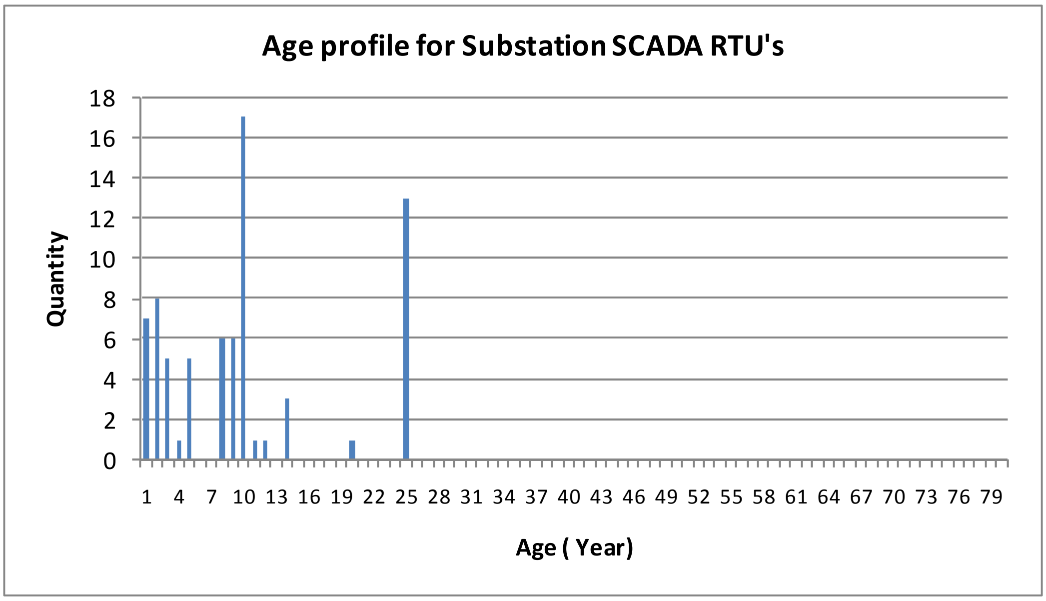


Figure 37. Substation SCADA and Control Equipment – Age Profile

3.3.21 Load Control Equipment

The load control system that operates via the NMS. This communicates to three primary 33kV static ripple injection sets on the WEL network with one set at the Hamilton GXP, one set at Te Kowhai GXP and one set which has been installed at Weavers for the Huntly GXP. These sets operate at 283Hz. The Weavers injector will allow old relays to be replaced with either new relays or smart meters and the removal of the five 11kV 500Hz rotary sets in the northern area. These rotary sets are located at Weavers, Te Kauwhata, Glasgow, Hampton Downs and Finlayson Rd substations.

An 11kV static injection plant is in service on the Hamilton 11kV GXP. An 11kV 283Hz static injection plant is also located at Pukete. The signals for this injector are initiated by SCADA load control commands simultaneously with the plant at Te Kowhai GXP.

Condition and reliability of the equipment is good. As mentioned in 6.4.20 the older rotary plants will be taken over by the static plant at Weavers once relays have been replaced.

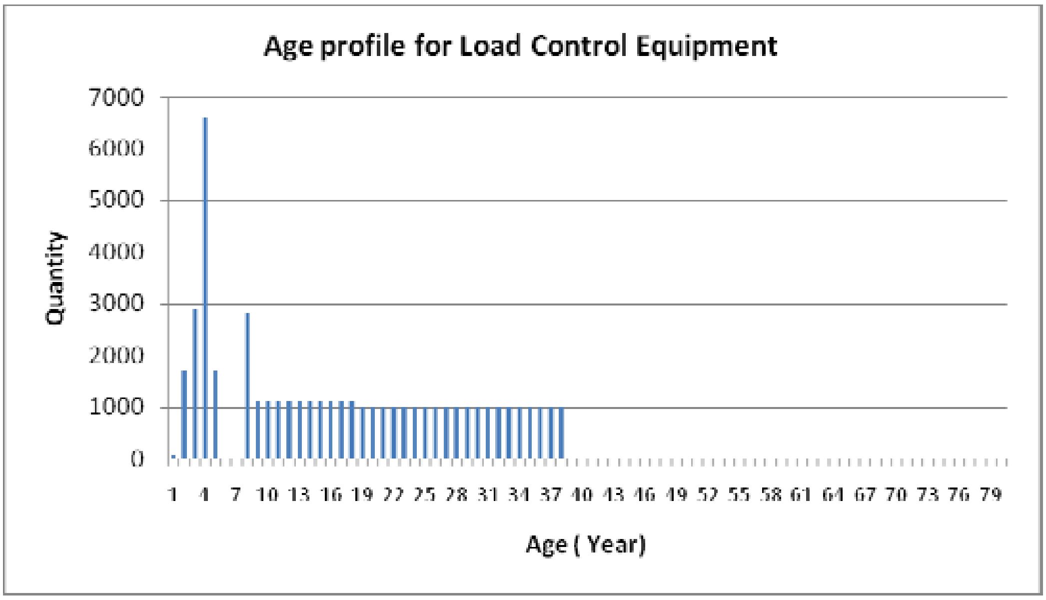


Figure 38. Load Control Equipment – Age Profile

3.4 Value and Quantities Of Assets In Each Asset Category

Asset Values and quantities are shown below. Land and buildings were re-valued to market value on 31 March 2010 by independent valuers, TelferYoung (Waikato) Ltd Registered Valuers – Property Advisors. The distribution network before 31 March 2010 was re-valued on 31 March 2011 by independent valuers, Sinclair Knight Merz (NZ) Limited Registered Engineers and audited by PricewaterhouseCoopers (PWC) -electricity lines valuation advisors.

The valuation of the network fixed assets has been prepared on the basis of depreciated replacement cost (DRC) given the challenges of determining fair value on infrastructure assets. The DRC valuation approach is in line with the company accounting policies and consistent with NZ IAS 16: Property, Plant and Equipment.

The land and buildings have been valued on the basis of market value given the nature of the assets. Again this market value consideration is consistent with the accounting policies and accounting standards view on determining fair value. Table 5 includes only assets have been commissioned and capitalised as at 31 March 2011.

Refer to section 3.3 for details about the age, condition and maintenance programmes for each asset category. Refer to section 6.4 for asset renewal programme information.

Table 6 Asset Quantities and Values As At 31 March 2011

Asset Category	**Unit**	**Quantity**	**"Asset Value ($000 in DRC)"**
33kV Lines	km	198	4,785
33kV Cables	km	186	45,899
33kV Zone Substations and 11kV switching stations	No.	42	32,454
Zone Substation transformers	No.	48	25,670
11kV Lines	km	1,910	20,226
11kV Cables	km	581	53,045
Ring Main Units	No.	1,834	9,788
Air Break and Gas switches	No.	1,344	4,628
Reclosers	No.	74	2,151
Distribution Transformers	No.	5,389	38,315
LV Lines	km	1,053	12,063
LV Cables	km	1,125	40,727
Street Light Lines	km	263	1,980
Street Light Cables	km	1,133	29,699
SCADA; Communications and Control Equipment			4,949
Poles including Value of Crossarms	No.	38,738	37,121
Land and Building	No.	0	11,595
Other		31,886	18,740
Total			393,837

Photo 7 Vegetation Management

3.5 Justification for the Network Assets

WEL recognises that its network has been built up over 80 years by incremental investment decisions. While optimal at the time, it would probably not be optimal if the network were to be rebuilt in a single instance of time to supply the exact needs of the existing consumers.

The WEL network was reviewed to determine the extent to which the network is over-designed. The review was done with regard to the quality of supply criteria contained in the Conditions of Supply and also with regard to specific contracts with some large users of electricity.

The underground cabling systems in WEL's network were reviewed against the requirements of the Hamilton City Council and the Waikato District Council District Plans and requirements applying to lifestyle subdivisions. The use of separate trenches to bring cables out at rural zone substations was reviewed and considered appropriate to avoid uneconomic de-rating of cables.

In recent times there has been considerable load growth within the WEL network. This has placed significant demands on the capacity of the 33kV sub-transmission systems. A number of network augmentation projects are planned to overcome any load capacity limitations and security of supply risks.

The recent triennial asset valuation result considers WEL's network to meet that requirement to provide the desired quality of supply given reasonable load forecasts. Comments from the report on the suitability of various parts of the network include the following:

- All Transpower points of supply supplying WEL's network are required to meet WEL's quality of supply criteria.
- Load flow studies undertaken show that removal of any sub-transmission circuits would directly lead to security levels and voltage limits being exceeded.

- Removal of any one zone substation in urban areas would place unacceptable loadings on the 11kV network. Removal of any rural zone substations would directly affect voltage levels and require uneconomically large 11kV conductors to achieve the required quality of supply criteria. One new zone substation is currently under construction to meet present load growth. Three new zone substations are planned for construction within the planning period to meet expected load growth.
- Local authorities require all new work within Hamilton City boundaries and all new work outside the Hamilton City boundary in urban, rural lifestyle and significant interest areas to be underground even though overhead reticulation would, in most cases, be less expensive.
- Due to the CBD requirement of (N-1) security the backup available via the 33kV and 11kV networks is appropriate.
- The use of indoor 33kV switchgear installed at Horotiu, Pukete and Sandwich Road zone substations is in line with current practice for newer, high density, industrial and residential locations where space, visual and pollution impacts are of importance.
- The majority of 11kV feeder cables and lines are appropriately sized to deliver WEL's forecast loads within the planning period and to maintain the required quality of supply.
- Distribution transformer capacity utilisation is 38% which is consistent with the ODV handbook.
- The LV network in the CBD is an interconnected radial system which is appropriate given the N-1 security requirement. In suburban and rural areas the LV network is radially fed and generally not interconnected. This is appropriate given the reduced level of security required, and is therefore not considered to be over designed.

Photo 8 33kV – 11kV Standard Configuration

4 SERVICE LEVELS

This section describes how WEL sets its various service levels according to the following principles:

- What is most important to consumers?
- Can WEL achieve consumers expectations cost effectively?
- What trade-off between price and what consumers consider is “most important” are consumers willing to accept.

These issues are discussed more fully in the section below.

4.1 Customer Consultation Process

WEL maintains a relationship with major customers on its network. Major customers have direct access for any issues or questions they may have, whether this is concerning price, quality or load increase requirements. WEL also conducts a yearly survey of the top 50-100 major customers concerning growth intentions. This information feeds into network planning and the Asset Management Plan.

The aim is to hold twice yearly seminars with major industrial and commercial customers. In addition to the seminars, top energy consumers are contacted on a regular basis to ascertain their views on supply. The top 50 energy consumers are visited and surveyed at least once a year.

For the “Mass Market” one on one communication is not practical, instead WEL conducts annual customer surveys to assess views on the trade-off between price and quality.

A statistically significant number of WEL consumers participate to ensure the data collected is valid and meaningful.

The surveys focus on understanding the level of customer satisfaction and their future expectations for reliability of supply. Information sought includes:

- What the customers’ current feelings are on reliability of power supply
- What they want in the future in terms of reliability of supply
- Whether they are willing to pay more for higher performance or less for lower performance

The quantitative data gained from these surveys is supplemented by a series of qualitative focus groups. WEL has also been liaising with Federated Farmers to better understand opportunities for getting price/quality information to the rural sector.

Customers are placed into four classes to assist with understanding the collective requirements of each group. These classes are:

- Urban Residential
- Urban Commercial
- Rural Dairy and Business
- Rural Dairy & Lifestyle.

The key points from the most recent customer survey undertaken February 2011 are that:

- 96% of customers rate the WEL present power supply in terms of reliability as acceptable or more than acceptable

- 96% of customers felt the power supply reliability had stayed the same or improved over the past year
- 81% of customers would prefer to have the present level of reliability maintained at the present prices

The February 2011 results show a minor improvement in most areas above and are up from those in previous years.

- 29% of customers would like to see further improvement in reliability, however only 8% (of that 29%) would be prepared to pay more
- 46% of customers would prefer fewer outages (accepting that, if outages occurred, they may be of a longer duration), whilst 54% would accept more outages provided they be of shorter duration.

The survey showed that different customers have different priorities and place different emphasis on network performance.

4.2 Justification of Reliability Targets Based On Customer Consultation Process

Based on the recent customer survey result, customer acceptable reliability targets including LV network are summarised below as shown in Figure 39:

- SAIDI of 137.60 minutes
- SAIFI of 2.00
- CAIDI of 68.80 minutes

Calculated SAIDI from Survey Result (including 400V)					
Customer Group	Input from survey		Output		
	Acceptable Outage Number Per Customer Per Year	Average duration (minutes)	SAIDI (minutes)	SAIFI	CAIDI (minutes)
Urban Commercial	2.00	41.00	7.11	0.17	41.00
Urban Residential	2.00	71.00	91.47	1.29	71.00
Rural Dairy and Business	2.00	71.00	9.73	0.14	71.00
Rural Residential / Lifestyle	2.00	73.00	29.28	0.40	73.00
Grand Total	2.00	68.80	137.60	2.00	68.80

Figure 39. Calculated SAIDI from Survey Results (including 400V).

WEL has collected LV reliability data since November 2007. LV SAIDI and SAIFI represent 19% and 11% of the system total respectively. Hence, customer acceptable reliability targets excluding LV network can be derived as shown below:

- SAIDI of 111.46 minutes
- SAIFI of 1.78
- CAIDI of 62.62 minutes

The above customer acceptable reliability targets will be tested along with analysis of strategies to improve reliability and cost implications discussed below.

4.2.1 Strategies for Improving Reliability

WEL has focused on the following strategies:

- Segmentation of customer groups with targeted investment

Major customers and those in the Hamilton CBD are separately grouped and managed to ensure that the number of interruptions is at an acceptable level. Investment will also target those customers with the worst network performance.

- Reducing the number of customers affected when a fault occurs

The strategies include a continuation of distribution automation projects. However the major focus will be on reducing the number of customers on large feeders. These capital projects will result in a significant increase in capital expenditure required for each SAIDI minute saved.

- Improving restoration time

Restoration times will be reduced by the use of remotely monitored and controlled network components e.g. remote operated switches and ring main units. This will ensure that switching to restore supplies can commence before fault staff arrive on site to carry out manual switching.

- Maintenance and Asset Renewal Strategies

Improvement of network reliability features as a determinant of maintenance and asset replacement programmes.

- Vehicle related outages

Incidence and location of car vs. pole accidents are being analysed to identify where improvements can reduce vehicle accidents.

- Reducing the impact of outages

The investment made to maintain the current condition of the network will focus on the components that cause the maximum supply interruption impact. For example maintenance on a component that fails but does not interrupt supply to customers may be reduced as long as public safety is not compromised. In this way improved performance should be achieved at the same cost.

In order to gain the maximum improvement in reliability from the minimum investment, WEL studied the sensitivity of SAIDI to a range of factors. The list below ranks the factors with the most sensitive at the top.

1. System length
2. Total Number of ICPs on the feeder

3. Average number of customers affected by the outage
4. Average switching time
5. Controllable outages
6. Uncontrollable outages
7. Average repair time
8. Average number of customers affected by repair

The study was used to guide reliability asset strategy development. As a result of strategy development, a number of projects were identified. These projects have been rated for cost per expected SAIDI minute savings, linked to the reliability strategic glide path. This allowed us to clearly communicate to the Board the reliability strategy to achieve the strategic objectives, and to engage with them on a cost/benefit basis relating to reliability improvements. The reliability project has seen an average annual improvement of 23 SAIDI minutes. This improvement has allowed WEL to meet regulatory requirements despite a significant increase in uncontrolled outages.

In addition to these reliability strategies, WEL has decided to continue its live line approach to maintenance. This helps to keep WEL's planned outage SAIDI minutes to a minimum.

In addition WEL is increasing the level of expenditure on items requiring planned replacement. These assets are identified in the five yearly line patrols. Condition grading has been implemented in these patrols and the grading information has been stored in the maintenance management system. It is planned to introduce automatic criticality assessment based on condition grading, equipment type and location to determine the priority of work.

WEL has used historical data from 28 lines companies in a study to determine the relationship between controllable failure rate and maintenance cost, refer to Figure 40.

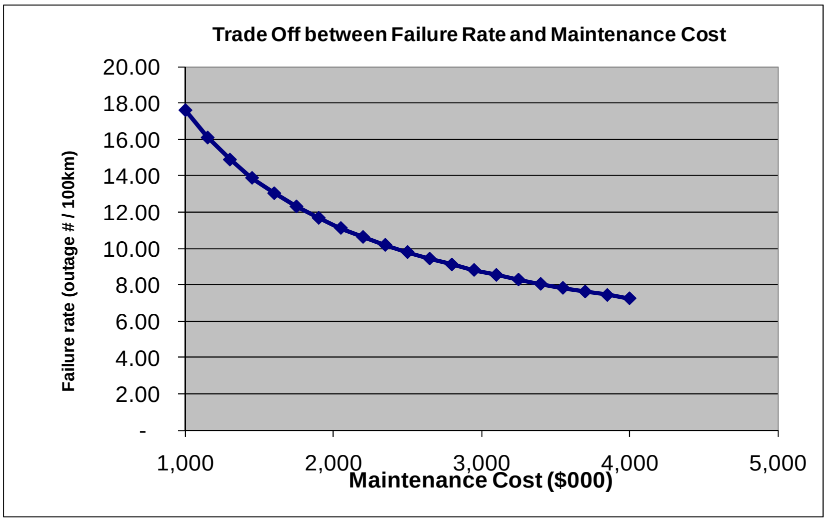


Figure 40. Likely Trade Off Between Failure Rate and Maintenance Cost

Most of the 33kV sub-transmission system is meshed. An insulator replacement programme was commenced in 2005 to improve security and reliability on radial sections of the network. Most of the lines were completed in the 2007/08 year. The project of replacing insulators in the Te Kauwhata to

Meremere circuit, which contributed to around 6 SAIDI minutes in 2008/09, was completed in 09/10 financial year.

WEL has selected repeated rural interruptions as a focus area for network reliability improvement. This area was of concern to the company with approximately 1600 rural consumers experiencing more than eight outages per annum three years ago.

WEL started the project by looking at five years' worth of history to identify main outage causes. The staff then initiated reliability projects to address the main outage causes (e.g. broken lines) that would improve performance by up to 48%.

Outage causes were classified as being either controllable or uncontrollable. Controllable causes (insulators and disks, broken lines and defective equipment) make up nearly two thirds of all outages and were the focus of reliability projects. Uncontrollable causes (bird strike, adverse weather etc.) were not targeted but the expectation was that some of these would also reduce.

Three years after commencing this work the number of rural customers experiencing eight or more outages per annum has dropped to less than 200. WEL's work in this area continues and reliability projects are routinely factored into the company's annual asset management planning process. WEL is planning to spend over $1M dollars next year to further improve it. The following graph shows that further improvement will be made after the completion of next year's reliability projects.

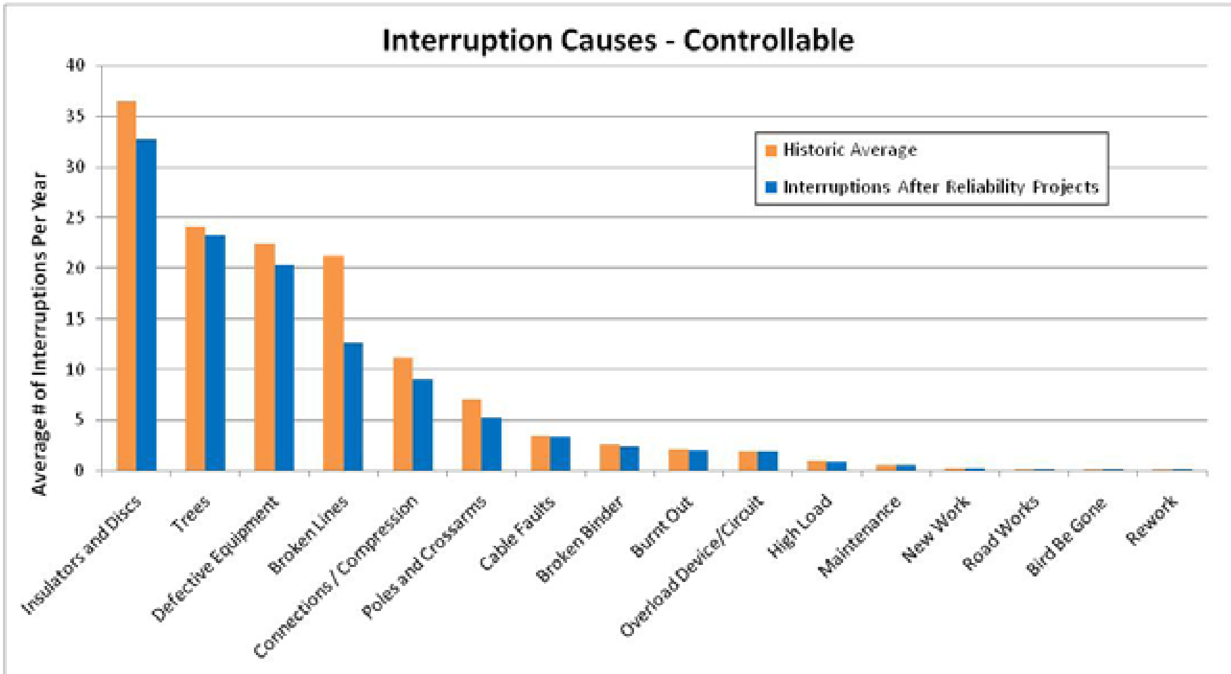


Figure 41. Projected Rural Area Repeated Customer Interruption Improvement After Proposed project

WEL trends repeat outages and has set targets for rural and urban areas in relation to the number of outages on a rolling 12 month basis.

4.2.2 Setting Strategic Reliability Targets

In addition to customers' requirements and cost for implementation, WEL has developed a benchmarking reliability indicator known as the "New Zealand Best Practice Index" (NZBPI). Each year WEL uses this index to compare the top quartile performers for SAIDI, CAIDI, and SAIFI.

Figure 42 below shows WEL's historical reliability performance and future targets compared to the NZ Best Practice Index Trend.

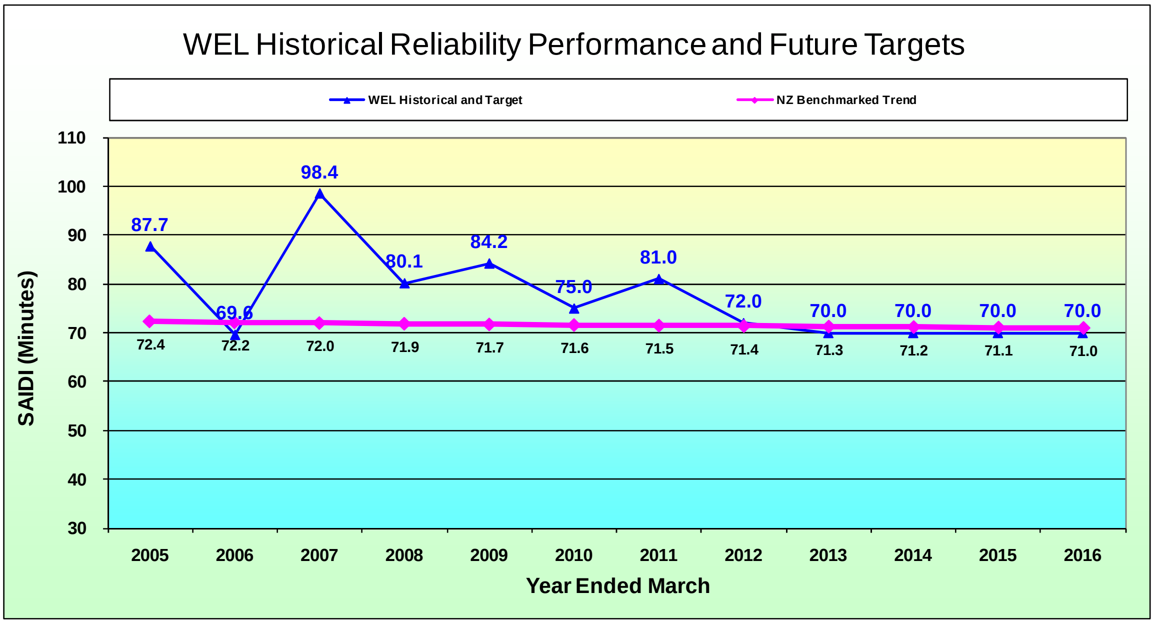


Figure 42. WEL Historical and Target SAIDI vs. NZBPI

The 2010/11 SAIDI target was 81 minutes and included 8 minutes of planned SAIDI for the identified RMU maintenance works programme. The actual performance achieved was 83 SAIDI minutes which included 17 minutes of required planned SAIDI due to the RMU maintenance programme.

The 2011/12 SAIDI target of 72 minutes includes 5 minutes of planned SAIDI.

The strategic SAIDI target of 70 minutes is aligned with the up to date NZBPI industry benchmarking trend and will position WEL in New Zealand's best practice performance category. It also meets customer acceptable reliability targets.

4.3 Consumer Oriented Performance Targets

WEL's goal is to provide a quality level of service to all consumers. WEL defines quality as "providing a network that is safe, reliable and fit for purpose". Appropriate levels of reliability are determined by combining customer survey results with benchmarking studies and by taking implementation costs into account. Primary customer service levels are measured by the safety and reliability indicators shown below.

Secondary service levels are those attributes which consumers rank behind safety and reliability. These service levels are "timely shutdown notices", "customer service level for load control" and "timely response to customer enquiries".

4.3.1 Safety

- WEL's Public Safety Management System focuses on the risk of harm to the public and damage to property for each asset class and details controls to mitigate these risks.
- Total Injury Rate (TIR) has been used as a measure and the target is for all employees to go home everyday safe.
- Key processes are:

- Hazard identification through a formal on site hazard identification process and record
    - Issues identified for further action or investigation through Field Action Reporting (FAR)
    - Continuous development of controls
    - Defining clear accountabilities by assigning control owners
    - Control owners conducting self assessments to verify:
        - Adequacy
        - Effectiveness and
        - Cost-effectiveness
    - Measuring and monitoring performance of controls
    - Performance review and audits for corrective and preventative actions
- Key controls are:
    - Design standards
    - Restricted access to dangerous equipment.
    - Use of qualified staffs that have been trained and are deemed competent.
    - Field staff and contractors using safe work practices
    - Adequate electrical protection systems to cut the power to potentially dangerous situations.
- ACC accreditation

  WEL has achieved tertiary level certification for ACC WSMP (Workplace Safety Management Practices).

4.3.2 Reliability

Reliability means continuity of supply and quick restoration if an outage occurs. It can be measured in a number of ways. WEL uses the following indicators to measure reliability performance.

- Number of Faults per 100km of circuit.
- System Average Interruption Duration Index (SAIDI).
- System Average Interruption Frequency Index (SAIFI).
- Customer Average Interruption Duration Index (CAIDI).
- Maximum outage duration for each outage for urban and rural customers
- Number of interruptions
- Customer repeated interruptions for urban and rural customers

The following table depicts the target performances for the plan. These targets exclude interruptions and faults emanating from Transpower's system or from the WEL low voltage systems.

Table 7 Number of Interruptions – WEL Networks

Measure	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
Unplanned 33kV	6	6	6	6	6	6	6	6	6	6	6
Unplanned 11kV	269	269	269	269	269	269	269	269	269	269	269
Planned	30	30	30	30	30	30	30	30	30	30	30

Table 8 SAIDI, SAIFI and CAIDI for WEL Networks & Faults per 100km

Measure	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
planned SAIDI	3	3	3	3	3	3	3	3	3	3	3
unplanned SAIDI	69	67	67	67	67	67	67	67	67	67	67
planned SAIFI	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
unplanned SAIFI	1.15	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
planned CAIDI	130	130	130	130	130	130	130	130	130	130	130
unplanned CAIDI	60	59	59	59	59	59	59	59	59	59	59
33kV Faults/100km	1.41	1.41	1.41	1.41	1.41	1.41	1.34	1.28	1.28	1.28	1.28
11kV Faults/100km	10.54	10.43	10.33	10.23	10.13	10.03	9.93	9.83	9.73	9.63	9.54

Refer to Section 4.2 for a description of how SAIDI, SAIFI and CAIDI targets are set.

Refer to Section 4.2.1 for a description on how Faults per 100km and Number of Interruptions are set.

4.3.2.1 Maximum outage duration.

As an overall incentive to meet outage duration target levels for urban and rural customers, identified by way of survey, WEL has initiated the WEL Customer Promise with customers, which provides a payment to customers for non-performance. The current standards are:

- Urban customers; supply to be restored within three hours.
- Rural customers; supply to be restored within six hours.

4.3.2.2 Customer Repeated Interruptions (CRI)

WEL has introduced a new reliability measure called “Customer Repeated Interruptions” for urban and rural customers.

“Customer Repeated Interruptions” is the sum of the number of interruptions for individual customers. CRI is applied at distribution transformer level for analysis.

The current standards are:

- Urban customers; 90% of customers have less than or equal to two outages per year.
- Rural customers; 80% of customers have less than or equal to four outages per year.

The aim is to define a minimum standard of service for customers based on the number of interruptions that they have in a year. In the most recent customer survey, both urban and rural customers stated that two outages per year would be acceptable. WEL intends to further discuss the number of acceptable outages and the price/quality trade off through a series of focus groups, amending targets and investment as needed.

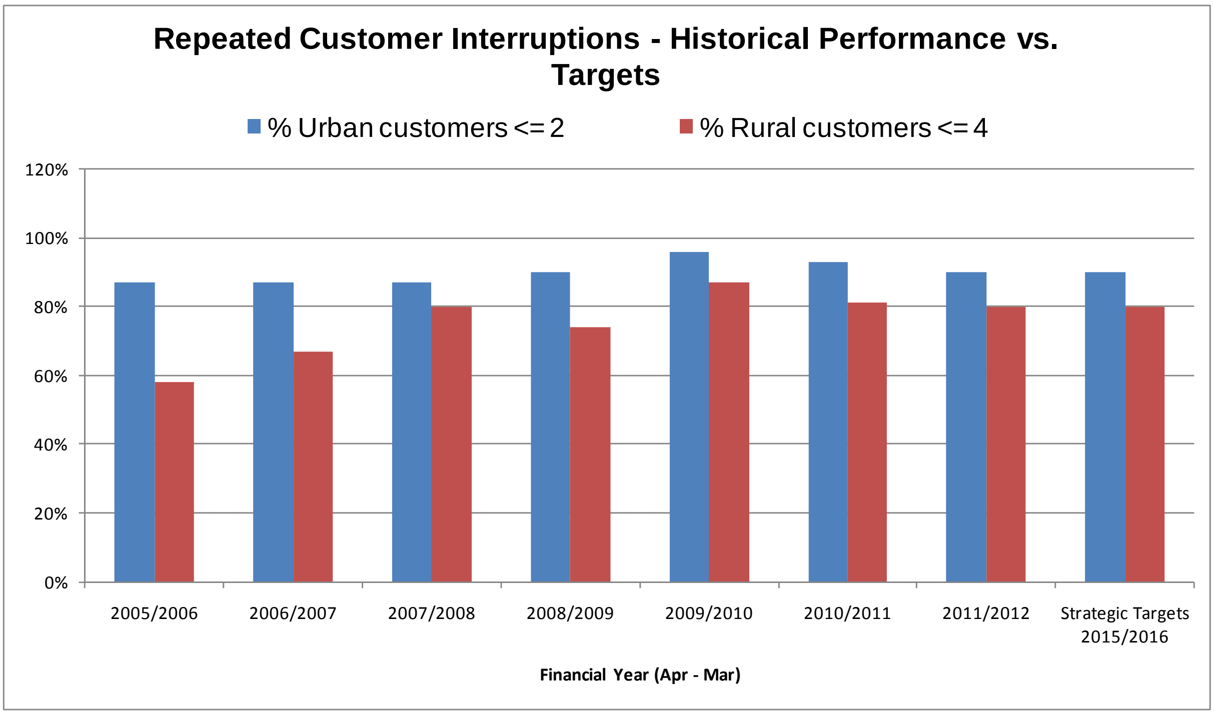


Figure 43. Customer Repeated Interruptions Historical Performance and Future Targets

4.3.3 Secondary Customer Services Level

These service levels include “timely shutdown notices”, “customer service level for load control” and “timely response to customer enquiries”.

“Timely shutdown notices” – this is something that can be improved and moreover it can be done by improving processes in non-real time. WEL acknowledges issues such as working with large consumers to schedule shutdowns during their quiet periods, ensure that shutdown notices are correctly addressed and confirm the shutdown 30 minutes ahead so consumers can initiate controlled shutdown procedures.

“Customer service level for load control” – WEL has a very comprehensive demand management strategy to minimise Transpower costs and improve load factor. However, the load control strategy shouldn’t compromise the following customer service level under normal conditions:

- No customer controlled load off for greater than 7 hours in any 24 hr period

- Maximum continuous time off in one switching period is 3 hours
- Minimum recovery time (between sheds) is 2 hours (after 3 hrs off)

"Timely response to customer enquires" – there are typical customer enquiries such as answering phone, design and quotation of customer driven projects, e.g. new connection, subdivision, relocation and undergrounding, invoicing and quality delivery of fault services and projects. WEL acknowledges that timely response to customer issues vary from the nature of the enquiries and the complicity of the enquiries.

WEL has implemented a customer complaint and compliment process to improve the secondary customer service level performance.

Performance targets:

- Immediate response for safety issues and after discussion with the customer the matter dealt with, as appropriate, but not more than three days.
- resolution within ten days for other complaints (this excludes agreed time for follow up actions)

4.4 Other Performance Targets – Operating and Asset Efficiency

4.4.1 Operating Efficiency – Cost per Customer

Operating Efficiency is defined as Operating Cost per Customer (CPC). This measure is used to monitor and compare operational performance on a continuing basis. WEL's strategic goal is to deliver costs in line with the best quartile of lines companies within New Zealand. The target for the 2011/12 financial year for CPC is $217.

WEL has significantly improved the maintenance programme in the last few years. SAP now records condition assessments, inspection results and maintenance records. This has significantly reduced compliance risks, but has added to our operating costs somewhat because of the additional information and detail relating to assets which is being recorded.

4.4.2 Delivery Efficiency – Billability and Productivity

WEL has introduced the measures of "billability" and "productivity" to ensure that the in-house workforce is effectively and efficiently delivering the approved capital and maintenance programmes.

"Billability" is defined as the hours charged to jobs divided by the hours paid to the field staff. Only time spent working on the job is chargeable with non-working time such as annual leave, sick leave, training, meeting attendance, waiting in the yard being excluded.

"Productivity" is defined as the planned labour costs divided by the actual labour costs (including subcontractors' costs).

The target for the 2011/12 financial year for billability and productivity is 80% and 95% respectively.

WEL designs, prices and plans most projects in-house. The design team prices work with a software package known as "CUE" (Comparable Unit Estimation). The price is then peer reviewed before the proposed work is accepted by Field Services for delivery.

Designs must comply with WEL's design and construction standards. CUE generates an "assembly list" which provides a detailed listing of all materials, labour, transport and other cost items required to complete the work. The CUE assembly list matches WEL's latest Design and Construction standards.

WEL carries out regular benchmarking of labour rates and task times to ensure the data used in CUE is competitive in the market.

4.4.3 Asset Efficiency – Load Factor

WEL faces two emerging risks to the business:

- Investment Return Risk

  The return achieved for the large investment in the network could be compromised if certain changes occur within the network. An example of this would be increased use of distributed generation which could significantly change the energy and load flows around the network.

- Risk of a Shrinking Business

  Several trends threaten to divert revenue from us which would reduce income and could strand some assets.

Traditional network planning is based on potential system peak demand. However, income is mainly from total energy used. Load factor is a measure of the relationship between peak demand and energy used and indicates how much of the asset capacity is being used on average.

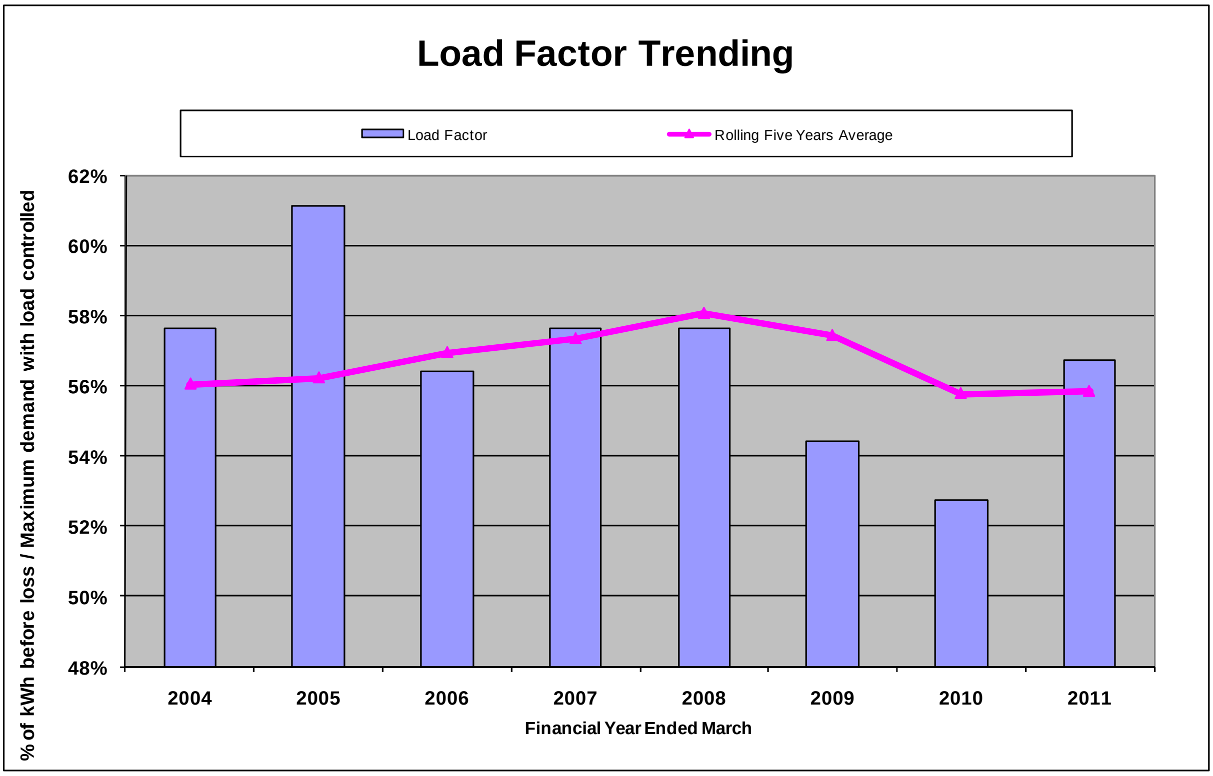


Figure 44. Network Load Factor Trending

Figure 44 shows annual historical load factor in comparison to the five year rolling average. Currently trending down, it is anticipated to worsen.

WEL is introducing load factor measures as a strategic means to monitor investment costs.

WEL's long term objective is to achieve a load factor of around 60%

4.4.4 Asset Efficiency – Capacity Utilisation

Asset utilisation is defined as the peak load divided by the installed capacity of the asset and is a measure of how much of the capacity of an asset is used efficiently. All assets must be able to carry the transient, daily, weekly and seasonal peak loads hence asset utilisation will always be less than 100%. Target transformer utilisation for industrial customers is set at 80%, unless requested differently by the customer.

WEL has set a network wide capacity utilisation target to maintain or exceed 38.1%.

4.4.5 Low Voltage Complaints

WEL records all low voltage complaints (LVCs). The total number of LVCs and the details of each are monitored to determine the quality of voltage supplied to customers. A process has been put in place to identify the root causes of the LVC. WEL's aim is to reduce the number of LVCs that WEL is responsible for and to respond to all customer requests promptly. Current initiatives include the installation of load monitoring devices on distribution transformers, which will assist in identifying power quality issues before they reach unacceptable levels.

Photo 9 WEL competing in the line mechanic competition 2010

4.5 Network Operations and Asset Management Priorities

WEL controls network operations in real-time from the Control Centre (SYSCON). SYSCON is staffed 24/7 by shift operators who are responsible for maintaining network integrity and for ensuring continuity and quality of supply to WEL's customers in real-time. In addition to SYSCON, WEL uses a Call Management Centre for handling customer phone calls, and afterhours dispatch of faults staff. WEL has its own working hours dispatch.

WEL treats all loss of supply issues with urgency. In situations where multiple faults have taken place, resources have to be prioritised to restore all supplies. Due to the company goal of minimising SAIDI, the fault affecting the most customers would normally be addressed first. The exception to this is where one of the supplies affected is likely to have an effect on the public good or have a serious economic impact on one or more parties. In such cases the priority order is altered. For example customers with critical supplies such as those requiring dialysis, flood pumps and dairy farms during milking periods would be prioritised ahead of others.

WEL's Network Planning policy is to provide a level of security that is proportional to the load magnitude. Therefore larger loads are likely to be provided with higher levels of security. The cost of providing a certain level of security is also taken into account. Projects designed to improve security are prioritised using the following table. The following points are noted:

At the zone substation level currently 25% of WEL customers have a C2 security level, 47% have a C3 level, 18% have a B1 level, 3% have a B2 level, 3% have a B3 level and 4% have an A level.

The Hamilton CBD is wholly supplied by Bryce Street, Kent Street, Cobham and Claudelands zone substations all of which supply power at the C2 security level.

Table 9 WEL security criteria applied in system design

Class	*Range of Post Contingent Demand (PCD) MVA*	*Customer Impact*	*Security Level*	*Contingent Capacity*	*Time to Restore after 1st Interruption*	*Time to Restore after 2nd Interruption*
E	Above 140MVA Major Transpower GXP 3 transformers	>10k	n-2	100%	Maintain 100% of PCD	Maintain 100% of PCD Immediate offloading required (switching)
D	25 to 140MVA Transpower GXP 2 transformers	>10k	n-1	100%	Maintain 100% of PCD	Majority restored within an hour (switching), 100% in repair time. For longer repair time – field generation
C1	20 to 50 MVA Super zone substations 3 transformers	>5000	n-2	100%	Maintain 100% of PCD	Maintain 100% of PCD Immediate offloading required (switching)
C2	10 to 25 MVA CBD zone and switching substations	>2000	n-1	100%	Maintain 100% of PCD	Majority restored within two hours, 100% in repair time
C3	10 to 25 MVA Small GXP or large urban zone substations	>5000	n-1	100%	Maintain 100% of PCD	Within three hours restore 90%, repair time 100%
B1	5 to 10 MVA Medium urban zone substations	>2000	n	100%	Within 15 minutes restore 75%, within three hours 90%, repair time 100%	Within three hours restore 90%, repair time 100%
B2	2.5 to 5 MVA Rural zone subs and urban interconnected feeders	>1000	n	80%	Within one hour restore 75%, within three hours 90%, repair time 100%	Restore 100% in repair time
B3	1 to 2.5 MVA Urban & rural interconnected feeders	>300	n	67%	Within one hour restore 50%, within three hours 75%, repair time 100%	Restore 100% in repair time
A	Under 1 MVA Rural feeder, urban spur, distribution transformers	<300	n	Note 1	Restore 100% in repair time	Restore 100% in repair time

Note 1: Refer to WEL's Customer Service Standards for LV Network backup, dual distribution transformer capacity or temporary supply criteria.

Other Notes:

No interruption at first event (N-1) and under switching (N-2) with or without a short outage.

Post Contingent Demand is the peak demand after effecting demand reduction through contracted load control services.

5 NETWORK DEVELOPMENT PLANNING

WEL is continuing to have a high level of capital expenditure over the next 11 years to meet growth, security, quality of supply improvement, asset replacement and regulatory requirements.

5.1 Planning Criteria And Assumptions

5.1.1 Planning Assumptions

The key assumptions taken into account during the planning process include:

- Load growth will generally follow the trends for both the region and areas of the region as modified by input from local authorities
- Interconnection with adjacent distribution companies
- Generation within the service area.
- Embedded generation (i.e. Te Rapa CoGen or the Wind Farm) is considered not to be available during post contingent events.

5.1.2 Planning Criteria

- Determining future customer needs through changing load patterns, security of supply, reliability and customer surveys
- Territorial Authority District Plan requirements for distribution asset integration
- Public safety
- Adequacy of supply capacity to customers
- Acceptable voltage regulation
- Appropriate reliability and levels of system security meeting the security standards as set out in Section 3. For example, 11kV feeders are considered for augmentation when their loading reaches 60% of nominal rating. Maximum ICPs per feeder is set at approximately 1200
- Major Transpower GXPs, having N-1 security, will presumably have available post contingent rating (PCR) at least
- Correct limitation of the maximum loadings as well as fault ratings applied to network elements
- Economic loading of circuits and optimal selection of conductors
- Acceptable system performance under contingent and emergency conditions.

5.1.2.1 Customer Capacity Development

- Capacity required by new customers, or alterations to capacity required by existing customers, are calculated by WEL's Planning Engineers in consultation with the customer concerned. As a minimum, new assets (or changes to existing) are sized such that all loadings are maintained within rated asset limits and all voltages are maintained within regulatory requirements.
- Where the customer requires a greater level of security the capacity of the new installation will be chosen such that the required level of security is met. An example of this is where a customer requires full restoration within 30 minutes for the loss of any one network asset

item. In such a case it is likely that full backup from an independent feeder would be provided and all switching would be automated. In general the customer contribution towards the installation would increase with the required security level.

- Where, as a result of a new customer installation, security levels to other customers are affected, a solution is developed that ensures the required levels of security are met into the foreseeable future. Any customer contribution towards that cost will depend on their capacity requirements as a proportion of the overall network capacity achieved by the project.
- Connection studies for major new load developments or distributed generation are undertaken on an asset-specific basis. Many of these types of projects are fully or partially funded by customers through capital contributions.

5.1.2.2 Network Capacity Development

Computer based load flow modelling of the network is used to ensure the desired level of security is met and so that the capacity of new power system equipment is chosen appropriately. This process usually involves modelling the worst case situations and the required investment to ensure restoration can occur.

Known future step load increases, expected population growth and other estimates of future load growth are fed into the network load forecasting model. The model is then used to compare the forecast levels of security versus the network security level requirements as set out in Table 10. Where a future shortfall in required security levels is forecasted, options to restore the security levels are identified, evaluated, costed and compared.

Photo 10 Live Line Maintenance

Table 10 Asset Planning Criteria

Asset	Description	Criteria
Zone Substation	Structures	Where possible structures and buildings are designed and selected to ensure standard plant and components are used and extensible future activities are not restricted.
	Transformers	Selection is based on the capacity requirements matched against standard sizes and the economic operating factors.
	Switchgear	Selection is based on the capacity requirements and fault rating matched against standard sizes and supply transformers.
33kV Cables	Conductor	Selection is based on the capacity requirements matched form the standard sizes.
	Terminations	Terminations are selected to withstand network voltages and minimisation of discharge between cores.
	Surge Arrestors	Selection is based on the surge capability requirements matched against standard sizes from distribution or substation class units.
33kV Lines	Conductors	Selection is based on the capacity requirements matched from the WEL standard sizes.
	Poles	Poles are selected from WEL standard adopted sizes and the mechanical strength requirements for the specific application and ensuring the appropriate code of practice is met.
	Insulators	Selection is based on the voltage withstand requirements matched from the optimised WEL standard adopted sizes. These must meet the specific application with creepage and over voltage withstand needs.
Distribution Cables	Conductor	Selection is based on the capacity requirements matched from the WEL standard sizes
	Terminations	Terminations are selected to withstand network voltages and minimisation of discharge between cores.
	Surge Arrestors	Selection is based on the surge capability requirements matched against standard sizes from distribution or substation class units.
Distribution Lines	Conductors	Selection is based on the capacity requirements matched form the standard sizes.
	Poles	Poles are selected from WEL standard adopted sizes and the mechanical strength requirements for the specific application and ensuring the appropriate code of practice is met.
	Insulators	Selection is based on the voltage withstand requirements matched from the optimised WEL standard adopted sizes. These must meet the specific application with creepage and over voltage withstand needs.
Distribution	Transformers	Selection is based on the capacity requirements matched against standard sizes and the economic operating factors.
	Switchgear	Selection is based on the capacity requirements matched against standard sizes with suitable fault rating and specific design for each application.
	Low Voltage	Capacity is based on an average of 4kVA per dwelling with a range between 3kVA and 6kVA. Commercial applications are through specific design selection based on the customer's requirements for supply capacity.

5.1.2.3 Safety

It is WEL's policy that the safety of the public and staff is paramount. It is necessary that system design, equipment type and size selection, protection design and work execution is reviewed, checked and appropriately carried out.

5.1.2.4 Reliability

WEL has a continuing focus on providing a reliable network by:

- Monitoring and reporting of performance in relation to both the network and types of equipment
- Development of planning and design methodologies with an emphasis on industry best practice
- Use of modern technology to continually improve asset performance and incident responses, for example fibre optic communications and electronic protection relays
- Training of staff at all levels to ensure the highest levels of competency and service
- Setting of service level standards and implementation of processes to ensure compliance.

Planning criteria to improve reliability is an ongoing activity with initiatives driven by and aligned to the service levels and performance as described in section 4

5.1.2.5 Security

Planning criteria are aligned to the security standard as defined in Table 9 for Asset Management Priorities. A post contingent demand (PCD) increase may trigger an improvement in the applied security level. In addition customer driven security levels may be applied through negotiation, line charges and/or capital contributions.

5.2 Prioritisation Methodology for Development Projects

5.2.1 Methodology

Throughout the year the Asset Investment and Growth division within WEL builds up a list of capital projects aimed at addressing customer security, compliance, reliability, load growth and asset replacement needs. This coupled with an economic analysis tool ensures that valuation changes and lifecycle costs are in line with the company vision, long-term sustainable objectives and therefore which options are appropriate for different network segments. Economic analysis is also applied to optimise the balance between capital and maintenance decisions across the lifecycle of the network assets. WEL uses this investment model to determine the priority of each project on the list of capital projects. The model evaluates:

- Alignment with Mission, Vision and strategic directions
- Health and safety and regulatory compliance
- Reliability of supply
- Economic and financial aspects
- Competitive advantage
- Customer needs
- Security standard

- Environmental impact

Each group above is given a weighting that in total adds to 100% while each element of each group is given a weighting within its own group. The model then gives a numerical result which is then modified by customer needs and the security standard. Compliance with legislative and health and safety requirements are given a high weighting.

5.3 Demand Forecasting

5.3.1 Methodology

WEL has developed an electronic model for network demand forecasting that derives input from a number of sources such as:

- Load forecast data updated several times per year from SCADA/metering data and zone substation data
- Distribution transformer recording equipment
- Inputs from larger commercial customer surveys
- Economic indicators
- Proposed regional projects (e.g. the expressway).
- Local developments such as proposed land subdivision
- Council population and development data
- Regional plans

The model includes expected point loading, allowance for the risk of uncertain loads and for unexpected loads. The impact of embedded generation on feeders and zone substations is also included. Embedded generation is considered as being either WEL controllable and thus operationally supportive to demand, or externally controlled and thus not reliably or continuously supporting demand under contingency.

The model determines the loading and energy throughput separately for each zone substation. Present energy throughput is taken and projected forward in each of the following four sectors: residential, commercial, industrial and farming. The energy forecast is converted to maximum demands by applying historical consumption data and zone substation load factors, and then projected forward. The forecasted load for each zone substation and each GXP is shown in the Appendix 2

Figure 45 shows the aggregated load growth values as one tool in the model generated results and the required planning period to which due cognisance is given.

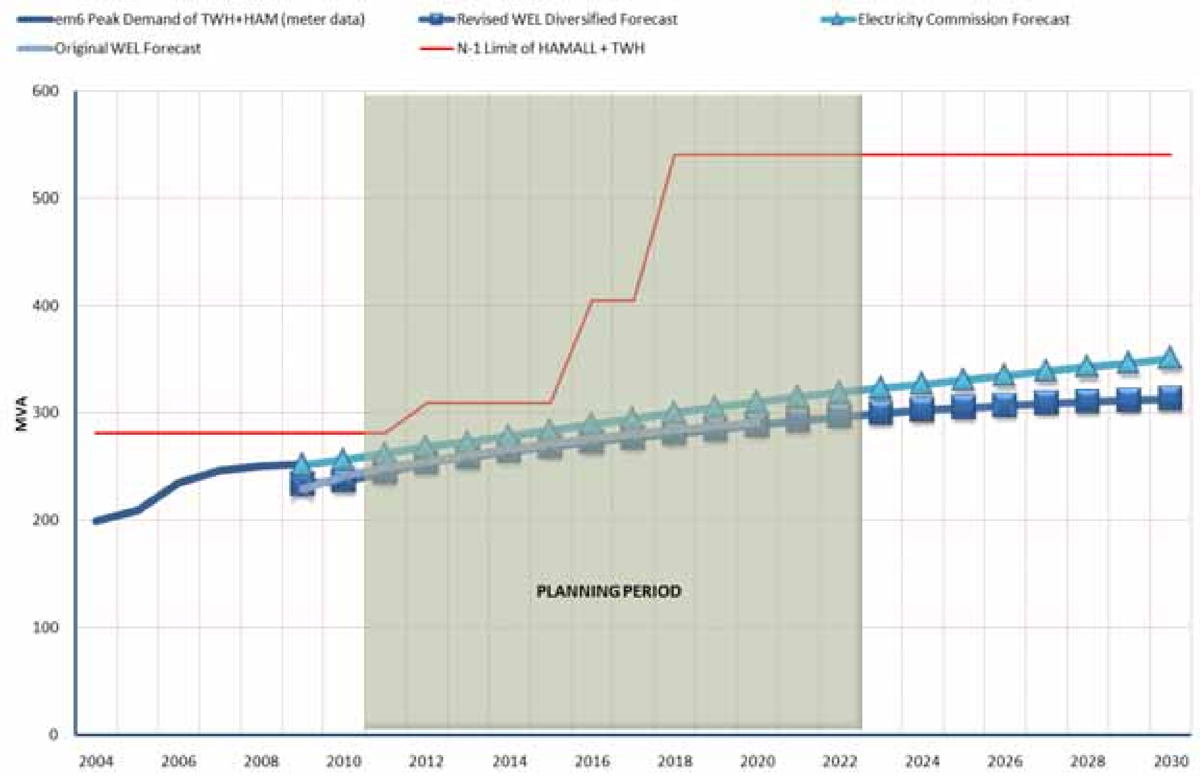


Figure 45. Overall Load Growth for The Greater Waikato

5.3.2 Factors affecting load growth

Factors that influence load growth and are included in the forecasting model are:

- Population growth - large areas of land have been subdivided within the WEL service area especially in the north and west of Hamilton. This land has been subdivided for residential, commercial and some industrial development. Council plans for these developments greatly assist load forecasting although the recent rapid turnaround of economic conditions has made load prediction inaccurate and led to a slowdown in the rate of growth.
- Changing load patterns in the residential sector - load patterns change due to factors such as appliance efficiency, number of appliances in households, increasing use of electrical technology and an increasing use of gas for heating and cooking.
- Changes in the major industries in the WEL service area. Although industry changes are difficult to predict effort is made to include provision as follows:
  - For residential loads: using the projected population load growth (as per the Future Proof Strategy) and applying a calculated load profile specific to the residential type (i.e. urban or rural) and suburb.
  - For commercial/industrial loads: determining the area usage as per the district and council plans and applying a demand usage based on existing similar loads (i.e. commercial, office, industrial). Known spot loads were also taken into account.
- Embedded generation - embedded generation can substantially change the loading on a zone substation. Embedded generation that can be controlled by WEL can be used to manage the network and is especially useful for controlling the peak demand. Generation not controlled by WEL is not considered in load forecasts.

The forecast projections include a diversity factor derived for each zone substation and based on historical data and trends. No increase in base load has been identified.

The forecast peak loads are subject to variations due to uncertainties in:

- The council plans for commercial and industrial growth.
- Economic conditions.
- Climatic conditions, especially cold and/or wet weather.
- Other factors, such as the availability and changes in technology.

Demand management: WEL has in place demand management by:

- Controlled load (ripple control of hot water and controllable loads)
- Tariffs
- Distributed generation agreements.

The impact of each of these factors is included in the demand forecasting model.

By the winter of 2022 the ADPCD (After Diversity PCD) on the existing GXPs is projected to rise as shown in Table 11 below. The loading of Te Kowhai, excludes the embedded Contact generator at Pukete Zone Substation and Te Uku wind farm.

The uncertainties in predicting demand can result in either overestimating load or underestimating load. Overestimation of load will cause unnecessary capital investment in assets that are underutilised while underestimation of future load can result in poor service, increased faults and lower customer satisfaction. Electricity distribution is capital intensive which requires a careful consideration of demand before investing in new or renewing of assets.

Table 11 GXP ADPCD

Grid Exit Point	Transformers	Firm Capacity N-1	Post Contingent Limits (2011)	Customers Supplied	Winter 2011 ADPCD (Actual)	Winter 2022 ADPCD (est.)
Hamilton 33kV	100+120 MVA	100 MVA	132 MVA	41,150	127 MVA	156 MVA
Hamilton 11kV	2 x 40 MVA	40 MVA	40 MVA	12,909	39 MVA	NIl
Te Kowhai 33kV	2 x 100 MVA	100 MVA	109 MVA	20,767	85 MVA	159 MVA
Meremere 33kV	Nil	14 MVA	4.5 MVA	2,730	8 MVA	Nil
Huntly 33kV	2 x 60 MVA	60 MVA	82 MVA	5,981	18 MVA	42 MVA

Detailed demand forecasts for each PGXP and zone substation are shown in Appendix 2.

5.3.3 Assumptions about future demand management.

Technology and customer awareness will likely impact future load growth. Government initiatives are encouraging customers to be more involved in managing their own demand through home efficiency programs. WEL, in its own initiative, is introducing technologies such as smart boxes and appliance control devices which will provide customers with better appreciation of their power consumptions. WEL's goal is to encourage customers to appropriately manage power consumption, use more efficient appliances and time-of-use tariffs.

5.4 Growth Related Network Constraints

Potential network constraints that have the effect of restricting substantive load connection within the network have been identified, including:

- Remote rural industrial load such as quarries and mining, requiring feeder upgrades and/or voltage support
- Rapid point loading through commercial growth beyond expected predictions, requiring network augmentation and new zone substation capacity installations
- Rapid loading through residential subdivision within new territorial boundaries for growth beyond expected predictions, requiring network augmentation and new zone substation capacity installations
- Reliability of feeder supplies, requiring feeder augmentation or installation of a new zone substation
- Northern network security, requiring new 33kV sub-transmission circuits from Huntly GXP

Each of these constraints is addressed in the AMP as network augmentation, capacity monitoring and upgrade. Detailed investigations or non-network solutions are detailed in 5.5 to 5.7. This is a standard monitoring and ongoing planning process activity.

5.5 Distributed Generation Policy

Since the Electricity Industry Reform Act 1998 was amended allowing lines companies to participate in distributed generation from renewable energy sources, WEL has carried out research into opportunities in the Waikato region and has found that there are future opportunities such as landfill gas generation, municipal solid waste biomass generation, wind generation, wave generation, woody biomass generation, hydro generation and coal seam gas. Some of these options have been investigated in detail for their overall benefits and fit to the economic development of the network.

WEL's website at www.wel.co.nz contains an overview of distributed generation information and links to the policy and implementation requirements. The information provided is:

- Generation less than 10kW
    - Information and Application Process
    - Connection Application form
- Generation greater than 10kW
    - Policy and process overview
    - Connection Application Form (Initial)
    - Connection Application Form (Final)
- Distributed Generation regulated terms
- Electricity Industry Participation Code 2010, Part 6 Connection of Distributed Generation

- WEL's policy is that Distributed Generation (DB) connection and processes comply with the Electricity Governance (Connection of Distributed Generation) Regulations 2007. To achieve this WEL has provided information on connection and the application forms required to collect the data needed to manage set-up and maintenance of the connection. The size of the generation is important for management of the network loading so generation is split into below 10kW and above 10kW.

Once an application for connection of generation is received, WEL, in conjunction with the customer, will evaluate the project on a case by case basis taking into account network capacity, stability and performance, cost of transmission, cost of line and reactive power and avoided planned network development costs. Once the embedded generation is confirmed with the customer a plan of integration is prepared. The planning and forecast models are updated to establish the impact on network development plans and how the network is required to be changed to reflect the new generation injection.

WEL owns a 1MVA landfill gas generator at the Horotiu landfill site. Fonterra owns and operates a 50MW co-generation plant at Te Rapa. The Meridian owns and operates the 65 MW generation at the Te Uku wind farm.

Photo 11 Turbine construction at the farm site at Te Uku

Photo 12 Wind turbine and electricity distribution lines at Te Uku

5.6 Non-Network Solution Policy

The primary non-network solution to relieve constraints on the network employed at WEL is by the use of Demand Side Management (DSM) techniques.

DSM can be defined as shaping the overall consumer load profile. This is principally achieved by reducing the peak load which governs much of the network physical development since a network must be capable of supplying the anytime peak. The benefits from DSM are:

- Increased utilisation of the network and increased effective investment return
- Improved utilisation of Transpower's transmission capacity

The above benefits flow on to consumers who are the ultimate beneficiaries of WEL Networks.

Strategies for implementing DSM include:

- Directly controlling or interrupting thermal loads
- Providing pricing options using differential rates
- Arranging with large customers for them to shed load at peak times
- Arranging with customers for them to start their emergency generators to reduce the load taken from WEL at peak times
- Optimising Power Factor of industrial loads by pricing incentives
- Promoting heat pumps, which are more efficient than ordinary electrical heaters
- Promoting home energy efficiency by providing audits for low income consumers (funded by the WEL Energy Trust)
- Assisting developers at the design stage to help new commercial buildings benefit from demand management

- Introduction of smart meters

Direct control and interruption of hot water and other storage heating loads at peak times is achieved by employing the ripple relay system.

Arrangements have been set up with major customers to shed load at critical times. In some cases the communication is by using the ripple control system to send a pre-arranged warning signal. In other cases it is by telephone.

Two projects have been completed using emergency standby generators at customer sites to reduce their demand on the system at critical times. These generators are remotely controllable.

A Te Rapa industrial customer operates a 50 MVA co-generation scheme, which produces power and heat for the factory processes and power for export into WEL's network. In the dairy off season this unit is normally shut down for maintenance.

In previous years innovative means of reducing energy consumption on the WEL system were initiated by the WEL Energy Trust which included the provision of hot water cylinder wraps at a subsidised cost to selected customers. Currently WEL Networks manages the project for subsidised home energy efficiency audits, offered by the WEL Trust to low income families.

5.7 WELconnect

Over the next three years WEL expects smart boxes to be deployed to all ICPs within its distribution area. These smart boxes are expected to provide considerable demand side management opportunities.

Smart boxes with home area networks and in home displays (IHDs) deployed at customer premises will allow any and all residential and commercial consumers to:

- accurately monitor and manage their energy consumption
- set consumption limits and/or financial limits
- respond to time of use price differentials and incentives
- respond to messages sent from WEL Networks or their retailer
- time shift or adjust smart appliances such as heat pumps and refrigerators

As stated in 5.3.3, a target has been set to reduce peak demand growth by 10% though the implementation of network intelligence.

Photo 13 Live Line Crossarm Replacement

The initial stage of the project involves the installation of smart devices in the Western and Northern regions and deployment of a mesh radio communications infrastructure for the entire WEL area. Where agreement has been reached with retailers, existing meters will be replaced. In later stages it is anticipated that smart boxes will be installed at all WEL customer premises.

In addition to the opportunity for peak demand reduction, the introduction of smart boxes it expected to provide the following benefits:

- Replace obsolete ripple control relays in the northern region;
- Enhanced consumption and demand information at each ICP for network operation and management (such as transformer utilisation, ability to parallel or back-feed between feeders);
- Monitoring of network performance at each network connection (we currently rely on customer contact to our call centre to advise us of localised and low voltage network faults or low voltage issues). The smart boxes will be interfaced to the OMS for reporting of power outages.
- Real time communication providing network pricing and customer signalling support;
- Deferral of network investment through the ability to produce real time loading profiles beyond our zone substations

- The communications network will also provide a mechanism for further introduction of distribution automation equipment.

The convergence of cost effective metering and communications technologies will enable WEL to extend monitoring and control to potentially every part of the network. It will be possible to monitor what is happening at every customer connection and understand power flows along feeders, gain visibility across our low voltage networks, improve ability to back feed and automate switching, better size network assets, automate switching of load, and pro-actively respond to outages.

The ability to reduce investment and operational costs through smart grid technology has been identified. Modeled benefits are summarised below.

- Network operational benefits
  The following network operational benefits have been identified and are supported by work carried out by the Electricity Network Association's smart grid working group:
    - Fault management savings, e g reduced customer fault visits
    - Additional peak load reduction (Transpower charges)
    - Reduced non-technical losses, better energy reconciliation
    - Reduced technical investigations such as low voltage issues
    - Additional reserves market benefits
- Deferring network investment
  In addition, better planning and having a clearer understanding of load flows means we can defer network upgrades and improve our design.
- Deferring Transpower investment
  Other benefits include deferring Transpower investment through improved load flow management across Hamilton. The deferral of a new Grid Exit Point and instead upgrade of the existing Grid Exit Point is a significant saving and will be supported by the introduction of smart boxes.
- Other benefits
  There are a number of unquantified operational and customer service benefits such as improved reliability and responsiveness to outages that have not been factored into our benefits modeling.

5.8 Analysis Of Network Development Options Available and Details Of Decisions Made To Satisfy And Meet Target Levels of Service

The WEL planning processes include assessment of all viable ways of achieving the target level of service. The following three high level options are always considered in conjunction with benefit, cost and risk:

- Do nothing
- Network solution
- Non-Network solution

Options are evaluated technically and financially and the most appropriate solution selected that, on balance, provides the best outcome in conjunction with benefit, cost and risk. Factors that are considered are:

- Technical

- Network connection arrangements
- Present and future loading
- Equipment type and rating
- Use of recovered equipment
- Equipment upgrade
- Load transfer to under loaded plant
- Load flow analysis
- Load control
- Non-technical
- Customer agreements
- Construction contract arrangements and methodology
- Financial
- Procurement
- Timing with Transpower and/or other party's investment plan

The options available are unique to each project and are identified, analysed and the most suitable option selected depending on compliance with WEL standards, regulations and financial performance requirements. The options considered for some of the major projects are identified in the following paragraphs.

5.8.1 Grid Exit Points

Site	Issue	Options	Decision Made	Principal Reasons
HAM 33 & 11	Load exceeds capacity, particularly under contingent event	New GXP, increase capacity, transfer load	Increase capacity, balance loads across GXP's	Optimise timing through demand management technique
Te Kowhai	Load exceeds capacity particularly under contingent event in 10 year planning period	Increase capacity, New GXP	Fit cooling to existing Transformers and eventually add 3rd transformer unit	Optimise timing through demand management technique
Huntly	Nil			
Meremere	Single feeder GXP supply, "n" contingency	Link Northern network with Huntly Add new line from BOM	Link Northern network with Huntly	Lowest cost solution long term

5.8.2 Sub-transmission Network Enhancement Or Upgrade

Site	Issue	Options	Decision Made	Principal Reasons
Huntly to TEK Cabling	Northern Network N-1 security form BOM inadequate	Dual line form BOM	Twin 33kV circuits from HUN to TEK	Most cost effective solution
LAT-PEA 33kV cable overlay of overhead	Under contingency circuit overloads	Nil, urban district plan constrained	Cable overlay	Contingency overload
HAM-PEA 33kV cable overlay of overhead	Under contingency circuit overloads	Nil, urban district plan constrained	Cable overlay	Contingency overload
Tasman 3rd Transformer	Considerable Immediate Load Growth	Install 3rd Transformer ahead of original schedule	Install 3rd Transformer ahead of original schedule	Cater for the immediate and Future Load Growth
AVA-TAS 33kV link	Load Growth and Security	Install new 33kV ccts between AVA and TAS	Install new 33kV ccts between AVA and TAS	Cater for the expected Load Growth of the Rotokauri District Plan
TWH –AVA 33kV cable circuits and AVA 33kV GIS install	Load Growth, Security	Install new 33kV ccts between TWH and AVA	Install new 33kV ccts between TWH and AVA	To increase the transfer capability between HAM and TWH GXPs. As well as to cater for load growth
Forest Lake 33kV Switching Station	Security	Construct new switching station to increase transfer capability between HAM and TWH GXPs	Construct new switching station to increase transfer capability between HAM and TWH GXPs	To increase the transfer capability between HAM and TWH GXPs. As well as to cater for load growth
Latham – Forest Lake 33kV link	Security	Install new 33kV ccts between LAT and Forest Lake Switching Station	Install new 33kV ccts between LAT and Forest Lake Switching Station	To increase the transfer capability between HAM and TWH GXPs. As well as to cater for load growth
Chartwell 3rd Transformer	Load Growth	Install 3rd Transformer	Install 3rd Transformer	Cater for the expected Load Growth
Crosby 33kV Switching Station and cabling	Load Growth, Security and Asset Replacement	Construct new switching station to connect CHA, GOR & BOR, increase security and replace existing ABS	Construct new switching station to connect CHA, GOR & BOR, increase security and replace	Cater for the expected Load Growth, increase security and replace existing ABS

			existing ABS	
Crosby 3rd 33kV circuit	Load Growth and Security	Install a 33kV cct from HAM to Crosby Switching Station	Install a 33kV cct from HAM to Crosby Switching Station	Cater for the expected Load Growth and increase security

5.8.3 Substations including new substations and substation upgrades

Substation	Issue	Options	Decision Made	Principal Reasons
Latham Transformers	Load growth	Upgrade Capacity	Increase capacity	Long term cost effective solution
Peacockes Transformers	Load growth	Upgrade Capacity	Increase capacity	Long term cost effective solution
Hoeka Rd Zone substation	Load growth	New Zone – Will cater for loads on the far south east and transfer some load of HAM110/11kV which has a 30 degrees phase shift with other 11 kV network	Increase capacity, improve voltage levels due to 11 kV feeders being near to Zone substation and ability to backfeed other 11 kV feeders in the network	Long term cost effective solution
Ruakura Zone	Load growth	New Zone – transfer remaining load (less Hoeka substation) from HAM 110/11 kV which has a 30 degrees phase shift with other 11 kV network	Increase capacity- ability to backfeed other 11 kV feeders in the network	Long term cost effective solution
Peacockes 33kV GIS Installation	Load growth and Asset Replacement	Upgrade Capacity and replace aging assets	Install indoor 33kV and remove redundant outdoor equipment	Long term cost effective solution. Provide connection point for new Airport 33kV feeder cables
Airport Zone Substation	Load growth	New Zone – Will cater for loads around the Airport development and	Increase capacity, improve voltage levels due to 11 kV feeders being near	Long term cost effective solution

		Titanium Park	to Zone substation	
Tainui Developments – Ruakura inland port facility	Load growth	New Zone – Will cater for loads around the Tainui Ruakura inland port development facility	Increase capacity, improve voltage levels due to 11 kV feeders being near to Zone substation	Long term cost effective solution

5.8.4 11kV Distribution Network Enhancement or Upgrade

Feeders	Issue	Options	Decision Made	Principal Reasons
SANCB4	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	Upgrade capacity	Long term cost effective solution
TASCB6	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	Install new cable then load transfer to TASCB5	Long term cost effective solution
New CLA-PCH Trunk	Load growth	Install new cable trunk to increase capacity	Install new cable trunk to increase capacity	Long term cost effective solution
HORCB5	Load exceeds capacity particularly under contingency	Upgrade, load transfer	Load transfer, utilize 5 km redundant 33 kV OH line	Long term cost effective solution
FORCB4	Load exceeds capacity particularly under contingency	Upgrade, load transfer	Upgrade capacity	Long term cost effective solution
WALCB6	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	Extend overhead circuit then load transfer to WHACB6	Long term cost effective solution
CHACB6	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	Extend cable circuit and rearrange RMU open points to load transfer to BORCB5	Long term cost effective solution

5.8.5 Related Computer Systems Development Options

Key Functions	Issue	Options	Decision Made	Principal Reasons
Communication Systems	Overloaded analogue system channels, slow and issues with reliability. Enabling of a high level of SCADA & Network Management System functionality. Unable to get full advantage of functionality of installed IEDs on the network. Limited availability of 12 core fibre circuits without sharing of functions. Predominantly single path radial communications to sites. Smart Metering requires cost effective backhaul communications paths. Secure and reliable communications paths required for unit protection signalling.	Upgrade network hardware using existing frequencies. Upgrade systems to modern IP technologies Multiplexing of fibre circuits for better utilisation. Utilise multiple comms paths provided when fibre installed with new cable runs and backup radio paths. Automatic failover using dynamic routing. Utilise existing communications network, where available, for smart metering data backhaul from access points at major communications nodes. Provide low latency secure paths in existing communications network.	Upgrade systems to modern IP technologies Multiplexing of fibre circuits for better utilisation. Utilise multiple comms paths using dynamic routing. Provide low latency secure paths in existing communications network.	Long term cost effective solution Technology to cater for future trends Reliability Capacity for expansion Flexibility for changing requirements. All new devices are IP enabled.

Load Control	Replacement of aged load control plants and relays in northern network.	Relocate underutilised second static ripple injection plant from HAM 33kv GXP to WEA Utilise Smart Box load control functionality as replacement relays in northern network	Relocate underutilised second static ripple injection plant from HAM 33kv GXP to WEA Utilise Smart Box load control functionality as replacement relays in northern network	Cost effective solution to replace 5 aged rotary plants with one static plant. Utilise meter hardware. Save space on customer meter boards. Provide reserves market participation in northern network
Smart Metering	Implement a complex head end software system with limited time and resources	Implement a licensed, managed or Software as a Service model for head end deployment	Implement head end through Software as a Service	Only practical way to implement such a complex system with limited time and resources. Migration to a managed or licensed model is possible in the future. Consistent with SmartCo decision.

5.9 Programme of Works for AMP Planning Period

5.9.1 Introduction

The following programme of works is planned for network investment for the period covered by this AMP:

Project information is organised in the categories listed below:

- Asset replacement and renewal
- System growth including load growth, security - POS & zone sub, load control and smart grid projects
- Reliability, safety and environment including safety and compliance, reliability and communication enhancement projects
- Customer connections including new connections, subdivision and new relays
- Asset relocations including undergrounding

Where investment in a project is split by asset the discussion is presented under the dominant asset and reference is made to the other asset types.

Projects are summarised based on project timing for

- the projects currently underway or planned to start in the next twelve months
- the projects planned for the next four years
- the projects being considered for the remainder of the AMP planning period
- The projects carried out for the whole AMP period

Refer to Appendix 6 for detailed project information in the summarised Project Definition Documents for projects to be currently underway or planned to start in the next 12 months.

Refer to Appendix 8 for project maps of a selection of the major projects WEL plans to undertake within five years from 1 April 2011.

Unless stated otherwise, budgets are for the entire project in this AMP period, and may span financial years.

All costs are stated in 2011 dollars. Project timeline may vary from time to time due to the difference between forecasted load growth and actual growth. Estimated project cost may also vary from time to time due to the following reasons:

- Project scope change due to unforeseen circumstances such as results of consenting process, etc.
- Raw material price movement. There were dramatic changes in previous years for the key assets used on WEL's network.
- Exchange rate variations. Exchange rates between New Zealand and other main currencies have varied significantly. It has a huge impact on cost variance between AMP indicated cost and actual spending for some projects.

5.9.2 Significant Assumptions and Uncertainties Affecting Forecast Expenditure

The forecasted expenditure is based on a number of assumptions shown below:

- Historic load trends, modified by the latest knowledge of business and economic conditions and population changes, are a reasonable indicator of the future.
- The roll out of the new advanced technologies (smart boxes) will allow the capital expenditure deferral and reduce operational expenditure improving the customer service at the same time. Hence the base peak load growth forecast is appropriately considered.
    - New technology is usually introduced gradually and its use can therefore be well planned. However, significant new technologies can lead to the early retirement of older less efficient or poorer performing plant resulting in higher than expected lifetime costs.
    - Customers are also using new technology such as more efficient appliances and better control and this can lead to lower demand or lower peak demand due to a shift in the time of peak demand. Lower consumption reduces the Company's income while lower peak demand can reduce the utilisation of assets.
- Significant effort is invested into demand forecasting. Commercial and residential development will not significantly deviate from what is known. As discussed in section 5.3

WEL models zone substation demand twice per year. The model trends demand but also modifies demand according to information from Council planning and customer surveys as well as economic indicators. The total load on plant depends on both the number of customers and the average load per customer. Any unpredicted decrease or increase in these values will result in over or under expenditure in the Company's network

- Electricity distribution is capital intensive and requires long term planning. Short term variations of two to three years will not materially affect long term planning though short term planning and investment will change in response. Development by large customers is monitored closely to ensure investment is timed appropriately.
- The Company financial performance will follow recent trends:
  - WEL has strong governance and management systems in place however rapid changes in conditions can affect WEL's financial performance (e.g. a major storm)
  - The regulatory environment will not change significantly. Any increase or decrease in the extent of regulatory compliance requirements may affect operating costs of the business or the financial performance of new and continuing investment. Regulation changes are usually signaled well ahead of time and provision will be made where needed.
  - Estimated project cost may also vary from time to time due to the following uncertainties, project pricing in the AMP doesn't include contingency allowance for these elements of potential cost increases: Project scope change due to unforeseen circumstances such as results of consenting process etc.
  - Raw material price movement. There were dramatic changes in previous years for the key assets used on WEL's network. Cost of materials can exceed 70% of investment in new projects. The cost of raw materials is very dependent on international price of raw materials.
  - Exchange rate variations. Exchange rates between New Zealand and other main currencies have varied significantly. It has a huge impact on cost variance between AMP indicated cost and actual spending for some projects.

5.9.3 Short Term - Projects planned for 2011 – 2013

The following projects are in progress or planned for completion by the end of the 2013/14 financial period.

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Security	Te Kauwhata Zone Substation replace outdoor 33kV Circuit Breakers	Replace with new outdoor circuit breakers. Replace with indoor GIS	Upgrade to 33kV Indoor GIS	Reduce ongoing maintenance costs. Ability to connect planned additional circuits. Reduce visual impact of site.	1,133
Security	Te Kauwhata Zone Substation replace transformers	Upgrade transformers. Do nothing	Upgrade transformers.	Increase security level of site. Cater for load growth predicted by lifestyle blocks close to South Auckland Optimise assets being removed from other site.	350
Asset Replacement / Load Growth	Latham Zone Substation replace 33/11kV Transformers	Replace with new 15/23 MVA transformers	Replace with new 15/23 MVA transformers	Increase capacity of site Increase security level of site Reduce maintenance costs.	1,926
Asset Replacement	Findlay Rd reconductoring	Do nothing. Upgrade conductor to replace large section of $16mm^2$ Cu in 11kV feeder.	Upgrade conductor.	Increase voltage capacity of circuit Increase security level of feeder Reduce maintenance costs.	400
Asset Replacement	Horotiu Security Fence Replacement	Do nothing. Repair existing fence. Replace existing zone substation security fence.	Replace existing zone substation security fence.	Protect against unauthorized site access. Reduce maintenance costs.	40

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Asset Replacement	Dey St pole replacement	Do nothing. Replace hardwood poles.	Replace hardwood poles.	Increase security level of feeder Reduce maintenance costs.	250
Safety and Compliance	Seismic strengthening of Bryce St substation	Do nothing. Install seismic bracing. Replace non-compliant section of building.	Replace non-compliant section of building.	Protect against risk of earthquake damage. Increase security level of site Aesthetically pleasing result for high-profile CBD site.	475
Safety and Compliance	Seismic strengthening of Glasgow and Avalon (old) substation buildings	Do nothing. Install seismic bracing. Replace non-compliant section of building.	Install seismic bracing.	Protect against risk of earthquake damage. Increase security level of site Possible DR location site	138
Safety and Compliance	Temple view pole removal.	Do nothing. Install taller poles. Install cable section and remove poles from private property.	Install cable section and remove poles from private property.	Provide acceptable solution for property owners Increase security level of feeder Reduce maintenance costs.	250
Safety and Compliance	Designate existing Zone substation sites	Do nothing. Designate sites Apply for resource consents as projects arise	Designate sites across three years	Reduce on-going costs for resource consent applications. Surety around the ability to upgrade / modify existing sites.	300

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Safety and Compliance	Arc flash protection installation	Do nothing. Provide full-cover flash protection PPE Install arc flash protection.	Install arc flash protection.	Comply with latest safety standards Provide safe environment for switching operators.	650
Load Growth	Peacockes Rd substation transformer upgrade	Do nothing. Upgrade transformers. Shift load by changing Network open points	Upgrade transformers.	Increase security level of site. Cater for load growth predicted by deferral of Airport Substation. Optimise existing assets being removed from other site.	350
Load Growth	Horotiu substation transformer upgrade	Do nothing. Upgrade transformers. Shift load by changing Network open points	Upgrade transformers.	Increase security level of site. Cater for load growth predicted major customer load increase Optimise assets being removed from other site. Install new transformer bunding to reduce environmental harm risk.	713
Customer Driven	Caro St 11kV switching station	Do nothing. Install additional 11kV RMU and transformer Establish 11kV switching station. Install diesel generators to support major customer.	Establish 11kV switching station.	Increase security level of site. Provide for large proposed increased load by critical major customer. Ability to decommission and abandon existing site with old assets and difficult access. Avoid noise pollution of generators.	1,078

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Load Growth	Raglan Zone Substation Construction	Do nothing. Shift Network open points. Upgrade conductor and install voltage regulators. Install new Zone Substation	Install new Zone Substation	Off-load existing substation to increase security and reduce loading levels. Mitigate against voltage support issues. Ability to connect and support planned rural lifestyle areas	2,000
Load Growth	Installation of LV transformer load monitoring devices.	Do nothing Install LV load monitors. Install temporary data loggers as required. Acquire data from Smart Meters	Install LV load monitors while waiting for smart meter's technology trial. Across four years' period	Proven technology available now. Permanent installation Smart meters may provide what is needed if the business case approved	380
Load Growth	Tasman CB5 11kV extension	Do nothing. Shift Network open points. Install voltage regulator. Upgrade circuit and offload TAS CB6	Upgrade circuit and offload TAS CB6	Off-load existing 11kV feeder to increase security and reduce loading levels. Increase security level of feeder	250
Load Growth	Whatawhata CB6 11kV extension	Do nothing. Shift Network open points. Install voltage regulator. Extend circuit and offload WAL CB6.	Extend circuit and offload WAL CB6.	Off-load existing 11kV feeder to increase security and reduce loading levels. Increase security level of feeder	250

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Customer Driven	External Subdivision	Not pursue – do nothing. Submit tender	Submit tender	Complete the final stages of an external subdivision started several years ago	253
Customer Driven	Dannemora Subdivision remedial work	Do nothing. Complete remedial work. Sell subdivision	Complete remedial work.	Improve reliability performance for subdivision. Potential to sell subdivision once improvements completed	1,050
Customer Driven	Simsey Place new load connection application	Do nothing. Supply from existing 11kV feeder. Upgrade network to provide for major new load connection.	Upgrade network to provide for major new load connection.	Provide for new load. Defer breach of N-1 security level for nearby zone substation.	1,450
Security	Pukete substation 33kV cable reterminations	Do nothing. Reterminate 33kV cables.	Reterminate 33kV cables.	Reduce maintenance costs. Ensure protection operates correctly.	300
Security – Huntly POS	Huntly to Te Kauwhata 33kV dual cable circuits.	Do nothing. Convert 11kV circuit to 33kV and Install additional 33kV circuit on existing pole line. Install dual 33kV circuits and a fibre.	Install dual 33kV circuits and a fibre.	Increase security of northern area Transpower cost saving by disconnecting Meremere POS supply Eliminate risk of having dual circuits on the same pole. Establish fibre communications link between stations.	3,597

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Security	Chartwell CB6 off-load to Borman	Do nothing. Extend 11kV cable circuit and rearrange RMU open points.	Extend 11kV cable circuit and rearrange RMU open points.	Off-load existing 11kV feeder to increase security and reduce loading levels. Increase security level of feeder	400
Security	CLA – PCH 11kV trunk feeder	Do nothing. Install new cable to increase rating of trunk feeder. Rearrange circuits to off-load feeder circuits	Install new cable to increase rating of trunk feeder.	Increase security level of trunk feeder. Provide for load shifting under contingency events.	450
Security / Reliability	Weavers Petersen coil installation.	Do nothing. Major upgrade of all 11kV feeders in worst performing area of network Install Petersen coil at substation	Install Petersen coil at substation	Eliminate high SAIDI impact of worst performing feeders. Provide for continuation of supply during adverse weather events	350
Security	Latham – Peacockes upgrade of weak section of 33kV circuit	Do nothing. Upgrade smallest section of conductor Reconductor entire circuit. Replace overhead with cable circuits.	Upgrade smallest section of conductor	Increase security level of site. Increase sub-transmission load transfer capability. Optimise existing assets and established sites. Avoid the need for easements	1,593

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Security	Hamilton-Peacockes CCT1 Cable	Do nothing Upgrade	Upgrade	Increase security level of site. Increase sub-transmission load transfer capability. Optimise existing assets and established sites.	395
Security	33kV Protection Upgrade distance to differential	Do nothing. Review settings to reduce Permissive Over-reach Install differential protection on circuits. Install open points in the 33kV mesh.	Install differential protection on circuits. Project is planned to be completed by 2017	Better tripping discrimination for meshed 33kV Network. Reduces the risk of cross-system faults	2,600
Communication Enhancement	Pole Top Channel installation	Do nothing. Install new radios with serial Comms and Ethernet IP ports.	Install new radios with serial Comms and Ethernet IP ports. Planned to be completed by 2013	Reduce annual radio licence fees. Future-proof for changes to Radio Spectrum Management procedures.	287
Communication Enhancement	SCADA Communication Enhancement	Do nothing. Convert existing sites to IP Network	Convert existing sites to IP Network	Improve speed of communications network and reliability	481
Communication Capital requirements	Multiplexing of Fibre Circuits Outside Wind Farm	Do nothing Install multiplexors to make more efficient use of existing 12 core fibre	Install multiplexors to make more efficient use of existing 12 core fibre	Improve efficiency of existing assets	83

Category	Project Description	Options	Decision Made	Justifications	Budget in AMP Period ($000)
Communication Enhancement	Install routers and switches and close fibre gaps to take advantage of fibre links in the city	Do nothing and wait Take advantage of existing links as part of SCADA fibre infrastructure	Take advantage of existing links as part of SCADA fibre infrastructure	Take advantage of existing links as part of SCADA fibre infrastructure	351

5.9.4 Medium Term - Projects proposed for 2013 – 2017

The following projects are proposed for completion by the end of the 2016 financial period.

Category	Project Description	Options	Preferred Option	Justifications	Budget ($000)
Asset Replacement / Load Growth	Peacockes Rd Zone Substation replace outdoor 33kV Circuit Breakers	Replace with new outdoor circuit breakers. Replace with indoor GIS	Upgrade to 33kV Indoor GIS	Reduce ongoing maintenance costs. Ability to connect planned additional circuits. Reduce visual impact of site.	2,049
Asset Replacement	Weavers Zone Substation replace transformers	Upgrade transformers. Do nothing	Upgrade transformers.	Maintain N-1 security level of site with the projected demands of load growth in the area. Optimise assets being removed from other site.	2,000

Category	Project Description	Options	Preferred Option	Justifications	Budget ($000)
Load Growth	Airport Zone Substation Construction	Do nothing. Install new 11kV express cable circuit and RMU. Construct Airport Zone Substation. Supply diesel generation	Construct Airport Zone Substation.	Off-load existing substation to increase security and reduce loading levels. Provide for customer driven load increase. Optimise assets being removed from other site.	2,243
Load Growth	Wallace Rd Transformer Upgrade	Do nothing Replace with new 15/23 MVA transformers. Shift 11kV load by changing Network open points.	Replace with new 15/23 MVA transformers	Increase capacity of site Increase security level of site Reduce maintenance costs.	1,918
Load Growth	Hoeka Rd Zone Substation	Do nothing. Shift Network open points. Upgrade conductor and install voltage regulators. Install new Zone Substation	Upgrade conductor and install voltage regulators – Stage 1A and 1B Install new Zone Substation – Stage 2	Mitigate against immediate voltage support issues. Provide long term security. Ability to connect and support planned rural lifestyle areas. Phase shift removal.	9,414
Load Growth	Tasman 3rd Transformer	Do nothing Shift 11kV load by changing Network open points. Install third 15/23 MVA transformer.	Install third 15/23 MVA transformer.	Increase capacity of site Increase security level of site Cater for load growth in Rotokauri growth cell	3,300

Category	Project Description	Options	Preferred Option	Justifications	Budget ($000)
Customer Driven	UFB Roll-out make ready works for overhead fibre deployment	Do nothing. Underground network. Upgrade network to allow for fibre installation.	Upgrade network to allow for fibre installation.	Provide space on the overhead network to accommodate fibre installation.	1,082
Security	Forest Lake 33kV Switching Station	Do nothing. Install new circuits from Avalon to Latham. Establish Forest Lake 33kV switching station. Install cable circuits from Te Kowhai to Latham	Establish Forest Lake 33kV switching station.	Increase security level of existing sites. Increase sub-transmission load transfer capability. Optimise existing assets and established sites. Gain ability to switch zone substations between GXP's	1,595
Security	Te Uku Substation Upgrade	Do nothing. Upgrade Te Uku	Upgrade Te Uku	Increase security level of existing sites. Optimise existing assets and established sites.	1,500
Security – Hamilton POS	Ruakura Zone Substation Construction	Do nothing. Install 3rd 220/33kV transformer at HAM or 110/33kV transformer at HAM Install 33/11kV Zone substation at Ruakura.	Install 33/11kV Zone substation at Ruakura while Transpower invests for 3rd transformer Investment planned to be across three years starting from 2013.	Overcome HAM GXP capacity issues to satisfy n-1 security standard Remove phase shift issues	7,150
Security	Purchase of 11kV Switch Board	Do nothing. Purchase	Purchase	Obtain asset ownership for better control	505

Category	Project Description	Options	Preferred Option	Justifications	Budget ($000)
Communication Enhancement	Sub-transmission upgrade communications	Do nothing. Upgrade point to point communications at the same time as sub-transmission upgrade work	Upgrade point to point communications at the same time as sub-transmission upgrade work	Improve speed of communications network and reliability. Establish suitable back-up communications for protection	474

5.9.5 Long Term - Projects proposed for 2017 – 2022

The following projects are to be considered for inclusion in the period between 2016 and the end of this AMP period.

Category	Project Description	Justifications	Budget ($000)
Load Growth	Gordonton Substation Upgrade	Increase capacity of site Future proof for lifestyle block establishment.	3,390
Load Growth	Ruakura Inland Port Facility	Load growth	4,000
Security – Huntly POS	Huntly to Glasgow 33kV cable	Increase security levels.	1,400
Security – Huntly POS	Huntly to Kimihia 33kV cable	Increase security levels.	1,200
Security	Glasgow 33kV switchgear replacement	Connection point required for proposed new cable circuits	1,400
Security	Glasgow 2nd Transformer	Proposed load growth in the Huntly area	600
Security	Kimihia 33kV switchgear replacement	Connection point required for proposed new cable circuits	615

Category	Project Description	Justifications	Budget ($000)
Security	Finlayson 33kV ring and FIN South Zone Substation	Load growth	3,630
Security	Te Kowhai – Avalon 3x 33kV cable circuits and 33kV GIS switchgear at Avalon	Network capacity upgrade Increase security levels.	13,640
Security	Avalon 33kV switchgear configuration	Increase security level of existing site.	802
Security	Avalon – Tasman 33kV Link	Increase security level of existing site.	4,246
Security	Latham – Forest Lake – Avalon 33kV cable link	Network capacity upgrade Increase sub-transmission load transfer capability.	5,346
Security	Chartwell install 3rd transformer and 11kV cabling link	Network capacity upgrade Support proposed load growth	4,125
Security	Consenting cost	Ensure compliance	1,100
Security	HAM 11kV interconnection upgrade	Network capacity upgrade	1,500
Security	Crosby switching station and 3rd 33kV Circuit	Improve the security in Chartwell area	2,835

5.9.6 Whole categories of assets proposed for 2011 – 2022

Annual allowances are made for the following items in the period for the entire period of this AMP.

Category	Project Description	Justifications	Total Budget (000)
Asset Replacement	Aging asset replacements	Age profile of existing assets	104,121
Safety and Compliance	Mitigation of Line Clashing near Zone Substations	Eliminate fault induced line clashing	880
Safety and Compliance	Power Quality – works required to correct customer complaints	Investigate and correct Customer Low Voltage Complaints where proven to be WEL issue.	3300
Safety and Compliance	Seismic upgrades of substations	Ensure safety compliance	600
Customer Connection	New Connections including new relays	Respond to customer request to connect to WEL Network	41,974
Customer Connection	Subdivisions	New developments	17,381
Asset Relocation	Relocations	Shift assets due to development or third party requests	26,575
Load Growth	Distribution Network Optimisation	Load growth	4,100
Load Growth	CBD and Rural LV Circuits Upgrade	LV Network capacity upgrade to avoid LV issues	11,600
Load Growth	LV Feeder Overloading Issues	LV Upgrades to eliminate overloading	4,000

Category	Project Description	Justifications	Total Budget (000)
Security	Discretionary Fibre Installation	Opportunity to install fibre or ducting while other cabling projects are in progress to future-proof	1,650
Security	11kV Cables Zone interconnections upgrade	Network capacity upgrade Increase 11kV level load transfer capability.	4,266
Security	Network automation	Develop smart grid to improve customer services and network security	1,400
Load Control and Smart Grid	Smart Meters roll-out project	New technology to enable load control and to gain better understanding of load profiles and customer demands	33,995
Reliability	Other reliability projects	To be reviewed and implemented to gain best SAIDI impact per dollar spent.	4,150
Asset Relocation	Undergrounding	In conjunction with Council and WEL Energy Trust	11,000
Communication Enhancement	Allowance for ongoing communication network upgrade or enhancement	Upgrade point to point communications at the same time as network upgrade work	426
Customer Driven	Allowance for ongoing external subdivision enhancement work	Improve customer services as required for the existing external subdivisions	150

5.9.7 Asset Replacement and Renewal

The overall spend profile and programme for asset replacement is discussed in Section 6.4. The following projects have been identified and optimised in conjunction with asset replacement requirements and network development due to load growth. Detailed project cost and timeline information can be found in sections 5.9.3 to 5.9.6.

<u>Te Kauwhata Transformer Upgrade & 33kV GIS</u>

Refer to Northern Network development stage 4 in section 5.9.8.1

<u>Latham Zone Substation transformer replacement</u>

The two 33/11kV transformers rated at 15MVA are to be replaced with new 15/23 MVA units that will ensure the N-1 security levels of the site are maintained with the projected load growth for the Latham / Kahikatea Drive areas.

<u>Peacocks Zone Substation 33kV switchgear and transformer replacement</u>

The 1970 vintage outdoor 33kV oil filled switchgear is nearing the end of its economic life and is to be replaced with indoor 33kV GIS (Gas Insulated Switchgear). The new switchgear will allow connection of the 33kV cables for the proposed new Airport substation.

The two 33/11kV transformers rated at 10MVA are to be replaced with 15MVA units from Latham Court substation.

<u>Weavers Zone Substation transformer replacement</u>

The two 33/11kV transformers rated at 7.5MVA are to be replaced with 10MVA units that will ensure the N-1 security levels of the site are maintained with the projected load growth for the Weavers / Huntly West areas.

<u>Wallace Rd Zone Substation transformer replacement</u>

The two 33/11kV transformers rated at 10MVA are to be replaced with new 15/23 MVA units that will ensure the N-1 security levels of the site are maintained with the projected load growth for the Wallace and Western HCC areas.

<u>Gordonton Zone Substation transformer replacement</u>

The two 33/11kV transformers rated at 5MVA are to be replaced with new 10MVA units that will ensure the N-1 security levels of the site are maintained with the projected load growth for the rural Gordonton area.

5.9.8 Network Development Projects To Address System Growth

5.9.8.1 Northern Network Development Plan (NND)

There are a number of separate projects phased over the life of the AMP. Timing for these is dependent on growth and the impact of other infrastructural projects such as the Waikato Expressway.

Stage 2: Huntly to Te Kauwhata Dual 33kV Circuits

The Huntly GXP has been provided to pick up industrial load growth and generation occurring in the northern area and also to provide additional capacity and security as far north as Maramarua.

Installation of dual 33kV cable circuits and a fibre link is required from Huntly 33kV switching station to Te Kauwhata substation to provide 33kV interconnections as part of the overall 33kV mesh. The installation is in progress and the cables will provide N -1 security to Te Kauwhata and provide capacity for future load growth in this area and will also allow eventual post disconnection of the existing 33kV supply from Transpower Bombay – Meremere. The potential disconnection of the Meremere GXP will be reviewed post 2016.

Primary Assets affected:.........................33kV cable

RMA Requirements:............................Council have been approached and have approved the preliminary design to install the cables to the Rangiriri Bridge. A more detailed design is currently being prepared.

Building Act Requirements:....................N/A

Stage 3: Te Kauwhata to Meremere 33kV Line re-insulation

This project was completed in the 2009/10 year.

Stage 4: Te Kauwhata Transformer Upgrade and 33kV GIS

Te Kauwhata zone substation has outdoor 33kV buswork, circuit breakers and switchgear. This equipment is nearing the end of its economic life and requires replacement. It is proposed to install a new indoor gas-insulated 33kV switchboard in a purpose built building similar to the Huntly 33kV switching station. This project is also in conjunction with the new dual 33kV feeders from Huntly GXP - refer to NND stage 2 above.

The existing Te Kauwhata transformers rated at 5MVA each are to be replaced with refurbished 10MVA units to cater for voltage management, area generation and load growth.

Primary assets affected:....................33kV GIS switchgear, protection relays, refurbish transformers

RMA Requirements:.........................A notice of requirement for designation has been lodged and approved by Council for the existing site and the proposed upgrade.

Building Act Requirements:..............Building consent is required.

Stage 5: Huntly - Glasgow and Huntly - Kimihia 33kV Cables

Since the gas-filled cables between Western Road and Glasgow became unserviceable and were abandoned, Glasgow was reduced to N security. Kimihia also has only one 33kV supply and is at N security.

This project is to install single 33kV cable circuits from the Huntly GXP 33kV switching station to each of the Glasgow and Kimihia substations. This will provide N -1 security to both Glasgow and Kimihia and provide capacity for future load growth in these areas. This project will be triggered by industrial load growth and the extent to which the 11kV network can be backed up under contingency conditions.

Primary Assets affected:..............................33kV cable

RMA Requirements:...................................Consultation required with Tainui, Waikato Regional Council and potentially Waikato District Council.

Building Act Requirements:...........................N/A

The following options were considered during planning for improved security to N-1 for this project

- Several route options
- Switching through Distribution Automation

Stage 6: Glasgow second transformer and 33kV GIS

Glasgow zone substation currently has one 10MVA transformer and a second is required to achieve (N-1) security (Glasgow supplied load can currently be backed up through the 11kV network, this will no longer be the case as local demand increases).

Replacement of the old outdoor 33kV switchgear with indoor GIS is also required as additional circuit breakers are needed to enable connection of the 33kV cable from Huntly GXP and the second transformer.

Primary Assets affected:.................................. 33kV GIS switchgear, protection relays, refurbish transformer

RMA Requirements:...Notice of requirement required to designate the site.

Building Act Requirements:...............................Building permit required for additional transformer pad and building modifications.

Stage 7: Kimihia 33kV GIS

The existing outdoor oil-filled 33kV circuit breaker at Kimihia is old and nearing the end of its economic life. An additional circuit breaker is needed to enable the connection of the 33kV cable from Huntly GXP. The opportunity is to be taken to replace the outdoor 33kV switchgear with GIS and also provide N-1 security. This project will be triggered by industrial load growth factors

Primary Assets affected.....................................33kV GIS switchgear, protection relays

RMA Requirements:... Notice of requirement required.

Building Act Requirements:.................................Building permit required for building modifications.

Stage 8: Finlayson - Finlayson South Substation and 33kV Ring

The far north zone substations are fed via radial 33kV feeders and are subject to occasional failure without available alternative switching. It is planned to complete the ring between Finlayson and Te Kauwhata zones to allow mesh operation of 33kV feeds and improve security to N-1; this includes construction of a new substation. This project will be triggered by load growth in due course.

Primary Assets affected:..................................... 33kV cable

RMA Requirements:...N/A

Building Act Requirements:.................................N/A

Stage 9: Weavers Transformer Upgrade

The Weavers transformers are rated at 7.5 MVA each and are to be replaced with refurbished larger units to cater for area generation and load growth.

Primary Assets affected:..................................... Refurbish transformers

RMA Requirements:...Notice of requirement may be required.

Building Act Requirements:.................................Building consent may be required.

5.9.8.2 New Zone Substations

Airport Zone Substation

Hamilton Airport and the surrounding district is undergoing commercial and industrial sub divisional growth which is exceeding the ability of the 11kV network to satisfactorily supply within permitted design and regulatory limitations.

A new 33/11kV zone substation is required in this area to service the expected load growth. Two 10MVA transformers ex Horotiu Zone substation are to be utilised for this application. The zone substation is to be built with radial 33kV supply from the 33kV Peacockes Zone substation bus, designed for WEL standard dual transformer capacity.

Site investigations were completed in 2007. Cabling works were completed in 2008/2009 with substation construction works subject to timing of load requirements. This project will be completed in conjunction with Peacockes zone upgrade to allow the 33kV cable connections. In the interim the zone is being fed via the new 33kV cables at 11kV through an RMU.

Primary Assets affected:............33kV switchgear, refurbish 33/11kV transformer, 11kV switchgear, protection relays

RMA Requirements:...................Notice of requirement and subdivision are completed.

Building Act Requirements:.........Building consent is required.

The following options were considered during planning for improved security to N-1 for this project

- Many possible sites
- Type and equipment arrangements to meet requirements of the District Plan
- Extension of the 11kV network

Hoeka Rd Zone Substation

Lifestyle blocks and other residential growth in the Tauwhare, Matangi, Newstead and Eureka areas are placing increasing demand on the 11kV supply from Hamilton CB2802 and Silverdale CB4. There is voltage and loading issues which cannot be easily addressed with voltage regulators or conductor upgrades. Network loading in the area is currently at full capacity at peak times and predicted load growth will be exceeded within the next five years. Reconfiguration options for the existing network are not viable as they shift the problems elsewhere within the network. A new 33/11kV zone substation is required in this area to service the expected load growth and to ease loading issues on the existing 11kV system.

The final configuration and proposed design of the substation is still under evaluation and is subject to further feasibility, land acquisition and detailed network design studies.

Temporary work has been undertaken in the winter of 2010 involving voltage regulator installations and conductor upgrades as the first stage of the overall substation establishment process.

Primary Assets affected:.......... 33kV switchgear, 33/11kV transformer, 11kV switchgear, 33kV cable, 11kV cable, protection relays, communications equipment

RMA Requirements:....................Notice of requirement and subdivision are required.

Building Act Requirements:.........Building consent required.

Photo 14 Transformer installation at the Cobham Drive zone substation

Ruakura Zone Substation

There is increasing pressure being placed on the Hamilton GXP at both the 33 and 11kV levels. Transpower are to supply a third 220/33kV transformer to increase the supply capacity and maintain the N-1 security level. Once this is in place, a 33/11kV zone substation will be created at Ruakura with the installation of 3x 15/23 MVA transformers and the procurement of the existing HAM 11kV switchboard from Transpower.

This arrangement will allow for rationalisation of the existing 11kV network in the area and the removal of the phase shift issue that presently exists between the 220/33/11kV and the 110/11kV systems at HAM GXP.

The establishment of the Hoeka Rd zone substation will mean the Ruakura substation originally planned to commence in the 2011-12 financial year, can now be deferred to commence in the 2013-14 year.

Primary Assets affected:.......... 33kV switchgear, 33/11kV transformers, 11kV switchgear, 33kV cable, 11kV cable, protection relays, communications equipment

RMA Requirements:....................Notice of requirement required.

Building Act Requirements:.........Building consent required.

Raglan Zone Substation Construction

A new 33/11kV zone substation is being constructed in Raglan to service the load growth and reduce rising loads in the adjacent feeder supply areas.

A new radial 33kV supply and associated switchgear and communications are planned from Te Uku substation to Raglan. This 33kV sub-transmission feeder is currently operating at 11kV via an RMU. A single 15/23MVA will be installed initially with provision made for a second transformer to be installed at a later date.

RMA Requirements:...............................Notice of requirement and subdivision are completed.

Building Act Requirements:.....................Building consent is completed.

Photo 15 Raglan Zone Substation nearing completion

5.9.8.3 Hamilton GXP's and Sub-transmission Security Projects

Load growth in the Hamilton area is such that the Hamilton GXP 33kV supply capacity has reached constraints and cannot service the projected load growth area. The operation of the GXP above the constrained limits compromises the security of supply. The preferred solution is to upgrade the capacity at the two existing GXPs with integration into an upgraded sub-transmission network.

In considering the requirements to overcome these constraints and expected demand growth, a number of options were considered to achieve the planning and business objectives. Of these; new zone substation, interconnection of 33kV sub-transmission feeders, new GXP, upgraded GXPs and embedded generation solutions were analysed both technically and commercially.

The timing, location and configuration of GXP capacity improvements will be firmed up in consultation with Transpower.

As part of this work it is expected that both Te Kowhai and Hamilton GXP will undergo replacement and upgrades for interconnection and security consolidation around the WEL 33kV supplies. These will also be developed in conjunction with Transpower.

To ensure a suitable secure and long term solution is obtained, the planning of the GXP capacity changes is aimed to align with Transpower's proposals for the region.

As part of the overall capacity upgrades at GXP level it is planned to upgrade the capacity into the western industrial/commercial areas of Te Rapa. This will support the load growth and security for the zones of Tasman, Avalon, Latham and Wallace. New sub-transmission feeders from Te Kowhai and 33kV sub-transmission feeder upgrades will be included to form 33kV improved meshing and transfer capability across Hamilton, particularly under contingency to ensure N-1 security.

5.9.8.4 33kV Protection Upgrade Projects

WEL is experiencing rapid expansion of its network with the recent addition of several new zone substations, the wind farm and upgraded GXPs. The 33kV meshed network will become even more complex in the future.

When the capability of the 33kV protection system is exceeded there is an increased risk that for certain faults significant parts of the meshed networks will trip with a resultant widespread loss of supply.

WEL has planned to upgrade the protection of all 33kV circuits from Distance protection schemes to Unit protection schemes in the form of Line Current Differential schemes. The Line Current Differential schemes require reliable communication between the opposite ends of the lines. These are now becoming available. The Differential protection schemes will be designed so that where possible, multiple communication paths are employed to cater for situations where a communication link has failed. In all cases, the Distance protection functions will be maintained as backup.

One consequence of differential protection is that the usual, automatic, time graded backup protection from upstream circuit breakers is lost. To overcome this issue Busbar protection will be implemented on those 33kV switchboards that are presently not fitted with this. At the same time Breaker failure protection will also be implemented. Furthermore, to minimise the risk of a circuit breaker failing to trip, Trip Circuit Supervision will be fitted to any circuit breakers that do not already have this feature applied. It is planned to implement the changes over the next 10 years.

The following new 33kV circuits were fitted with Line Current Differential protection (and back up Distance protection) as part of their project construction specifications:

- Te Uku wind farm to Te Kowhai circuit
- Te Uku wind farm to Avalon circuit
- Te Uku wind farm to Whatawhata circuit

A number of existing 33kV circuits have had their existing protection schemes upgraded. These include:

- Te Kowhai to Pukete circuits 1&2
- Te Kowhai to Horotiu circuit 1
- Hamilton to Cobham circuit 1
- Hamilton to Cobham circuit 2

The following existing 33kV circuits are yet to be upgraded

- Te Kowhai to Horotiu circuit 2
- Hamilton to Bryce Street circuit 1
- Hamilton to Bryce Street circuit 2
- Hamilton to Avalon circuit 1
- Hamilton to Avalon circuit 2
- Hamilton to Peacockes circuit 1
- Hamilton to Peacockes circuit 2
- Hamilton to Chartwell circuit 1
- Hamilton to Chartwell circuit 2
- Hamilton to Claudelands circuit 1
- Hamilton to Claudelands circuit 2
- Hamilton to Latham circuit 1

33kV switchboards that at present are not fitted with Bus Zone protection, or Breaker Fail protection include Horotiu, Sandwich and Pukete. This is scheduled to be rectified within the next 5 years.

In recent times all protection equipment has been specified to compliant with, or upgradeable to, the IEC 61850 standard. Future protection equipment will only be accepted if it is fully compliant to ensure future proofing. However at this stage there is no intention to design or construct substation control and protection systems based on the 61850 standard.

TCP/IP communications systems have now been extended to a 39 zone substations and this allows direct communication with the SEL protection equipment from the central engineering office provided the local substation communication processor is adequate. Where this is not the case, such as Sandwich road substation, they will be upgraded at minimal cost. Upgrading of the TCP/IP communications systems for the remaining substations is scheduled for the next few years (as described elsewhere in this document).

The implementation of the TCP/IP systems provides a platform for significant efficiency gains in dealing with protection issues. For SEL relays it allows direct access from the central engineering office to:

1. Interrogate relay settings
2. Interrogate relay operation
3. Interrogate events (since currents and voltages are monitored these parameters can be used for fault analysis.)
4. Apply relay settings; revised or new

So far only items 1 to 3 have been employed for stations where the TCP/IP systems have been applied.

The above applies to protection equipment both at the 33kV and 11kV levels but only for SEL relays at present.

Photo 16 33/11kV transformers at Latham Court Substation

5.9.8.5 Existing Substation Works

Tasman Zone Substation

Tasman 33/11kV zone substation capacity will need to be upgraded with a third 33/11kV 15/23MVA transformer within four years to service both the immediate load growth at Te Rapa and the expected load growth resulting from the Rotokauri District Plan establishment.

New meshed 33kV feeders and associated switchgear and communications are planned from Tasman to Avalon substations.

Primary Assets affected:........... 33kV switchgear, 1 of 33/11kV transformer, 11kV switchgear, 33kV cable, protection relays, and communications

RMA Requirements:....................Alteration to designation is required.

Building Act Requirements:.........Building consent is required for building extension.

The following options were considered during planning for improved security to N-1 for this project

- Other possible sites
- Type and equipment arrangements to meet requirements of the District Plan
- Extension of the 33/11kV network
- Building options for acceptance by the local community
- Increased capacity of surrounding zone substations.

Chartwell Zone Substation

Chartwell 33/11kV zone substation capacity will need to be upgraded with a third 33/11kV 15/23MVA transformer within six years to service the expected load growth resulting from the District Plan growth predictions and commercial shopping mall improvements.

New meshed and rationalised 33kV feeders and associated switchgear and communications are planned from Puketaha to Chartwell substation to support the Chartwell upgrade.

Primary Assets affected:.......... 33kV switchgear, 1 of 33/11kV transformer, 11kV switchgear, 33kV cable, protection relays, and communications

RMA Requirements:....................Notice of requirement is required.

Building Act Requirements:........Building consent may be required for any structures to contain the transformer.

The following options were considered during planning for improved security to N-1 for this project

Type and equipment arrangements to meet requirements of the District Plan

Extension of the 33/11kV network

Building options for acceptance by the local community

Increased capacity of surrounding zone substations.

Wallace Road Zone Substation Upgrade

A WEL standard 33/11kV dual 15/23MVA transformer replacement and upgrade is planned for this substation to accommodate load growth. During the 11kV switchgear replacement project in 2007/08, the first runs of all feeder cables were replaced from the switchgear to the line termination points. Checks should now be done to identify what sections of overhead conductor need to be upgraded to increase the feeder ratings in line with the Protection Based Feeder Upgrade Project.

Load partially shifted to Whatawhata, hence the deferral.

Primary Assets affected:......... 15 / 23 MVA 33/11kV transformers

RMA Requirements:....................Notice of requirement is required.

Building Act Requirements:........Building consent may be required for any structures to contain the transformer.

Peacockes 33kV GIS Switchgear Installation and Transformer Replacement

The new Airport Substation will be fed via two 33kV cable circuits from Peacockes Substation and will require the installation of two additional circuit breakers. The outdoor bus has limited available space and is an eyesore in a residential area which is also adjacent to a day-care centre. The opportunity will be taken to replace the outdoor equipment with an indoor 33kV GIS switchboard with on-board protection to enable connection of the 33kV cables to the airport. This can be achieved by installing the switchgear within the existing building with relatively minor structural modifications.

Refurbished 15 MVA transformers ex Latham Court will be installed on full size bunded pads to accommodate load growth.

Primary Assets affected:........ 33kV switchgear, refurbished transformers, Protection relays

RMA Requirements:....................Notice of requirement is required.

Building Act Requirements:........Building consent may be required for any structures to contain the switchgear.

The following options were considered during planning for improved security to N-1 for this project

- Use of new or refurbished equipment

Gordonton Zone Substation Upgrade

A WEL standard 33/11kV dual 15/23MVA transformer upgrade is planned for this substation to accommodate load growth. Appropriate communication upgrades will also be carried out during this upgrade.

Primary Assets affected:.......... 33kV switchgear, 15/23 MVA 33/11kV transformers, 11kV switchgear, protection relays

RMA Requirements:...................Notice of requirement is required.

Building Act Requirements:........Building consent may be required for any structures to contain the transformer.

The following options were considered during planning for improved security to N-1 for this project

- Use of new or refurbished equipment

Horotiu Zone Substation Upgrade

Within the next two years, a large customer proposes to expand on a site near the Horotiu substation. This is expected to add a further 3MW of load. The additional load will reduce the security below the N-1 level. It is proposed to replace the two existing transformers with 18MVA 33/11kV units recently removed from Claudelands.

The two existing 33/11kV 10MVA transformers will be refurbished and transferred to the new Airport zone substation.

Protection will be upgraded to the current WEL standards.

Primary Assets affected:......... Refurbished 33/11kV transformer, protection relays

RMA Requirements:...................Notice of requirement is required.

Building Act Requirements:........Building consent may be required.

Latham Transformers upgrade to new 2 x 15/23MVA

The two existing 33/11kV transformers are rated at 15MVA and are to be replaced with 2 x 15/23MVA new units to allow load growth and load management in the adjacent industrial areas.

Primary Assets affected:......... 15 / 23 MVA 33/11kV transformers

RMA Requirements:...................Notice of requirement is required.

Building Act Requirements:.........N/A

The following options were considered during planning for improved security to N-1 for this project

- Use of new or refurbished equipment

Te Uku Substation Upgrade

The existing 1970 vintage outdoor 33kV oil filled switchgear is nearing the end of its economic life and does not meet the security standard of N-1 for the area. In addition as part of the wind farm development and connection in the area there is a requirement to upgrade the protection schemes and generation control. The existing switchgear is to be replaced with indoor 33kV GIS (Gas Insulated Switchgear).

Primary Assets affected:.......... 33kV switchgear, 11kV switchgear, protection relays

RMA Requirements:....................Notice of requirement may be required.

Building Act Requirements:........Building consent may be required.

5.9.8.6 Distribution Network Upgrade and Optimisation

11kV Feeder Upgrades

Loads on 11kV feeders are constantly monitored to ensure overloading does not occur and solutions to prevent overloading are evaluated. These are usually a combination of network configuration changes, upgrades of feeder conductors, and construction of new feeders and feeder links as required. Each year the top ten 60% plus loaded 11kV feeders are identified and plans are put in place to alleviate any issues that exist.

- SANCB4 Upgrade – necessary to increase capacity and provide n-1 security to SANCB1
- TASCB6 Upgrade – to provide n-1 security to TASCB2
- HORCB5 load transfer – this will utilize redundant 33 kV OH lines to offload highly loaded HORCB5 to WHACB6
- CLA – PCH trunk – new 11 kV trunk is required to reinforce highly loaded CLA PCH trunk and provide n-1 security to CLA-PCH-FDL-STE ring
- FORCB4 upgrade – provides n-1 security to FORCB3 and TASCB3 and standardizes transformer connection

5.9.8.7 LV Network Upgrade and Optimisation

Data loggers indicate that some distribution transformers and associated LV circuits are highly loaded and upgrading should take place. This project is for the replacement of two CBD distribution transformers in the current financial year while a further four transformers and two LV circuits will be upgraded in subsequent years.

This project also provides for the replacement of old and unreliable LV maximum demand indicators with new data loggers. These will be placed at selected locations with selection based on known loading or service issues. The number of loggers to be installed is 21 for this financial year and 45 units for succeeding three financial years to cover all the CBD transformers. These loggers will make significant amounts of additional data available for proactive management of the network and maintenance of service standards.

New load applications are being assessed to network capacity and necessary upgrade that is required is being implemented. This is to make sure new connection will not contribute to low voltage problems.

5.9.8.8 Load Control and Advanced Infrastructure

Relocate Ripple Plant from Hamilton GXP to Weavers

A spare static 33kV ripple plant located at Hamilton GXP has been moved to Weavers zone substation located in the northern area of the network. This move will allow the existing 11kV 500Hz rotary ripple plants in the northern area to be removed as they are old and have become unreliable. The new ripple plant operates at 283Hz which will require all ripple relays in the northern area to be replaced.

The completion of this move would immediately allow for the transfer of Ngaruawahia substation to Huntly GXP as all relays at Ngaruawahia have already been upgraded to 283Hz. This is an important part of the necessary future load transfer from Hamilton to Te Kowhai and from Te Kowhai to Huntly in order to balance load between GXPs and avoid overloading during peak times.

A project is underway in 2011/12 to install smart boxes which have built in ripple relay functions. These functions include fast under frequency load shed capability which will enable WEL to include the northern network into the reserves market.

Photo 17 Construction of the 33kV Te Uku Wind farm transmission line

5.9.9 Reliability, Safety and Environment

5.9.9.1 Reliability Improvement Projects

In the past few years there has been a focus on improving reliability by:

- Automating 11kV air break switches
- Installing new reclosers
- Fusing 11kV spur lines

Strategic asset replacement/upgrades will be undertaken on the worst performing feeders to reduce repeated customer outages. The focus is on 16mm conductor, aging poles, crossarms and insulators on rural feeders such as Weavers and Te Uku.

Asset replacement projects will be compiled to maximize reliability at lowest cost. This is done through strategic analysis of feeders to assess asset age and condition in order to put together projects that have the greatest impact on reliability.

5.9.9.2 SCADA Communication Network

As substation and field protection, monitoring and control technologies have developed, there has been a need to increase the speed and capacity of data communications to and from these sites.

A study was undertaken in 2005 to determine the adequacy of the WEL communications network and to assess requirements and technologies for the future support of the network. As a result of the study a staged development was approved for the construction of an IP addressable communications network using data transfer technology based on Ethernet physical media with both digital serial data and IP data superimposed on this media using TCP/IP data protocols, i.e. DNP3 over IP. The data over radio links and fibre optic cables is designed to support WELs main operational systems including SCADA- RTU VLAN, pole top radio network, smart metering data backhaul, communications network management, IED engineering, IT business devices & VOIP.

The project over the last 6 years has progressed to provide the infrastructure for:

- IP communications to 39 of the 51 substations, GXPs, ripple plants and switching stations
- The installation of five new radio repeaters and refurbishment of two existing repeaters
- Installation of 35 radio links and 14 fibre optic links

The IP communications network is designed to provide high availability and reliability and cater for expected growth in TCP/IP devices as well as supporting future smart grid initiatives.

The infrastructure provides a range of functionality for simultaneous data traffic, diverse communication routes, deterministic data transfer and consistent data traffic latency.

To provide for this range of functionality a system of VLANs was implemented. This was to allow for segregation of traffic types into virtual networks each with their own controlled capacity and co-existing on the same physical media. This was achieved by utilising layer two industrial IP switches relying on layer three routers to cater for the management of diverse communication routes.

With using a 10 year horizon the expected capacity for a substation with a converged TCP/IP network is 320 k/ps. This is made up as follows:

- 64kb/s for protection devices.

- 64kb/s for SCADA connected devices (SCADA & SEL communication processor).
- 128kb/s for 10 year expansion of IEDs.
- 64kb/s for Substations with Smart Metering Access Points.
- 32kb/s for VOIP

The use of TCP/IP for protection is not suitable due to the non-deterministic nature of the data transfer protocol, i.e. it is not possible to guarantee the delivery time of data packets. To overcome this, the TCP/IP network includes multiplexers to divide off capacity for dedicated serial protection services independent of the IP equipment.

As the network has developed and more fibre routes have been established more opportunities have emerged for routed diverse backups than originally planned. An example of this is at the Hamilton GXP which was originally designed as part of the radial radio network from the Te Uku repeater now has fibre which could be used as part of an alternate route. To set up for dynamic routing a router would have to be set up and changes made to the setting on all other switches on the route. The fibre into HAM also goes on the provide comms to COB, STE and HOS.

Studies are underway to design changes in the routing schemes to provide higher levels of redundancy in the system. This would require the installation of more layer 3 routers in place of some of the present layer 2 IP switches

WEL IP communications network has been designed to allocate separate VLANs to the various types of traffic and functions. The allocation of (QOS) Quality of Service is based on the following priority order

1. SCADA- RTU VLAN
2. Pole Top Radio IP network
3. IT Business Devices & VOIP
4. Smart Metering Data Backhaul
5. Network Management
6. IED Engineering

The allocation of bandwidth is based on a percentage of the total bandwidth of the comms path e.g. 1Mb/s for copper pilots, up to 8Mb/s for radio, up to 100Mb/s for fibre.

WEL has had a practice over many years of installing fibre optic cables along with the running of new 33kv sub transmission underground network cables. The earlier fibre cables were not installed in ducts and contained only 12 cores of single mode fibre. With the increased use of these fibres for SCADA, internet and LAN connections and the need for diverse backup paths for protection signaling for the windfarm the number of cores available in the 12 core fibres was quickly depleted. Multiplexing technologies on the existing 12 core fibre cables has been used to allow for multiple uses of single pairs. The Multiplexors also allow for protection serial data to be transmitted over the same media, fibre or radio, without being affected by the non-deterministic IP traffic.

Multiplexors will be applied to the 12 core fibres at SAN, KEN and CRA to allow for the differential protection project.

The communications to substations and 11kV switching stations in the Hamilton central city area are presently provided by analogue Conitel protocol over aging multi-core copper pilots. This technology has been appropriate for the predominantly electromechanical protection devices at these sites. The Conitel protocol is no longer common in new equipment and the medium and long term plan for these sites is to upgrade the RTUs and protection over the 12 year period to 2022. As this work is carried out the communication to these sites will be upgraded to IP firstly over the copper pilot network using DSL technologies and as more fibre becomes available as city network cables are upgraded fibre optic will be run to increase the bandwidth capability to these sites.

WEL presently has 140 remote pole top sites on the network which are SCADA controlled from the old WEL House in London St and via various repeater sites. With the progression of the network automation program over several years these channels have become overloaded. This overloading causes a slowdown in critical control and monitoring communications to the state where a signal may take over a minute to be processed and acknowledged by the system.

A three year project is underway to install 5 new pole top base channels at existing repeater sites using 4RF Aprisa SR 12.5kHz radios operating in the 420 - 450MHz range. These channels are set up in the point to multipoint mode using one radio spectrum license for each channel. The radios are designed to operate serial communications as well as providing 2x Ethernet IP ports which will allow us to migrate to IP comms in the future with the advantage of no degradation in service through increased usage.

The future trend for the pole top network on the ten year horizon is for the RTU's to evolve to IP based devices, however with the small amount of data transported to and from each pole top RTU the short to medium term plan is for low bandwidth digital communications to remain as the primary method for small or remote communications.

The pole top network utilizes the main bearer links between major communications sites to link the digital network and to integrate the pole top back to back repeaters within the overall telecommunications network. The capacity catered for by the digital pole top channels over the next 5 years is 4800Bb. Eventually we see this system aligned or integrated with the WELconnect mesh communications.

Although the height and location of the old WEL building in London Street is ideal for line of site radio communications to the east, south and central city areas as well as connection to the copper pilot network the long term plan is to reduce the reliance on WEL House London Street as a major communication node. One stage of this process is to move the main substation and pole top radio channels out to the communications nodes at the major repeater sites. As WEL still has a large number of serial communications links out of WEL House will mean that the downgrading of the building as a major communications site will take some time to complete. The reliance on Conitel protocol over copper pilot cables in the majority of City switching stations will stay for the life of the Plan as the RTUs at these sites are programmed for replacement and converted to IP over this time.

The following communications network projects are planned over the next 5 years

- Multiplexors will be applied to the 12 core fibres at SAN, KEN and CRA to allow for the planned differential protection project.
- Install IP phones using VOIP at all substations.

- Continuation of the Pole Top Radio upgrade project by conversion of remaining Conitel pole top sites. This work includes replacement of the old Conitel RTUs and installation of 4RF Aprisa SR Radios.
- Complete fibre circuit to BRY using Velocity network/ducts. New Ducts to be laid over the Tristram Street rail bridge. This work involves 130m of fibre and duct drilled from BRY to Velocity duct then in duct to connection point to Velocity Dark Fibre.
- Install Routers for HAM Fibre LAN. This work includes a new router at HAM.
- Complete the fibre circuits from HOS to LAT using ducts between LAT and Allison Street laid last year and install new ducts from Allison Street to HOS.
- Run new fibre link from Steel Park switching station to Hamilton Gardens pavilion building and install a microwave link across river to Peacockes Substation to allow for protection circuits and backup communications' to PEA, AIR, HOS, COB. This work includes STE to Hamilton Gardens duct and fibre of 2km plus Microwave link over river to PEA.
- Routers and IP Switches for City Fibre LAN.
- Conversion of the remaining city based copper pilot connected switching stations to I/P There are 11 switching stations left to converted. They are CIV, RUR, BAR, WHI, GAR, PCH, ALE, MAS, ANG, KIL, FLD. The work involves fitting wall mounted comms panels and I/P switches with copper interfaces. These have been catered for in the RTU replacement and protection upgrade Programme identified in the 12 year asset replacement budget.
- Replacement of the existing copper communications pilots will be catered for as various trunk cable are upgraded through the city. An allowance should be made in these projects to install fibre at the same time as the cables are replaced.
- Communications required to cater for the 33kV Protection Upgrade from distance protection to differential protection.

5.9.9.3 Safety and Compliance

Mitigation of line clashing near zone substations

Overhead lines near zone substations are more liable to clash under fault conditions, as a result of rising fault levels. This project provides for further work around the Peacockes, Whatawhata and Raglan zone substations. Mitigation work will entail a combination of correcting line tensions, conversion to delta configuration, installation of inter-span spacers, installation of wider cross-arms and re-conductoring as required. Conductor and crossarms in poor condition will be replaced.

Installation of Arc Flash protection on existing switchboards

Hazards from Arc Flash incidents have always existed to a greater or lesser extent but have recently gained additional prominence because of EEA's involvement. EEA have recently decreed that Arc Flash must be classified as a significant hazard under the Health and Safety Act and must be addressed according to the hierarchy of the ACT i.e.

Eliminated , or

If it cannot be eliminated, then isolated, or

If it cannot be isolated, then minimised and PPR gear provided.

Legislative requirements are that an assessment of all assets shall be completed no later than 31/12/2013. For metal clad switchgear this has already been completed. This has identified that there are 3 off 33kV switchboards and 25 off 11kV switchboards where the Arc Flash levels exceed the allowable. (Switchboards purchased in recent years are al Arc Flash proof.) It is planned to eliminate or reduce the Arc Flash hazards to acceptable levels by fitting Arc Flash protection relays. In addition, in a number of cases where this is possible, existing front panel doors will replaced by Arc Proof doors. The upgrading is planned to be completed by the end of the 2013 financial year.

Power Quality - works required to correct customer complaints

WEL investigates power quality issues raised by customer complaints and enquiries. Power quality issues include:

- Low or excessive voltage
- Harmonic interference
- Electrical noise
- Audible noise
- Stray voltage
- Power factor

Investigations into supply quality issues are logged, investigated, corrected, recorded and reported to management on a monthly basis.

Seismic strengthening Bryce Street, Glasgow Rd and old Avalon 11kV substation buildings

The Bryce Street substation, Glasgow Rd substation and the old Avalon 11kV switch room buildings have been identified as needing strengthening work to meet current seismic strength regulations.

This Bryce St work has been scheduled to be completed in the 11-12 year and involves the complete removal and replacement of the oldest unstable portion of the building.

At Glasgow Rd, the work involves the installation of steel framing to the interior of the buildings to provide the required structural strength.

Whilst the old Avalon 11kV building is no longer used for Network operations, there is potential for it to be used as a DR site. The work on this building involves the installation of minor steel reinforcing braces to existing steel beams and the removal of some large windows.

The Glasgow and Avalon work is scheduled for the 2012-13 financial year.

5.9.10 Customer Connections

Annually around 900 new residential sections and 240 new infill connections are required to be reticulated to meet customer demand. Additionally, around 3 MVA of commercial capacity is connected annually. This often requires network augmentation. A significant investment is made annually to provide for these new developments.

5.9.11 Asset Relocation

Relocation

Demand is driven by a number of council road realignment and relocation projects.

Information on future work volume is provided by the Waikato District and Hamilton City councils. These indicate that the level of road realignment and relocation requirements will continue, in future supported by the WEL Energy Trust commitment to part fund selected uneconomic undergrounding work.

Uneconomic Undergrounding Projects

Typical undergrounding projects fall into two categories, either overhead to underground conversions or asset relocations. WEL receives numerous requests each year from other parties to either relocate overhead lines, cables or equipment, or to convert existing overhead lines to underground cables. These third parties include Transit NZ, Hamilton CC, Waikato DC, Waipa DC, subdivision developers, and private landowners.

Requests from roading authorities are usually for construction of a new road or alteration to an existing road as described above in relocation. Developers and landowners request relocation or undergrounding in order to clear a site for development or construction of buildings, or to improve the aesthetics of the area. This is a requirement under local planning criteria.

WEL does not have its own undergrounding or relocation program. The uneconomic undergrounding programme is partially supported by the WEL Energy Trust commitment and requester's contribution.

5.10 Projects Under Investigation for Short and Medium Term Consideration:

An updated analysis of Grid Exit Point (GXP) capacities to provide a secure supply for the Hamilton area shows that a need for an additional GXP or upgraded GXP capacity will arise as early as 2015. WEL intends to defer the proposed GXP investment as long as possible, and seeks to develop a regional solution with Transpower and possibly with neighbouring lines companies. The following stages and projects are under investigation, subject to optimisation and integration into a least cost regional solution. A total investment of $40m has been included in the plan.

Stage 1: Hamilton 33kV Outdoor to Indoor Conversion Project

Transpower is upgrading the Hamilton 33kV GXP's existing 33kV overhead bus and circuit breakers with indoor GIS switchgear. To manage the protection aspects of the project for WEL a number of relay upgrades are required and changeover of 33kV cable to the new GIS gear.

Stage 2: HAM 33kV GXP Changes

The loading of the Hamilton 33kV GXP has exceeded the constrained limit for secure operation. In addition, HAM11kV GXP has a 30 degree phase shift does not allow for load to be transferred to adjacent networks without the loss of supply to customers. HAM11 load is projected to exceed the constrained limit by 2016. Under investigation is the addition of a third 120MVA transformer to provide additional capacity and security to mitigate post contingency limit and to incorporate the HAM11kV loads to mitigate the phase shift issue, cater for the projected load growth and allows for the transfer of the HAM 11kV loads to an alternate supply in the event of a major contingency. Transpower has installed a new 120MVA transformer to replace an old 100MVA transformer and plans to replace the other 100MVA transformer. These developments are Transpower's activities together with the addition of a third 120MVA transformer.

Stage 3: Hoeka Rd and Ruakura Zone Substation

As well as a 30 degree phase shift with other 11kV networks. HAM11 also operates with highly loaded feeders and high customer numbers per feeder. In addition, loss of the 11kV bus under contingency cannot be served by other zones. Two new zone substations are proposed.

Refer to Section 5.9.8.2

Stage 4: Puketaha / Crosby Zone Land & Substation

Puketaha / Crosby Road is a strategic point for network connection of 33kV sub-transmission circuits, zone transformer feeders and a possible future northern GXP development. As such it is planned to develop a 33kV switching station initially as a transfer point and protection segregation hub. Additional capacity for zone transformer connection as load in the area demands is planned for this point or consideration of a 3rd transformer at Chartwell.

Te Kowhai – Hamilton Transfer Capacity Enhancement

Under the 2010 planning studies it has been identified that the security across the two Hamilton GXPs is inadequate particularly under contingent events. To overcome this insecurity it is planned to enhance the transfer capacity across the two GXPs by increasing the sub-transmission capacity and installing switching stations to achieve flexibility in switching. Further studies are in progress to enable a final decision to be made.

Load growth Te Rapa / Rotokauri

Council plans have indicated an increase in residential, commercial and industrial activities in the Te Rapa and Rotokauri areas. Tasman and Avalon zone substations do not have the capacity to service the load growth in the area. A third transformer in Tasman is planned in order to service immediate and future load growth.

Tasman to Avalon cabling

The meshing of the sub-transmission network between Tasman and Avalon is under investigation for load growth and security. This can be achieved by installing a circuit between Tasman and Avalon.

Latham to Avalon cabling

The meshing of the sub-transmission network between Latham and Avalon is under investigation for load growth and security. This can be achieved by installing a circuit between Latham and Avalon.

Te Kowhai to Avalon cabling

The meshing of the sub-transmission network between Te Kowhai and Avalon is under investigation for load growth and security. This can be achieved by installing circuits between Te Kowhai and Avalon.

Sub-transmission reinforcement

Load flow studies have identified various sections of the sub-transmission networks as constraining. These sections are to be upgraded to ensure continuity and security of supply. They are under consideration of overall optimisation of sub-transmission networks.

- Wallace to Latham
- Latham to Peacockes
- Hamilton to Peacockes
- Chartwell Incomer Circuits
- Hamilton Latham Reactor Removal

The last few years have seen consistent and significant growth. As a result, WEL's focus continues to be on development projects around GXPs, sub-transmission, zone substations and switching stations to ensure robustness, security, reliability, growth and specific customer needs. With the exception of the Hamilton GXP's capacity improvements these issues have been largely addressed and the next levels of assets are being considered for development.

5.11 Ongoing Projects Under Investigation

A number of projects continue to be planned and are under investigation for ongoing consideration. These projects are categorised as:

- Low voltage cable augmentation for high load growth areas
- High voltage cable augmentation for high load growth areas
- High voltage cabling links for zone interconnection
- High load zone and feeder balancing
- Reliability improvements
- Potential safety and compliance issues
- Customer driven specific projects
- Line upgrades for capacity and security improvement
- Distributed generation opportunities

Photo 18 Live Line Replacement of HV Insulators

5.12 Capital Expenditure Projections

Table 12 and Figure 46 below show the Capital Expenditure Projection for the AMP period.

Table 12 Capital Expenditure Projection for AMP period.

Capital Expenditure	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Customer Connection	5,658	7,109	5,709	5,923	5,423	5,423	5,423	5,423	5,398	5,398	5,398
System Growth	16,704	16,617	21,564	21,126	11,938	15,650	22,445	13,703	8,071	7,435	3,606
Reliability, Safety and Environment	1,823	3,440	2,175	1,008	898	884	944	899	773	707	742
Asset Replacement and Renewal	8,601	8,990	9,710	10,470	10,220	10,960	9,420	9,640	9,920	9,805	8,500
Asset Relocations	4,000	4,075	4,075	4,075	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Total Capital Expenditure	36,785	40,231	43,233	42,602	31,529	35,967	41,282	32,715	27,212	26,395	21,296

*Note 1: Asset Replacement includes capitalised maintenance.

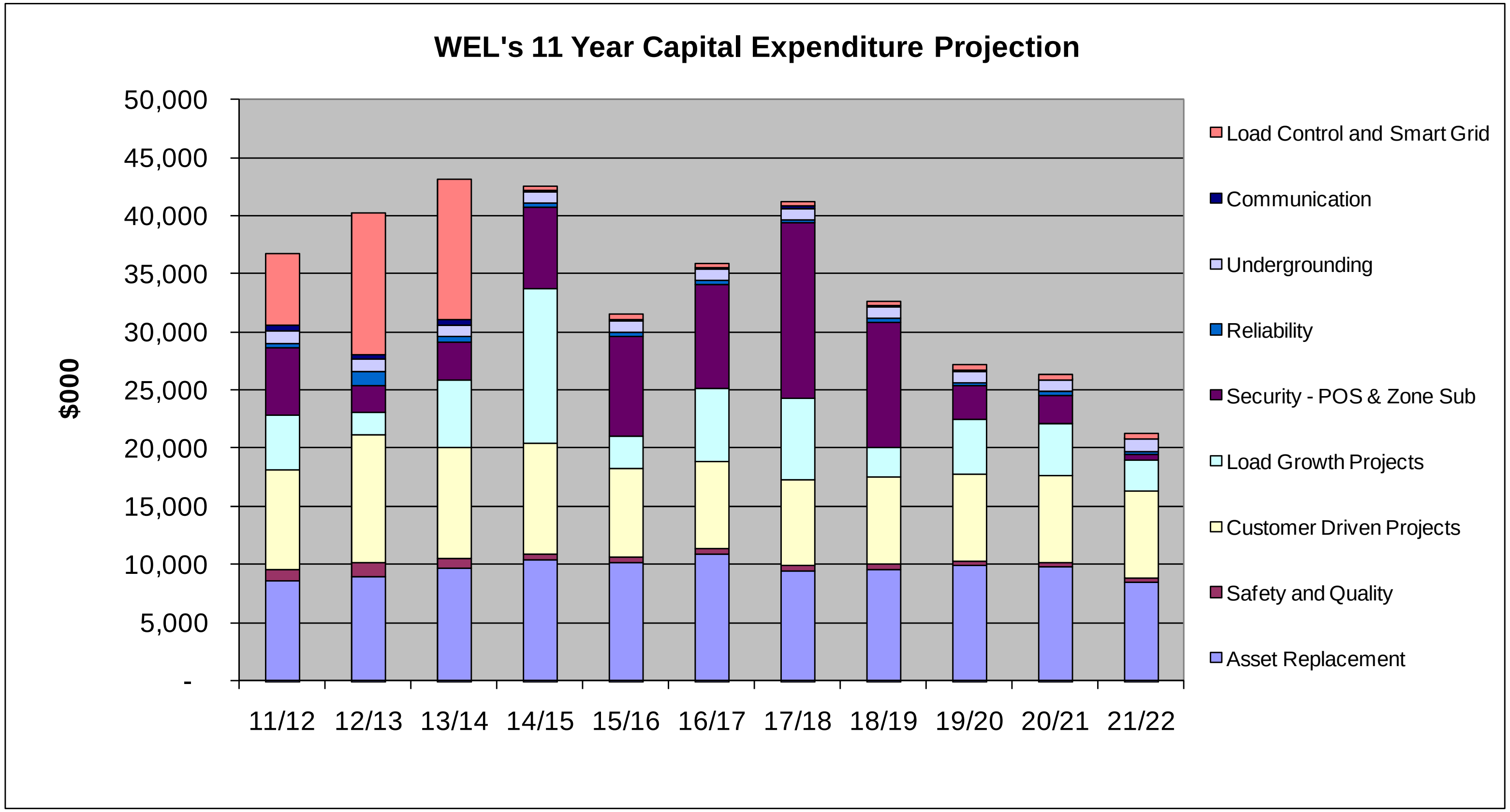


Figure 46. Capital Expenditure Projection for AMP period.

6 LIFE-CYCLE ASSET MANAGEMENT PLANNING

6.1 Maintenance Planning Criteria

6.1.1 Drivers and Strategy

At WEL, maintenance is applied as a technique to address risk (reliability, financial, safety etc). (The risk management process is addressed in section 8).

The following asset maintenance drivers are applied:

- Ensure continued safe operation.
- Improve present network reliability. The main maintenance focus being on total outage numbers and number of repeat outages for customer classes
- Ensure cost effective maintenance.
- Minimise asset life-cycle costs through optimal planning, design, operation and maintenance, renewal and replacement.

Several maintenance strategy options have been adopted, each applied in accordance with the drivers above.

- **Scheduled**

  Periodic maintenance where maintenance occurs at a frequency dependent on manufacturer's recommendations or company experience

- **Condition based**

  Maintenance is determined by inspections and condition monitoring techniques. This identifies immediate defects and also allows candidates to be identified for replacement programs.

- **Reliability Centred Maintenance (RCM)**

  Maintenance taking into account plant performance, failure modes and function rather than the asset itself

- **Reactive (fix when failed)**

  Do nothing until a failure occurs

Other techniques employed to achieve world class maintenance practice include Root Cause Analysis (RCA) and Failure Mode Effects and Criticality Analysis (FMECA).

An optimal balance between the above options is required and this depends on the type of asset, its condition and the consequence of failure.

6.1.2 Optimisation Process

WEL selects the type and level of maintenance which results in minimal overall costs, this being the point where the sum of the maintenance costs and the risk of failure costs are at a minimum while achieving the desired level of network performance.

A formal Maintenance Optimisation process has been developed, as shown below.

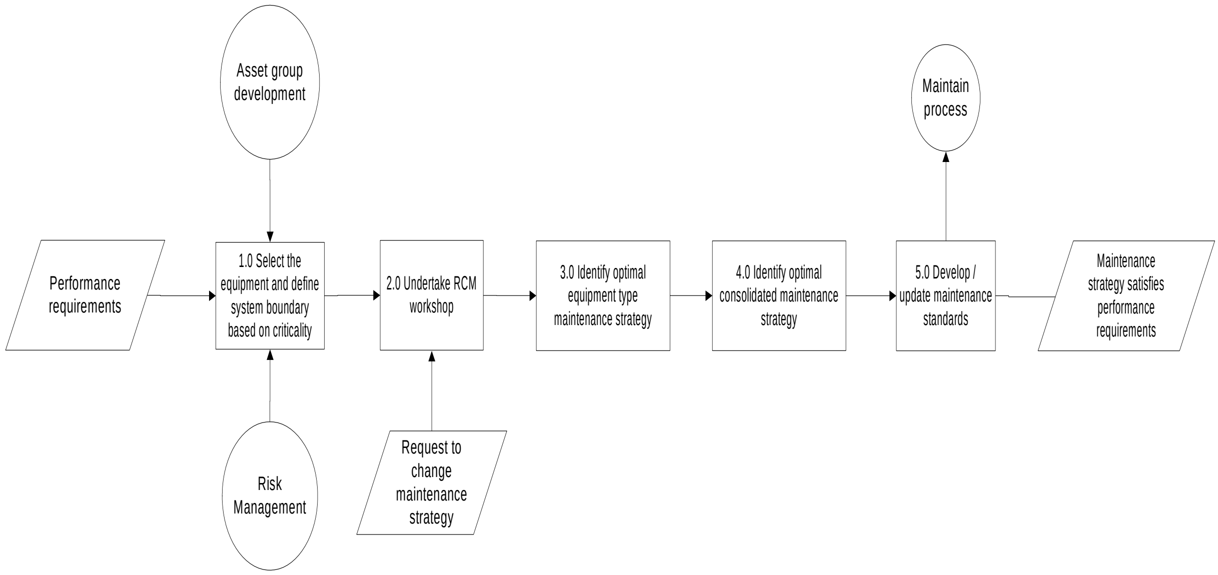


Figure 47. Maintenance Optimisation Process

In addition WEL has implemented a Computerised Maintenance Management System (CMMS). This software combined with the formal optimisation process, described above, aims to deliver a maintenance process which is more efficient and effective. Features of CMMS include:

- List of network equipment
- Criticality assessment of equipment and location
- List of preventative maintenance tasks and inspections that reflect the maintenance strategy for that class of equipment
- History of work performed and costs incurred against equipment
- History of condition assessments obtained from maintenance tasks and inspections.

6.2 Maintenance Programme and Expenditure by Asset Category Projections

6.2.1 Programme

For a description of the maintenance programme for each asset category refer to Section 3.3.

6.2.2 Expenditure Projections

Maintenance spend increases and then is expected to remain relatively flat over the reporting period. The main drivers are:

- A significant part of the capital spend in the last few years has been for additional assets. The creation of additional assets will result in an increase in the total amount of maintenance required. The new wind farm related assets (a switching station and 33kV circuits) and two new zone substations (Whatawhata and Cobham) have been added. Provision is also made in 2012/13 year for maintenance costs associated with the planned rollout of smart meters.
- Routine inspections are still needed, even on new equipment.

- Increasing demand for the gathering of network data and asset data validation
- It has also been determined that in many cases further reliability improvements can be more cost effectively achieved through additional maintenance spending, rather than committing to replacement capital spend.

The next 11 years' total network maintenance expenditure projection including the current year is summarised in Table 13.

2011 AMP WEL's 11 Year Maintenance Expenditure Projection ($000)											
Operational Expenditure	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Routine and Preventative Maintenance	3,094	3,068	3,127	3,190	3,190	3,194	3,194	3,199	3,199	3,203	3,203
Refurbishment and Renewal Maintenance	1,800	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720
Fault and Emergency Maintenance	2,364	2,425	2,431	2,438	2,438	2,439	2,439	2,439	2,439	2,440	2,440
Total Operational Expenditure	7,257	7,213	7,278	7,348	7,348	7,353	7,353	7,358	7,358	7,363	7,363

Table 13 Maintenance Expenditure Projection for AMP Period ($000)

Assumptions for the maintenance expenditure profile are provided below.

Faults

It is assumed that the level of fault activity will remain fairly steady. The number of fault jobs per period has tracked quite consistently over the last few years. Approximately 2/3 of fault costs are incurred on the LV network and are of a low cost/high volume nature with more than 90% being less than $500

	% Number Jobs	% Cost
No specific asset - LVMISC, NHW, Streetlight, power quality	34%	29%
Poles (typically fuses and cutouts)	26%	20%
LV Service (typically fuses)	16%	10%
Conductor faults (often LV)	5%	16%
HV Fuses/ABS/Tx	14%	17%
Other various	5%	8%

Approx 63% of maintenance fault costs relate to LV problems.

Relocation Related Maintenance Work

This category relates to the situation where additional maintenance is carried out where an existing asset is moved to a new location. It is assumed that this need will continue at the current level of activity, and is mainly customer driven.

SCADA and External Subdivision Faults

The spend has increased significantly because of a greater emphasis on planned maintenance. Offsetting this is an expectation that the number of externally owned subdivisions will reduce over time.

Vegetation

The expenditure in this area has historically been below optimum. Bringing the vegetation work in-house and the application of better systems and equipment has improved efficiency. It is expected that more trees will be able to be cut with the same amount of money. However the quantity of high priority (P1) sites has now reached a steady state value, see below graph, and additional budget is therefore required to ensure a downward trend.

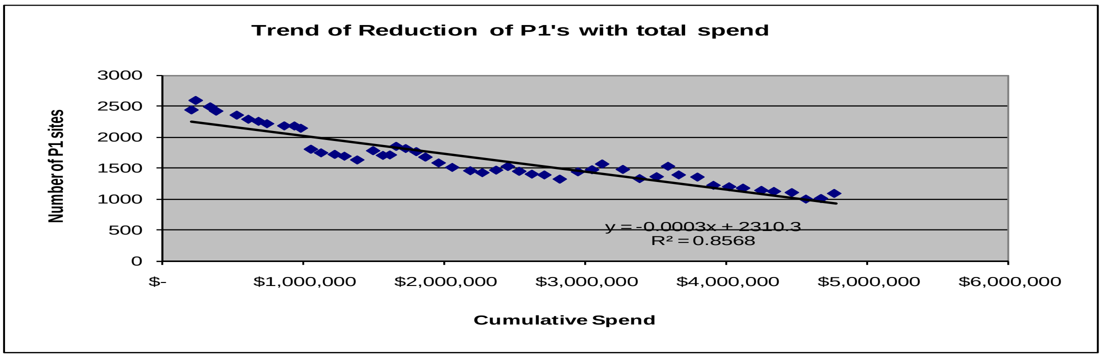


Photo 19 Vegetation removal by WEL crew

Zone Substations

The trend is expected to remain relatively flat once the zone substations that have been built or extended recently are added to the maintenance volume. There are variations in costs from year to year as major corrective works such as building maintenance or zone transformer refurbishment becomes due.

Ring Main Units

Oil filled ring main units (RMUs) are gradually being replaced with low maintenance alternatives. A two year project was initiated in November 2008 to inspect and service all oil filled units and to ensure correct alignment and operation of the switches is nearing completion. A higher priority has been given to older units and those susceptible to contact misalignment. The project has now been completed and RMU's will now be inspected every four years with full maintenance carried out on the oil type RMU's on an eight year cycle.

Distribution Maintenance

This spend covers all non substation assets and primarily covers preventative maintenance, inspections, condition assessments, and corrective maintenance. Provision is also made for costs related to the gathering of asset related data, investigations and changes to network configuration and protection. It is anticipated that the overall spend level will remain fairly constant.

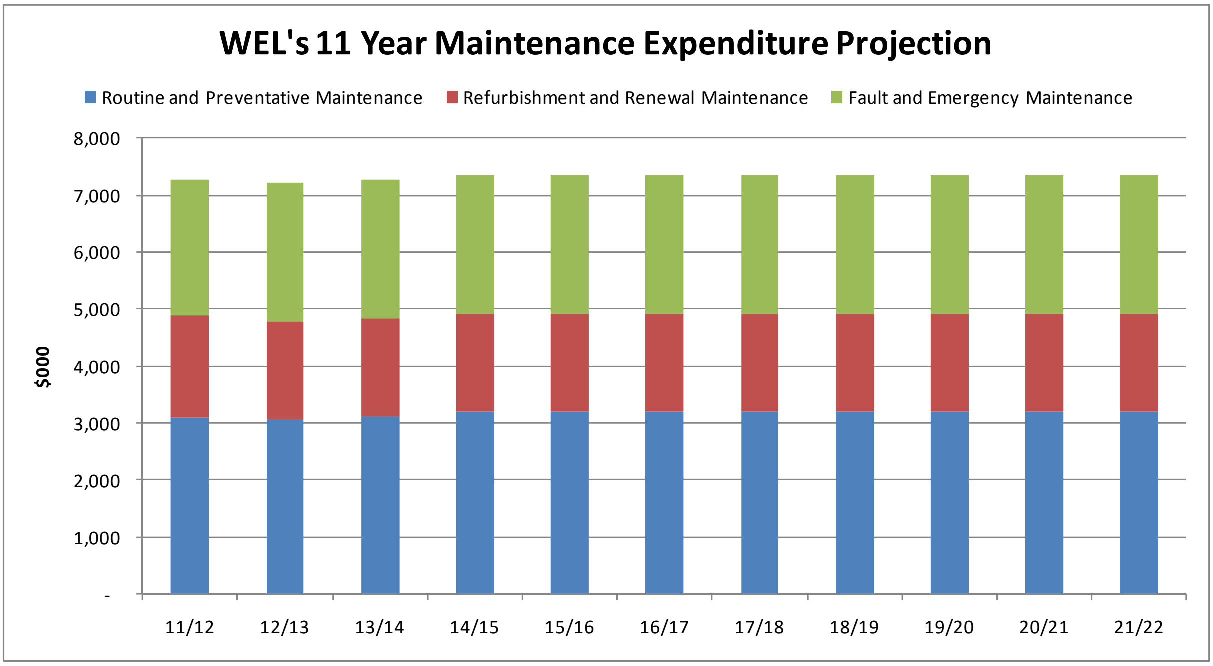


Figure 48. Maintenance Expenditure Projection for AMP period.

6.3 Asset Renewal Policy

Network assets have a finite life. To ensure assets provide an acceptable level of service throughout their life system assets must be renewed over the course of time. Renewal expenditure makes up about 30% of WEL's overall capital expenditure programme.

An asset renewal plan has been developed to ensure assets maintain acceptable performance throughout their life and to ensure optimal return for the investment in the asset. This plan provides decision points for replacement or refurbishment of each class of asset.

Some network assets such as overhead lines or zone substations are comprised of separately identifiable items. Restoring such composite assets to an acceptable condition often requires only replacement of some components rather than replacement of the whole asset (for example crossarms vs. poles). The extent of the replacement work is determined from regular condition assessments.

Asset replacement involves replacement of the whole of the asset, which has reached or exceeded its reasonable service life. In the WEL model assets are itemised as identifiable items hence all expenditure on assets is considered to be replacement, rather than refurbishment. The exception to this is zone transformers and switchgear, where refurbishment does take place.

Refurbishment will extend the life of assets at a substantially lower cost than replacement. For example, new zone transformers are considered to have an economic life of 45 years. However, mid-life refurbishment at a cost of less than 10% of replacement will extend the life by over 30% to 60 years.

WEL's strategies and focus for cost effective asset renewal are:

- Asset replacement requirements by age
- Asset replacement requirements by condition
- Potential risk to the reliability and security of the network of alternative replacement scenarios
- The various technical drivers for asset replacement
- An existing asset database which provides age profiles
- Condition assessment and monitoring of critical asset types which provides fault/failure data
- A policy which defines standard engineering lives and economic working lives of assets
- Comparison of long-term operating costs (maintenance, spares holdings, system losses) against capital cost of replacement
- Assessment of the expected contribution to improvement in network performance
- Resource and financial ceilings and desirability of smoothing resource requirements and expenditure on a year on year basis.

The decision to undertake to renew an asset is based on age plus the following factors:

- Performance requirements
- Asset condition monitoring
- Level of refurbishment, maintenance and operating costs
- Historical failure statistics
- A risk assessment associated with deferring asset replacement expenditure.
- The economic cost/benefit of continued repair versus the cost of replacement

The methodology employed for forecasting future capital resource requirements for the replacement of system assets relies on:

- The age profiles for the various types of assets in the network
- An estimation of the remaining service life of the assets from expected economic working life or standard engineering life
- The modern replacement cost of assets

A forecasting model has been populated with existing asset classes, quantities and age profiles to arrive at an estimate of the spend profile.

A "Risk Limit" is introduced to mitigate the risk of all assets in an asset category reaching the end of their life at the same time; use of the "Risk Limit" factor also avoids over-investment in an asset category.

The benefits of the asset replacement approach described in this Plan are that it:

- Provides a consistent, long-term asset replacement strategy which allows real investment requirements to be forecast.
- Results in a reduction in volatility of the total resource (financial and manpower) requirements year on year.
- Reduces risk of assets failing by avoiding the position where large quantities of assets reach the end of their expected life over a short period of time.

6.4 Asset Renewal Programme, Inspections and Maintenance Plan

The age profiles of the asset classes are shown in 3.3. The age profiles have been updated as a result of a major effort to improve asset data in preparation for entry into the financial asset register. The age profiles adjusted by survey derived condition information drive the asset renewal programme. Other smoothing has been made to reflect funding constraints and the timing of major projects.

Table 14 and Figure 49 summarises the total expenditure by Asset Category.

For many asset classes comprising smaller discrete assets (e.g. poles, crossarms, 11kV overhead switches, ring main units, distribution transformers and 11kV EDO's) the renewal programmes consist of ongoing replacements indicated by the spend profile below. Lists of specific assets are accumulated and assigned to specific future years as identified from inspection and condition assessment activities.

For more substantial assets (such as switchgear and power transformers) renewal projects are planned and these are also discussed below. The time frames for these projects are indicated in the sections below.

Table 14 Asset Renewal Expenditure Projection by Asset Category for the AMP Period

WEL's 11 Year Asset Renewal Capital Projection ($000) 2011											
Asset replacement Category ($000)	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**	**20/21**	**21/22**
11kV Circuit Breaker (Upgrade)	30	-	-	-	-	400	-	180	150	300	90
11kV Ring Main unit	400	500	500	500	400	300	300	200	200	300	500
11kV Switching Station/Zone Sub	100	140	200	100	-	400	50	200	200	295	-
11kV Air Break Switch	150	260	600	600	900	1,100	760	650	510	340	340
11kV Reclosers and Sectionalisers	50	60	60	60	60	-	-	-	-	60	60
33kV Circuit Breaker	200	50	-	800	-	-	-	-	-	-	-
33kV Overhead Lines	-	-	-	-	-	-	-	-	-	-	-
33kV Sub-transmission UG cable	-	-	-	-	-	-	-	-	-	-	-
Distribution 11kV OH Lines	300	480	450	300	250	250	250	250	250	250	250
Distribution 11kV UG cables	100	100	100	100	100	100	100	100	100	100	100
Protection Relays	100	100	-	200	-	350	-	150	100	190	190
Poles-	600	1,050	800	800	800	400	300	200	200	300	300
Crossarms	700	1,400	1,700	1,700	2,000	2,000	2,000	2,000	2,000	2,500	1,500
Distribution Transformers(11kV/400V)	450	500	800	800	1,500	1,500	1,500	1,500	2,000	1,000	1,000
Fuse 11kV	200	200	200	200	100	100	100	100	100	50	50
LV Overhead Reticulation	50	50	50	60	60	60	60	60	60	70	70
LV Underground cables	400	400	400	400	400	400	400	400	400	400	400
SCADA & Comms	200	100	150	150	-	150	150	200	200	200	200
Zone Substation Transformer	926	-	-	-	-	-	-	-	-	-	
Service and Dist Pillars	300	400	500	500	500	400	400	400	400	400	400
Capitalised faults	1,405	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
Capitalised Maintenance	1,000	950	950	950	900	800	800	800	800	800	800
Medium mixed projects	840	450	450	450	450	450	450	450	450	450	450
Other	100	100	100	100	100	100	100	100	100	100	100
Total	**8,601**	**8,990**	**9,710**	**10,470**	**10,220**	**10,960**	**9,420**	**9,640**	**9,920**	**9,805**	**8,500**

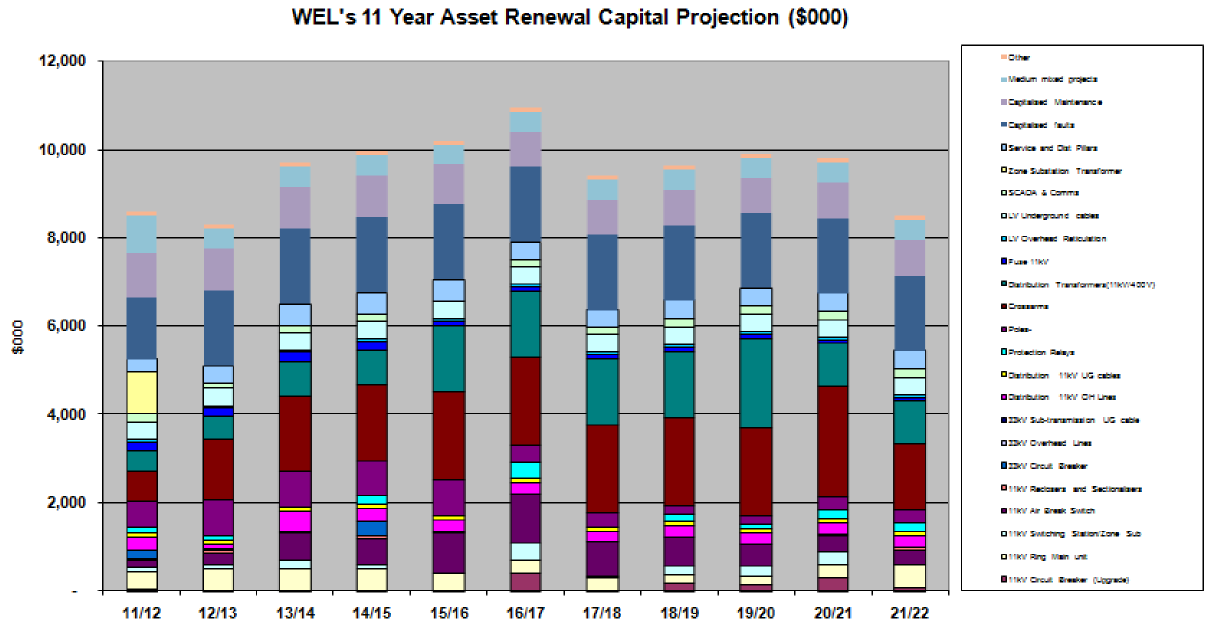


Figure 49. Asset Renewal Expenditure Projection by Asset Category for AMP Period

Underground conductor replacement is increasingly dominant in the second half of the period.

The above presentation includes provision for capital fault asset replacement and urgent replacement based on the likelihood of immanent failure. It also includes a category for provision of medium sized projects where a group of assets are replaced at the same time and not necessarily replaced with the same asset type. An example of this would be undergrounding of a cluster of wooden poles around an intersection.

The above projections are generally based on standard replacement costs. One exception is the replacement of wooden poles. These remaining poles are typically in complex or difficult situations so their replacement costs are expected to be significantly higher than a standard situation. Contingency amounts may be requested where there are significant additional costs identified such as unusual access difficulties, major traffic management or significant temporary generation during changeover of the asset is required.

6.4.1 33kV Sub-Transmission Underground Cables

The older 33kV cable circuits are the paper insulated solid type. All gas insulated cables have been removed from service.

Temperature measurement points have been installed on key cables. The temperatures are monitored to ensure cables are loaded appropriately for the condition they are in.

No other specific inspection or maintenance is performed on this asset class.

6.4.2 33kV Overhead Lines

Existing lines through residential areas are being under-grounded as city development takes place. For new (rural) construction and reconstruction work, conductor sizes have been rationalised and butterfly is now the standard. Crossarms are usually replaced and the construction configuration changed to delta if this is cost effective to do at the same time.

Maintenance takes cognisance of the meshed nature of the 33kV system. That is some maintenance is reduced because of the built in redundancy. For example bird-be-gone is no longer replaced on mesh circuits.

The maintenance programme includes an annual drive-by of the network assets through which the state of the lines is monitored and assessed for appropriate action.

After faults it is common practice to carry out thermal imaging to ensure conductors, terminations and connections are performing satisfactorily.

In addition, an intermediate six-monthly inspection is performed on the spur sections of 33kV line. The inspection is to identify obvious defects that might affect network reliability within the next two years.

6.4.3 33kV Circuit Breakers

SF_6 and vacuum circuit breakers are maintained at intervals not exceeding two years between services. This interval is reduced if multiple or high fault level trips have occurred.

The inspections include checking at least one breaker at every location for dust accumulation, partial discharge tests, gas pressure alarm integrity checks, trip timing checks, trip circuit integrity checks, SCADA alarm, and control checks and contact maintenance according to manufacturer recommendations. If needed, dust is removed using live line techniques.

The oil circuit breaker maintenance programme includes partial discharge testing as determined appropriate, contact and turbulator erosion checks, oil change if required, trip timing checks, trip circuit integrity checks, SCADA alarm and control checks.

The 33kV circuit breakers at Peacockes will be replaced with an indoor board in 2014/15 as part of the substation upgrade and breakers at Te Uku will be replaced as a result of an upgrade and interconnection to the wind farm circuits.

6.4.4 Zone Substation Transformers

These assets are given a visual inspection bi-monthly as part of the substation inspection. DGA oil tests are carried out annually or more frequently if required. Minor inspection and maintenance is carried out every three years and major maintenance and service every 8 years. All zone transformers are fitted with silica gel breathers to minimise moisture ingress, which are inspected regularly. Where necessary oil has been dried out and de-acidified.

Where testing shows oil condition is outside acceptable values the oil is reconditioned with the transformer in service. Zone transformers undergo a mid-life refurbishment to extend their life. This work requires removing (detanking) the core, an internal inspection, dry out, testing and repairs as required. The remaining life is assessed at this time though it is expected that well maintained transformers with mid-life refurbishment will have a life exceeding 60 years.

No zone transformers will exceed their nominal lives within the planning period, however two will be replaced. Two new transformers are being purchased to accommodate load growth in one area and the existing ones will be used to replace the two transformers at Te Kauwhata that are over 50 years of age and have never been refurbished. Additionally, 5 transformers will reach their half life, and an allowance for “half life” refurbishment has been provided for within the 11 year planning period. Transformers at WEL are usually run well within normal ratings and furans analysis shows their remaining useful lives are better than or consistent with their ages.

6.4.5 11kV Switching Stations/Zone Substations Switchgear and Protection

11kV circuit breakers and switchgear are serviced at three yearly intervals. This interval is reduced where multiple trips have occurred or where trips have involved high fault levels. Major services are performed every six years. Periodic inspection and condition monitoring techniques such as partial discharge tests are carried out and the insulating oil in oil filled circuit breakers is changed at regular intervals. The maintenance programme also includes contact and turbulator erosion checks, trip-timing tests, trip circuit integrity checks, close circuit integrity checks, SCADA alarm and control checks.

A number of replacements have been made in recent years and replacement of the Horotiu 11kV board was completed in 2011 as it had reached end of life and other capacity upgrades at the site were also completed.

Circuit breakers at the following sites will exceed the normal life expectancy in the planning period. Provision is made to replace these in a staged manner from 2016 onwards, Claudelands (2016/17), Alexandra St (2018/19), Barton St (2019/20) and Civic Car Park and Findlay (20120/21. The existing 11kV circuit breakers are of the withdrawable oil filled type. New switchboards are likely to consist of the fixed pattern types which have reduced maintenance requirements.

Original electromechanical relays at these sites will be replaced with modern electronic devices at the same time the switchgear is replaced. This defers the expenditure on relay replacement from what is suggested by the replacement model.

6.4.6 11kV Switching Stations

All substation equipment items are subject to regular, documented maintenance regimes. The 11kV switching station maintenance programme includes bi-monthly visits where building condition and building security, grounds and fence security are checked and maintained. For switchgear, SCADA equipment and communications equipment, regular routine maintenance is carried at defined intervals. 11kV buses are inspected every eight years and cleaned as required. Thermo vision, partial discharge and ultrasonic inspections are carried out on most HV equipment on an annual basis, or when problems are suspected. These checks can detect unusually high levels of temperature or electrical discharges.

In the current year the MAF switching station has been rebuilt and the Cobham switching station was converted into a zone substation.

6.4.7 Distribution 11kV Underground Cables

There is no routine maintenance regime as such in place for the 11kV cables.

Ad hoc maintenance consists mostly of repair of cables damaged by external sources. When there is a reason for the cables to be repaired samples are taken and examined to assess the internal condition of the cable.

Most PILC cable is still well below expected life though an increasing amount of XLPE cable with a lower expected life is anticipated to become an issue towards the end of the planning period. Sections of cable of both types are being replaced where capacity constraints are identified, load requirements are increasing or deterioration has a result of high load factors has occurred. Where failures occur samples of cable are being retrieved to assess the internal condition of the cable. Provision is made for situations where a fault occurs and it is found the cable condition is such that a larger section needs to be replaced.

6.4.8 Distribution 11kV Overhead Lines

RCM based maintenance is applied with an inspection regime similar to that used for the 33kV lines.

A drive by inspection of the critical sections of the overhead network is carried out annually. Each year 20% of the network is given a detailed condition assessment inspection. This inspection includes poles, crossarms, DDOs, air break switches, conductors, surge arrestors and transformers. Thermal imaging and ultrasound testing is used annually on each of the overhead feeders with emphasis on the first protection zone out from the substation. Thermal imaging is also used after major faults to check the conductor and joint integrity. Corona discharge inspection is being used on feeders where there are higher incidences of insulator failure. The condition of the line equipment is recorded in the maintenance records database and is regularly analysed.

Although the asset replacement model suggests that little conductor replacement is required, there is an ongoing programme to replace 16mm2 Cu conductors with Iodine (AAAC). This replacement is predominantly in coastal areas where conductor ageing is accelerated by corrosion. In other areas conductor damage as a result of line clashing has been identified.

Where conductor replacement is performed the crossarms are replaced in a delta construction. As a result of the number of zone substations being installed in previously rural or end of feeder areas, fault levels have risen and conductor construction configuration and rating are no longer appropriate. These sections of conductor are being upgraded as part of the zone substation projects.

6.4.9 Wooden Poles

About 10% of the poles are wooden and most of these will require replacing within the 10 year planning period. Visual pole inspections are carried out on a periodic basis (generally as part of the five year assessment). Where practical any refurbishment is coordinated with the undergrounding plans to avoid unnecessary replacement of overhead lines. Because of the difficulty of making objective assessments of wooden poles a new technology is being used to cover the entire population of wooden poles in the current year. This involves the use of radiation backscattering to measure wood density and remaining pole strength. The objective is to classify all of these poles and assign a replacement date based on priority. Costs for the replacement of these poles is expected to be higher than standard as they are usually in difficult and/or complex situations.

Where wood pole lines are to be replaced with concrete pole lines, the crossarms and hardware are all replaced as well.

6.4.10 Concrete Poles

Concrete poles are visually inspected as part of the five yearly condition assessments of overhead assets. Those given a poor assessment are then tagged for replacement in the following period's capital programme. The projected spend on this asset class is minimal over the 11 year planning period.

6.4.11 Crossarms

We are entering a period when the number of crossarms expected to require replacement increases significantly. The standard life of crossarms has been decreased to 35 years and where crossarms are replaced insulators are also replaced and the 33kV or 11kV configuration is generally changed to delta with a raised centre conductor. Candidates are identified from inspection and prioritised for ongoing replacement.

6.4.12 11kV Ring Main Units

Whilst age is a major factor in replacing assets, it is not the sole determinant and there have been programs in the past where issues with particular makes or models have been identified.

Each year 20% of the ring main population are maintained by carrying out visual inspections and condition reports, earth testing, vegetation control, oil level checks or SF_6 gas pressure checks, ultrasound testing and through-fault indicator checks. At the same time checks are made on the operating handles, earthing conductor ratings, tank condition, pitch box leaks, panel steelwork, labels and warning signs. For ring main units over 15 years old oil samples are taken. Where these test results indicate a problem an internal inspection is performed. Due to problems encountered with particular models of oil filled ring main units, all oil filled RMUs were internally inspected and the oil changed. This programme was completed at the end of the 2011 financial year.

For ring main units with bus extension units, partial discharge testing is carried out and visual inspection of bus boxes is performed.

The age profile shows that over the next 10 year period significant numbers of ring main units are reaching end of life reflecting an increasing spend projected for this asset type. The condition can vary considerably with the make/model and the environmental exposure being the key factors having an influence. Replacement costs can also be greater due to the need to keep power on for customers and because of physical constraints at existing sites.

Oil filled switches are being replaced with SF_6 insulated types.

6.4.13 11kV Air Break Switches

Many air break switches have only infrequent operation, usually associated with network faults. Hence they are quite critical in the performance of a network. RCM studies have been carried out to determine an optimum maintenance regime.

Details of the maintenance programme include:

- Five yearly visual inspections: insulators, arc horns/chutes, contacts, handles, earthing conductor rating, steelwork.
- Five yearly earth tests.
- Five yearly condition monitoring through thermal vision and ultrasound tests in the urban area, including automated ABSs in rural areas.
- Contact and alignment maintenance, exercise, lubricate and adjust using live line and jumper techniques on a planned maintenance basis driven by condition monitoring.
- Analysis of the switch to see if it can be moved or removed (including; position, accessibility, necessity for the switch, network switch ability, reliability, and speedy restoration).
- Automated, remotely operated ABSs undergo a five yearly operational verification of the line recloser operation as well as SCADA and communications signalling.
- Testing of Through Fault Indicators (TFI).

WEL continues to use SF_6 gas-insulated switches instead of traditional air break switches for new installations. Though similarly priced, the gas switches are more reliable, are lower maintenance and have a longer operating life. A programme has been initiated to replace a number each year over the next 11 year budget period. Replacement is being prioritised by network criticality, fault rating and age. Many air break switches associated with 2 pole transformer structures are being removed completely and in other situations cable end switches are being replaced with solid isolating links rather than switches.

6.4.14 11kV Reclosers and Sectionalisers

Maintenance is programmed and consists of the following activities:

- Five yearly visual inspection and report on condition of; insulators, handles, earthing conductor rating, steelwork.
- Five yearly operational verification of line recloser SCADA and communications signalling.
- Five yearly earth test, thermal vision, ultrasound tests and reporting of results.

The removal of the line recloser from service on the network when maintenance is recommended based on condition monitoring. Workshop based maintenance and testing including:

- Recording all nameplate data and as found conditions.
- All tests required to verify protection trip, close, reclose, lockout integrity indications and unit is fit for purpose.
- Measure vacuum contact wear.

- Test oil dielectric breakdown.
- Check oil level.
- Test remote digital and analogue signalling and SCADA operations.
- Test power supply battery and charger.
- Check tank and cabinets for cracks, rust and leaks and maintain as required.
- Check and clean bushings. Clean and paint tank and cabinets as required.

A large number of reclosers were installed in 2004 and 2005, which will not require replacement within the 11 year period. A smaller number of older reclosers are of the oil filled hydraulic type which are difficult to co-ordinate with electronic protection relays at the feeder circuit breakers. These units are not repaired but replaced with the newer types. A regular programme of replacing two units per year is envisaged. Some problems have been experienced with drop out sectionalisers that were installed relatively recently. It is expected that these will be progressively replaced over the first five years of the plan.

6.4.15 Distribution Transformers

All transformers (pole mounted and ground based) with the exception of the CBD (ex HCC network) and transformers >= 750kVA are inspected on a 5 yearly cycle, timed to coincide with the overhead feeder inspections.

The CBD transformers and other transformers >= 750kVA are inspected on a yearly bases.

Transformers 100kVA and under are driven to failure or to the point before they become an environmental or safety hazard.

In addition pad-mounted transformers are checked for security, external panel deterioration or damage, vegetation control, access and to perform cleaning of HV and LV cubicles, thermal imaging of connections and bus bars.

For larger ground based city and industrial distribution transformers the maintenance programme includes:

- Annual inspection of ground based transformers and city distribution substations
- Thermal imaging inspections of all links, bus bars and connections
- Maintenance checks on tank and cubicles
- Cleaning equipment and building internal areas
- Oil tests conducted on a condition basis for transformers 750kVA and above
- Reading of maximum demand indicators (MDIs) at six monthly intervals, timed to occur at peak load times.

WEL has had new data loggers developed that are fitted to all new ground mounted transformers 300kVA and over. Furthermore loggers have been retrofitted to existing transformers each year. These loggers replace the traditional MDI units and log three phase voltage, transformer temperature, three phase transformer currents and one phase of outgoing circuit current. This data will enable much more accurate evaluation of transformer loading over time. Only a few sites still have MDI units, but these will be changed by the end of the 2011/12 financial year.

Provided that the tanks and oil are well maintained, transformers may be kept in service for up to 55 years. The majority of distribution transformer faults are caused by lightning damage. Failed units are refurbished if economically viable.

6.4.16 LV Underground Reticulation

There is currently no routine maintenance performed on LV cables but allowance has been made in the asset replacement budget to replace LV cabling of the earlier vintage paper based types that are reaching their nominal design life. This is not a clearly defined age but is evidenced by situations where patterns of faults begin to appear in certain localised areas. As well, there is a programme to replace service pillar boxes of a particular design (concrete/fibrolite and fibreglass) where failures are occurring due to brittleness and disintegration.

A program has been initiated to inspect service pillars to identify safety issues particularly in regard to damaged or insecure lids this program will be completed by end of the 2011/12 financial year.

6.4.17 LV Overhead Reticulation

Many of the LV lines are under built on the same poles as the 11kV and hence inspection of the LV lines is carried out at the same time as the 11kV lines. Maintenance policy is similar to the previously mentioned 11kV policy and is mainly RCM based with an inspection regime from which the asset condition determines the actual maintenance.

Many of the LV lines are under built on the 11kV or 33kV circuits and will be replaced along with these higher voltage lines. Condition assessments and inspections are used to determine when wood or concrete poles need replacement. Crossarms and fittings are replaced at the same time as poles. There are a growing number of instances where concrete poles are in satisfactory condition but crossarms and fittings need replacing. If more than one crossarm/pole is replaced in a line section, WEL now has a policy that the conductor be changed to Aerial Bundled Conductor and therefore crossarms are not required.

The number of LV (and 11kV) crossarms needing replacement is expected to become significant so increased provision has been made for replacement during the next 11 years.

6.4.18 SCADA: Communications and Control Equipment

Planned maintenance consists of four monthly and 12 monthly inspections and tests on all remote station equipment including:

- Visual inspections, dusting, cleaning and minor repairs.
- Operational checks and measurements.
- Testing, calibration checks and adjustments.
- Meter reading and downloading of data.
- Checking and reporting status indications and software error logs.
- Maintenance of database related to the location, maintenance history and status of all equipment and the filing of test sheets and reports.

Other SCADA indication testing is done in co-ordination with circuit breaker and protection testing.

In recent years the Remote Terminal Unit (RTU) function is typically being performed by SEL- series 20XX devices that act as data concentrators and protocol converters.

The SCADA master station and data storage system is scheduled for replacement in 2011. Please refer to section 2.6.3.2 for the new Network Management System and 5.9.9.2 for SCADA communication enhancement.

6.4.19 Protection Relays

Electro-mechanical protection relays will be progressively replaced over the coming 10 years with modern numerical relays. This work will typically be done in conjunction with other upgrade work at the zone substation or switching station. The electro - mechanical relays that are still serviceable though past their nominal life, lack the more complex protection functions that are increasingly required, and are unable to provide other detailed information such as power measurement and fault event downloads.

6.4.20 Load Control Equipment

Currently a condition driven approach is followed by an annual inspection and test run of plant prior to winter around March/April. This involves visual checks, a test run of plant, signal strength tests and production of reports. Thermal imaging supports this process. Additionally each year the static plants undergo a condition assessment performed by the supplier.

The smaller original static injection plant from the Hamilton point of supply has been moved to Weavers in order to enable the injection of a 283Hz signal into this northern area. This will enable the replacement of old obsolete relays and allow parts of the Te Kowhai point of supply to be fed from Weavers under contingency conditions while still maintaining control of relays. Field located ripple relays will be replaced as their economic life is reached. Currently new technology options are under investigation for the future transmission of load control signals in the Meremere and Huntly point of supply area.

Photo 20 33kV Indoor gas-insulated switchboard

7 RISK MANAGEMENT

WEL recognises risk management to be critical in the achievement of its Vision and Mission statements. WEL has a clearly defined Risk Management Policy. This Policy and supporting procedure identifies risk management as a core management responsibility and outlines in broad terms the emphasis given to this in both the day-to-day and longer-term facets of managing its assets and overall business.

The Policy shows risk management to be an integral part of the management (including asset management) and operating structure designed to improve decision-making leading to minimisation of losses and maximisation of opportunities.

WEL has developed and maintains a “risk aware” culture with employees empowered and enabled to identify all relevant risks and has in place processes to evaluate, prioritise and manage the risks with the appropriate balance of costs versus consequences and likelihood.

This is achieved by systematic application of processes to identify, analyse, evaluate, prioritise, treat and monitor any situations where undesired or unexpected outcomes could be significant or where opportunities could ensue.

WEL is currently in the process of adopting the new risk management standard, ISO 31000. This will see us updating our practices which are currently compliant with AS/NZS 4360:2004. We do not envisage this will significantly change our current practices but will improve and validate them.

7.1 Risk Analysis

WEL has adopted a systematic approach to risk analysis. The Quantate Risk Management application, a software-based process that is compliant with the New Zealand Standard AS/NZS 4360:2004 Risk Management has been implemented. This ensures a structured approach to the whole process of risk management and has proven to be more efficient and effective than paper based programmes. The application is made up of the following components.

7.1.1 Identifying Risks

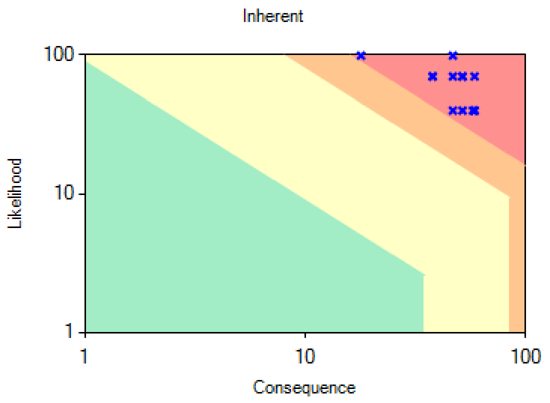
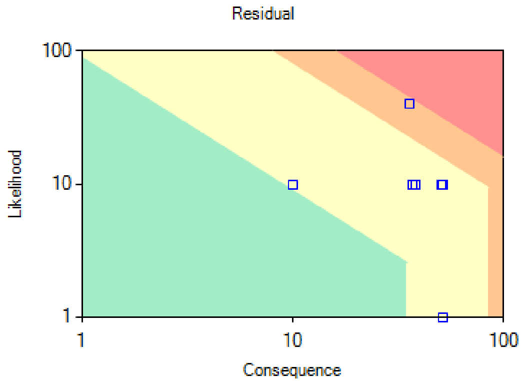
Any staff member is able to identify a risk and have that risk added to the Risk Management database. The staff member identifying the risk will work with the Risk and Regulatory Manager to input the risk collaboratively. The new risk will then be assessed and ratified by the Risk Management Committee.

Risks are also identified via the hazard identification process where any hazard scoring highly will be submitted to the Risk Management Committee for review. The WEL Board is also asked to consider strategic risk on a regular basis.

7.1.2 Operational Risks

Risk management identification processes apply to all categories of risk, whether they are strategic, commercial, corporate or operational. The following table lists the top 10 operational risks that have an inherent risk classification of “Class 4, Intolerable”, all of these risks have controls in place that bring their residual classification to “Class 2, Tolerable”.

Table 15 Risk Evaluation Table

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
		
1	Someone is harmed and/or there is a SAIDI minute loss due to defective work being carried out or failure to test.	• Induction training • Technical qualifications • Health and safety • CG 101 Health and safety standards for personnel working on WEL's network • Equipment operating training • Network design and construction standards DCM 01/02/03/04/05 • Work method statements • Work quality auditing • Control of Test and Inspection Equipment requiring calibration FS-WC-03 Field Services • Work Compliance OR 105 • Limited Induction for Contractors Working on WEL's Network
2	Staff and/or contractors working live line on our network are harmed.	• Induction training • Technical qualifications • Health and safety training • CG 101 Health and safety standards for personnel working on WEL's network • Equipment operating training • Equipment operating manual • OR 101 Network Outage and Management Permits and Switching • Work method statements • Live line manual • Personal Protective Equipment (PPE) • Annual assessment of competency by external assessor. • FS-WC-03 Field Services Work Compliance

3	Serious harm to staff member or contractor or member of public in the distribution centre or depot e.g. due to incorrect operation of machinery that is used for moving stores	• Induction training • Technical qualifications • Health and safety training • Equipment operating training • Personal Protective Equipment (PPE) • Forkhoist Code of Practice • Safe job procedure - loading and unloading of trucks (DOL Certificate) • Holding the NZQA qualification
4	Harm occurs to a contractor due to the incorrect operation of equipment because the contractor is not sufficiently familiar with WEL's equipment.	• Induction training • Technical qualifications • Equipment operating manual • OR 101 Network Outage and Management Permits and Switching • Personal Protective Equipment (PPE)
5	Potential for injury and reliability impact if there is misalignment between Syscon SCADA data and actual network status as a result of no or poor commissioning procedure.	• Equipment operating training • Network design and construction standards DCM 01/02/03/04/05 • OR 101 Network Outage and Management Permits and Switching • AIS 108 As-Builting Procedure (Asset Database) • Personal Protective Equipment (PPE) • AIS 110 Asset commissioning and decommissioning process
6	Safety equipment or associated equipment fails and causes harm.	• Induction training • CG 101 Health and safety standards for personnel working on WEL's network • SAP • Control of Test and Inspection Equipment requiring calibration • Pre-start hazard assessment • FS-WC-03 Field Services Work Compliance • Purchasing the correct category of equipment
7	Harm to a member of the staff or of the public due to inadequate earthing installed on an item of equipment, or theft of earthing.	• Network design and construction standards DCM 01/02/03/04/05 • Work quality auditing • Maintenance works delivery plan • Personal Protective Equipment (PPE) • Physical inspection of lines • AIS 110 Asset commissioning and decommissioning process • WD 03 Works Delivery - Construction
8	Injury to staff and destruction of equipment due to failure of ring main units when closing on a fault as a result of internal damage or defective internal state.	• Equipment operating training • Personal Protective Equipment (PPE) • Operational constraints on the operation of RMUs • Purchasing policy for RMU type

9	Harm to staff or members of the public or to property as a result of the failure of network equipment due to not following accepted maintenance programmes and processes.	• Health and safety training • Work quality auditing • WEL Maintenance Manual • SAP • Records of equipment test and inspection reports Maintenance works delivery plan • Personal Protective Equipment (PPE) • Signoff sheet to be completed by Field Services staff for work completed
10	Widespread damage to network and prolonged outages due to Major (Bola type) cyclone.	• CG 106 Disruption Recovery Business Continuity Plan • Insurance • OR 100 Storm - Civil Defence Emergency Procedure • OR 102 Communication Process for Major Unplanned Outages • Ensure adequate resources are available to complete work on the network • Establish reciprocal resource arrangements with other line companies • Back-up supply available for critical customers • Smartrack monitoring of driver speed and performance

7.1.3 Evaluating Risk

Each risk is analysed and evaluated by measurement against established criteria to determine the degree of acceptability. The criteria include:

7.1.3.1 Likelihood:

History, empirical and/or relevant epidemiological data is considered in determination of likelihood.

7.1.3.2 Consequences:

Three categories of risk are considered. They are:

1. Health & Safety

- Is there a risk of single or multiple fatalities, serious harm or minor injury?

2. Financial impact

- Estimated costs brackets from $0 to > $100,000,000 are included.

3. Reputation

- Choices of likely effects on WEL's reputation, from loss of confidence and widespread national condemnation to no significant impact, are given.

7.1.4 Ranking of Risk

In considering each risk, the 'inherent risk', (which includes the consequences if no mitigation existed for the risk) is considered first. Any existing procedures or actions that mitigate the likelihood and consequences are then added and the risk is re-evaluated in light of these. This indicates the 'residual risk'. The larger the 'gap' the more effective the mitigation actions are considered to be. However, the importance of this gap depends on where the risk lies on the Risk Acceptability table.

Each option in the ranges of consequence descriptors has been given a value according to the potential impact on the business. The scores are calculated in the database and a graph (shown in Figure 50) indicates where the risk lies regarding acceptability.

Assumptions made or further explanation as to the rationale for identification of the issue as a risk, are entered in text boxes provided. Provision is made for the employee to indicate the degree of confidence in the information provided so as not to discourage those who believe a risk exists, but may need more qualified or experienced help to determine the real significance of the risk.

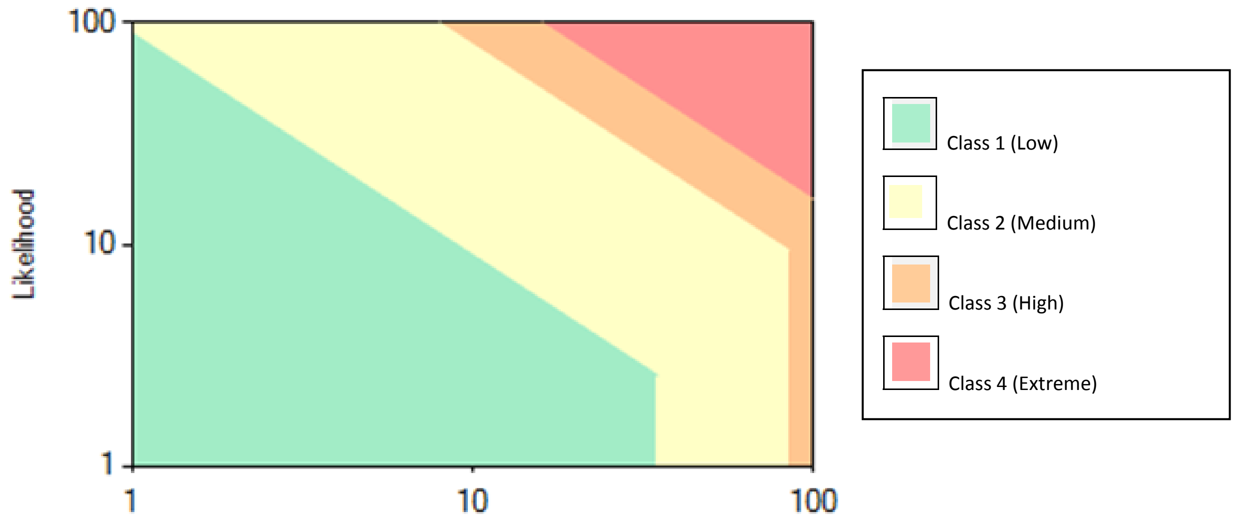


Figure 50. Risk Acceptability Chart

7.1.5 Acceptability Benchmarking

The Risk Acceptability Chart contains four classes or levels of risk (as shown in figure 49) described as follows:

- Class 4 (Extreme) risks are considered intolerable. Risk reduction actions must be applied to reduce the level or consequences of the risk.
- Class 3 (High) risks are unacceptable without further controls unless the cost of such controls outweighs the benefits.
- Class 2 (Medium) risks are tolerable but undesirable. Higher consequences (those further over to the right hand side of the chart) are less desirable. Low cost mitigation may be justified unless the cost of such controls outweighs the benefits.
- Class 1 (Low) risks are acceptable.

The Risk Acceptability Chart 'bands' have been set to reflect WEL's requirements. These settings were determined once 80 risks had been identified and each one reviewed to establish the potential impact and degree of acceptability to WEL.

Decisions were made as to where each risk should sit on the Risk Acceptability Chart. If a risk was clearly acceptable, or if mitigation costs outweighed any advantages that could be accrued through Risk Treatment Options identified, it was used as a benchmark to indicate the class of risk. In this manner, the bands or classes of risk acceptability were adjusted and finalised to reflect WEL's appetite for risk.

7.1.6 Treatment Options

Wherever practicable, options to provide improved mitigation are entered. The costs (both initial and ongoing) of the proposed options are estimated. The risk is then re-evaluated and the position of the options is shown relative to the 'inherent' risk on the chart (see Figure 8.1). Once again, the 'gap' indicates the effectiveness of the option.

7.1.7 The Risk and Audit Management Committee

The Risk and Audit Management Committee (RAMC) comprises a mix of managers including the Chief Executive, GM Operations and Customer Delivery, GM Asset Investment and Growth, the GM Corporate Services, the Risk and Regulatory Manager, the Risk and Quality Auditor, and senior operational and health and safety managers. The RAMC therefore contains a wealth of experience and in-depth knowledge of WEL and the electrical industry as a whole.

It is the task of the RAMC to review all risks entered in the risk database to validate the data and determine the classification of the risks according to WEL's appetite for risk. This is accomplished at quarterly meetings (more frequently when necessary) to critically review the risks entered. Assumptions are challenged and clarification/additional information sought where necessary to enable accurate evaluation of the risk. Changes are made where required to realign the risk with the RAMC's collective judgement and decisions.

7.1.8 Prioritisation

Once risks are reviewed, treatment action programmes are prepared. Actions required are included in business plans and budgets where necessary. Priorities are set and timeframes for actions are agreed with the relevant personnel.

7.1.9 Monitoring

The Risk Management application and processes are monitored by the Risk and Regulatory Manager. Risk actions are assigned and their progress monitored on a regular basis using the Quantate system.

7.2 Network Risks

Network risks are identified by real-time and planning staff. This may occur in response to a network event, as part of an investigation or planning study, or during the course of routine monitoring. In addition to the software indicated in 7.2 there are other avenues available for reporting the risk. If the risk has been identified from a network event, a Root Cause Analysis meeting will be held. The underlying problem is identified and recommendations for alterations to the maintenance programme and/or capital works programme will be suggested. The recommendations are evaluated by an appropriate specialist and risk mitigation actions and/or strategies developed. The associated cost is also estimated. Periodically the complete list of risk mitigation actions or strategies are compared and subsequently ranked. Those items above a budget cut-off mark will be included in the respective budget. However where the risk identified is assessed as requiring urgent attention, current priorities may be reassessed and the action performed without going through the ranking process.

In addition to adjustments to maintenance and/or capital programmes, network risks can often be mitigated by the development of a contingency plan.

7.3 Emergency Response And Contingency Planning

The following operational contingency plans are in place:

7.3.1 Lifelines.

WEL as a lifelines utility has a significant Civil Defence Emergency Management (CDEM) role to play in New Zealand and has an obligation under section 60 of the CDEM Act 2002 to:

- Function at the fullest possible extent during and after an emergency
- Have plant for such functioning
- Participate in CDEM planning at national and regional levels
- Provide technical advice on CDEM issues where required
- WEL is a participating member of Waikato Engineering Lifelines Group (WELG) which has overall goals to:
- Assist members to meet their obligations under the CDEM Act
- Coordinate and work to progress the completion of Projects which benefit lifeline organisations in their Region
- Strive to ensure that member organisations get value for money through their participation
- Endeavour to meet ever increasing customer expectations that Lifeline Utilities will deliver secure services.

Lifeline utilities are responsible for strengthening relationships within and across sectors, and individually committing to actions that ensure continuity of operation and delivery of service.

Through its membership in WELG, WEL has access to regional and national studies carried out on natural, technological and biological hazards. From these WEL has identified the top hazards and developed a comprehensive vulnerability assessment which identifies the risks in terms of importance, vulnerability, resilience, and impact of each major asset on the network.

7.3.2 Routine Emergency Response.

WEL responds regularly to routine emergencies such as network system outages. The methodologies and procedures devised for these are used as the basis for the planning of large scale emergencies.

The Storm- Civil Defence Emergency Procedure outlines the actions to be taken to:

- Prepare for impending storms that have been forecast.
- Manage increased or increasing numbers for faults due to storm conditions.
- Respond to Civil Defence requirements such as priority for restoration of supply.
- Liaise with Civil Defence in the event of a Civil Defence Emergency being declared.

This procedure is applicable when events e.g. weather, flood and/or earthquake have a major impact on the ability of the WEL network to supply electricity or when a Civil Defence Emergency is declared.

This procedure is designed for escalating situations that require resources beyond the normally rostered and on call resources

WEL has a Communications Process for Major Unplanned Outages which identifies the process for external communications during an event.

Where the Chief Executive declares a major event triggered by a CDE or serious effect on Public or Company escalation to the Disruption Recovery/Business Continuity Plan applies.

7.3.3 Network Contingency Plans.

WEL has developed general contingency plans for loss of significant assets or groups of assets. Further development of specific plans for zone substations and critical 33kV circuits is ongoing.

WEL's contingency plans include switching processes to ensure essential services, as much as is practicable, are able to continue to receive supply in the event of a major outage. WEL has also entered into arrangements to gain priority access to emergency generation.

7.3.4 Transpower

WEL and Transpower interact on an operational basis as below:

- Planned releases of equipment (both for Transpower and for WEL sourced requests).
- Unplanned releases of equipment and restoration of supply.
- Co-ordination and impact.
- Liaison with Civil Defence authorities.

7.3.5 Automatic Load Shedding

WEL is contracted to provide automatic under frequency load shedding (AUFLS) of minimum 2x16 % total load of each GXP under certain frequency conditions. The same circuits would also be utilised as the first stage of manual load shedding.

System Operator (Transpower) is planning to revise the current AUFLS regime and has been conducting seminars on the proposed changes. Such changes are; 4 x 8% in lieu of 2 x 16%, use of centralised AUFLS relay per zone substation, change of frequency target for Interruptible Load (IL) among others.

7.3.6 Alternative Control Centre

WEL operates its control centre from its Maui Street premises. When this is not available for whatever reason, there is a standby facility located at WEL House in Hamilton from which SCADA and control operation can be carried out. A simulated emergency exercise was carried out on the 7th July 2009 which demonstrated that the stand-by facility is fully functional and available on an immediate basis when required.

7.3.7 Emergency Exercises

Regular full scale simulated emergency exercises are carried out to test the emergency procedures and methodologies and determine scope for improvement. Typically these have involved full scale alarms being initiated with only a selection of staff having knowledge of the timing of the exercise.

Photo 21 WEL Office Building, Maui St

8 PERFORMANCE EVALUATION

8.1 Review of Progress Against Plan, Both Physical And Financial

8.1.1 Capital Expenditure

Actual capital expenditure for the 2010/2011 financial year was $8,936k more than the value forecast in the 2009 AMP (difference of 25.5%). Table 16 gives the reasons for key differences.

Table 16 2010/2011 Capital Expenditure: Actual versus Budget

Forecasted Capital Expenditure in 2009 AMP compared with Actual Spend for the Period from April 2010 to March 2011				
Total Network Capital Expenditure	**10/11 Actual ($000)**	**2009 AMP Indicated ($000)**	**Variance (%)**	**Comments**
Customer Connection	5,138	4,795	7.2%	More customer connections were completed than expected
System Growth	29,090	19,291	50.8%	Mainly ahead due to the $8million spent on the Wind Farm Reticulation.
Reliability, Safety and Environment	679	925	-26.6%	Some reliability projects were delayed due to the economic recession.
Asset Replacement and Renewal	5,519	6,992	-21.1%	asset replacement projects were modified as better information became available
Asset Relocations	3,502	2,989	17.2%	Asset relocations projects were higher than expected due to roading work requirements.
Total Capital Expenditure	**43,927**	**34,991**	**25.5%**	

8.1.2 Network Development Programme

The following tables show that the physical progress of 2011/12 listed capital projects with an associated description. Most of the capital works programme has been completed except the eight projects shown in Table 18:

Table 17 Completed Projects

Completed Capital Projects during 2010/2011
SCADA Communication
OKSS RMU Replacement
Substation Fences
Poles
Air Break Switches
Concrete LV Service Pillars
Crossarm Replacement
11kV Conductor Replacement OH Lines
Distribution Transformer Replacement
11kV EDO Replacement
11kV switchgear Replacement HOR
Top 10 Feeder Loadings
PILC Cable Replacement
Whatawhata Substation
Cobham Drive Substation
WNUP 33kV Line - Design & Construction
WNUP 33kV Line - Wind Farm Substations
MAF 11kV Switchgear Replacement
Huntly to Te Kauwhata 33kV Dual Cable Circuits – Stage 1

Table 18 Capital Projects in Progress

Capital Projects in Progress as at 31 March 2011		
Project description	**% completed**	**Comments**
Raglan Substation	85%	Delayed due to consenting issues
Horotiu Substation 11kV Switchgear replacement	75%	Staged to work in with the Cobham upgrade and fitting in with customer requirements to manage security supply.
Huntly to Te Kauwhata 33kV Dual Cable Circuits – Stage 2	0%	Stage 2 programmed for 2011 / 12, aligned with Expressway works.
MAF 11kV Switchgear Replacement	75%	Delayed due to easement issues to allow temporary alternate feed to be installed to site.
Bryce St Seismic strengthening	0%	Solution has been changed as a result of further structural surveys and practical site limitations.
Weavers Ripple plant	30%	Delayed due to design completion and resourcing issues.
Steel Park reconfiguration	0%	Delayed by Cobham switching station conversion project.

8.1.3 Maintenance Expenditure

Actual versus budgeted maintenance expenditure for the 2010/11 year is shown in Table 19 below.

Table 19 2010/11 Maintenance Expenditure- Actual versus budget.

Forecasted Maintenance Expenditure in 2009 AMP compared with Actual Spend for the Period from April 2010 to March 2011				
Operational Expenditure	**10/11 Actual ($000)**	**2009 AMP Indicated ($000)**	**Variance (%)**	**Comments**
Routine and Preventative Maintenance	3,053	2,821	8.2%	Increased inspections on service pillars required
Refurbishment and Renewal Maintenance	1,580	1,656	-4.6%	Less corrective work required that budgeted
Fault and Emergency Maintenance	2,428	2,439	-0.4%	As expected
Total Operational Expenditure	**7,061**	**6,916**	**2.1%**	

8.2 Evaluation And Comparison of Actual Performance Against Targeted Performance Objectives

8.2.1 Safety

There were no serious harm injuries for the year 1 April 2010 to 31 March 2011.

Health and safety statistics since April 2009 are shown in Appendix 5.

Photo 22 Inspection of the 11kV switchgear at Whatawhata substation

8.2.2 Reliability

WEL's performance for the year 1 April 2010 to 31 March 2011 compared to target is shown in the table below.

Table 20 Performance Measures for Reliability

Performance Measures	Target 2010/11	Actual 2010/11	Variance
WEL Networks unplanned 33kV	6	8	2
WEL Networks unplanned 11kV	272	221	-51
WEL Networks planned	70	104	34
Total interruptions - unplanned	278	229	-49
WEL Networks planned SAIDI	8.00	16.73	8.73
WEL Networks unplanned SAIDI	73.00	65.82	-7.18
WEL Networks planned SAIFI	0.06	0.13	0.06
WEL Networks unplanned SAIFI	1.16	1.13	-0.03
WEL Networks planned CAIDI	130.00	133.14	3.14
WEL Networks unplanned CAIDI	63.08	58.26	-4.82
WEL Networks Total SAIDI	81.00	82.55	1.55
WEL Networks Total SAIFI	1.22	1.26	0.04
WEL Networks Total CAIDI	66.46	65.76	-0.70
33kV Faults/100km	1.82	2.08	0.26
11kV Faults/100km	10.76	8.87	-1.89

There were no Transpower outages over the last year. Excluding any Transpower impact, the SAIDI performance for the year ending March 2011 was 82.55 minutes compared to a target of 81, SAIFI was 1.26 compared to a target of 1.22, and CAIDI 65.76 minutes compared to a target of 66.46.

The following table shows the breakdown of outage causes for the year.

Table 21 Outage Statistics for 2010/2011 Financial Year

Controllable / Uncontrollable Category	Outage Numbers	Customer Count	SAIDI (Minutes)	% SAIDI	SAIFI	CAIDI (Minutes)
Controllable Events						
Equipment Failure	130	38,184	27.30	33%	0.45	60.65
Planned Shutdowns	102	10,525	16.62	20%	0.12	133.71
Trees	18	7,718	6.01	7%	0.09	66.16
Total Controllable Events	**250**	**56,427**	**49.94**	**60%**	**0.67**	**75.05**
Uncontrollable Events						
Adverse Weather	31	10,934	8.73	11%	0.13	67.74
Vehicle Accidents	43	17,807	14.53	18%	0.21	69.17
Diggers v Cables	7	2,056	1.19	1%	0.02	49.16
Birds	16	6,617	4.72	6%	0.08	60.52
Others	26	12,625	3.44	4%	0.15	23.11
Total Uncontrollable Events	**123**	**50,039**	**32.62**	**40%**	**0.59**	**55.28**

Note: The outage number here means the number of 11kV feeder trips. One 33kV outage could result in more than one 11kV feeder outage.

Controllable events contributed to the majority of outage time and customers affected. Planned shutdown work included the ring main unit servicing.

Of the unplanned outages, insulator failures on 16 feeders were a major fault cause. Our crossarm asset replacement program for the 2011/12 financial year is targeted to address the worst performing feeders.

Other events relate to a range of causes, some of the main outages include:

- Underground cable joint failures, due to moisture ingress. These joints have been in service for a number of years and although hard to determine exact causes; we suspect poor workmanship.
- Cast ion pot head cable termination failures,
- Other contributors were failed crossarms, broken lines, and human error.

8.2.3 Repeated Customer Interruptions

Customers' perception of the standard of service provided by WEL is strongly linked to the number of interruptions in supply that affect the customer. WEL measures the minimum standard of service to urban and rural customers, based on the number of repeated interruptions that affect them in a year.

8.2.3.1 Rural Customers

The 12 month rolling average for repeated outages for rural customers with ≤4 outages as at 31 March was 81% with a target of 80%. Last year's performance was 87%. Figure 51 below shows the spread of customers against the number of outages they experienced.

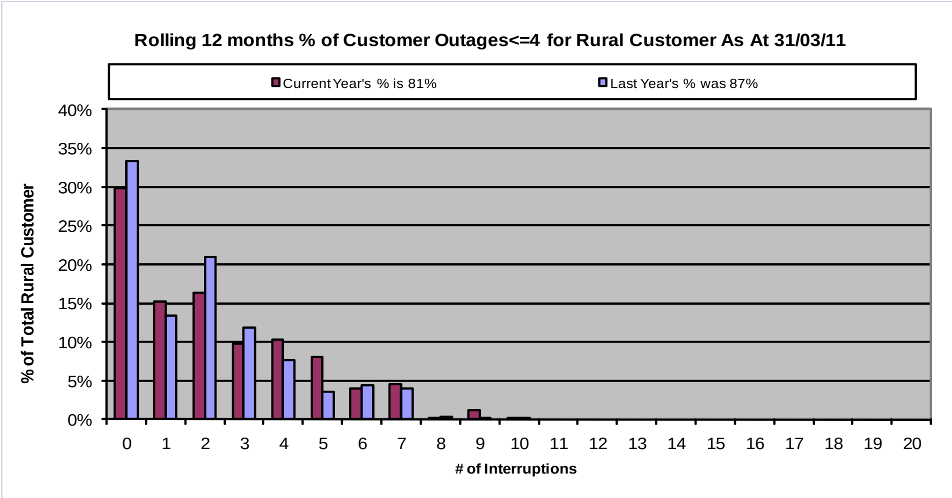


Figure 51. Rural customers against number of outages experienced.

Additionally we are aiming to bring rural customers with greater than eight outages back to less than eight outages per year. There were 408 rural customers who experienced more than eight outages compared with 60 in the previous year.

The main causes for the high number of repeated outages on the rural feeders were:-

- The adverse weather conditions during the September storm period
- Vehicle accidents
- Insulator failures, as noted above

8.2.3.2 Urban Customers

The 12 month rolling average for repeated outages for urban customers with ≤2 outages as at 31/03/2011 is 93% with a target of 88%. Last year's performance was 96%.

We are aiming to bring customers with greater than four outages back to less than 4 outages per year. There were 1,461 urban customers who have experienced more than four outages per year compared with 92 last year.

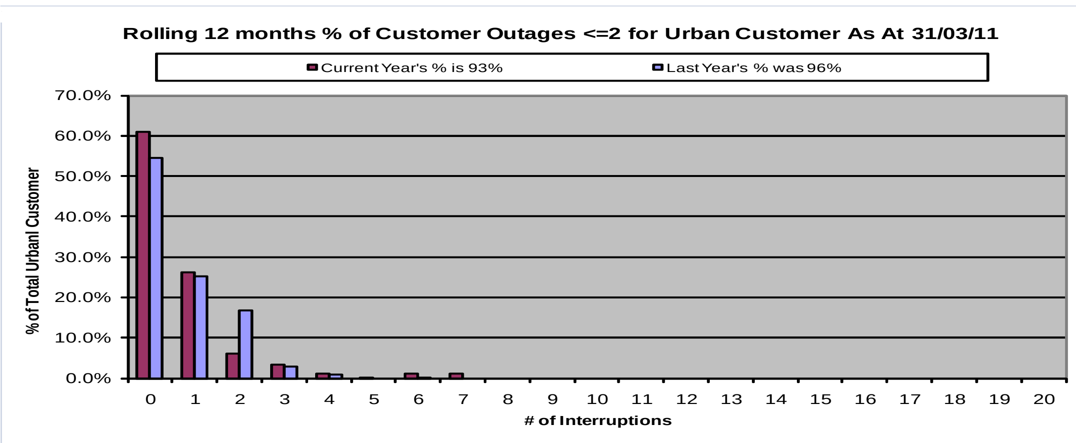


Figure 52. Urban customers against number of outages experienced.

The large number of customers that experienced greater than 4 outages was due to 3 feeders that had multiple unrelated outages. These were:-

1. Sandwich Road CB7, which had one vehicle accident, two cable faults due to contractor damage, a cable joint failure, and an air break switch failure.

2. Tasman Road CB6, which had one vehicle accident, two ring main unit maintenance outages, a cable damaged by a contractor, and tree branches blown onto the line during adverse weather conditions.

3. Pukete CB2, which had two cable joint failures and three ring main unit maintenance outages.

8.2.3.3 Forward Focus

Reliability projects for the 2012/13 financial year include mid-feeder Sectos switch installations which will further reduce the number of affected customers during an outage, replacement of poor performing Haycolec sectionalisers to ensure reliable fault section discrimination and further line clashing mitigation projects.

Strategic asset replacement/upgrades to be undertaken on worst performing feeders to reduce repeated customer outages. Focus is on 16mm^2 conductor, aging poles, crossarms and insulators on rural feeders such as at Weavers and Te Uku.

8.2.4 Secondary Customer Services Level

WEL has implemented a customer complaint and compliment process to improve the secondary customer service level performance.

The following graph shows the overall customer complaints and compliments for the period from 1 April 2010 to 31 March 2011. WEL has received far more customer compliments than complaints. Follow up actions resolved within 10 working days have been improved. Most of overdue fault services complaints happened in Oct 2010 due to a storm issue.

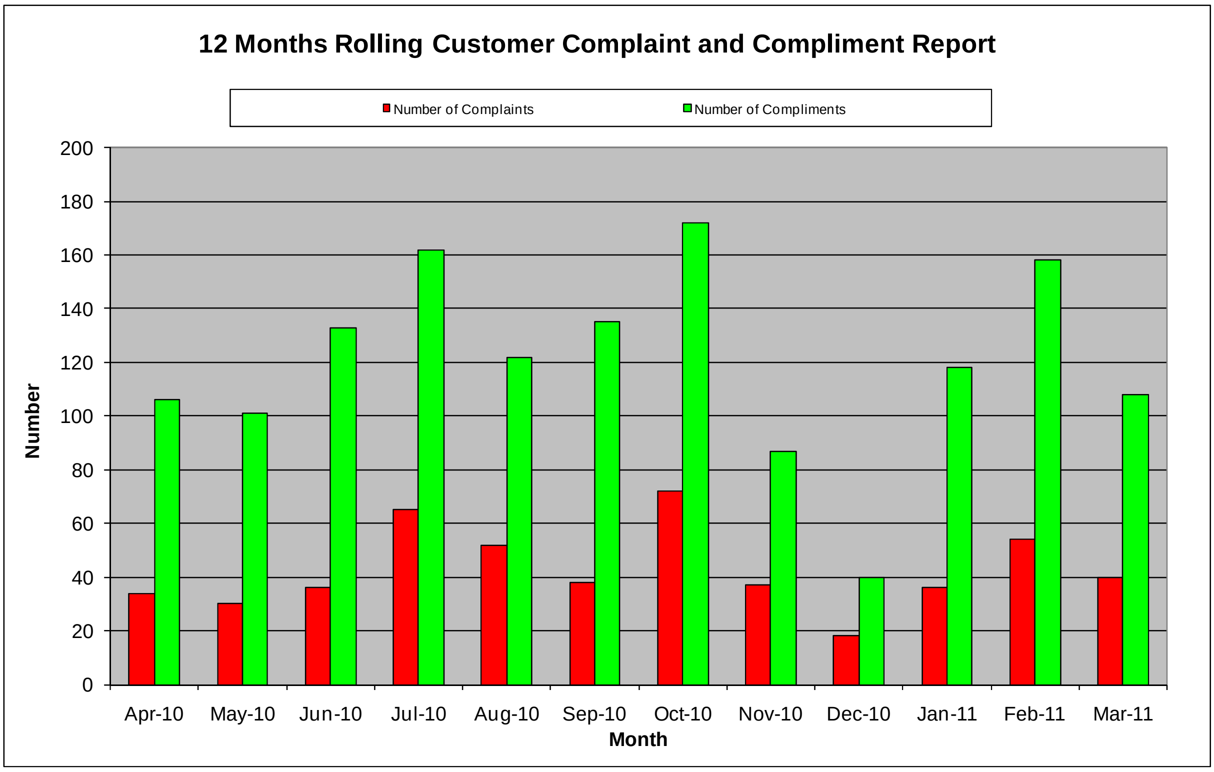


Figure 53. Monthly Customer Complaints and Compliments

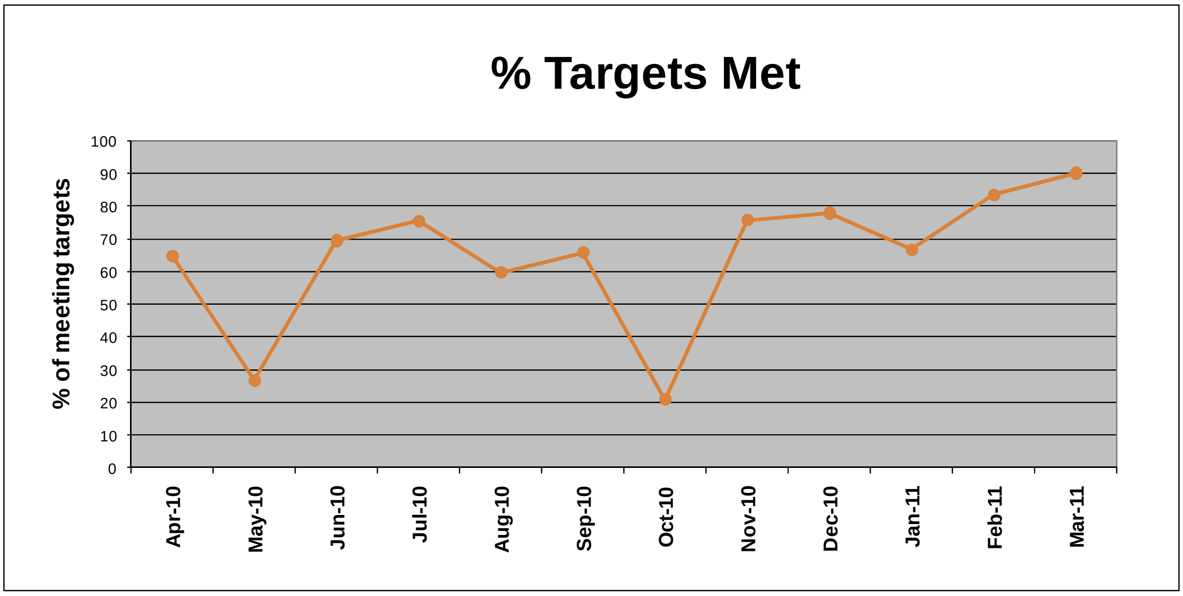


Figure 54. % Targets Met

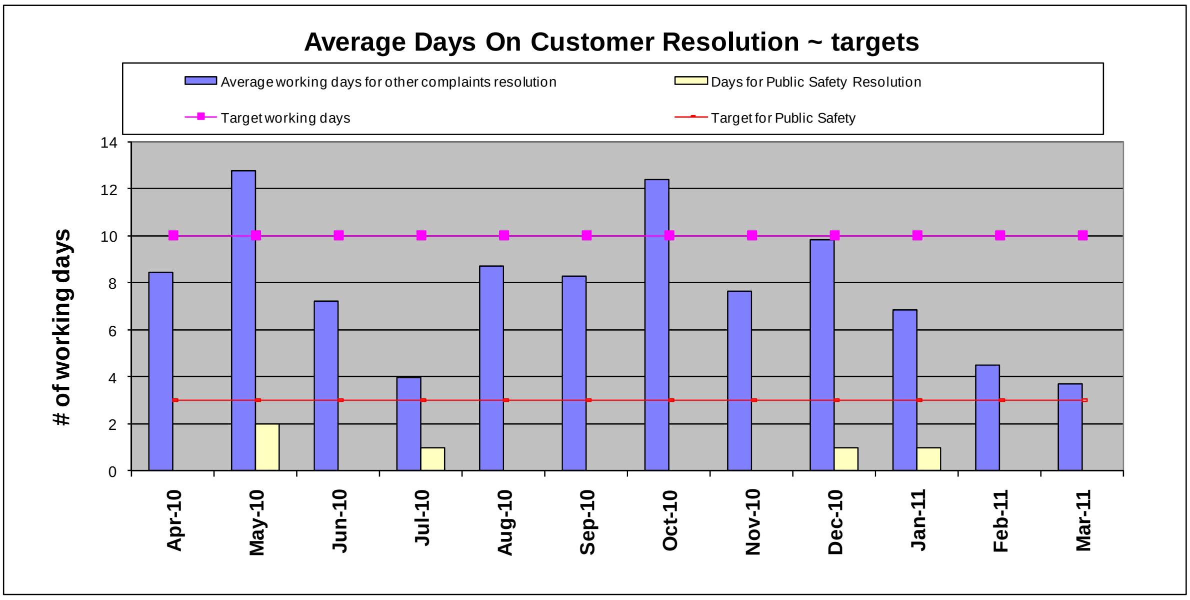


Figure 55. Average days for customer complaint resolution compared to target.

8.2.5 Operating Efficiency – Cost per Customer

Cost per Customer performance for the year 1 April 2010 to 31 March 2011 was $203 compared to a target of $209.

8.2.6 Delivery Efficiency – Billability and Productivity

Billability performance for the year 1 April 2010 to 31 March 2011 was 81% compared to a target of 80%.

Productivity performance for the year 1 April 2010 to 31 March 2011 was 96% compared to a target of 95%

8.2.7 Asset Efficiency – Load Factor

The top 100 peaks have been used for the following load factor graphs. The load factor for each GXP for the period from 1 April to 31 August 2011 including combined HAM is shown below:

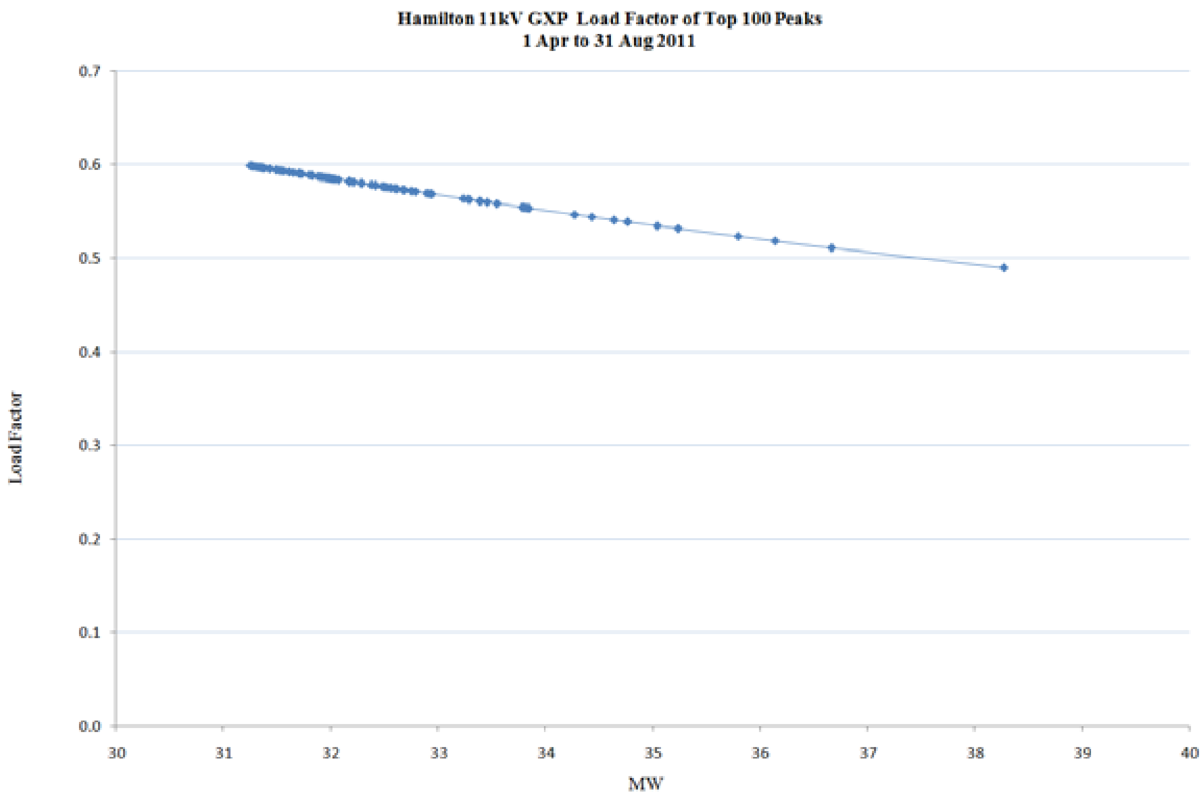


Figure 56. Hamilton 11kV load factor of top 100 peaks

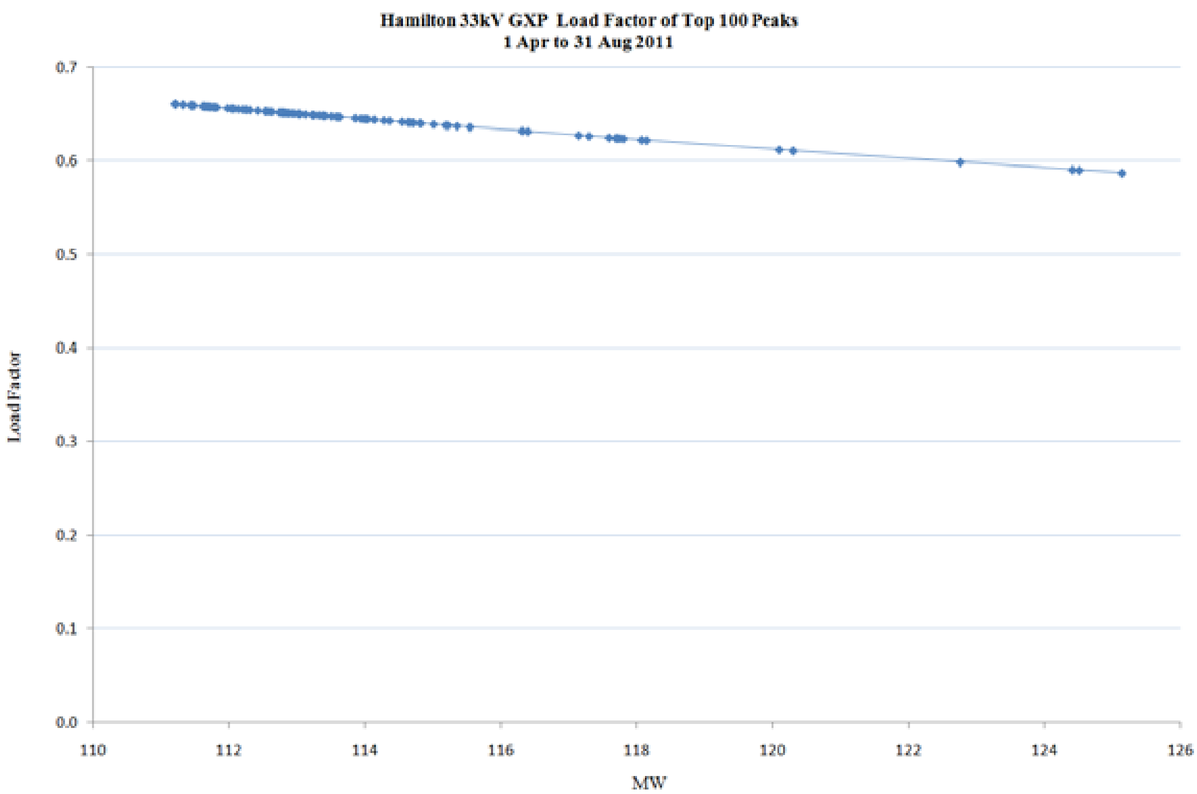


Figure 57. Hamilton 33kV load factor of top 100 peaks

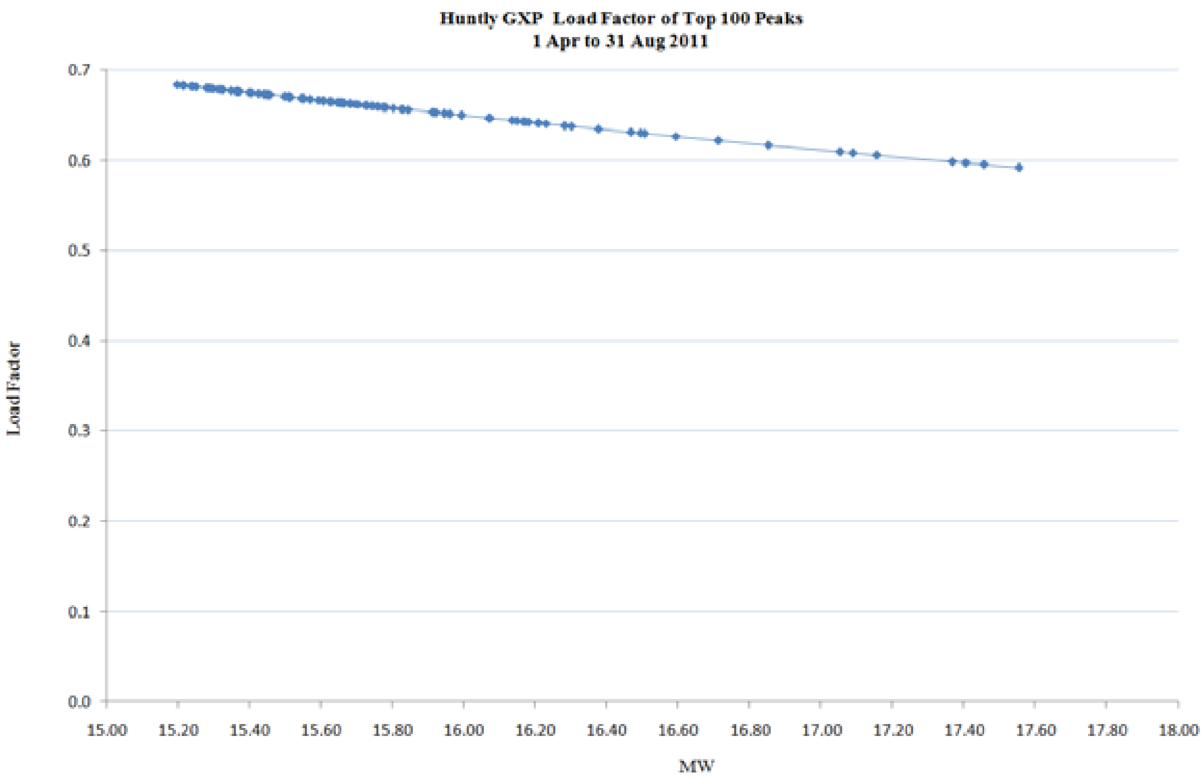


Figure 58. Huntly 33kV load factor of top 100 peaks

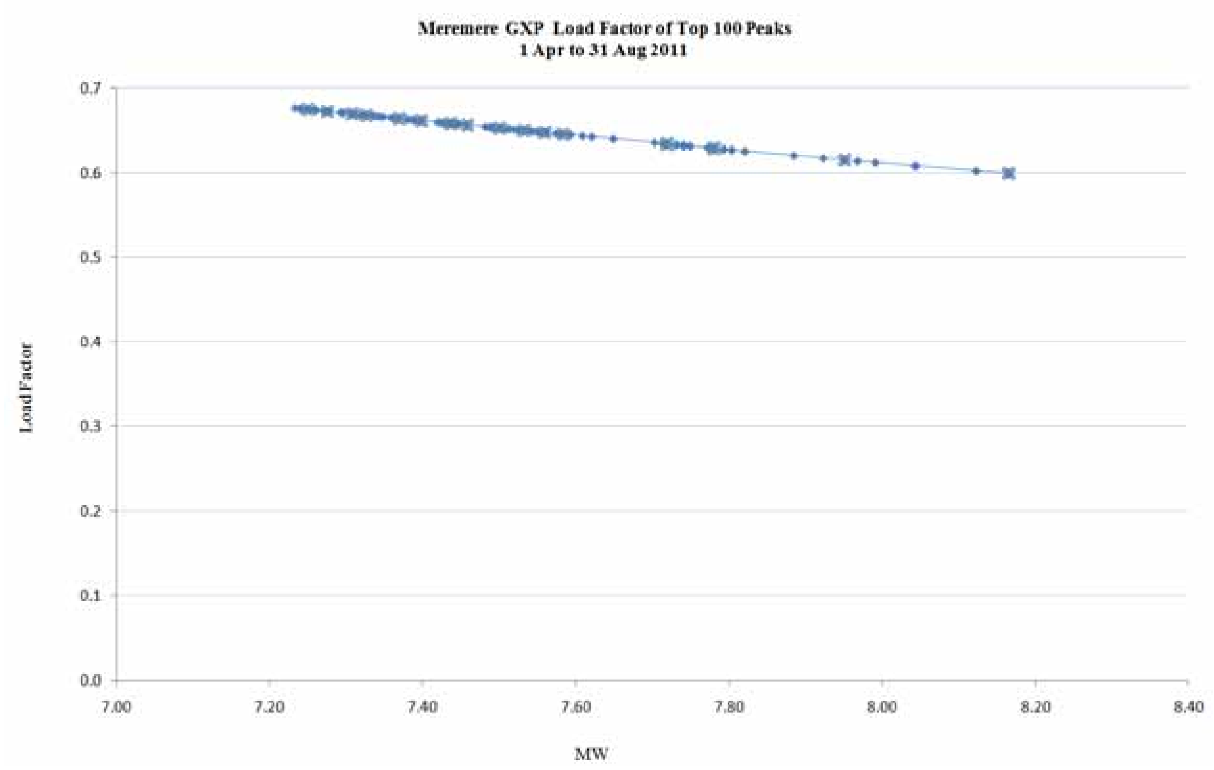


Figure 59. Meremere 33kV load factor of top 100 peaks

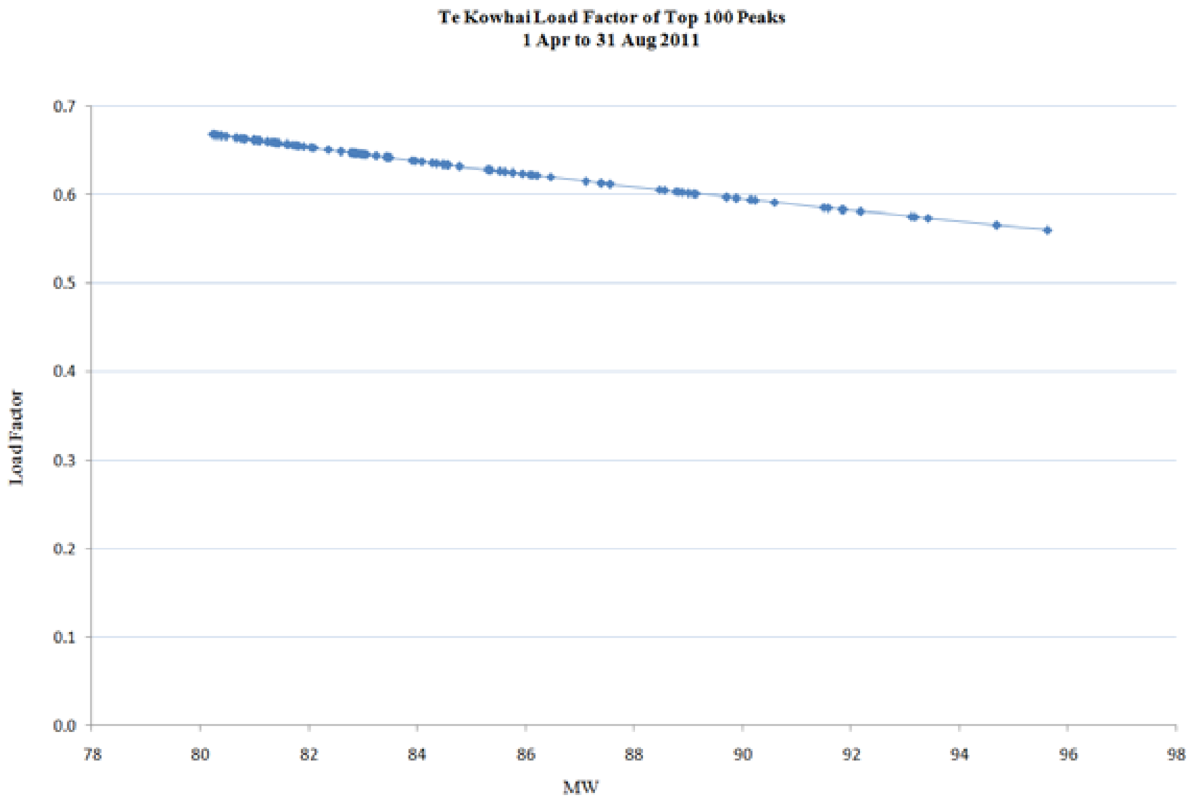


Figure 60. Te Kowhai 33kV load factor of top 100 peaks

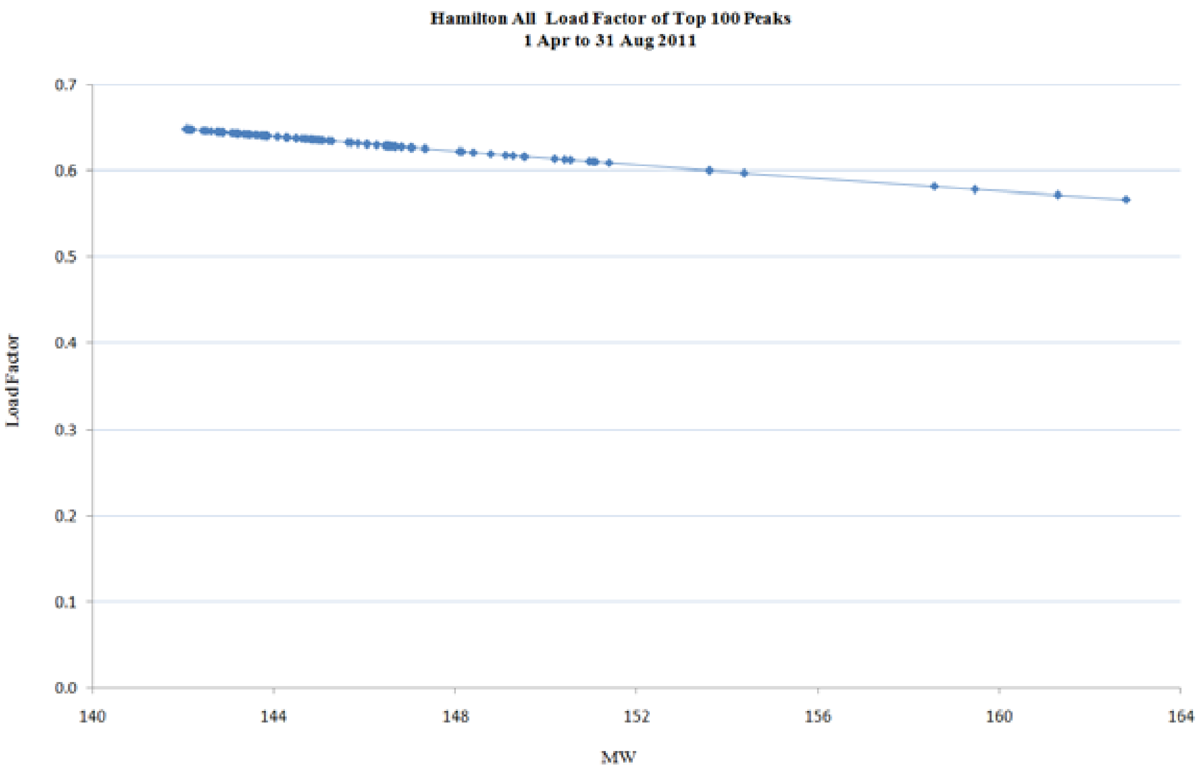


Figure 61. Combined Hamilton load factor of top 100 peaks

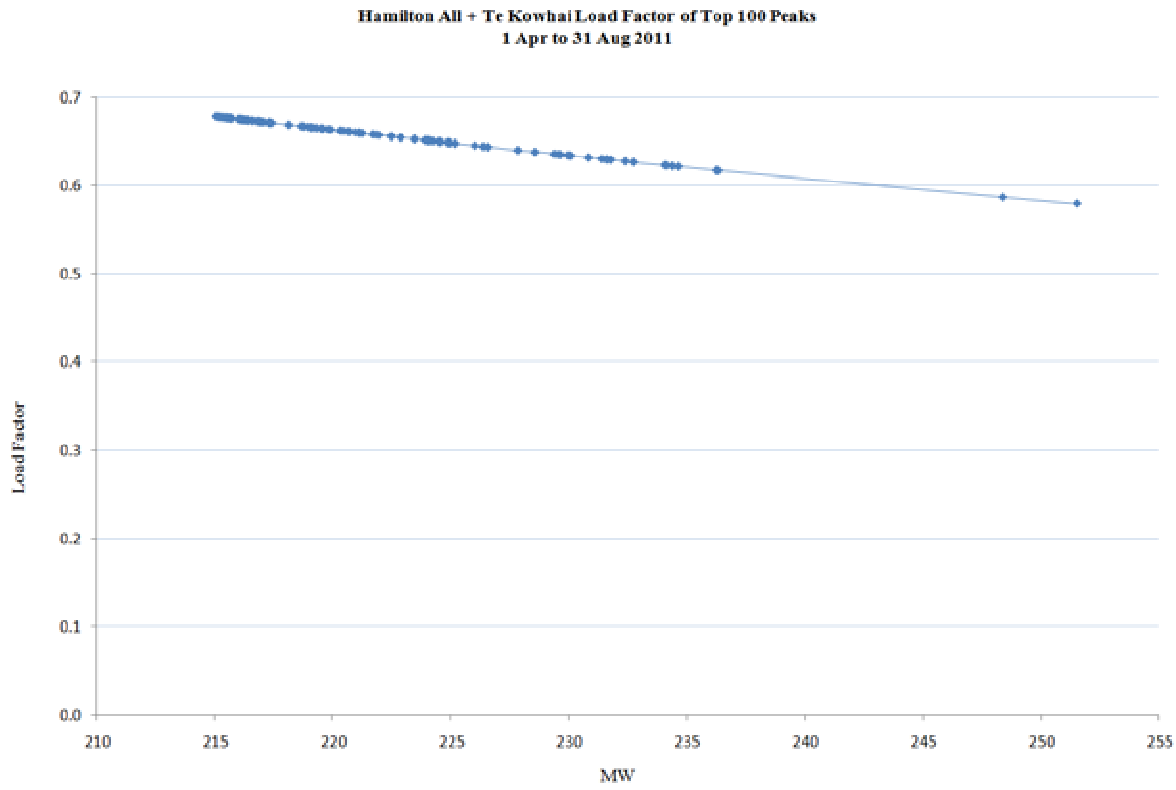


Figure 62. Combined Hamilton and Te Kowhai load factor of top 100 peaks

8.2.8 Asset Efficiency – Capacity Utilisation

WEL's capacity utilisation is the fourth highest in the industry based on 2010 disclosed figures. WEL's utilisation is 37.1% for the year ended March 2010 against an industry average of 28.8%.

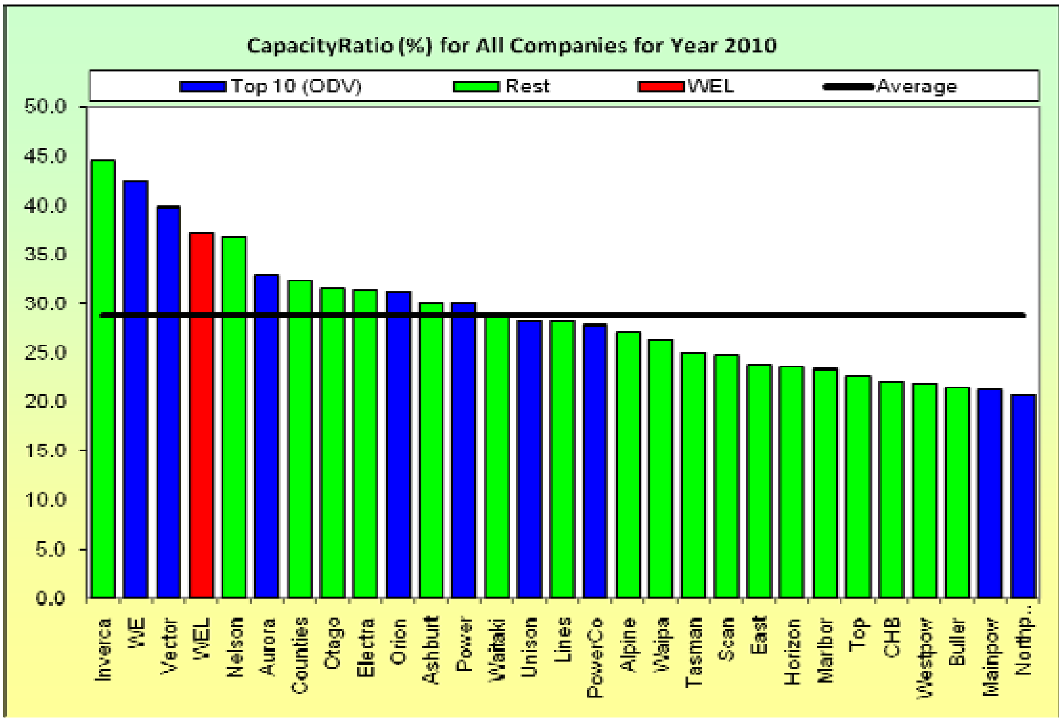


Figure 63. Asset Efficiency Measure – Capacity Ratio (%) for all NZ Line Companies

8.2.9 Low Voltage Complaints (LVCs)

The number of LVCs received and the number proven are reported monthly for comparison with the previous year's data. Table 22 below shows the comparison between the 2010/11 year and 2009/10 year. It shows a 40% reduction in LVCs that have been proven to be WEL's responsibility. In total, it shows an overall 44% decrease in the number of LVCs.

We expect an increase in voltage issues as WEL deploys its smart boxes in the rural networks, over time complaints will reduce further as WEL pro-actively identifies voltage issues.

Table 22 Low Voltage Complaints

Year Ending	Proven WEL	Proven Customer	Proven WEL & Customer	Not Proven	Total
March 2010	5	2	1	8	16
March 2011	3	4	1	1	9

The "Proven WEL" voltage complaints have decreased significantly. All "Proven Customer" complaints were caused by clearly identifiable unauthorised increases in load from customers in rural locations.

"Proven WEL and Customer" complaints were found to be due to excessive service line voltage drops combined with higher than standard low voltage network drops with too many customers connected to a single transformer. WEL is continuing to focus on quality of supply.

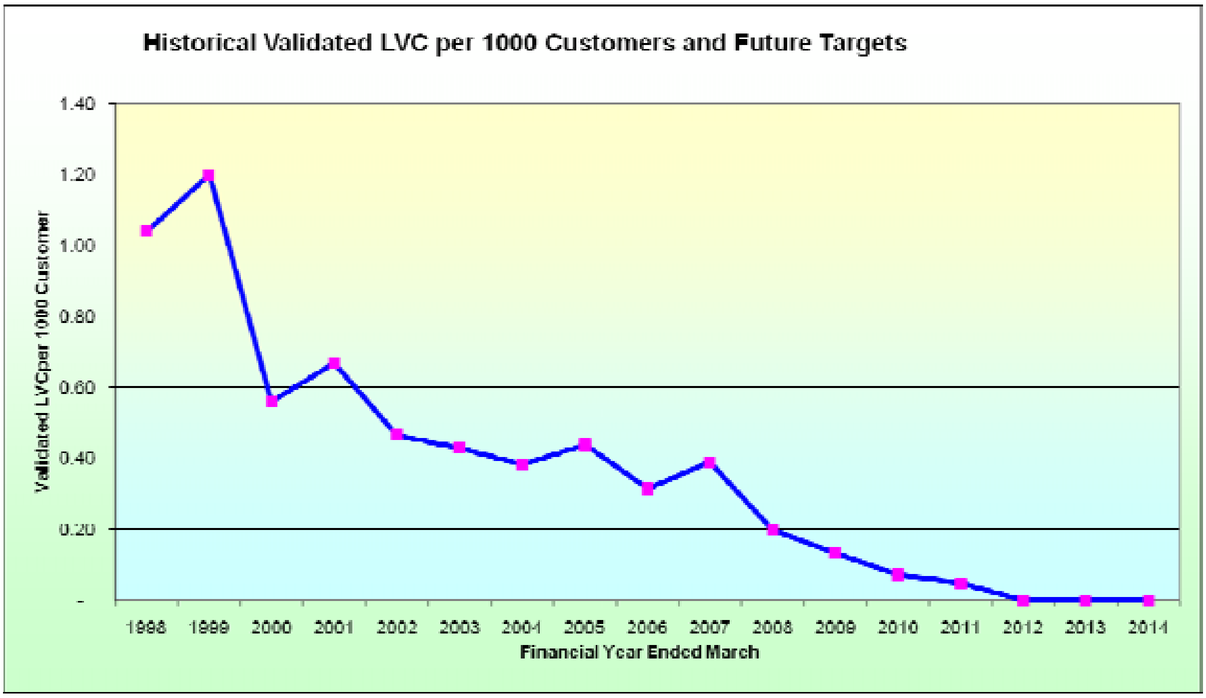


Figure 64. Validated LVC Per 1000 Customer Trending for WEL

8.3 Gap Analysis and Identification of Improvement Initiatives

8.3.1 Capital Project Management Both of Physical and Financial

The following key initiatives aimed at reducing variance between the AMP and actual have been implemented during this report year:

- Established a Master Planner role to ensure optimal in house resource planning for the effective and efficient delivery on maintenance and capital programme.
- Formalised communication between project managers and schedulers to avoid resource conflicts and priority issues.

The following key initiatives have been implemented in previous years:

- Improved handover meetings from the design team to the capital project team and the works planning and scheduling team.
- More detailed design options completed before AMP approval. The first year in the AMP has been used as next year's budget with minor changes.
- Further refinement of staff structure to further enhance in-house project management capability and contractor management. The new company structure is shown in Figure 6.
- More detailed resource planning before budget approval to ensure appropriate resource levels for the delivery of the approved capital programme.
- Improved handover from the Capital Project Manager back to the project owner and key stakeholders for sign off.
- Enhanced the internal review process for major capital project scope and pricing.
- Documented assumptions of key cost variables during asset management planning
- Centralised the internal design team to undertake most of the conceptual and detailed design and review and approve external design.
- Compatible Unit Estimation tool for cost estimation to help improve the productivity.
- PSS SINCAL 11kV model development to enable network optimisation and 11kV capability based protection setting, continue implementation of a combined model of 33kV and 11kV.
- Refinement of specific KPIs relating to quality and project scopes as part of the performance management system.
- Continued improvement of the GIS data collection and validation process which has ensured quality data is available in GIS for network planning, project delivery and operations.
- Network asset attributes have been validated in the field and entered into GIS and SINCAL.
- Enhanced process reporting between the Operations & Customer Delivery groups and the Asset Investment and Growth group.
- Terminate major capital alliance contractors to improve contestability.

- The Works Delivery Master Process has been redesigned and implemented. The Works Delivery Master Process consists of four sub-processes: Customer Enquiries, Sizing and Design, Works Planning and Scheduling, Construction and Maintenance.
- Implementation of self audit templates to ensure onsite and offsite check lists for Maintenance, Overhead Services and Underground Services.
- Reporting - timely, high quality reports have been set up automatically for project managers to more easily gauge the financial situation. This reduces duplication and mistakes.
- KPIs have been established for project managers regarding project completion to quality standards, on time and within budget. These are assessed regularly during performance reviews.
- Asset commissioning and decommissioning processes have been implemented.

8.3.2 Maintenance Programme Delivery Both of Physical and Financial

WEL has initiated several maintenance initiatives over the last financial year. These and future initiatives are highlighted below:

- Line clashing due to high fault currents has been identified as a significant contributor to outage severity. The correction of these through the introduction of spacers, wider crossarms or delta construction continues to be a priority.
- Improvements actions as identified in the Root Cause Analysis (RCA) meetings are raised in the Action Request System(AR), to ensure the identified opportunities are carried out.
- Lists of defects and poor condition assessments are being captured into the CMMS and are being programmed for corrective action based on priority. Priorities are being determined by position in the network (impact of failure) and from the condition grading (probability of failure).
- A major programme to internally inspect and change the oil of all oil filled ring main units was undertaken. This was prompted when a failure was experienced where the switch contact travel was found to have been maladjusted during manufacture.
- Inspection data is being used to target particular areas for significant upgrade.
- Corona discharge testing is being performed on feeders where there are high incidences of insulator failure.
- A new technique is being used for the assessment of wooden poles. This uses radiation backscatter to measure the pole density and remaining strength.
- A full inspection of service pillars is underway to ensure public safety.

Defect correction will target the removal of line tap connectors on overhead circuits, replacement of kidney insulators, and the change to a delta conductor configuration on a number of rural circuits. Increased frequency of inspections will give improved condition information for future asset replacement projections.

8.3.3 Service Levels

WEL's service level and asset performance compared with targets in these areas has been analysed and performance improvements are discussed below.

8.3.3.1 Initiatives to improve safety:

Safety is not negotiable to WEL. WEL is committed to achieving no lost time injuries (LTIs). WEL introduced a Field Action Reporting (FAR) procedure. One of the objectives of this procedure is to identify previously unrecorded hazards for which controls currently do not exist.

All staff are encouraged to continually assess their working environment for the possibility of hazards. When a new hazard is identified, this is recorded as a FAR. Upon receipt of a new report it is investigated. The response depends on the combined weightings of consequence and likelihood. Controls are identified and developed through a number of forums:

- Monthly Health and Safety delegate meetings

- Regular Health and Safety contractor meetings
- Monthly team briefings
- Incident investigations

Once a suitable control has been established an owner is assigned to each control. The ownership responsibilities include conducting assessments to ensure the controls are still effective and appropriate. If an incident occurs, then other similar situations within the network will be checked to ensure that the incident cannot be repeated. This process satisfies the very core of the Health and Safety in Employment Act, with its proactive, responsible approach to identifying risks and implementing appropriate controls.

The resources provided include; site inductions, six monthly safety refreshers, safety equipment, operator training, active fatigue management, first-aid facilities, counselling services, and annual health assessments (including drug testing).

The health and safety process integrates with the business management system. The business management system has been regularly audited to ISO 9001:2008. The audit periods have been steadily extended, from the initial six monthly reviews, then to nine months and now to 12 monthly intervals.

The FAR system provides feedback to senior management so that they can monitor the effects of the programmes. Health and safety performance is reviewed as follows:

- Review at the weekly executive management meetings
- Review for the adequacy and effectiveness of the hazard controls by the Health, Safety and Compliance Manager, occurs periodically and when needed
- Regular site safety audits by the Health, Safety and Compliance Manager
- Periodical risk management audit by the Risk and Quality Auditor.

These measures have resulted in very few lost time injuries while field staff numbers have increased from 63 in May 2006 to over 100 as of now.

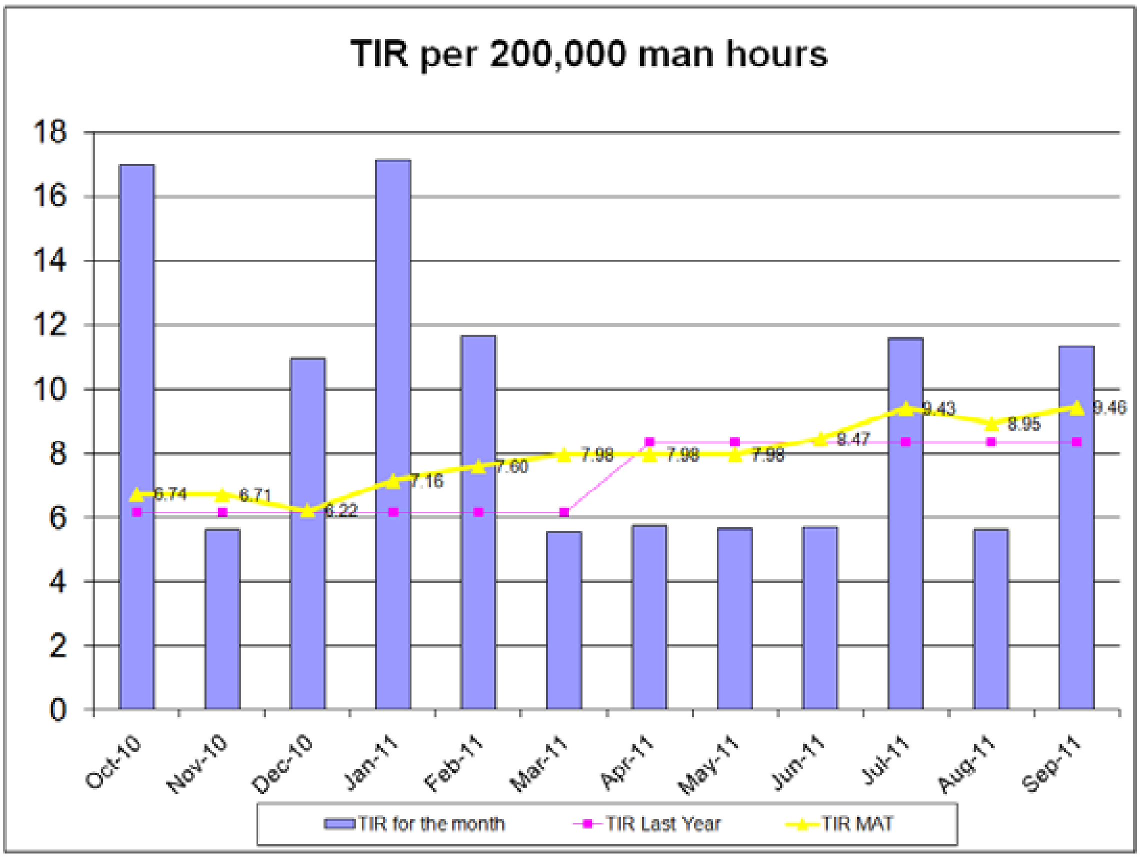


Figure 65. Total Incident Rate (TIR) 12 Month Rolling Average

WEL started measuring TIR (Total Incident Rate) per 200,000 man hours. TIR includes both LTIs and Medical Treatment Injuries (MTIs). This is done to bring focus and attention to MTIs which are one step below the LTIs in the injury pyramid. Figure 6.4 shows the safety performance as of 31 September 2011.

WEL Networks met the secondary level accreditation requirements for ACC Workplace Safety Management Practices at the initial audit in February 2008 resulting in a discount of 15% in the levies WEL pays. This was upgraded to tertiary level accreditation, which receives a discount of 20%, subsequent to a successful audit in February 2010.

8.3.3.2 Initiatives to improve reliability:

As the load on the network has increased and capital projects have been undertaken to accommodate the increased load, reliability issues caused by inadequate protection have been experienced. These have been addressed using the process outlined below.

- GIS data cleansing

Most of the GIS conductor data cleansing and implementation of SINCAL for network power analysis was completed. This included the validation of the calculations and the base network data. Settings continue to be reviewed and changes implemented. Additional controls have been implemented to ensure correct settings are entered and there is continual alignment between SCADA and the protection database. The capacity based protection settings project for the whole 11kV network was completed. Capacity based protection is dependent on the conductor data. It is critical to continue improving conductor data quality. WEL plans to purchase an objective measure tool for conductor information.

- Implementation of SINCAL for the 11kV network

The SINCAL power flow analysis software has been implemented for the 11kV network. SINCAL is being used to model areas of the network which show signs of service issues and is also being used to confirm capacity increase designs and network planning proposals.

- Review of protection philosophy

A further review of the protection philosophy has been completed for the 33kV meshed network. WEL has decided to complete a 33kV protection upgrade from distance protection to differential protection in next 6-8 years.

- LV network adjustments

The construction of new zone substations has highlighted the need to upgrade conductor ratings for existing feeders, adjust distribution transformer voltage taps and reconstruct line configuration to prevent line clashing due to increased fault levels. Some equipment, such as reclosers, is being relocated to more effective positions.

- Asset replacement programme

An asset replacement programme for poles, crossarms, connections and other equipment types identified during condition assessment surveys will continue through the plan life.

- Continuing maintenance and defect correction

Planned maintenance and defect correction programmes will continue into the future.

- Improvements to asset management and works delivery processes

Structural changes have been made in the asset management and works delivery areas to better align with defined processes. A dedicated design group has been formed to provide scoping, detailed design and cost estimates for all construction work. Estimating functionality in the CMMS has been implemented to assist in this work. This will lead to better productivity, improved consistency and better adherence to the design standards. These are expected to flow through to improved reliability.

- Planned maintenance work practices

Planned maintenance work practices have been adapted so that work orders for all planned work for the year are now being generated and scheduled in advance by the Maintenance Planning Group. A similar process is being followed for asset replacement work.

- Repeat outage performance

WEL will continue to work to improve repeat outage performance. Several reliability projects included in each year are aimed at improving repeat outage performance. Increased spend on vegetation management will also improve reliability.

Particular attention will be given to reducing the number of customers who have had more than four outages in the last two years in rural areas. A comprehensive analysis on worst performing feeders of repeated outages has been completed. Many projects have been developed. Cost $ / SAIDI minute and cost $ / repeated outage reduction have been developed and used for project prioritisation.

About $1m was included in 2012-2013 to undertake point to pint asset replacement projects for prioritised worst performing feeders.

Photo 23 Te Uku wind farm

8.3.3.3 Ongoing work for reliability improvement

Reliability improvement work and study is continuing as discussed below.

8.3.3.3.1 Asset failure modes and maintenance strategies

WEL continues to review asset failure modes and reassess maintenance strategies. More information is being collected and recorded about faults and the quality and accuracy of fault information improved. This will allow WEL to better identify the asset type, the failure mode and the root cause of the failure. The improved information and analysis is allowing WEL to make more accurate assessments of underlying causes which is enabling the development of improved solutions to problems. RCM software to allow the statistical analysis of failure data and optimize maintenance strategies will be purchased in the current period.

8.3.3.3.2 Root Cause Analysis (RCA) of significant events

WEL continues to apply Root Cause Analysis (RCA) of significant events to identify new failure modes and risks. This information is used immediately to identify where maintenance practices can be improved to prevent re-occurrences. All high voltage faults are being reviewed to understand whether they are preventable or can be prevented by improved maintenance planning, work practices or materials. Opportunities to minimize the impact of faults through improved network design are also considered.

8.3.3.3.3 Data collection

Data continues to be added to WEL's Computerised Maintenance Management System (CMMS). Over the longer term this will provide information that will allow WEL to continually improve asset replacement and maintenance strategies and therefore improve reliability and reduce costs. Significant steps have been taken over the last year to improve the accuracy and consistency of asset related data. This has involved field validation of data in many cases. A team has been set up with specific responsibility to manage the data within GIS, the CMMS and Financial Asset Register and ensure user information requirements are met.

8.3.4 Initiatives to Improve Secondary Customer Service Levels:

The first issue was that not all customer complaints/compliments are being registered in the AR system. It is difficult to understand and identify real systemic issues in order to take corrective and preventive action. Secondly some customer complaint took too long to resolve and there was no system to monitor the resolution.

The Action Request (AR) system has been used from October 2009 to record and monitor the resolution of customer complaints/compliments. The issue of AR for customer complaints/compliments does not require prior consultation with the recipient.

The following initiatives have been implemented by 31 March 2011:

- A customer service team was established to improve customer services performance including customer complaint/compliment process.
- Executive management are to ensure the process is applied in order to catch all customer complaints/compliments and register them in the AR system.
- The number of customer complaint ARs has increased since October 2009. A report which shows the trend, in percentage term, of the ARs going overdue will be included in the monthly report.
- The customer complaints & compliments process is to be amended so that the Chief Executive is also informed of any 'Public Safety – Electrical' complaints
- Any customer complaint resolution that takes more than 10 days will be included in the monthly management report.

8.3.5 Initiatives to improve Operating Efficiency – Cost per Customer

WEL has implemented a very comprehensive performance management framework. Each cost item has been assigned clear management accountability in order to deliver the required business outcomes at lowest cost. Regular performance monitoring for preventative and corrective actions is in place. Effective and efficient delivery of maintenance programme is the key driver. A Kaizen improvement project has been approved to identify inefficiencies and improvement opportunities.

8.3.6 Initiatives to improve Delivery Efficiency – billability and productivity

The current billability measure as defined in Section 4.4.2 takes into account acceptable and measurable non productive factors such as annual leave and training time, and thus the target cannot be increased without a change in the measure itself. The monthly result may vary from the target depending on the timing of training schedules and annual leave requirements. The 80% target should therefore be viewed as an optimal point rather than a target to be improved on.

However, this measure should be monitored on a micro level by the managers responsible for the resources to ensure all staff are being utilised as efficiently as possible. As managers have the responsibility to approve time sheets, they should be immediately aware of any non productive issues that arise.

Unlike billability, continuous improvement is possible with the productivity measure. There are two sides to this measure, firstly, getting the estimate as accurate as possible in the most efficient manner, and secondly, completing the site work as efficiently as possible without compromising safety and quality.

To improve the estimated/planned costs the following area are improvement opportunities:

- Our estimators need to gain more experience in estimating and using the systems available.
- Due to heavy workloads, sufficient time to complete "on site" scoping of the work has not always been possible, but as backlogs are addressed more site visits will improve the accuracy of planned costs.
- The accuracy and ease of using the CUE will also improve the ability to produce an accurate estimated/planned cost for the job.

To improve the onsite component of the productivity result the following areas need to be improved on:-

- Better job planning/scheduling with minimal disruptions to the work plan.
- Comprehensive and complete job pack information given to field staff.
- Correct and sufficient tools and plant available for the task.
- Competent and motivated staff

The optimum staff level to complete the task safely & efficiently.

8.3.7 Initiatives to Improve Asset Efficiency – Load Factor

WEL is working to improve its load factor and efficiency of the system by reducing network peak demand for electricity without sacrificing reliability and customer service. WEL has embarked on a programme of demand management. Currently, load control is performed during winter, shifting loads between the Upper and Lower North Island GXPs to minimize peak at a GXP where the other GXP has a relatively low load. By doing so, WEL also helps in reducing the regional demand for both Lower and Upper North Island.

WEL is continuing to investigate innovative ways of reducing peak demand and improving customer load factor on our network. This is achieved by firstly ensuring that connection capacity is optimised via our customer management processes and secondly by working with customers to help them reduce, shift or utilise spare capacity within their plant and facilities to achieve a win-win situation.

Industrial and commercial customers and developers receive consultancy advice on load management. Peak demand reduction can be achieved through improved understanding of the WEL demand tariff. To assist with this WEL has developed a range of tools that include demand signalling and control devices for its customers within Hamilton.

We are also looking at ways to deliver greater value to residential opportunities and have trialled devices that allow non mission-critical commercial plant and appliances (dishwashers, clothes driers and washing machines etc.) to be cycled or turned off during the network demand periods. This is extending to include adjustment of heatpump temperature settings to maintain comfort during peak demand events.

An example of these services is work with primary schools which has identified significant opportunity for heating load management to improve the load factor of school facilities during the morning demand period or getting them to shift to more energy efficient technologies like heat pumps and insulation. This work is undertaken to improve the load factor, through smarter operation of electric heaters during demand periods, as well as the learning environment for children in the WEL Network area. WEL's Consultancy services further support the focus to optimise WEL's load factor.

8.4 Overall Quality of AMP Planning and AMP itself

The following section summarises differences between the 2010 AMP and this AMP in order to highlight recent improvements.

8.4.1 Capital Expenditure

Table 23 Key Changes from 2010 AMP for the same period

KEY CHANGES FROM INDEXED 2010 AMP	
Asset replacement	$0.5M decrease, due to better asset information, offset by increased costs for wood pole replacement following pole scanning programme
Safety and quality	$2M increase is for retro-fitting Arc Flash protection to existing switchboards and for the seismic upgrade of substations.
Customer driven	$2.5M increase is attributable to new 10 MW load application in Te Rapa, remedial work at Dannemora subdivision ($1.1M) and overhead network upgrade to accommodate the fibre rollout ($1.2M), offset by impact of lower economic growth
Growth based	$5.2M increase contingency has been included for the proposed Tainui inland port facility.
Security projects	$1.2M net increase mainly due to refined subtransmission development, additional costs of $2.5 M for South East Hamilton zone substation offset by savings around Ruakura
Smart Network	$0.8M decrease through refined pricing as deployment commences

Reliability projects	$0.6M increase, due to inclusion of projects to improve reliability of 'worst performing feeder' outages, also inclusion of enhanced earth protection (Weavers Te Akau) using network compensation via resonant earthing (Petersen coil).
Communications	$1.2M increase in communication for ongoing development of the comms network to utilise new fibre links (i.e. connecting new 33kV Unit Protection schemes, disconnecting old copper pilot wires).

A summary of changes from the 2010 AMP for the same period from April 2011 to March 2022 is shown in the following table:

Table 24 11 Year Capital Spend Profile Comparison Between 2011 AMP and 2010 AMP

11 Year Capital Spend Profile Comparison Between 2011 AMP and 2010 AMP					
Total Network Capital Expenditure	2011 AMP	2010 AMP + 2.5% cost increase	Variance	Variance (1-5 Years)	Variance (6-11 Years)
Asset Replacement	106,236	106,766	530	2,083	(1,553)
Safety and Quality	6,593	4,592	(2,001)	(1,758)	(243)
Customer Driven Projects	90,994	88,447	(2,546)	(2,920)	373
Load Growth Projects	56,231	51,061	(5,171)	(2,582)	(2,588)
Security - POS & Zone Sub	67,548	66,364	(1,184)	(1,982)	798
Load Control and Smart Grid	33,995	34,782	787	721	66
Reliability	4,500	3,946	(554)	(906)	353
Undergrounding	11,000	11,000	-	-	-
Communication	2,150	940	(1,210)	(738)	(472)
Total	379,247	367,898	(11,349)	(8,082)	(3,267)

The figures from the 2010 AMP have been adjusted by 2.5% using the Labour Cost Index - Public Sector - Electricity, Gas and Water Supply.

Individual project scopes and timing have been reviewed and adjusted accordingly.

8.4.2 Maintenance Strategy and Expenditure

Key changes from the indexed 2010 AMP for the same period are summarised below:

- There are no major variances in faults, relocations, distribution lines, wind farm lines and smart meter maintenance expenditure.
- Small increases in Zone Substations and SCADA maintenance due to an increase in zone substation numbers.

- A small increase in project driven maintenance spend to align with current maintenance requirements in capital projects.
- A decrease in the provision for faults in external subdivisions due to current historical spend requirements.
- An increase of $2.7M in the vegetation budget spend over the 11 year planning period is due to P1 (priority 1) sites reaching steady state, and not reducing as originally expected.

Key changes from the 2010 AMP for the same period from April 2011 to March 2022 are shown in table below:

Table 25 11 Year Maintenance Spend Profile Comparison Between 2011 AMP and 2010AMP

11 Year Maintenance Spend Comparison Between 2011 AMP and Indexed 2010 AMP			
Maintenance	**2011 AMP**	**2010 AMP plus a cost index of 2.5%**	**Variance**
Faults	24,145	24,138	(7)
Relocations	792	806	14
Distribution Lines	28,180	28,167	(13)
Vegetation Management	12,650	9,912	(2,738)
Zone Substations	8,370	8,296	(74)
SCADA	1,300	1,277	(23)
Faults External Subdivision	550	673	123
Project Driven Maintenance Expenditure	2,200	2,132	(68)
Wind Farm Maintenance	550	513	(38)
Smart Meter Maintenance	1,855	1,904	48
Total	**80,592**	**77,816**	**(2,776)**

The figures from the 2010 AMP have been adjusted by 2.5% using the Labour Cost Index - Public Sector - Electricity, Gas and Water Supply.

The result of this is a net increase in spend of $2.8M over the 11 year period.

9 EXPENDITURE FORECASTS AND RECONCILIATIONS

Electricity Distribution Business: WEL NETWORKS

For Year Ended: 2011

($000)

A) Five year forecasts of expenditure

From most recent Asset Management Plan

	Actual for Current Financial Year	Forecast Years year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10	year 11
for year ended	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Capital Expenditure: Customer Connection	5,138	5,658	7,109	5,709	5,923	5,423	5,423	5,423	5,423	5,398	5,398	5,398
Capital Expenditure: System Growth	29,090	16,704	16,617	21,564	21,126	11,938	15,650	22,445	13,703	8,071	7,435	3,606
Capital Expenditure: Reliability, Safety and Environment	679	1,823	3,440	2,175	1,008	898	884	944	899	773	707	742
Capital Expenditure: Asset Replacement and Renewal	5,519	8,601	8,990	9,710	10,470	10,220	10,960	9,420	9,640	9,920	9,805	8,500
Capital Expenditure: Asset Relocations	3,502	4,000	4,075	4,075	4,075	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Subtotal - Capital Expenditure on asset management	**43,927**	**36,785**	**40,231**	**43,233**	**42,602**	**31,529**	**35,967**	**41,282**	**32,715**	**27,212**	**26,395**	**21,296**
		-	-	-	-	-	-	-	-	-	-	-
Operational Expenditure: Routine and Preventative Maintenance	3,053	3,094	3,068	3,127	3,190	3,190	3,194	3,194	3,199	3,199	3,203	3,203
Operational Expenditure: Refurbishment and Renewal Maintenance	1,580	1,800	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720
Operational Expenditure: Fault and Emergency Maintenance	2,428	2,364	2,425	2,431	2,438	2,438	2,439	2,439	2,439	2,439	2,440	2,440
Subtotal - Operational Expenditure on asset management	**7,061**	**7,257**	**7,213**	**7,278**	**7,348**	**7,348**	**7,353**	**7,353**	**7,358**	**7,358**	**7,363**	**7,363**
		-	-	-	-	-	-	-	-	-	-	-
Total direct expenditure on distribution network	**50,988**	**44,043**	**47,444**	**50,511**	**49,950**	**38,877**	**43,320**	**48,635**	**40,073**	**34,570**	**33,758**	**28,659**
Overhead to Underground Conversion Expenditure	846	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

The Electricity Distribution Business is to provide the amount of Overhead to Underground Conversion Expenditure included in each of the above Expenditure Categories (explanatory notes can be provided in a separate note if necessary).

Overhead to underground conversion expenditure is included in Asset Relocations for each of the forecasted year.

B) Variance between Previous Forecast for the Current Financial Year, and Actual Expenditure

	Actual for Current Financial Year (a)	Previous forecast for Current Financial Year (b)	% Variance (a)/(b)-1
Capital Expenditure: Customer Connection	5,138	4,795	7.2%
Capital Expenditure: System Growth	29,090	19,291	50.8%
Capital Expenditure: Reliability, Safety and Environment	679	925	-26.6%
Capital Expenditure: Asset Replacement and Renewal	5,519	6,992	-21.1%
Capital Expenditure: Asset Relocations	3,502	2,989	17.2%
Subtotal - Capital Expenditure on asset management	**43,927**	**34,991**	**25.5%**
Operational Expenditure: Routine and Preventative Maintenance	3,053	2,821	8.2%
Operational Expenditure: Refurbishment and Renewal Maintenance	1,580	1,656	-4.6%
Operational Expenditure: Fault and Emergency Maintenance	2,428	2,439	-0.4%
Subtotal - Operational Expenditure on asset management	**7,061**	**6,916**	**2.1%**
Total direct expenditure on distribution network	**50,988**	**41,907**	**21.7%**

Explanation of variances

Distribution Business must provide a brief explanation for any line item variance of more than 10%

Explanatory notes (can be provided in a separate note if necessary): More customer connections were completed than expected. System growth is substantially mainly ahead due to the $8million spent on the Wind Farm Reticulation. Some reliability projects and asset replacement projects were delayed due to economic recession. Asset relocations projects were higher than expected.

Appendix 1 Glossary of Terms

The following represents a list of terms encountered in the text and their associated meanings.

Term	Meaning
ABS	Air Break Switch
Annual Business Plan	The WEL plan consolidating objectives and financial expenditure for a given financial year.
Best Practice	A practice identified through international Benchmark Studies to give the most cost-effective improvement in asset management or other core business performance.
CAD	Computer Aided Drawing
CAIDI	Customer Average Interruption Duration Index is the average total duration of interruption per interrupted customer.
CB	Circuit Breaker
CBD	Central Business District
CMMS	Computerised Maintenance Management System
Connection and Disconnection	Connection/disconnection of service mains to or from overhead or underground LV networks including the removal, reinstatement or installation of neutrals.
Consumer	Refer to Electricity Act 1992. WEL use the term Customer. Refer to the definition of Customer. See also definition of User.
Continuous Improvement	Recurring activity to increase the ability to fulfil requirements.
CPC	Cost per customer – Internal measure of operating efficiency.
Customer	The end user or beneficiary or purchaser of a product or service, either internal or external to the organisation.
Defect	Substandard workmanship, product or service resulting in the non-fulfilment of intended usage requirements.
DG	Distributed Generation
Distribution Line	[Ref NZECP 34] Means works that are owned by WEL used for the conveyance of electricity to one or more electrical installations.
Division	A WEL division or section under the control of an executive manager.
DMS	Distribution Management System, a semi-geographical operator interface linked with SCADA within NMS, to manage the distribution system.
DM	Demand Management
Equipment	Electrical apparatus, distribution or sub-transmission circuits or plant that forms part of the network. Equipment. Used with the same meaning as "Fittings" as defined in the Electricity Act 1992.
Field	The location where the work is being carried out.

Fixed Asset	A purchase of >$200 with an intended life cycle of > 1 year.
FRS-3	Financial Reporting Standard – Version 3
GIS	The Geographic Information System used for electronic mapping of the Network.
Grid Exit Point (GXP)	The point at which WEL Equipment is deemed to connect to the Transpower Grid System. The term is interchangeable with POS.
High Voltage (HV)	Any voltage exceeding 1000 V a.c. or 1500 V d.c. but usually pertaining to the 11kV or 33kV distribution system.
ICP	Installation Control Point. A number that uniquely identifies each connection to an electrical lines network that is recorded in a national registry.
IHD	In home display. A display associated with smart boxes that allow customers to see and manage their power use.
Inherent Risk	The level of risk that exists before any risk treatment measure or control has been implemented.
Inspection	Activities such as measuring, examining, testing and gauging characteristics of a product or service.
Kaizen	A methodology used for continuous improvement
Key Performance Indicator (KPI)	A standard unit of measure used to enable comparative analysis between organisations or within an organisation.
Lines	The LV and HV network of overhead and underground electricity conductors and cables and their associated equipment such as insulators, poles, crossarms etc.
Low Voltage (LV)	Any voltage exceeding 32 V a.c. or 115 V d.c. but not exceeding 1000 V a.c. or 1500 V d.c.
LTI	Lost Time Injury
LVCs	Low Voltage Complaints – from customers. These are investigated by WEL.
MTI	Medical Treatment Injury
N-1 security	A load is said to have N-1 security if for the loss of any one item of equipment, supply to that load is not interrupted or can be restored in the time taken to switch to alternate supplies.
Network	Utility reticulation system or asset owned by the utility Company, Trust or other body having control and/or ownership in the utility reticulation system including the land, buildings, installations, individual customer connections up to the point of supply, and other improvements on or under which the utility reticulation system is located.
NMS	Network Management System consists of SCADA, DMS, OMS, TCS, and Load Management.
ODV	Optimised Deprival Value
OMS	Outage Management System
Ownership Boundary	The boundary between the equipment owned by WEL and the equipment owned by the Customer. See also Point of Demarcation.
Point of Connection	The point at which a Customer's Equipment is deemed to connect to the Distribution System.

Point of Demarcation	The point at which a Customer assumes authorised control and maintenance of his system.
Point of Supply [POS]	In this document is defined as the point at which WEL equipment is deemed to connect to the Trans Power Grid System. The term is interchangeable with GXP.
PSS SINCAL	Power flow modelling software
QMS	Quality Management System - A system that provides processes to assist achievement of the business critical success factors.
Quality	The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs, i.e. "fitness for purpose for intended use".
Quality & Safety Procedures	Detailed description of process activities, records and applicable specifications.
RC	Resource Consent
RCM	Reliability Centred Maintenance – A process to develop and optimise maintenance strategy.
RCPD	Regional Coincident Peak Demand used by Transpower for connection charges.
Reliability	The ability of an item to perform a required function under stated conditions for a stated period of time.
Residual Risk	The remaining level of risk after risk treatment measures has been taken.
Retailer	An electrical energy supplier who has a User Supply Agreement with WEL Networks.
Risk	A combination of the probability (likelihood) and consequences, positive or negative, of an event. In some situations, risk is a deviation from the expected.
Risk Management	AS/NZS 4360 defines risk management as a term applied to a logical and systematic method of identifying, analysing, evaluating, treating, monitoring and communicating risk associated with any activity, function or process in a way that enables maximisation of benefits or minimisation of losses or detrimental effects.
RMC	The Risk Management Committee comprising duly appointed managers responsible for review of WEL's risk management process.
RMD	The Risk Management Database located on InGrid, the WEL Intranet. This is the software application used to record and assist with analysis and management of risk.
RMU	Ring Main Unit
RTAP	The Risk Treatment Action Programme function that specifies what additional action is required, by whom and by when, to further mitigate a risk.
RTU	Remote Terminal Unit – Communications device used for relaying data from the field.
SAIDI	System Average Interruption Duration Index is the average total duration of interruption per connected customer.
SAIFI	System Average Interruption Frequency Index is the average number of interruptions per connected customers.
SCADA	System Control And Data Acquisition System which is part of NMS is the primary tool for monitoring, controlling and switching operations for WEL's Network.

Smart Box	An intelligent network device located at customer premises to deliver real time monitoring of power quality and consumption and to provide load management.
SR-EI	The Safety Rules Electricity Industry July 2000
Stakeholder	People and organisations who may affect, be affected by, or perceive themselves to be affected by, a decision or activity.
Standard	The document that prescribes the requirements with which the product or service has to conform. The criteria for acceptable levels of safety performance/behaviours set by WEL Networks, industry codes or relevant legislation.
Standard Operating Procedure	A locally controlled work method statement or 'desk top' file.
Supplier	Organisation that provides a service or product to the customer: – in a contractual situation the supplier may be called the contractor – the supplier may be the producer, distributor, importer, assembler or service organisation – the supplier can be internal or external to the organisation.
SYSCON	The WEL Networks Ltd network system control centre and the distribution network controllers.
Territorial Authority (T/A)	The controlling authority having control and responsibility for roads and road reserves.
TIR	Total Incident Rate
Transpower	The owner and operator of the National Grid.
User	Any person or organisation using the Distribution System, but excluding Trans Power. It includes all Customers, embedded generators, and where appropriate, Electricity Retailers acting on behalf of their customers.
Vegetation	Any trees or other plants threatening the WEL Networks overhead lines.
WEL	WEL Networks Ltd with its offices at Maui Street, Te Rapa
WEL Operations	The section of WEL responsible for the day to day operations and maintenance of WEL Networks
WIP	Work in Progress
Zone Substation	Consist of transformers, switchgear, communication equipment, protection relays and control.

Appendix 2 Forecasted Load for zone substations and each GXP

Zone Substations	ABB	GXP	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Airport *	AIR	HAM33	-	-	-	-	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4
Avalon Dr	AVA	HAM33	17.4	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3	19.3	19.4	19.5
Borman	BOR	HAM33	8.8	9.8	10.8	11.7	12.7	13.4	14.0	14.6	15.2	15.8	15.8	15.8
Bryce St	BRY	HAM33	18.6	21.1	21.2	23.2	23.3	23.3	23.3	23.4	23.4	23.5	23.5	23.5
Chartwell	CHA	HAM33	22.7	22.9	23.2	23.4	23.6	23.7	23.8	24.0	24.1	24.2	24.4	24.5
Claudelands	CLA	HAM33	15.7	18.6	19.1	19.2	19.2	19.3	19.3	19.4	19.4	19.5	19.5	19.5
Cobham	COB	HAM33	15.4	15.8	16.3	16.8	17.3	17.7	17.7	17.8	17.8	17.8	17.8	17.8
Finlayson Rd	FIN	MEM33	3.1	4.7	4.8	4.9	5.0	5.2	5.3	5.4	5.5	5.7	5.8	6.0
Glasgow St	GLA	HUN33	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.3	9.5	9.7
Gordonton	GOR	HAM33	6.4	6.5	6.7	6.9	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4
HAM 11 kV/Ruakura*	RUA	HAM11	37.8	36.2	38.4	38.5	26.7	26.8	27.0	27.1	27.2	27.4	27.5	27.6
Hampton Downs	HPT	MEM33	1.7	3.2	3.5	3.7	4.0	4.1	4.2	4.3	4.5	4.6	4.7	4.8
Hoeka Road*	HOE	HAM33	-	-	-	-	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Horotiu	HOR	TWK33	9.1	11.6	14.2	14.4	14.5	14.6	14.7	14.8	15.0	15.1	15.2	15.3
Kent St	KEN	TWK33	16.8	17.0	17.1	17.3	17.5	17.7	17.9	18.0	18.2	18.4	18.6	18.8
Kimihia	KIM	HUN33	2.6	3.1	3.6	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Latham Court	LAT	HAM33	17.6	18.1	18.5	19.0	19.5	20.0	20.0	20.0	20.0	20.0	20.1	20.1
Ngaruawahia	NGA	TWK33	5.2	5.4	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.7	6.9
Peacockes Rd	PEA	HAM33	14.1	15.2	16.0	17.1	13.1	13.3	13.4	13.4	13.5	13.5	13.6	13.6
Pukete - 11kV	PUK	TWK33	7.4	9.2	9.7	9.7	9.7	9.7	9.7	9.8	9.8	9.8	9.8	9.8
Pukete - Anchor	ANC	TWK33	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Raglan**	RAG	TWK33	-	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.1	5.2	5.4
Sandwich Rd	SAN	TWK33	20.0	21.1	21.2	21.2	21.3	21.3	21.3	21.4	21.4	21.4	21.5	21.5
Tasman	TAS	TWK33	19.4	18.8	20.9	21.6	29.1	30.5	32.0	33.4	34.8	36.2	37.7	38.6
Te Kauwhata	TEK	MEM33	4.2	4.5	4.6	4.7	4.8	5.0	5.1	5.2	5.3	5.5	5.6	5.7
Te Uku	TEU	HAM33	7.1	3.1	3.1	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.8	3.9
Wallace Rd	WAL	HAM33	13.9	13.9	14.0	14.0	14.1	14.1	14.1	14.1	14.2	14.2	14.2	14.3
Weavers	WEA	HUN33	9.0	9.9	10.2	10.4	10.7	11.0	11.2	11.5	11.8	12.1	12.4	12.7
Whatawhata	WHA	TWK33	3.0	3.1	3.2	3.3	3.4	3.4	3.5	3.6	3.7	3.8	3.9	4.0

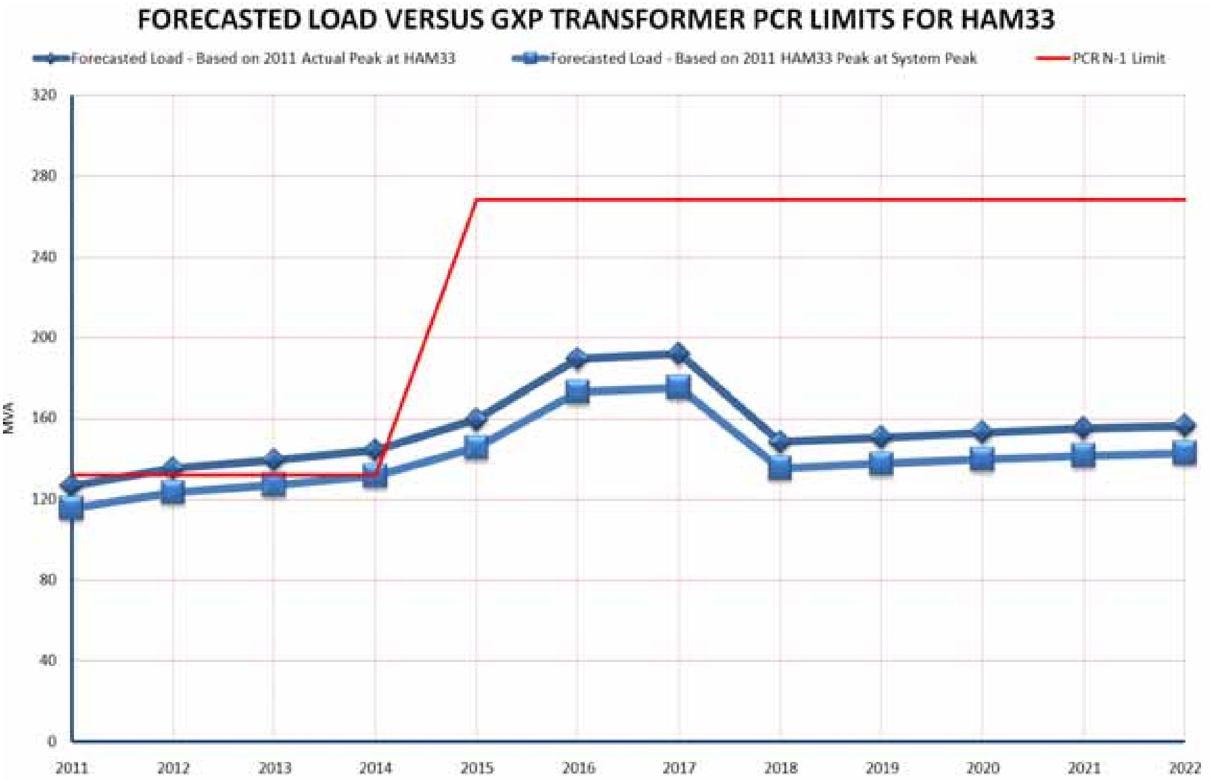
* Proposed new zone substation

The preceding table shows zone substation capacities, predicted loads and indicative time for remedial action to be taken, and is intended as a visual planning tool.

Cells in the table are colour coded for clarity and show the normal operating safe region in green, contingency operation in yellow and emergency operation in red.

Installed capacity, (N-1) firm capacity, and short term overload capacity of transformers and where applicable the sub-transmission feeder capacities or 11kV feeder capacities are taken into account. Existing loads are inserted and load predictions applied over the planning period. In some zones, planned transformer capacity upgrades and sufficient off loading during contingency can be affected and this is taken into account for remedial action planning purposes.

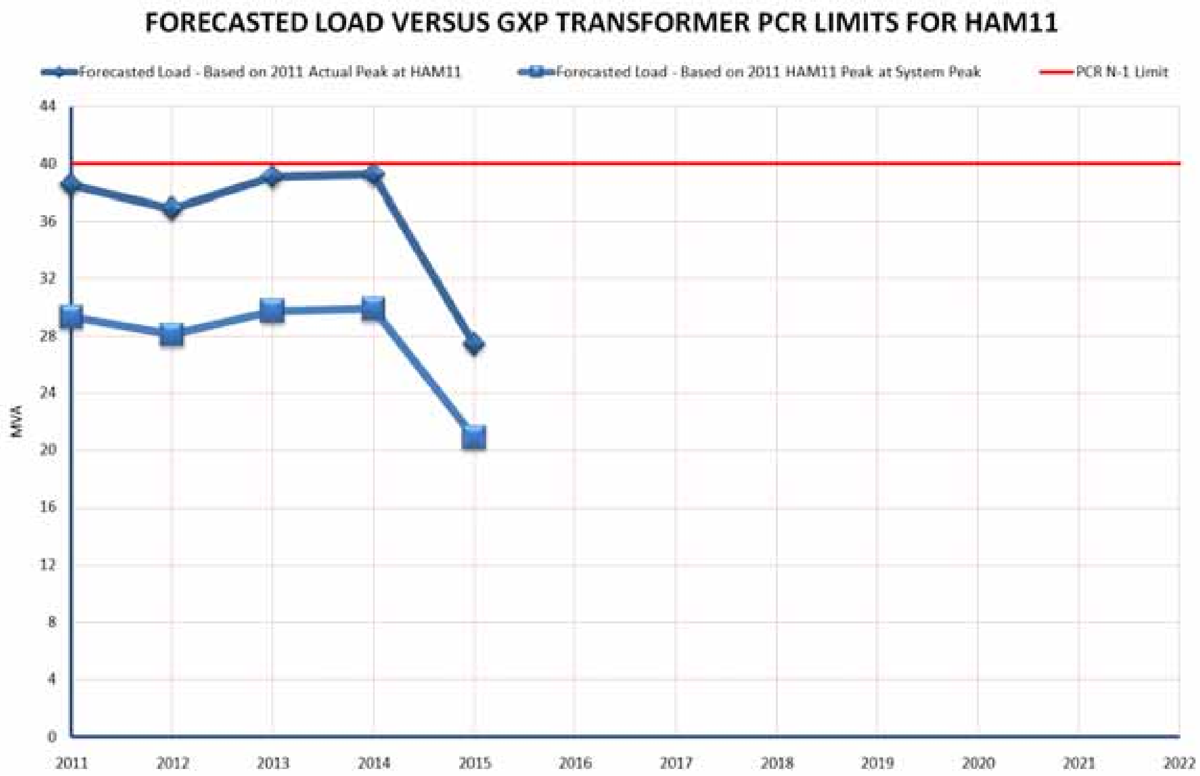
The following figures (from Figure 66 to Figure 72) show the forecasted loads for each GXP.



NOTE: HAM11 load will be transferred to HAM33 by 2016

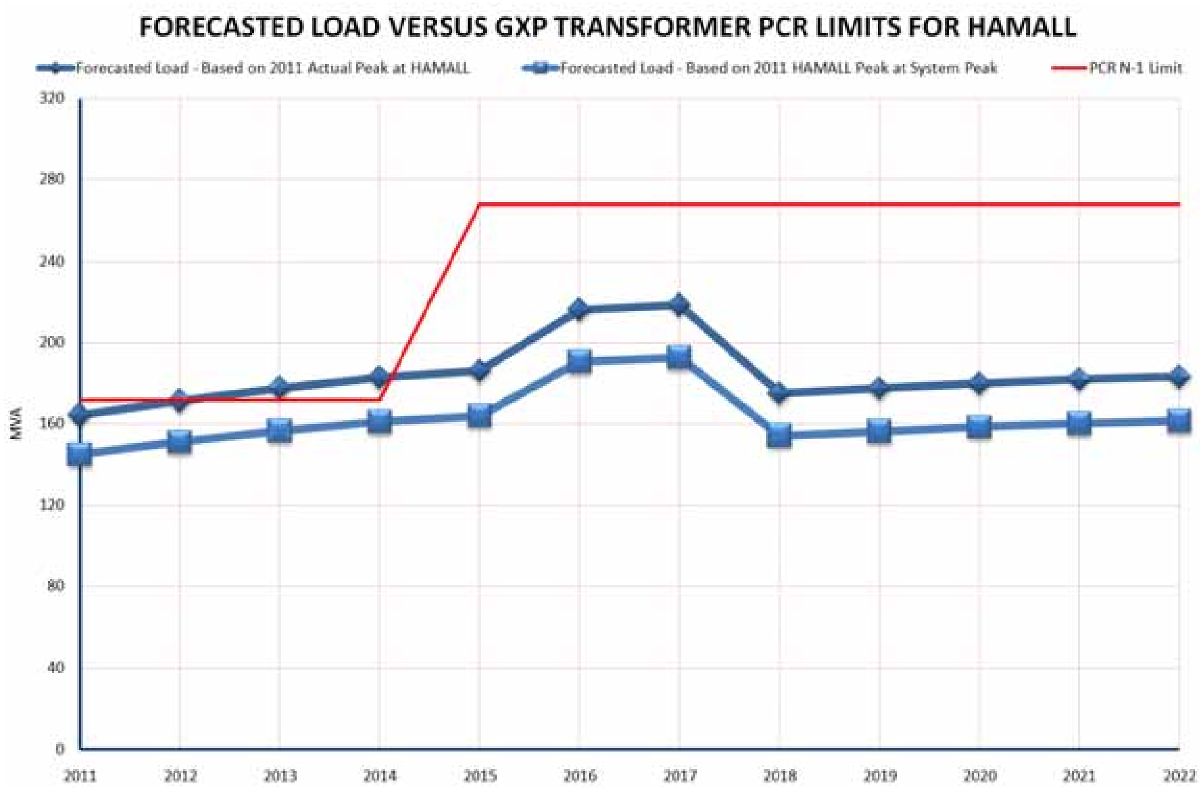
LAT, WAL and AVA will be transferred to TWH by 2018

Figure 66. Forecasted ADPCD Loading for HAM33kV



NOTE: HAM11 load will be transferred to HAM33 by 2016

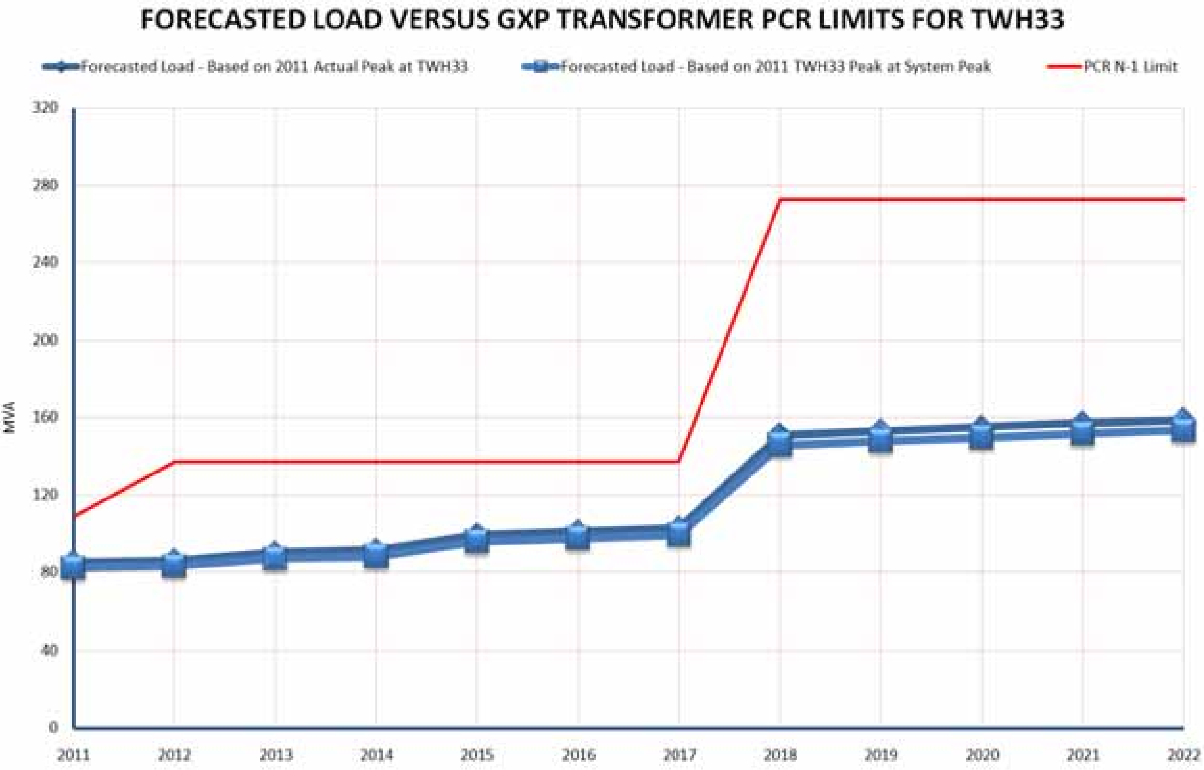
Figure 67. Forecasted ADPCD Loading for HAM11kV



NOTE: HAM11 load will be transferred to HAM33 by 2016

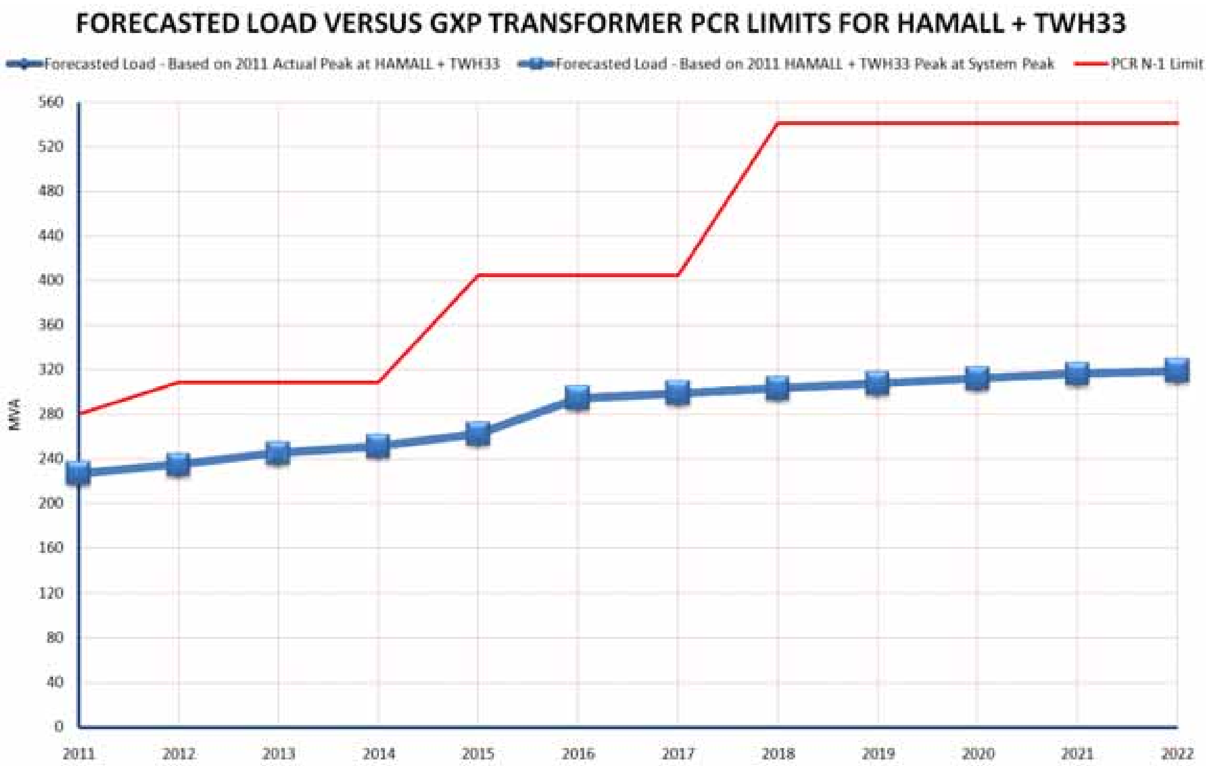
LAT, WAL and AVA will be transferred to TWH by 2018

Figure 68. Forecasted ADPCD for HAMALL



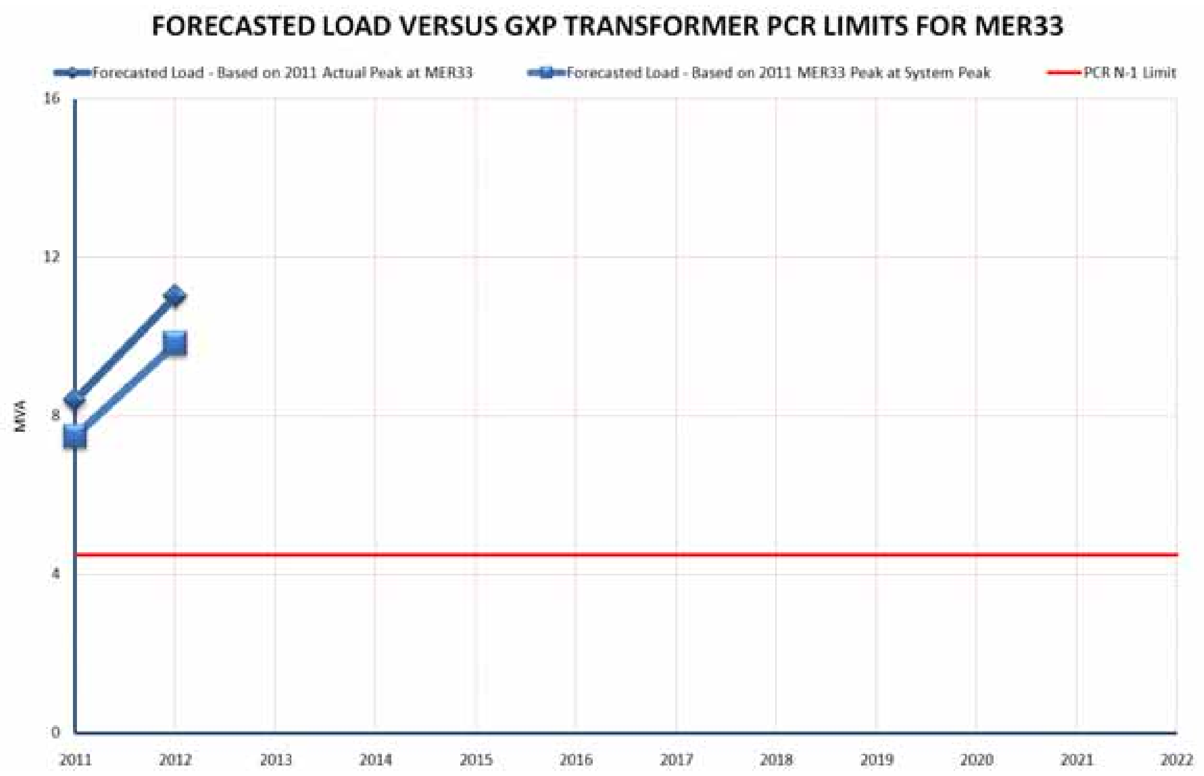
NOTE: LAT, WAL and AVA will be transferred to TWH from HAM33 by 2018

Figure 69. Forecasted ADPCD Loading for TWH33kV



Note: HAM ALL+TWH peaks at the same time as the System peaks

Figure 70. Forecasted ADPCD Loading for HAM ALL + TWH33kV



Note: Meremere load will be transferred to HLY by 2013

Figure 71. Forecasted ADPCD Loading for Meremere

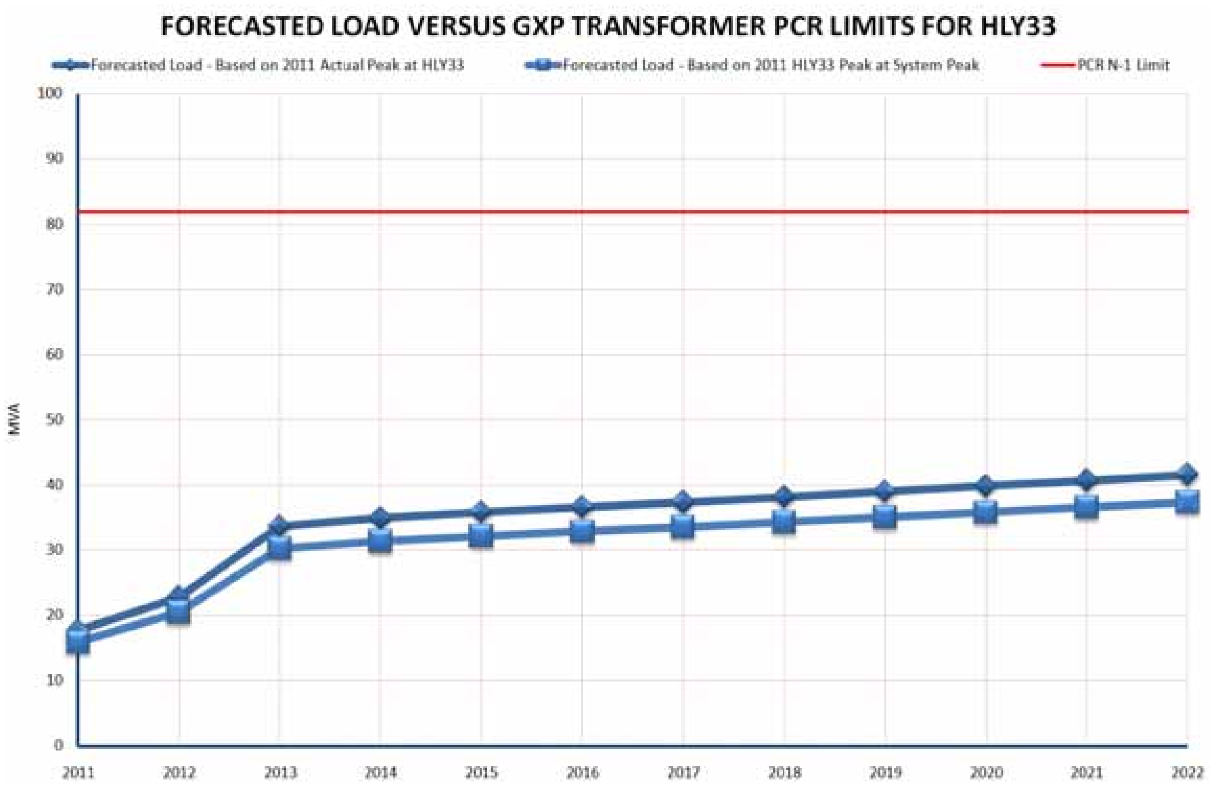


Figure 72. Forecasted ADPCD Loading for Huntly includes transfer of MER loads by 2013

Appendix 3 Customer Type Distribution by Zone Substation

Pie Chart Legend:

Customer Type					
Accomm. Cafes & Restaurants		Electricity, Gas & Water Supply		Property & Business Serv.	
Agriculture-Forestry & Fishing		Finance & Insurance		Residential	
Communication Services		Health & Community Services		Retail Trade	
Cultural & Recreational Service		Manufacturing		Transport & Storage	
Electricity, Gas & Water Supply		Other		Wholesale Trade	

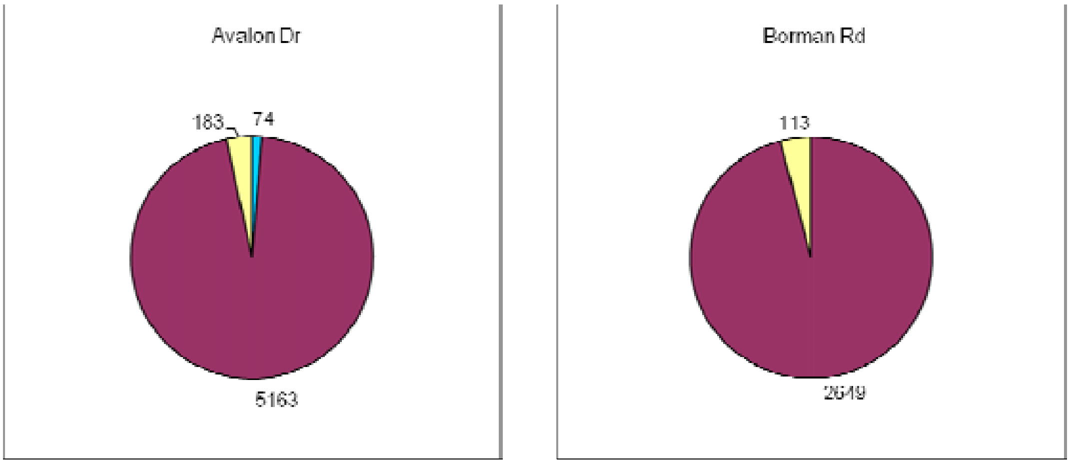


Figure 73. Chart 1 of 12 showing Zone substation customer makeup

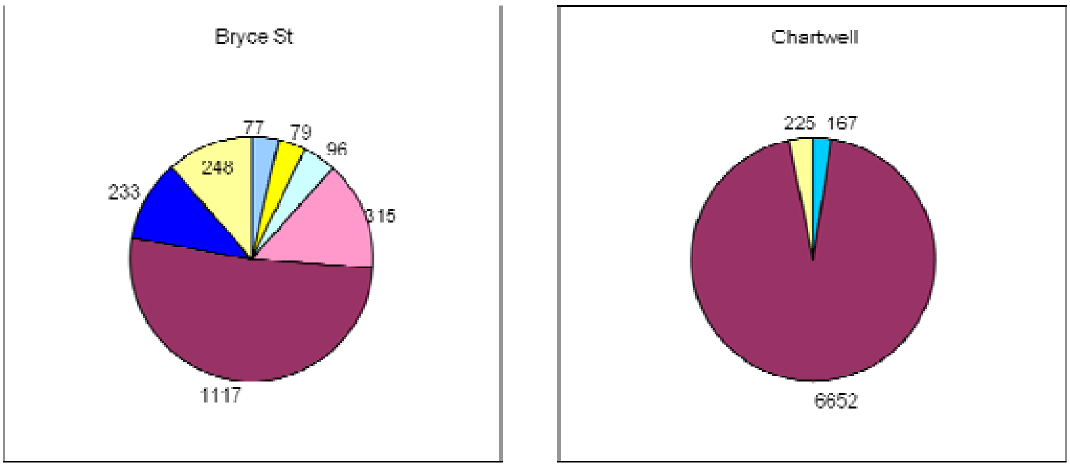


Figure 74. Chart 2 of 12 showing zone substation customer makeup

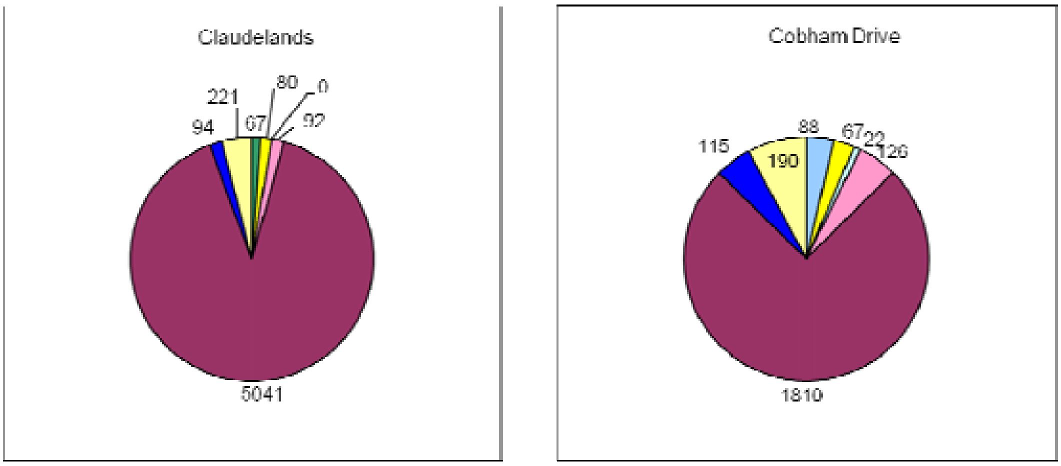


Figure 75. Chart 3 of 12 showing zone substation customer makeup

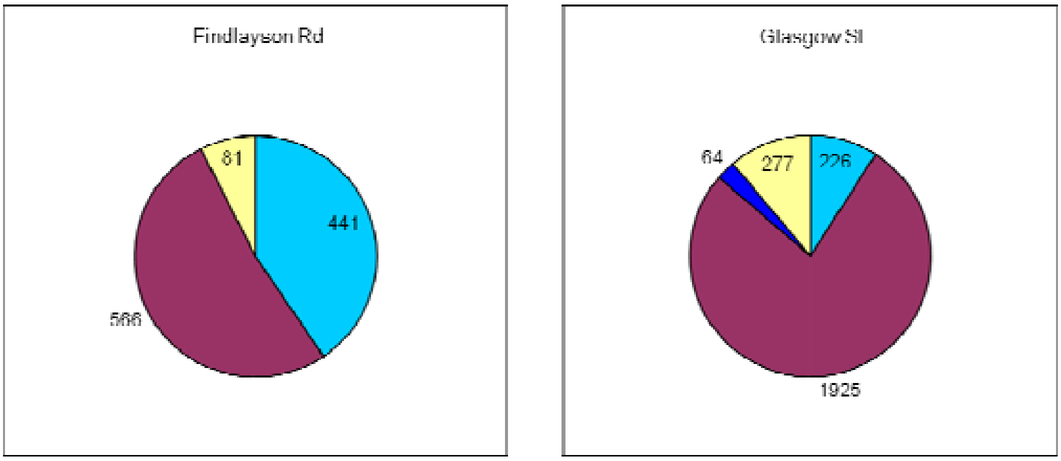


Figure 76. Chart 4 of 12 showing zone substation customer makeup

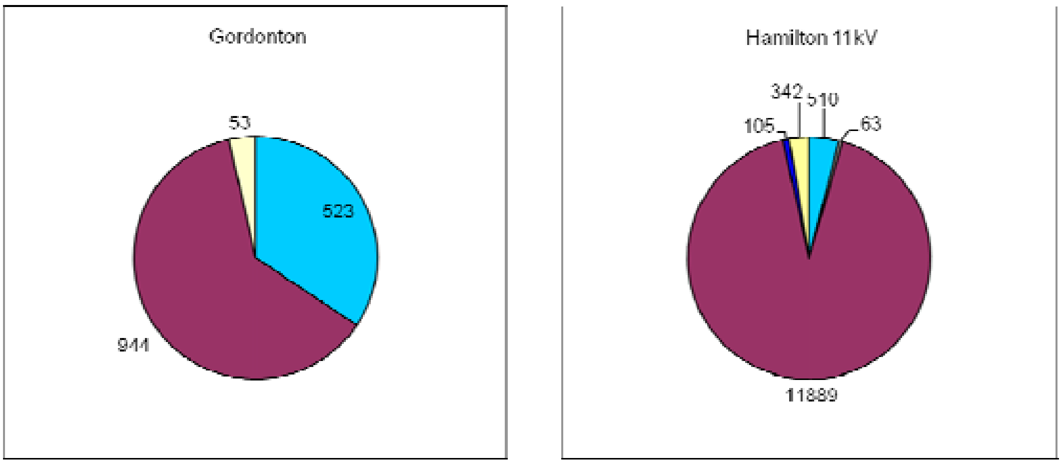


Figure 77. Chart 5 of 12 showing zone substation customer makeup

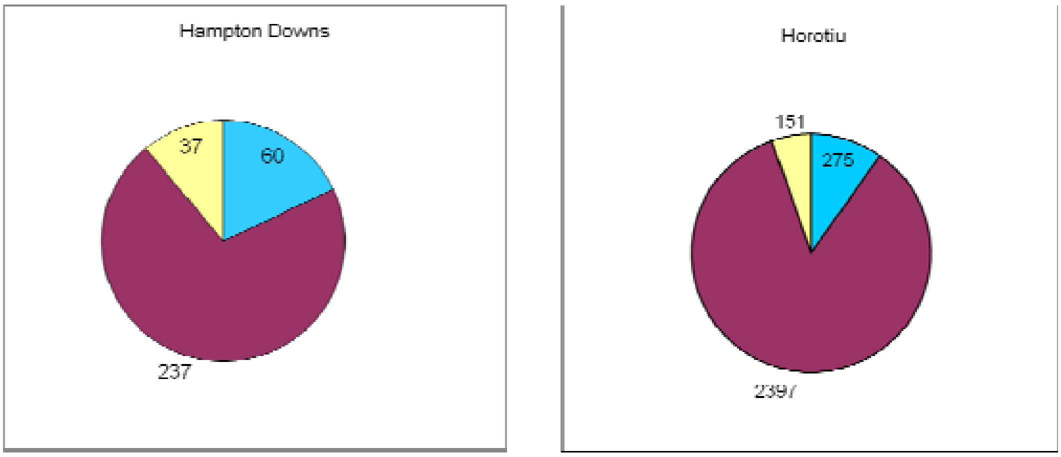


Figure 78. Chart 6 of 12 showing zone substation customer makeup

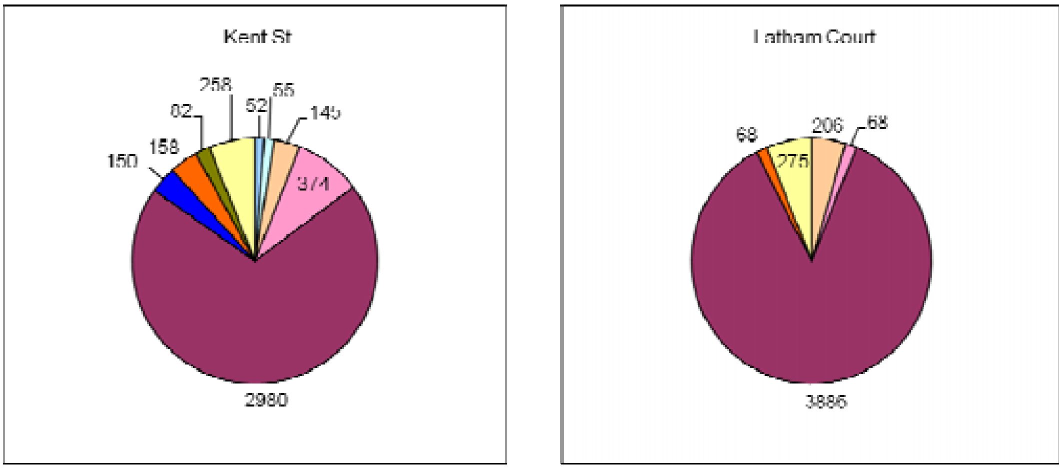


Figure 79. Chart 7 of 12 showing zone substation customer makeup

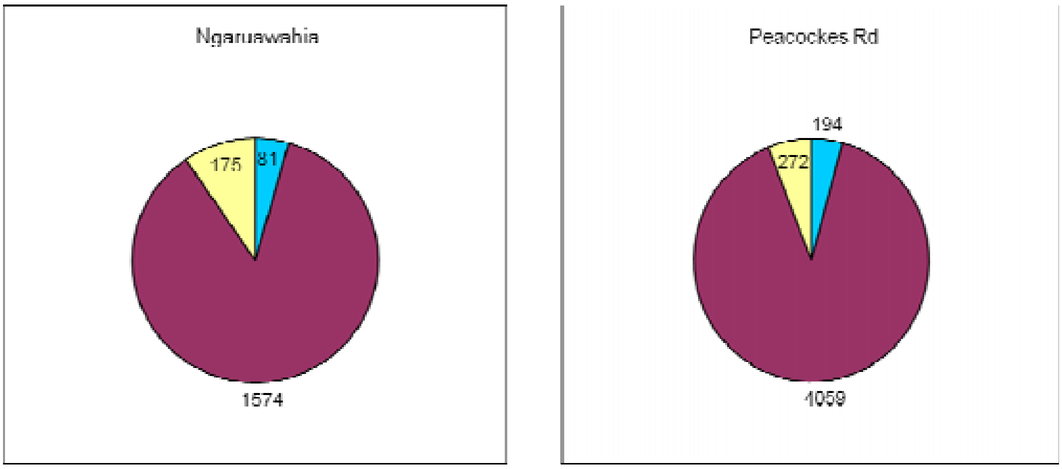


Figure 80. Chart 8 of 12 showing zone substation customer makeup

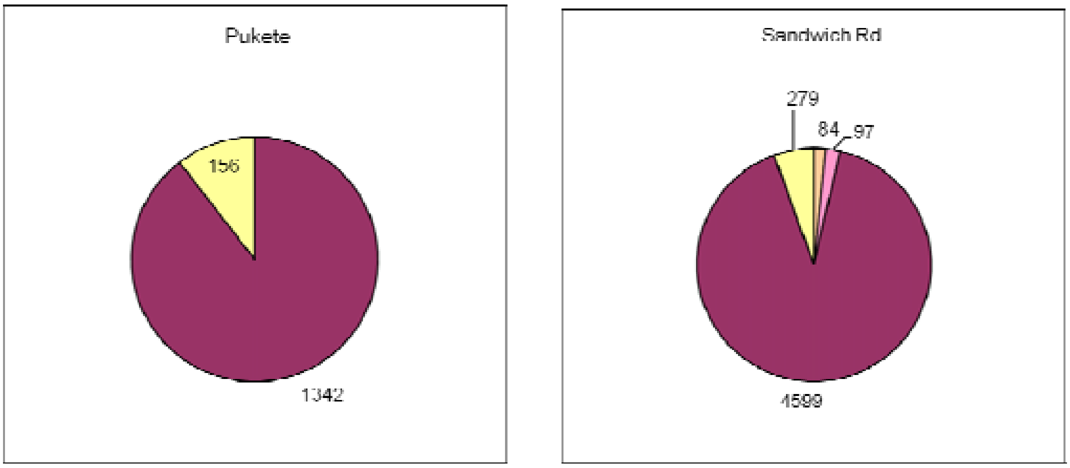


Figure 81. Chart 9 of 12 showing zone substation customer makeup

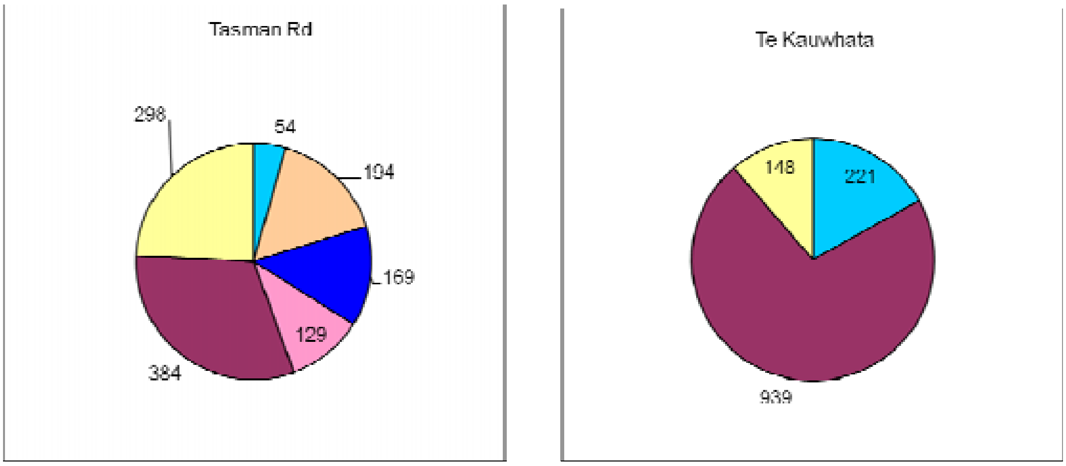


Figure 82. Chart 10 of 12 showing zone substation customer makeup

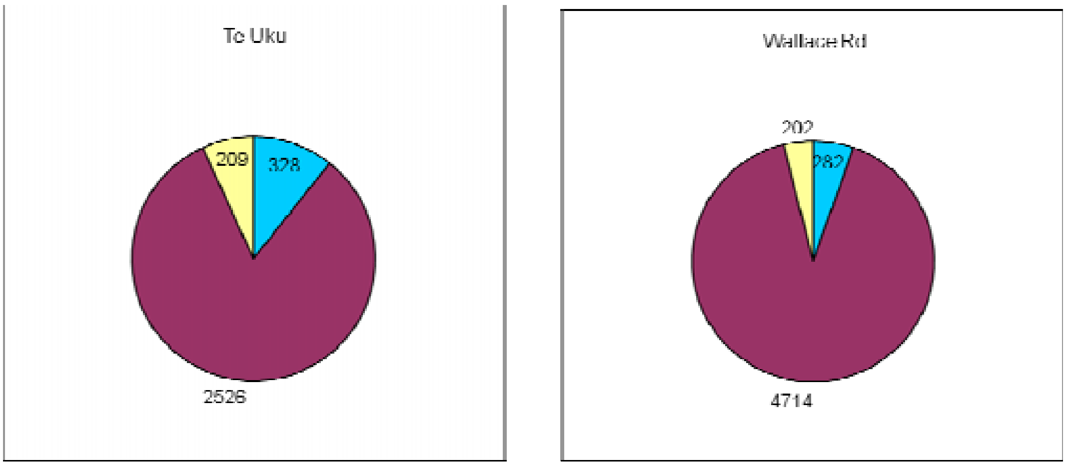


Figure 83. Chart 11 of 12 showing zone substation customer makeup

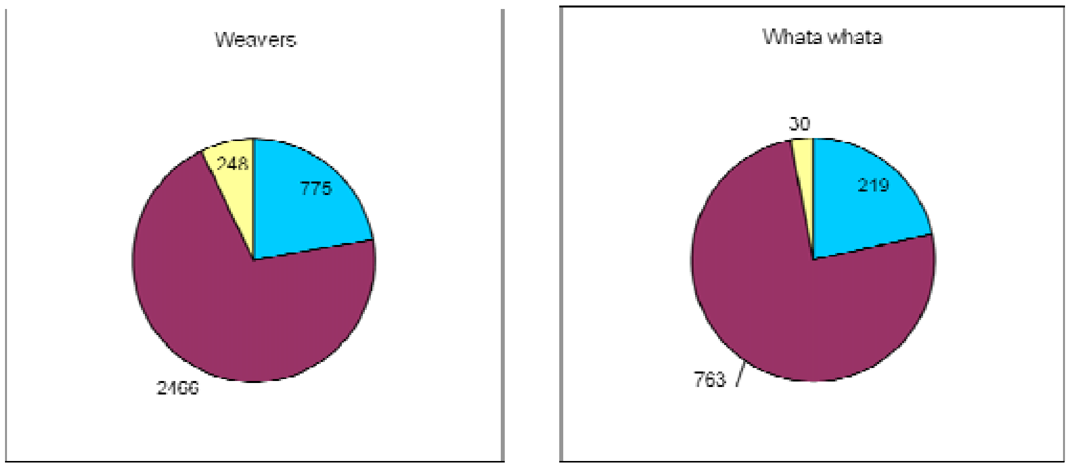


Figure 84. Chart 12 of 12 showing zone substation customer makeup

Appendix 4 Schematic Diagrams of 33kV Sub-transmission System

App 4.1 33kV Network Configuration - Hamilton Point of Supply

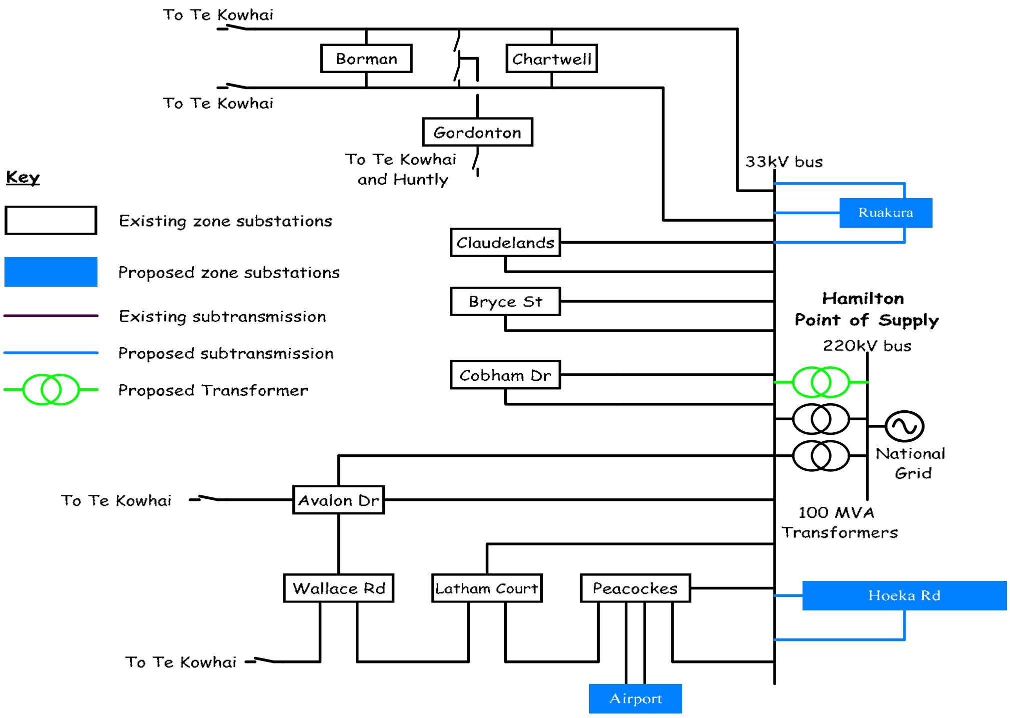


Figure 85. 33kV Network Configuration – Hamilton Point of Supply

App 4.2 33kV Network Configuration - Te Kowhai Point of Supply

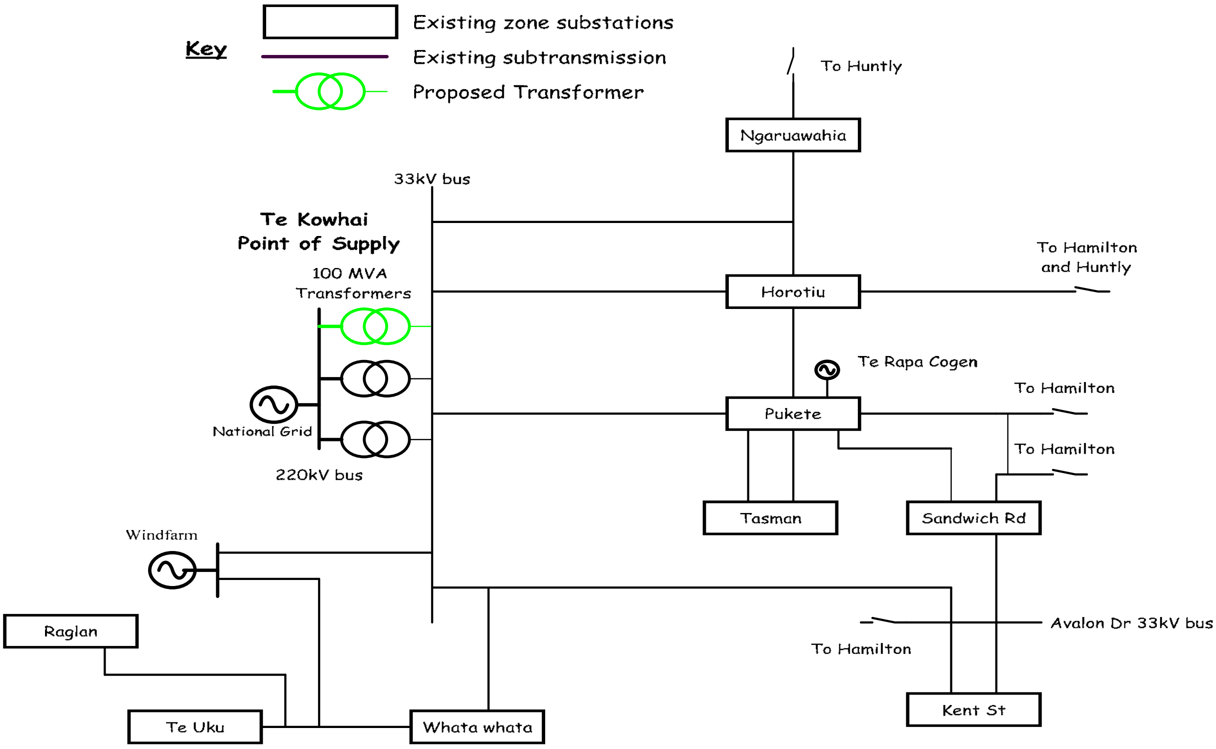


Figure 86. 33kV Network Configuration – Te Kowhai Point of Supply

App 4.3 33kV Network Configuration - Huntly Point of Supply

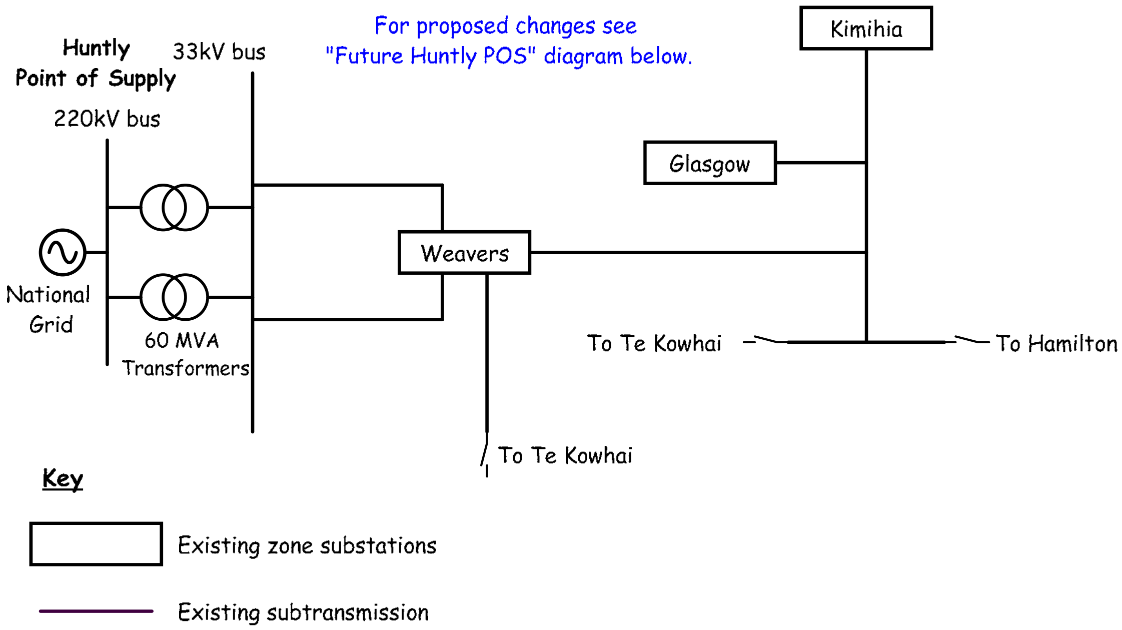


Figure 87. 33kV Network Configuration – Huntly Point of Supply

App 4.4 33kV Network Configuration - Meremere Point of Supply

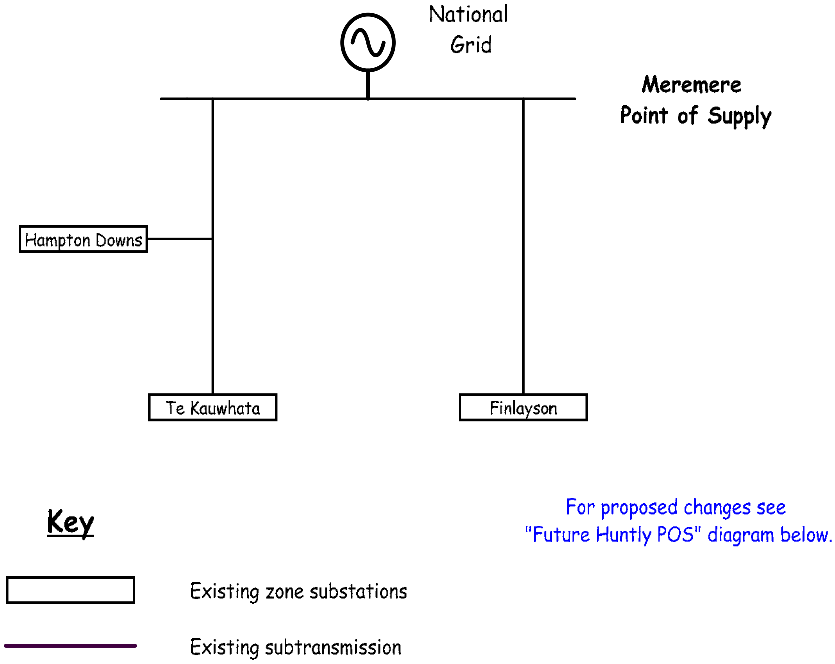
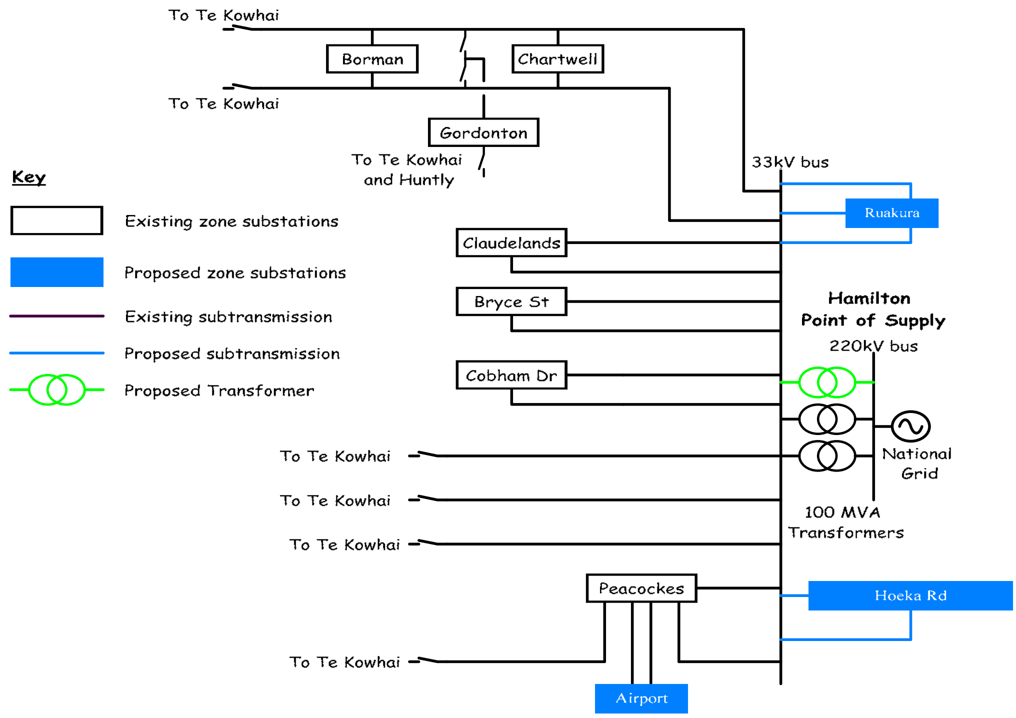
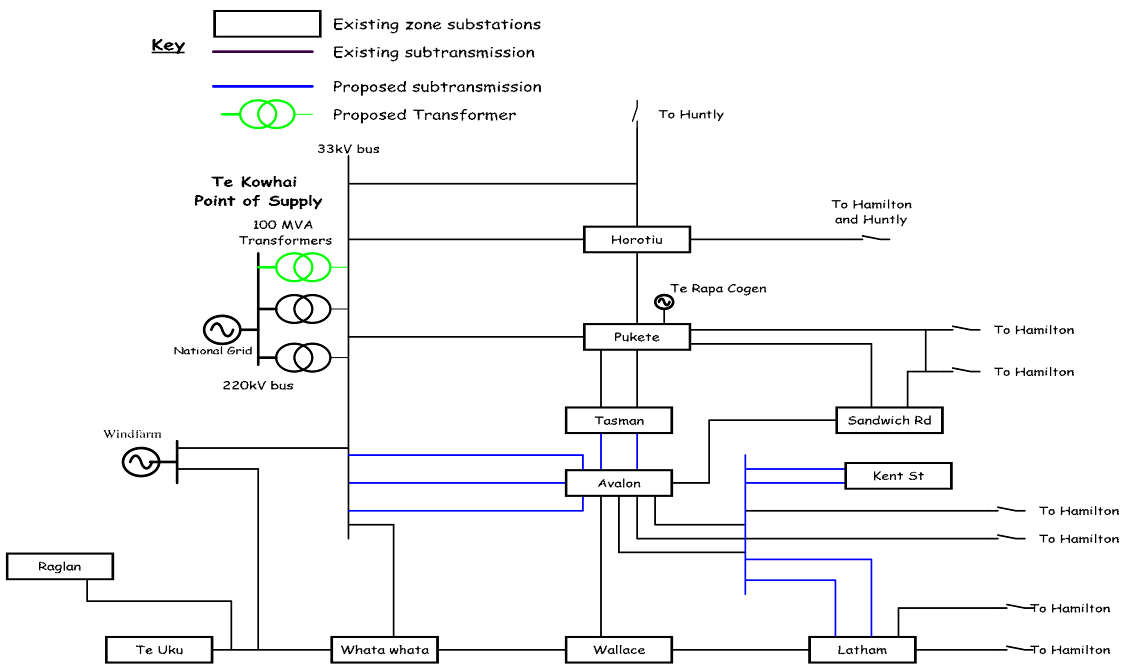


Figure 88. 33kV Network Configuration – Meremere Point of Supply

App 4.5 33kV Network Configuration – Future Hamilton POS



App 4.6 33kV Network Configuration – Future Te Kowhai POS



App 4.7 33kV Network Configuration – Future Huntly POS

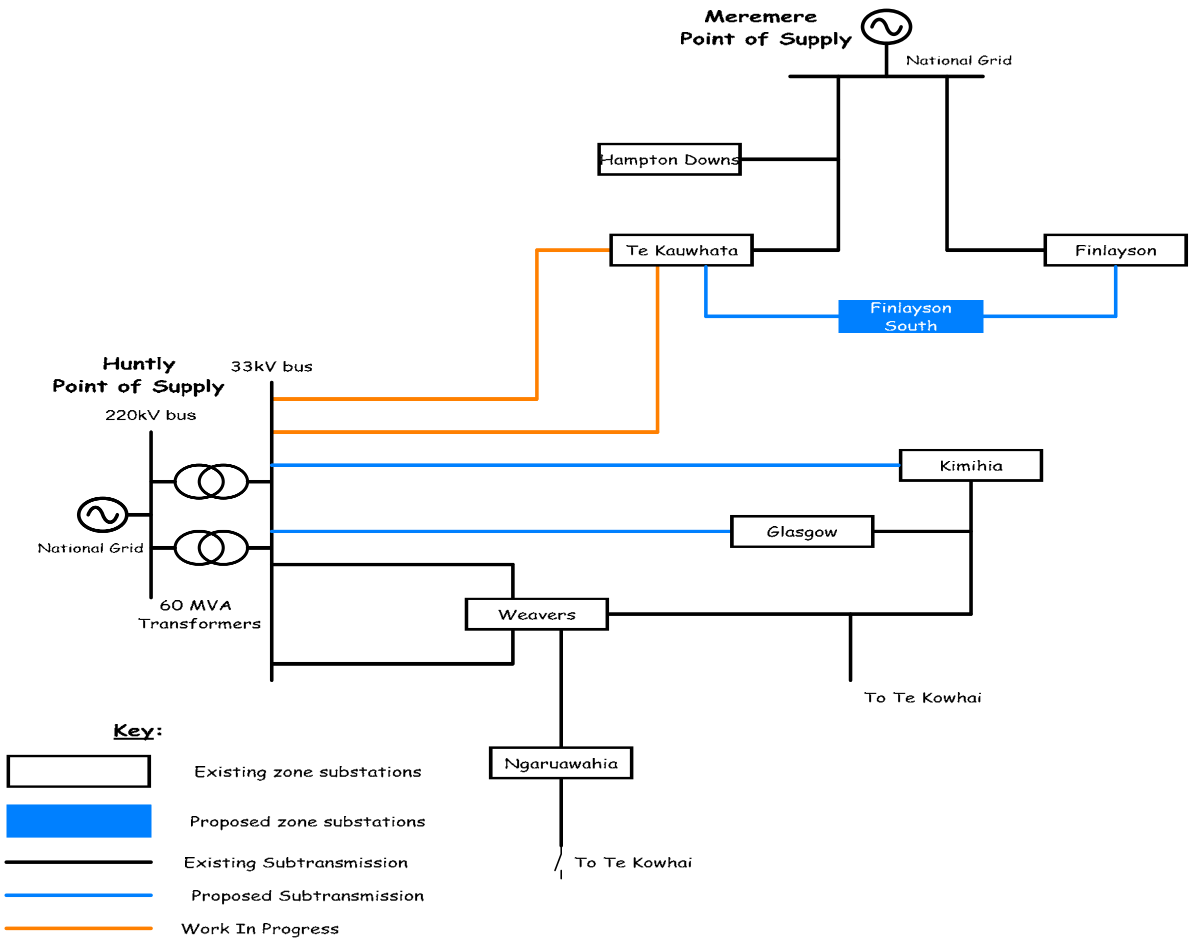


Figure 89. 33kV Network Configuration – Future Huntly POS

Appendix 5 Health and Safety Statistics since April 2009

Table 26 Performance Statistics for Health and Safety

Month	Total No of FARs Received	Serious Harm	Lost Time Injury (LTI) / Medical Treatment Injury (MTI)	Minor Injuries	Near Misses
April 2009	18	0	0	2	0
May 2009	22	0	0	2	5
June 2009	30	0	0	6	1
July 2009	26	0	0	7	6
August 2009	43	1	2	9	6
September 2009	38	0	1	3	7
October 2009	24	0	0	0	4
November 2009	37	0	1	3	6
December 2009	23	0	3	4	7
January 2010	22	0	1	6	5
February 2010	31	1	0	4	4
March 2010	30	0	0	5	8
April 2010	24	0	1	4	4
May 2010	27	0	1	3	4
June 2010	22	0	0	7	1
July 2010	27	0	0	4	3
August 2010	27	0	2	3	7
September 2010	29	0	1	6	2
October 2010	19	0	3	2	4
November 2010	31	0	1	4	6
December 2010	33	0	2	2	4
January 2011	25	0	3	5	2
February 2011	43	0	2	8	6
March 2011	39	0	1	6	4

(**Notes: FAR –** Field Action Report, **LTI –** Lost Time Injury)

Photo 24 Live Line Installation of Delta Support

Appendix 6 Project Definition Documents for Projects within next 12 months

App 6.1 Northern Network Development Stage 2 Huntly to Te Kauwhata Dual 33kV Cable Circuits

6.1.1 Background

A new point of supply (POS) to WEL from Transpower has been established at Huntly Power Station. The purpose of the Huntly POS is to provide the ability to pick up substantial load growth in the industrial sector and to feed north to Maramarua. Western Road POS has been decommissioned and it is intended to decommission Bombay POS in due course. This will result in decommissioning of the Bombay–Meremere 33kV line and decommissioning of the Transpower Meremere 33kV switching station. Construction of the Huntly POS and upgrade of Weavers Substation formed Stage 1 of the Northern Network Development and were completed in 2008.

The objective of this project is to provide the second stage of 33kV circuit interconnections as part of the overall northern 33kV mesh. This involves the installation of dual 33kV cable circuits from the new Huntly POS to Te Kauwhata Substation. This will provide N-1 security to Te Kauwhata and provide capacity for future load growth in this area, and will allow disconnection of the existing 33kV supply from Transpower Bombay– Meremere.

11kV interconnection between Weavers and Te Kauwhata includes an overhead line across the Waikato River just south of the Rangiriri Bridge (TEKCB5 feeder). This section of line is in poor condition and access to some of the pole sites is via boat. This section of 11kV overhead will be replaced by underground cable.

6.1.2 Scope of Work

To design and construct the following underground cable circuits:

- Install two new 33kV cable circuits, two x 3 x 1c/400mm^2 AL XLPE, plus one fibre optic cable from the Huntly POS circuit breakers to Te Kauwhata Substation. Proposed route is from Huntly Power Station via Te Ohaaki Rd to Rangiriri road-bridge, through the bridge, and north along SH1 to Te Kauwhata Substation. Total route length is approx 16km.
- The two 33kV cable circuits (two x 3 x 1c/630mm^2 AL XLPE) have been installed from Huntly switchboard out to Te Ohaaki Rd under the Huntly POS project. It will be necessary to through-joint these cables and continue their installation north to Te Kauwhata.
- Connect above cables to new 33kV GIS circuit breakers CB4206 and CB4220 at Huntly, and proposed 33kV GIS incomer circuit breakers at Te Kauwhata. The replacement of the outdoor 33kV structure with indoor GIS at Te Kauwhata is scheduled for the 2011/12 financial year. Further investigation is required to determine if the new cables can be connected to the existing outdoor transformer circuit breakers now so that the cables can be livened.

Install a fibre optic cable in the same trench as the 33kV cables, enclosed full length in PVC ducting. Cable type single mode 48 core. Route length approx 16km.

6.1.3 Timing of Works:

The 33kV and 11kV cabling as described in this document are programmed for installation over two financial years from April 2010 to March 2012.

The 11kV cable is to be livened and the overhead river crossing removed by 31 March 2012.

Connection and commissioning of the new 33kV cable circuits and fibre optic link are to be completed by 31 March 2012.

App 6.2 Northern Network Development Stage 3 Te Kauwhata Substation 33kV GIS Indoor Switchgear Installation

6.2.1 Background

Construction of the Huntly POS and upgrade of Weavers Substation formed Stage 1 of the northern network development and these projects were completed in 2008 and 2009 respectively. Stage 2 of the 33kV circuit interconnections as part of the overall Northern 33kV mesh involves the installation of dual 33kV cable circuits from the Huntly POS to Te Kauwhata Substation. This will provide N-1 security to Te Kauwhata and provide capacity for future load growth in this area and will allow disconnection of the existing 33kV supply from Transpower Bombay – Meremere. This project is to be staged over two financial years with completion due in the first quarter of the 2011 / 12 budget year.

The objective of this project is to provide the third stage of 33kV circuit interconnections as part of the overall northern 33kV mesh. This involves the connection of the dual 33kV cable circuits from the new Huntly POS to Te Kauwhata Substation. Long term plans are to have four 33kV circuits terminating at Te Kauwhata; the two cable circuits from Huntly, one overhead circuit to Hampton Downs / Finlayson, and a future proposed line to a new Finlayson 33kV ring circuit (Finlayson South Substation). Terminating four lines at Te Kauwhata necessitates significant extensions to the outdoor switchyard or conversion to GIS indoor switchgear

Extensions to the existing outdoor switchyard would require significant earthworks. A previous feasibility study deemed the installation of 33kV GIS switchgear to be more cost effective, creating space in the outdoor structure for extending transformer foundation pads to accommodate new transformers if required in the future.

6.2.2 Scope of Work

To design and construct the following upgrade of Te Kauwhata Zone Substation:

- Replace the outdoor 33kV structure, circuit breakers and disconnectors with new indoor 7-unit 33kV GIS switchboard (4 x incomers, 2 x transformer feeders, 1 x bus-section).

- Construct a new building on the edge of the existing switchyard to house the new GIS switchgear and the new 24v DC system.
- Test, connect and liven the two new 33kV 3 x 1c 400 mm^2 AL XLPE cable circuits from Huntly to the new GIS incomer circuit breakers.
- Install new 3 x 1c 630 mm^2 AL XLPE 33kV cable connections from the 33kV transformer feeder circuit breakers to transformers T6 and T7. This will require the installation of 2 cable stands in place of the existing 33kV outdoor CBs to allow the cable circuits to connect to the exposed transformer bushings.
- The existing 11kV cables from transformers T6 and T7 to 11kV incomer circuit breakers CB36 and CB37 are 3 x 1c 500 mm^2 Cu PILC (one per phase). They were installed approx 1984 and are to remain in place.
- Install SEL relays for protection, monitoring and control of the new switchgear and transformers. SEL 351-6 and SEL 387A for transformer protection, SEL 311L for 33kV line protection, SEL 487B for 33kV bus-zone protection. A SEL 2032 will be installed on the GIS switchgear to communicate with the on-board protection relays and marshall the signals to the existing communications panel.
- Install a WEL standard 24V DC distribution system complete with battery and charger to supply the new GIS switchgear and protection.
- Install an AC supply and distribution panel in the new 33kV switch room, the building should also be wired with door sensors, security lights and smoke detectors.
- Install a new 33kV 3 x 1c 400 mm^2 AL cable circuit from one of the new GIS feeder circuit breakers to the Finlayson / Hampton Downs circuit and terminate at pole P505182 at the northern end of the substation site. Conductor to connect to is Stoat 110 mm^2 ACSR – distance approx. 60m
- The 48c fibre installed with the cable circuits to Huntly is to be terminated at the Te Kauwhata communications panel and commissioned to link with Huntly. This will become the primary communications path and the existing radio link will become the back-up path. Other cores in the same fibre will be required to be patched through to the GIS switchgear to enable the end to end differential protection for the HUN-TEK circuits to be enabled. Modify the communications panel and fibre patch panel as required.
- The earth grid and earthing of equipment is to be done in accordance with WEL standards. The existing substation earth grid will probably need extending / modifying to connect the 33kV GIS and building.

Switchyard asphalting, metalling, fencing, landscaping etc; the Network Design Team is to confirm the requirements.

6.2.3 Timing of Works

The 33kV cables and associated fibre optic cable from Huntly to Te Kauwhata are programmed for installation over two financial years commencing in November 2010 with completion due in the first half of the 2011/12 financial year. It is proposed to install the GIS switchgear towards the end of the 2011/12 financial year to gain the benefit from the cables as soon as possible after installation. Ideally, the project close-out is required by the 31st March 2012.

App 6.3 Latham Court Zone Substation Transformer Replacement

6.3.1 Background

The existing Brush 33/11 kV transformers at Latham Court Substation do not have a sufficient power rating to provide the required level of security for the expected peak loads. They are to be upgraded with new 15/23 MVA 33/11kV transformers and the AVR control relays upgraded with the standard REG-D voltage regulating relay and Remote I/O system.

6.3.2 Scope of Work

Upgrade Latham Court Substation as follows:

- Modify the existing transformer foundation pads and oil containment facilities to accommodate two new 15/23 MVA transformers.
- Relocate the existing Brush transformers either to store, to be refurbished or to Peacockes Substation for reinstallation (depending on condition of transformers and progress on other projects). Liaise with AIG team closer to changeover.
- Install the two new transformers at Latham Court in accordance with the installation sequence, including the modified REG-D transformer control and monitoring equipment. Install an SEL 3332 communications processor in the communications panel to connect the new REG-D relays to the IP network.
- Modify / extend the 33kV and 11kV cables at T6 and T7 as required to reach the new transformer bushing termination cubicles.
- Commission as appropriate to match the installation sequence.
- Replace the existing Pro-Meters on CB36 and CB37 incomer panels with SEL 734 Revenue Meters.

6.3.3 Timing of Works

To be completed in the 2011/12 financial year.

App 6.4 Peacockes Road Zone Substation Transformer Replacement

6.4.1 Background

The Network Load Forecasting Winter 2009 Model identified the Latham zone substation and Peacockes zone substations were exceeding their N-1 security limits. Latham zone substation has more potential load growth and is seen as another source of supply to the Hospital Switching Station with the existing strong distribution feeder link. Latham zone substation transformers will be replaced with two new 15/23 MVA, 33/11kV transformers which are being provided under a separate PDD.

The existing 2 x 15 MVA Brush transformers that will be removed from Latham will be installed in the Peacockes zone substation. These transformers will be refurbished if required prior to installation.

6.4.2 Scope of Work

- Construct new transformer foundation pads complete with oil containment facilities and blast wall to accommodate two 15 MVA Brush transformers recovered from Latham zone substation. To future proof the installation, the pads should be suitable to accommodate the standard larger 15/23 MVA transformers. The cable stands from Latham should be retained for re-use at Peacockes.
- Relocate the existing Peacockes 2 x 10 MVA Brush transformers to store for refurbishment.
- Install the two new transformers at Peacockes Road in accordance with the installation sequence. There are relatively new REG-D relays at Peacockes that will be retained as they are without the addition of Remote I/O modules.
- Check the rating of the 33kV bus jumpers to the transformer bushings and replace if required.
- Modify / extend the 11kV cables at T6 and T7 as required to reach the cable support stands that should be fixed to the transformer bunding wall.
- Commission as appropriate to match the installation sequence.

6.4.3 Timing of Works

To be completed in the 2012/13 financial year.

App 6.5 Caro Street 11kV Switching Station

6.5.1 Background

The HTC building, at the corner of Caro St and Anglesea St, houses a major customer’s automatic network exchange equipment for the central North Island. It is regarded as one of their most important hubs. A high level of power supply security is maintained with standby diesel generators on site to back-up the main supply from WEL. The site currently has two 1MVA transformers, and the customer has requested an additional two 1 MVA transformers for this year and another two 1 MVA transformers in two to three years time. With total future load expected to be 6 MVA.

A new switching station is proposed to increase the capacity to the customer and to improve the level of security.

Caro Street Switching Station will improve the load distribution in the CBD and is envisaged to offload Garden Place Switching Station which has inadequate access due to its underground location.

6.5.2 Scope of Works

To design and construct a new 11kV switching substation on the selected site to be provided by the customer off Anglesea Street consisting of:

- Switching station building approximately 10 m long x 4 m wide. Proposed construction to be concrete block, with colour steel roof, similar to recently constructed Hospital switching station. Space to be provided minimum 1000mm horizontal clearance around switchboard to all walls. Walls to include some glass blocks to allow natural light into the building.
- Install new 11kV 11-unit switchboard, (2 x incomers, 8 x feeders, 1 x bus-section and 1 x bus-riser).
- Install SEL relays and meters for protection, monitoring and control of new switchgear and transformers. SEL 751A and SEL 311L for incomer protection, SEL 351-6 and SEL 734 for customer's feeder protection and metering, SEL 751A for 11kV bus-coupler and external feeder protection c/w arc flash protection. Siemens 7SD6101 for differential protection
- Install 24V DC distribution system complete with battery and charger. Emergency DC lighting required.
- Install new service pillar and connect through joint by cutting through existing UG LV cables 4c 195mm^2 Cu on Anglesea Street. Install 3c 16mm^2 Cu NS cable from the new service pillar to switching station LV meter board. LV is required for local services supply to battery charger, lighting, wall-mounted heater, CB panels etc.
- Communications link via radio or fibre cable connection to WEL SYSCON. SCADA I/O as per WEL standards.
- Radio Telephone set to be supplied and installed for Operations voice communications.
- Earth grid and earthing of equipment in accordance with WEL standards. An earth grid design will be prepared for the site and the equipment installed.
- No fencing or landscaping is required as the building will be located in the corner of an existing asphalt car park area.
- Install two 11kV trunk feeder cables 3c 300mm^2 ALXLPE, one from TELCB3 and one from TELCB7 along Anglesea Street northwards along Anglesea Street across Caro Street. Cut and connect through joint to existing UG 11 kV cable 3c 300mm^2 ALXLPE, trunk feeder BRYCB5 beside P621. Approximate cable route length is 90 meters. Note the new cables shall connect to existing cables and the two existing cable joints shall be abandoned.

- Install fibre optic cables 48 core from the new switchgear along Anglesea Street up to P621 across Caro Street to run in conjunction with 2.10 above. Connect to existing pilot cable 6 x 2.5 mm^2 Cu + 8 pr 1 mm^2 Cu. Approximate length is 90 meters.
- Install two 11kV feeder cables 3c 95mm^2 ALXLPE, one from TELCB2 and one from TELCB4 along Anglesea Street northwards then eastwards on Caro Street until it reaches the two existing 1 MVA transformers T3685 and T3686. Terminate TELCB1 – 3c 95mm^2 ALXLPE to T3685. Terminate TELCB2 – 3c 95mm^2 ALXLPE to T3686. Approximate cable route length is 105 meters.
- Install new 11kV feeder cables 3c 95mm^2 ALXLPE from TELCB6 along Anglesea Street northwards until it reaches the new 2 MVA transformer. Approximate cable route length is 20 meters. Terminate the new cable 3c 95mm^2 ALXLPE to the new 2 MVA transformer 11 kV bushings.
- Carry out review and changes to protection settings at affected zone substations.

6.5.3 Timing of Works:

Presently programmed to be performed in the 2011/2012 financial year; however this project is entirely dependent on the client committing to the upgrade work and may be performed later than the timeframe indicated.

App 6.6 Horotiu Zone Substation Transformer Replacement

6.6.1 Background

The 11kV switchboard at Horotiu has recently been replaced as Stage 1 of the Horotiu upgrade and asset replacement projects. The second stage of the project is to replace the existing 10 MVA transformers.

The two 18 MVA Bonar and Long units that were removed from Claudelands will be installed and commissioned at Horotiu. This will give Horotiu the capacity when a major customer in the area carries out a proposed load increase of approximately 3 MW.

6.6.2 Scope of Works

- Upgrade Horotiu Substation as follows:
- Remove the two existing 10MVA transformers at Horotiu and replace with the 18MVA units ex Claudelands. Transformers to be installed outdoors on concrete pads including oil containment facilities. The existing transformer and ex-CB pads will require removal and replacement with new pads complete with bunding and oil spill containment facilities and to accommodate the separate radiator banks of the Bonar Long transformers. They should be designed to accommodate standard 15/23MVA transformer in the future. The old Horotiu transformers are

to be stored at Claudelands using the existing concrete slabs and anchors, until required elsewhere.

- Transfer the two 33/11kV 18MVA Bonar Long transformers, currently stored at Claudelands Substation, to Horotiu Substation. These transformers may need to be modified to replace the HV and LV cable termination boxes, new gaskets, and general tidy-up of their exteriors (all rust spots to be removed and touched-up with galvanized paint). Insulating oil to be reconditioned and topped up as required.
- Civil pad and bund to contain each transformer complete with radiator bank and associated pipe-work.
- Re-route, extend, re-terminate and reconnect the existing 33kV transformer incomer cables 3 x 1c 500 mm² AL XLPE to the new transformer cable box terminals.
- Extend or re-route the recently installed 11kV incomer cables from T6 to CB 36 and T7 to CB 37. There should be enough length on these circuits installed during Stage 1 to allow them to be re-terminated at the transformer termination boxes without additional through joints.
- Relocate the newly installed (Stage 1) 11kV NCT from the old T6 and T7 onto the relocated 18 MVA units.
    - The T6 and T7 Reg-D relays were upgraded during Stage 1 to be I/P compatible and will connect to I/O modules by fibre connection. Reg-D Remote I/O modules are to be retro-fitted to the transformers using an appropriate enclosure mounted on each unit. Install transformer control cables into the building as required
    - The earthing of the relocated transformers shall be in accordance with WEL standards.

6.6.3 Timing of Works:

The transformers are in storage at Claudelands substation and are available now for installation at Horotiu however the upgrade will not proceed until the 2011/12 financial year.

6.6.4 Peacockes Substation Seismic Upgrade

6.6.5 Background

In 2010-11 an assessment was also made of the Peacockes Rd substation building. It has been identified that it only marginally meets seismic compliance requirements and recommendations were made for a moderate amount of work to bring the building up to a better standard.

6.6.6 Scope of Works

Upgrade the existing Peacockes building to meet seismic requirements as follows:

- Remove and fill-in some of the windows on the west side of the building.

- Installation of welded reinforcing "knee" braces to the existing steel beams
- Replacement of concrete block work around the existing steel beams.
- Obtain building consents as required
- Submit a seismic compliance report to HCC on completion.

6.6.7 Timing of Works:

To be performed in the 2011/12 financial year.

App 6.7 HAM-PEA 33kV Circuit Upgrade

6.7.1 Background

33 kV Mesh steady state load flow calculation identified sections on the Hamilton to Peacockes 33kV circuit nearly exceeding the conductor thermal limits. The load flow calculation is worse under contingency scenario (when one HAMCB is switched off) which results in thermal limits being exceeded by as high as 27%.

With the proposed upgrade the thermal limit on the particular 33 kV mesh circuit will increase to acceptable limits and mitigate the risk of conductor thermal limit being exceeded.

Under the steady state load flow scenario the percentage on HAM-PEA circuit is reduced from 98% to 61% while under contingency it is reduced from 127% to 78%.

6.7.2 Scope of Works

Upgrade weak section of HAM CB1152 – PEA CB872 33kV Circuit as follows:

- Install new 3 x 1c 630 mm^2 AL XLPE 33kV cable from PEACB872 out to Peacockes Road, then eastwards along Peacockes Road until it reaches pole P543087 on Weston Lea Drive.
- Disconnect and remove the existing 3c 185 mm^2 33 kV AL XLPE cables from P543087 and the other end from PEACB872. Cap and seal both ends then bury this removed cable. This cable to be abandoned and could possibly be used as 11kV as the need arises.
- Terminate the new 3 x 1c 630 mm^2 AL XLPE UG cable to PEACB872. Run the other end up pole P543087 and connect hard on to existing 320 mm^2 AAC Butterfly conductor.
- Protection settings and alarms to be reviewed and amended as required.

6.7.3 Timing of Works:

To be performed in the 2011/2012 financial year.

App 6.8 PEA-LAT 33kV Circuit Upgrade Stage 1

6.8.1 Background

33kV mesh steady state load flow calculation identified sections on the Peacockes to Latham 33kV circuit nearly exceeding the conductor thermal limit. The load flow calculation is worse under contingency scenario (when one HAMCB is switched off) which results to thermal limits being exceeded by as much as 35%.

With the proposed upgrade the thermal limit on the particular 33kV mesh circuit will increase to acceptable limits and mitigate the risk of conductor thermal limit being exceeded.

Under the steady state load flow scenario the percentage on the LAT-PEA circuit is reduced from 80% to 60% but under the contingency of HAMCB1192 the thermal limit is still exceeded. This issue will be looked at in stage 2, by upgrading another section to increase the thermal limit to 550 Amps.

6.8.2 Scope of Works

Upgrade weak section of PEA CB392 – LAT CB362 33kV Circuit as follows:

- Replace existing 33kV 105 mm2 Dog ACSR OH lines from P537441 to P551651 with 320 mm2 Butterfly AAC (or equivalent rating). Existing crossarm assembly to be converted to delta configuration and insulators to be changes to 33kV K-Line polymer clamp tops. Approximate line route length is 740 meters.
- Replace existing 33kV 158 mm2 Krypton AAAC OH lines from P551651 to P551654 with 320 mm2 Butterfly AAC (or equivalent rating). Existing crossarm assembly to be converted to delta configuration and insulators to be changed to 33kV K-Line polymer clamp tops. Approximate line route length is 115 meters.
- Protection settings and alarms to be reviewed and amended as required.

6.8.3 Timing of Works:

To be performed in the 2011/2012 financial year.

App 6.9 Raglan Zone Substation & Cabling

6.9.1 Background

A new 33/11kV zone substation is to be built at Raglan. This will provide enhanced security to the area and cater for both existing and future load growth. It will provide additional security in the event of loss or unavailability of Te Uku zone substation. The local 11kV network will be reconfigured to take advantage of the enhanced supply and offload Te Uku.

A zone substation site has been identified at the corner of Hills Rd and SH23 and is currently undergoing RMA and geotechnical assessment for suitability.

6.9.2 Scope of Work

To design and construct a new zone substation on the selected site consisting of:

- One 33/11kV 15/23MVA transformer to be installed indoors on standard pad including oil containment facilities.
- Provision is to be made for the installation of a second 15/23MVA transformer in the future when required by load growth.
- Indoor 3-unit 33kV GIS switchboard (1 x incomer, 1 x transformer feeder, 1 x bus-section).
- Indoor 7-unit 11kV switchboard, (4 x feeders, 2 x incomers, 1 x bus-section).
- Relays and meters for protection, monitoring and control of new switchgear and transformers. Relay for transformer voltage regulator control.
- All substation equipment, including 33/11kV transformer, 33kV and 11kV switchgear, and control equipment to be housed inside new building. Space to be provided for second transformer and additional future CBs at each end of 33kV and 11kV switchboards whilst maintaining minimum 1000mm horizontal clearance to all walls. Building construction to be done in accordance with the NoR application. Removable roof to be installed above transformers.
- Install local service transformer unit outside new substation building. Install low voltage cables to control building as required

6.9.3 Timing of Works:

Site was purchased 2009/10.

Substation construction commenced in 2010/11 due to consenting delays and commissioning to be done during 2011/12 financial year. Project close-out by 31 March 2012.

Photo 25 Transformer being installed at the new Raglan Substation

App 6.10 Hoeka Rd Substation Stage 1A – Hoeka Rd Re-conductoring

6.10.1 Background

This project provides an interim solution for the voltage and loading issues that currently exist in the Matangi lifestyle, Matangi Township, Tauwhare and Eureka area's until a new zone substation can be constructed in the area. To achieve this one voltage regulator and several new Sectos switches have been installed under Stage 1. To complete this interim work, around 2km of 11kV overhead Line will be re-conductored. This will allow SIL CB1 to pick up part of the load currently supplied by HAMCB2802 and SILCB4 the outcome being acceptable levels of voltage and loading, for the areas described above, for an estimated 3 years. To allow the described interim configuration to be applied the plan includes offloading of SILCB2 and CB5. HAM CB2862 and CB2822 are used to achieve this and while that is acceptable in the short term it is not sustainable in the long term. The heavily loaded HAMCB2762 will also be offloaded to an acceptable level as part of the sequence

Several potential zone substation sites have been identified in the area and assessment and consultation with landowner's presently underway.

6.10.2 Scope of Work

<u>Hoeka and Tauwhare Rd overhead line re-conductoring</u>

- Reconductor the 11kV overhead line on Hoeka Rd from pole 536677 to pole 506003 with Krypton 160mm^2 AAAC. A delta configuration will be applied which results in the centre conductor being 1m higher than the outer conductors. The re-conductored section will be an approximate circuit length of 1400m or 4200m of overhead conductor.
  - On the section to be re-conductored replace any pole requiring replacement.
  - For poles where single pin insulators are required apply assembly code AHV7.
  - For poles where double pin insulators are required apply assembly code AHV8.
  - On a pole where a DDT or 11kV tap-off exists upgrade the cross arm to 2.7m if the existing cross arm is shorter than that or requires replacement based on condition.
  - For any pole on the section between pole 536677 and 506003 replace the existing cross arm with a 2.1m cross arm if required based on condition.
  - Delta configuration is to be applied to all poles on the indicated section including those with transformers, 11kV tap offs, 11kV switches or DDT's.
  - Connect so that each side of the switch forms a connection with opposite sides of the HV shackle point.
- Reconductor 11kV overhead line on Tauwhare Rd from pole 506003 to pole 545480 (post the connection into the spur) with Krypton 160mm^2 AAAC. A delta configuration will be applied which results in the centre conductor being 1m higher than the outer conductors. The reconductored section will be an approximate circuit length of 600m or 1800m of overhead conductor.
  - On the section to be re-conductored replace any pole requiring replacement. Site inspection by contractor's already revealed that P545480 will require replacement as it is an old hardwood pole.
  - For poles where single pin insulators are required apply assembly code AHV7.
  - For poles where double pin insulators are required apply assembly code AHV8.
  - On a pole where a DDT or 11kV tap-off exists upgrade the cross arm to 2.7m if the existing cross arm is shorter than that or requires replacement based on condition.

- For any pole replace the existing cross arm with a 2.1m cross arm if required based on condition. Inspection of this section has revealed it will be necessary to replace just one hard wood pole with a new concrete pole.
- Delta configuration is to be applied to all poles on the indicated section including those with transformers, 11kV tap offs, 11kV switches or DDT's.
- Relocate HAMCBX99 to AB217

6.10.3 Timing of Works:

To commence in the 2012/13 financial year with completion required before the end of May 2012.

App 6.11 Avalon and Glasgow Substation Seismic Upgrades

6.11.1 Background

In 2010-11 an assessment was made of several of the existing zone substation and switching station buildings. It has been identified that some only marginally meet seismic compliance requirements and recommendations have been made for remedial work to bring the buildings up to a better standard. Glasgow assessment was completed with a recommendation to add steel bracing to the gable ends and steel portals across the existing room to tie everything together

6.11.2 Scope of Works

Upgrade the existing Glasgow building to meet seismic requirements as follows:

- Install steel portal beams to support the existing concrete walls.
- Install steel beams across the room and above the suspended ceiling level to tie the portal beams together.
- Portal beams to be epoxied into the existing foundation slab of the building.
- Obtain building consents as required
- Submit a seismic compliance report to WDC on completion.

Upgrade the old Avalon 11kV switchgear building to meet seismic requirements as follows:

The old Avalon 11kV building may be used as a DR site for an event that renders the WEL building inoperable. No seismic assessment of the old building has been completed as yet; however a consultant has been engaged with report pending. The Avalon building is the same vintage and design as the Latham building which has been assessed and requires no further action so it is not anticipated that the Avalon building will require much work, if any.

6.11.3 Timing of Works:

To be performed in the 2012/13 financial year.

App 6.12 Pukete Substation – Re-termination of 33kV Cable Screens

6.12.1 Background

During recent project related work at Pukete, a contractor identified that the existing 33kV cable screen terminations at Pukete CB 672, 682, 692, 712 and 722 do not comply with the manufacturer's recommendations or the D&C Manual. These cables are required to be re-terminated as the screens have not been earthed at the circuit breaker as per regulation (refer to Design & Construction Manual Volume III section 3.1.8). If left in this present state, a fault could damage the cable due to lack of screen earthing at the termination end of the cable and circuit breaker.

The objective of this Project is to replace the existing cables so as to lay new cable with the appropriate cable screen terminations at the circuit breakers.

6.12.2 Scope of Works

Excavate a jointing pit outside the front of Pukete substation:

- Disconnect the existing cables from PUKCB672.
- Cut the cables at the jointing pit.
- Remove the existing cables towards PUKCB672 and replace them with new 3 – 1x 630 mm^2 Al XLPE.
- Through joint the new cables at the jointing pit to the cables to TEKCB2842.
- Terminate new cable at PUKCB672. Refer to termination kit provided by the manufacturer for instruction/correct procedures on the cable termination procedure. The screen rating for the cable is *3 kA*.
- Perform screen termination for the cable at PUKCB672.
- Perform cable testing on the new cables.
- Energise the cable by livening PUKCB672 and TEKCB2842.

Repeat the above procedure for Pukete CBs CB682, CB722, CB692 and CB712.

6.12.3 Timing of Works:

The work is to be performed in the 2012/2013 financial year, during Fonterra's annual routine maintenance of the co-generation plant (June – July).

App 6.13 Dannemora Subdivision – remedial work Stage 1

6.13.1 Background

During recent times, there have been several issues raised about the quality of work performed by a design / build contractor at WELs external 'Dannemora' subdivision in Auckland. These work quality issues have resulted in several outages where WEL has been exposed to numerous customer complaints and loss of reputation. A project has been scoped to provide several stages of improvements that will restore the subdivision to acceptable reliability levels.

Stage 1 is works that is required as soon as practicable to ensure the integrity of supply and those future remedial stages can also be completed.

6.13.2 Scope of Works

Carry out remedial works to existing RM630 as follows:

- Upgrade incomer cable between RM630 and 11kV Metering unit to 3c 300 mm^2
- Re-level RM630 onto stabilized backfill base and extend with an SDAF-14 unit.
- Connect existing 750 kVA transformer T5248 to this new fuse unit with a new section of 3c 95 mm^2 cable.
- Install a new section of 3c 300 mm^2 cable between RM630 and RM631.
- Temporary 11kV generation will be required to support the customers while the upgrade change-over work is in progress.

6.13.3 Timing of Works:

The first stage of this work is to be performed in the 2012/2013 financial year.

App 6.14 Horotiu Substation Security Fence replacement

6.14.1 Background

The fence at Horotiu is approaching the end of its life and will need replacement. The fencing provides security from intruders, inquisitive children and animals.

There are exposed cables to overhead jumper connections at the transformers that provide a significant hazard if the security fence is breached.

The outcome is to replace the Horotiu Substation fence with construction to the latest standards.

6.14.2 Scope of Works

Replace the existing Horotiu Security Fence as follows:

- Replace the wire mesh and support wiring including electric fence supports and wire, the existing support posts can be re-used if suitable.
- Install a concrete strip under the fence for its entire length to contain the site switchyard metal.
- Re-use the existing gate frames with upgraded wire mesh.
- Ensure the fence earth bonding is compliant with the latest standard.
- Installation to comply with current substation fencing standards.

6.14.3 Timing of Works:

To be performed in the 2012/13 financial year.

Photo 26 WEL Depot, Maui St

Appendix 7 Key Amendments to the AMP dated December 2011

Clause Amended	Amendment	Amendment Date
General	Plan reviewed and updated for the new 11 year period	1 November 2011
Executive summary	Shortened to avoid duplication in the body of the document	1 November 2011
Section 2	References to MAXIMO removed and replaced with references to SAP	1 November 2011
Section 5	WELconnect initiative introduced and benefits defined and incorporated	1 November 2011
Appendix 6	Project Definition Documents replaced with the projects for the upcoming year	1 November 2011

Appendix 8 Project Maps

The following maps give an overview of the major projects WEL plans to undertake within five years from 1 April 2011. There is no guarantee all of these projects will go ahead and timing may vary, due to external factors, and WEL's project prioritisation process. The maps show only the major projects (over $450k) and excludes the numerous smaller projects WEL plans to undertake. More detailed lists of proposed projects are described in section 5.9 of the Asset Management Plan, including smaller capital projects, customer driven projects and asset replacements projects. The northern network region fed from Meremere and Huntly GXPs; has been grouped within the Huntly GXP region in the following maps.

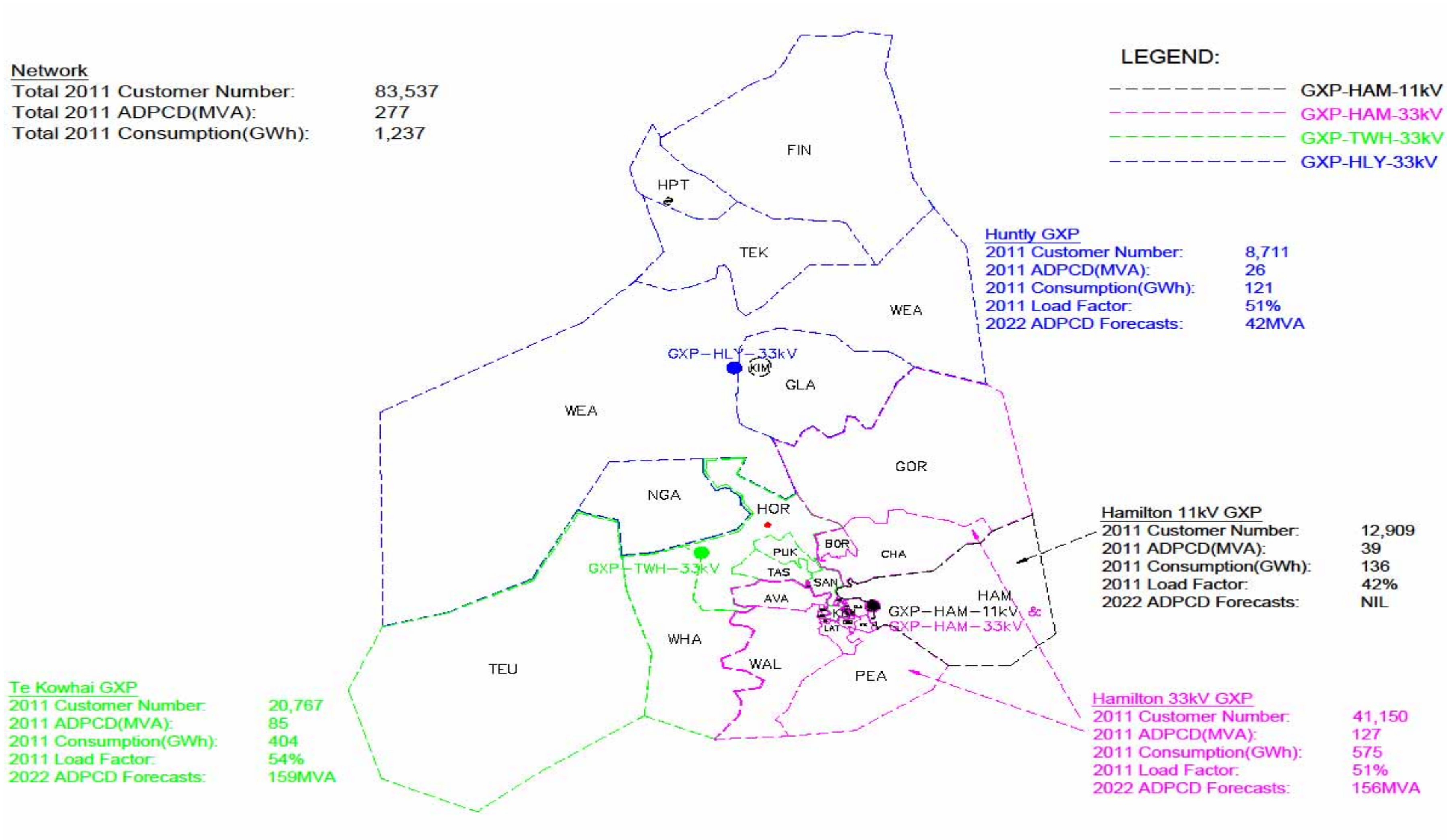


Figure 90. Key Statistics By Each GXP

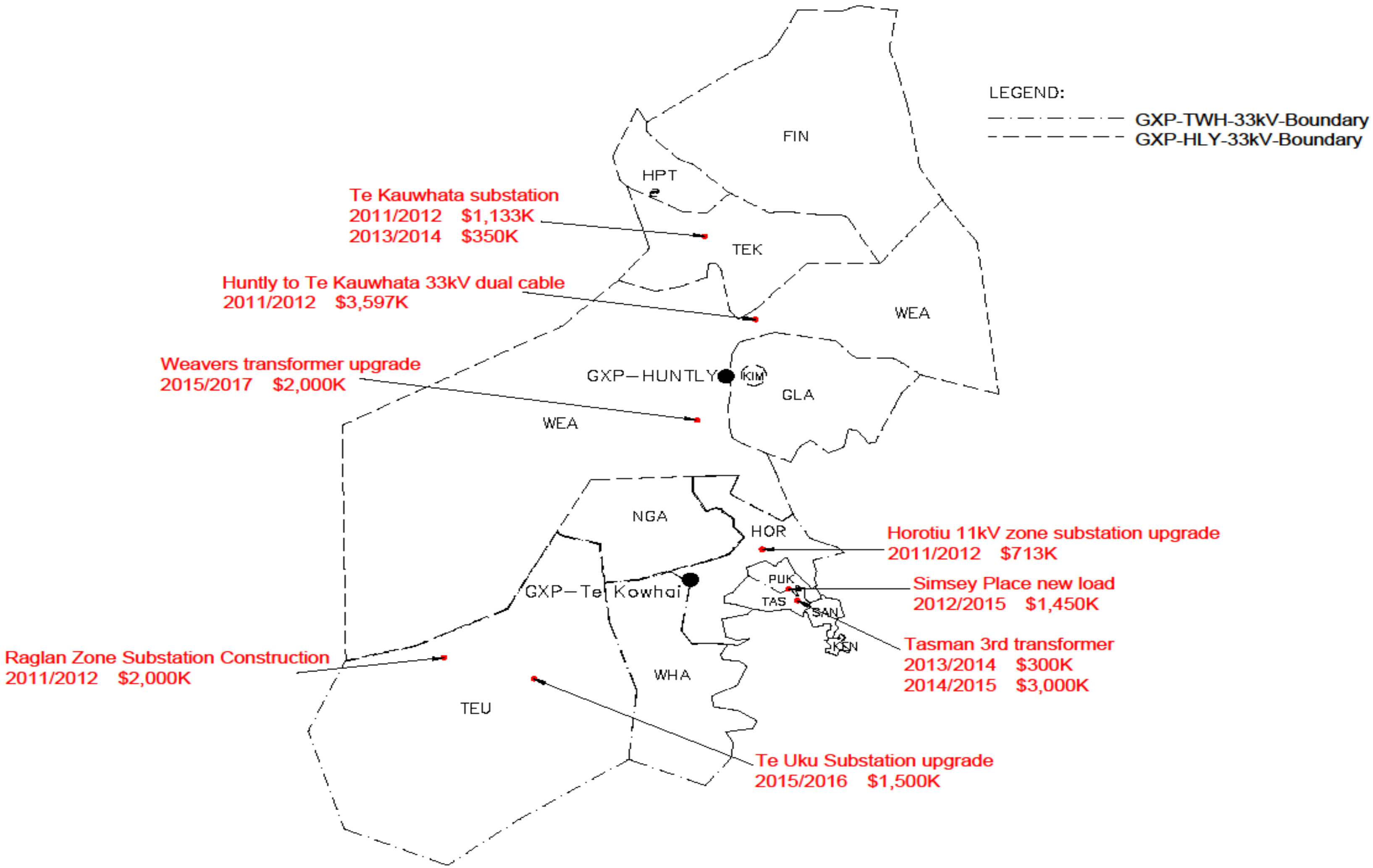


Figure 91. Major projects WEL plans to undertake within five years from 1 April 2011 for Huntly and Te Kowhai GXP areas

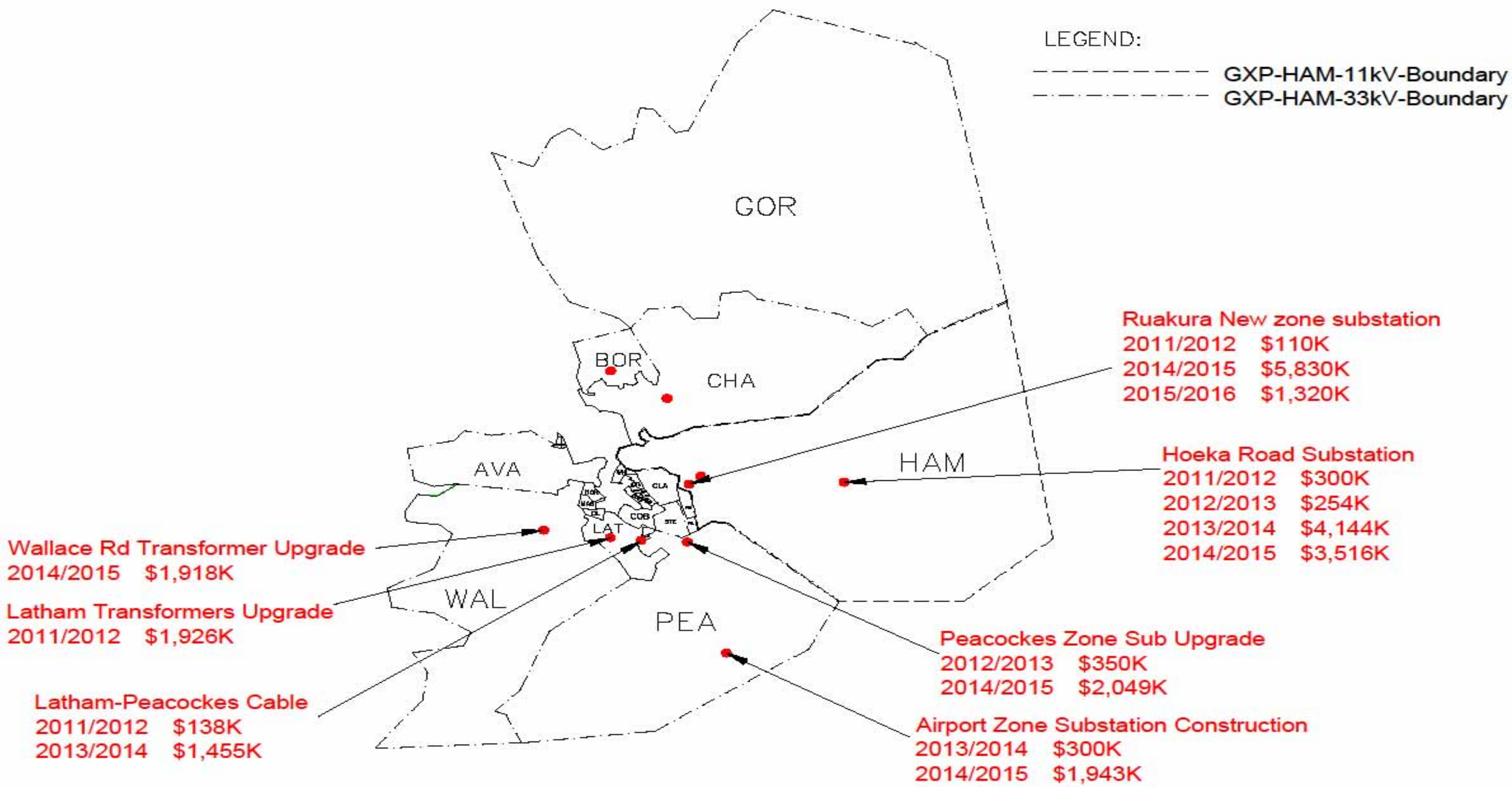


Figure 92. Major projects WEL plans to undertake within five years from 1 April 2011 for the HAM area excluding the CBD

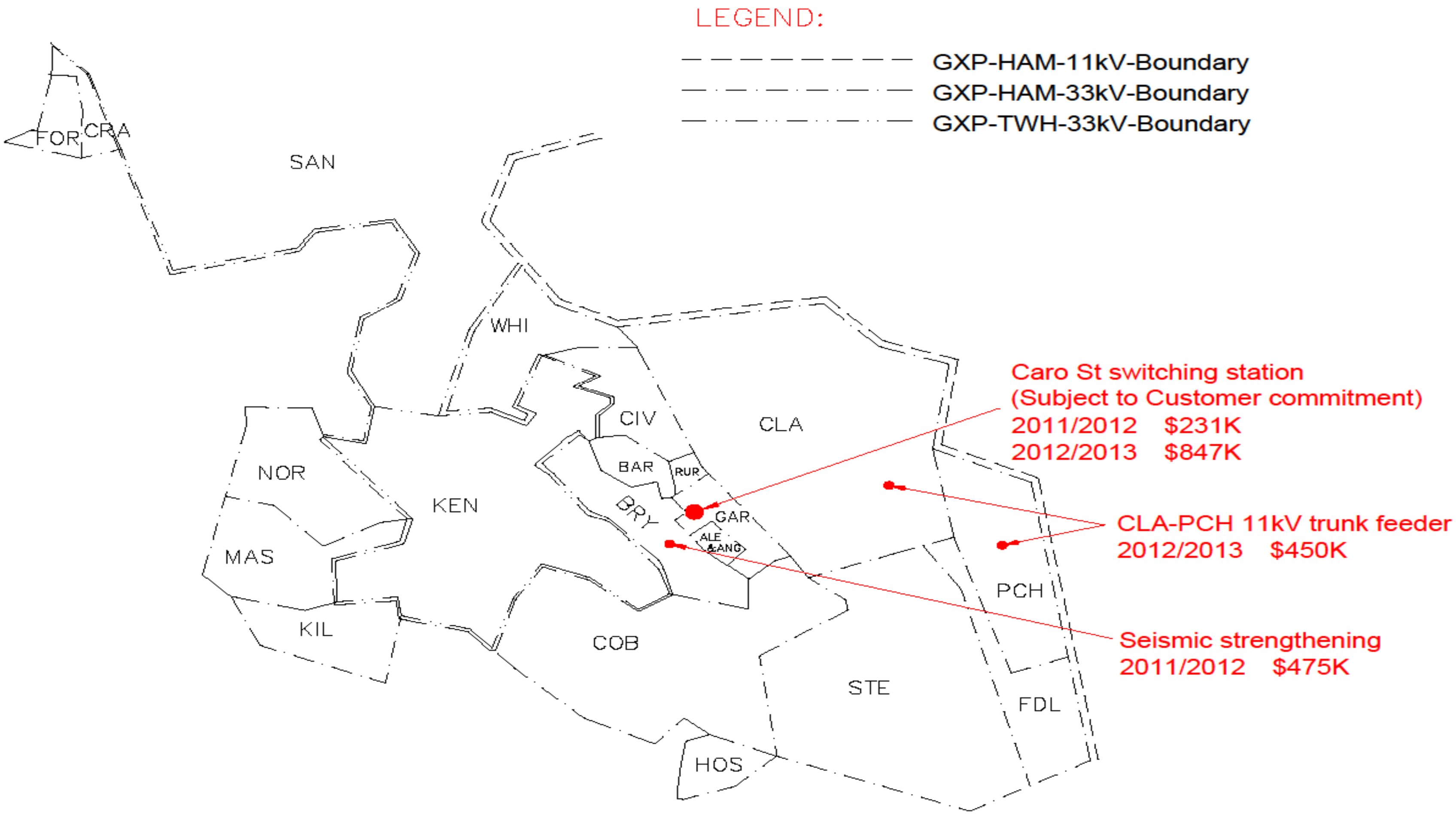


Figure 93. Major projects WEL plans to undertake within five years from 1 April 2010 for the CBD in the HAM area