ASSET MANAGEMENT PLAN

14 December 2010

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 2010 to 31 March 2021

Disclosure Date: 14 December 2010

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<u>WEL Board of Governance Statement</u>
<u>for</u>
<u>2010-11 Asset Management Plan</u>

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 2010 Board Meeting by the WEL Board of Directors. It covers a period of 11 years from the financial year beginning 1 April 2010 until the year ending 31 March 2021.

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 level of 70 SAIDI minutes by 2015. This Plan recognises a change in emphasis from capital investment to maintenance and fault work improvement, driving improved reliability.

3 This Plan reflects a growing emphasis on the maintenance of our network. Even though we continue to make efficiency gains in maintenance, the overall maintenance spend will increase slightly throughout the planning period.

4 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.

5 This Plan recognises the importance of asset renewal and the methodologies to ensure that the optimal life is achieved from our existing assets.

6 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 2010 AMP shows a strong emphasis on demand management and other commercial arrangements.

7 There is strong economic growth in the Waikato and 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 $384m during the planning period on capital works which reflects a significant economic investment in the future of the Waikato.

8 This Plan recognises WEL's commitment to help achieve the national target of 90% renewable energy generation by 2025, through investment in the Te Uku wind farm generation project and its integration into our network.

9 This Plan also notes WEL's commitment to explore smart grid technology in order to provide better customer services and mitigate potential business risks.

10 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

Photo 1 WEL faultman working during September 2010 storm (Photo by Waikato Times)

WEL NETWORKS ASSET MANAGEMENT PLAN

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ASSET MANAGEMENT PLAN 2010

For period 1 Apr 2010 – 31 Mar 2021

Photo 2 University of Waikato switching station

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 which are:

1.1.1 WEL's Vision:

WEL' Networks:***THE*** supplier of network and energy services to the Waikato.

1.1.2 WEL's Mission:

WEL's mission is to provide best practice, high quality reliable services valued by customers, while protecting our people, sustaining excellent returns, growing the business and taking a leadership position in the Waikato energy market.

1.1.3 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	Costs Per Customer

	best lines companies in NZ	Delivery Efficiency
Industry leader	Be progressive	Customer Services Satisfaction
		Capability and Employee engagement index

1.1.4 Asset Management Systems And Processes

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

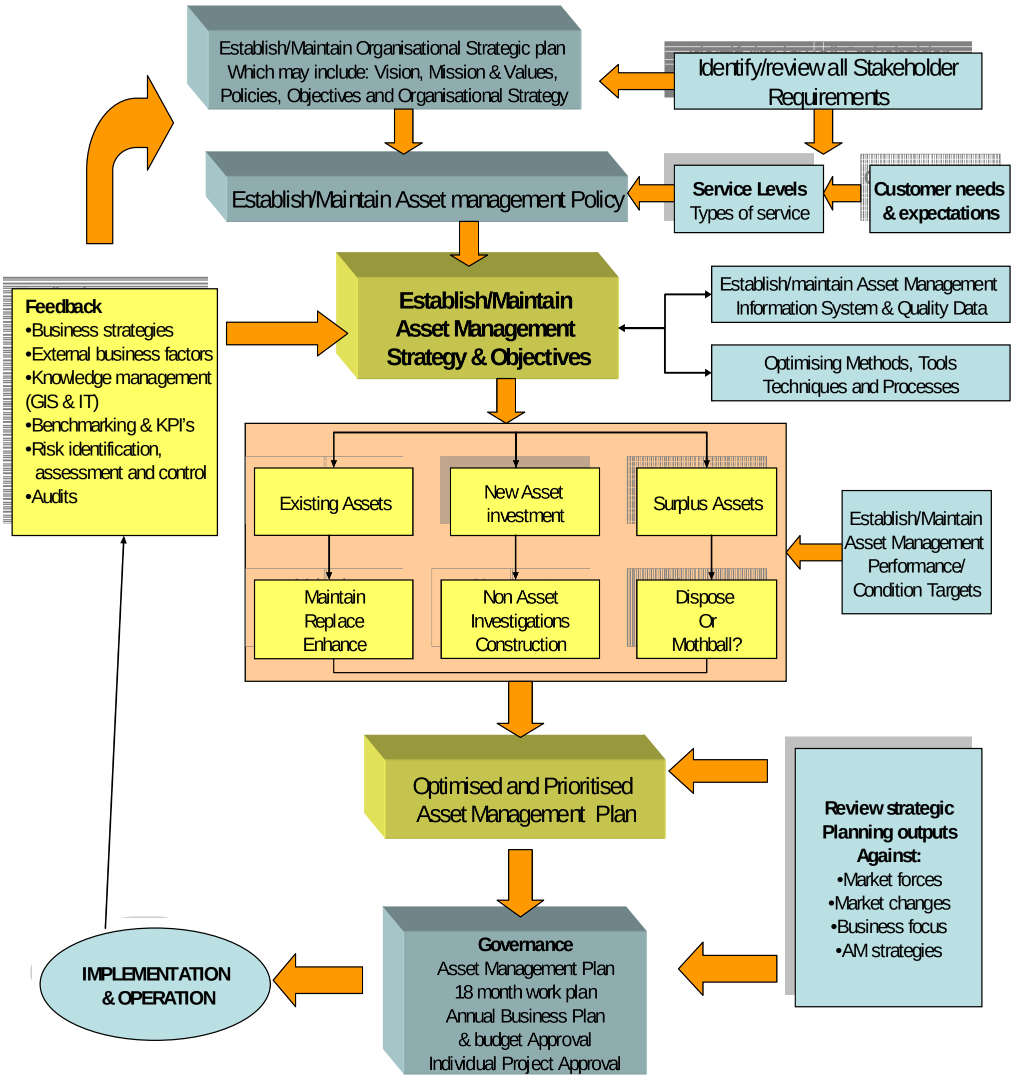


Figure 1. **The link between Corporate Strategic Drivers and Asset Management**

Key information systems include:

- GIS
- SCADA/NMS
- Outage Management System
- Contingency Planning
- ICP Database
- Call Centre Management
- Capital Works Library
- Load Flow and Analysis Software tools

- Maintenance Management System
- Vegetation Management Database

Systems are integrated to provide a cohesive asset management system.

1.2 Assets Covered

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.

Photo 3 The WEL Network area

This is shown in Figure 15 to Figure 19 in 3.1 and consists of: four Transpower Grid Exit Points, 23 zone substations, approximately 329km of 33kV sub-transmission circuits, 2,502km of 11kV distribution circuits, 2,212km of low voltage circuits and associated transformers, switches and equipment. A coincident system peak demand of 263MW was recorded during the winter of 2009. Total power delivered over the 2009/2010 year was 1,226GWh.

Land and buildings were revalued to market value on 31 March 2010 by independent valuers, TelferYoung (Waikato) Limited, Registered Valuers. The distribution network was revalued on 31 March 2010 by independent valuers, Sinclair Knight Merz (NZ) Limited, Registered Engineers and audited by PricewaterhouseCoopers.

The total value as at 31 March 2010 has been determined to be $376.8M.

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

Twice yearly 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.

The strategic targets by March 2015 of 70 SAIDI minutes and 1.35 SAIFI meet customer expectations, as derived from customer surveys.

1.3.2 Safety

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

- Targets for number of accidents/events and serious harm incidents are zero.
- Lost time injury accident (LTIA) has been used as measure and target is zero for every year.
- 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.

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 2010/11 financial year for CPC is $209. WEL has significantly improved the maintenance programme in the last few years. MAXIMO 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 2010/11 financial year for billability and productivity is 80% and 95% respectively. The strategic targets for 2014/15 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 55%.

Asset utilisation is defined as the ratio of average load divided by the capacity of the asset and is a measure of effective investment. For example, for a transformer the asset efficiency is the average load as a percentage of the transformer normal full load rating. 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:

- HAM 33 &11 GXP upgrade.
- TWH 33 GXP upgrade.
- Extensive new 33kV sub-transmission and existing sub-transmission 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.
- 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).

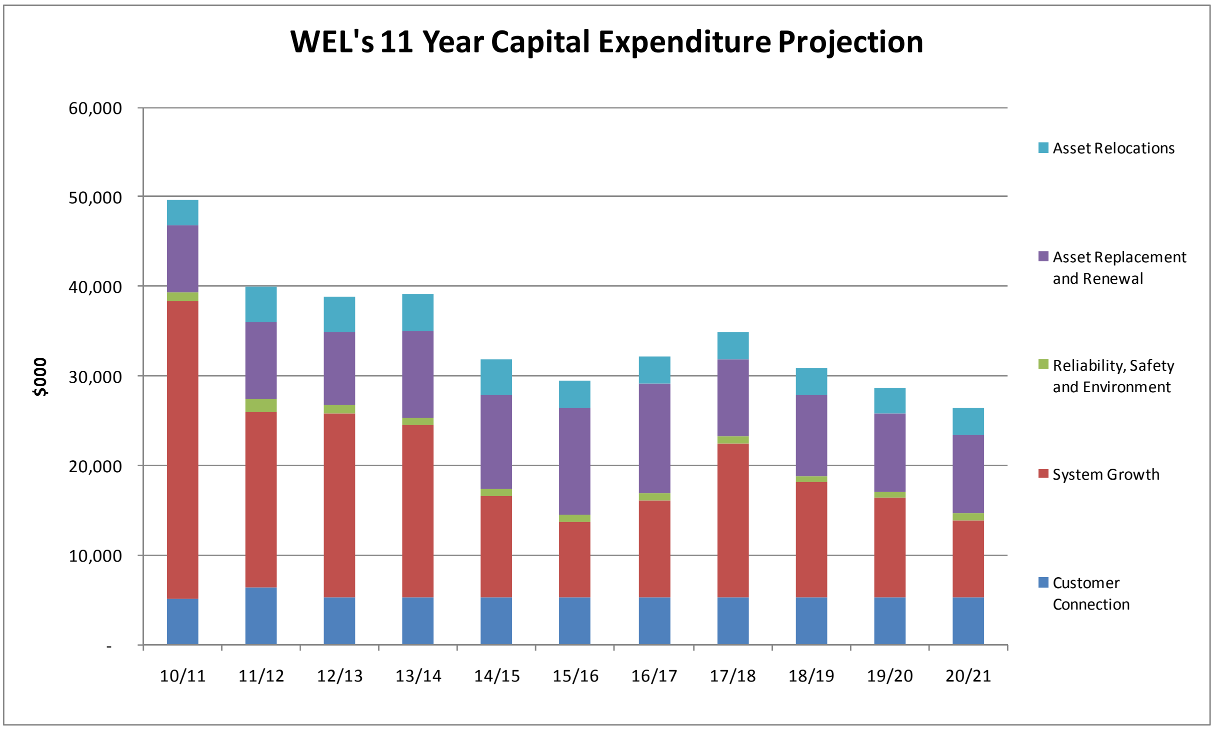


Figure 2. Capital Expenditure Projection for AMP Period

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.

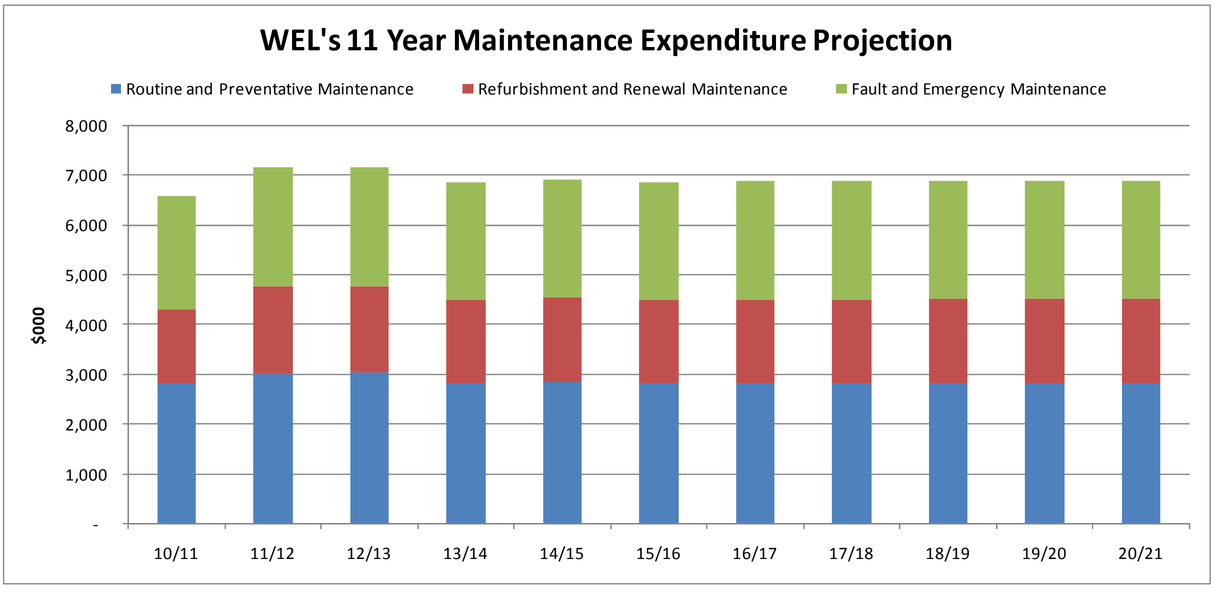


Figure 3. Maintenance Expenditure Projection for AMP period.

Reliability Centred Maintenance (RCM) is used as the primary driver for maintenance planning taking into account plant performance and function. Other 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 to renew 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.

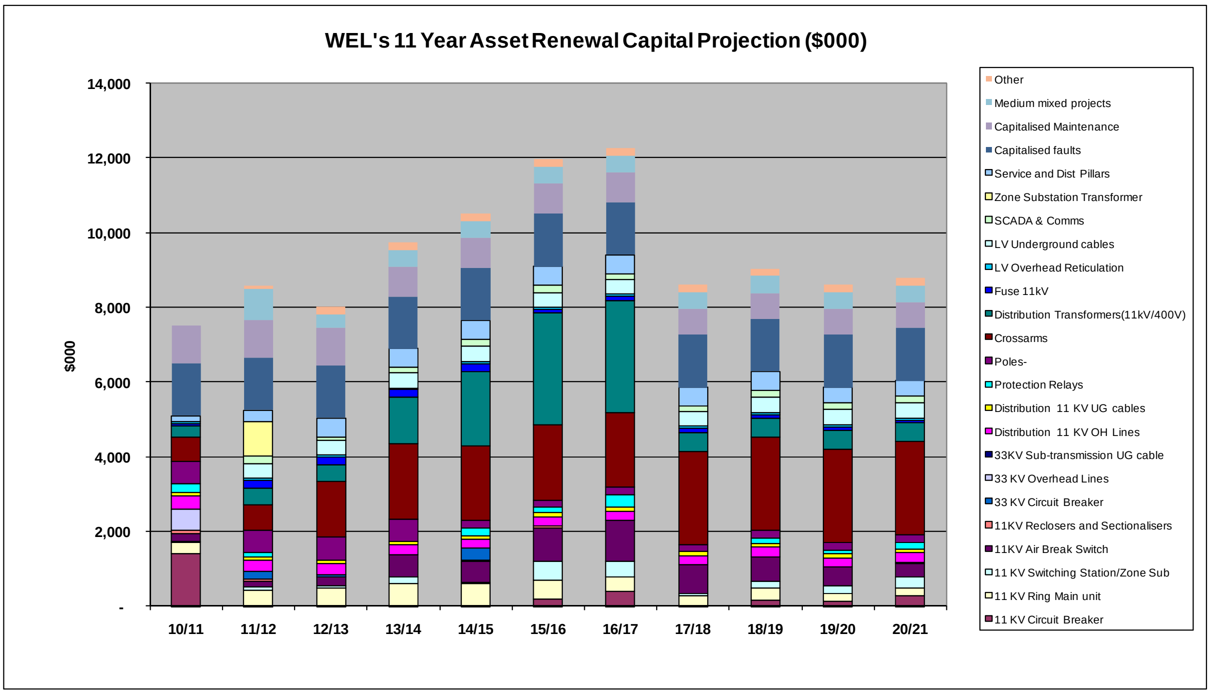
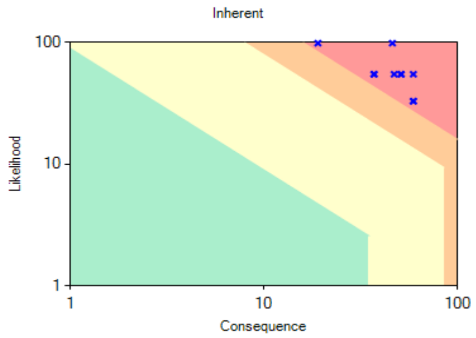
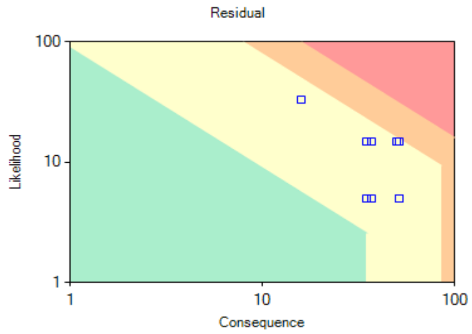


Figure 4. Asset Renewal Expenditure Projection for AMP Period

1.6 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.

Table 1 Risk Evaluation Table

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
		
1	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
2	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)
3	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 training • 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

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
4	Significant SAIDI minute loss or injury to persons resulting from defective work being carried out due to ambiguous, inadequate, or a lack of access to drawings in the Design & Construction Manual	• Network design and construction standards DCM 01/02/03/04/05 • Work quality auditing • AIS 113 Updating of Design and Construction Manual • Regular New Technology briefings
5	Safety equipment or associated equipment fails and causes harm.	• Induction training • CG 101 Health and safety standards for personnel working on WEL's network • MAXIMO • Control of Test and Inspection Equipment requiring calibration • Pre-start hazard assessment • FS-WC-03 Field Services Work Compliance
6	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)
7	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 • Network design and construction standards DCM 01/02/03/04/05 • WEL Maintenance Manual • MAXIMO • Maintenance works delivery plan • Personal Protective Equipment (PPE)
8	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.

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
		• FS-WC-03 Field Services Work Compliance
9	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 • OR 104 SCADA management and GUI-DMS update process • AIS 108 As-Builting Procedure (Asset Database) • Personal Protective Equipment (PPE) • AIS 110 Asset commissioning and decommissioning process
10	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

1.7 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.
- Network Development Programme Delivery Gap.
- 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.

1.8 Best Practice

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

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

Photo 4 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 and Mission statements. The following WEL Asset Management Policy reflects WEL's approach:

This Policy is based on WEL Networks Ltd (WEL) Vision and Mission Statements.

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

WEL Networks: THE supplier of network and energy services to the Waikato.

2.2.2 WEL's Mission

WEL's mission is to provide best practice, high quality reliable services valued by customers, while protecting our people, sustaining excellent returns, growing the business and taking a leadership position in the Waikato energy market:

- Secure Supply - Operate a safe and sustainable network
- Reliable Network - Deliver reliability to meet or exceed customer expectations
- Profitability - Growing the underlying profit and creating value
- Lower Costs - Deliver costs in line with the best quartile of New Zealand lines companies
- Recognised 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 and Mission statements.

2.2.3 WEL's Core Business Performance Drivers

WEL's asset management practices are consistent with the company Vision and Mission statements 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
		Capability and Employee engagement index

2.2.4 Relationship between Corporate Strategic Drivers and Asset Management

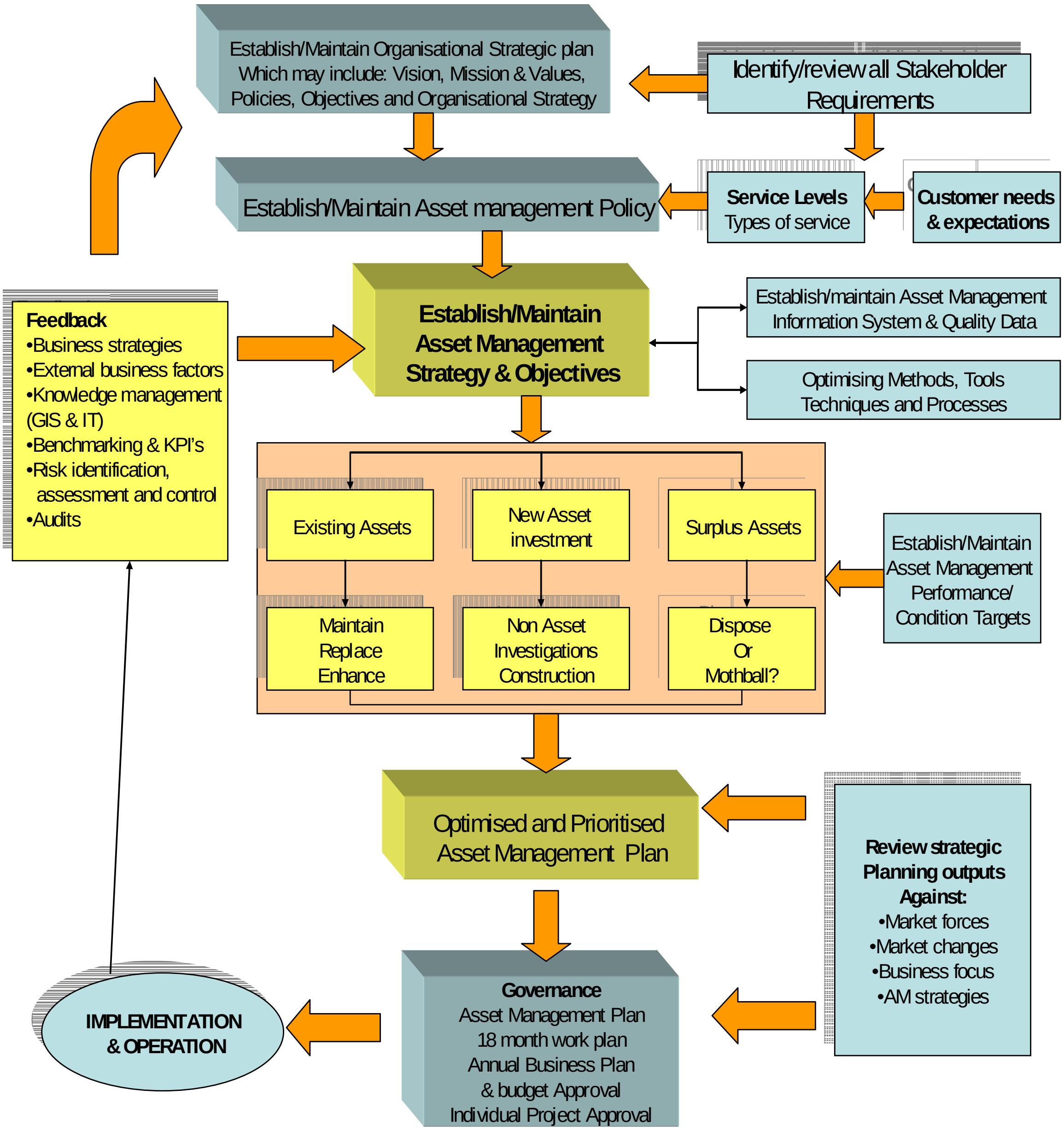


Figure 5. The link between Corporate Strategic Drivers and Asset Management.

- 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 works 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 5 33kV Insulator Replacement

2.3 The Period Covered By The Plan

This AMP was approved at the December 2010 Board Meeting by the WEL Board of Directors. It covers a period of 11 years from the financial year beginning 1 April 2010 until the year ending 31 March 2021.

The AMP provides the capital and maintenance expenditure projections for the next 11 years. The 11 year period covers the current financial year plus following 10 years 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 grid.

2.4 Stakeholder Interests

WEL is 100% 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 six Trustees) and elections are held every three years. The next election will be in June 2011.

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

Table 3 Stakeholder Interests.

Strategic Stakeholder Requirements by 2014/15				
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	▪ Quality and reliability ▪ Customer service ▪ Fair pricing ▪ Price/quality to manage customer expectations ▪ Service levels and equitable arrangements for retailers	▪ "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 five 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 each month:

- 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 four divisions of Corporate Services, Asset Investment and Growth, Operations and Customer Delivery and Human Resources shown in Figure 6 - Executive and Senior Management Team

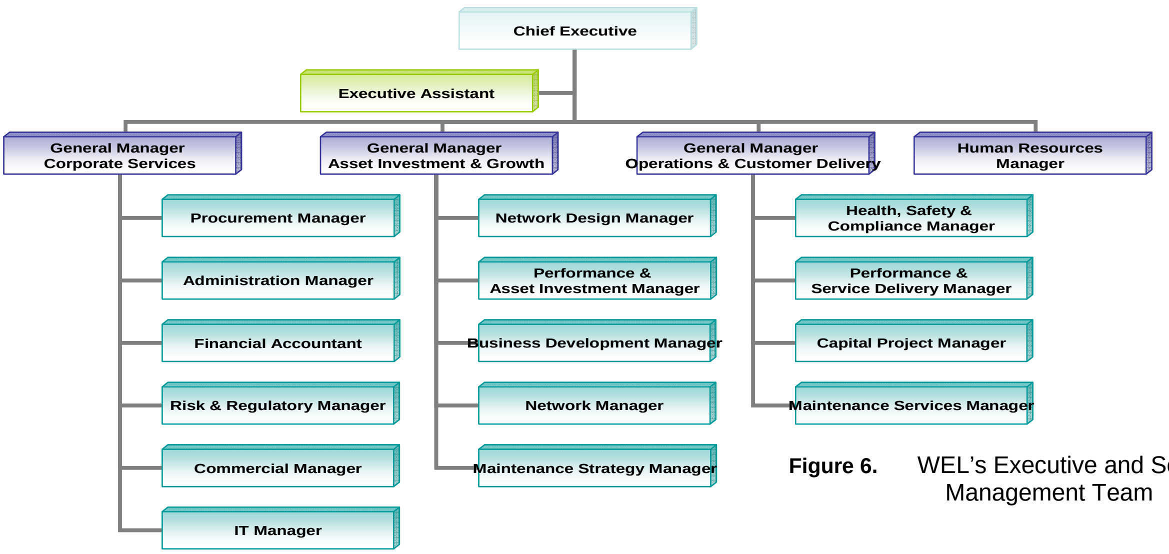


Figure 6. WEL's Executive and Senior Management Team

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 summarized below:

Managers	Key Asset Management Outcomes
Business Development	• Major projects generating new business for the network and business development • New major connections, large customer network enquiries and 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
Maintenance 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
Performance and Services Delivery	• 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 programme 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 project management and delivery. Maintenance, faults and capital works are delivered by WEL's own Field Services staff. Major capital projects and specialised communications and SCADA 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:

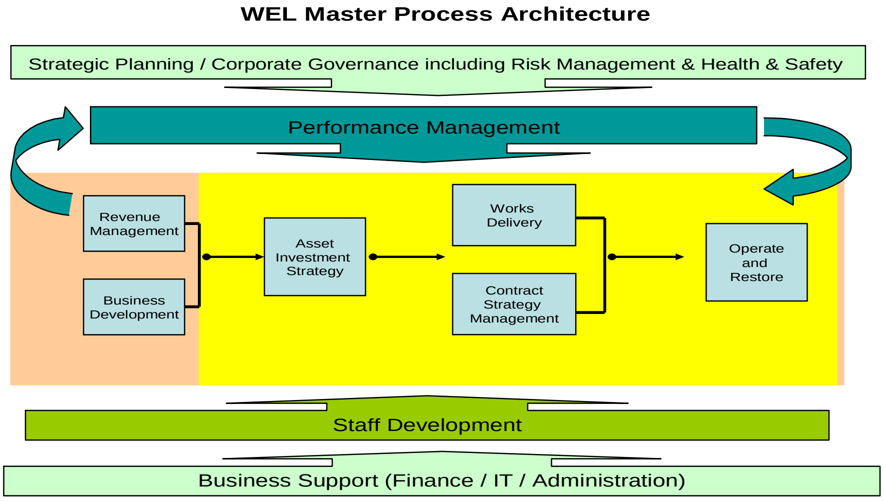


Figure 7. The Master Process Architecture

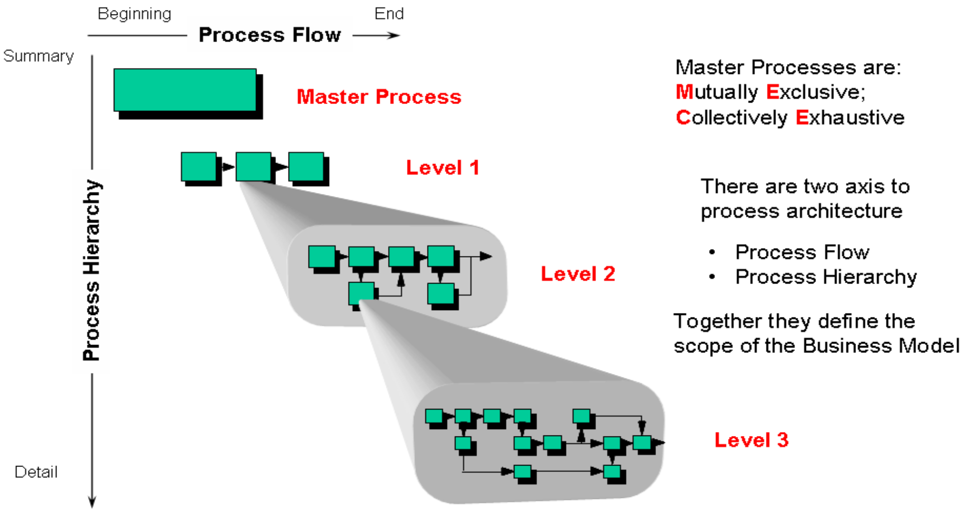


Figure 8. Master Process explanatory diagram

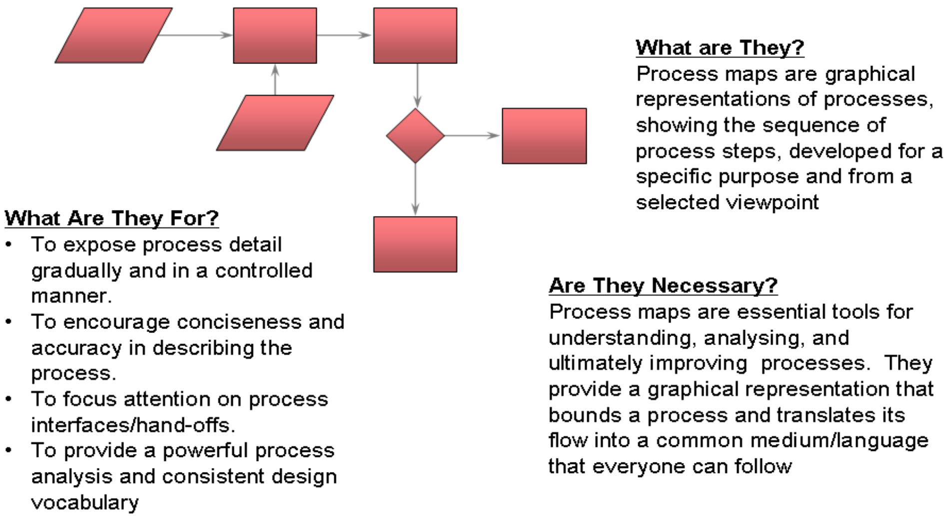


Figure 9. The Master Process Level 1, 2 & 3 Demonstration

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:

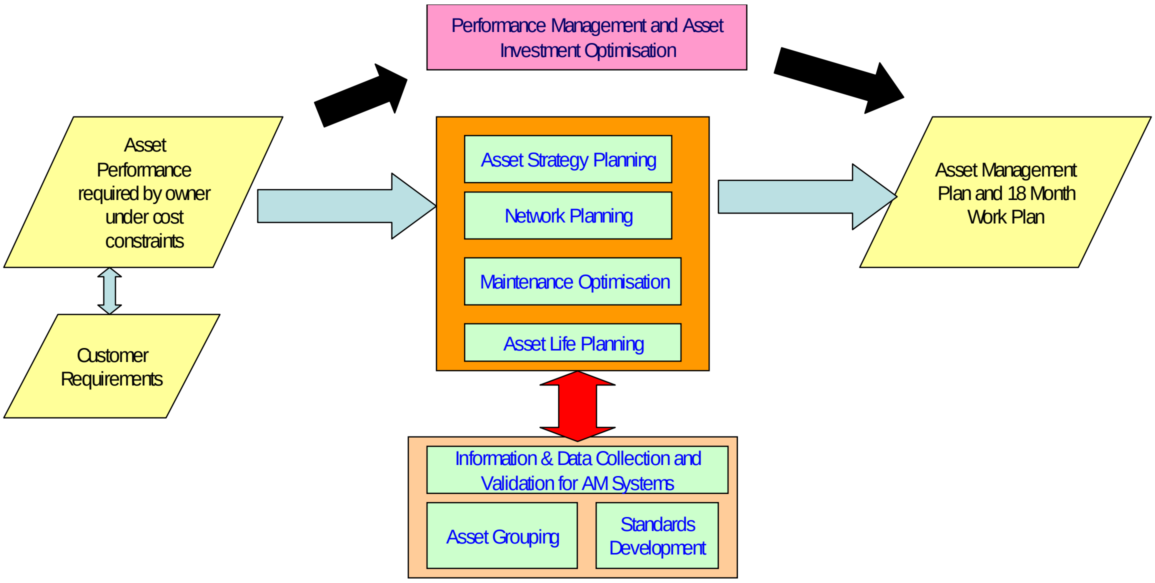


Figure 10. Interaction between high level asset management planning processes

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) (MAXIMO). 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 CALIB, a software application (see 7.2.7) which allows these and other parties to record new network development opportunities.

Ideas for new capital or maintenance projects are entered into CALIB 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, MAXIMO and SINCAL (the network planning tool).

The GIS, in particular, is not intended to be simply a data repository. More importantly it is intended to leverage existing data and present it in a way that decision makers can easily comprehend. Spatial displays are particularly powerful, since the human brain is very efficient at processing such visual information. When the spatial data is combined with attribute data from the GIS and other systems, important patterns can emerge, which result in quick, clear and correct decision making. One of the strategic focuses for the GIS, therefore, 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.

The Asset Data team, and the as-built process they administer, are intended to ensure only good quality data are entered into the GIS. Where the process has failed and the data has become corrupt they are tasked with correcting the errors. The Asset Information Manager is responsible for identifying and correcting the next courses.

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. This gave at least a tenfold return on investment over three years. Attributes of major equipment items such as transformers, circuit breakers, RMUs and other switches have been verified in the field. Corrections made in preparation for the new Asset Information System and Financial Asset Register. 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.

Traditionally, data quality initiatives have been viewed as isolated data cleansing projects that are exceptions to the normal flow of business. Data enhancement, by comparison, is broader in scope and duration. It does include correction of errors, but extends to upgrading important data sets in order to realise improved business benefits. One such example has been the purchase of aerial photography. It continually provides cost savings across the company and also is a means of improving the data quality. The scope of data enhancement further extends across departments within WEL. To this end, data integration is being pursued in order to provide better quality data in each of the systems and more comprehensive reporting. Data enhancement also extends over time in order to support continuous improvement. This requires yearly provision of resources.

Recent data enhancement initiatives include the criticality project, addition of easements, 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. A particularly important focus is to implement processes and systems that will extract more valuable information from the GIS in combination with other systems.

2.6.3.2 Network Management System

WEL is in the final stages of 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) and 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. Access can be via full operational workstation or web view access.

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 will use a standalone load management package which will interface through NMS to provide load control commands to the network. This load management system is planned to be commissioned in conjunction with the NMS

SCADA (Supervisory Control and Data Acquisition)

All data collected from the field and other operational data is presented to the operator in a clear, concise manner. The operator is alerted audibly and visually to events important to the operation of the network.

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

Specific functions performed using SCADA 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.

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.

Switching management, as a component of DMS, allows for safe and consistent switching plans and operations for both planned and unplanned work. This is achieved through the integration of switching and permitting logic into each step of the process.

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 is due for commissioning in the first quarter next 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 IVR to automatically update customers with known outage information and predicted restoration

Load Management System

WEL's load management system will provide centralised intelligence to monitor regional and network peak demands, calculating and forecasting the half hourly out turns, and managing control of interruptible load within service levels to ensure demand does not exceed targets. 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 interfaced with the network.

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 Capital Works Library (CALIB)

CALIB is a web based application designed to store all information relevant to the Capital Works Programme. WEL actively encourages employees to identify network issues. CALIB is a tool for capturing those issues, initiating and tracking the workflow required in assessing them.

The process starts when an employee identifies a network issue and has an idea about how that issue can be rectified. The idea is entered into CALIB. That initiates the creation of a new project and assigns tasks to the various specialists involved in completing the assessment. The work completed by each specialist is stored within the database or via links to other documents. This allows for a timely and consistent approach to capital project evaluation, helps to ensure effort is not duplicated and allows all parties to track progress. In summary, CALIB provides a single repository for the network issues people identify and the solutions proposed to address them.

Examples of the type of data held within the database include project name, project initiator, project details, budget category, technical options, costing or budget information, links to other files such as EXCEL, WORD or email, project status, work task completion due dates and persons responsible for tasks.

2.6.3.5 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.

2.6.3.6 Computerised Maintenance Management System (CMMS)

The CMMS 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 (MAXIMO) uses a web browser interface and 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.

Further minor enhancements are expected to be implemented over time. Currently the system (MAXIMO) is the subject of a major review.

2.6.3.7 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.

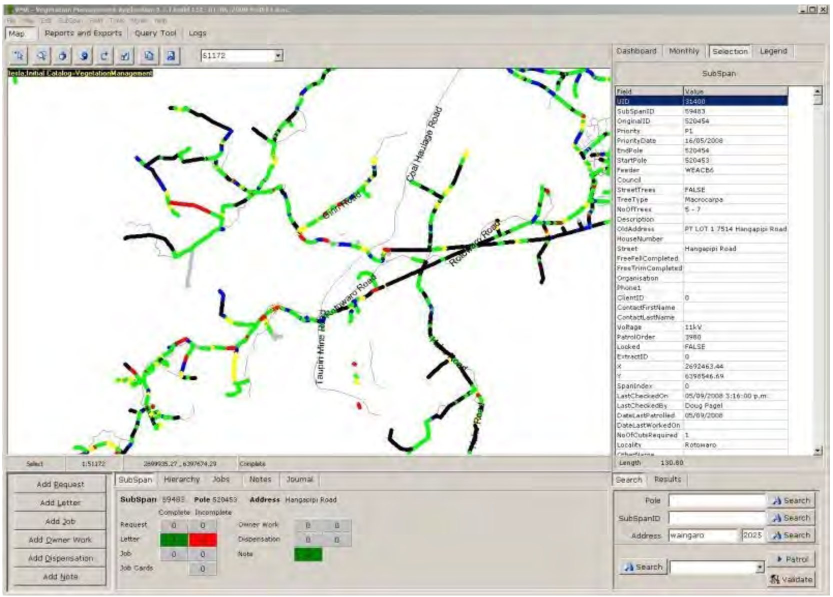


Figure 11. Screen Shot of Vegetation Management Database

2.6.3.8 SQL OLAP and Slice and Dice

Slice and Dice is a reporting tool that utilises SQL's OLAP technology. The ICP, OMS and Navision (financial) databases reside on a common SQL server. SQL OLAP is used to extract information from these databases to create cubes for use by the Slice and Dice reporting application. As such Slice and Dice can be used to extract and combine data from various sources for reporting or analysis reasons.

2.6.3.9 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.

2.6.3.10 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 CMMS, 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.

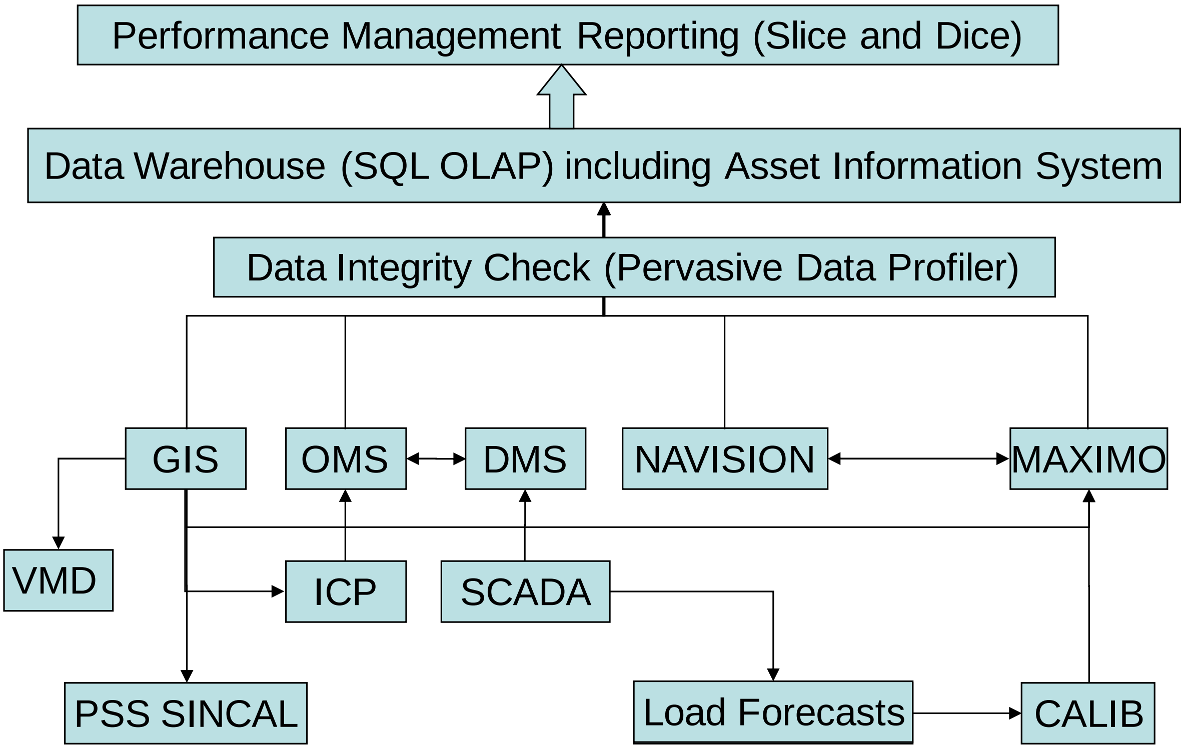


Figure 12. Data flow between applications.

Refer to Appendix 1 for an explanation of acronyms used.

2.6.5 System And Data Ownership

WEL has adopted a policy of allocating ownership of systems to the primary users of the system (as opposed to the IT department). This fosters a culture of ownership and care and ensures that functionality is in accordance with the users' requirements. Ownership of the data is also vested in the system owners who are responsible for the accuracy and timeliness of collection of the data.

2.6.6 Information Framework And Integrity Assurance

Five 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. WEL was one of the first companies to create such a position.

Recently WEL conducted a data quality assessment with two key components across the whole company. The first measures the current level of data quality within the company and the second is a framework, which guides systematic, continuous improvement. The manager developed a data quality maturity model to measure the current level of data quality. WEL is at level 2 ½, in a range of 1 to 5, where 5 is the most mature. The immediate goal therefore is to move WEL up to level 3 and ultimately to level 5. The model shows the economic benefit for moving from one level to the next. The question therefore is 'how to move WEL up to level 3 and beyond?'

The answer lies in an information framework. The second part of the assessment adopted an information framework that is compatible with the maturity model. This framework guides company wide data quality improvement programmes. It has six processes and is shown below:

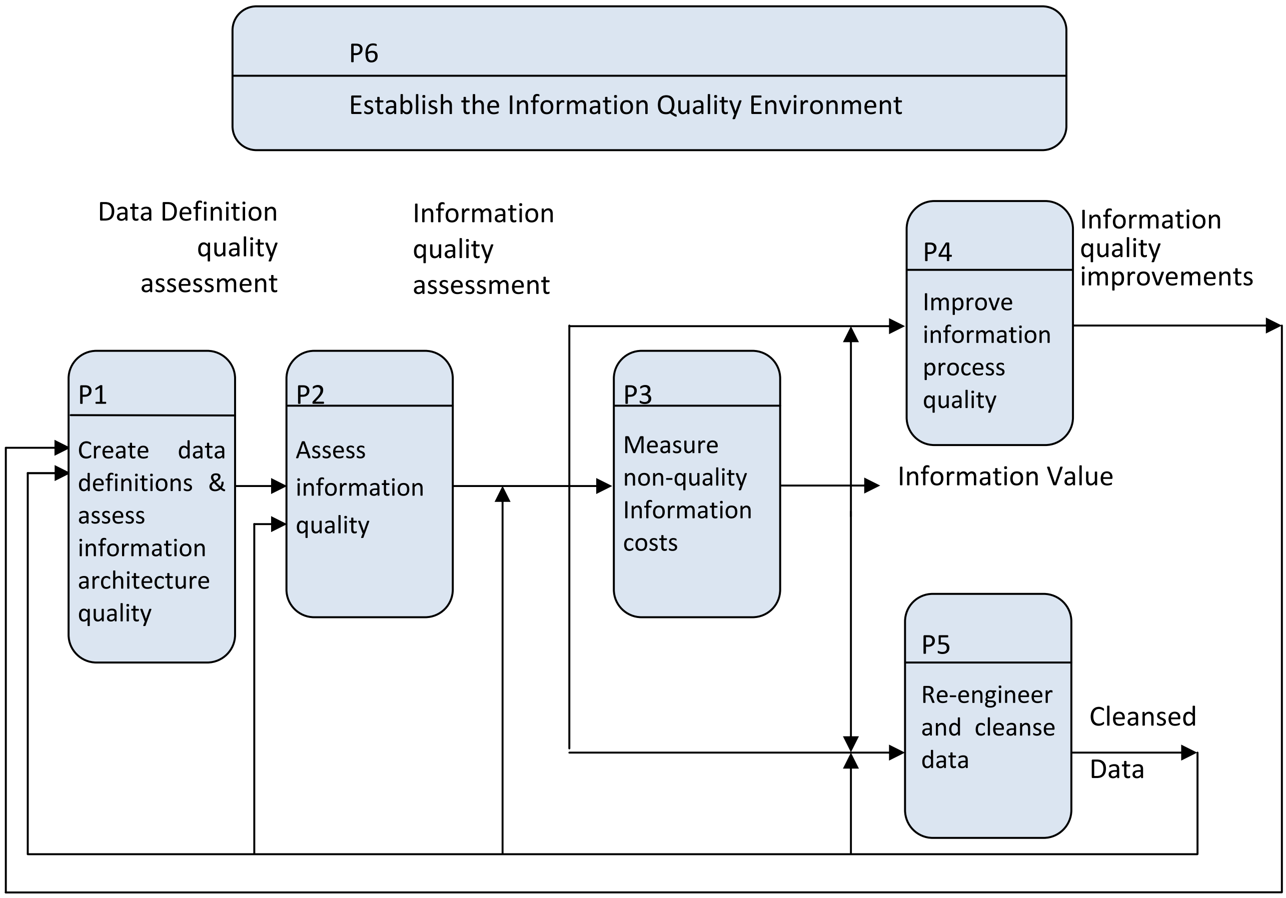


Figure 13. Generic Information Framework.

Each process is briefly described and then the developments, over time, are described for each one.

Process 6 describes the cultural change necessary to ensure good data quality. It is integral to all the other processes and therefore the most important, so is described first. The specific actions described under all the process are designed to move WEL from its current position to level 3 within twelve months (by March 2012). Process 6 is arguably the most important. It is cultural change. Ultimately cultural change can only be driven by senior management. An Information and Data Intergrity Policy, signed by the Chief Executive, is already published within WEL. The Executive report on data quality performance associated with the as-built process on a monthly basis. In order to drive the data quality culture deeper within the organisation, greater education and training is required. The example needs to begin at the top and filter down. The training should include the importance of data quality, which must be implemented across the company.

Process 1

Process 1 - create definitions for data where necessary and assess the information architecture. Due to the large quantity of data, creating definitions for each individual datum is impractical. Therefore some mechanism for identifying the most important data is required. WEL assesses the impact of a datum on the business objectives to determine the appropriate level of investment for each one. Senior management state that safety is the most important business objective at WEL. Therefore asset data is more important than financial data. Definitions have been provided for a number of the important parameters. However, a recent project exposed some oversights. The relevant stakeholders must be engaged to reach a consensus on the missing definitions. The results must be codified and published within WEL.

A recent assessment of the information architecture for the asset management systems exposed some practises that violated data quality principles. As the opportunity arises (for example when new systems are installed) the information architecture must be improved to increase data sharing, reduce duplication and reduce the number of interfaces while increasing integration. Remedial actions to improve processes supporting the information architecture are described in Process 4.

Process 2

Process 1 provides the cannon for measuring data quality within the organisation. In Process 2 specific measurements are established. In combination with the cannon of Process 1, the quality of asset data must be measured against the actual assets in the field. However, comparing data from disparate systems can act as a proxy. WEL implemented a data profiling tool to automatically generate data quality metrics on the key parameters, which are identified in Process 1. These are reported monthly and drive the data enhancement and process improvement functions at present.

A second important aspect of Process 2 is identifying the value chain of data. The cost centres and value creation centres are identified qualitatively as a precursor to quantifying the cost benefits of the data and resulting information. This requires continuing maintenance.

Process 3

Once specific measures of data quality are available and the information value chain is established, then the costs of poor quality data can be calculated. Some of the base data for these calculations are derived from the surveys associated with the data quality maturity model. The data maturity model itself provides some guidance concerning the costs of poor quality data. The focus is on the costs of “scrap and rework”, since lost opportunity costs, while more significant, are harder to quantify. This cost analysis also provides guidance about the areas of greatest need. WEL needs to establish a process to continually assess the costs of scrap and rework, and if possible provide guidance about the magnitude of lost opportunity costs.

A recent project to create an asset information system (a data warehouse) and a financial asset register exposed previously hidden data errors. The data quality in the maintenance management system was found to be seriously lacking. WEL corrected the data, but had to change the process in order to prevent further corruption. Another area of concern is the condition data.

Process 4

Given the analyses of the previous processes the areas needing process improvement become evident. A fundamental quality principle is that the process must be fixed before correcting historic data. If the process is not first corrected, then after the data is cleansed it will be corrupted again. Associated with this principle is the need to truly identify the root cause of problems. Again the comprehensive analysis of the earlier processes allows for improved diagnoses.

The process improvements followed the data governance principles of personal accountability for data quality and delineation of responsibilities. These improvements have already provided a significant improvement in data quality. However, the principle of capturing data at the point of creation is not currently being followed. This is the next step in the continual improvement process. Another lack is limited control over the data capture process. A new policy is about to be introduced whereby plant will not be commissioned unless complete and correct as-built documentation has been provided.

Process 5

Having established reliable processes erroneous data can be purged from the affected systems. Once the data and processes are reliable, the focus of Process 5 can move from data cleansing to data enhancement. This move has already occurred for at least one system within WEL. As part of this WEL plans to more accurately locate the meters associated with ICPs. Processes must be established to manage the installation of ultra fast broadband and the deployment of smart meters.

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 6 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 (area inside the red line).

Figure 14. A map of the WEL Networks coverage area

Figure 15, Figure 16 and Figure 17 outline the areas WEL supplies. Figure 18 and Figure 19 show the entire network and indicate zone substations situated outside Hamilton City. Figure 16 shows Hamilton City and indicates zone substations located within city boundaries. The corresponding area supplied by each zone substation is outlined. Both Figure 15 and Figure 16 use WEL acronyms for zone substations. 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 18 and Figure 19 show WEL's 33kV sub-transmission network.

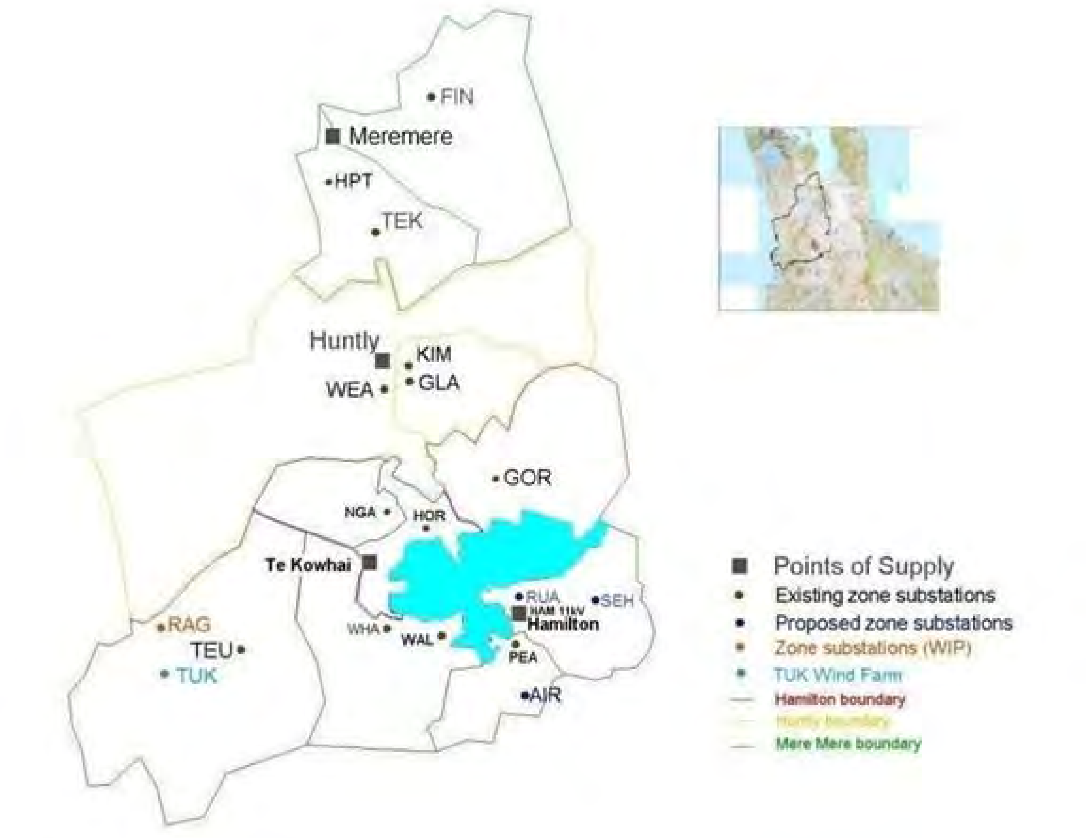


Figure 15. Points of Supply, existing zone substations, associated supply zones and proposed zone substations.

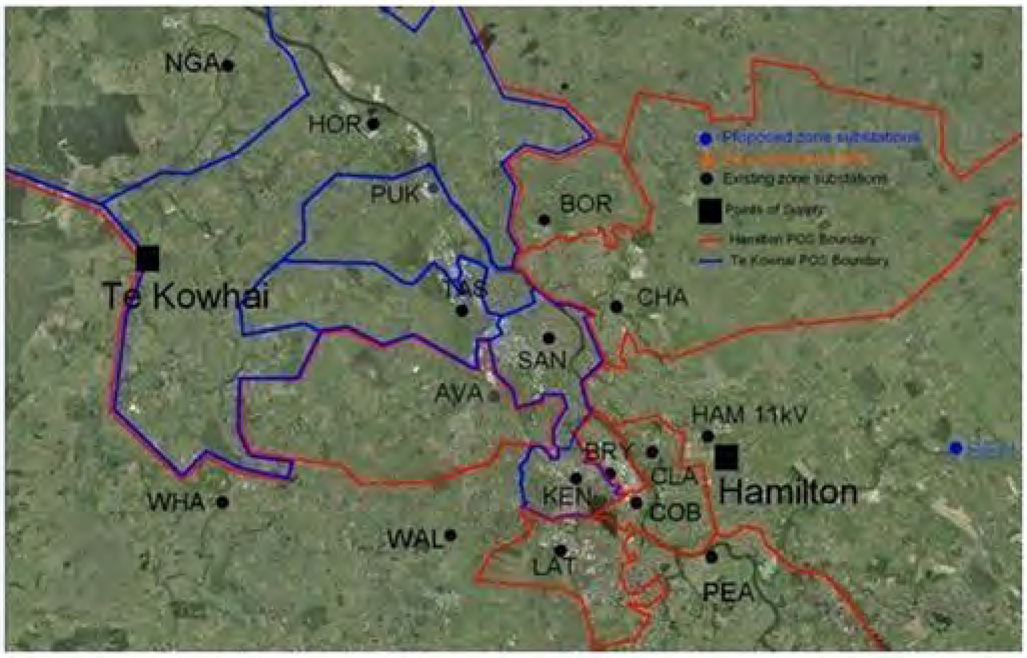


Figure 16. Hamilton City zone substations and associated supply zones.

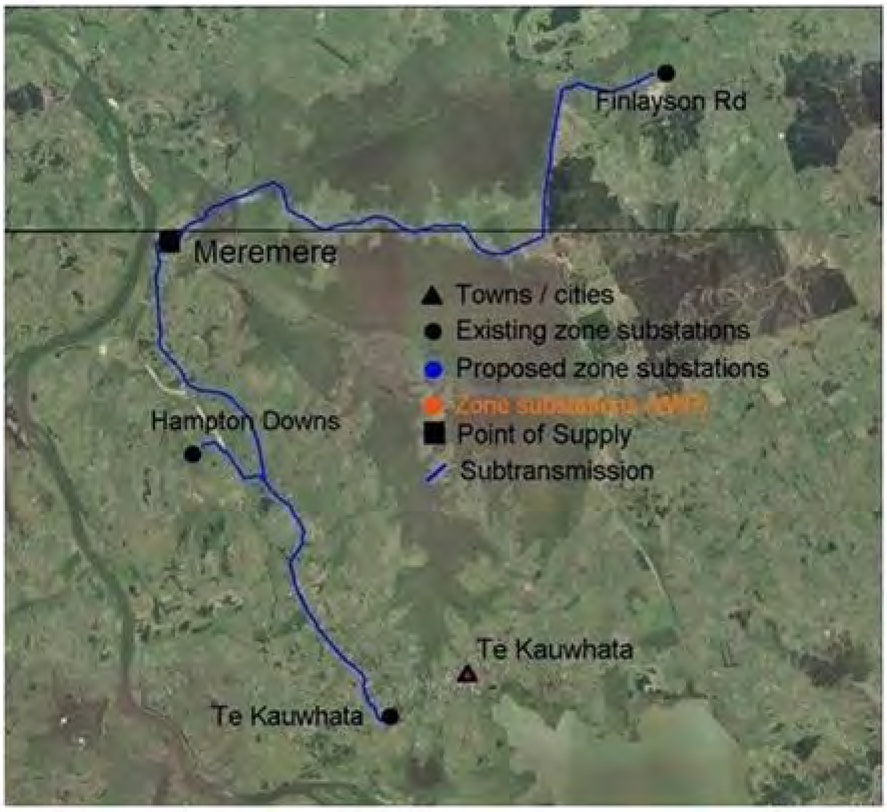


Figure 17. North Waikato Area 33kV Sub-transmission Network

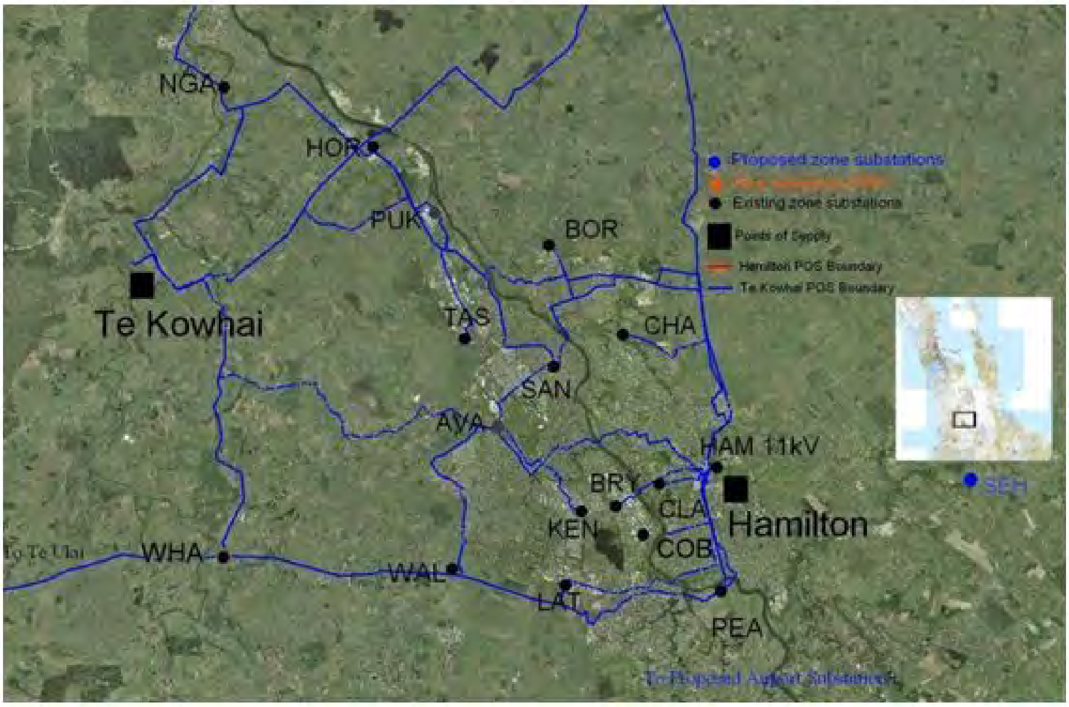


Figure 18. Huntly Area 33kV Sub-transmission Network.

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 five 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 2009/2010 financial year for WEL's network was 273 MW. The coincident system peak demand with RCPD was 263MW. The highest peak demand so far for the 2010/11 financial year is 256MW (to end of August 2010).

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 2009/2010 financial year was 1,226 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 substations as well as from embedded generation. Contact operates an embedded 50MVA co-generation plant at Fonterra which connects to the Pukete zone substation. Meridian owned 65 MW wind farm at Te Uku is being commissioned at present.

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	44,879
Hamilton 11kV	2 x 40 MVA	80 MVA	40 MVA	44 MVA	12,727
Te Kowhai 33kV[1]	2 x 100 MVA	200 MVA	100 MVA	109 MVA*	16,394
Meremere 33kV[2]	Nil	20 MVA	10 MVA	4.5 MVA*	2,722
Huntly 33kV	2 x 60 MVA	120 MVA	60 MVA	81 MVA	5,983

Note 1: Planned to be upgraded to 138MVA.

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.

Planning is currently under way for the installation of 33kV cables to connect Huntly, Te Kauwhata, Maramarua and surrounding areas. Once this happens the Meremere GXP may no longer be required in the longer term. 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 mostly of overhead construction except where they traverse the residential areas of Hamilton.

Figure 20. University of Waikato switching station

3.2.3 Key Information for Zone Substations

Table 5 Key information for Zone Substations As At 31 March 2010

Code	Full Name	Installed Capacity (MVA)	Firm Capacity N-1 (MVA)	Emergency Capacity 4 hours (MVA)	Capacity Utilisation (2009 Winter)	Customers Supplied	Customer load Type	Security Class required	Security class achieved - 1st interruption
AVA	Avalon Drive	46	23	28	34%	5,381	Industrial, Commercial and Residential	C2	C2
BOR	Borman	46	23	28	16%	2,597	Residential & light commercial	C3	C3
BRY	Bryce St	46	23	23	50%	2,606	Central Business District	C2	C2
CHA	Chartwell	46	23	28	55%	6,938	Residential & light commercial	C3	C3
CLA	Claudelands	46	23	28	51%	7,536	Residential, light commercial & Central Business District	C2	C2
COB[3]	Cobham	46	23	28	0%		Central Business District and Residential		
FIN	Finlayson Road	7.5	5	5	53%	1,087	Residential & light commercial	B2	B3
GLA	Glasgow Street	10	10	15	74%	2,482	Residential and commercial	B1	B1
GOR	Gordonton	10	5	7.5	63%	1,510	Rural and Residential	B1	B2
HAM 11Kv	Hamilton 11kV	80	40	44	52%	12,727	Residential & light commercial	D	D
HOR	Horotiu	20	10	15	52%	2,692	Industrial and Rural	B1	C3
HPT	Hampton Downs	10	10	15	5%	24	Rural and commercial		
KEN	Kent Street	46	23	23	38%	4,245	Industrial, commercial & residential	C2	C2
KIM	Kimihia	10	1	1	28%	1 (Industrial)	Industrial		
LAT	Latham Court	30	15	15	61%	4,502	Industrial and commercial	C3	C3
NGA	Ngaruawahia	15	7.5	7.5	35%	1,815	Residential & light commercial	B1	C3*
PEA	Peacockes Road	20	10	15	84%	4,501	Residential & light commercial	C3	B1
PUK	Pukete 11	30	15	15	25%	1,490		C3	C3
SAN	Sandwich Road	46	23	28	48%	5,365	Residential & light commercial	C3	C3
TAS	Tasman Road	46	23	28	34%	815	Commercial and industrial	C3	C3
TEK	Te Kauwhata	10	5	7.5	58%	1,649	Residential & light commercial	B1	B3

Code	Full Name	Installed Capacity (MVA)	Firm Capacity N-1 (MVA)	Emergency Capacity 4 hours (MVA)	Capacity Utilisation (2009 Winter)	Customers Supplied	Customer load Type	Security Class required	Security class achieved - 1st interruption
TEU	Te Uku	10	5	7.5	62%	3,028	Rural	B1	A
WAL	Wallace Road	20	10	15	78%	6,161	Residential & light commercial	C3	B2
WEA	Weavers	15	7.5	11.25	64%	3,498	Residential & light commercial	B1	C3
WHA[3]	Whatawhata	23	23	28	0%		Residential & light commercial		

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.

Note 3: COB and WHA are new zone substations that were recently commissioned.

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.

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 has been modelled using the PCORP software from which maximum allowable current flows have been determined.

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.

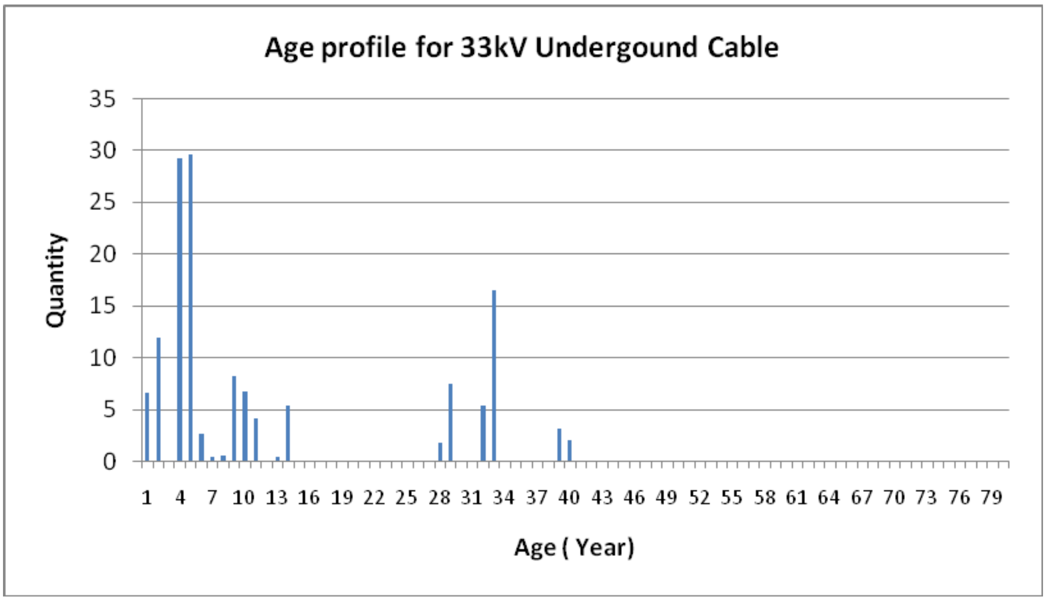


Figure 21. 33kV Sub-transmission Underground Cable – Age Profile

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.

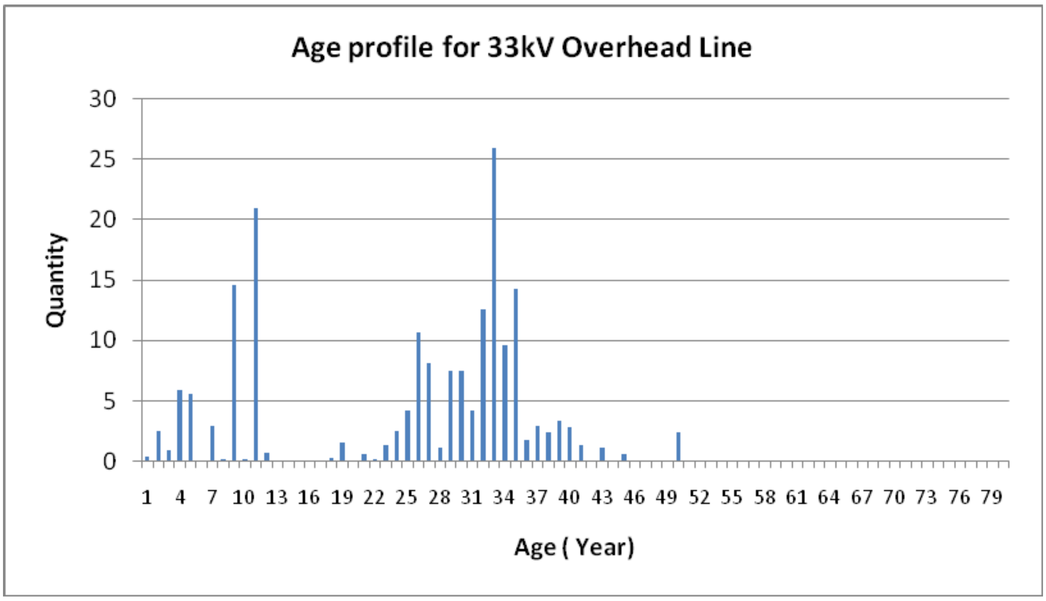


Figure 22. 33kV Overhead Conductors – Age Profile

3.3.4 33kV Circuit Breakers

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

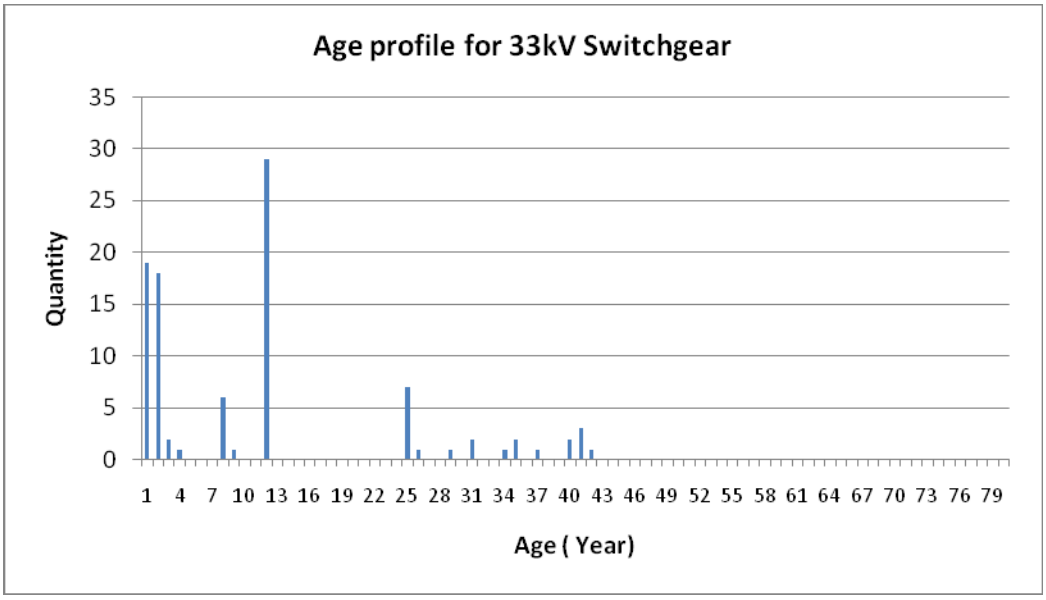


Figure 23. 33kV Circuit Breaker – Age Profile

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 23 zone substations with construction dates ranging from the 1950s to 2010. 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.

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.

No transformers will exceed the expected life during the 11 year planning period.

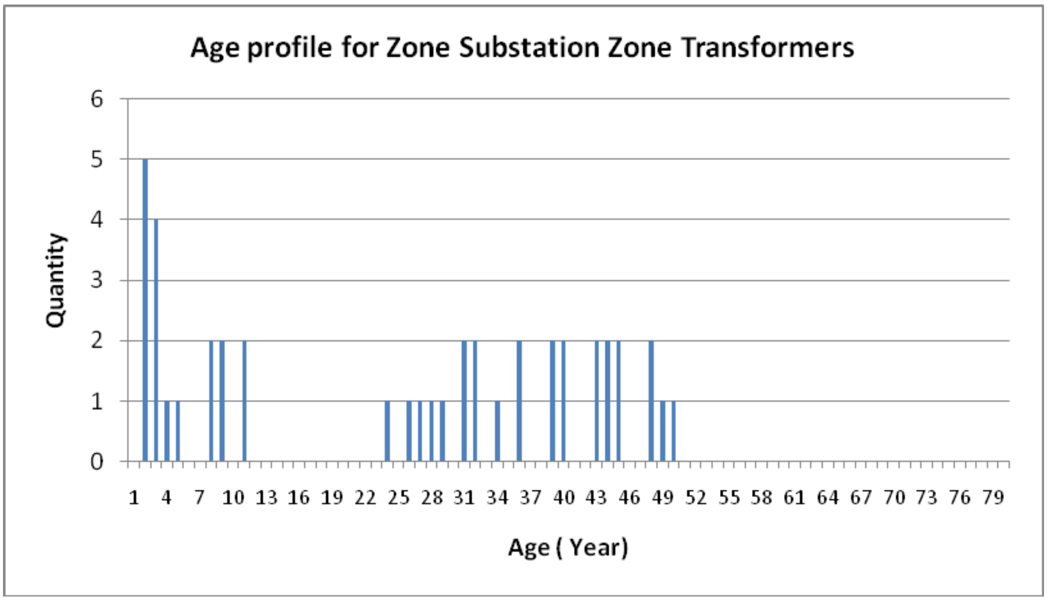


Figure 24. Zone Substation Transformers – Age Profile

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

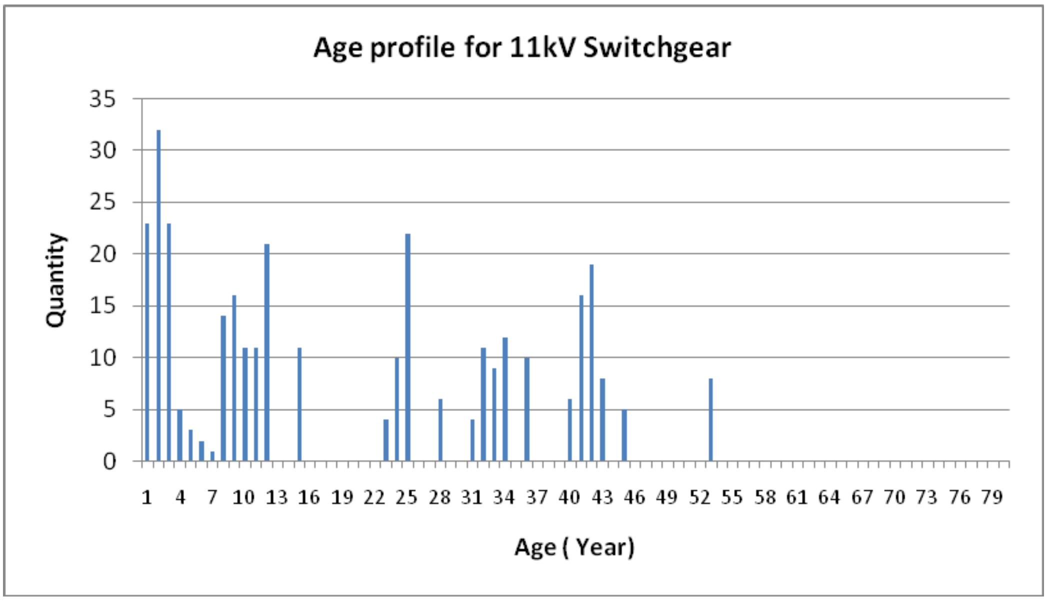


Figure 25. 11kV Switchgear – Age Profile

3.3.8 <u>Distribution 11kV Underground Cables</u>

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.

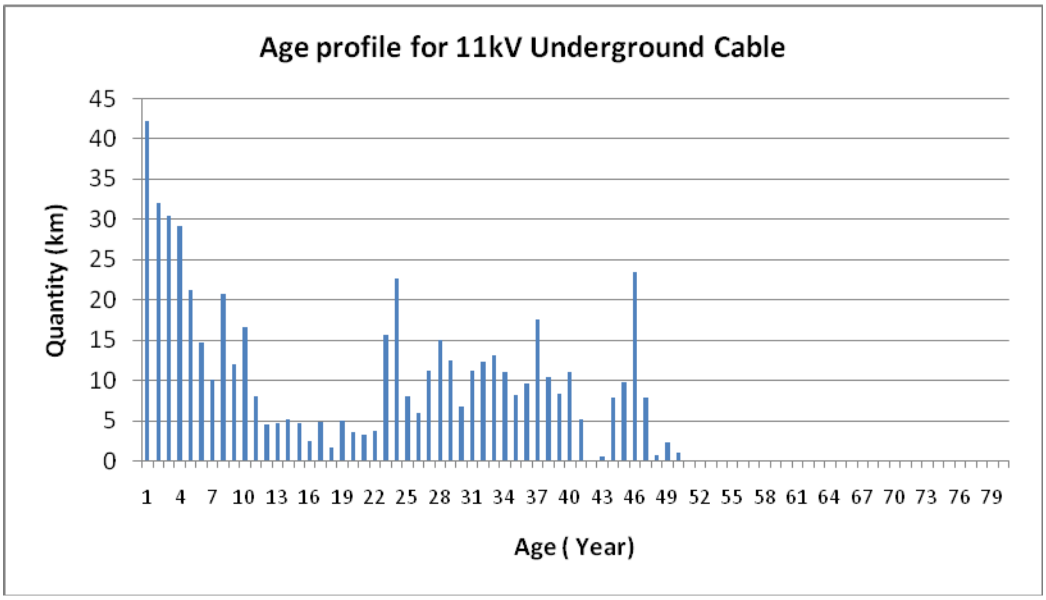


Figure 26. Distribution 11 kV Underground Cables – Age Profile

3.3.9 <u>11kV Overhead Distribution Lines</u>

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

The 11kV overhead lines are generally in satisfactory condition for their required purpose. Where practical any refurbishment is coordinated with the undergrounding plans to avoid unnecessary replacement of overhead lines.

Only minor routine maintenance is needed on concrete pole lines. However, near the end of the planning period there will be an increase in replacement of crossarms.

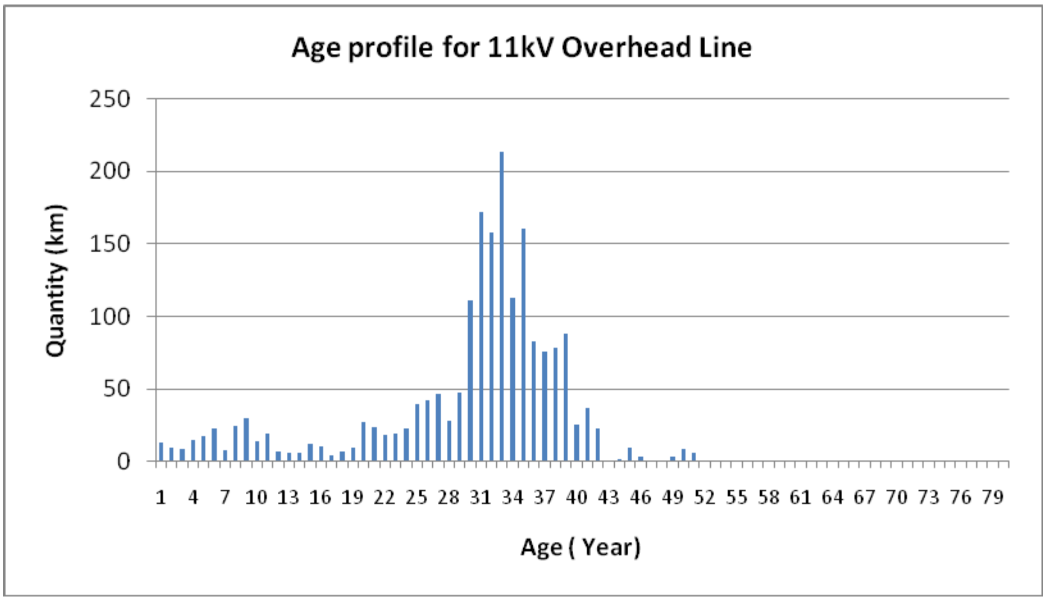


Figure 27. Distribution 11kV Overhead Conductors – Age Profile

3.3.10 <u>Poles Wooden</u>

Given that WEL has approximately 1,400 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 2010/11 year. Each pole will be given a replacement date based on the data obtained.

Condition assessments so far suggest a wide range of remaining strengths but that the assets are more likely to need replacing before reaching the nominal lifespan.

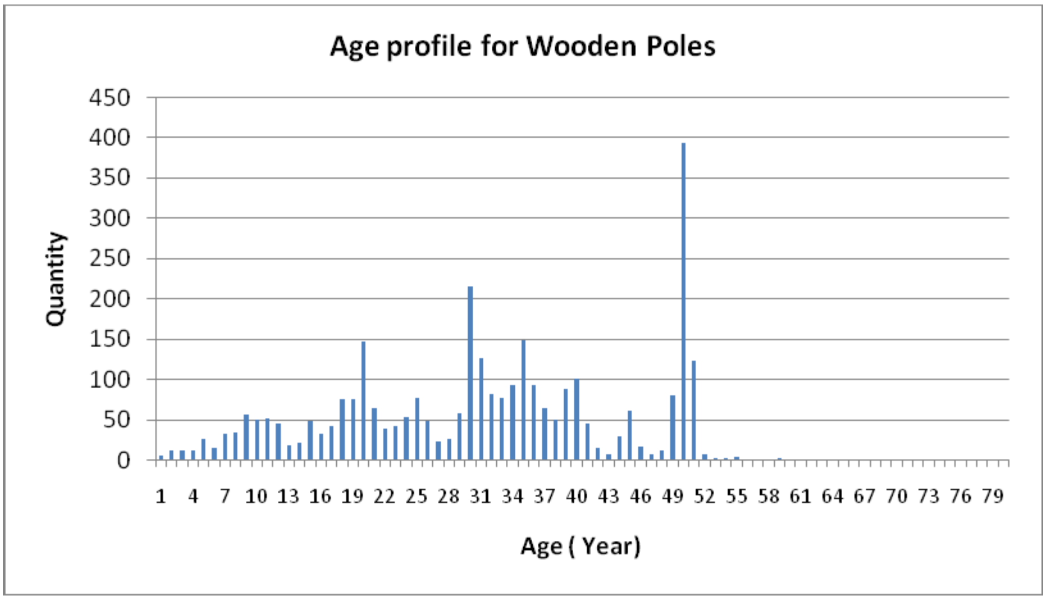


Figure 28. Wooden Poles – Age Profile

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.

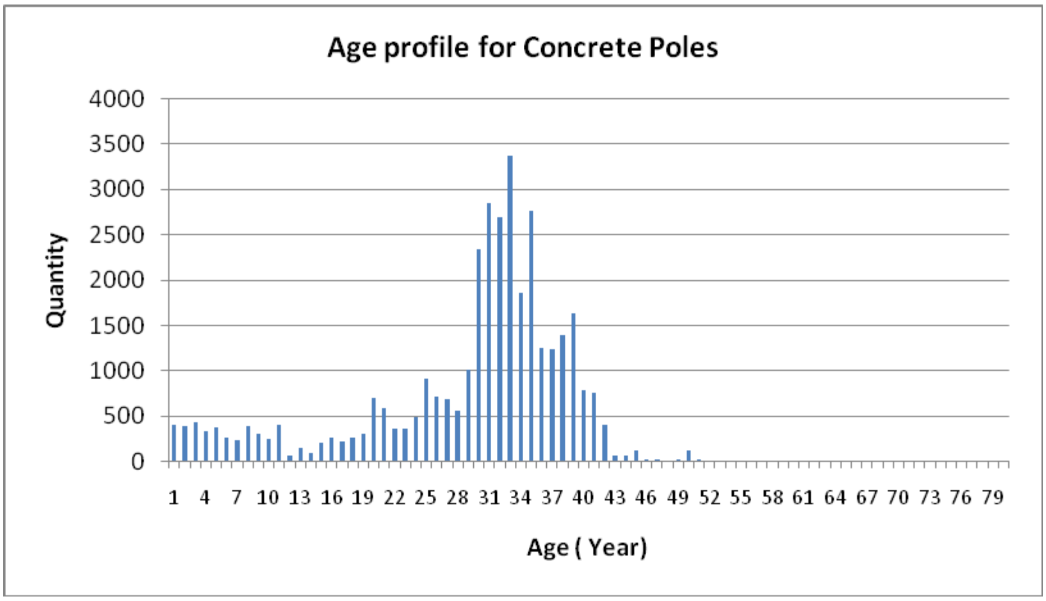


Figure 29. 33kV Concrete Poles – Age Profile

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 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.

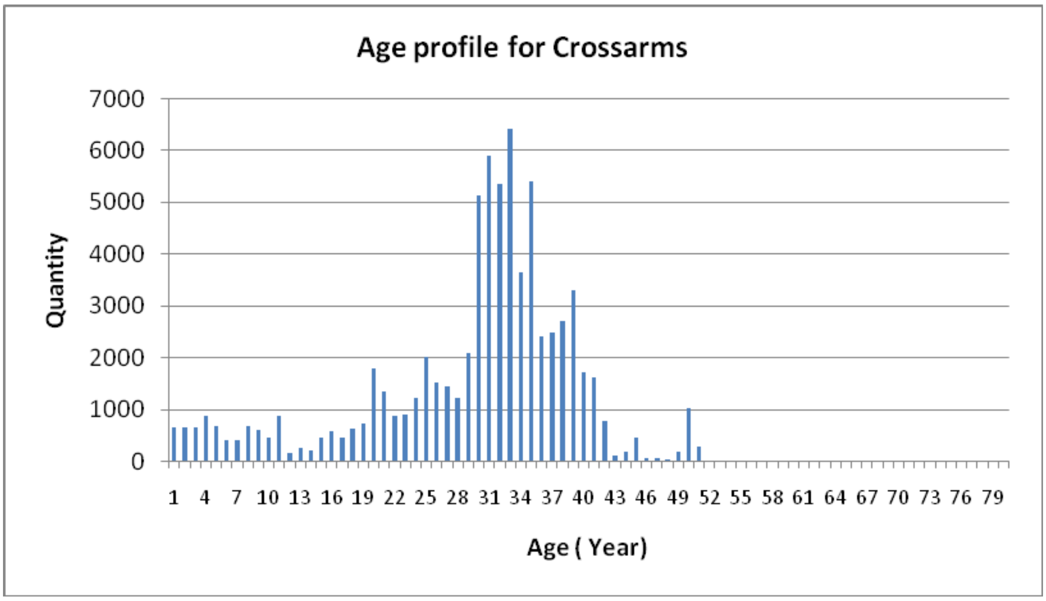


Figure 30. Crossarms – Age Profile

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.

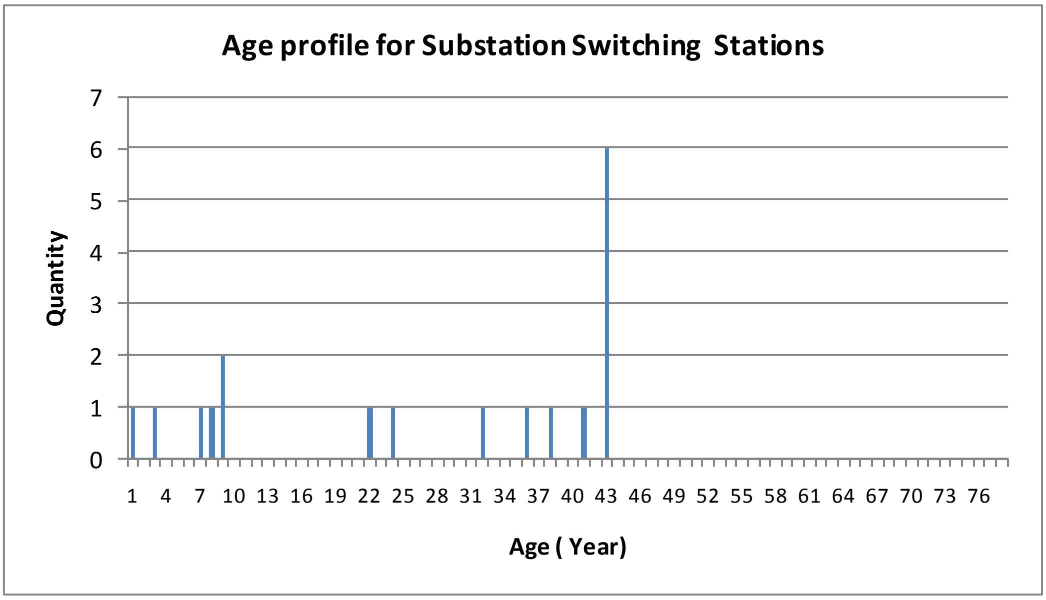


Figure 31. 11kV Switching Stations – Age Profile

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. Currently because of problems encountered with particular models of oil filled ring mains, all oil filled RMUs are being internally inspected and having the oil changed. This programme is expected to be completed at the end of the 2011 financial year.

The condition can vary considerably with the make/model and the environmental exposure being the key factors having an influence.

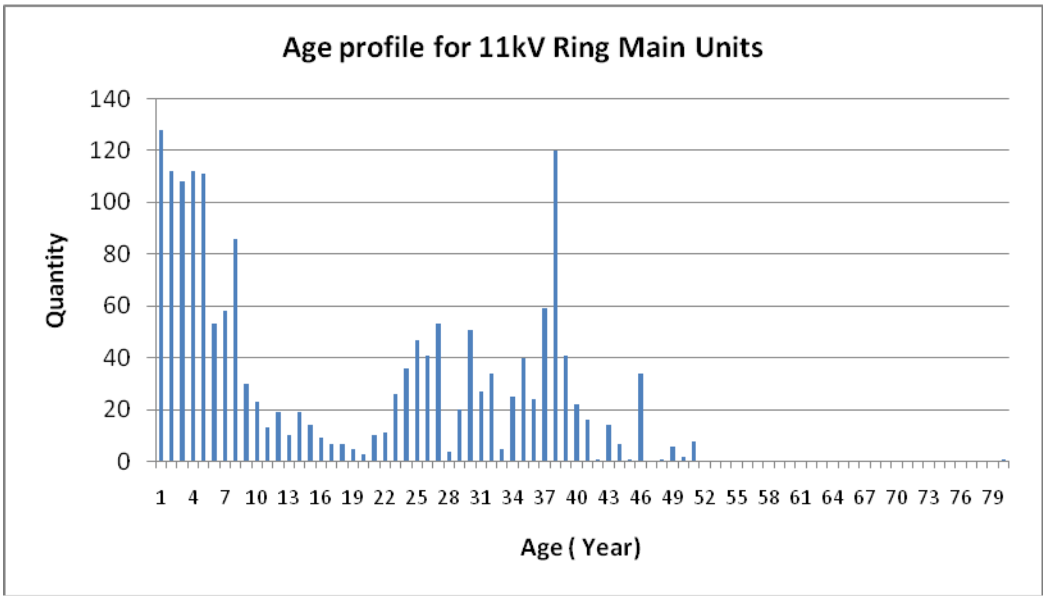


Figure 32. 11kV Ring Main Units – Age Profile

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. Condition of these is generally poor. Load breaking line switches are in better condition and many have already been replaced with sealed gas insulated units in recent years.

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.

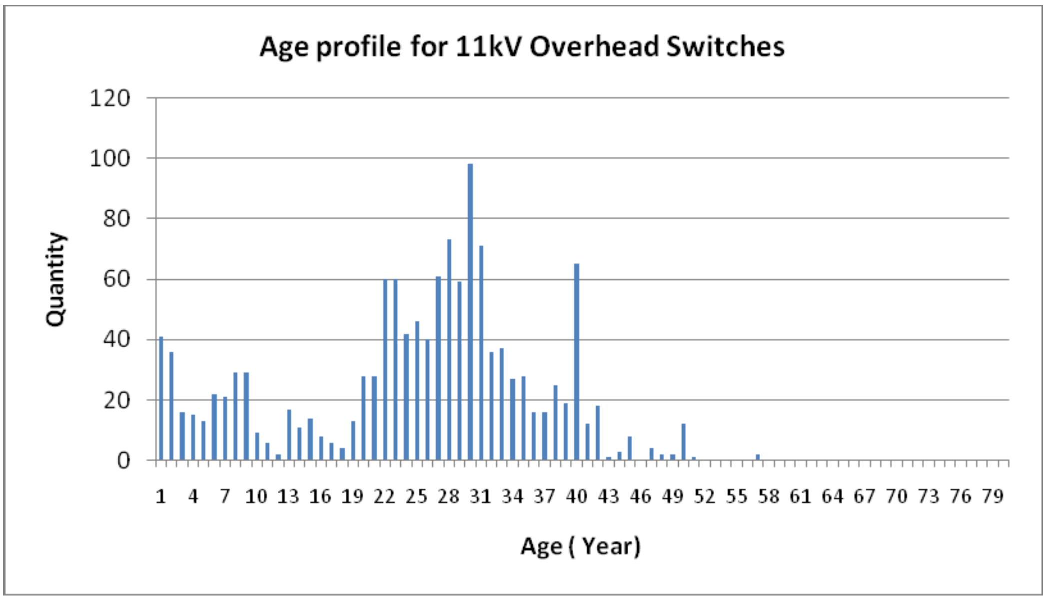


Figure 33. 11kV Air Break Switches (ABS) – Age Profile

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 negative effect on the reliability of their operation. Therefore testing will only be done when there is an indication from SCADA data that incorrect operation has occurred.

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

In the recent past there have been a number of electronic related failures of the more recently installed units. These failures aren't confined to any one 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 attempts 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 first five years of the plan.

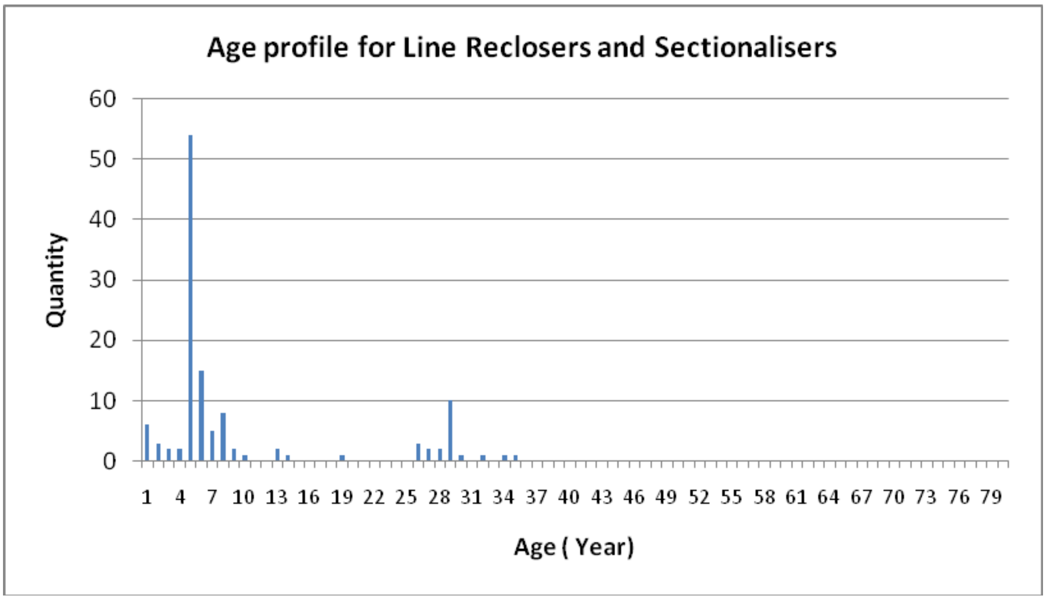


Figure 34. 11kV Reclosers and Sectionalisers – Age Profile

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 the time, 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 prior to 1970 that can be economically returned for 20 years further service are reconditioned.

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 to their lids.

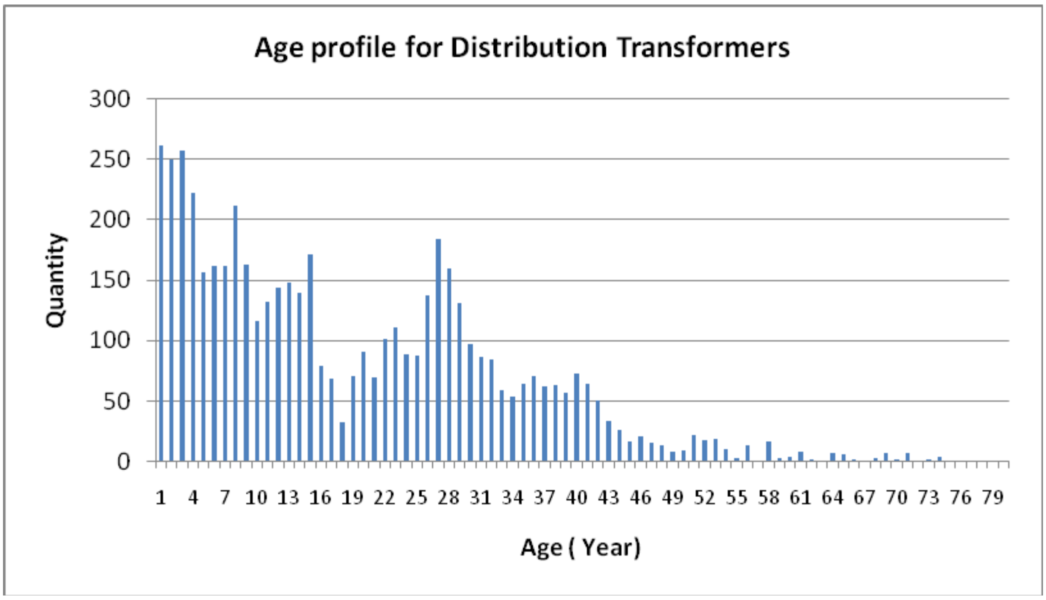


Figure 35. Distribution Transformers – Age Profile

3.3.18 LV underground cables

Underground LV cabling is exhibiting only a small number of failures, primarily of the 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 become apparent when faults begin to appear in particular localised areas.

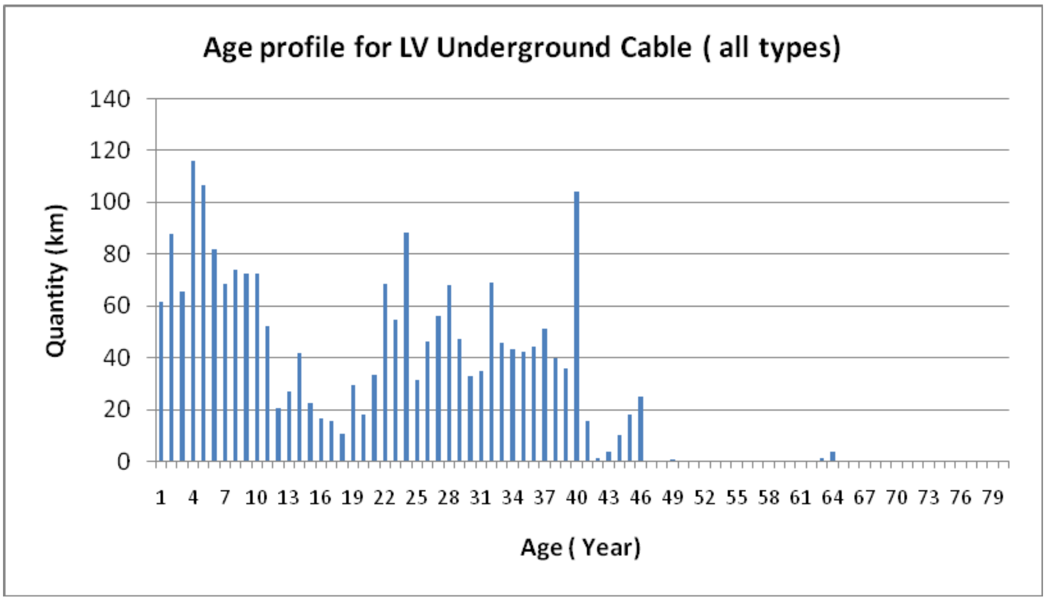


Figure 36. LV Underground Cable – Age Profile

3.3.19 LV Overhead Reticulation

LV overhead reticulation is in 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 in line 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.

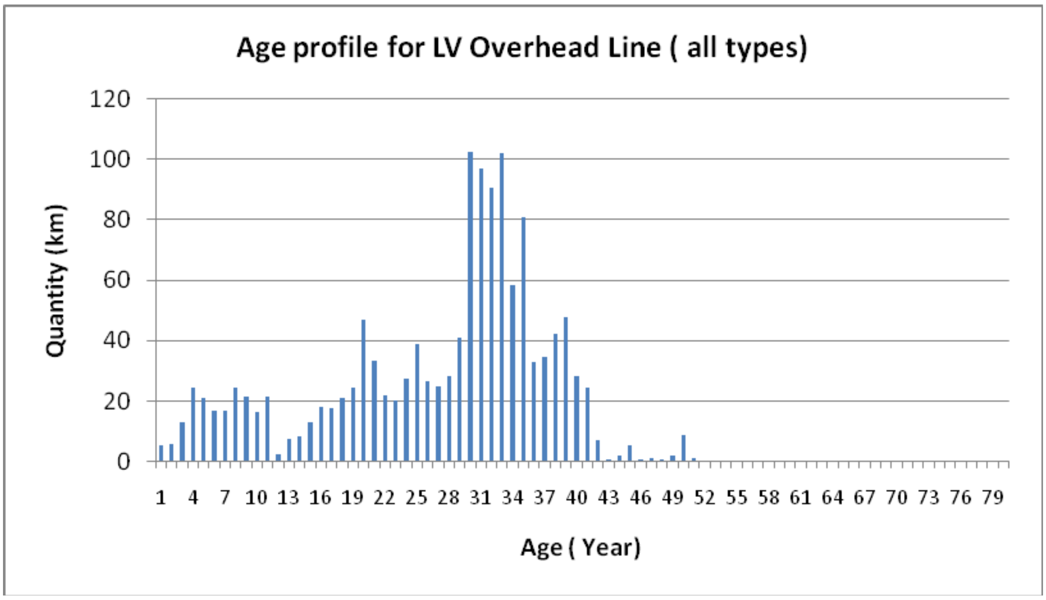


Figure 37. LV Overhead Reticulations – Age Profile

3.3.20 SCADA; Communications and Control Equipment

WEL has a fully functional SCADA system comprising of a master station, data storage systems, alarming, and load control systems based at the WEL central premises. Furthermore there is a communications infrastructure, substation wiring and RTU's.

Condition and reliability of the SCADA and communications system is generally good. The older RTU's, though reliable will progressively be replaced to provide improved functionality and communications capability.

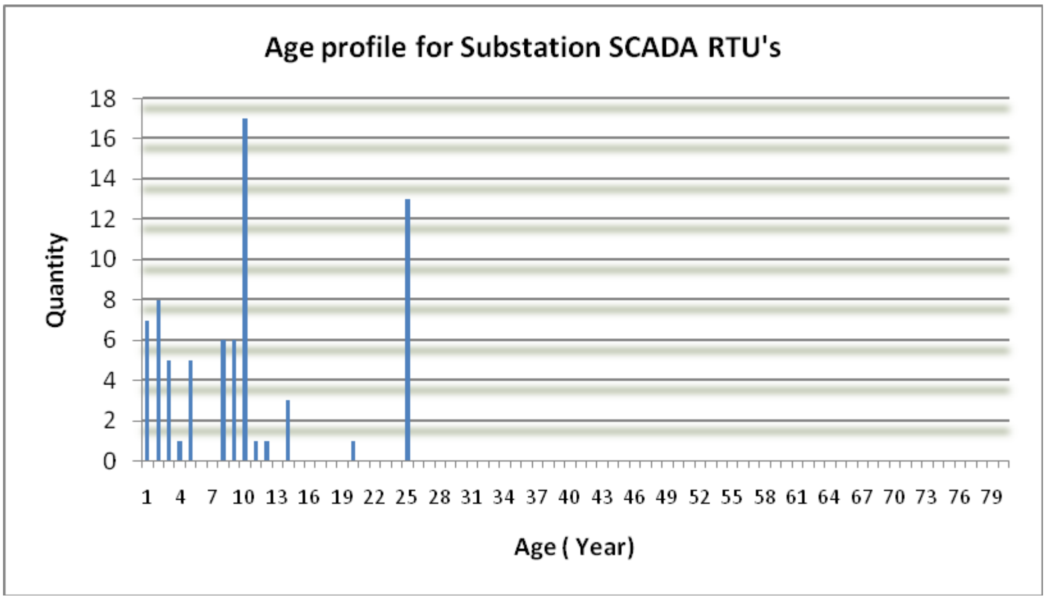


Figure 38. Substation SCADA and Control Equipment – Age Profile

3.3.21 Load Control Equipment

There are three primary 33kV static ripple injection sets on the WEL network with one set at Hamilton GXP, one set at Te Kowhai substation and one which was the backup at Hamilton, being installed at Weavers for the Huntly point of supply. These sets operate at 283Hz. The Weavers injector will allow relay replacement and removal of the four 11kV 500Hz rotary sets in the northern area.

Three rotary 11kV plants are used in substations supplied from the Meremere 33kV Point of Supply while there are 2 rotary plants at Weavers and Glasgow substations (supplied from Huntly GXP). An 11kV 283Hz static injection plant is in service on the Hamilton 11kV point of supply. An 11kV 283Hz static injection plant is located at Pukete. The signals from this injector are initiated by a SCADA load control command 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 replaced by the static plant being installed at Weavers.

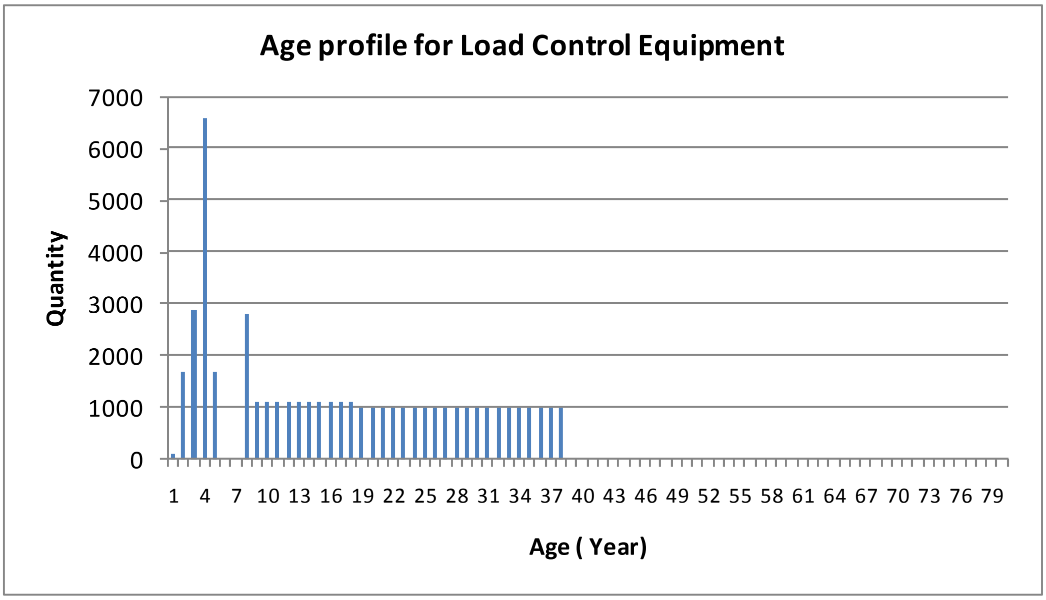


Figure 39. Load Control Equipment – Age Profile

Photo 7 Vegetation Management

3.4 Value and Quantities Of Assets In Each Asset Category

Asset Values and quantities are shown in Table 6 below. Land and buildings were revalued to market value on 31 March 2010 by independent valuers, TelferYoung (Waikato) Ltd Registered Valuers – Property Advisors. The distribution network was revalued on 31 March 2010 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.

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 2010

Asset Category	Unit	Quantity	"Asset Value ($000 in DRC)"
33kV Lines	km	186	4,086
33kV Cables	km	143	33,364
33kV Zone Substations and 11kV switching stations	No.	41	27,321
Zone Substation transformers	No.	45	23,071
11kV Lines	km	1,932	21,567
11kV Cables	km	570	48,967
Ring Main Units	No.	1,820	9,787
Air Break and Gas switches	No.	1,341	4,081
Reclosers	No.	77	2,275
Distribution Transformers	No.	5,479	46,248
LV Lines	km	1,123	12,887
LV Cables	km	1,149	41,419
Street Light Lines	km	260	2,074
Street Light Cables	km	1,113	29,840
SCADA; Communications and Control Equipment			6,256
Poles including Value of Crossarms	No.	39,076	38,050
Land and Building	No.		9,640
Other			15,810
Total			376,742

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, they would probably not be optimal if the network was rebuilt in a single instance of time to supply the exact needs of 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 derating of cables.

In recent times there has been considerable load growth within the WEL network. This has placed significant demands on the capacity of 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 required 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 four 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. Three new zone substations are currently under construction to meet present load growth. Two 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-2) 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-2 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 what consumers have said is most important 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 versus quality or if they wish to increase their load. WEL also conducts a yearly survey of the top 50-100 major customers concerning growth intentions. This feeds straight into network planning and into the Asset Management Plan.

The distribution of customer types for zone substations is shown in Appendix 3.

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 and 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 are that:

- 98% 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
- 88% of customers would prefer to have the present level of reliability maintained at the present prices

The February 2010 results show a minor improvement in most areas above and are up from those in previous years.

- 38% of customers would like to see further improvement in reliability, however only 10% (of that 38%) would be prepared to pay more
- 44% of customers would prefer fewer outages (accepting that, if outages occurred, they may be of a longer duration), whilst 56% 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 40:

- SAIDI of 121.19 minutes
- SAIFI of 1.91
- CAIDI of 63.34 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	1.00	37.00	3.21	0.09	37.00
Urban Residential	2.00	62.00	79.88	1.29	62.00
Rural Dairy and Business	2.00	79.00	10.83	0.14	79.00
Rural Residential / Lifestyle	2.00	68.00	27.28	0.40	68.00
Grand Total	1.91	62.20	121.19	1.91	63.34

Figure 40. Calculated SAIDI from Survey Results (including 400V).

WEL has collected LV reliability data since November 2007. LV SAIDI and SAIFI represent 17% and 12% of the system total respectively. Hence, customer acceptable reliability targets excluding LV network can be derived as shown below:

- SAIDI of 100.62 minutes
- SAIFI of 1.69
- CAIDI of 59.44 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 projects are capital works in nature and will result in a significant increase in capital expenditure required for each SAIDI minute saved (See Figure 42).

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

The above 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. It then 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 main benefit of the reliability project has been 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 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 MAXIMO 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.

- Faults per 100km and Number of Interruptions

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 41.

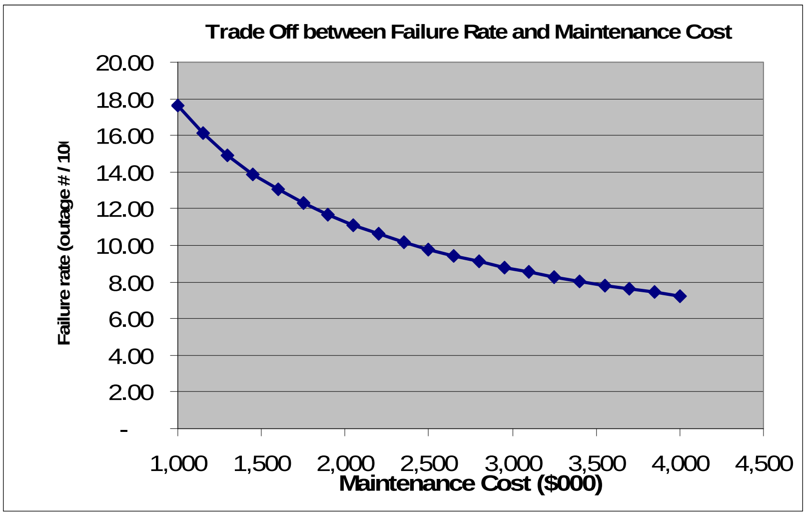


Figure 41. Likely Trade Off Between Failure Rate and Maintenance Cost

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. Following completion of this work it is considered reasonable to allow up to 6 outages annually for uncontrollable events.

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.

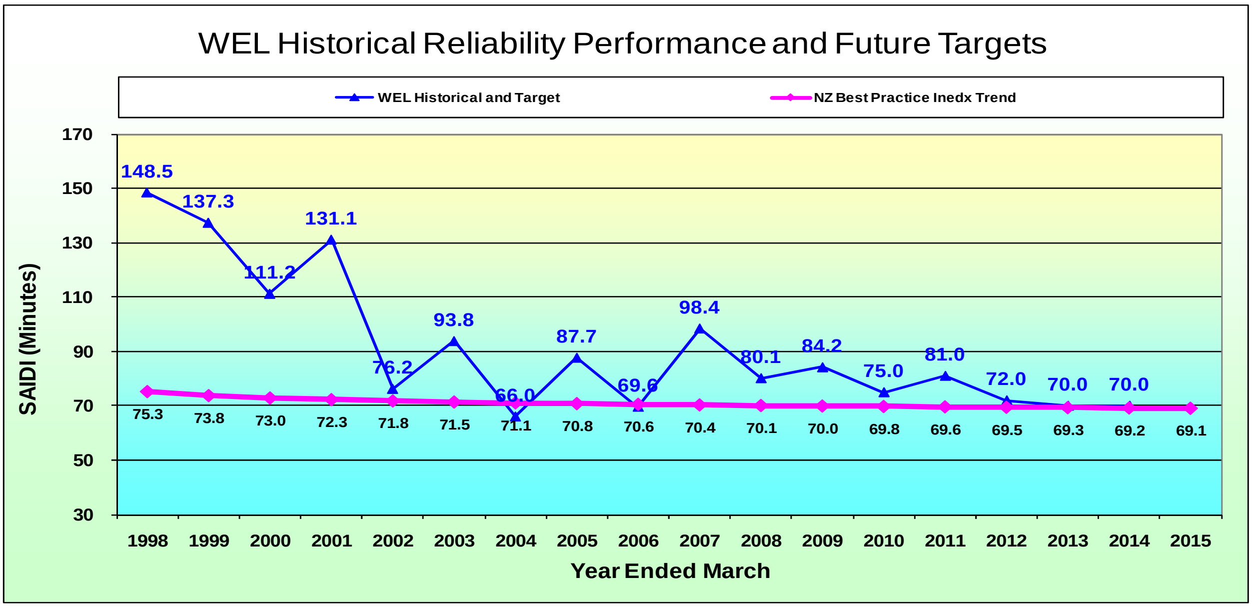


Figure 42. WEL Historical and Target SAIDI vs. NZBPI

The 2010/11 SAIDI target of 81 minutes includes 8 minutes of planned SAIDI for the identified RMU maintenance works programme.

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 top decile 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". Of the factors contained within the definition WEL places primary importance on safety. As such, safety practices are chosen to be consistent with industry best practice. Reliability is also 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. Primary customer service levels are measured by the following safety and reliability indicators.

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

- Targets for number of accidents/events and serious harm incidents are zero.

- Lost time injury accident (LTIA) has been used as the measure and the target is zero for every year. Key processes are:
  - Hazard identification through the 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.
  - Field staff and contractors using safe work practices
  - Adequate electrical protection systems to cut the power to potentially dangerous situations.

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	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
Unplanned 33kV	6	6	6	6	6	6	6	6	6	6	6
Unplanned 11kV	272	269	269	269	269	269	269	269	269	269	269
Planned	70	30	30	30	30	30	30	30	30	30	30

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

Measure	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
planned SAIDI	8	3	3	3	3	3	3	3	3	3	3
unplanned SAIDI	73	69	67	67	67	67	67	67	67	67	67
planned SAIFI	0.06	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
unplanned SAIFI	1.16	1.15	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	63	60	59	59	59	59	59	59	59	59	59
33kV Faults/100km	1.82	1.41	1.41	1.41	1.41	1.41	1.41	1.34	1.28	1.28	1.28
11kV Faults/100km	10.76	10.54	10.43	10.33	10.23	10.13	10.03	9.93	9.83	9.73	9.63

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

The plan 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, urban customers stated that two outages per year would be acceptable while rural customers also stated that two outages per year would be acceptable. This compares to four outages per year used as a measure for rural customers. 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.

Note that faults due to the low voltage system are not included in the analysis or the target setting. Emphasis over the next five years will be to maintain the current performance and achieve a desired outcome: Number for urban customers >4 and Number for rural customers >8.

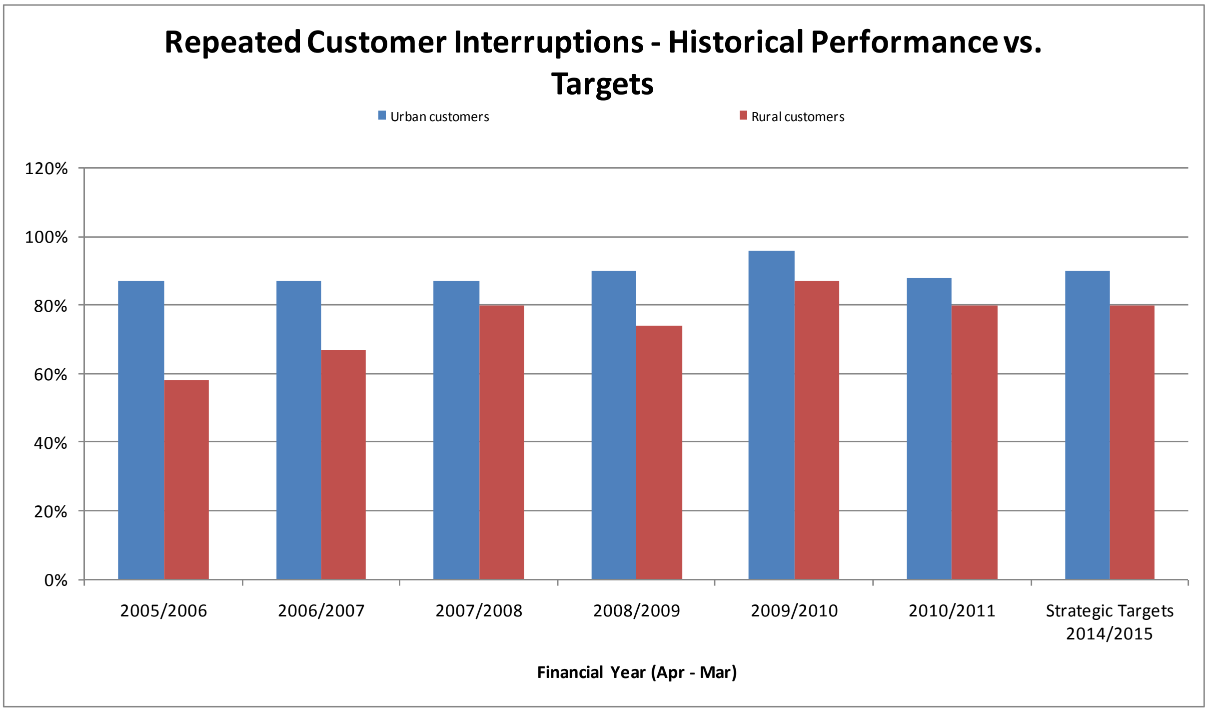


Figure 43. Customer Repeated Interruptions Historical Performance and Future Targets

4.3.3 <u>Secondary Customer Services Level</u>

These service levels are "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, measure 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 2010/11 financial year for CPC is $209.

WEL has significantly improved the maintenance programme in the last few years. MAXIMO 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 2010/11 financial year for billability and productivity is 80% and 90% respectively. The strategic targets for 2012/13 are 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.

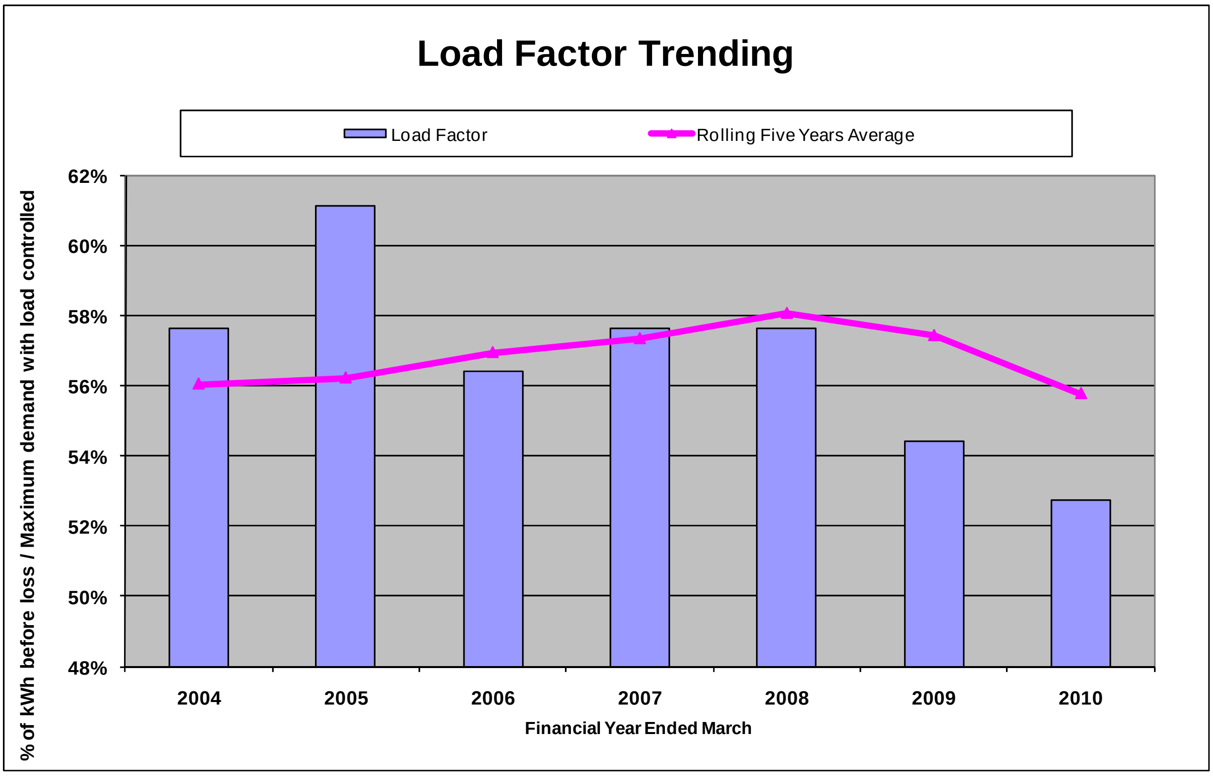


Figure 44. Network Load Factor Trending

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 55%.

4.4.4 Asset Efficiency – Capacity Utilisation

Asset utilisation is defined as the ratio of average load divided by the 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 realisation for industrial customers is set at 80%, unless requested differently by the customer.

WEL has set a 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 table in Table 9. The following points are noted:

- At the zone substation level currently 28% of WEL customers have a C2 security level, 43% have a C3 level, 10% have a B1 level, 11% have a B2 level, 4% have a B3 level and 4% have an A level.
- The Hamilton CBD is wholly supplied by Bryce Street, Kent Street 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,	<300	n	Note 1	Restore 100% in repair time	Restore 100% in repair time

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
	distribution transformers					

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 3. 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 to ensure 100% safety of the public and staff. It is necessary that system design, equipment type and size selection, protection design and work execution is correctly 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 section 3 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.

The formal process helps WEL to achieve maximum benefits consistent with company vision and mission statements.

5.2.2 Health and Safety and Regulatory Compliance

Compliance with legislative and health and safety requirements are given a high weighting. The probability and consequence of risk to compliance, public health and safety and operational health and safety are prime factors in the prioritisation of projects.

5.2.3 Reliability of Supply

Projects are also ranked for expected SAIDI and SAIFI improvements. These factors are determined by considering historic failure rates, reliability data and feeder lengths.

5.2.4 Economic and Financial Aspects

The financial evaluation uses estimated project costs to evaluate NPV, EBIT and other factors that would be achieved by the project.

5.2.5 Competitive Advantage

Competitive advantage gained by implementing the project is taken into account by making an assessment of improvements to brand, reputation and customer satisfaction. Because of the subjective nature of this assessment, this category has a lower weighting.

5.2.6 Customer Needs

WEL will discuss the requirements with the customer and ensure that the service achieves what the customer both needs and expects. In meeting customer needs (and expectations) WEL will not compromise health and safety or regulatory compliance and will also factor in trade-offs with environmental impact, costs and security of supply.

5.2.7 Security Standard

The security standard is set out in Table 9 and this is the basis for the provision of service. Where costs are perceived to be excessive, alternative more economic means of providing service at the required level of security are sought.

5.2.8 Environmental Impact

The conditions of Resource Consents are complied with fully and will not be compromised. Where there are conflicts between Resource Consent requirements these are addressed in consultation with all stakeholders and agreement reached that allows the Resource Consent conditions to be fully complied with.

Even if Consents are not required WEL considers how the environment is affected and will ensure the works will have a minimum impact on the environment.

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, zone substation data and billing 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 POS 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.

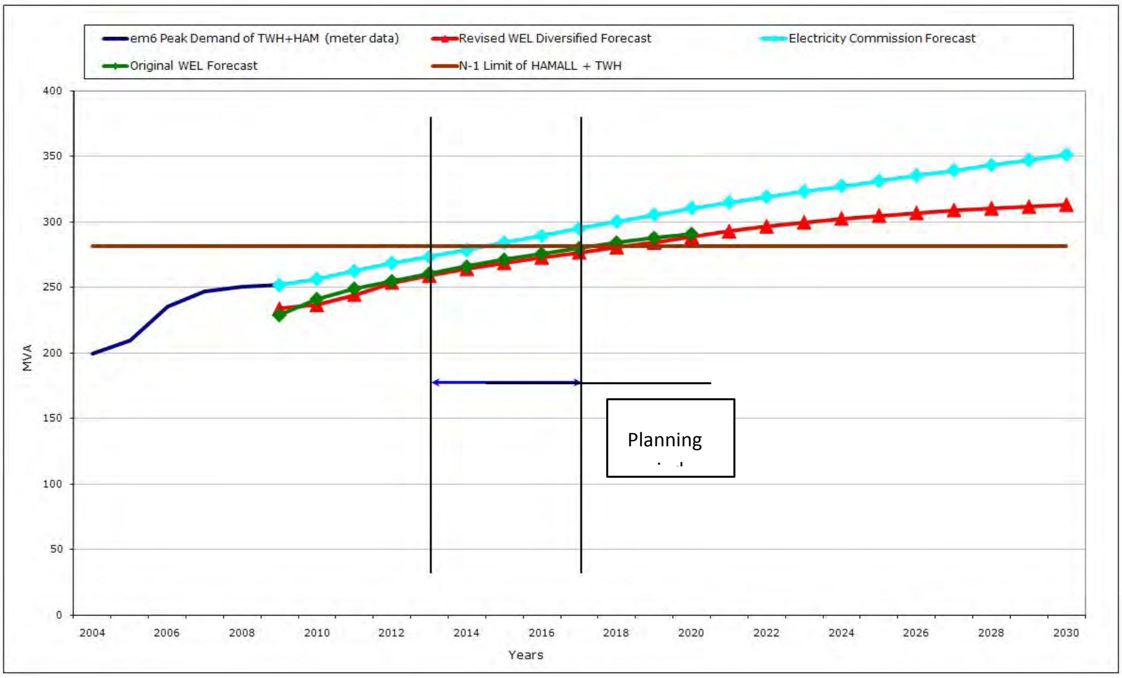


Figure 45. Overall Load Growth for The Greater Waikato

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 2020 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 under utilised 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	Customers Supplied	Winter 2010 ADPCD (Actual)	Winter 2020 ADPCD (est.)
Hamilton 33kV	100+120 MVA	100 MVA	132 MVA	44,616	125 MVA	164 MVA
Hamilton 11kV	2 x 40 MVA	40 MVA	44 MVA	12,702	37 MVA	32 MVA
Te Kowhai 33kV	2 x 100 MVA	100 MVA	109 MVA	16,317	70 MVA	92 MVA
Meremere 33kV	Nil	10 MVA	4.5 MVA	2,753	8 MVA	Nil
Huntly 33kV	2 x 60 MVA	60 MVA	81 MVA	6,028	17.3 MVA	41 MVA

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

5.3.3 Assumptions about future demand management.

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

- Progressive impact from introduction of smart meters in our network
- 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 meters) and also to make plant, equipment, appliances and living space e.g. increased use of heat pumps more efficient.

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

- Lower power consumption choices
- Purchase of more efficient appliances
- Increased use of time-of-day tariffs

The impact of these factors is assumed to be gradual and the demand forecasts have not been adjusted.

Refer also Section 5.6 for more information on non-network methods of managing demand and to Section 5.7 for a discussion about the proposed smart metering project.

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
- Potential GXP capacity at Hamilton GXP requiring monitoring and options investigation.

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 sections 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 key 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 owned 65 MW wind farm at Te Uku is being commissioned at present.

Photo 11 Turbines being delivered to the wind farm site at Te Uku

Photo 12 Wind turbine blades

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 heating 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)
- 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 Smart Metering

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

Smart meters 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 smart appliances such as heat pumps and refrigerators out of peak periods

Photo 13 Live Line Crossarm Replacement

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	Principle Reasons
HAM 33 & 11	Load exceeds capacity, particularly under contingent event	New GXP, increase capacity, transfer load	Increase capacity, balance loads across GXP's	Lowest cost solution

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	Lowest cost solution
Huntly	Nil			
Meremere	Single transformer (line) 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	Principle Reasons
Huntly to TeKauwhata 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

5.8.3 Substations including new substations and substation upgrades

Substation	Issue	Options	Decision Made	Principle 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
South East Hamilton Zone	Load growth	New Zone – Will cater for loads on the far south east, will reduce load on HAM 110/11 kV feeders	Increase capacity, improve voltage levels due to 11 kV feeders being near to Zone substation	Long term cost effective solution
Ruakura Zone	Load growth	New Zone – transfer load from HAM 110/11 kV which has a 30 degrees phase	Increase capacity-ability to backfeed other 11 kV feeders in the network	Long term cost effective solution

		shift with other 11 kV network		

5.8.4 11kV Distribution Network Enhancement or Upgrade

Feeders	Issue	Options	Decision Made	Principle Reasons
LATCB5	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	N-1 security to be met	Long term cost effective solution
SANCB1	Load exceeds capacity particularly under contingency	Upgrade, load transfer to other feeders	N-1 security to be met	Long term cost effective solution
Steele Park Reconfiguration	Load growth	Load transfer from CLA 11 kV ring to COB	Reduce 11 kV loads	Long term cost effective solution
Heaphy Terrace cabling and RMU	Load Growth	Load transfer from HAM feeders to CLA Zone	Reduce HAM 110/ 11 kV feeders load	Long term cost effective solution

5.8.5 Related Computer Systems Development Options

Key Functions	Issue	Options	Decision Made	Principle Reasons
Load Management System	Management of Transpower interconnection charges, network utilisation, localised network peaks, street light and meter tariff register changeover control. PowerOn NMS has no adequate load management system incorporated	Retain legacy SCADA for Load Control Stand alone system controlling and monitoring through PowerOn	Stand alone Catapult system controlling and monitoring through PowerOn	Legacy System old and overdue for replacement. Catapult OnDemand system proven in NZ.
Communication Systems	Overloaded analogue system channels, slow and issues with reliability. Enabling a high level of SCADA &	Upgrade network hardware using existing frequencies. Upgrade systems to	Upgrade systems to modern IP technologies Multiplexing of fibre circuits for better utilisation.	Long term cost effective solution Technology to cater for future trends Reliability Capacity for expansion

	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.	modern IP technologies Multiplexing of fibre circuits for better utilisation.		Flexibility for changing requirements
SCADA/DMS/OMS	Legacy System old and overdue for replacement. Limited navigation and search options. Unable to get full advantage of functionality of installed IEDs on network. No connectivity to allow effective outage management and auditable accounting for reliability statistics	Minor upgrades to present system. Install new SCADA only platform. Install proven integrated package including all NMS and call management functionality	Install proven integrated package including all NMS and call management functionality. GE PowerOn NMS	Meets business objectives. New Hardware and Software Extended functionality to SCADA Safety Logic incorporated.

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 and wind farm 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 2010.

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

All costs are stated in 2010 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.
- There will be no significant new technology introduced. The base load remains similar.
    - 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 improved efficiency 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 and therefore its ability to fund operations
  - 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 signalled 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 2010 – 2012

The following projects are in progress or planned for completion by the end of the 2012 financial period.

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
Asset Replacement	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
Asset Replacement	Horotiu Zone Substation replace 11kV Switchgear	Replace with new indoor circuit breakers.	Replace with new indoor circuit breakers.	Increase capacity of site Reduce ongoing maintenance costs. Ability to connect planned additional feeder circuits.	1,294
Asset Replacement	MAF Switching station replace 11kV Switchgear	Replace with new indoor circuit breakers. Replace with outdoor RMU arrangement.	Replace with new indoor circuit breakers.	Increase security level of site Reduce ongoing maintenance costs. Ability to connect planned additional feeder circuits.	476
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

Category	**Project Description**	**Options**	**Decision Made**	**Principle Reasons**	**Budget in AMP Period ($000)**
Asset Replacement	Knighton Rd / Clyde St pole replacements	Replace with new concrete poles. Replace with UG cabling, RMU installations and ground-mount transformers	Replace with UG cabling, RMU installations and ground-mount transformers	Remove assets from unsuitable locations i.e. roundabouts, reducing public / traffic safety hazard Reduce ongoing maintenance costs. Reduce visual impact of site.	276
Asset Replacement	Hetherington Rd pole replacements	Replace with new concrete poles in existing alignment. Replace with UG cabling in new road edge alignment	Replace with UG cabling in new road edge alignment	Remove assets from unsuitable locations i.e. swampy ground prone to flooding. Reduce ongoing maintenance costs. Reduce visual impact of site.	130
Asset Replacement	Glasgow 11 / 33kV line upgrade	Do nothing Replace the line	Replace the line	Increase the reliability	60
Safety and Compliance	Seismic strengthening Bryce St and Sandwich Rd substations	Do nothing. Install seismic bracing.	Install seismic bracing.	Protect against risk of earthquake damage. Increase security level of site	100
Safety and Compliance	Designate existing Zone substation sites	Do nothing. Designate sites Apply for resource consents as projects	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	Principle Reasons	Budget in AMP Period ($000)
		arise			
Customer Driven	External Subdivision	Not pursue – do nothing. Submit tender	Submit tender	finishing the work already starting years ago	1,482
Load Growth	South East Hamilton 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 1 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	5,999
Load Growth	Cobham Zone Substation Construction	Do nothing. Shift Network open points and upgrade existing 11kV cables. Convert existing switching station to full zone substation Install diesel generators to support major customer.	Convert existing switching station to full zone substation Last stage of the construction in 2010/2011 year	Increase security level of site. Provide for increased load by critical major customer. Optimise existing assets and established site. Avoid visual and noise pollution of generators.	1,912

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
Load Growth	Whatawhata Zone Substation and 33 & 11kV cabling and line works	Do nothing. Shift Network open points. Upgrade conductor and install voltage regulators. Install new Zone Substation	Install new Zone Substation Last stage of the construction in 2010/2011 year	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	547
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	3,778
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
Load Growth	Latham Court CB1 upgrade to enable load shifting to CB2 and off-	Do nothing. Extend building and install new CB and	Upgrade existing cable circuits and shift load by changing Network open	Opportunity to off-load highest loaded 11kV Network feeder. Avoid need for large capital outlay	410

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
	load CB5	feeder cable Upgrade existing cable circuits and shift load by changing Network open points	points	for new equipment and building alterations.	
Load Growth	Steele Park reconfiguration	Do nothing. Connect new feeder to existing spare CB Rearrange feeders and swap to other side of bus coupler.	Rearrange feeders and swap to other side of bus coupler.	Rearrange feeders to better balance supplies and provide for security across bus coupler	22
Load Growth	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 visual and noise pollution of generators.	1,078
Load Growth	Firth St new 500 kVA Transformer	Do nothing. Upgrade transformer. Shift load by changing LV open points	Upgrade transformer.	Reduce LV overloading and voltage issues. Provide for new and increased connections to LV Network	199

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
Load Growth	Graham St new 500 kVA Transformer	Do nothing. Upgrade transformer. Shift load by changing LV open points	Upgrade transformer.	Reduce LV overloading and voltage issues. Provide for new and increased connections to LV Network	79
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	On hold to install LV load monitors while waiting for smart meter's technology trial. Across four years' period	Proven technology available now. Permanent installation Smart meter may provide what is needed if the business case approved	200
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.	7,194
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	Install 33/11kV Zone substation at Ruakura while transpower invests for 3rd transformer Investment planned to be	Overcome HAM GXP capacity issues to satisfy n-1 security standard Remove phase shift issues	7,150

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
		substation at Ruakura.	across three years starting from 2011.		
Security	Latham – Peacockes upgrade of weak section of 33kV circuit	Do nothing. Upgrade smallest section of conductor only – Stage 1 Upgrade next smallest section of conductor – Stage 2 Reconductor entire circuit. Replace overhead with cable circuits.	Upgrade smallest section of conductor only – Stage 1 Upgrade next smallest section of conductor – Stage 2	Increase security level of site. Increase sub-transmission load transfer capability. Optimise existing assets and established sites. Avoid the need for easements	1,593
Security	Hamilton – 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	395

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
Security	Kent – Massey install new 11kV trunk	Do nothing. Shift load by changing Network open points. Install new 11kV trunk circuit.	Install new 11kV trunk circuit.	Increase security level of site. Optimise existing assets and established sites. Increased ability to transfer 11kV load around the network in contingency / emergency situations.	578
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	2,427
Security	Heaphy Terrace Stage 2 – Boundary Rd to Sare Crescent cabling and RMU installation	Do nothing. Shift load by changing Network open points. Install new 11kV express cable circuit and RMU Reconductor 11kV overhead circuit	Install new 11kV express circuit and RMU Last stage of the project	Increase 11kV supply levels into highly loaded residential area. Eliminate need for outages to reconductor. Off-load existing 11kV circuits	124

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
Security	Vickery St 11kV reconfiguration	Do nothing. Shift load by changing Network open points. Install new 11kV RMU and cable circuits to overhead lines.	Install new 11kV RMU and cable circuits to overhead lines.	Increase 11kV switching flexibility in manufacturing area. Off-load existing 11kV circuits	123
Security	Cobham – Steele Differential Protection installation	Do nothing. Install OC and EF protection on feeder. Install differential protection on feeder.	Install differential protection on feeder.	Better tripping discrimination for meshed 11kV Network.	27
Security	Fullerton Rd switching station	Do nothing. Construct a switching station	Construct a switching station	Improve the security particular due to wind farm	217
Load Control and Smart Grid	Relocate Ripple Plant from Hamilton to Weavers	Do nothing. Install ripple plant at Weavers	Install ripple plant at Weavers	Ability to shift Ngaruawahia substation load from Te Kowhai POS to Huntly POS	505
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.	460

Category	Project Description	Options	Decision Made	Principle Reasons	Budget in AMP Period ($000)
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	643
Wind Farm	Wind Farm transmission line and associated wind farm substation and reticulation	110kV option 33kV option	Construct 33kV transmission line and purchase associated wind farm substation and reticulation	Commercial decision based on benefit, cost and risk analysis	21,632

5.9.4 Medium Term - Projects proposed for 2012 – 2016

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

Category	Project Description	Options	Preferred Option	Principle Reasons	Budget ($000)
Asset Replacement	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	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

Category	Project Description	Options	Preferred Option	Principle Reasons	Budget ($000)
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 assets being removed from other site.	350
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	Gordonton Substation Upgrade	Do nothing Install 33kV switchgear and upgrade transformers Do above plus install 11kV switchgear. Do all three. Shift 11kV load by	Install 33kV switchgear, upgrade transformers and install 11kV switchgear.	Increase capacity of site Upgrade equipment to meet the expected change in security level requirement of the site Reduce maintenance costs and remove protection issues with 33kV CB on bypass. Future proof for lifestyle block	3,390

Category	Project Description	Options	Preferred Option	Principle Reasons	Budget ($000)
		changing Network open points.		establishment.	
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
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	190

5.9.5 Long Term - Projects proposed for 2016 – 2021

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

Category	Project Description	Principle Reason	Budget ($000)
Asset Replacement	Weavers Zone Substation replace transformers	Age profile of existing assets	2,000
Load Growth	11kV Rural upgrade to 22kV for capacity and voltage improvement	Network capacity upgrade Voltage improvement	1,500
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
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

Category	Project Description	Principle Reason	Budget ($000)
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	Cabling from wind farm to Teu substation	Improve security for the raglan area	2,000
Load growth	Tasman 3rd Transformer	To supply Rotokauri growth area	2,915

5.9.6 Whole categories of assets proposed for 2010 – 2021

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

Category	Project Description	Principle Reason	Total Budget (000)
Asset Replacement	Aging asset replacements	Age profile of existing assets	100,070
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.	3,114
Customer Connection	New Connections including new relays	Respond to customer request to connect to WEL Network	40,967
Customer Connection	Subdivisions	New developments	16,950

Category	Project Description	Principle Reason	Total Budget (000)
Asset Relocation	Relocations	Shift assets due to development or third party requests	25,861
Load Growth	Distribution Network Optimisation	Load growth	3,600
Load Growth	CBD and Rural LV Circuits Upgrade	LV Network capacity upgrade to avoid LV issues	10,340
Load Growth	LV Feeder Overloading Issues	LV Upgrades to eliminate overloading	3,600
Security	Discretionary Fibre Installation	Opportunity to install fibre or ducting while other cabling projects are in progress to future-proof	1,500
Security	11kV Cables Zone interconnections upgrade	Network capacity upgrade Increase 11kV level load transfer capability.	3,800
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	33,495
Reliability	Other reliability projects	To be reviewed and implemented to gain best SAIDI impact per dollar spent.	3,750
Asset Relocation	Undergrounding	In conjunction with Council and WEL Energy Trust	11,000

5.9.7 Asset Replacement and Renewal

The overall spend profile and programme for asset replacement can be seen on the spend plan 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.

Te Kauwhata Transformer Upgrade & 33kV GIS

Refer to Northern Network development stage 4 in section 5.9.8.1

Peacocks Zone Substation 33kV switchgear and transformer replacement

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 airport substation.

The two 33/11kV transformers rated at 10MVA are to be replaced with 15MVA units from Latham Court substation. Also refer to section 5.9.8.1Horotiu Zone Substation Upgrade 11kV CB Replacement

This project involves the replacement of end of life oil filled 11kV switchgear at Horotiu with a relatively new board to be relocated from the Cobham Drive switching station. Additional equipment including SCADA, protection, and distribution transformers will be upgraded concurrently.

Refer to existing substations work in section 5.9.8.5

MAF Switching Station Upgrade 11kV CB Replacement

This project makes provision for replacement of 11kV circuit breakers that have reached the end of their economic life or are considered to be unreliable.

Other Circuit Breakers

Two circuit breakers at Kent Street and one at Killarney Road are being replaced with higher rated vacuum breakers, to remove capacity constraints on outgoing feeders. This work will be carried out in the 2010/11 year.

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 Expressway.

Stage 2: Huntly to Te Kauwhata Dual 33kV Circuits

The Huntly POS 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 cables will provide N -1 security to Te Kauwhata and provide capacity for future load growth in this area and will also allow eventual disconnection of the existing 33kV supply from Transpower Bombay – Meremere.

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

Consents................................... Consent from affected parties required to install cables across Rangiriri Bridge

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

- Second 33kV line from Bombay GXP
- Additional 33kV overhead lines on the east and west sides of the river
- Installation of distributed generation to delay capital expenditure

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

The 33kV insulators on the Te Kauwhata to Meremere circuit have shown signs of failure, contributing around 6 SAIDI minutes in the past year. Porcelain insulators of this vintage have already been replaced on the Wallace to Te Uku and Meremere to Finlayson circuits with an immediate SAIDI benefit on both those radial 33kV circuits.

This project will replace all the 33kV Level 1 wooden crossarms and porcelain insulators with new standard Delta steel crossarms and K-line insulators. The objective is to eliminate the primary fault cause and reduce the SAIDI impact of the insulator failures.

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

Consents.................... Resource consent or NOR/building permit required for 33kV switch room

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 has 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 POS 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 factors

Primary Assets affected:..............................3kV cable

Consents........................Consent from affected parties/ easement required for river crossing

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

- Several route options

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 POS and the second transformer.

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

Consents..Resource consent or NOR/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 POS. 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

Consents..Resource consent or NOR /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

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 voltage management, area generation and load growth.

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

5.9.8.2 New Zone Substations

Airport Zone Substation

Hamilton Airport and 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

Consents......................................RC – completed: BC – 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

South East Hamilton Zone Substation (Morrinsville Road)

Lifestyle block 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 are voltage, fault level 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 cost benefit analysis 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

Consents.......................................NOR – required: BC – required

Cobham Drive Zone Substation Construction and Cabling

Both the WDHB's Waikato Hospital and Hamilton CBD are undergoing load growth which exceeds the ability of the 11kV network and adjacent zone substations to satisfactorily supply this type of load within permitted regulatory limitations.

A new 33/11kV zone substation between the Hospital and the CBD is required for the area to service the expected load growth. The existing Cobham Switching Station is to be converted into a zone substation with dual radial 33kV supply from the 33kV Hamilton bus. New WEL standard dual 15/23MVA transformers are being installed along with an up-rated and increased capacity 11kV switchboard. Substantial civil and building works on the existing site are underway to accommodate the change in service levels of the site. 11kV underground network augmentation is also required as part of the substation loading regime and will impact on load shifting of Peacockes, Latham and Claudelands zone substations. The project will be completed in mid 2010/2011.

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

Consents NOR – completed, BC – completed: COC to be completed

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
- Building options for acceptance by the local community
- Increased capacity of surrounding zone substations.

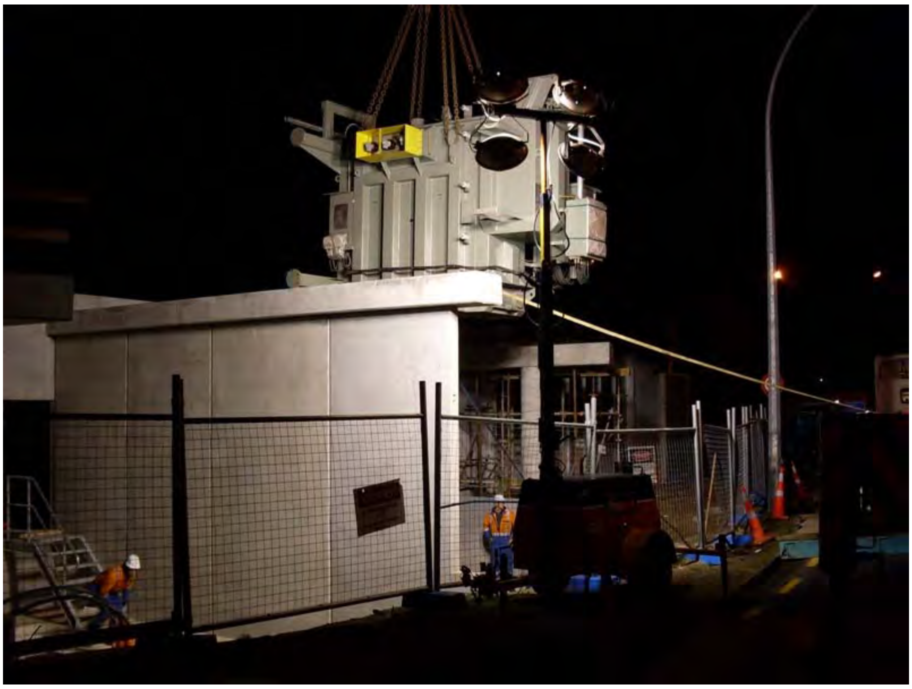


Photo 14 Transformer installation at the Cobham Drive zone substation

Whatawhata Zone Substation and 33kV/11kV cabling & line works

Wallace Road zone substation supplies a mixture of rural and urban 11kV feeders; this area has the potential for extensive subdivision growth. A new 33/11kV zone substation is newly commissioned in the Whatawhata area to supply the rural load. Existing rural feeders supplied from Wallace Road zone substation will be available to cater for future urban growth. Reliability of supply to the whole area is improved.

The substation includes indoor 33kV GIS switchgear, 11kV switchgear and control, protection and communications equipment. As part of the NOR process, it was agreed to install the transformers inside an enclosure to reduce the visual effects of the site. Dual transformers are catered for with pads poured for two and only one transformer initially installed until further load growth warrants installation of the second transformer.

The new substation has been designated under the NOR process and works commenced in mid 2009 and completed in 2010/2011.

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

Consents.......... ....NOR – completed: BC – completed, COC to be completed

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
- Building options for acceptance by the local community
- Increased capacity of surrounding zone substations.

Photo 15 Whatawhata zone substation

Raglan Zone Substation Construction

A new 33/11kV zone substation is required in Raglan within the next two years to service the expected 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 or recycled transformer will be installed initially with provision made for a second transformer to be installed at a later date.

Consents.....................................NOR – completed: Subdivision – in progress: BC – 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
- Building options for acceptance by the local community
- Increased capacity of surrounding zone substations.

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 2010 peak winter loading places Hamilton 33kV GXP marginally above the constrained limit. The preferred solution is to provide for an additional GXP in the northern part of Hamilton or upgraded 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 receives supply from Transpower GXPs at 33kV which is fed to the WEL 33/11kV zone substations via the WEL sub-transmission system. Originally the WEL 33kV network was a radial system centred on the Transpower Hamilton GXP. The protection installed on the 33kV feeders was mostly of the simple Overcurrent and Earthfault type.

During the 1990s the 33kV network was changed to a meshed system by the installation of several parallel circuits that linked the zone substations. At the same time, the Overcurrent and Earthfault protection schemes were replaced by basic Distance Protection schemes which were relatively simple to install as they did not require communication links. Those communication links were generally not available at that time.

For a meshed network with short lines, Distance Protection is not optimal since the line impedances are low compared to the source impedance or the fault impedance, and hence the protection cannot always discriminate between faults that are within the protected zone and faults that are outside of the protected zone. With a meshed system there is thus a risk that for certain faults the wrong circuits and/ or significant parts of the meshed networks are tripped with a resultant widespread loss of supply. The risk increases as the meshed system becomes larger and more complex.

It is planned to change from Distance Protection to Differential Protection on all 33kV feeders that emanate from Transpower GXPs together with associated protection scheme changes. The project involves the following:

- Retrofitting Line Differential Protection scheme on all 33kV circuits and ensuring duplicate communication links are available.
- Installing Busbar Protection on those 33kV switchboards that are presently not fitted with this.
- Installing Breaker Failure Protection schemes on all switchboards that have Busbar protection fitted.

- Installing Trip Circuit Supervision to all relevant circuit breaker control circuits where this is not already fitted.

The above is planned to be implemented within the next 6 to 8 years with the priority based on the risk profile of the particular circuit.

Photo 16 33kV Air Break Switches

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 six years to service 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

Consents......................................NOR – completed: BC – completed

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 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

Consents....................................RC – in progress: BC – 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 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.

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

Consents....................................RC – required: BC – required

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

Consents................................... RC – required: BC – required

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

Consents.................................. RC – required: BC – required

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.

The existing Crompton-Parkinson 9 panel 11kV double bus switchboard is over 50 years old and has pitch filled 11kV cable termination boxes. This old board is to be replaced by a 12 panel 1250A single bus board that will be removed from Cobham Drive switching station during its upgrade.

Some 11kV cabling work is required to balance feeder loads.

Protection will be upgraded to the current WEL standards.

The Horotiu building will be modified to accommodate the ex Cobham Drive switchboard.

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

Consents.................................. RC – not required: BC – 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

Consents:.................................. RC - not required: BC - required

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

Consents:.................................. RC - not required:BC - required

Ruakura MAF Switching Station

The Ruakura MAF 11kV switching station is located in a building just north of the railway line adjacent to the Ruakura squash courts. The building is in a low-lying area that is prone to flooding and the switchgear has suffered flood damage several times over its life. It is in a poor state of repair and is due for replacement.

This project will replace the existing switchgear with a suite of modern indoor 11kV switchgear and a new local service transformer. Protection will be upgraded with onboard new relays and a communications processor.

The existing switching station building, with improved flood protection, will be suitable to accommodate a suite of switchgear. Supply to the new switchboard will be from the existing feeder 11kV cable from Hamilton substation CB2762 via RMU78.

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

Consents:...................................RC - not required:BC - not required

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

- Upgrade of existing or use of new equipment
- Abandonment of existing equipment in conjunction with adjacent development.

5.9.8.6 Distribution Network Upgrade and Optimisation

Heaphy Terrace– Cabling and Ring Main Unit

The eastern Hamilton City area is currently supplied from the Hamilton POS 11kV bus. These feeders are heavily loaded and have a large number of customers per feeder. In addition, adjacent 33/11kV zone substations have a 30 degree phase shift with these 11kV feeders, presenting difficulty with load shifting, safety and contingent events.

New 11kV cable and a ring main unit, fed from Claudelands zone, in this area, is required to overcome these issues and to provide for infill and subdivision growth. This is in progress during 2010/2011.

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.

- Latham Court CB5 upgrade - to reduce high levels of load on the LAT CB5 feeder an upgrade is required.
- Kent to Massey Street feeder installation - to provide N-1 security on the Killarney Road, Norton Street, Massey Street 11kV ring.
- Steele Park reconfiguration - to provide N-1 security on the Peachgrove Road, Findlay Street, Steele Park 11kV ring.
- Feeder upgrades associated with south east Hamilton growth issues

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 40. These loggers will make significant amounts of additional data available for proactive management of the network and maintenance of service standards.

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 so all ripple relays in the northern area will have 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.

As new advanced technologies are becoming available (i.e. smart meters), we are currently investigating the alternatives to relay replacement, trying to find the best solution on how to control loads and include the northern network into the reserves market.

5.9.8.9 Te Uku Wind farm

WEL is working in partnership with a large energy provider to construct a substantial wind farm generating 64MW from 28 turbines, reflecting our commitment to developing regional renewable generation opportunities. WEL's partner will own and operate the wind farm whilst WEL will own and operate the transmission infrastructure. The transmission facilities consist of a substation at the wind farm and a 33kV transmission line about 25km long. The Te Kowhai to Whatawhata 33kV line will be reinforced to allow the generation to be supported by the network

Commissioning is expected during the 2010/2011 year

Primary Assets affected:.......................	33kV switchgear, 33/11kV transformers, 11kV switchgear, 33kV overhead line, protection relays
Resource Management Consents:	required

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

- Transmission line construction methods and route
- Transmission voltages
- Network connection options
- Commercial arrangements

Photo 17 Construction of the 33kV 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

Significant projects aimed specifically at reliability improvement have all been completed. A small annual budget is now provided to allow for small improvements as the opportunity arises. Reliability improvements now generally take place as opportunities are presented during larger projects required by load growth. One such project is the Raglan zone substation upgrade where remote controlled 11kV reclosers and RMUs will be installed instead of standard overhead switchgear. Remote operation of the switches will allow the rapid return of service to customers outside the fault area and minimise the number of customers affected by the fault while it is being repaired

5.9.9.2 SCADA Communication Enhancement

As a result of communications capacity limitations and slow retrieval of station data, a study was undertaken in 2005 to determine the adequacy of the WEL communications network and to assess requirements 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 network. The project scope includes:

- IP communications infrastructure to 45 substations and switching stations
- Installation of five new radio repeaters and refurbishment of two existing repeaters

Installation of 35 radio links and 14 fibre optic links

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

- Various technologies
- System configurations
- “Future proofing”

This project is due for completion in the 2011/12 year.

A project is well underway to provide multiplexing technologies on the existing 12 core fibre cables. This is required to enable effective protection signalling and SCADA communications to the developing network and also to accommodate the Te Uku wind farm substation and associated HV circuits.

WEL presently has 140 remote pole top sites on the network which are SCADA controlled over 5 radio channels radiating 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.

It is also a long term plan to reduce the reliance on WEL House as a major communication node. The last stage of this process is to migrate the pole top channels out to the communications nodes at the major repeater sites.

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 would be 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 communications in the future with the advantage of no degradation in service through increased usage.

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 and Ngaruawahia 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.

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.

<u>Seismic strengthening Bryce Street & Sandwich Road substation buildings</u>

Both Bryce Street substation and Sandwich Road substation have been identified as needing strengthening work to meet current seismic strength regulations.

This work has been scheduled to be completed in the 09-10 year to meet regulatory requirements.

Most of the work involves the installation of steel framing to the interior of the buildings to provide structural strength.

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 10 MVA of commercial capacity is connected annually. This often requires network augmentation. A significant investment is made annually to provide for these new developments.

The growth in rural lifestyle properties has placed particular demands on the rural network as these customers have high expectations although they reside in rural or semi rural areas.

WEL is presently is contracted for the reticulation services for this Wellington development. WEL is also happy to consider selling this development to the incumbent network operator. As an interim measure we have included in our budgets the future staged development costs.

5.9.11 Asset Relocation

<u>Relocation</u>

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.

<u>Uneconomic Undergrounding Projects</u>

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: Ruakura 33kV GIS

As part of a Transpower upgrade to the Hamilton GXP the existing 33kV overhead buswork and circuit breakers are to be replaced 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: Ruakura Zone Substation

Hamilton 110/11kV bus has a 30 degree phase shift with other 11kV networks in the WEL area and 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. A new zone substation is proposed.

A number of options were considered to achieve the planning and business objectives. Of these; multiple sites, new zone interconnect 11kV feeders, voltage regulators, capacitor support and embedded generation solutions were considered both technically and commercially with the following optimised solution.

A new 33/11kV zone substation at the Hamilton GXP is required for the area to service the expected load growth and to split high customer numbers across feeders. The zone substation is to be built with radial 33kV supply from the 33kV Hamilton bus and designed for WEL standard dual/triple 15/23MVA transformer capacity. This will also require 11kV underground network augmentation as part of the substation loading regime and will impact on unloading of Chartwell, Gordonton and Claudelands zone substations.

Stage 3: HAM 110kV GXP Changes

The loading of the Hamilton 110/11kV GXP has exceeded the constrained limit for secure operation. In addition, a 30 degree phase shift does not allow for load to be transferred to adjacent networks without the loss of supply to customers. Under investigation is the replacement of the HAM 110/11kV transformers with 110/33kV 2 x 60MVA or a single 120MVA transformer(s), together with the Ruakura zone substation mitigates the phase shift issue, caters 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. The replacement of the transformers is a Transpower activity but minor works for connection to the Ruakura zone substation are required by WEL.

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 new substation in the Rotokauri area or a third transformer in Tasman is planned in order to service 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

2010 power flow studies 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 level 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. On average $11m per annum has been included in the plan. 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
- 33kV protection upgrade from distance protection to differential protection
- 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	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**	**20/21**
Customer Connection	5,147	6,380	5,302	5,302	5,267	5,267	5,267	5,267	5,267	5,267	5,267
System Growth	33,185	19,616	20,474	19,169	11,304	8,485	10,915	17,250	12,858	11,136	8,645
Reliability, Safety and Environment	1,021	1,348	1,064	875	755	730	775	780	730	730	730
Asset Replacement and Renewal	7,516	8,601	8,015	9,755	10,516	11,966	12,266	8,626	9,046	8,626	8,800
Asset Relocations	2,861	4,000	4,000	4,000	4,000	3,000	3,000	3,000	3,000	3,000	3,000
Total Capital Expenditure	**49,729**	**39,944**	**38,855**	**39,101**	**31,842**	**29,447**	**32,222**	**34,922**	**30,900**	**28,758**	**26,441**

*Note 1: Asset Replacement includes capitalised maintenance.

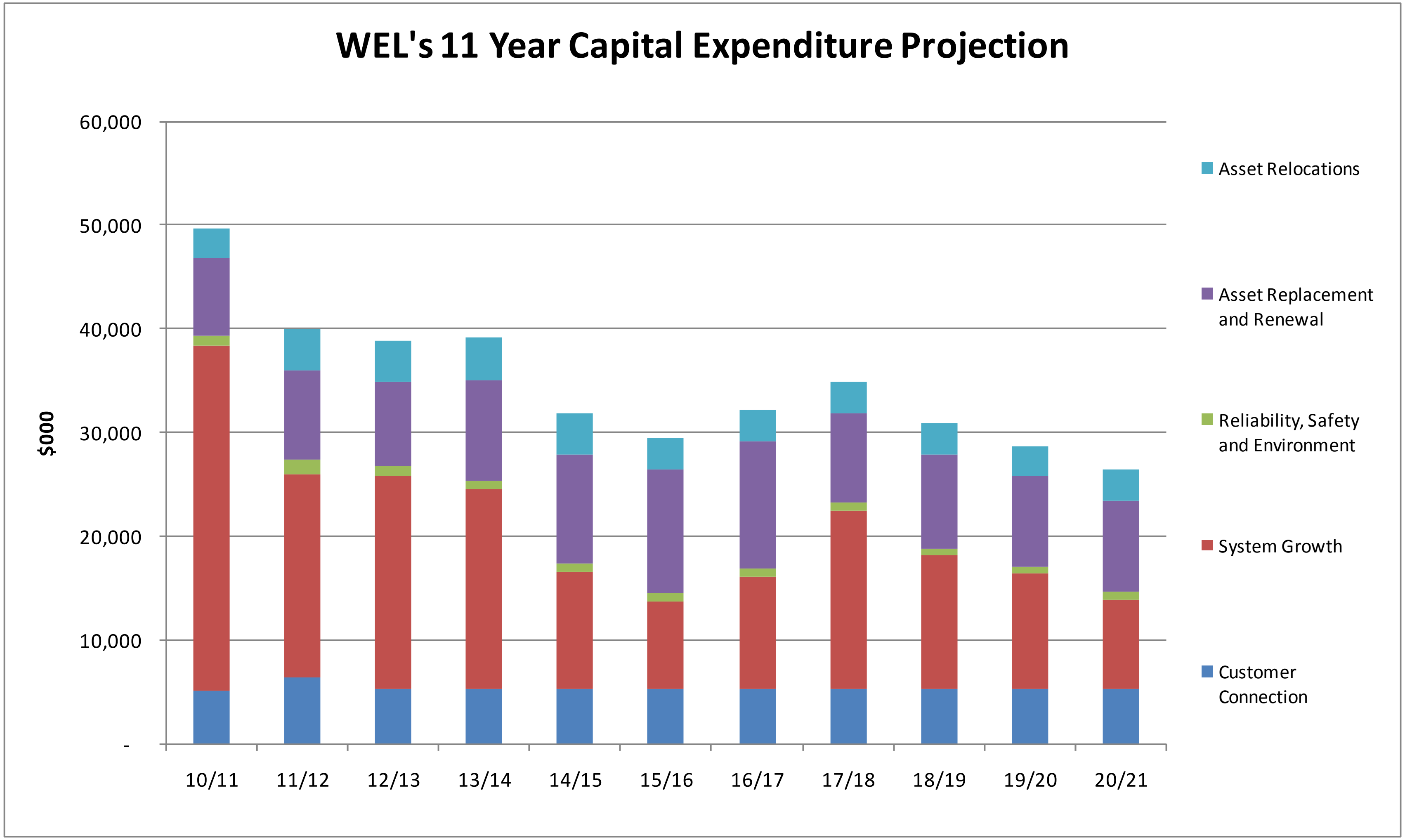


Figure 46. Capital Expenditure Projection for AMP period.

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.

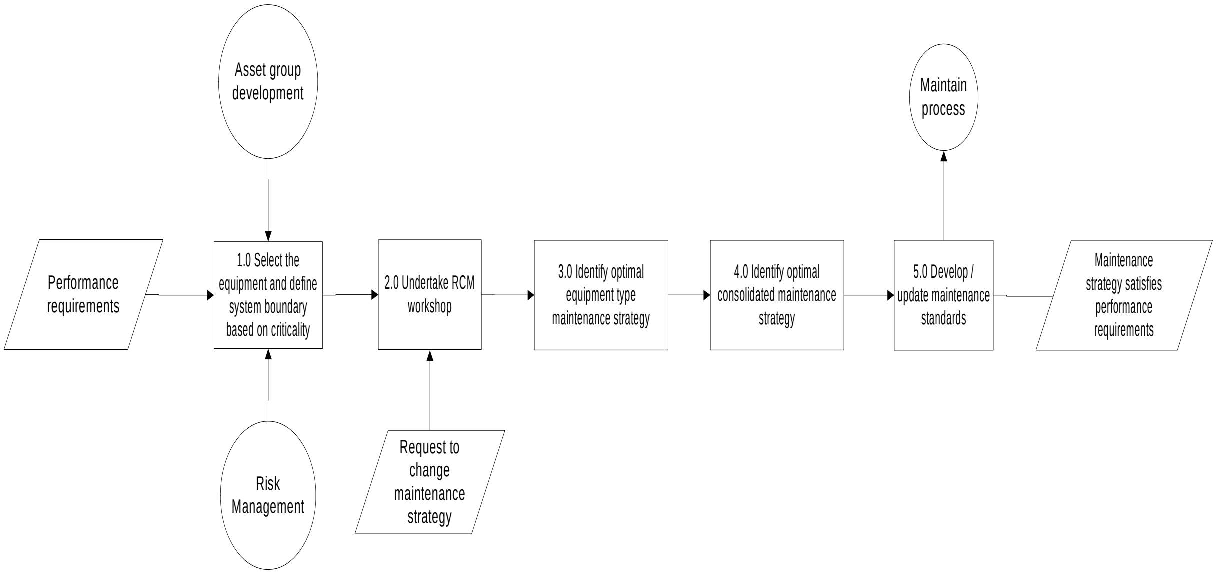


Figure 47. Maintenance Optimisation Process

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. In the current year new wind farm related assets (a switching station and 33kV circuits) and two new zone substations (Whatawhata and Cobham) will be added. Provision is also made beginning in the 2011/12 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.

2010 AMP WEL's 11 Year Maintenance Expenditure Projection ($000)											
Operational Expenditure	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**	**20/21**
Routine and Preventative Maintenance	2,807	3,011	3,047	2,807	2,835	2,811	2,813	2,815	2,823	2,825	2,827
Refurbishment and Renewal Maintenance	1,494	1,752	1,732	1,688	1,702	1,688	1,688	1,688	1,692	1,692	1,692
Fault and Emergency Maintenance	2,281	2,399	2,373	2,366	2,366	2,367	2,367	2,367	2,367	2,367	2,368
Total Operational Expenditure	**6,582**	**7,162**	**7,152**	**6,862**	**6,904**	**6,866**	**6,868**	**6,870**	**6,882**	**6,884**	**6,886**

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. The quantity of high priority sites will be tracked to ensure a downward trend. An additional provision has been made to clear LV tree problem sites.

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.

Distribution Maintenance

This spend covers all non substation assets and primarily covers preventative maintenance, inspections and 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. In the current year the RMU inspections will continue. It is anticipated that flowing on from this will be a program to inspect and correct any safety issues related to service pillars.

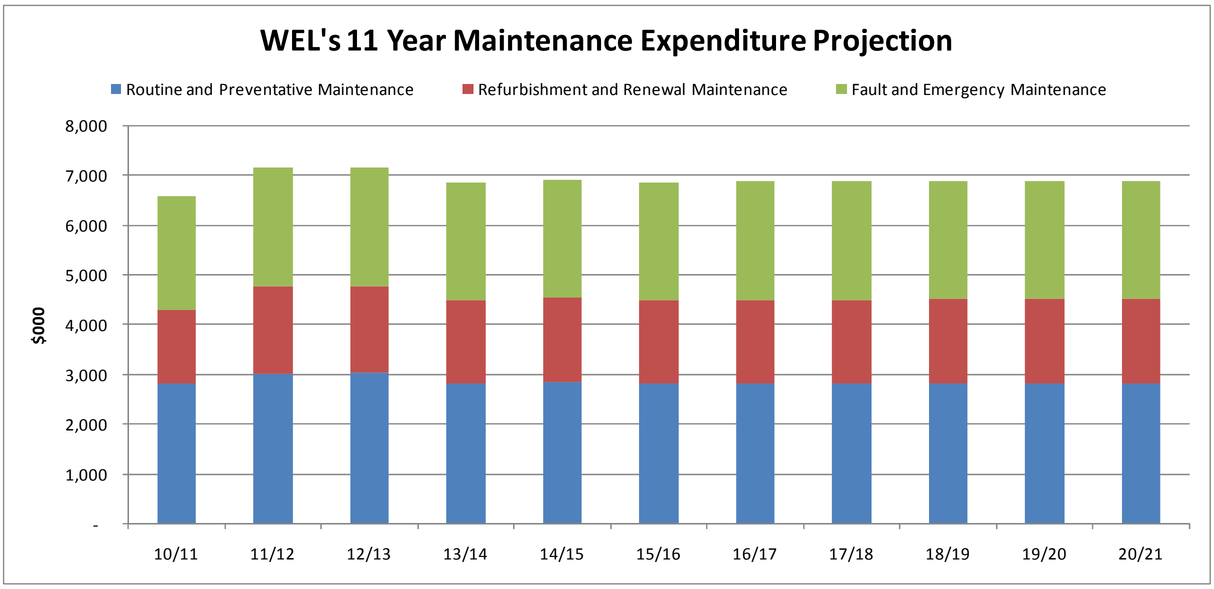


Figure 48. Maintenance Expenditure Projection for AMP period.

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)

Asset replacement Category ($000)	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
11 KV Circuit Breaker	1,405	30	-	-	-	200	400	-	180	150	300
11 KV Ring Main unit	320	400	500	600	600	500	400	300	300	200	200
11 KV Switching Station/Zone Sub	26	100	50	200	50	500	400	50	200	200	295
11KV Air Break Switch	200	150	250	600	550	900	1,100	760	650	510	340
11KV Reclosers and Sectionalisers	101	50	-	-	50	50	-	-	-	-	50
33 KV Circuit Breaker	-	200	50	-	300	-	-	-	-	-	
33 KV Overhead Lines	564	-	-	-	-	-	-	-	-	-	
33KV Sub-transmission UG cable	-	-	-	-	-	-	-	-	-	-	
Distribution 11 KV OH Lines	353	300	300	250	250	250	250	250	250	250	250
Distribution 11 KV UG cables	75	100	100	100	100	100	100	100	100	100	100
Protection Relays	246	100	-	-	200	150	350	-	150	100	190
Poles-	600	600	600	600	200	200	200	200	200	200	200
Crossarms	650	700	1,500	2,000	2,000	2,000	2,000	2,500	2,500	2,500	2,500
Distribution Transformers(11kV/400V)	300	450	450	1,250	2,000	3,000	3,000	500	500	500	500
Fuse 11kV	60	200	200	200	200	100	100	100	100	100	50
LV Overhead Reticulation	50	50	50	50	61	61	61	61	61	61	70
LV Underground cables	-	400	400	400	400	400	400	400	400	400	400
SCADA & Comms	-	200	100	150	200	200	150	150	200	200	200
Zone Substation Transformer	-	926		-	-	-	-	-	-		
Service and Dist Pillars	160	300	500	500	500	500	500	500	500	400	400
Capitalised faults	1,405	1,405	1,405	1,405	1,405	1,405	1,405	1,405	1,405	1,405	1,405
Capitalised Maintenance	1,000	1,000	1,000	800	800	800	800	700	700	700	700
Medium mixed projects		840	360	450	450	450	450	450	450	450	450
Other		100	200	200	200	200	200	200	200	200	200
Total	**7,516**	**8,601**	**8,015**	**9,755**	**10,516**	**11,966**	**12,266**	**8,626**	**9,046**	**8,626**	**8,800**

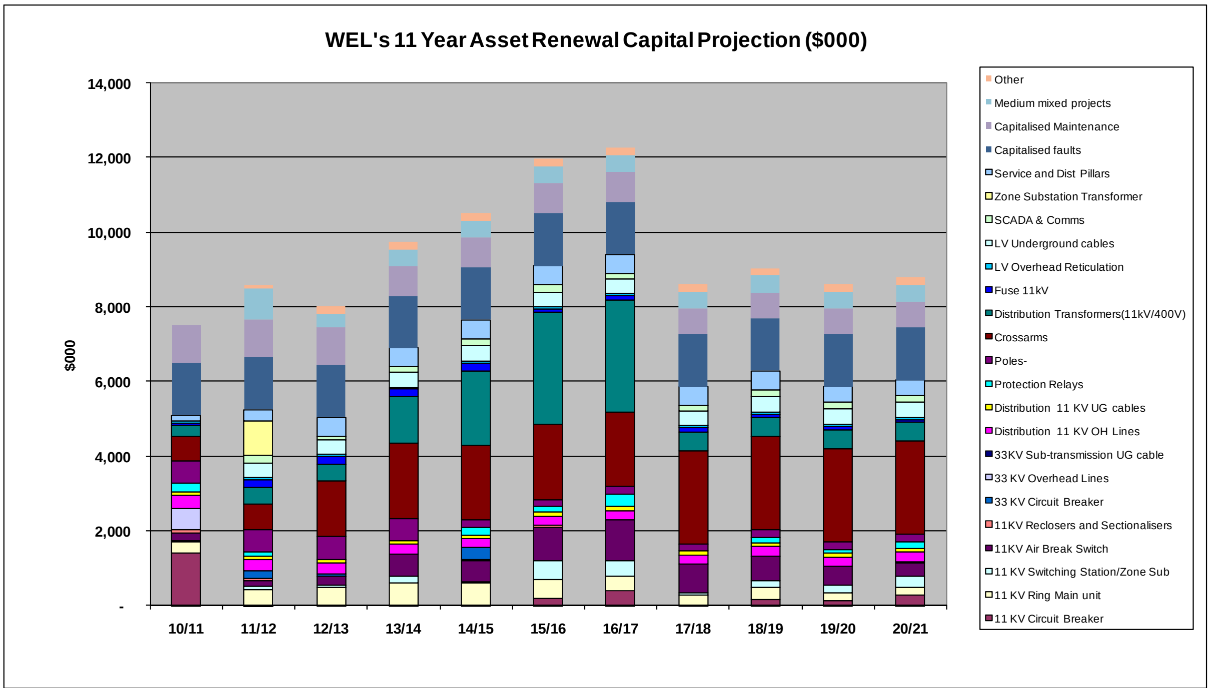


Figure 49. Asset Renewal Expenditure Projection by Asset Category for AMP Period

In this planning period, renewal is primarily targeted to switchgear and other overhead distribution equipment. Underground conductor replacement is increasingly dominant in the second half of the period.

The above presentation has been changed from the previous year in that it explicitly 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.

A breaker at Gordonton is being replaced in the current year due to problems with the contacts and the inability to source replacement components. 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 quick 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 large new transformers are being purchased to accommodate load growth in one area and the existing ones will be used to replace 2 other 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 is planned in 2010/11 as it has reached end of life and other capacity upgrades at the site are also required.

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 2013 onwards. Garden Pl (2015/16), 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 ten 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 is being rebuilt and the Cobham switching station is being 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 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 and delta construction installed. 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 11 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. Currently because of problems encountered with particular models of oil filled ring mains, all oil filled RMUs are being internally inspected and having the oil changed. This programme is expected to be completed at the end of the 2011 financial year.

Finally for oil-insulated 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 11 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. Based on past experience, 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

A five yearly inspection regime, arranged to coincide with line inspections and earth testing, is currently performed for distribution transformers with the exception of pole mounted distribution transformers under 100kVA. These transformers are driven to failure or to the point just before they become an environmental or safety hazard at which time they are replaced.

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 will be fitted to all new ground mounted transformers 300kVA and over. Furthermore 40 loggers are being 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.

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.

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 11 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 273Hz 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 11kV 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

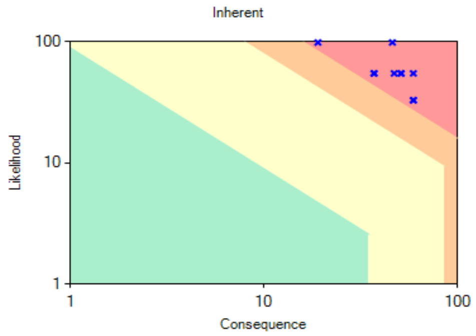
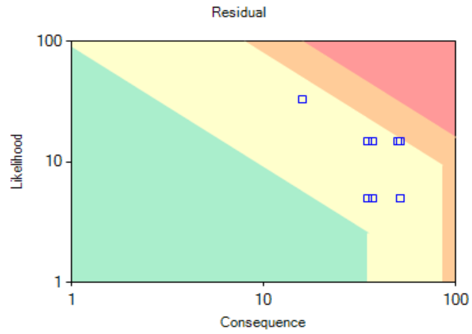
Any staff member is able to identify a risk and have that risk added to the Risk Management database. The staff member identifying the risk will work with the Risk and Regulatory Manager to input the risk collaboratively. The new risk will then be assessed and ratified by the Risk Management Committee.

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	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
2	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)
3	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 training • 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
4	Significant SAIDI minute loss or injury to persons resulting from defective work being carried out due to ambiguous, inadequate, or a lack of access to drawings in the Design & Construction Manual	• Network design and construction standards DCM 01/02/03/04/05 • Work quality auditing

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
		• AIS 113 Updating of Design and Construction Manual • Regular New Technology briefings
5	Safety equipment or associated equipment fails and causes harm.	• Induction training • CG 101 Health and safety standards for personnel working on WEL's network • MAXIMO • Control of Test and Inspection Equipment requiring calibration • Pre-start hazard assessment • FS-WC-03 Field Services Work Compliance
6	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)
7	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 • Network design and construction standards DCM 01/02/03/04/05 • WEL Maintenance Manual • MAXIMO • Maintenance works delivery plan • Personal Protective Equipment (PPE)
8	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
9	Potential for injury and reliability impact if there is	• Equipment operating training

Rank	Uncontrolled Risk Risk Description	Risk with active controls in place Risk Controls
	misalignment between Syscon SCADA data and actual network status as a result of no or poor commissioning procedure.	• Network design and construction standards DCM 01/02/03/04/05 • OR 101 Network Outage and Management Permits and Switching • OR 104 SCADA management and GUI-DMS update process • AIS 108 As-Builting Procedure (Asset Database) • Personal Protective Equipment (PPE) • AIS 110 Asset commissioning and decommissioning process
10	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

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.

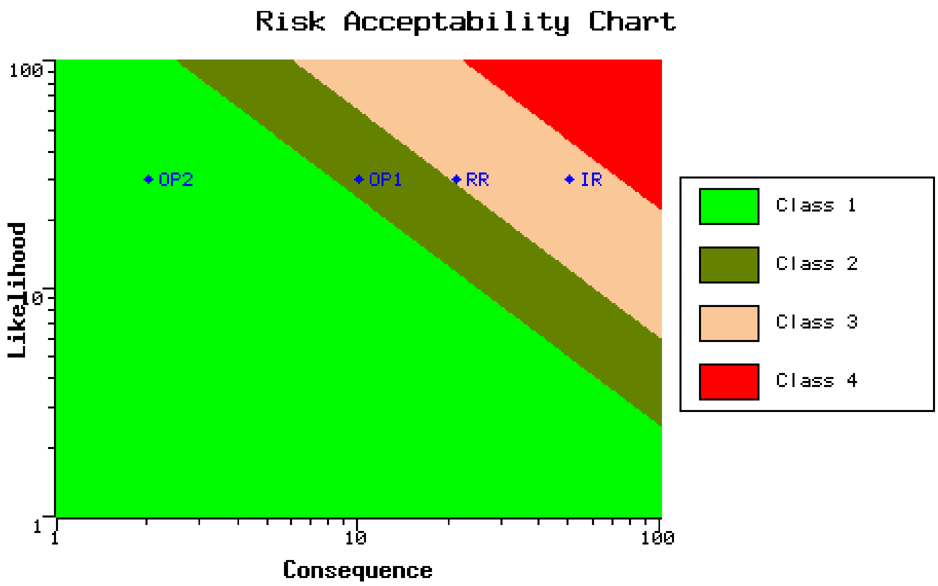


Figure 50. Risk Acceptability Chart

7.1.5 <u>Acceptability Benchmarking</u>

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. Monthly reports on the status of planned action treatments are prepared for divisional General Managers.

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. There 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 Risk Scenario Planning

WEL has put in place a programme of regular modelling of major risk events. This process incorporates the risk management aspects as detailed above but goes on to model the impacts should the risk event actually occur. Risks are chosen to be taken through this process because they are significant and also because they are representative of a range of similar risks. The scenario modelling exercise, including findings, is presented to the WEL Board of Directors for its review.

Risk scenario modelling is beneficial for both detailed risk management and also in contributing to business continuity planning. It is shown below:

Table 16 Risks currently included in risk scenario modelling

Rank	Risk	Inherent Classification	Residual Classification	Status
1	Loss of a POS (Hamilton, Te Kowhai, Huntly, Bombay)	Extreme	High	Completed
2	Fatality (public, staff)	Extreme	Medium	Completed
3	Major oil spill	Medium	Low	Completed
4	Pandemic/Loss of multiple staff	High	Medium	Completed
5	Bankruptcy of generator/retailer	High	Medium	Completed
6	Loss of a substation	Medium	Medium	Completed
7	Loss of strategic circuits	Medium	Medium	Completed
8	Major Storm	Extreme	High	Completed
9	Regulatory breach	Extreme	Medium	Completed
10	Control Room switching and the operation of defective equipment	High	Low	Completed
11	Accident with machinery in the Distribution centre or Depot	Extreme	Medium	Completed
12	Defective work or failure to test results in harm	Extreme	Medium	Completed
13	Inconsistent data in linked operational systems resulting in reliability and financial losses and potential safety issues.	Extreme	High	Due October 2010
14	Catastrophic failure of Ring Main Units during operation	Extreme	Medium	Due November 2010

7.4 Emergency Response And Contingency Planning

The following operational contingency plans are in place:

7.4.1 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.

7.4.2 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.

7.4.3 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.

7.4.4 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.

7.4.5 Automatic Load Shedding

WEL is contracted to provide automatic under frequency load shedding (AUFLS) of minimum 2x16 % of its total load under certain frequency conditions. The same circuits would also be utilised as the first stage of manual load shedding.

7.4.6 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.

7.4.7 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 2009/2010 financial year was $1,336k more than the value forecast in the 2009 AMP (difference of 4.9%). Table 17 gives the reasons for key differences.

Table 17 2009/2010 Capital Expenditure: Actual versus Budget

Forecasted Capital Expenditure in 2009 AMP compared with Actual Spend for the Period from April 2009 to March 2010				
Total Network Capital Expenditure	09/10 Actual ($000)	2009 AMP Indicated ($000)	Variance (%)	Comments
Customer Connection	5,292	2,851	85.6%	Many more customer connections were completed than expected
System Growth	14,665	13,991	4.8%	Higher consenting costs due to both volume and higher costs
Reliability, Safety and Environment	1,283	2,283	-43.8%	Some reliability projects were delayed due to the economic recession.
Asset Replacement and Renewal	5,108	5,256	-2.8%	
Asset Relocations	2,519	3,150	-20.0%	Asset relocation projects, particularly the uneconomic undergrounding programme were fewer than expected. These are customer driven.
Total Capital Expenditure	28,867	27,531	4.9%	

8.1.2 Network Development Programme

Table 18 and 19 show that the physical progress of 2009/2010 listed capital projects with an associated description. Most of the capital works programme has been completed except the eight projects shown in Table 19:

Table 18 Completed Projects

Completed Capital Projects during 2009/2010
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 WAL
Top 10 Feeder Loadings
PILC Cable Replacement
Huntly POS WEL switching station 33kV work
Huntly POS - Weavers 33 lines rationalisation
Hampton Downs Zone Sub
Sentry System Replacement
Borman Substation
Cobham Drive Substation – 33kV&11kV Cabling
Hospital Switching Station
Horsham Downs Zone Sub
Airport Cable install & PEA
Springhill Zone Substation

Completed Capital Projects during 2009/2010
Raglan Substation – Land Purchase

Table 19 Capital Projects in Progress

Capital Projects in Progress as at 31 March 2010		
Project description	% completed	Comments
Whatawhata Substation	63%	Delayed due issues with placement of foundation
Cobham Drive Substation	56%	Delayed due to consenting issues
WNUP 33kV Line - Design & Construction	40%	Due for completion in the current financial year
WNUP 33kV Line - Wind Farm Substations	0%	Due for completion 21 Jan 2011
Weavers Ripple Control Plant Project	10%	Material purchase waiting design from TESLA
New 11kV Trunk Feeder between Kent and Massey Streets	40%	Stage 2 due for completion Nov 2010

8.1.3 Maintenance Expenditure

Actual versus budgeted maintenance expenditure for the 2009/10 year is shown in Table 20 below.

Forecasted Maintenance Expenditure in 2009 AMP compared with Actual Spend for the Period from April 2009 to March 2010				
Operational Expenditure	09/10 Actual ($000)	2009 AMP Indicated ($000)	Variance (%)	**Comments**
Routine and Preventative Maintenance	2,729	2,557	6.7%	
Refurbishment and Renewal Maintenance	1,430	1,295	10.4%	$100k project driven cost wasn't included in original AMP.
Fault and Emergency Maintenance	2,134	1,885	13.2%	Both fault volumes and unit costs were slightly higher than expected
Total Operational Expenditure	**6,293**	**5,737**	**9.7%**	

Table 20 2009/10 Maintenance Expenditure- Actual versus budget.

8.2 Evaluation And Comparison of Actual Performance Against Targeted Performance Objectives

8.2.1 Safety

There were two serious harm accidents for the year 1 April 2009 to 31 March 2010.

Health and safety statistics since April 2008 are shown in Appendix 5.

Photo 22 EEA National Public Safety Awards For WEL's "Look Out" Campaign

8.2.2 Reliability

WEL's performance for the year 1 April 2009 to 31 March 2010 compared to target is shown in Table 21.

Table 21 Performance Measures for Reliability

Performance Measures	Target 2009/10	Actual 2009/10	Variance
WEL Networks unplanned 33kV interruptions (No.)	6	7	1
WEL Networks unplanned 11kV interruptions (No.)	332	199	(133)
WEL Networks planned interruptions (No.)	130	76	(54)
WEL Networks total unplanned interruptions (No.)	338	206	(132)
WEL Networks planned SAIDI (Minutes)	13.00	9.84	(3.16)
WEL Networks unplanned SAIDI (Minutes)	77.00	65.14	(11.86)
WEL Networks planned SAIFI	0.10	0.08	(0.02)
WEL Networks unplanned SAIFI	1.54	1.08	(0.46)
WEL Networks planned CAIDI (Minutes)	130.00	129.13	(0.87)
WEL Networks unplanned CAIDI (Minutes)	49.94	60.06	10.11
WEL Networks Total SAIDI (Minutes)	90.00	74.98	(15.02)
WEL Networks Total SAIFI	1.64	1.16	(0.48)
WEL Networks Total CAIDI (Minutes)	54.82	64.59	9.77
33kV Faults/100km	1.82	2.13	0.30

Performance Measures	Target 2009/10	Actual 2009/10	Variance
11kV Faults/100km	13.27	7.95	(5.31)

There were no Transpower outages over the last year (other than for hot water control for grid security purposes in the northern region). Excluding any Transpower impact, the SAIDI performance for the year ending March 2010 was 74.98 minutes compared to a target of 90, SAIFI was 1.16 compared to a target of 1.64, and CAIDI 65 minutes compared to a target of 55.

The following table shows the breakdown of outage causes for the year.

Table 22 Outage Statistics for 2009/2010 Financial Year

Controllable / Uncontrollable Category	Outage Numbers	Customer Count	SAIDI (Minutes)	% of SAIDI	SAIFI	CAIDI (Minutes)
Controllable Events						
Defective Equipment	123	37,197	33.33	44%	0.44	75.66
Planned Shutdowns	77	9,767	10.13	14%	0.12	87.55
Trees	8	656	0.91	1%	0.01	117.42
Total Controllable Events	**208**	**47,620**	**44.38**	**59%**	**0.56**	**78.67**
Uncontrollable Events						
Adverse Weather	11	5,394	3.95	5%	0.06	61.80
Vehicle Accidents	34	12,538	11.09	15%	0.15	74.76
Diggers v Cables	1	55	0.01	0%	0.00	19.00
Birds	25	16,994	7.98	11%	0.20	39.77
Others	40	15,477	7.56	10%	0.18	41.29
Total Uncontrollable Events	**111**	**50,458**	**30.60**	**41%**	**0.60**	**51.27**

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, a large contribution (recorded as 15 outage events and several SAIDI minutes) relates to the case late last year where a small fault at Chartwell caused an 11kV line clash and subsequent flare into the 33kV lines with a loss of power to Chartwell, Gordonton and Borman zone substations. This section of lines will be undergrounded in the near future as part of the Wairere Drive extension.

Other events relate to a range of causes, some of the main outages include:

- A number of LV panels becoming overloaded or having poor connections, resulting in the panel burning out during high winter loading. Additional thermal imaging was instituted and transformer load loggers are being progressively installed to identify heavily loaded transformers.
- A voltage regulator suffering an internal failure which resulted in major damage.
- Failure of a live line clamp due to corrosion, being in a coastal environment. Patrols of these areas have identified more problematic sites; remedial work is scheduled for this financial year.
- Other contributors are failed insulators and 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 87% with a target of 80%. Last year's performance was 74%. Figure 51 below shows the spread of customers against the number of outages they experienced.

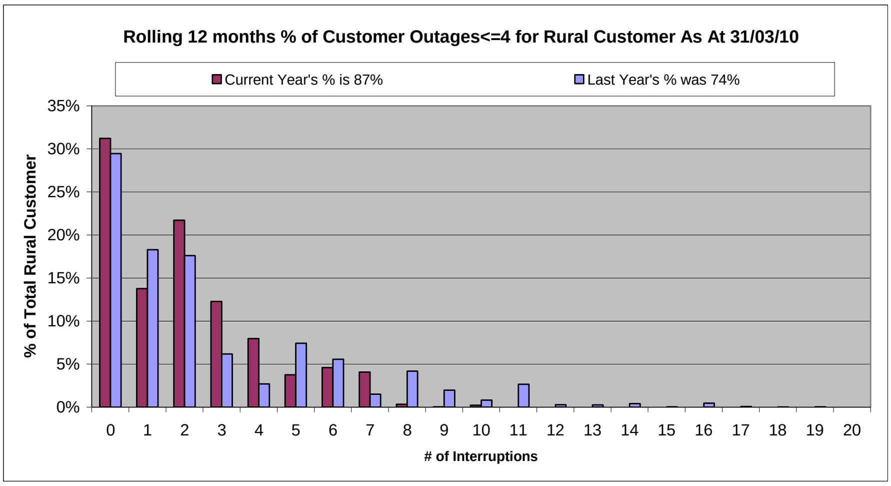


Figure 51. Rural customers against number of outages experienced.

Additionally WEL is aiming to bring rural customers with more than eight outages back to less than eight outages per year. There were 60 rural customers who experienced more than eight outages compared with 1,734 in the previous year.

Improvements from the previous year are mainly attributable to the reduction in Glasgow 33kV outages, due to Weavers and Glasgow being connected to the new Huntly GXP. There has also been an increased focus on inspections and patrols and asset replacement on the 33kV between Weavers and Glasgow.

Further work is planned for Gordonton zone substation, where the 33 kV supply comes from two GXPs and cannot be readily meshed. Plans are in place to replace an aging circuit breaker and the remote control change-over between 33 kV feeders.

8.2.3.2 Urban Customers

The 12 month rolling average for repeated outages for urban customers with ≤2 outages as at 31/03/2010 is 96% with a target of 88%. The previous year's performance was 90%.

We are aiming to bring customers with greater than four outages back to less than four outages per year. There were 92 urban customers with more than four outages in the year compared with 2,540 last year.

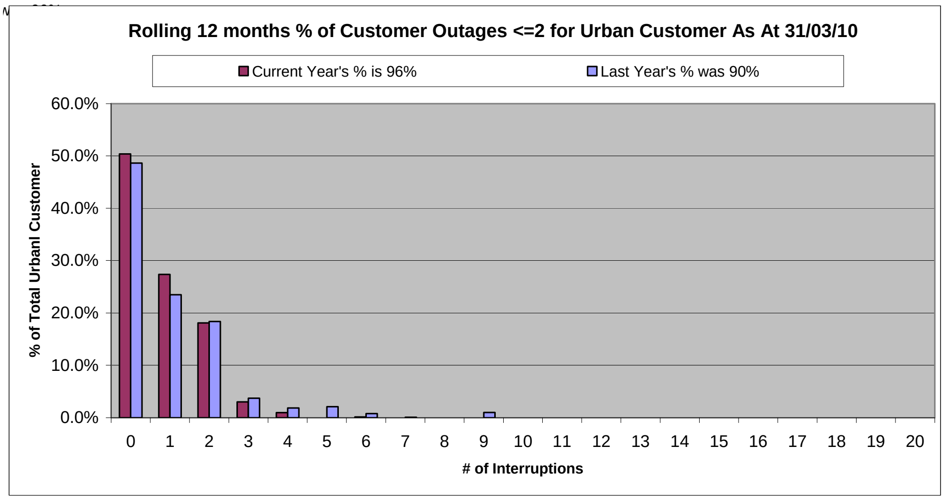


Figure 52. Urban customers against number of outages experienced.

The Te Uku TEUCB3 feeder, which covers the Raglan Township, continues to experience repeated outages. Live line clamps in particular in the coastal areas are being replaced in an effort to eliminate 11kV corrosion related failures.

Repeated outages to feeders at Chartwell are due to; a 33kV outage and more significantly from planned outages to perform ring main servicing. These outages have been necessary because of the network design in this area (many ring mains with five or more units, little HV and no LV interconnectivity).

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 2009 to 31 March 2010:

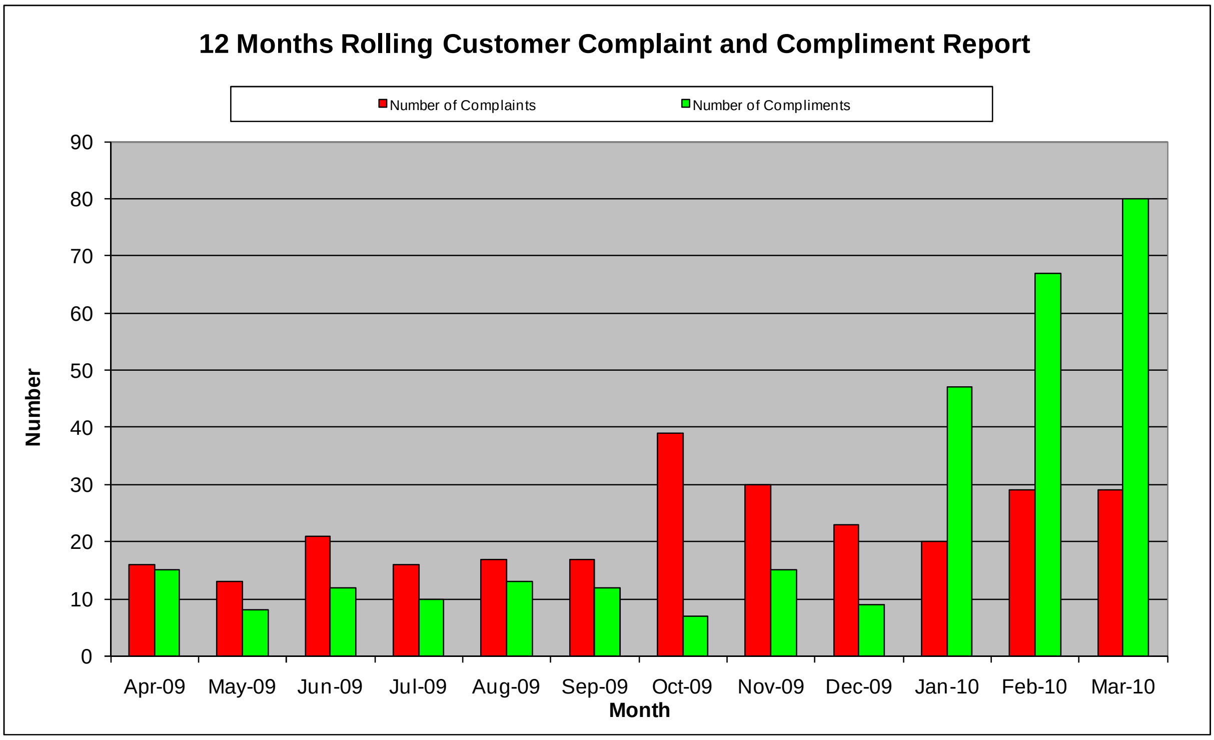


Figure 53. Monthly Customer Complaints and Compliments

The increase from January 2010 reflects a change in the feedback process whereby we now collect feedback on all fault works.

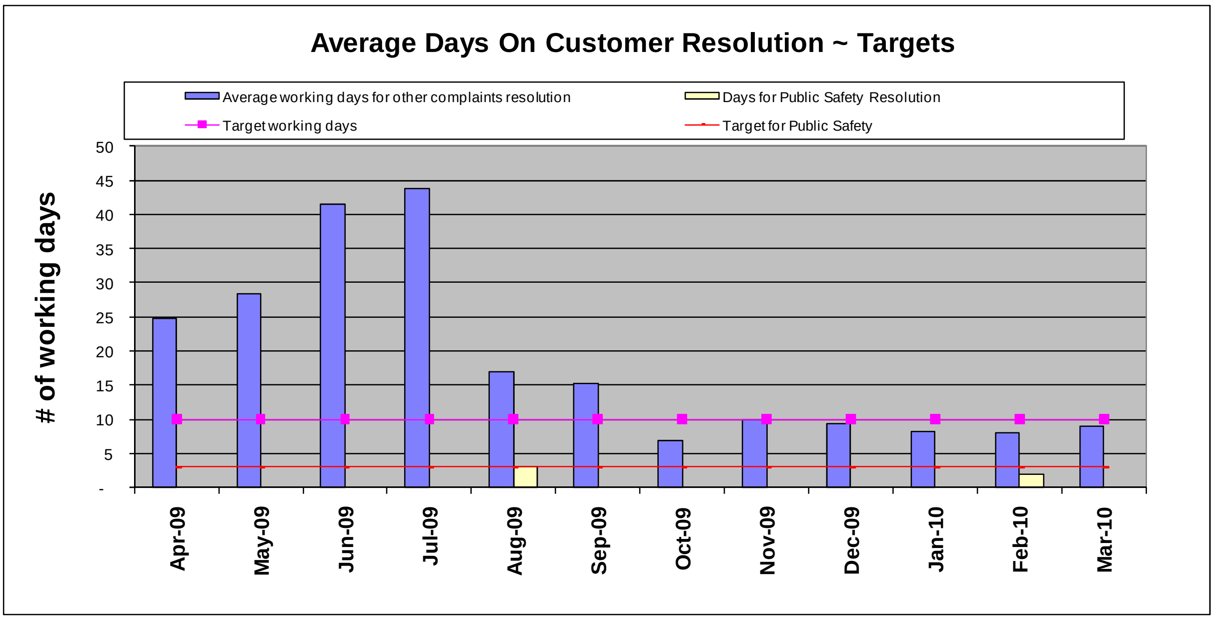


Figure 54. Average days for customer complaint resolution compared to target.

8.2.5 Operating Efficiency – Cost per Customer

Cost per Customer performance for the year 1 April 2009 to 31 March 2010 was $200 compared to a target of $202.

8.2.6 Delivery Efficiency – Billability and Productivity

Billability performance for the year 1 April 2009 to 31 March 2010 was 80% compared to a target of 80%.

Productivity performance for the year 1 April 2009 to 31 March 2010 was 90% compared to a target of 90%.

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 2009 to 31 March 2010 including combined TWH and HAM are shown below:

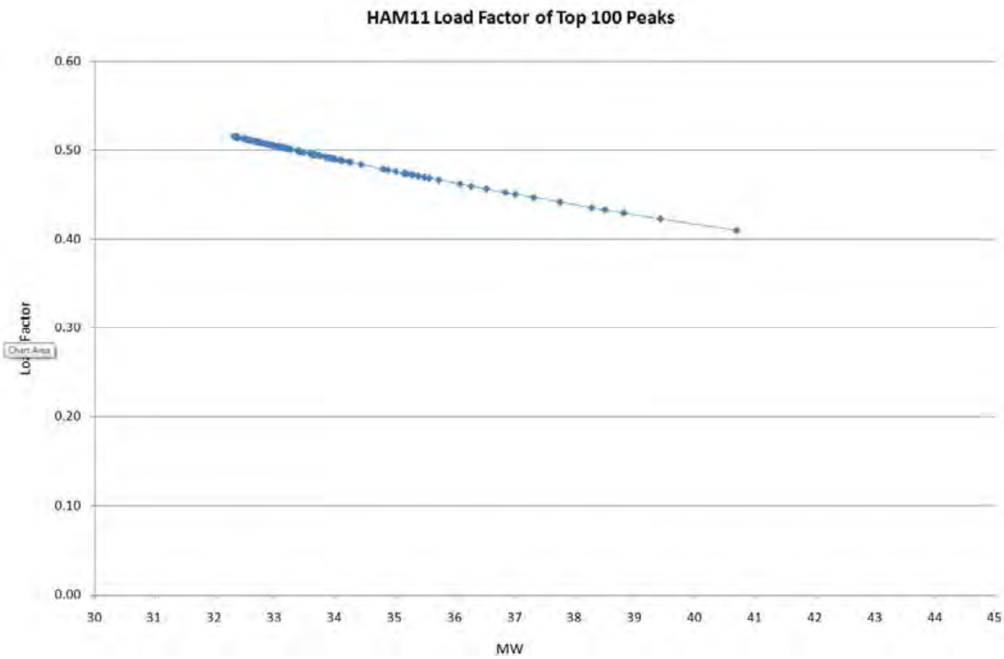


Figure 55. Hamilton 11kV load factor of top 100 peaks

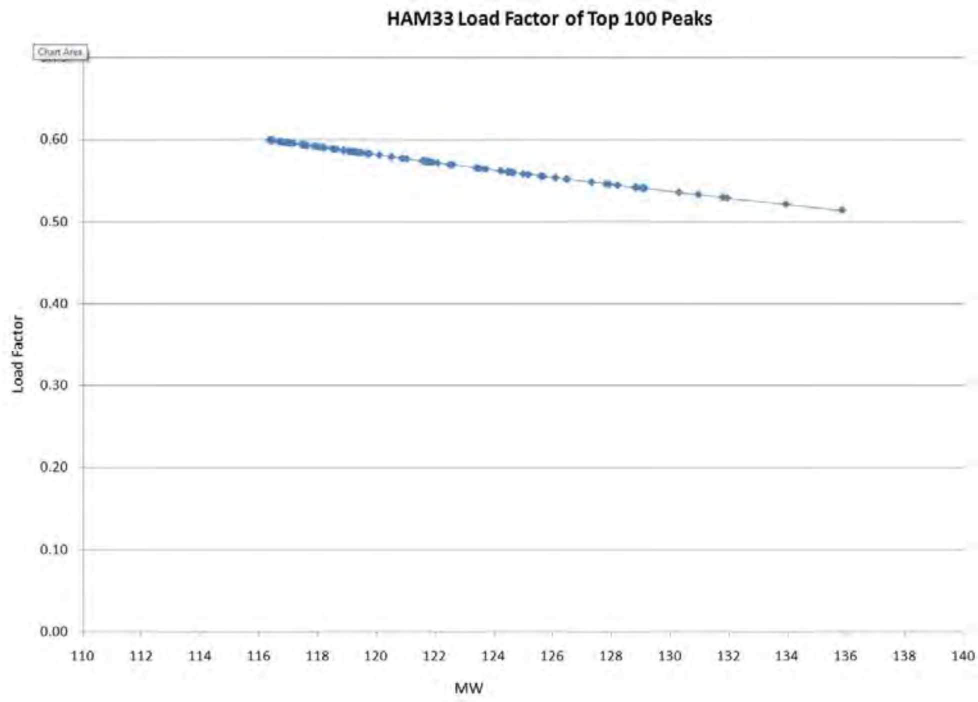


Figure 56. Hamilton 33kV load factor of top 100 peaks

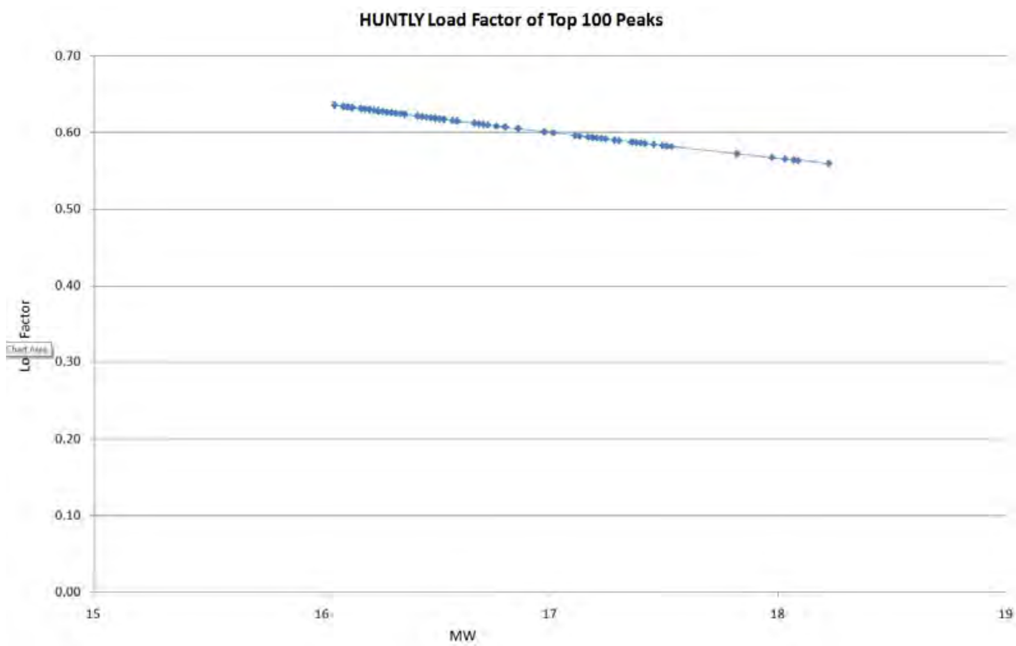


Figure 57. Huntly 33kV load factor of top 100 peaks

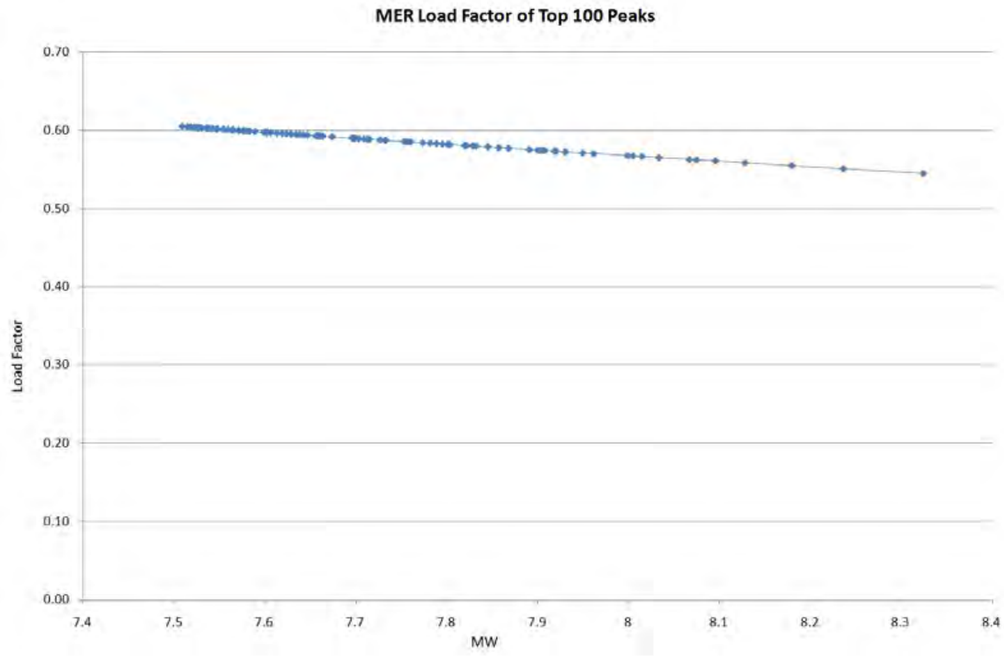


Figure 58. Meremere 33kV load factor of top 100 peaks

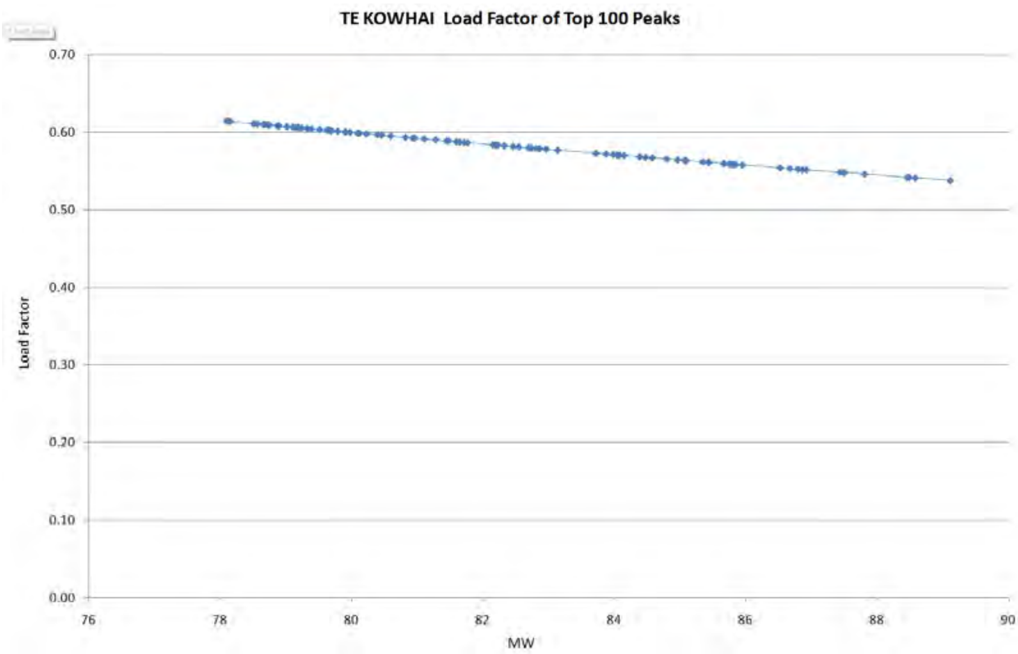


Figure 59. Te Kowhai 33kV load factor of top 100 peaks

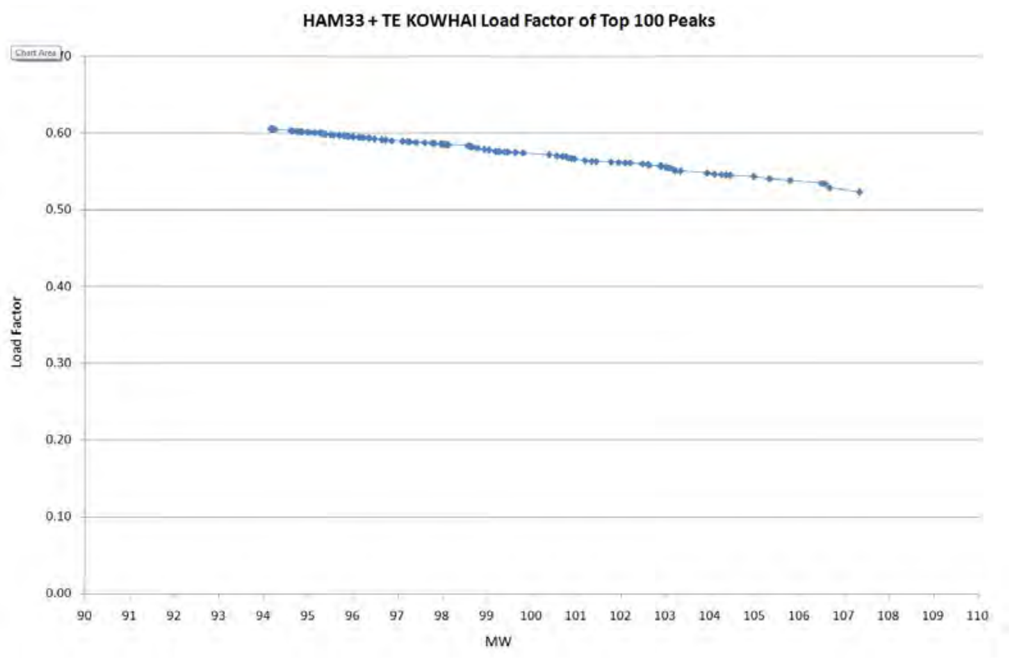


Figure 60. Te Kowhai 33kV and Hamilton 33 kV combined load factor of top 100 peaks

8.2.8 Asset Efficiency – Capacity Utilisation

WEL's capacity utilisation is the eleventh highest in the industry based on 2009 disclosed figures. WEL's utilisation is 38.2% for the year ended March 2010 against an industry average of 28.9%.

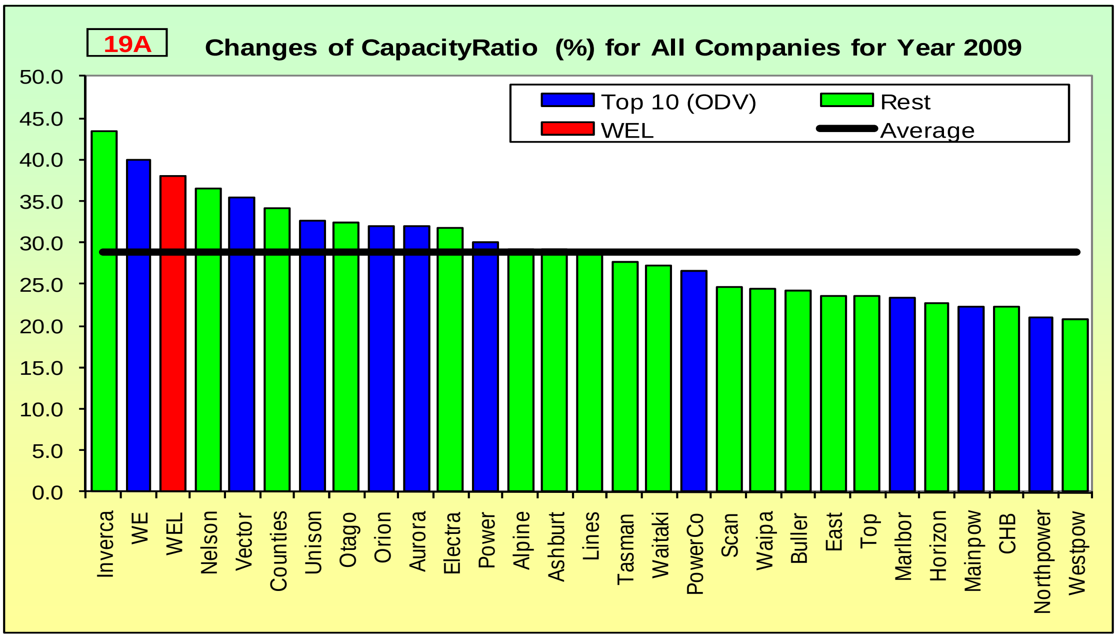


Figure 61. Asset Efficiency Measure – Capacity Ratio (%) for all NZ Line Companies

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 23 below shows the comparison between the 2009/10 year and 2008/09 year. It shows a 60% 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.

Table 23 Low Voltage Complaints

Year Ending	Proven WEL	Proven Customer	Proven WEL & Customer	Not Proven	Total
March 2009	9	2	1	11	23
March 2010	3	4	1	5	13

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. The following graph shows an ongoing reduction in validated LVCs.

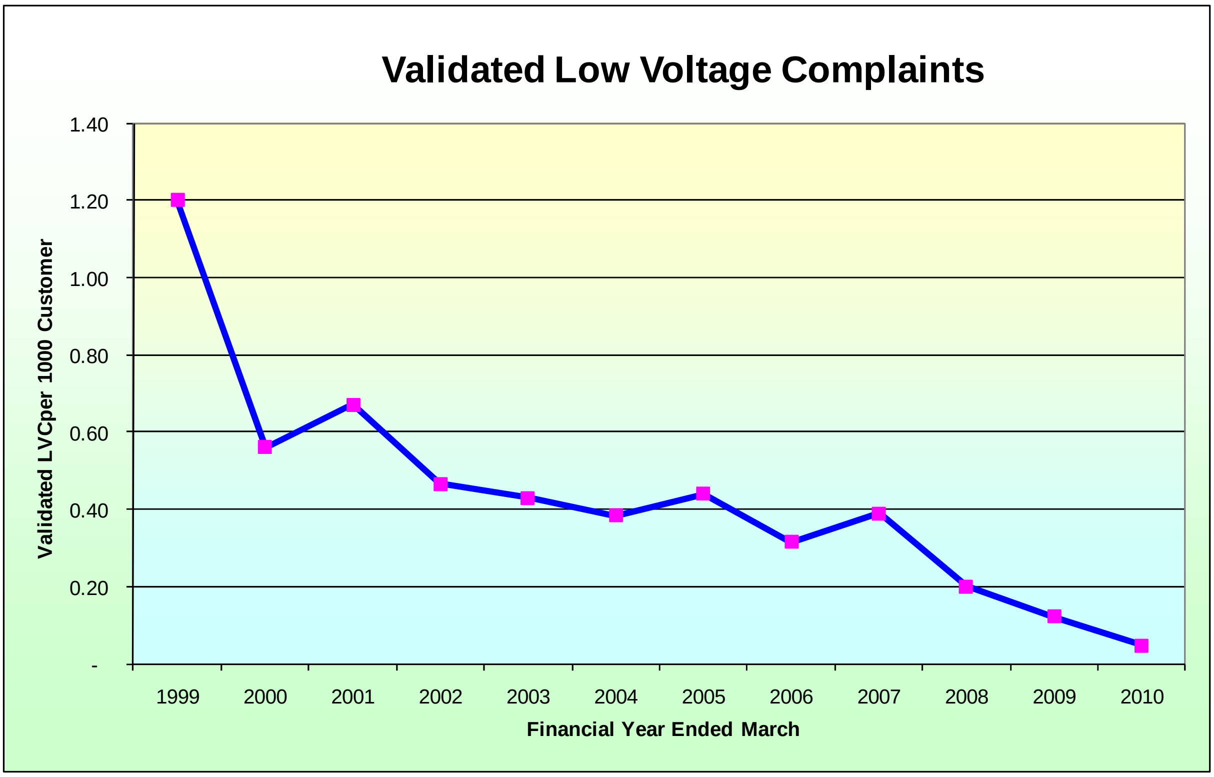


Figure 62. Validated LVC Per 1000 Customer Trending for WEL

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 actuals have been implemented during this report year:

- 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.

The following key initiatives have been implemented in previous years:

- 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.
- Lists of defects and poor condition 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 continues to internally inspect and change the oil of all oil filled ring main units. 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 planned 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 Level

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. The purpose 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
- Monthly review for the adequacy and effectiveness of the hazard controls by the Health, Safety and Compliance Manager
- 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.

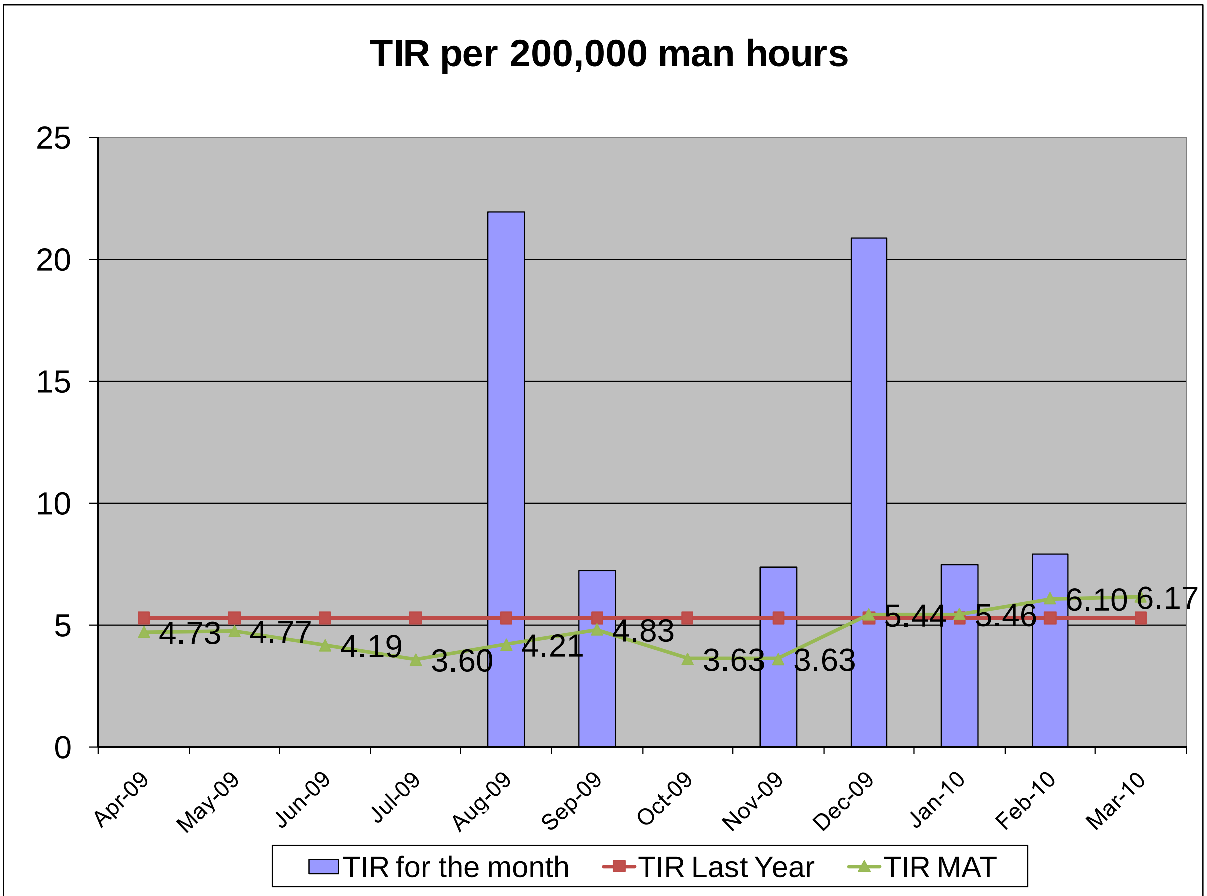


Figure 63. Total Incident Rate (TIR) 12 Month Rolling Average

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 63 shows the safety performance as of 31 March 2010.

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 is now complete. 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 recently. 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 twelve months.

Feeder reconfiguration will reduce connection numbers in areas fed from Te Uku, Glasgow (Huntly region), and Gordonton zone substations. Improvements are planned at Raglan and Te Uku, with the wind farm line reconductoring and the new Raglan zone substation, the 33kV circuit breaker replacement at Gordonton will improve the response time to 33kV outages to the North East of Hamilton.

Photo 23 Te Uku wind farm transmission line

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. Refer to Section 2.6.6 for more detail. 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 are planned to be implemented by 31 March 2011:

- 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 looking to improve its load factor and efficiency of the system by minimising peaks without sacrificing reliability and customer service. WEL has embarked on demand management. Currently, load control is done 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 investigating 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 networks to achieve a win-win situation. Industrial and commercial customers 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 capture the residential opportunities and are trialling 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.

An example of this service 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. 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 2009 AMP and this AMP in order to highlight recent improvements.

8.4.1 Capital Expenditure

Key Changes from 2009 AMP for the same period are summarised below:

- $8.5M decrease in asset replacement is due to updated asset age profile and revised asset lives (from valuation exercise).
- $0.24M increase in safety and quality is to allow for designating several substations during HCC's district plan review
- $5.2M increase in customer driven work in the first 5 years is attributable to expressway relocation projects, finishing external subdivision work and a new CBD switching station. (2011/12).
- $4.7M decrease in growth based spend over the plan is due to refined subtransmission solutions for Rotokauri area and optimisation of GXP connections to address demand growth
- There is a $2.6M increase in growth projects in the first 5 years, mainly due to $2.5M budget carry over for Cobham and Whatawhata substations (in 2010/11 year)
- $2.7M decrease in security projects mainly due to refined GXP solution offset by an additional project to connect the wind farm to Te Uku zone substation (cabling at $2M in 2020/21)
- $0.5M decrease in load control comes from cancellation of northern ripple relay replacement project

- $0.9M increase in reliability projects, being an increase in annual spend from $250k to $350k as a result of recent Reliability Outage Root Cause Analysis information (sectionaliser failures leading to a replacement project)
- Undergrounding is fixed at $1M/yr (no indexing from last year, linked to $250k/yr Trust contribution)
- $0.98M increase in communication to connect new 33kV Unit Protection schemes, also smart metering communication's integration
- Phasing of Wind Farm project reflects delayed start to construction in 2009
- $33.5M implementation of smart meter project roll out from next year is subject to Board approval.

In the 2009 Plan the implementation of smart grid technology through deployment of an advanced metering platform was highlighted. The use of this technology to improve our load transfer capabilities and also provide more responsive demand side initiatives with customers, was reflected in a deferral of investment in a new GXP North of Hamilton. The Plan incorporated a deferral of $22m of WEL capital investment by two and a half years, due to implementation of smart grid technology.

These benefits have been incorporated into this Plan, but in addition we have made further refinements to our GXP investment needs, resulting in an additional saving on top of the deferral, of around $6m in capital spend.

A summary of changes from the 2009 AMP for the same period from April 2010 to March 2021 is shown in the following table:

Table 24 11 Year Capital Spend Profile Comparison Between 2010 AMP and 2009 AMP

11 Year Capital Spend Profile Comparison Between 2010 AMP and 2009 AMP					
Expenditure	**2010 AMP**	**2009 AMP + 3.2% cost increase**	**Variance**	**Variance (1-5 years)**	**Variance (6-11 years)**
Asset Replacement	103,732	112,248	8,516	(643)	9,159
Safety and Quality	4,495	4,257	(238)	(280)	42
Customer Driven Projects	86,339	82,219	(4,120)	(5,145)	1,026
Load Growth Projects	51,889	56,029	4,141	(2,557)	6,697
Security - POS & Zone Sub	66,186	68,906	2,720	724	1,996
Load Control	505	1,032	527	527	-
Reliability	3,750	2,838	(912)	(360)	(552)
Undergrounding	11,000	11,000	-	-	-
Communication	1,293	310	(983)	(888)	(95)
Total Excluding Wind Farm and Smart Meters	**329,188**	**338,839**	**9,651**	**(8,622)**	**18,274**
Wind Farm Project	21,632	9,249	(12,383)	(12,383)	-
Smart Meters	33,494	-	(33,494)	(30,856)	(2,638)

The figures from the 2009 AMP have been adjusted by 3.2% 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 2009 AMP for the same period are summarised below:

- There are no major variances in faults, relocations, zone substations or vegetation expenditure.
- $3.4M increase for distribution lines are mainly due to additional spending on:
  - Wooden pole scanning
  - Corona discharge survey of overhead lines
  - Service pillar safety
  - Data collection and validation
  - Telecom pole changeovers
  - Distribution transformer refurbishment and oil testing
  - ABS servicing
- Provision for wind farm lines and substation maintenance
- Provision for smart meters and associated communications maintenance
- Adjusted provision for project driven opex based on recent experience
- Current year variances to the 2009 AMP
  - Zone transformer refurbishment deferred (Horotiu)
  - Vegetation forecast to be reduced this year
  - Project driven opex in current year is $270k less than in 2009 AMP

Key changes from the 2009 AMP for the same period from April 2010 to March 2021 are shown in table below:

Table 25 11 Year Maintenance Spend Profile Comparison Between 2010 AMP and 2009 AMP

11 Year Maintenance Spend Profile Comparison Between 2010 AMP and 2009 AMP			
Maintenance	**2010 AMP**	**2009 AMP plus a cost index of 3.2%**	**Variance**
Faults	23,549	23,701	152
Relocations	786	564	(222)
Distribution Lines	27,480	24,062	(3,418)
Vegetation Management	9,670	9,388	(282)
Zone Substations	8,094	7,839	(255)
SCADA	1,246	1,186	(60)
Faults External Subdivision	656	657	0
Project Driven Maintenance Expenditure	2,080	3,437	1,357
Wind Farm Maintenance	500	-	(500)
Smart Meter Maintenance	1,857	-	(1,857)
Total	**75,918**	**70,833**	**(5,085)**

The figures from the 2009 AMP have been adjusted by 3.2% using the Labour Cost Index - Public Sector - Electricity, Gas and Water Supply.

The result of this is a net increase in spend of $5M over the 11 year period.

9 EXPENDITURE FORECASTS AND RECONCILIATIONS

Electricity Distribution Business: WEL NETWORKS

For Year Ended: 2010

($000)

A) Five year forecasts of expenditure

From most recent Asset Management Plan

ref		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
9	*for year ended*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
10	Capital Expenditure: Customer Connection	5,292	5,454	6,505	5,427	5,482	5,419	5,422	5,367	5,422	5,449	5,267	5,267
11	Capital Expenditure: System Growth	14,665	33,856	19,616	20,474	19,169	11,304	8,485	10,915	17,250	12,858	11,136	8,645
12	Capital Expenditure: Reliability, Safety and Environment	1,283	1,021	1,348	1,064	875	755	730	775	780	730	730	730
13	Capital Expenditure: Asset Replacement and Renewal	5,108	7,516	8,601	8,015	9,755	10,516	11,966	12,266	8,626	9,046	8,626	8,800
14	Capital Expenditure: Asset Relocations	2,519	2,861	4,000	4,000	4,000	4,000	3,000	3,000	3,000	3,000	3,000	3,000
15	**Subtotal - Capital Expenditure on asset management**	**28,867**	**50,707**	**40,069**	**38,980**	**39,281**	**31,994**	**29,602**	**32,322**	**35,077**	**31,083**	**28,758**	**26,441**
16			-	-	-	-	-	-	-	-	-	-	-
17	Operational Expenditure: Routine and Preventative Maintenance	2,729	2,807	3,011	3,047	2,807	2,835	2,811	2,813	2,815	2,823	2,825	2,827
18	Operational Expenditure: Refurbishment and Renewal Maintenance	1,430	1,494	1,752	1,732	1,688	1,702	1,688	1,688	1,688	1,692	1,692	1,692
19	Operational Expenditure: Fault and Emergency Maintenance	2,134	2,281	2,399	2,373	2,366	2,366	2,367	2,367	2,367	2,367	2,367	2,368
20	**Subtotal - Operational Expenditure on asset management**	**6,293**	**6,582**	**7,162**	**7,152**	**6,862**	**6,904**	**6,866**	**6,868**	**6,870**	**6,882**	**6,884**	**6,886**
21			-	-	-	-	-	-	-	-	-	-	-
22	**Total direct expenditure on distribution network**	**35,160**	**57,289**	**47,231**	**46,132**	**46,143**	**38,898**	**36,468**	**39,190**	**41,947**	**37,965**	**35,642**	**33,327**
24	**Overhead to Underground Conversion Expenditure**	1,620	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

ref		Actual for Current Financial Year (a)	Previous forecast for Current Financial Year (b)	% Variance (a)/(b)-1
34	Capital Expenditure: Customer Connection	5,292	2,851	85.6%
35	Capital Expenditure: System Growth	14,665	13,991	4.8%
36	Capital Expenditure: Reliability, Safety and Environment	1,283	2,283	-43.8%
	Capital Expenditure: Asset Replacement and Renewal	5,108	5,256	-2.8%
38	Capital Expenditure: Asset Relocations	2,519	3,150	-20.0%
39	**Subtotal - Capital Expenditure on asset management**	**28,867**	**27,531**	**4.9%**
41	Operational Expenditure: Routine and Preventative Maintenance	2,729	2,557	6.7%
42	Operational Expenditure: Refurbishment and Renewal Maintenance	1,430	1,295	10.4%
43	Operational Expenditure: Fault and Emergency Maintenance	2,134	1,885	13.2%
44	**Subtotal - Operational Expenditure on asset management**	**6,293**	**5,737**	**9.7%**
46	**Total direct expenditure on distribution network**	**35,160**	**33,268**	**5.7%**

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):

Customer Connection: More customer connections were completed than expected.
Reliability, Safety and Environment: Some reliability projects were delayed due to economic recession.
Asset Relocations: Asset relocation projects were less than expected.
Refurbishment and Renewal Maintenance: $100k project driven maintenance cost was not included in the previous forecast.
Fault and Emergency Maintenance: Both of fault volumes and unit costs were slightly 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.
BC	Building Consent
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.
CALIB	Capital Works Library
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.
Continual 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 geographical operator interface updated from SCADA and based on the GIS database, used 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.
GPD	Group Peak Demand
Grid Exit Point (GXP)	The point at which WEL Equipment is deemed to connect to the Trans Power 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 meters that allows 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.
JDE	The J.D. Edwards One World business data system.
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.
MAXIMO	Maintenance Management System used by WEL to record system information
MMS	Maintenance Management System (Transpower owned system)
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
ODV	Optimised Deprival Value
OMS	WEL's computerised Outage Management System.
Operator	The SYSCON system controller in charge of the operation.
Ownership Boundary	The boundary between the equipment owned by WEL and the equipment owned by the Customer. See also Point of Demarcation.
PE	Type of insulation – Cross linked Polyethylene
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.
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	WEL's computerised System Control And Data Acquisition System being the primary tool for monitoring and controlling access and switching operations for WEL's Network.
SQL OLAP and Slice and Dice	Slice and Dice is a reporting tool that utilises SQL's OLAP technology
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 network system controllers.
Territorial Authority (T/A)	The controlling authority having control and responsibility for roads and road reserves.
Test Permit	The permit for access to HV equipment which has been removed from service to enable testing and where procedures are required to control hazards created by the testing.
TIR	Total Incident Rate
Transpower	The national grid operator.
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	Includes HV substations, switching stations, voltage regulators, ground mounted HV switchgear, large industrial/commercial distribution substations, ripple control plant, and associated protection and controls.

Appendix 2 Forecasted Load for zone substations and each POS

Zone Substations	ABB	POS	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Avalon Dr	AVA	HAM33	16.6	18.5	19.1	19.8	20.4	20.5	20.6	20.7	20.7	20.8	20.9	21.0	21.1
Bryce St	BRY	HAM33	20.2	20.8	20.8	22.4	22.4	22.5	22.5	22.5	22.6	22.6	22.6	22.7	22.7
Chartwell	CHA	HAM33	19.1	19.3	19.4	19.5	19.7	19.8	20.0	20.1	20.2	20.4	20.5	20.6	20.8
Claudelands	CLA	HAM33	20.7	15.4	15.9	16.0	16.0	16.1	16.1	16.2	16.2	16.3	16.3	16.4	16.4
Gordonton	GOR	HAM33	6.4	6.6	6.8	6.9	7.1	7.3	7.5	7.7	7.8	8.0	8.2	8.4	8.7
Horotiu	HOR	TWK33	9.9	12.5	15.1	15.2	15.3	15.4	15.6	15.7	15.8	16.0	16.1	16.2	16.4
Kent St	KEN	TWK33	16.3	16.5	16.7	16.8	17.0	17.2	17.4	17.6	17.7	17.9	18.1	18.3	18.5
Latham Court	LAT	HAM33	17.1	17.6	18.1	18.6	19.0	19.5	20.0	20.0	20.0	20.0	20.1	20.1	20.1
Peacockes Rd	PEA	HAM33	15.1	12.1	13.0	13.8	9.7	9.8	9.9	9.9	10.0	10.0	10.1	10.1	10.1
Pukete 11	PUK	TWK33	8.8	9.7	11.5	12.0	12.0	12.0	12.0	12.1	12.1	12.1	12.1	12.1	12.1
Sandwich Rd	SAN	TWK33	19.4	19.4	19.5	19.5	19.6	19.6	19.6	19.7	19.7	19.7	19.8	19.8	19.9
Te Uku	TEU	HAM33	6.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.3	3.4
Wallace Rd	WAL	HAM33	16.2	13.6	13.6	13.6	13.7	13.7	13.8	13.8	13.8	13.9	13.9	13.9	13.9
Glasgow St	GLA	HUN33	8.0	8.2	8.4	8.6	8.8	9.1	9.3	9.5	9.7	10.0	10.2	10.5	10.8
Kimihia	KIM	HUN33	2.9	3.4	3.9	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Weavers	WEA	HUN33	9.7	9.9	10.2	10.4	10.7	11.0	11.2	11.5	11.8	12.1	12.4	12.7	13.0
Te Kauwhata	TEK	MEM33	4.1	4.4	4.6	4.7	4.8	4.9	5.0	5.2	5.3	5.4	5.5	5.7	5.8
Finlayson Rd	FIN	MEM33	3.7	5.3	5.4	5.5	5.7	5.8	6.0	6.1	6.3	6.4	6.6	6.7	6.9
Airport	AIR	HAM33		-	-	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	11.2
Tasman	TAS	TWK33	16.4	18.0	17.4	18.1	18.9	19.6	21.0	22.4	23.9	25.3	26.7	28.1	29.1
Borman	HDS	HAM33	7.5	8.5	9.5	10.5	11.5	12.5	13.1	13.7	14.3	14.9	15.6	15.6	15.6
Ngaruawahia	NGA	TWK33	6.0	6.2	6.3	6.5	6.7	6.8	7.0	7.2	7.3	7.5	7.7	7.9	8.1
Hampton Downs	HPT	MEM33	0.5	2.9	4.4	4.7	5.0	5.3	5.4	5.6	5.7	5.9	6.0	6.2	6.3
Raglan[1]	RAG	HAM33	-	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.1	5.2	5.4	5.5
Whatawhata	WHA	HAM33		3.0	3.1	3.2	3.2	3.3	3.4	3.5	3.6	3.7	3.7	3.8	3.9
Cobham / Hospital	COB	HAM33		19.0	19.5	20.1	20.6	21.1	21.6	21.6	21.7	21.7	21.7	21.7	21.8
South East Hamilton[2]	SEH	HAM33	-	-	-	-	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5

[1] Zone Substation (WIP)

[2] 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 64 to Figure 69) show the forecasted loads for each GXP.

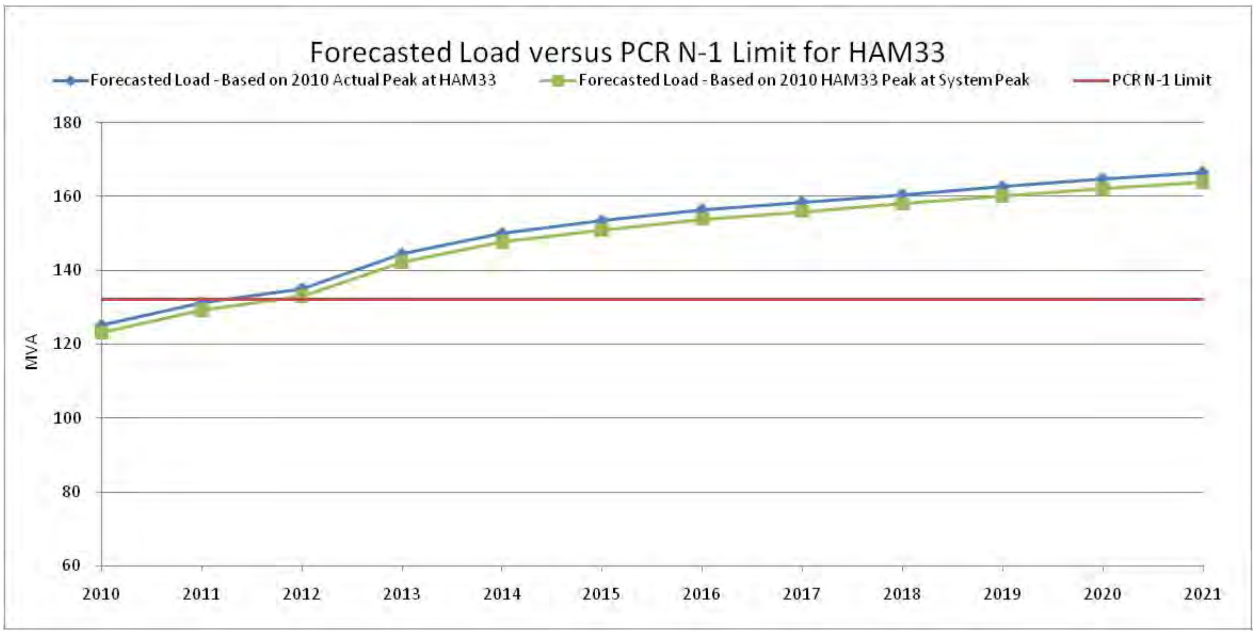


Figure 64. Forecasted ADPCD Loading for HAM33Kv

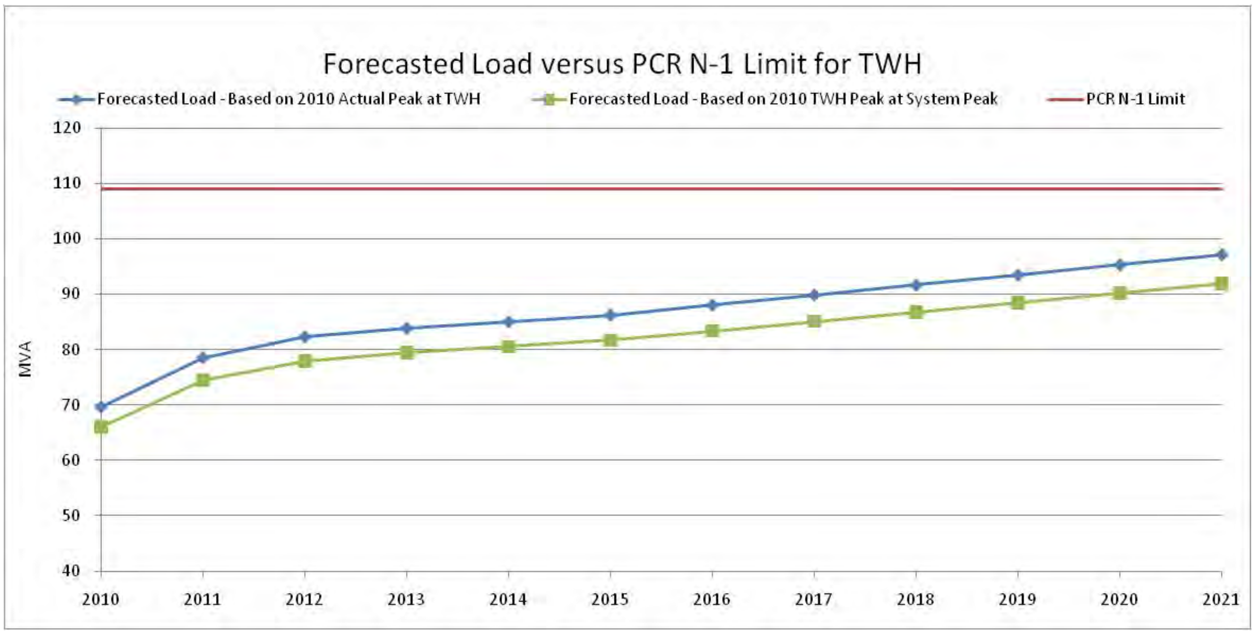
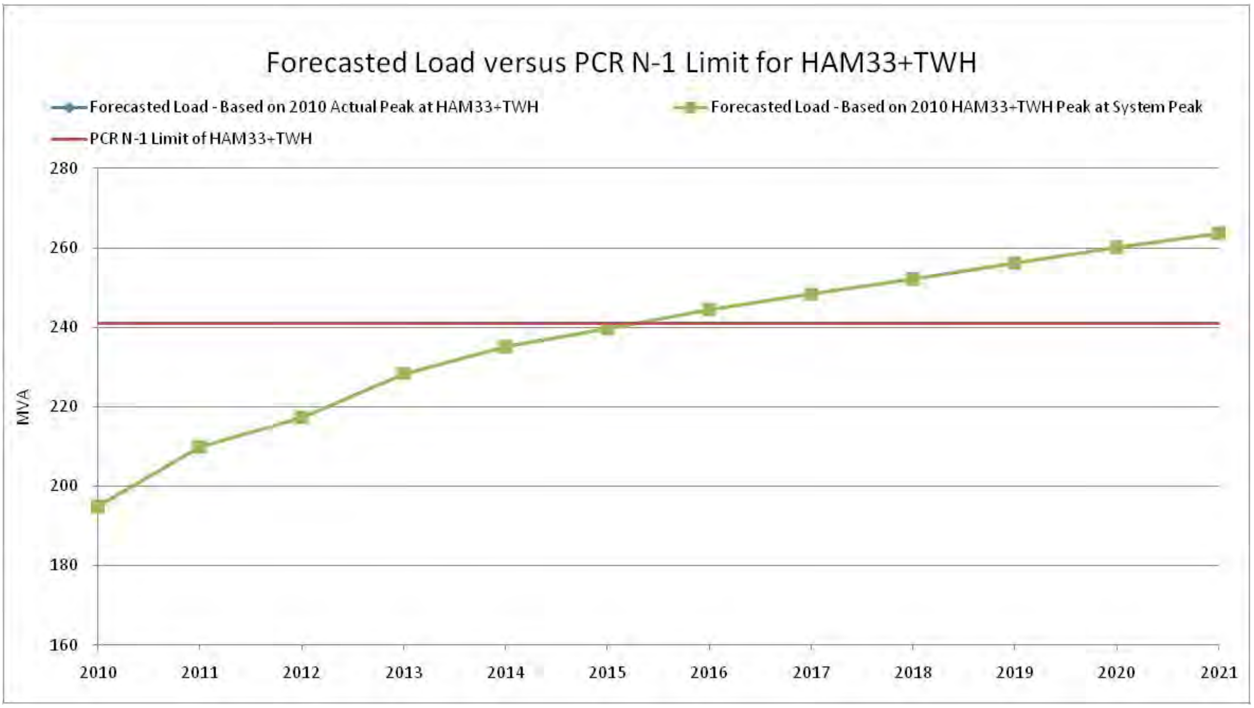
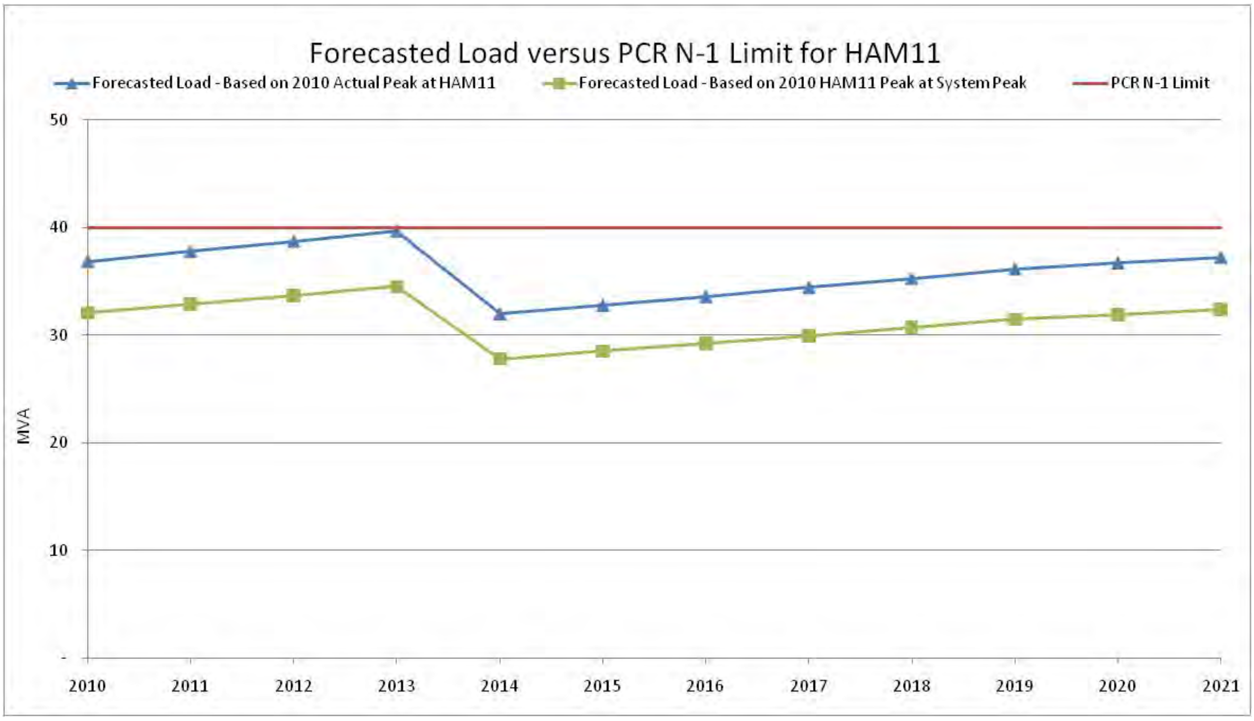


Figure 65. Forecasted ADPCD Loading for TWH33kV



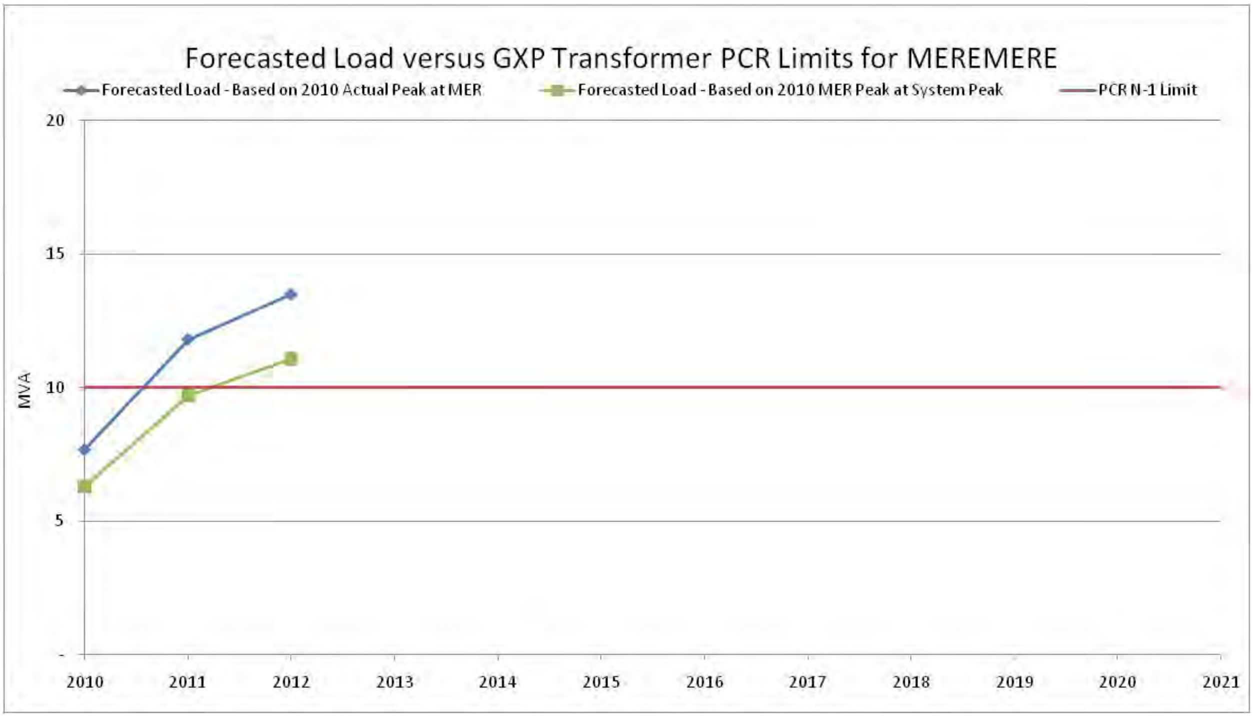
Note: HAM33+TWH peaks at the same time as the System peaks

Figure 66. Forecasted ADPCD Loading for HAM33kV + TWH33kV



Note: Some load of HAM11 will be transferred to HAM33 by 2014

Figure 67. Forecasted ADPCD Loading for HAM11kV



Note: Meremere load will be transferred to HLY by 2013

Figure 68. Forecasted ADPCD Loading for Meremere

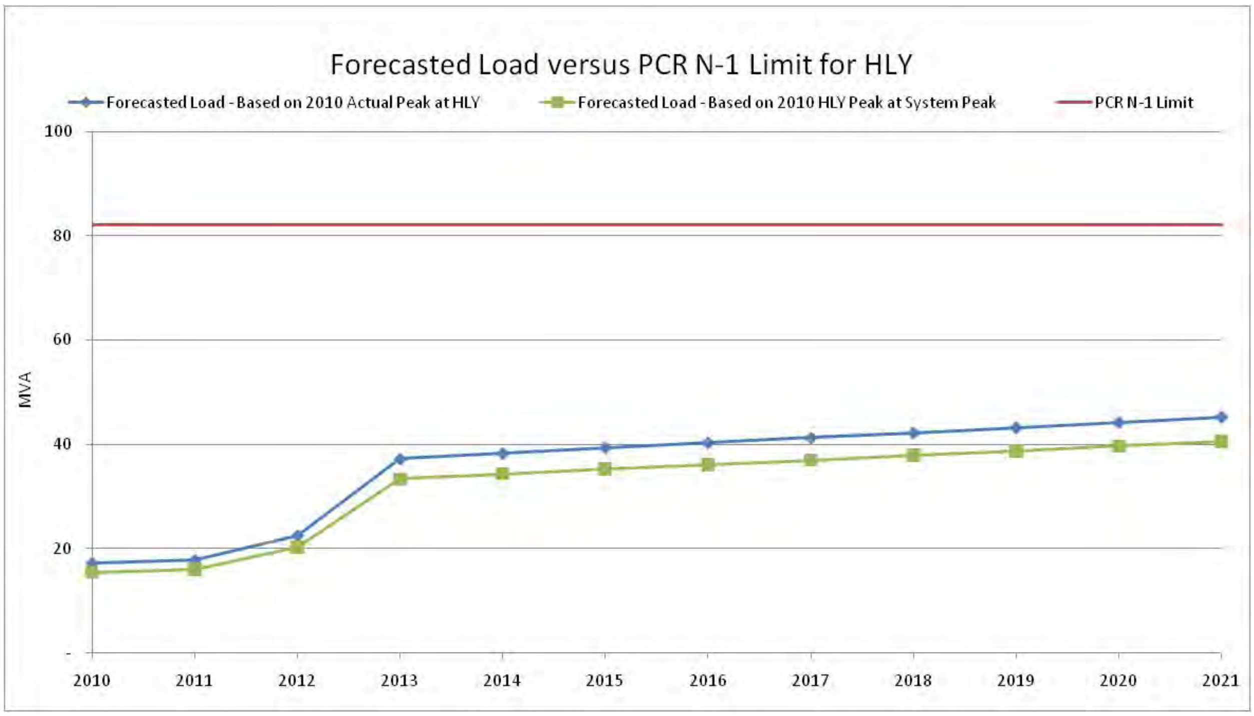


Figure 69. Forecasted ADPCD Loading for Huntly includes transfer of Mer loads by 2013

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	

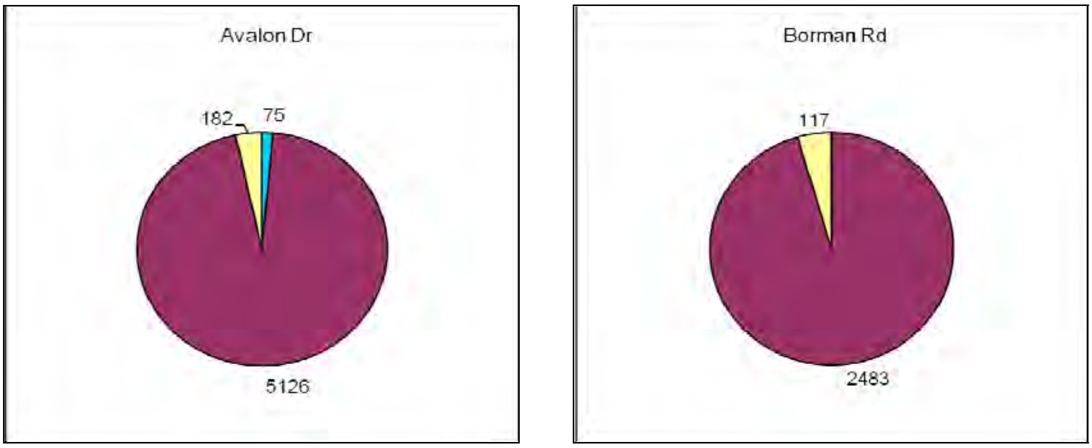


Figure 70. Chart 1 of 11 showing Zone substation customer makeup

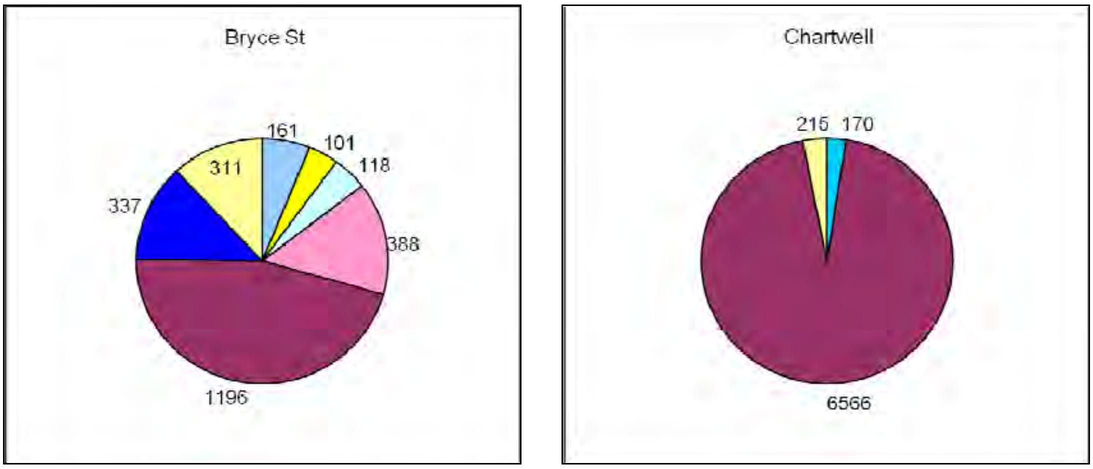


Figure 71. Chart 2 of 11 showing zone substation customer makeup

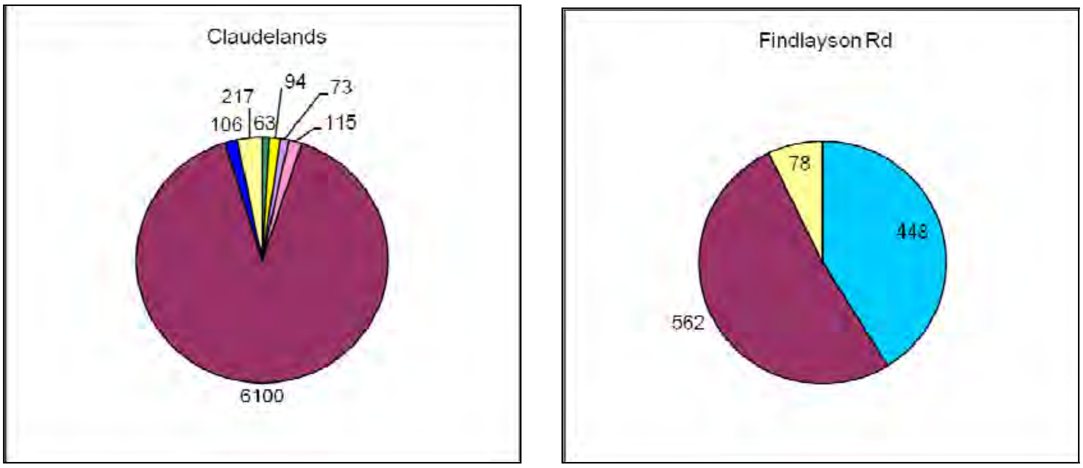


Figure 72. Chart 3 of 11 showing zone substation customer makeup

Figure 73. Chart 4 of 11 showing zone substation customer makeup

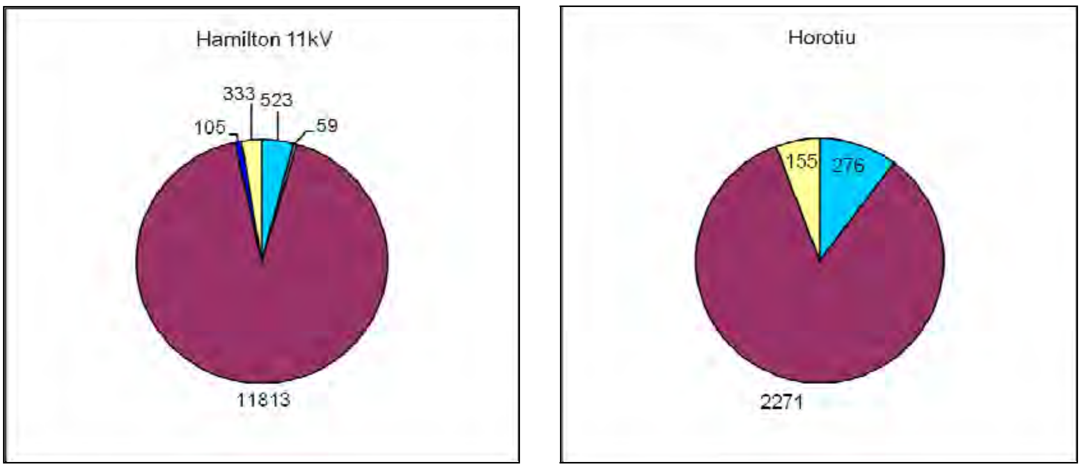


Figure 74. Chart 5 of 11 showing zone substation customer makeup

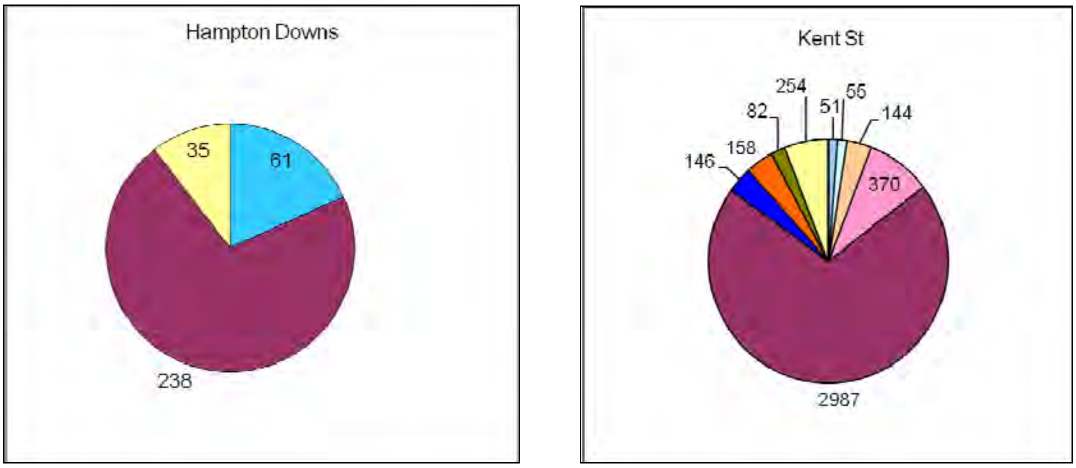


Figure 75. Chart 6 of 11 showing zone substation customer makeup

Figure 76. Chart 7 of 11 showing zone substation customer makeup

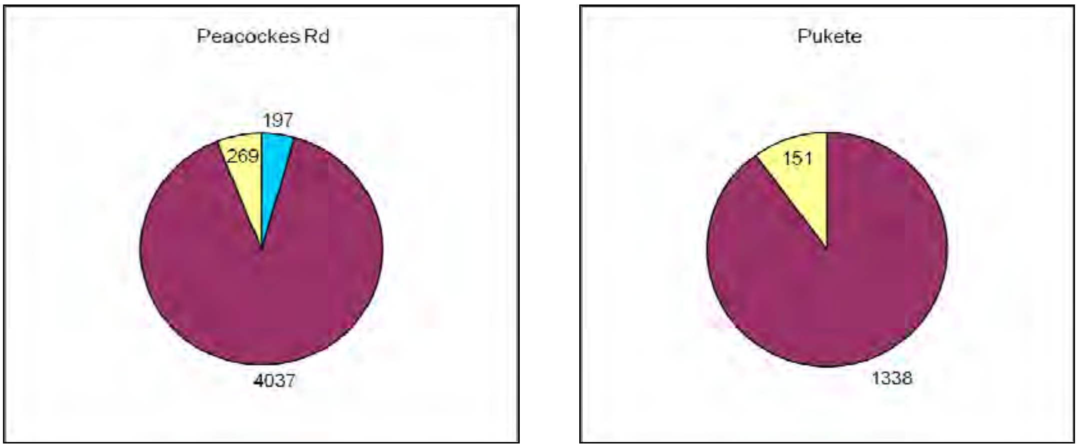
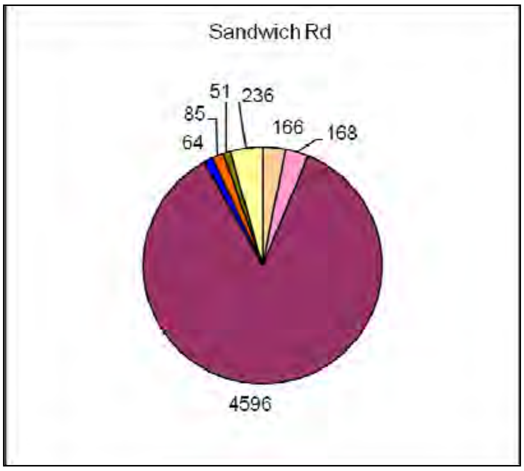


Figure 77. Chart 8 of 11 showing zone substation customer makeup



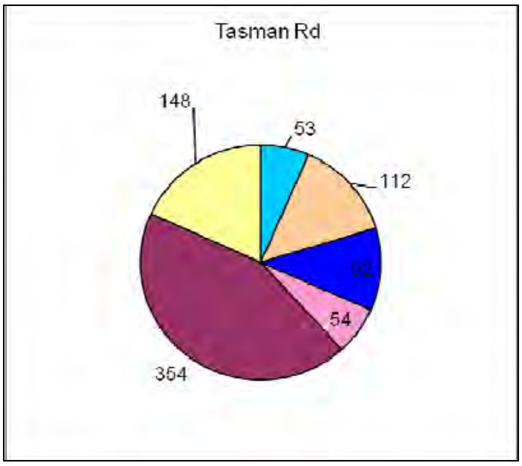
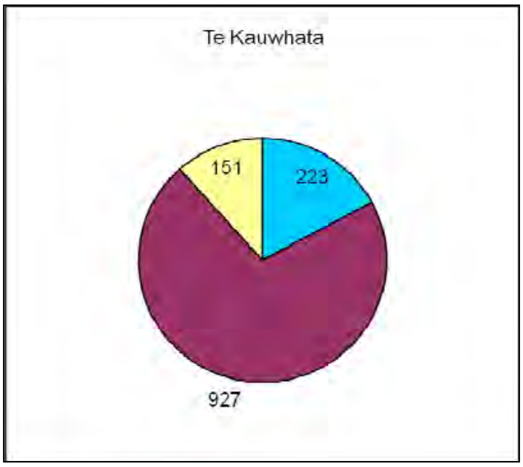


Figure 78. Chart 9 of 11 showing zone substation customer makeup



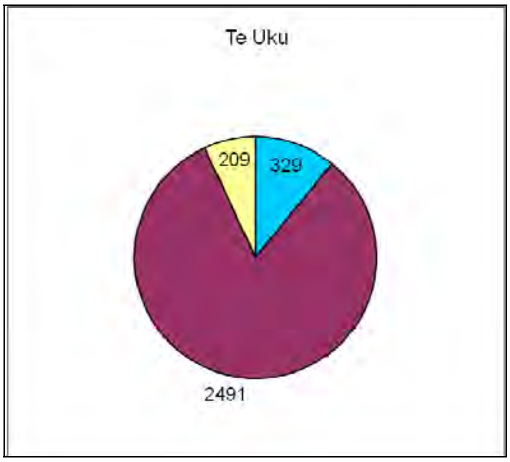
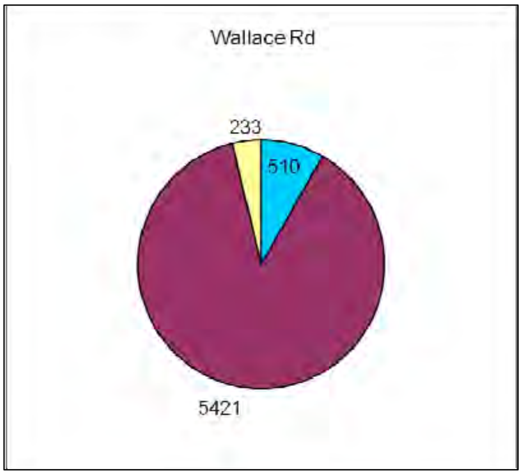


Figure 79. Chart 10 of 11 showing zone substation customer makeup



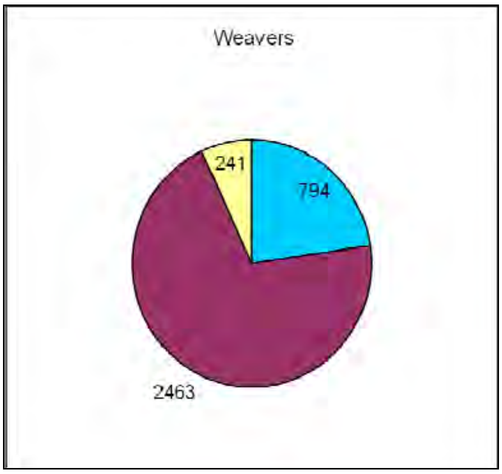


Figure 80. Chart 11 of 11 showing zone substation customer makeup

Appendix 4 Schematic Diagrams of 33kV Sub-transmission System

App 4.1 33kV Network Configuration - Hamilton Point of Supply

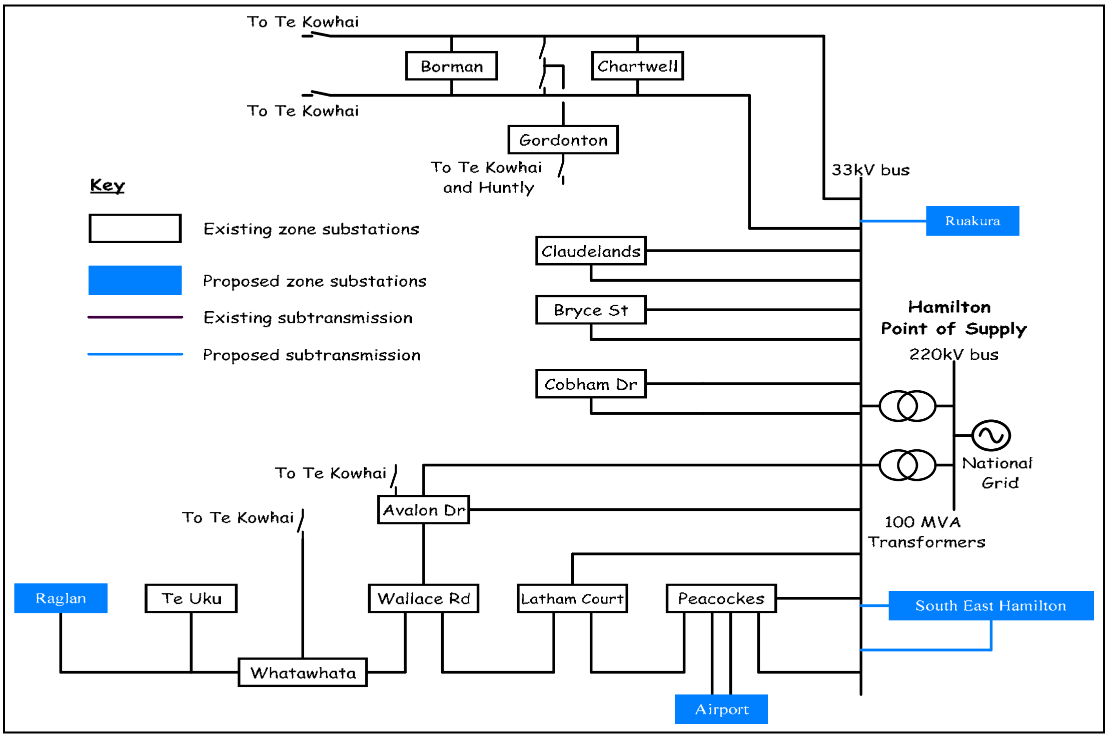


Figure 81. 33kV Network Configuration – Hamilton Point of Supply

App 4.2 33kV Network Configuration - Te Kowhai Point of Supply

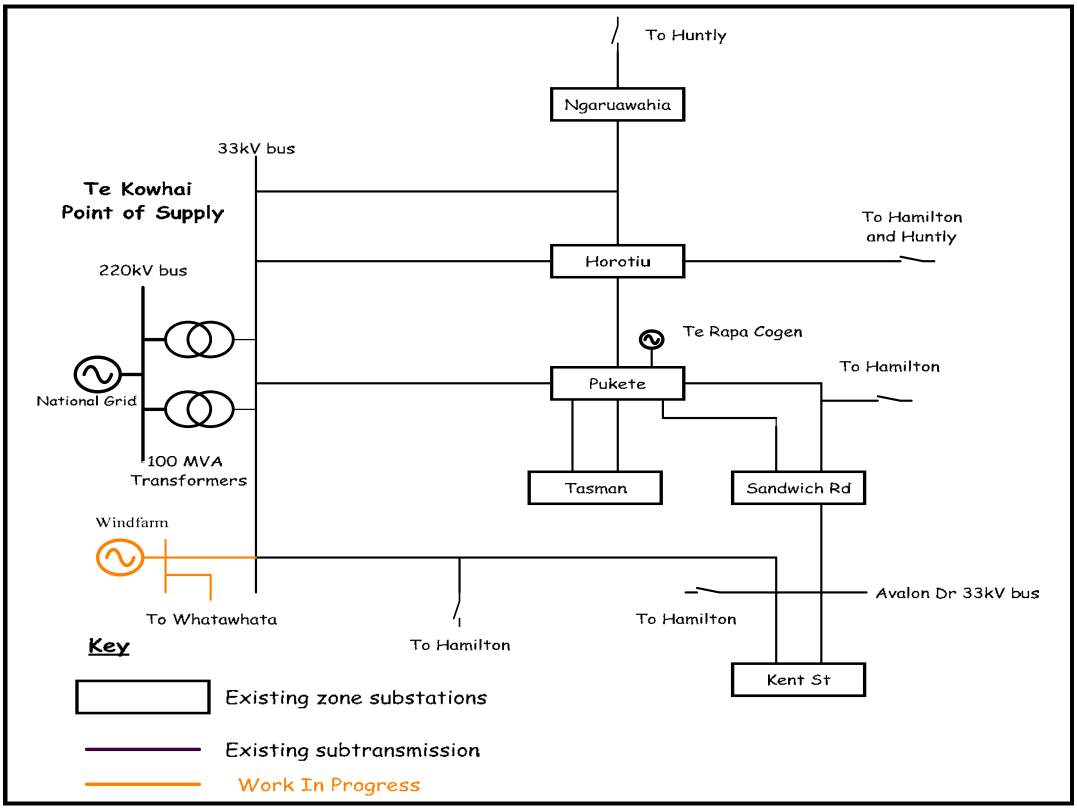


Figure 82. 33kV Network Configuration – Te Kowhai Point of Supply

App 4.3 33kV Network Configuration - Huntly Point of Supply

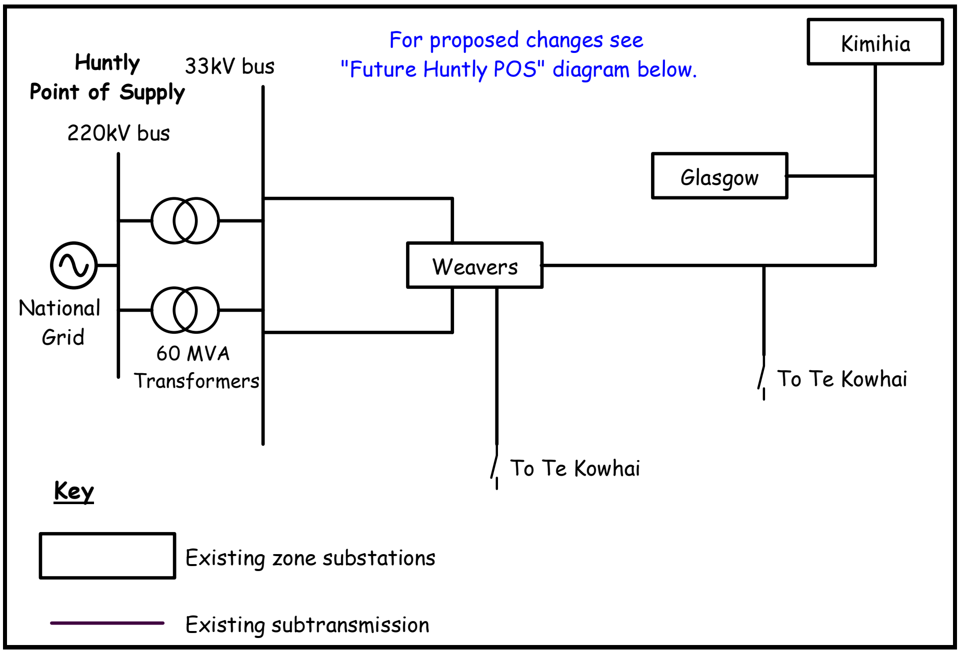


Figure 83. 33kV Network Configuration – Huntly Point of Supply

App 4.4 33kV Network Configuration - Meremere Point of Supply

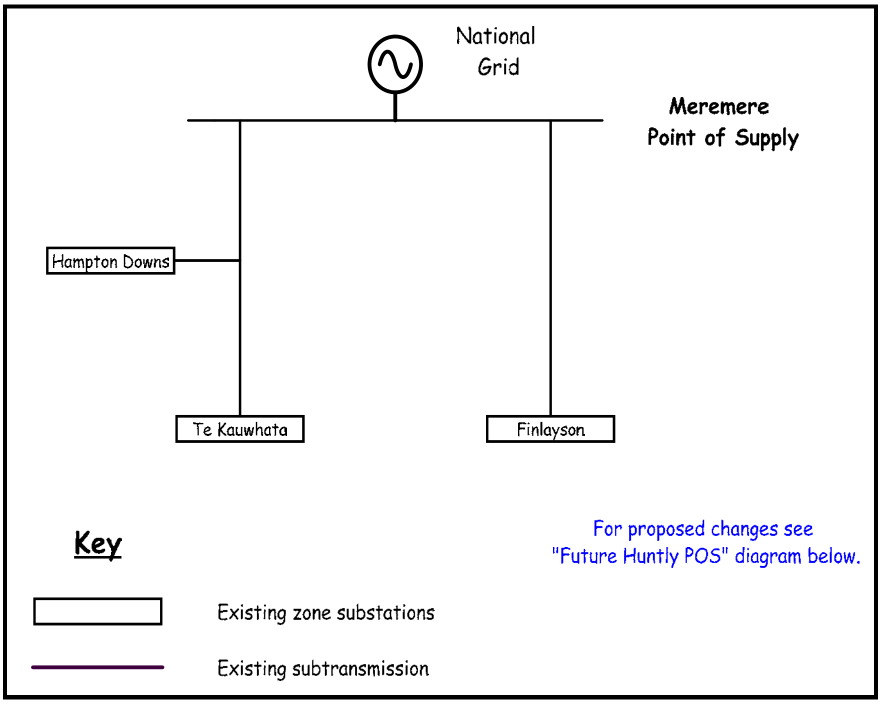


Figure 84. 33kV Network Configuration – Meremere Point of Supply

App 4.5 33kV Network Configuration – Future Huntly POS

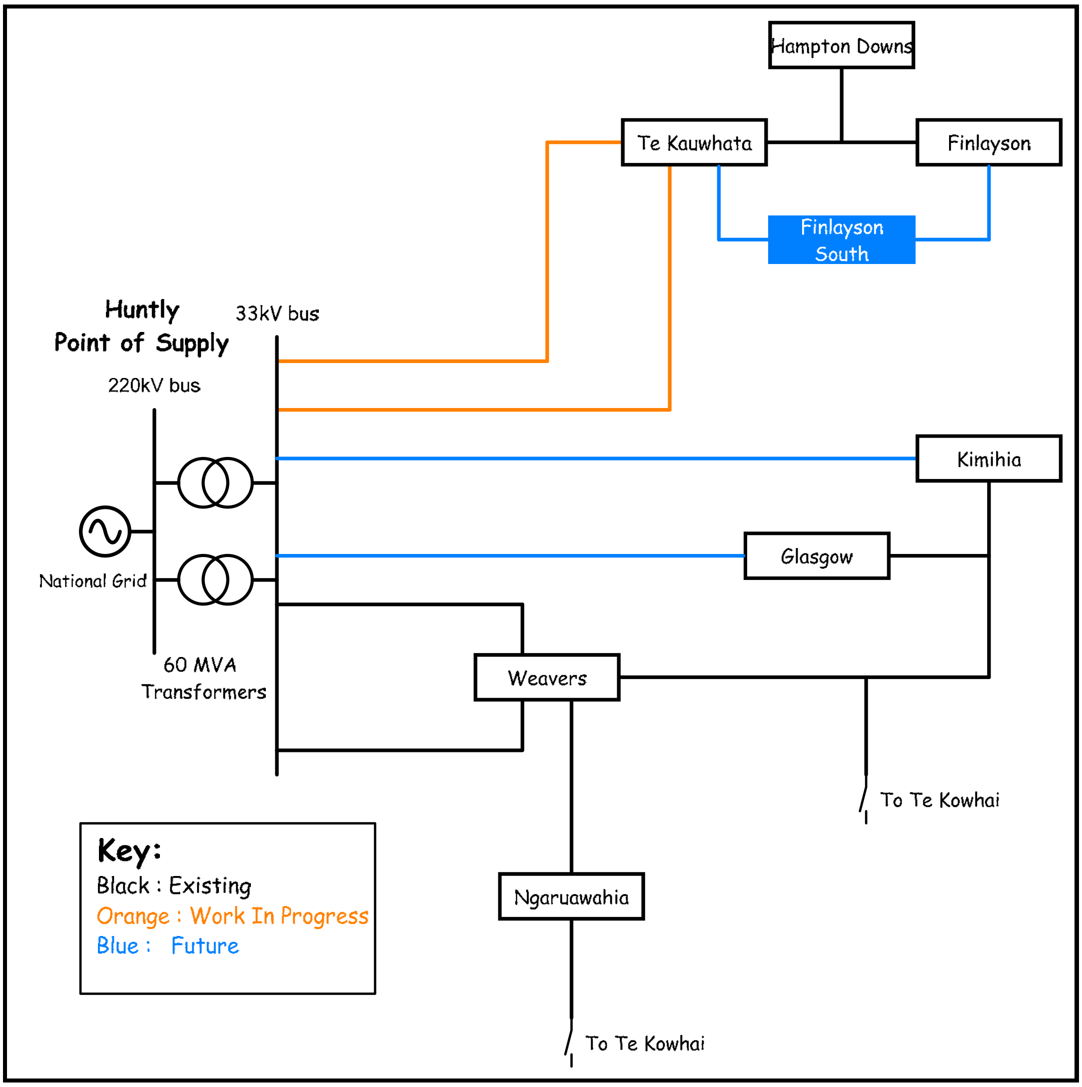


Figure 85. 33kV Network Configuration – Future Huntly POS

Appendix 5 Health and Safety Statistics since April 2008

Table 26 Performance Statistics for Health and Safety

(**Notes: FAR –** Field Action Report, **LTI –** Lost Time Injury)

Month	Number of FARs received	Minor Injuries	Near Misses	Number of LTIs (Days)
Apr-08	22	5	4	0
May-08	24	4	1	0
Jun-08	23	5	0	0
Jul-08	16	2	1	0
Aug-08	23	4	0	0
Sep-08	29	6	6	0
Oct-08	21	4	2	0
Nov-08	21	5	4	0
Dec-08	24	5	3	0
Jan-09	26	8	7	0
Feb-09	21	3	3	0
Mar-09	25	5	4	0
Apr-09	18	2	0	0
May-09	22	2	5	0
Jun-09	30	6	1	0
Jul-09	26	7	6	0

Month	Number of FARs received	Minor Injuries	Near Misses	Number of LTIs (Days)
Aug-09	43	12	6	12
Sep-09	38	4	7	22
Oct-09	24	0	4	2
Nov-09	37	4	6	0
Dec-09	23	7	7	4
Jan-10	20	6	5	19
Feb-10	31	5	4	20
Mar-10	30	5	8	23

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 Ohaki 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 Ohaki Rd under the Huntly POS project. It will be necessary to throughjoint 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 Primary Equipment Size and Ratings

- 33kV cables single core 400 mm^2 Aluminium, 3kA/1sec copper wire screen, XLPE insulation.
- 11kV cables three core 300mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- Fibre optic cable – BOS External Optical Fibre Single Tube Cable, Type NQDU, 48-core, Single Mode Fibres.
- Cable ducts (for road crossings) to be orange hi-impact strength PVC, 150mm diameter for 3c/300mm^2 cables, 100mm for 1c/630mm^2 and 125mm continuous ducting where directional drilling is required. Fibre optic cable to be installed in 100mm ducting full length.

6.1.4 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.

Replacement of the outdoor 33kV structure and switchgear at Te Kauwhata with new indoor 33kV GIS is programmed for the 2011/12 financial year.

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.
- Following commissioning, the 33kV supply to WEL from Transpower's bus at Meremere is to be disconnected. This will include removal of redundant assets:

  Te Kauwhata

  P505181 and the Stoat conductor from P505180 to the termination point on the TEK 33kV structure.

  Z17, Z18, Z3, G442, G452, CB 442 and CB 452.

  Meremere

  P546744, P546746, P546747, P546751, P547422, P547423 and P547421 and all conductors between these poles on the MER – FIN circuit.

  Z87, Z25 and CB 852 on the MER – FIN circuit.

  P546745, 546748, P546749, P546750, P505504 and P505503 and all conductors between P546745 and 505502 on the MER – TEK circuit.

  Z86, Z117 and CB 862 on the MER – TEK circuit.

The final configuration of the new TEK-FIN circuit needs to be reviewed and discussed with Syscon in regards to the need for Reclosers or 33kV switches to sectionalize the line for faults to enable the Hampton Downs section to remain in service for faults beyond the tee point.

6.2.3 Primary Equipment Size and Ratings

- A 7-unit 33kV GIS switchboard with vacuum CB's (4 x incomers, 2 x transformer feeders, 1 x bus-section), SF6 gas-insulated bus. 1250 Amp bus 25kA / 3 sec, 800 Amp incomer CB's, 800 Amp transformer feeder CB's, and 1250 Amp bus-section CB. Capable of future extension at each end.
- SEL relays and meters for protection, monitoring and control of the new switchgear and transformers.

- 33kV cables (transformers to switchboard) single core 630 mm^2 Aluminium, 13kA / 1 sec. copper wire screen, XLPE insulation.
- 33kV cables (switchboard to lines) single core 400 mm^2 Aluminium, 13kA / 1 sec. copper wire screen, XLPE insulation.

6.2.4 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 Primary Equipment Size and Ratings

- Two new 33kV/11kV 15/23 MVA zone transformers.

- Upgraded transformer pads and oil containment facilities
- Modify REG-D transformer control and monitoring system to include the Remote I/O module in the transformer cubicle.
- 2x SEL 734 revenue meters for CB36 and CB37 incomer panels.
- 1x SEL 3332 Communications Processor for installation into existing Comms panel.

6.3.4 Timing of Works

To be completed in the 2011/12 financial year.

App 6.4 Peacockes Road Zone Substation Transformer Replacement

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.

6.4.1 Scope of Work

- Construct new transformer foundation pads complete with oil containment facilities 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 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.

6.4.2 Primary Equipment Size and Ratings

- Two 33kV/11kV, 15 MVA Brush zone transformers, (ex Latham Zone Substation) with serial numbers
- New transformer pads and oil containment facilities

6.4.3 Timing of Works

To be completed in the 2011/12 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 Primary Equipment Size and Ratings

- 11-unit 11kV metal-clad switchboard with vacuum CB's (2 x incomers, 8 x feeders, 1 x bus-section and 1 x bus-riser). 1250Amp bus 25kA / 3 sec, 2 x 800Amp incomer CB's, 6 x 630Amp feeder CB's, and 1 x 1250Amp bus-section CB. SEL relays and meters for protection, monitoring and control of new switchgear and transformers. Refer to single line diagram. Network planning to confirm relays required and protection settings
- 11kV cables (trunks) three core 300mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- 11kV cables feeders three core 95mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- Cable ducts to be orange hi-impact strength PVC, 150mm diameter. Fibre optic cable to be enclosed in 50mm ducting.

6.5.4 Timing of Works:

To be performed in the 2011/2012 financial year in conjunction with the building work required to establish the enclosure for the switching station.

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 (serial numbers 02/72/2086 and 02/72/2087), 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 Equipment Size and Rating:

- Two x Transformers 18MVA, 33/11kV, 3-phase, Dyn11, OLTC. Ex Claudelands Substation, Bonar Long serial numbers 02/72/2087 and 02/72/2086. Tap change control to be via existing Reg-D relays coupled to new Reg-D remote I/O modules. New neutral CTs required.
- Eberle Reg-D relays (existing) for transformer voltage regulator control, new Remote I/O modules are required to be installed on each unit
- Relays required as follows:
  - x Eberle Reg-D Remote I/O Modules
  - 11kV cables (transformer to switchboard incomers) single core 630 mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation (if required)

6.6.4 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.

6.6.5 <u>Upgrade Latham CB1 and augment Latham CB2 and CB5 to solve Latham CB5 loading issues</u>

6.6.6 Background

LATCB5 is identified as the highest loaded feeder in the Network Load Forecasting Model for winter 2009. Peak loadings were 300A on a limit of 270A.

In this project LAT CB2 and LAT CB5 are to be augmented to allow load from LATCB5 to be offloaded to the more lightly loaded LATCB2. Additionally sections of LATCB1 are to be upgraded to allow load transferral from LATCB2 to LATCB1. This will have the effect of balancing loads on LATCB2 and CB5 at or around 190A on each with loading on LATCB1 of around 250A. The higher loading on LATCB1 is acceptable given the higher capacity of that feeder achieved by a close in section of $400mm^2$ Al XLPE cable.

The addition of Sectos switches on LATCB2 will ensure reliability standards are met by allowing backfeed to occur for a fault on various sections.

Additional benefits of the project will be a more sensible feeder pattern with local loads supplied from local feeders, greater diversification of LATCB1 loads by mixing residential and industrial loads on the same feeder, utilisation of all available circuit breakers on RM54 which will reduce expected SAIDI and enhanced ability to backup feeders under contingency.

6.6.7 Scope of Works

Reinforce LATCB1 / Install Fibre Optic Cable duct

- Install new 3c – 11kV 400mm2 Al XLPE cable from RM639U1 to RM804U3 allowing enough cable for connection at both ends. Length approximately 220m. Install Fibre Optic Duct (50mm) along the whole route.
- Remove cable from RM639U1 and from RM804U3 and connect new cable to RM639U1 and RM804U3.
- Install new 3c – 11kV 400mm2 Al XLPE cable from RM804U1 to RM54U1 allowing enough cable for connection at both ends. Length approximately 500m. Install Fibre Optic Duct (50mm) along the whole route.
- Remove cable from RM804U1 and from RM54U1 and connect new cable to RM804U1 and RM54U1.

Upgrade existing 40 mm2 AL PILC 11 kV to 300 mm2 AL XLPE on Alison Street

- Install new 3c 300 mm2 AL XLPE HV UG 11 kV cable from RM7 along Alison Street western side up to the boundary of 24 and 22. Approximate cable route length is 350 meters.
- Disconnect and remove existing new 3c 40 mm2 AL PILC HV UG cable terminated at RM7U2. This cable is to be capped and sealed. Terminate the new 3c 300 mm2 AL XLPE HV UG 11 kV to vacated RM7U2.
- Disconnect existing UG 11 kV cable 40 mm2 AL PILC jointed to 95 mm2 AL XLPE on Boundary 24 on Alison St. Cap and seal this cable. Through joint the other end of the new 11 kV cable 300 mm2 AL XLPE to the existing 95 mm2 AL XLPE.

New 11kV cable to connect LATCB2 on Mahoe St to LATCB5 on Collins Rd and switch reconfiguration

- Install new 3c 300 mm2 AL XLPE HV UG 11 kV cable from pole 547439 on Mahoe St to pole 554009 on Collins Rd. Cable route is to be via Prisk St. Cabling technique is to be the best combination of trenching and thrusting taking cost and practical feasibility into account. Cable length is approximately 620m taking required pole terminations at both ends into account.
- Relocate LATCBX149 and all associated control equipment from pole 547117 to pole 537505. Upgrade pole 537505 as required.
- Install new 11kV Sectos switch on pole 547117. No pole modifications will be necessary as the new switch can be installed in the position that LATCBX149 was removed from. The new switch will be a series switch in the LATCB2 feeder.

- Install new 11kV Sectos switch on pole 547119. The new switch will be a series switch in the LATCB2 feeder. Upgrade pole as required.
- Terminate the 11kV cable installed in 2.3.1 to LATCB2 on pole 547439. Install solid links to allow cable isolation and surge arrestors as per the current standards. Pole 547439 will either need to be replaced with a longer pole or the LV between pole 537512 and pole 547117 will need to be undergrounded to allow adequate space for cable termination to occur. If the LV undergrounding option is chosen it will be necessary also to underground the existing service to 121 Mahoe St. The detailed design process should be used to determine which the preferred option is. Cost and practical feasibility considerations should be taken into account.
- Remove LATCBX144 and all associated control equipment from pole 554009.
- Remove AB531 from pole 567373.
- Relocate LATCBX144 and all associated control equipment to pole 567373. There shouldn't be the need to upgrade the pole as an existing shackle point exists and AB531 was located there previously.
- Relocate AB531 (Sectos switch) to pole 554009. There shouldn't be the need to upgrade the pole as an existing shackle point exists and LATCBX144 was located there previously.
- Terminate the 11kV cable installed in 2.3.1 to the 11kV overhead circuit on pole 554009. The cable is to run up the west side of the pole and connect to the 11kV conductor on the west side of the newly installed Sectos switch. Install solid links to allow cable isolation and surge arrestors as per the current standards. It should be possible to arrange the new cable termination and Sectos switch installation on the pole without replacing the pole.
- LATCB1, CB2 and CB5 thermal and protection settings to be reviewed by applying the capacity based protection setting process.
- Standard WEL cable testing to be carried out on the new cable installed prior to jointing.

6.6.8 Equipment Size and Rating:

- ABB 11kV Sectos switch with no CTs.
- 11kV cables three core 400mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- 11kV cables three core 300mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- Cable ducts (for road crossings) to be orange hi-impact strength PVC, 150mm diameter for 3c/400mm^2 cable and 125mm continuous ducting where directional drilling is required.
- Cable ducts (for railway crossings) to be 150mm heavy duty rigid PVC conduit.

6.6.9 Timing of Works:

To be performed in the 2011/12 financial year, depending on budget approval.

Difficulty in obtaining planned outages (SAIDI impact and loading issues) may prevent the outages required to complete the commissioning work at certain times of the year. This is determined in conjunction with SYSCON.

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 Equipment Size and Rating:

- 33kV cables (PEA CB872 to P543087) single core 630 mm^2 Aluminium, 13kA / 1 sec. copper wire screen, XLPE insulation.
- Outdoor 33kV cable termination kits
- Pole hardware for cable crucifixes and 33kV surge arrestors

6.7.4 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 Equipment Size and Rating:

- 33kV O/H conductor Butterfly 320 mm² AAC.
- Delta steel brackets
- 33kV K-Line insulators

6.8.4 Timing of Works:

To be performed in the 2011/2012 financial year.

App 6.9 Vickery Street 11kV Re-configuration

6.9.1 Background

Significant load growth has been observed in the Sandwich substation area. There were applications for load increases on SANCB2 and SANCB1. An increase in load to 650 Amps on SANCB2 at T362 along Pukete Road and another 250 Amps new load on Vickery Street. This prompted an evaluation of

Sandwich feeder loadings which revealed that under steady state both feeders will be able to accommodate the proposed loads. However, under contingency neither feeder will be able to supply the combined feeder loads.

Load flow shows the current load on RM598 is 2.7 MVA. Pukete Road and the south end of Vickery Street (SANCB2, SANCB7, TASCB2, and TASCB6) will not be able to supply RM598 under contingency due to the present load levels of each feeder.

Further study identified SANCB5 as a lightly loaded feeder that can be utilized to provide the necessary security. This can be achieved by transferring load from SANCB1 to SANCB5 which will result in load balancing between the two feeders under steady state. This will also satisfy the requirement to fully restore all loads on SANCB1 and SANCB5 under contingency at any critical points along its feeder even for a loss of a pole (removing SANCB1 and CB5) on Bryant Road. The new configuration will also provide strongest back feed from SANCB7 via AB519.

To accomplish this purpose it is necessary to reconfigure the 11kV along Vickery Street which can be done by installing new 11kV cables and RMU.

6.9.2 Scope of Works

Upgrade the 11kV reticulation in the Vickery St area as follows:

- Consult with the HCC for a suitable site for the placement of an 11kV RMU type CCC preferably on the western side of Vickery Street south side of RM598.
- Construct concrete pad for the new RMU and install the new type CCC RMU on the site agreed with HCC.
- Connect the new RMU to SANCB1 by cutting through the existing 3c 185 mm2 AL XLPE 11 kV cable along Vickery Street. Terminate the existing 3c 185 mm2 AL XLPE 11 kV cable to RMU1 and RMU3. Install additional 3c 185 mm2 AL XLPE 11 kV cable if length is insufficient.
- Install a new 3c 300 mm2 AL XLPE 11 kV cable from the new RMU to RM598 also on Vickery Street. Approximate cable route length is 40 meters.
- Disconnect and remove the existing 3c 185 mm^2 AL XLPE 11 kV cable terminated to RM598U1. Through joint this disconnected cable to the new 3c 300 mm2 AL XLPE 11 kV cable. Terminate the other end of the new 3c 300 mm2 AL XLPE 1 kV cable to new RMU2.
- Replace P530584 with a 12.2 m concrete pole. Install new double crossarms on Level 1 retaining the existing double termination assembly construction type. Install a new 11kV Sectos switch with normally closed configuration on this crossarm. Install a level 2 crossarm for the new cable termination. Reinstate LV configuration.
- Install a new 3c 300 mm2 AL XLPE 11 kV cable from P530584 on Bryant Road, westwards then northwards along Vickery Street eastern side until it reaches 54 Vickery Street, then across Vickery Street up to RM598. Approximate cable route length is 360 meters. Terminate this new 3c 300 mm2 cable to the vacated RM598U1 and connect the other end hard on via crucifix complete with surge arrestors on P530584.

- Protection settings on SANCB1 and SANCB5 to be reviewed and amended as required.

6.9.3 Equipment Size and Rating:

- ABB Safelink, SF6-Insulated Ring Main Unit 12kV type CCC, with 1 unit TFI's complete with outdoor enclosure, painted olive green
- 11kV cables three core 300mm^2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation.
- Cable ducts (for road crossings) to be orange hi-impact strength PVC, 150mm diameter for 3c/300mm^2 cable and 125mm continuous ducting where directional drilling is required

6.9.4 Timing of Works:

To be performed in the 2011/2012 financial year.

App 6.10 Fullerton Rd 33kV Switching Station

6.10.1 Background

At Fullerton Rd there is a 33 kV Tee towards Rotokauri and connecting to Avalon zone substation. It is proposed to enhance the 33 kV connections so as to enable multi-directional power transfers between the Te Kowhai and Hamilton GXP fed substations, which would require a switching station with remote and/or automated control. This will provide added security for the Rotokauri growth cell, and to the Te Rapa industrial zone, and is a planned future network reinforcement project.

Once the wind farm related upgrade has been completed and the wind farm is fully operational, it will be relatively more difficult to take this part of the 33 kV network out of service in order to construct the switching station, there are also cost benefits of constructing this switching station at Fullerton Road and terminate the new cables immediately.

It is proposed to fully complete the Fullerton Road switching station now, rather than plan for it in a couple of year's time.

6.10.2 Scope of Works

- Install a remotely operated three way 33 kV ring main unit at the tee point between Te Kowhai, Whatawhata and Avalon substations at the juncture of Fullerton Rd and Horotiu Roads:
- At present there is a 70 mm2 copper conductor overhead 33 kV circuit from Whatawhata to Fullerton Road connecting onto the TWH – AVA 33 kV circuit via a remotely operated switch, and there is already a radio communications link to this site.
- The 70 mm2 circuit is to be disconnected from the 33kV TWH-AVA circuit but retained for future use as an 11kV feeder. The existing CB (Z151) will be removed and returned to WEL stores.
- A new 33 kV cable circuit and fibre optic cable from WHA to this point are being installed under a separate contract. The new 33 kV cable, with the cable circuit to AVA and the overhead circuit to TWH, will be terminated into the new three way remotely operated ground mounted 33kV RMU located on the road verge.

- The 33 kV RMU mounts on a concrete slab over a cable basement, and comes with an enclosure to weather proof it.
- The 33 kV RMU site has a 400V supply available on the existing pole line on the roadside, from which a 230 V supply shall be cabled to the RMU site. These will be used to supply a 24 V DC battery charger and battery bank mounted within the RMU enclosure for the 24 V DC supply to the RMU and associated switch motors, and also to supply the communications equipment required to remotely control the RMU and receive it's status indications (most likely a Power-Cat IPRTU or similar).
- Any communications equipment will be mounted in a cubicle on the side of the RMU enclosure.

6.10.3 Equipment Size and Rating:

- The Ring Main switch to be installed at the 33kV star points on Fullerton Road is to be 36kV, 630A, 170kV BIL, 20kA/ 3 sec, SF6 insulated.Ring main unit type MINEX made by Driescher of Germany, supplied through Delstar New Zealand Limited.
- The ring main switch will be supplied complete with a motor for each of the three switches and an auxiliary contact block (2 NO and 2 NC) for remote status indication of each main isolator and each earthing switch. An enclosure is being supplied by the manufacturer to allow the switchgear to be installed outdoors.

6.10.4 Timing of Works:

- The project is to be completed in the 2010 / 11 financial year by the first week of November 2010 to co-ordinate with the wind-farm construction timing.

App 6.11 Raglan Zone Substation & Cabling

6.11.1 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.

6.11.2 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.

6.11.3 Primary Equipment Size and Ratings

- One x Transformer 15/23MVA, 33/11kV, 3-phase, Dyn11, OLTC.
- 8-panel 11kV metal-clad switchboard with vacuum CB's (4 x feeders, 2 x incomers, 1 x bus-section, 1 x bus-riser), air-insulated bus. 2000Amp bus 25kA / 3 sec, 630Amp feeder CB's, 2000Amp incomer CB's, and 2000Amp bus-section CB. Capable of future extension at each end for possible additional feeders.
- 3-unit 33kV metal-clad switchboard with vacuum CB's (1 x incomer, 1 x transformer feeder, 1 x bus-section), SF6 gas-insulated bus. 1250Amp bus 25kA / 3 sec, 800Amp incomer CB, 800Amp transformer feeder CB, and 1250Amp bus-section CB. Capable of future extension at each end.
- Relays and meters for protection, monitoring and control of new switchgear and transformers, relay for transformer voltage regulator control.
- One x ABB combined Safelink CFC ring main unit / 100kVA transformer. LV panel c/w fuses as required for local service supplies.
- One x ABB Safelink CFCC ring main unit, complete with outdoor enclosure and precast pad, fuses @ 25Amps.
- One x 33kV pole-mounted circuit breaker complete with communications facilities to enable remote control and indication from SYSCON. Preferred supplier is Cooper Power Systems type NOVA38 complete with Form 6 control. Purchase CB c/w mounting bracket to suit concrete pole, and surge-arrestor mounting brackets fitted to both sides of CB tank.
- Five x 11kV pole-mounted switches. SF6-insulated pole-mounted switches type NXB24C630AM3, 24kV, 630A, complete with gas gauge, manual lockout, motorised operation, control box and communications facilities to enable remote control from SYSCON. Control voltage is 24Vdc so a suitable LV supply and charger will be required at each switch site.
- 33kV cables single core 400mm2 Aluminium, 13kA/1sec copper wire screen, XLPE insulation for extension of existing cables to CB4302.
- 33kV cables single core 630mm2 Aluminium, 13kA/1sec copper wire screen, XLPE insulation for connection between transformer T6 and switchboard CB4312.
- 11kV cables single core 630mm2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation for connection between transformer T6 and switchboard incomer CB36.
- 11kV cables three core 300mm2 Aluminium, 10kA/1sec copper wire screen, XLPE insulation for all feeders.
- Cable ducts (for road crossings) to be orange hi-impact strength PVC, 100mm diameter for 1c/400mm2 cables (one per phase), and 150mm diameter for 3c/300mm2 cables.

6.11.4 Timing of Works:

Site to be purchased 2009/10.

Substation construction and commissioning to be done during 2010/11 financial year.

Project close-out by 31 March 2011.

<u>App 6.12 Horotiu Zone Substation 11kV Switchgear Replacement</u>

6.12.1 Background

The 11kV switchboard at Horotiu is over 50 years old, manufactured by Crompton Parkinson. The switchgear is of a double bus arrangement and the PILC incomer and feeder cables are terminated in pitch-filled terminal boxes. This switchboard is past its scheduled replacement date and needs to be removed and upgraded with a modern single bus switchboard.

The existing ABB Unisafe 11kV switchboard at Cobham Drive is rated at 1250Amps. It is to be replaced by a new 2000Amp switchboard as part of the Cobham Drive zone substation project (2009/10). It is proposed that the 1250 Amp switchboard is relocated to Horotiu Zone Substation to replace the existing switchboard. New 1250A Incomer CBs and Bus Coupler will be required, some of the existing CTs are 5A secondary matched for the COB Solkor scheme, these will need to be replaced with 1A CTs. There are a mixture of relays on the COB board and they all need to be replaced which will require new panel doors for those with cut-outs in already.

11kV incomer cables, and feeder cables out to the nearest network connection points, are to be replaced with new XLPE cables.

Demand at Horotiu is expected to increase by approximately 3 MW in the near future. The N-1 capacity for Horotiu of 10 MVA will be exceeded and the transformers will need replacing. When necessary, the two 18 MVA Bonar and Long units recently removed from Claudelands will be installed and commissioned at Horotiu.

6.12.2 Scope of Work

Upgrade Horotiu Substation as follows:

- Remove the existing 9-unit double-bus Crompton Parkinson 11kV switchboard at Horotiu and replace with the 12-unit 11kV switchboard ex Cobham Drive switching station. This switchboard is rated at 1250Amps (10 x feeders, 1 x bus-riser, 1 x bus-tie), and is an ABB type Unisafe -12. Two new 1250A Incomer panels and a 1250A Bus Coupler panel are to be procured for installing into this switchboard. The old Horotiu switchboard is to be scrapped.
- All existing protection, monitoring and control of the transformers and the 11kV switchboard is to be upgraded to current WEL Standards.

6.12.3 Primary Equipment Size and Ratings

- Two x Transformers 18MVA, 33/11kV, 3-phase, Dyn11, OLTC. Ex Claudelands Substation, Bonar Long serial numbers 02/72/2087 and 02/72/2086. Tap change control to be via existing Reg-D relays coupled to new RegD remote I/O modules. New neutral CTs required.

- 12-unit 11kV metal-clad switchboard (10 x feeders, 1 x bus-riser, 1 x bus-tie), air-insulated bus 1250Amp, from Cobham Drive Switching Station refurbished with new protection relays. Two new incomers and a new bus-section CB are to be procured for installation at Horotiu.
- Relays and meters for protection, monitoring and control of new switchgear and transformers.
- Relays (existing) for transformer voltage regulator control.
- Two ring main units, complete with outdoor enclosure and precast pads, fuses @ 16Amps.
- kVA Dyn11 transformer.
- 11kV cables (feeders) three core 300 mm² Aluminium, 10kA/1sec copper wire screen, XLPE insulation. Approx quantities as per clause 2.17 above.
- 11kV cables (transformer to switchboard incomers) single core 630 mm² Aluminium, 10kA/1sec copper wire screen, XLPE insulation
- Cable ducts (for road crossings) to be orange hi-impact strength PVC, 150mm diameter for 3c 300 mm² cables. If directional drilling is required, 125mm continuous for 11kV ducting should be used.

6.12.4 Timing of Works

To be completed in the 2010/11 financial year.

App 6.13 Relocate Ripple Control Plant from Hamilton to Weavers

6.13.1 Project Description & Outcomes:

The spare 33kV 283Hz ripple control plant equipment at Hamilton substation is to be transferred and installed at Weavers substation.

6.13.2 Technical Overview

The new Transpower Point of Supply at Huntly has recently been commissioned.

WEL's northern region has 500Hz ripple control plants at Weavers, Glasgow, Te Kauwhata and Finlayson. Ngaruawahia has no ripple plant and receives its signals from Te Kowhai 283Hz plant. In order to change Ngaruawahia over to the Huntly POS it is necessary to install a 283Hz plant somewhere in this region.

Weavers has plenty of space available due to the recent removal of the outdoor 33kV structure and has spare connection ports available on two of the new indoor 33kV CBs.

The spare 33kV 283Hz ripple control plant equipment at Hamilton substation is to be transferred and installed at Weavers substation. Ngaruawahia substation can then be switched over to Huntly POS.

This will allow for progressive upgrade of the northern ripple relays to 283Hz. The benefits of inclusion of northern loads into the reserves market and the decommissioning of old rotary 500Hz plants at WEA, GLA, TEK and FIN can be realised. This solution will also cater for load control into the planned Hampton Downs substation.

6.13.3 Scope of Work

- Disconnect and remove the spare Zellweger Ripple Plant No 1 equipment from Hamilton substation. This includes an isolating transformer, set of air-cored tuning reactors, stand-mounted coupling capacitor bank, and cable support stand, and two indoor panels. Equipment not required at Weavers to be left where it is at Hamilton for the meantime.

- Arrange refurbishment of ripple plant and purchase of a new transmitter and controller.

6.13.4 Primary Equipment Size and Ratings

- Ring Main Units, complete with outdoor enclosure and remote control facilities: 1 x 36kV type 321.
- Ripple control converter and controller.
- Cables:
  - 33kV cables single core 120 mm² Aluminium, 10kA/1sec copper wire screen, XLPE insulation.

6.13.5 Timing of Works

To be completed in the 2010/11 financial year.

App 6.14 New 11kV trunk between KEN and MAS

6.14.1 Project Description & Outcomes

- Currently load on the KEN KIL MAS NOR 11k ring is around 8 MVA which exceeds the N-1 limit of 7 MVA. This limit is due to CB limitations of 400A (around 8MVA) on KEN CB1, CB13 and KIL CB5. Upgrades to KEN CB1, CB13 and KILCB5 (planned for 2010/11 financial year) will increase the N-1 limit to 9MVA. Given the need to offload around 1.5 MVA from LAT to KIL and the load growth currently being experienced, and predicted to continue, in the area there is a need to increase the N-1 limit to at least 13 MVA. The load growth described is due to residential infill in the Frankton area and industrial growth in the Ellis St area.
- To achieve the required capacity upgrade, as described above, it is proposed to install a new 11kV trunk circuit (3c 300mm2 Al XLPE cable) from Kent zone substation to Massey St 11kV switching station. New 630A 11kV circuit breakers will be required at KEN and MAS. The project will increase the N-1 capacity of the KEN KIL MAS NOR 11k ring to around 16 MVA.
- The opportunity to upgrade a weak section (0.04 sq inch Cu) of MASCB8 on Massey St will also be taken. Finally a ducted 48core fibre optic cable is also to be installed along the path of the new trunk and distribution feeder cables.
- Several options were considered when evaluating how best to serve the load requirements. These included a new zone substation, upgrading distribution feeders out of KEN, supplying MAS or KIL from LAT and various other ways of upgrading the existing trunks. The likely need to replace existing 11kV trunks (existing trunks are around 40 years old) in the future was also taken in to account. Findings were that:
  - The new zone substation option would be very expensive; there are issues with 33kV circuit availability and furthermore the existing zone substation capacity of KEN is adequate given the growth expected in the area.
  - Adding 11kV distribution feeders to KEN would require long runs of 11kV cable (as there would need to be interconnections with MAS CB8 and KIL CB6) and would result in KEN supplying loads much closer to KIL and MAS. The cost would be high, a

non–standard configuration would result and the increase in capacity achieved would be less than the preferred option.

- o Supplying MAS or KIL from new 11kV circuits out of LAT would not achieve the increase in capacity achieved by the preferred option. Four CB's (2 at LAT and two at KIL or MAS) would be required with twice the amount of cable. Additionally there are loading issues at LAT at the zone substation and at HAM at the POS level. This option would add load to LAT and HAM. Offsetting the downsides of this option is the easier trenching involved. However this factor is not significant enough to make this option preferred as security objectives are not met.
- o Other 11kV trunk upgrade options were either more expensive or involved abandoning existing cables with up to 30 years of useful life remaining.

6.14.2 Scope of Works

Stage 1

- Cabling of new trunk feeder, MASCB8 upgrade and fibre optic cable from Massey Street substation along Massey Street to the corner of Massey Street and Greenwood Street will be performed during this stage. This is to be performed in October 2009 and takes advantage of other parties having to dig up the road for their own works. Overall savings, as a result of taking this opportunity, are estimated at $Xk. The trunk cable laid in this stage will not be livened until stage 2 is complete. The distribution cable will be livened. Budget is out of relocations.
- New KEN MAS 11kV trunk feeder:
- Install new 11kV 3c 300mm2 Al XLPE cable from Massey Street substation along Massey Street to the corner of Greenwood Street and Massey Street. To obtain the required circuit rating Bentonite or equivalent thermal backfill is to be pumped into any ducting used. Through jointing along the route is to be performed as required. At both ends the cable is to be cut and capped.
- MASCB8 upgrade:
- Install new 11kV 3c 300mm2 Al XLPE from Massey Street substation along Massey Street to the corner of Massey Street and Greenwood Street. Use common trenching with the trunk installed in 2.1 to the extent possible. To obtain the required circuit rating Bentonite or equivalent thermal backfill is to be pumped into any ducting used. Through jointing along the route is to be performed as required.
- Through joint the cable at the corner of Greenwood Street and Massey St to the existing 70 square mm Cu cable which connects to RM188U4.
- Remove existing MASCB8 cable from the terminations at the Massey St switchboard. Terminate the new cable circuit to existing MASCB8.
- Fibre Optic Cable:
- Install a optic fibre duct from Massey Street substation to the corner of Massey Street and Greenwood Street. No fibre optic cable to be installed at this point.
- Relocation of communications cabinet at KEN:
- In preparation for the new 11kV CB installation at KEN (part of stage 2) it will be necessary to relocate the communications cabinet currently preventing CB installation next to KEN CB14. This

must be done prior to an independent KEN RTU and communications upgrade project to prevent unnecessary re-work and added cost. As such finance for this activity will be required in the 2009/10 financial year.

Stage 2

- This stage is to complete the KEN MAS trunk and MASCB8 upgrade projects commenced in 2009/10. Budget has been allowed in 2010/11 for this.
- Install new 630A 11kV CB at KEN. The CB is to be installed on the CB9, 10,11,12,13 & 14 side of the bus. The new CB is to have the same bus and circuit earthing functionality as the existing substation CB's. At the time of writing there was an existing communications cabinet in the way. This will have been shifted as part of stage 1.
- Install new 630A 11kV CB at MAS. The CB is to be installed on the CB6, 7 & 8 side of the bus. The new CB is to have the same bus and circuit earthing functionality as the existing substation CB's. Room to be cleared as required enabling this to be done.
- New KEN MAS 11kV trunk feeder.
- Install new 11kV 3c 300mm2 Al XLPE cable from the corner of Greenwood and Massey Streets along Massey Street to Waterloo Street, along Waterloo Street to the KENCB14 Railway crossing easement, under the railway using the aforementioned easement onto High Street and into Kent zone substation via the back entrance. To obtain the required circuit rating Bentonite or equivalent thermal backfill should be pumped into any ducted sections.
- Perform through jointing as required along the route including to the cable at the corner of Greenwood Street and Massey Street installed under stage 1.
- Terminate the new cable circuit at the new KEN and MAS circuit breakers.
- Protection:
    - Install relays at KEN and MAS ends.
    - Differential protection to be set up on new trunk.
    - Inverse time over current and earth fault protection to be set up on the KEN relay. That is consistent with the approach applied to the KEN NOR and KEN KIL trunks and provides cover for MAS, NOR and KIL bus faults.
    - Existing protection to be used for MASCB08.
- Fibre Optic Cable:
    - Install a fibre duct from the corner of Massey Street and Greenwood Street to Kent zone substation.
    - Install a 48core fibre optic cable from KEN to MAS using the ducts installed in stages 1 and 2.
    - Perform all connections as required to complete the path from Massey to Kent substations.
- No changes to the protection hardware for MASCB8 will be required.

- Temporary offloading of MASCB7 to KENCB14 and NORCB7 to KEN CB3 performed to alleviate ring loading (as requested on 29-07-09 – see wire doc for details) is to be reversed on completion of this project.
- It will be desirable to offload a portion of LATCB8 load to KILCB1 (KIL CB1 is normally open) to achieve a better load balance and for improved reliability.

6.14.3 Timing of Works:

Stage 1: 2009/10.

Stage 2: 2010/11.

App 6.15 Claudelands 11kV Cable Replacements Stage 3

6.15.1 Background

11kV Feeder cables in the Claudelands area are old Cu PILC cables which have reached the end of their economic life and are being replaced progressively. Some of these old cables have low current ratings. Replacement cables will be AL XLPE of full feeder strength.

The following works are Stage 3 of this replacement programme, and will complete this project.

6.15.2 Scope of Works

Refer attached marked-up GIS drawings and marked-up 11kV SCADA prints. A detailed cable route survey is required to confirm scope and methodology.

There are three cable sections to be replaced as follows:

- Section 1:
  - CLACB13 feeder from RM223U4 Peachgrove Rd to RM429U1 St Winifreds Avenue.
- Section 2:
  - CLACB01 feeder from RM427U3 Grey St to RM431U2 Grey Street.
  - RM431 is a Reyrolle JKSS oil-filled unit.
- Section 3:
  - CLACB01 feeder from RM431U1 Grey St to RM745U3 Beale Street.

6.15.3 Equipment Size and Rating:

- Cable:
  - 11kV 3c 300 mm² AL XLPE 13kA/1 sec copper wire screen–screen to earthed at both ends.
- Ducting:
  - 125 mm diameter continuous orange ducting for 11kV cable.
  - 100 mm diameter continuous salmon ducting for future fibre optic cables.

6.15.4 Timing of Works:

This project is scheduled to be done during the 2010/11 financial year.

The works should be scheduled for construction during the summer months when load is lightest.

App 6.16 MAF Switching Station 11kV Switchboard Replacement

6.16.1 Project Description & Outcomes

The MAF 11kV switching station is located in a building just north of the NIMT railway line adjacent to the Ruakura squash courts. The building is in a low-lying area that was prone to flooding and the switchgear has suffered flood damage several times over its life. It is in a poor state of repair and is due for replacement.

This project will replace the existing switchgear with a suite of modern indoor 11kV switchgear (RPS preferred) and a new local service transformer. Protection will be upgraded with on-board SEL relays and 2032 communications processor.

The existing switching station building will be suitable to accommodate a suite of RPS switchgear. Given the size of the building and the location of the cable trench this can be done with little or no alteration to the building using RPS.

Supply to the new switchboard will be from the existing feeder 11kV cable from Hamilton substation CB2762 via RMU78.

Communications to Syscon initially by temporary radio until a future additional 11kV cable is installed to Hamilton substation at which stage a fibre cable will be installed for use. A wall mounted SCADA panel will suffice for both configurations and a 24v DC Battery charger and battery can be free standing in the corner of the building as per the site sketch.

Presently there is a spare CB on the existing board at CB2 where the cable has been cut and abandoned. It is proposed to install an additional 11kV cable from Hamilton 11kV in the future and this spare replacement CB on the new switchboard will be utilised for this purpose.

6.16.2 Scope of Works

Refer attached design drawings, marked-up GIS drawings and marked-up 11kV SCADA prints, building sketch and site photos.

- Replacement of existing MAF 11kV switchboard with new RPS 11kV switchboard (2010/2011 financial year)
- Arrange for the existing MAF switchboard to be off-loaded by combination of switching around the site and installation of a temporary RMU adjacent to the switching station. Budget allowance has been made to purchase a new RMU for this purpose that can then be used at Horotiu.

- Install a new 6-way switchboard in the same location as the existing; positioned so there is 1m clearance from the northern wall and the cable boxes of the new switchboard are over the existing covered cable trench.

6.16.3 Equipment Size and Rating

- 11kV Switchboard:
  - 11kV switchboard with 1250A Bus complete with 630A circuit breakers on all feeders.
  - Bus VT – 25VA Class 0.2 / 3P
  - Bus CT – 15VA Class 0.2, Ratios 1200 / 800 / 200 / 1
- Transformer:
  - 500kVA 11kV/415V, Dyn11 transformer, equipped with LV panel fitted with fusing as required.
- Cables:
  - Extend cables as required by trifurcation to new 11kV switchboard air boxes.
- Protection:
  - Relays on all feeders, Communications processor and Satellite Clock.

6.16.4 Timing of Works

Stage 1: Replacement of the MAF 11kV switchboard to be done by 31 March 2011.

WEL Depot, Maui St

Appendix 7 Key Amendments to the AMP dated December 2010

Clause Amended	Amendment	Amendment Date
Table of Contents	Reduced it to level 1 headings and remove the lists of Tables and figures	30 Sep 2010
1.3	Remove asset quantities and values table	30 Sep 2010
2	Restructure whole section align with Commerce Commission's recommended order starting with purpose of the plan, incorporate asset management systems and processes under this section	30 Sep 2010
3	Restructure whole section align with Commerce Commission's recommended order and better information flow starting with a high level description of the distribution area.	30 Sep 2010
3.3	Moved detail age profile graphs and description back from appendix 9	30 Sep 2010
4	Changed Network Performance and Service Levels to Service Levels. Restructure whole section to align with Commerce Commission's recommended order and better information flow starting with the customer consultation process	30 Sep 2010
5	Incorporated programme of works for AMP Planning period back under this section.	30 Sep 2010
5.8	Added a section Analysis Of Network Development Options Available and Details Of Decisions Made To Satisfy And Meet Target Levels of Service	30 Sep 2010
5.9	Restructure the section to align with specific requirements on timeframe, currently or next year, the projects planned for the next four years and projects for the remaining period	30 Sep 2010
5.12	Changed capital expenditure projection to align with the format for information disclosure	30 Sep 2010
6.2	Changed maintenance expenditure projection to align with the format for information disclosure	30 Sep 2010
8	Move all gap analysis and improvement initiatives under one section to align with the requirements.	30 Sep 2010
8.4	Move difference between indexed 2009 AMP and 2010 AMP comparison from summary to a new section under 8	30 Sep 2010

9	Add a new section of Expenditure Forecasts and Reconciliations	30 Sep 2010
Appendix 8	Add a new section - Project Maps	30 Nov 2010

Appendix 8 Project Map

The following maps show a selection of the major projects WEL plans to undertake within five years from 1 April 2010. There is no guarantee all of these projects will go ahead and timing may vary, due to external factors and their impact on WEL's project selection process. The maps show only the major projects (over $450k) and exclude 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. There are still two GXPs in the northern network region, Meremere and Huntly, however the full region has been grouped within the Huntly GXP region in the following maps.

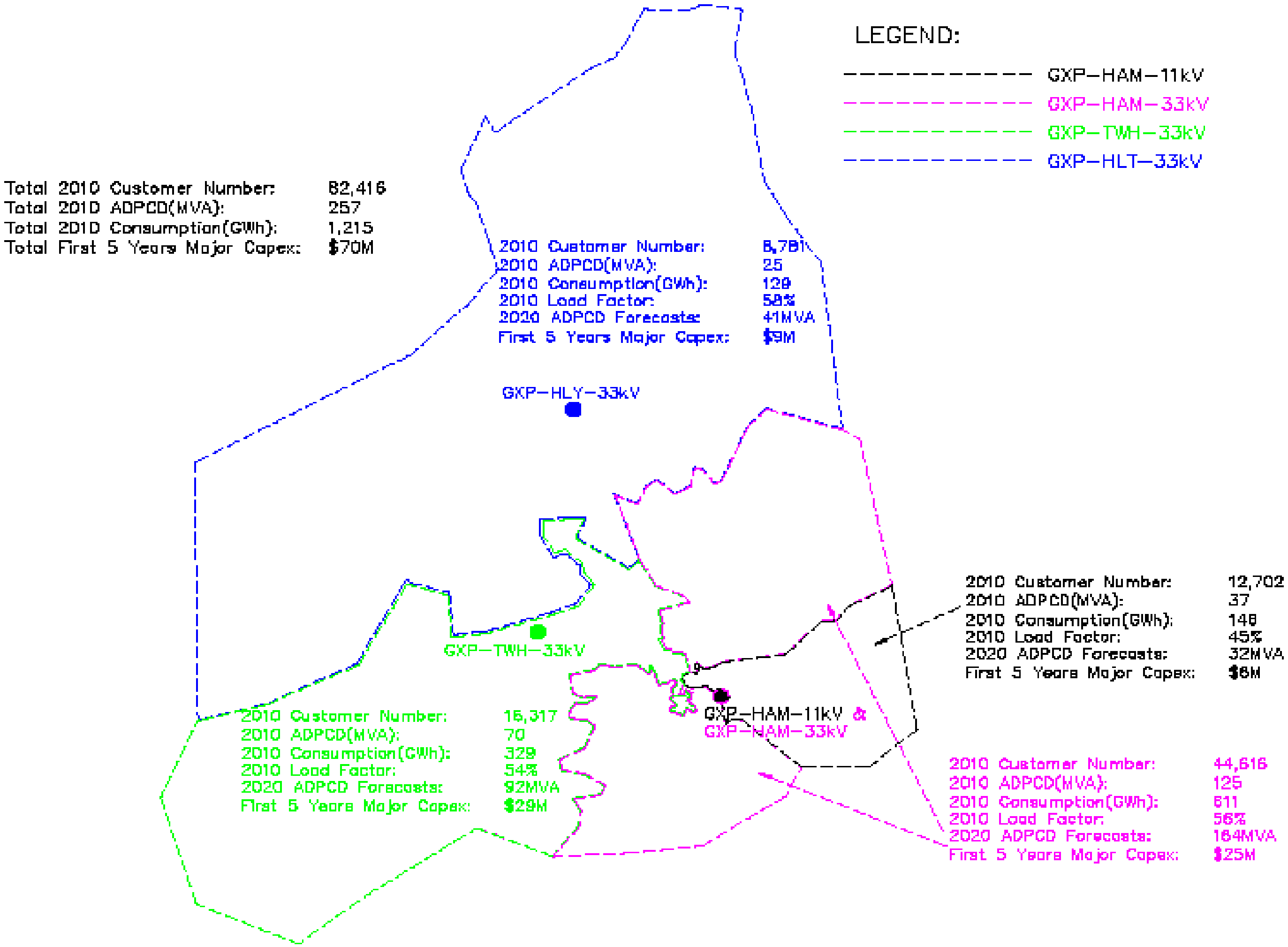


Figure 86. Key Statistics By Each GXP

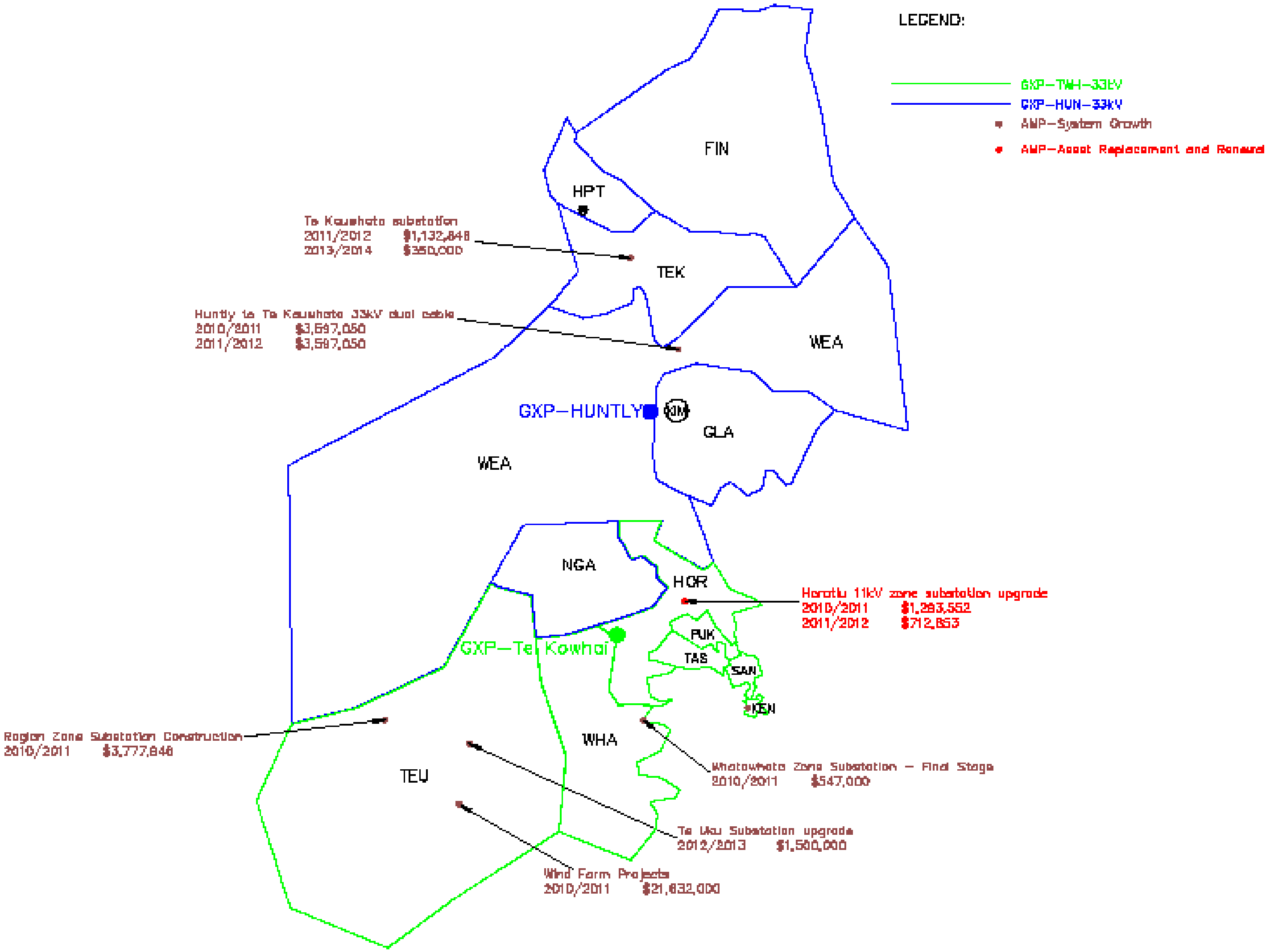


Figure 87. Major projects WEL plans to undertake within five years from 1 April 2010 for Huntly and Te Kowhai GXP areas

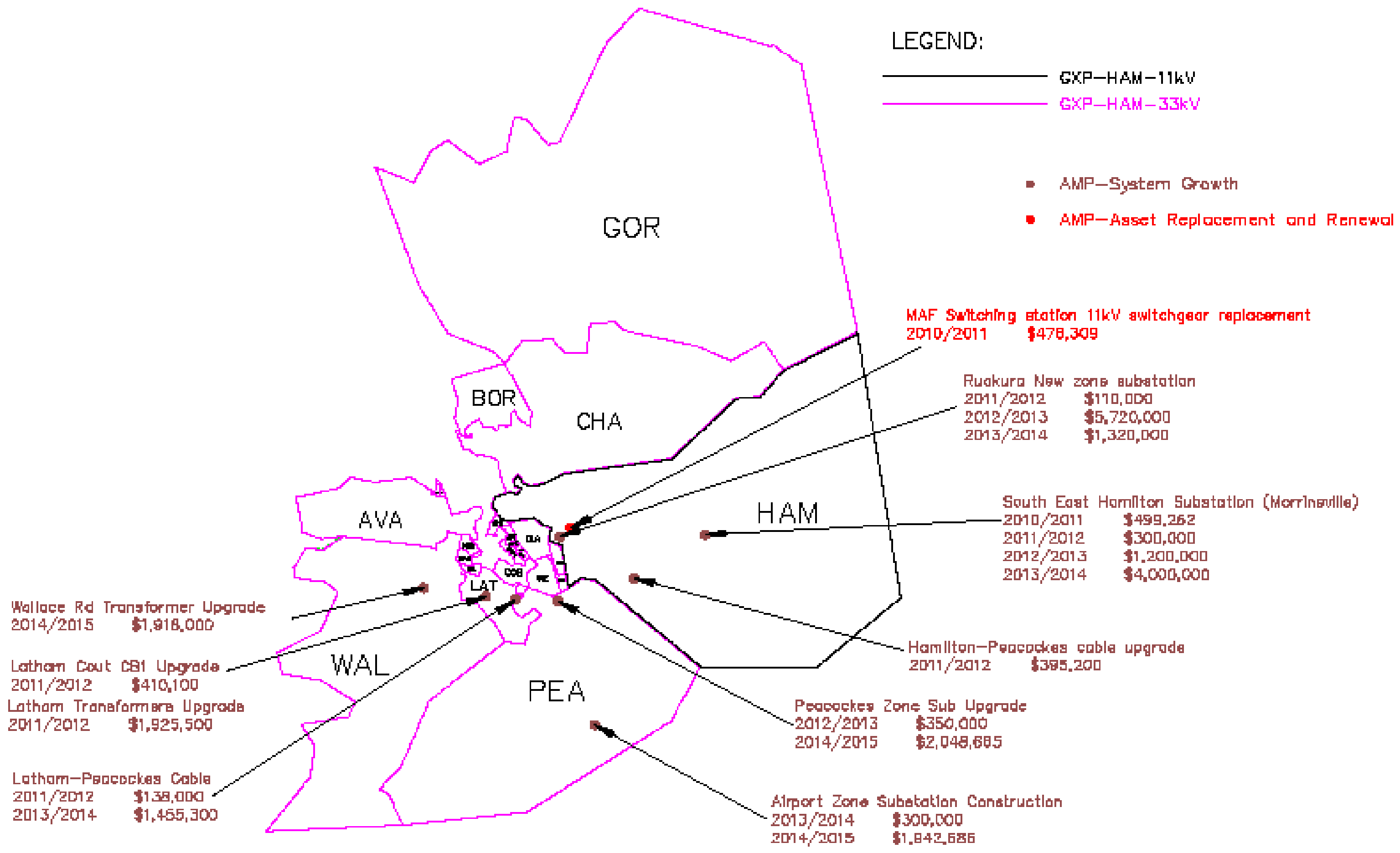


Figure 88. Major projects WEL plans to undertake within five years from 1 April 2010 for the HAM area excluding the CBD

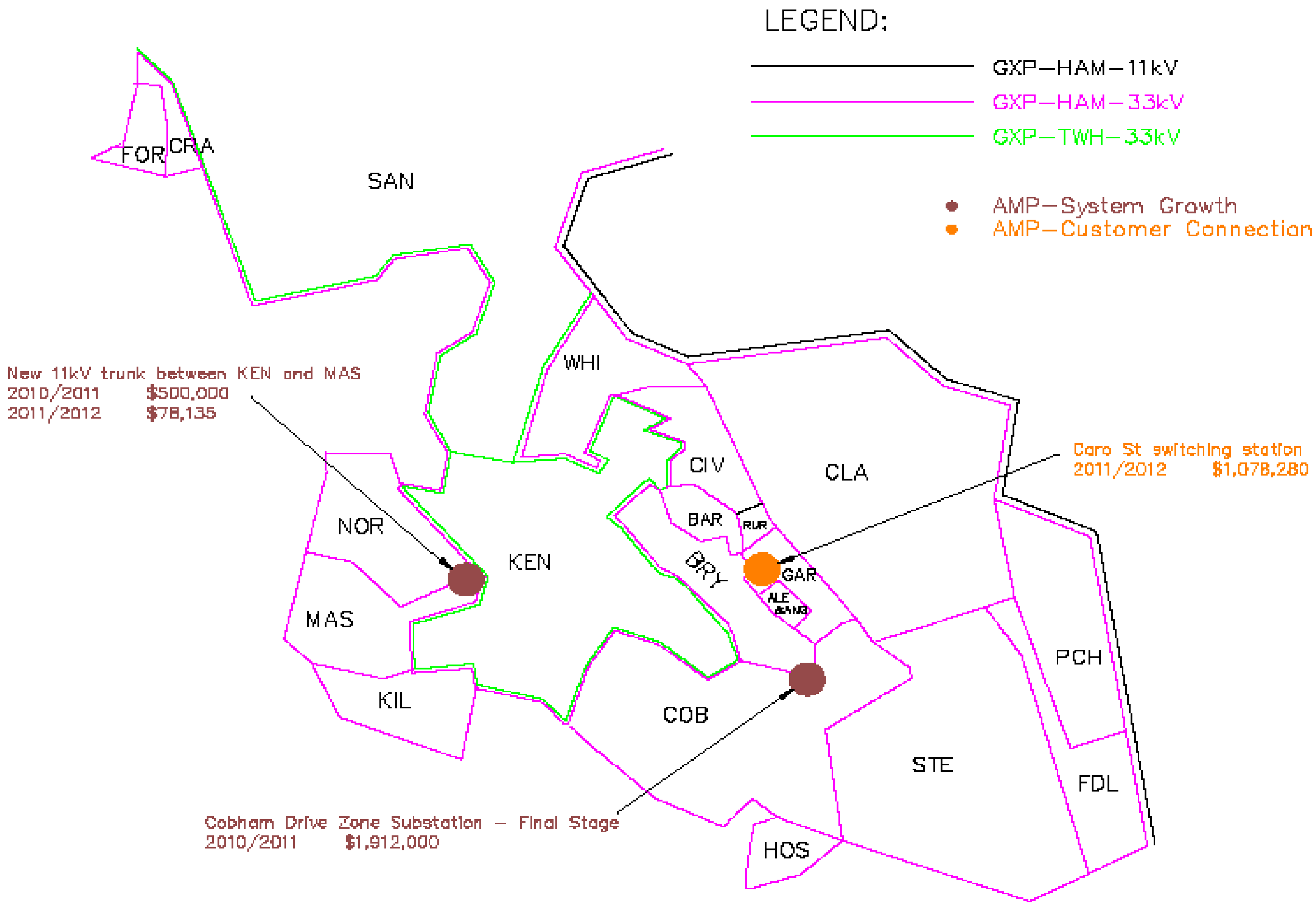


Figure 89. Major projects WEL plans to undertake within five years from 1 April 2010 for the CBD in the HAM area