MLL
Asset Management Plan

1 April 2016 to 31 March 2026

Marlborough Lines

Document Control

File Path:	C:\Users\sjwilkin\Desktop\AMP 2016 draft _ SJW.docx
Status:	Draft

Version Control

Version	Date	Comments
0.1	26 Feb 2016	First draft – compiled sections from all authors
0.2	6 March 2016	Reviewed RWS
0.3	23 March 2016	Further tidy ups - SJW
0.4	1 April 2016	Formatting - RJC

Summary

Welcome to Marlborough Lines Limited's (MLL) Asset Management Plan (AMP) for the planning period 1st April 2016 (FY 2017) to 31st March 2026 (FY 2026).

Electricity is an important component of modern society. The safe, secure, and reliable delivery of electricity is essential to our way of life, our homes and our businesses. Electricity provides energy for heating, lighting, appliances, computers, transport and industry. The effective management of MLL distribution system together with staff, contractors and all resources is important to all stakeholders.

This AMP forms the backbone of MLL asset management process and documents the assets, their condition, service levels, network development planning, lifecycle planning, risk management, and asset performance.

Key features of this asset management plan are:

- Reliability performance is very good on a comparative basis to other Networks given the type and length of Network.
- Assets with a Regulatory Asset Base value of $217 million which are generally in good condition.
- Improvements in service targets and performance and the inclusion of targets and performance data on an area basis (urban, rural, and sounds)
- 1.5% load growth used for planning purposes, this assumes that the economy will improve slightly and growth will return to levels consistent with the historical levels.
- Forecast Capital Expenditure of $11.5 million and Opex of $12.0 million for 2017. Continued investment in asset renewal, Network automation and a strong focus on vegetation management.
- Risk profile essentially unchanged from the past, however some discussion and commentary on the risks of high impact, low probability events included, i.e. Earthquake/Tsunami, major storm damage, loss of GXP or transmission, major fire events.
- The AMMAT (Asset Management Maturity Assessment) shows that MLL's asset management process and systems are consistent with the size and type of organisation and helps to identify possible areas for improvement.
- Details of proposed work and expenditure levels are given for the next ten years in sections 5 and 6. These are at levels consistent with current workload and therefore MLL has the capacity to deliver these work programmes.

List of Figures

List of Tables

1. Background and Objectives of the AMP

Marlborough Lines Limited's (MLL) Asset Management Plan (AMP) is the key document that translates MLL's data, analysis, procedures, policies and strategic aims into action and defines performance criteria and timeframes. It is also used as a means of communicating MLL's intentions to stakeholders.

MLL is the electricity lines business that conveys electricity throughout Marlborough to approximately 25,000 customer connections (ICPs) on behalf of a number of energy retailers. The diagram below indicates MLL's position in the electricity industry supply chain.

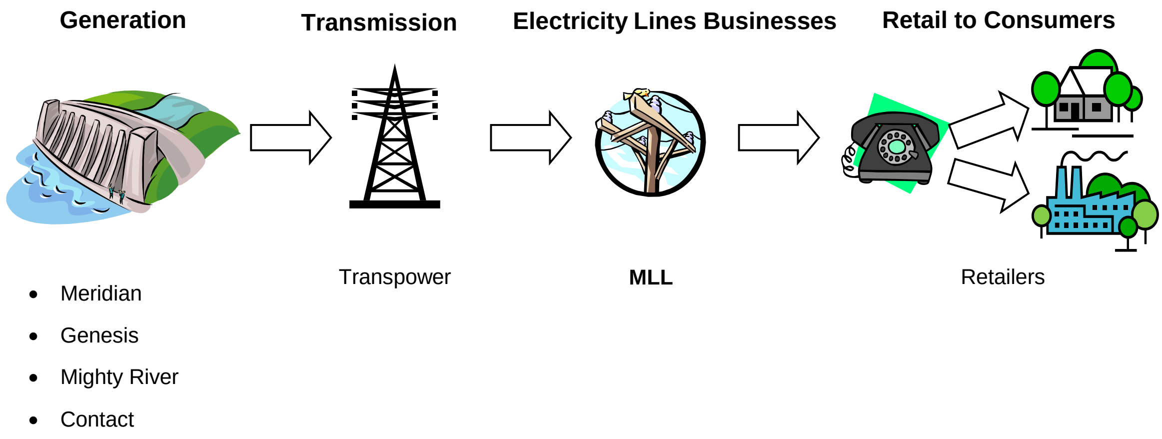


Figure 1 - Electricity Industry Structure

The wider MLL group also includes the following entities:

- A 50% stake in Nelson Electricity, which has its own AMP and is independently disclosed.
- An 80% stake in Yealand's Wine Group Holdings Limited, which is independently managed and audited.

The interrelationship of these entities along with the various holding companies and other investments by MLL, details of shareholders, along with the accounting treatment of results, is described in MLL's annual reports.

The MLL Statement of Corporate Intent also provides information relevant to the AMP. This AMP deals solely with the electricity assets in the Marlborough area and, along with MLL's other plans and policies, combines to demonstrate that MLL is responsibly managing its electricity Network assets consistent with regulatory requirements and best industry practice. The MLL Statement of Corporate Intent, along with other key company documentation is available on MLL's company website.

1.1 Purpose Statement

The objectives of this AMP are to summarise Asset Management at MLL, and to set out that MLL:

- Maintains and operates all assets in a safe manner to safeguard the health and welfare of staff, customers, contractors, landowners and the general public consistent with legislative requirements and best industry practice.
- Sets service levels for its electricity Network that will meet customer, community, stakeholder and regulatory requirements.
- Understands the levels of Network capacity, reliability and security of supply required now and in the future, as well as, the issues that drive these requirements.
- Has robust and transparent processes in place for managing all phases of the Network life cycle from initial concept to disposal.
- Adequately considers the classes of risk relative to its Network business, and ensures there are processes in place to mitigate identified risks.
- Makes adequate provision for funding and resourcing all phases of the life cycle of Network assets.
- Makes decisions within structured frameworks at each level within the business.
- Increases its knowledge of its asset components in terms of location, age, condition and the overall Network's likely future behaviour as it ages.

The AMP is the key internal planning document used by MLL as part of the asset management system. Disclosure of the AMP also assists MLL in complying with the requirements of Section 2.6 and Attachment A of the Electricity Distribution Information Disclosure Determination 2012 - (consolidated in 2015).

This AMP contains a general description of MLL's assets and descriptions of the thinking, policies, strategies, plans and resources that MLL uses, and will use, to manage its assets.

This plan covers the period 1 April 2016 (FY 2017) to 31 March 2026 (FY 2026) and was approved by the Board of MLL on 31 March 2016.

The next full AMP is expected to be prepared and issued in March 2018.

1.2 Strategic Planning Documents

MLL's key strategic planning documents are its vision and mission statements:

1.2.1 Vision

"Our Vision is to be a leader in all that we do in the distribution of electricity and related businesses for the benefit of our customers, shareholder and community".

1.2.2 Mission

To exceed our customer's expectations in all aspects of our operations and furnish our shareholder with a commercial return.

MLL's primary objectives are to:

- Operate as a successful business in the distribution of electricity and other related activities.
- Pursue the most efficient use of energy.

In achieving our objectives, we will:

- Develop and maintain customer-responsive transmission, reticulation and distribution systems.
- Ensure that all resources – financial, physical and human – are utilised efficiently and economically.
- Meet our commercial and productivity targets.
- Fulfil market requirements in terms of quality and price on a competitive, commercial basis.
- Ensure the safety of all systems, plant and equipment under our control and promote electrical safety within Marlborough.
- Care for the environment and ensure that any impact of our activities is minimised or, where possible, eliminated.
- Use all legislative powers fairly and in accord with the principles of natural justice.
- Be a good employer by observing and applying best practice in all areas relating to employment.

1.3 Statement of Corporate Intent

MLL's SCI is a requirement under Section 39 of the Energy Companies Act 1992, and forms the principal accountability mechanism between MLL's board and the shareholder. The SCI includes *inter alia* revenue and performance targets, which form the heart of the asset management activity. The SCI is available on MLL's company website and will be updated in late March 2016.

1.4 Interaction between Planning Documents

The interaction between MLL's major planning documents and processes is depicted in Figure 2 below. These plans are compiled annually (with the exception of the AMP) and are subject to regular review during the financial year.

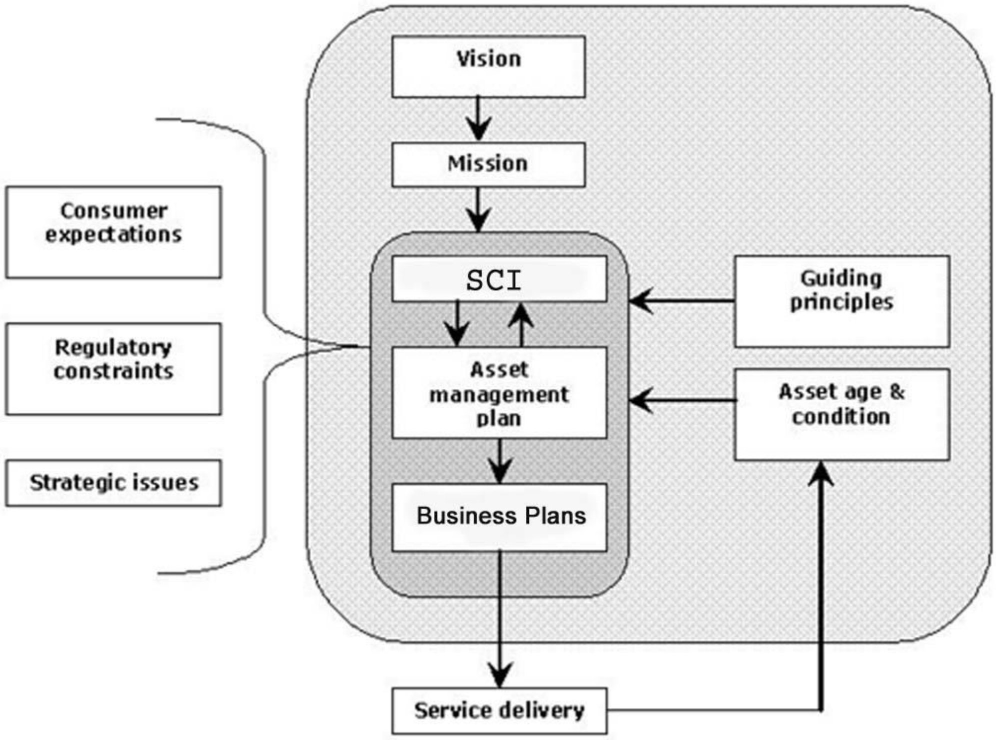


Figure 2 – Interaction between Major Planning Documents

The principal plans resulting from the annual planning process are:

- The AMP, a 10 year plan that documents MLL's thinking, policies, strategies and provides a summary of the expected Asset Management processes and works. Note that the AMP is not always prepared annually.

Table 1 outlines the principal guides to decision making within MLL.

Category	Description of Guide	Decisions to be Guided
Policies	Vision	All organisation decisions.
	Mission	All organisation decisions.
	Non-asset Solutions	Purchasing decisions in terms of whether alternative options can be considered.
	Distributed Generation	Whether distributed generation should be installed and on what terms & conditions.
	Redeployment & Upgrade of Existing Assets	Whether and how assets should be either redeployed or upgraded.
	Purchase of New Assets	Whether new assets should be purchased.
	Adoption of New Technology	Whether new technologies should be adopted.
	Disposal of Assets	How assets should be disposed of.
	Network Standards	How Assets are to be designed and constructed.
Plans	Strategic Plan	High level corporate decisions including growth and investment and responses to competitive and regulatory issues.
	Asset Management Plan	Asset maintenance, operational and investment decisions.
	Risk Management Plan	Whether the level of risk implicit in various options falls within MLL approved limits, controls needed to reduce risk.
	Contingency Plan	Responses to defined contingent events.
	Annual Business Plan	Allocation of resources to activities.
	Emergency Preparedness Plan	Documentation on managing response to emergency events
Standards	AS/NZS ISO 9001:2008	Critical business processes.
	AS/NZS ISO 14001:2004	Minimise effects of activity on environment.
	BS OHSAS 18001:2007	Maximise safety of staff, contractors and public.
	AS/NZS ISO 31000:2009	Risk management – Principles and guidelines
	NZS 7901:2014	Electricity and gas industries – Safety management systems for public safety
	BS ISO 55000 Series: 2014	Asset Management. Overview, principles and terminology.
	Technical eg. IEC, BS	Technical design & engineering.
	Financial eg. GAAP, IAS	Financial reporting & disclosure.
Legislation	Electricity Act 1992	
	Commerce Act 1986	Disclosure of information, restraining anti-competitive behaviour, setting appropriate tariff levels, ensuring supply reliability does not materially decline.
	Companies Act 1993	Requirement to file various returns.
	Health & Safety in Employment Act 1992	Requirement to provide a safe & healthy workplace.
	Resource Management Act 1991	Requirement to comply with all restrictions on use of natural resources defined in the district and regional plans.
Regulations	Electricity Regulations	Most decisions related to Network assets.
	Electricity Information Disclosure Requirements	What needs to be disclosed and by when.

Table 1 - Guides to Decision Making

1.5 Planning Period

A rolling 10 year horizon has been adopted covering the period 1 April 2016 to 31 March 2026. The activities for the first year form the basis of MLL's 2016/2017 business plan and have a relatively high degree of certainty. Activities from year two onward have progressively less uncertainty.

The activities described in this AMP are considered appropriate to provide, maintain and operate assets that will meet the projected levels of service. Should there be a change to customer requirements, greater or lesser levels of activity may be required subject to MLL's ability to fund those activities.

1.6 Date Approved by Directors

This plan was approved by the Board of Directors on 31 March 2016.

1.7 Description of Stakeholder Interests

MLL defines its stakeholders as any person or class of persons that:

- has a financial interest in MLL (be it equity or debt) and/or;
- pays money to MLL (either directly or through an intermediary) for delivering service levels and/or;
- is physically connected to the Network and/or;
- uses the Network for conveying electricity and/or;
- has an interest in land where MLL assets are located on the land; or has an interest in land that provides access to MLL assets and/or;
- supplies MLL with goods or services and/or;
- is affected by the existence, nature or condition of the Network (especially if it is in an unsafe condition) and/or;
- has a statutory obligation to perform an activity in relation to the Network's existence or operation such as: request disclosure data, regulate prices, investigate accidents, include in a District Plan, archaeological sites, Wahi Tapu sites etc and/or;
- has an interest in the safety of the Network and/or;
- is employed by MLL.

Figure 3 below highlights MLL's key internal and external stakeholder groups as well as the nature of their relationships with MLL.

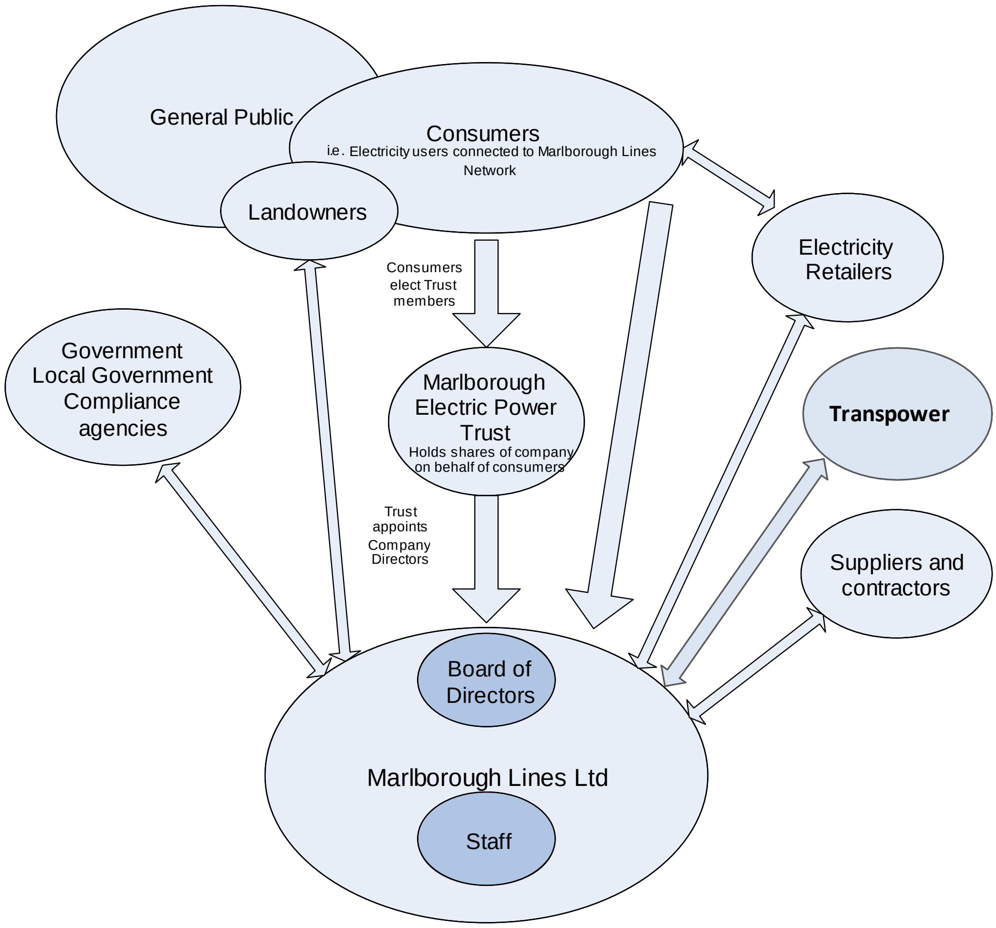


Figure 3 – Stakeholders

The suppliers and contractors group includes a wide range of business and service providers including: equipment suppliers, legal and professional advisors, bankers, insurers, Transpower and subcontractors.

Table 2 gives a general indication of the most significant interests of various stakeholders. It is recognised that most stakeholders will generally have an interest in all aspects of the business.

Stakeholder	**Interests**					
	Viability	**Price**	**Supply Quality**	**Safety**	**Compliance**	**Energy Efficiency**
Marlborough Electric Power Trust	✓	✓	✓	✓	✓	✓
Bankers	✓	✓		✓	✓	
Connected Customers	✓	✓	✓	✓	✓	✓
Energy Retailers	✓	✓	✓	✓	✓	✓
Mass-market Representative Groups	✓	✓	✓	✓	✓	✓
Industry Representative Groups	✓	✓	✓			
Staff and Contractors	✓	✓		✓	✓	✓
Suppliers of Goods and Services	✓	✓				
Public (as distinct from customers)				✓	✓	
Landowners				✓	✓	
Councils (as regulators)				✓	✓	✓
NZTA (Marlborough Roads)				✓	✓	
Ministry of Economic Development		✓		✓	✓	✓
Energy Safety Service				✓	✓	
EECA					✓	✓
Commerce Commission	✓	✓	✓		✓	
Electricity Authority			✓		✓	✓
Electricity and Gas Complaints Commission			✓		✓	
Ministry of Consumer Affairs		✓	✓	✓	✓	

Table 2 – Stakeholder's Interests

Table 3 indicates how stakeholder's expectations are identified.

Stakeholder	How Expectations are Identified
Marlborough Electric Power Trust	By their approval or required amendment of the SCI. Regular meetings between the MLL directors and the MEPT trustees.
Bankers	Regular meetings between the bankers and MLL staff. By adhering to MLL Treasury procedure. By adhering to banking covenants.
Connected Customers	Regular discussions with large industrial customers as part of their ongoing development need assessment. Regular customer surveys.
Energy Retailers	Annual consultation with retailers, regular contact and discussion.
Mass-market Representative Groups	Informal contact with group representatives.
Industry Representative Groups	Informal contact with group representatives.
Staff and Contractors	Regular staff briefings. Regular contractor meetings.
Suppliers of Goods and Services	Regular supply meetings. Newsletters.
Public (as distinct from customers)	Informal talk and contact. Feedback from public meetings.
Landowners	Individual discussions as required.
Councils (as regulators)	Formally, as necessary, to discuss issues such as assets on Council land.
NZTA	Formally, as required.
Ministry of Economic Development	Regular bulletins on various matters. Release of discussion papers. Analysis of submissions on discussion papers.
Energy Safety Service	Promulgated regulations and codes of practice. Audits of MLL's activities. Audit reports from other Lines Companies.
Commerce Commission	Regular bulletins on various matters. Release of discussion papers and direct communications. Analysis of submissions on discussion papers. Conferences following submission process.
Electricity Authority	Weekly update. Release of discussion papers. Briefing sessions. Analysis of submissions on discussion papers. Conferences following submission process. Information on Electricity Authority's website.
Electricity and Gas Complaints Commission	Reviewing their decisions in regard to other Lines Companies. Assistance with any complaint investigations.

Table 3 - Identification of Expectations

Table 4 provides a broad indication of how stakeholder interests are accommodated.

Interest	Description	How Interests are Accommodated	Asset Management Actions
Viability	Viability is necessary to ensure that shareholders and other providers of finance, such as bankers, have sufficient reason to keep investing in, or providing funding for MLL (and for shareholders to retain ownership).	MLL will accommodate stakeholder's need for long-term viability by delivering earnings that are sustainable and reflect an appropriate commercial return on employed capital.	Ensure expenditure is appropriate to maintain or enhance viability of Network, subject to customer requirements.
Price	Pricing is a means of gathering the revenue required to operate the business and signal underlying costs. Setting prices correctly is important for our customers and MLL. The pricing methodology adopted by MLL sets appropriate total target revenue and then tariff structures for different categories of consumers. As only a portion of network assets are dedicated to individual ICPs, this process involves elements of cost sharing between consumer groups, an approach commonly taken by most electricity network companies. Regulations currently require that increase in cost of supply in rural area should not exceed that of urban areas. This limits the ability of tariff to be cost reflective in some areas. The low fixed charge regulations also require tariffs to be set at a level for some consumers that means that their service is subsidised by other consumers on the Network.	Target revenue is set at a level which ensures the network business is sustainable in the long term and ensures there are sufficient funds to provide reliable assets. MLL takes a medium term view of revenue requirements so as to avoid price shocks from year to year. The pricing methodology is expected to be cost reflective to and pricing signals reflect the cost of supply where possible (the low fixed charge regulations mean that this is not able to be achieved for some consumers). MLL has an exception from applying the Low Fixed charge regulations across some areas on its network (those classified as "Remote") which reduces the level of cross subsidisation required.	Although not subject to the Price Control mechanism in the DPQ Path MLL revenue is quite consistent from year to year. MLL aims to fund its work through its annual revenues and therefore plans are to have relatively smooth expenditure from one year to the next. .

Interest	Description	How Interests are Accommodated	Asset Management Actions
Supply Quality	Emphasis on continuity, restoration and reducing flicker is essential to minimising interruptions to customer's businesses.	MLL will accommodate stakeholder's needs for supply quality by focusing resources on continuity and restoration and ensuring the assets are of a quality and standard to meet customer requirements.	MLL has a strong community mandate to maintain/improve reliability and to reduce flicker
Safety	Staff and contractors must be able to work on our Network in total safety. The general public must be able to move safely around Network Assets.	MLL will ensure that the public is kept safe by ensuring that all assets are structurally sound, live conductors are well out of reach, all enclosures are kept locked, all exposed metal is securely earthed and assets are built and maintained in accordance with legislative requirements and best practice. MLL will ensure the safety of staff and contractors by providing all necessary equipment, improving safe working practices, and ensuring that workers are stood down in unsafe conditions. MLL wll work to and in accordance with applicable industry standards and codes of practice.	All work is subject to rigorous safety standards with safety given the highest priority for expenditure. The Public Safety Management System (PSMS) will document MLL's procedures for ensuring safety of the public.
Compliance	MLL must comply with many statutory requirements ranging from safety to disclosing information.	MLL will ensure that all safety issues are adequately documented and available for inspection by authorised agencies. MLL will disclose performance information in a timely and compliant fashion.	Undertake sufficient monitoring and inspection to ensure compliance is maintained.
Energy Efficiency	As a good corporate citizen, MLL will encourage energy efficiency within its own business and for customers.	MLL will consider losses within its system and ensure that these are minimised where practical.	

Interest	Description	How Interests are Accommodated	Asset Management Actions
		MLL will assist customers by providing advice and assistance on energy efficiency.	

Table 4 - Accommodation of Stakeholder Interests

1.7.1 Managing Conflicting Interests

Most activities result in a need to balance a number of different issues, e.g. quality, cost, time. Finding a balance acceptable to all stakeholders requires that various solutions are carefully considered and priorities evaluated according to the specific circumstances and environment. The general priorities, in order of highest to lowest, for managing conflicting stakeholder expectations and interests are given below:

1. **Safety**: MLL will give top priority to safety. Even if budgets are exceeded or non-compliance arises, MLL will not compromise the safety of its staff, contractors or the public. Safety is fundamental to the way MLL will undertake any activity.
2. **Compliance:** MLL will give priority to compliance, noting that compliance which is safety related will be given highest priority.
3. **Viability**: MLL will give high priority to viability, because without it MLL will cease to exist.
4. **Return**: MLL recognises the need to operate as a successful business and provide a commercial rate of return. This ensures that funding will be available for future activities and ongoing supply continues to be available to customers.
5. **Supply Quality:** This is important to customers to allow them to operate their homes and businesses in a reliable and safe manner. An unreliable supply may drive customers to consider alternatives to grid supply.
6. **Environment:** As a socially responsible organisation, MLL will diligently respect the environment and ensure that its operations are based on sustainable practices. MLL will consider environmental issues in all aspects of its operations and whenever practicable seek to eliminate or mitigate the impact of our operations on the environment.
7. **Energy Efficiency:** Consideration will be given to maximising Energy Efficiency.
8. All other considerations will be given lower priority than those listed above.

Aside from safety, the priority given to these issues may vary slightly from those above, according to the issue(s), their respective magnitudes and the affected stakeholders. In practical terms, these issues are not mutually exclusive and all will factor in the decision process.

1.8 Accountabilities & Responsibilities for Asset Management

MLL's accountabilities and accountability mechanisms are shown in Figure 4 and are discussed in detail in the following sections.

The ultimate accountability is to connected customers. The Commerce Amendment Act recognises this accountability and accordingly the price path threshold does not apply to beneficially owned Lines Companies such as MLL. MLL undertakes independent surveys of customers annually and the overall satisfaction levels have been greater than 90% for a number of years.

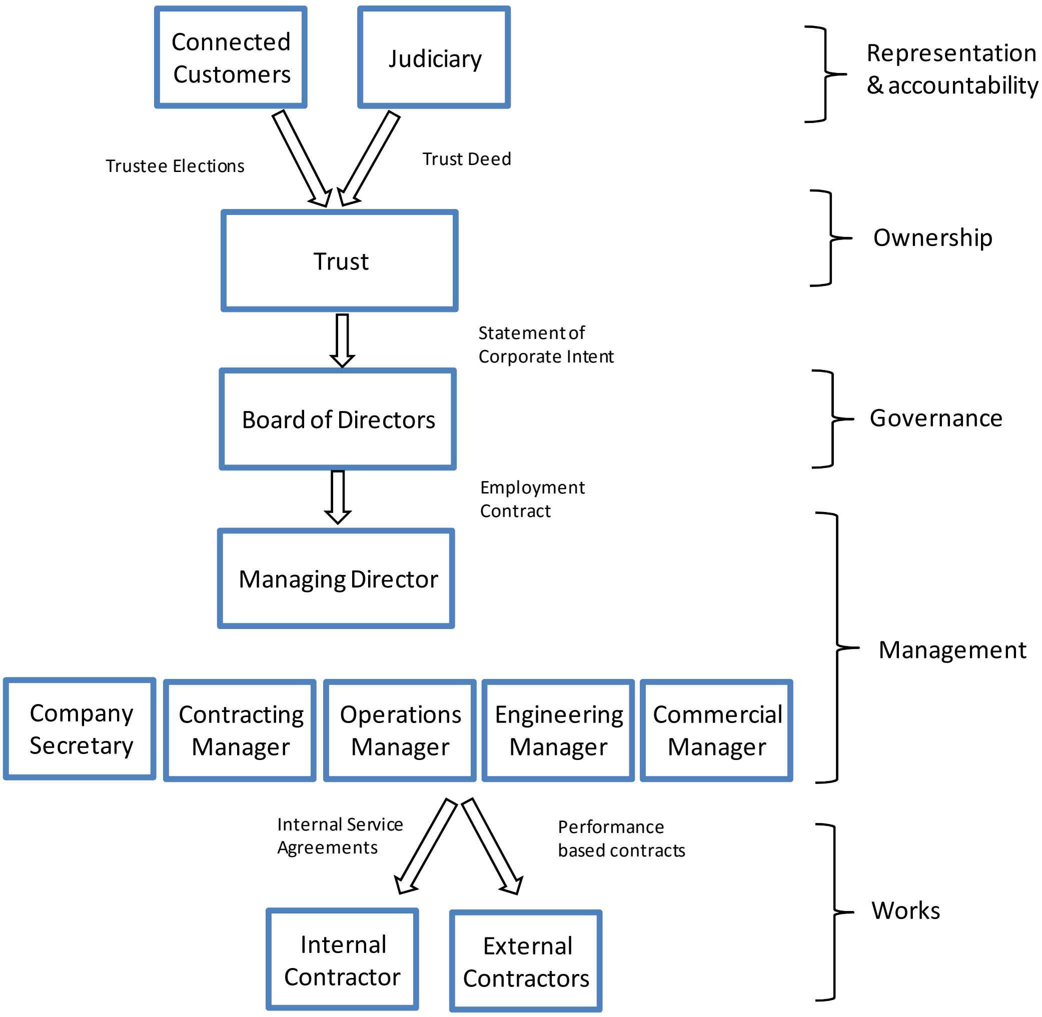


Figure 4 - Accountabilities for Asset Management

1.8.1 Accountability at Ownership Level

MLL has a single Shareholder – the Marlborough Electric Power Trust. The Trust currently has six trustees, each of whom holds 4,666,650 shares (with the exception of the Chair who holds 4,666,750 shares) in MLL on behalf of the Trust. The Trust members are currently:

- Ross Inder (Chair);
- Ian Martella;

- Paul Ham;
- Malcolm Aitken;
- John Cuddon; and
- Clive Ballett.

The Trust is subject to the following three accountability mechanisms:

- an election process;
- the Trust Deed which holds all Trustees collectively accountable to the New Zealand judiciary for compliance with the Trust Deed; and
- the provisions of the Trustee Act 1956.

Note that at the time of writing the above Trust members were correct. Trust elections are to be held in March 2016 whereby up to four of the above Trust Members may be replaced.

1.8.2 Accountability at Governance Level

MLL currently has seven directors who are collectively accountable to the Trust through the SCI. The current directors are:

- David Dew (Chair);
- Ken Forrest (Managing Director);
- Peter Forrest;
- Phil Robinson;
- Jonathan Ross;
- Tim Smit; and
- Ivan Sutherland.

The Board approves the annual budgets, SCI and this AMP. Each month it receives reports on the overall performance of MLL and key activities undertaken.

1.8.3 Board Reporting

MLL's regular board reports include the following:

- the capital expenditure program (progress and spend against budget);
- the maintenance program (progress and spend against budget);
- incidents and major outages; and
- any major changes to asset management processes or practices.

On a quarterly basis the Board receives a report on Legislative Compliance and Risk Management, which includes:

- all health and safety accidents and near-misses;
- all incidents of third party contact with the Network; and
- details of major customer works.

1.8.4 Accountability at Managing Director Level

The Managing Director, Ken Forrest, is accountable for all aspects of MLL's operations to the directors primarily through his employment contract and required objectives of the Board.

1.8.5 Accountability at Management Level

The second tier of management reports to the Managing Director. Accountability for asset management at the second tier is:

- Accountability for managing the existing assets and planning new assets lies with the Engineering Manager, Wayne Stronach. This role addresses long-term planning issues such as capacity, security and asset configuration.
- Responsibility for minute by minute continuity and restoration of supply lies with the Operations Manager, Brian Tapp, principally through control and dispatch, switching and fault restoration. The Operations Manager also has responsibility for asset maintenance.
- Accountability for the key area of line pricing lies with the Commercial Manager, Katherine Hume-Pike.
- Accountability for all administrative and financial activities lies with MLL's Chief Financial Officer. At the time of writing, this position is currently vacant. MLL is actively working towards filling this position. In the interim Geoff Hoare is acting CFO.

The key accountabilities of the four second tier managers are to the Managing Director through their respective employment contracts and required performance criteria.

1.8.6 Accountability at Works Implementation Level

MLL has an in-house contracting department. This operates as a separate division of the company/business. With the implementation of the Electricity Industry Reform Act 1998, many Lines Companies sold their contracting operations. MLL recognised it was very unlikely that active competition would be present in the Marlborough market and therefore chose to retain its contracting staff, rather than being subject to limited competition and consequent price gouging.

MLL Contracting undertakes the majority of the work on the MLL Network. Broadly this is:

- Construction of new assets.
- Maintenance of existing assets.

- operation of existing assets.

Photo 1 - Staff undertaking maintenance on 33kV line

It also undertakes work such as the construction of line extensions for external customers and the operation of hydroelectric schemes for Trustpower.

MLL retains relativity with prevailing market rates and undertakes testing from time to time to compare the commercial performance of MLL's Contracting division with other similar businesses in the area and throughout New Zealand.

The Contracting Manager, Stephen McLauchlan, is accountable both to the Operations Manager and Engineering Manager for the quality of work done, and to the Managing Director for the overall performance of the Contracting business unit.

1.9 Significant Assumptions

Significant assumptions underpinning this AMP include:

Assumption	Sources of Uncertainty of Each Assumption	Likely Impact of Uncertainty on AMP
That customers will continue to want and be willing to pay for a reliable power supply based on the MLL Network.	Changes in the economy or other factors may lead customers to prefer lower levels of service and reliability if that results in lower costs.	Constraints on expenditure will lead to reductions in service and reliability. As a result, SAIDI and SAIFI values may increase.
That the amount of capital expenditure is consistent with the objectives of maintaining a safe and reliable Network which meets the needs of customers and stakeholders.	Uncertainty here is based on the assumptions that there will be no unforeseen events which require an increase in expenditure.	May need to revise amount of expenditure if this is not consistent with providing safe and reliable Network. If this manifests, there may be increased capital costs.
That the current regulatory framework will continue, albeit with some changes and refinements.	A change in government may lead to changes in the regulatory framework.	Plan will need to be revised to comply with regulatory framework.

That MLL will be able to earn an appropriate commercial return on all capital expended.	MLL is not currently achieving a commercial return, costs need to decrease or prices to increase.	If unable to achieve an appropriate return on new investment, then renewal, upgrading and/or maintenance activities may need to be reduced. This could result in a lower return against expenditure.
That load will change as indicated by other sections of this plan.	Load changes are based on best estimates, however they are inherently inaccurate and vary according to international, national and local economies.	Changes to activities, in particular, growth - related activities. Expenditure reviewed as it occurs, AMP reviewed at least annually. Load increases or decreases will have a direct monetary effect on either return, expenditure or both.
That no major disasters or widespread systemic problems will occur.	While contingency planning and emergency response plans are in place, it is not possible to predict the extent or timing of disasters.	Significant change possible following major event such as damage from earthquake, tsunami. If these eventuate, there may be a significant increase in emergency related expenditure on the network.
That the introduction of distributed generation (DG) and other disruptive technologies will not significant alter the need for expenditure within the period of this plan.	Lowering of price point on solar (PV) and other generation, increases in cost of generation from wholesale market. Unknown development and advancement of relatively new technologies such as storage batteries.	Widespread introduction of PV and/or other disruptive technologies may lead to need to invest in "smarter solutions. This is turn will require investment in obtaining more real time information on Network performance. May lead to further investment in locations not identified within report. In general such investment will be funded by generators.
That no major new loads or major generation will be installed during the period of this plan.	Lack of knowledge, all known loads taken into account.	Changes in AMP activities and investment
That the Marlborough District Council (MDC) will contribute to the cost of overhead to underground conversion programmes.	MDC expenditure is constrained by a range of factors outside the scope of this AMP.	May lead to deferral of plans to convert overhead to underground.
Price Inflator Assumptions	Taken as 1.5% based on financial sector outlooks (Treasury and ANZ Bank).	May give incorrect nominal dollar amounts. Prices can be worked back into today's dollars.

Table 5 – Significant Assumptions

The assets which are covered by this Asset Management Plan generally have a very long life, i.e. 45 to 70 years and accordingly by reviewing this plan regularly it is possible to take account of variations or errors in the assumptions listed above.

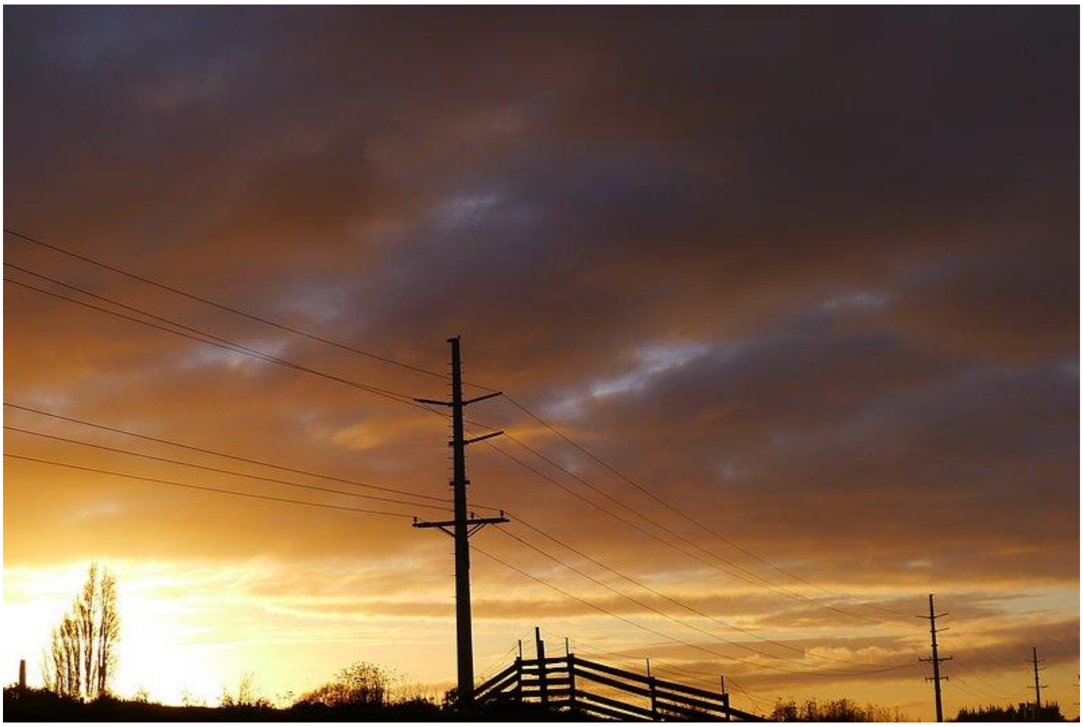


Photo 2 - renewed 33kV Line Landsowne Park to Riverlands - Steel Poles

1.10 Factors That May Lead to Material Differences

The following factors may lead to material differences between this disclosure and future outcomes:

Factor	Likely Outcome	Impact on AMP Performance
Increase or decrease in economic environment, especially in the wine, forestry and aquaculture sectors.	Increased kWh throughput, leading to additional revenue. Increased kW demand, leading to new capacity projects. Conversely, for a decrease in economic activity, there may be a decrease in revenue which would likely directly impact on amount of expenditure.	Some changes in growth related expenditure within first 3-5 years may need more significant changes thereafter.
Significant change (up or down) in unit cost of key inputs such as copper, steel, glass, plastic, diesel, labour	Increased cost of all classes of work if price increases, conversely, a decreased cost if prices fall significantly.	Reduced volume of work (leading to declining service and/or reliability) to balance higher costs. Higher prices to recover increased costs.
Unexpected systemic failure of assets.	Changes to components. Alterations in expenditure.	Some plans may not be achieved as resources are redeployed, expenditure may need to increase.

Table 6 – Disclosures/Future Outcomes

1.11 Overarching Asset Strategy

1.11.1 Asset Management Policy

MLL will:

- define its supply quality targets principally by consulting its respective customer classes, but also by considering other strategic, economic and regulatory drivers;
- achieve supply quality targets by maintaining existing asset and building new assets in accordance with MLL's design and construction standards, prevailing engineering standards and best applicable industry practice;
- maintain and build its Network and assets to minimise lifecycle costs, recognising that its owners are also its customers;
- seek to continuously improve its asset management practices to a level that is appropriate for a medium-sized, customer-owned EDB. Priority will be given to strengthening practices which result in greatest benefit for stakeholders.

Photo 3 - Switchgear at Cloudy Bay substation

1.11.2 Service levels

MLL will:

- provide a safe environment for the public and staff by ensuring that its Network is safe;
- continue towards the objective of halving fault SAIDI minutes from the average of the five year period ended 31 March 2010 (i.e. 165 minutes). For this year MLL will target an overall fault SAIDI of 80 minutes to be maintained at or below this level over the next 5 years;
- target to have less than 65 minutes of planned SAIDI.

- meet the minimum of statutory levels or agreed terms for supply voltage;
- follow its security of supply standards unless the required investment levels are inconsistent with good engineering practice and/or commercial criteria;
- endeavour to limit flicker to levels specified by AS/NZS 61000.3.7:12012, by educating and encouraging customers to comply with the standard;
- endeavour to limit harmonics to levels specified in ECP 36:1993, by educating and encouraging customers to comply with the standard;
- target a power factor of greater than or equal to 0.95 lagging at times of high load on the Network;
- facilitate connection of embedded generation where it doesn't compromise safety, Network operation, quality of supply to other customers, or power factor. MLL may require an embedded generator to pay the economic costs of connection where these costs are consistent with Part 6 of the Electricity Industry Participation Code; and
- interrupt supply to domestic customers in preference to hospitals, industrial and commercial customers for purposes of emergency demand management.

1.11.3 Asset configuration

MLL will:

- work with Transpower to minimise the fixed asset requirements commensurate with providing a reliable and secure supply to customers;
- take a long-term view of asset requirements, noting that customers ultimately benefit from well-planned investments;
- build all future sub-transmission lines insulated to at least 66kV;
- ensure that where possible, land purchases for new zone substations provide sufficient land to allow additional future transformer capacity to be installed;
- build all future rural distribution lines at 22kV;
- use fixed generators on long radical feeders such as the those supplying the Marlborough Sounds to improve reliability of supply; and
- use portable generators to improve reliability and reduce the effects of faults and planned work on customers.

1.11.4 Resourcing

MLL will:

- identify the required skill sets on a timeframe equal to the Asset Management Plan, and ensure that recruitment and training plans are consistent with needs and where appropriate use relevant contractors;
- endeavour to procure resources locally, where and when appropriate;
- retain its current field services business for fault restoration, inspections, maintenance and renewal work; and
- use contractors/consultants where its staff do not have the required skill sets, where resources are inadequate for works programmes or where it is more cost effective to do so, e.g. specialist work such as civil design, radio equipment installation and maintenance.

1.11.5 Materials:

MLL will:

- only use materials and equipment approved by its own internal standards and policies;
- endeavour to procure materials locally, where and when appropriate;
- reject offers that do not comply with its internal standards and policies, with relevant national standards, and/or with industry practice;
- consider the total lifecycle costs of materials when assessing offers;
- recycle materials where practical, taking into account the total lifecycle costs and overall risk; and
- purchase timber products such as cross-arms and poles from sustainable and renewable resources.

1.11.6 Risk:

MLL will:

- regularly review its risk position using a prevailing standard such as ISO 31000;
- adopt a risk-averse position, especially with regard to worker and public safety; and
- err on the side of over-investment in Network capacity, recognising that under-investment can lead to supply interruption and the overall economic cost suffered by customers can be markedly greater than the cost of prudent investment taken before it is required. Within the network industry invariably to wait until the demand exists is too late.

Photo 4 - Ward Substation

1.12 Overview of Systems and Information management data

1.12.1 Corporate overview:

The interaction between MLL's major planning documents and processes is depicted in Figure 5. This highlights the asset management system and its position within the company structure. These plans are compiled annually and are subject to regular review during the financial year. Note the AMP is publically disclosed on a two yearly cycle with an update in between.

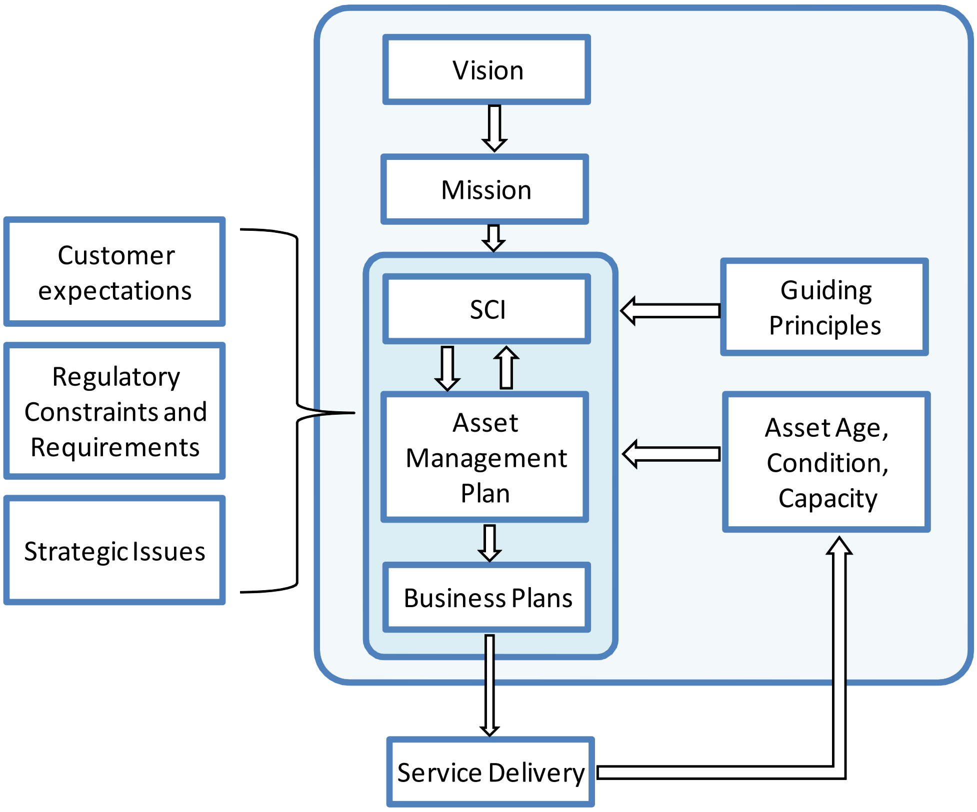


Figure 5 – Interaction Between Major Planning Documents – note the Asset Management System is largely encapsulated by the darker shaded blue box.

The vision statement guides MLL's mission statement. These documents provide an overall direction to the company's key planning documents, the Statement of Corporate Intent (SCI) and the AMP (this document). Business plans and annual budgets are developed from the Asset Management Plan.

The SCI is the key accountability mechanism between MLL's board and the Shareholder (the Marlborough Electric Power Trust). The SCI includes *inter alia* revenue and performance targets, which form the heart of the asset management activity. The SCI is updated annually.

1.12.2 Business management processes and standards

MLL recognises the importance of adopting best practice in its management. It also recognises it is important to provide confidence that its various management practices are consistent with required standards.

MLL has ISO accreditation for:

- Management Systems – ISO 9001:2008;
- Environmental Management – ISO 14001:2004; and
- Occupational Health and Safety – OHSAS 18001:2007.
- Public Safety – NZS 7901:2014.
- Quality Management – ISO 9001:2008

The ISO 9001 Quality Management system ensures that MLL's procedures and work practices meet with recognised industry best practice. Compliance with the system's procedures is integral to MLL's operations and, as such, regular audits (both internal and external) are completed.

As part of its accredited ISO 14001:2004 Environmental Management System one of MLL's key objectives is that:

> *"MLL will take a leadership role in environmental compliance activities and will demonstrate our commitment to caring for the environment."*

This will be achieved through the avoidance or mitigation of any adverse effects of MLL's activities upon the natural and built environment as well as the local community. All areas of MLL's operation have documented environmental policies and all staff are required to undertake their work in accordance with these policies.

Where appropriate, consultation will be undertaken to assist in obtaining the best possible outcome for all affected parties.

Because MLL regards safety as an integral part of its business it was one of the first New Zealand companies to achieve OHSAS 18001:2007 accreditation. This is in addition to the company's ACC Tertiary status, which enables MLL to gain a 20% reduction in ACC premiums.

1.12.3 Information Management

MLL has a suite of information systems which have all been configured and developed for its needs. The systems are primarily used to house and manage asset data; this data is used to drive many of the network activities (i.e. capital and operational expenditure). The following table highlights the key systems, their roles within the organisations, some of the more significant data that they hold and how this is used to drive work.

Photo 5 - testing new recloser, Saddle Hill

1.13 Limitations of Asset Management Data

The limitations in Asset Management data and information are:

Nature of Data	Limitation	Implications of Limitation	Likely Impact on AMP
Pole condition data	• Inability to accurately determine pole condition	• Possibility of premature replacement of sound poles. • Possibility of unsound poles remaining in service.	• Increased use of monitoring • Increases in failure, need to renew sections/pole types i.e. high capex/opex costs. • Increased faults/outages resulting in higher costs for restoration
Underground Cable Condition	• Inability to know precise condition or expected life – mainly applies to older XLPE cables	• Unexpected cable faults/failures – cables generally very reliable • Cable difficult to replace • Extended outages while fault finding	• Planning to replace older cables or provide alternative supplies • Planning to replace Cable T-joints with RMUs to allow better isolation/fault finding
Overhead Conductor Condition	• Very difficult to assess this accurately and in cost effective manner	• Conductor failure may occur, all such failure recorded and monitored	• Renewal activities may need to be re-prioritised
Distribution Transformer Condition	• Small Distribution transformers generally run to failure, no condition assessment aside from 5 yearly visits and external inspections.	• Failure rate may increase beyond that expected, although this is monitored and age profile accurately known.	• Need to monitor failure rates and may need to alter expenditure

General asset condition data gathering	High cost involved with monitoring/inspecting Network due to size of Network and remoteness of some assets	Limitation of data	Potential faults/outages from undetected defects – restoration costs

Table 7 – Limitations in AMP data

1.14 Description of Key Processes

1.14.1 Processes for inspections and maintenance

Regular inspections are scheduled using the asset and works management system EAM (see section1.14.5). This allows tasks to be scheduled and grouped into efficient groups and ensures work is completed in a timely manner.

Maintenance tasks, such as replacement of a cross-arm generally result from surveillance by staff and contractors. All work is approved by the Network division, the Contracting division collects the work into efficient groups and undertakes the work according to its location and criticality. Estimates of cost are approved early in the process and the actual costs, tasks completed and tasks outstanding are reviewed on a monthly basis.

All tasks are shown on the Geographical Information System (GIS) and prior to being approved for maintenance, consideration is given to the need for asset renewal, e.g. if most of the poles in a section of line need attention, it may be an indicator that the line is at the end of its life and should be replaced, rather than each pole being replaced individually.

1.14.2 Processes for development projects

Network development and renewal work are undertaken as projects. At the beginning of the year an overall programme for work is developed and agreed by the Network division of MLL. Project managers are assigned to each project to:

- consider the brief and reasons for the project;
- develop a project plan covering the design and implementation
- produce a design;
- obtain all required permissions, such as easements, consents from relevant stakeholders;
- obtain a quotation for the work from MLL's contracting division (or outside contractor);
- approve the quotation;
- order any long lead items/large capital items;
- liaise with the Contractor's work manager as to actual implementation
- arrange commissioning;
- finalise payments and as-built documentation; and
- complete project review/close-out.

As major issues arise they are dealt with by the project manager, or escalated as required. EAM and Finance One provide information on costing and progress.

The complete work programme is reviewed on a monthly basis to consider progress, priorities and any outstanding issues.

1.14.3 Processes for performance measurement

The principal asset and works management system at MLL is Infor's Enterprise Asset Management (EAM).

Asset Information, such as line lengths and distribution transformer capacity is contained within EAM, as well as asset heirarchical structure details. Information on connected ICPs is contained in Velocity's software 'Gentrack' and MLL's electircal connectivity software Milsoft.

Reliability and regulatory reporting uses the asset relationships to determine any ICPs affected by an outage. This module has been configured to suit the information disclosure requirements of the Ministry of Economic Development and the Commerce Commission.

For each fault, the time and operation of assets is recorded and the Network reliability figures (i.e. SAIDI, SAIFI, etc) are calculated based on the connectivity model and customer connection data. This information is generally tracked within Milsoft.

1.14.4 Wider processes, information resources and software

MLL makes use of a wide range of systems, processes and technology assets to capture, utilise, store and present information derived from, and about, its assets. This information is continually updated as the status of the Network changes (e.g. load variations, switching, faults, connection of new customers, new investments). Processed information can range from single items of raw data used by operations staff in making real-time decisions to highly processed and aggregated data used by executives in making long-term decisions.

MLL's IT and information systems were renewed in 2015 to ensure that the new disclosure information requirements required by the Commerce Commission as well as management information is captured and produced in a cost effective manner.

Legacy systems WASP and BASIX (asset management and works order systems) were replaced with Infor's EAM . A new electrical connectivity (outage management and call and dispatch) system, Milsoft, was also installed in late 2014. The GIS was also upgraded around this time.

The purpose of this systems upgrade project is to provide the assets and works order element of the business; (i) efficiency through standardisation of key business processes, (ii) effectiveness via information being centralised, and (iii) cost controlled by means of higher visibility of financials throughout the business, thus seeking to continually improve the core competency of managing electrical networks in accordance with the overarching organisational vision.

1.14.5 Asset and Works Management Software

The current asset management system at MLL is EAM, an asset and works management program, which has been available for use from October 2015. EAM consists of a series of modules built around a central asset register of over 100,000 equipment records that make up MLL's Network assets. The functionality covered by these modules includes:

- asset creation, modification and deletion;
- asset attribution and attribution history;
- management of MLL's Capex projects (creation and management of project records and information);
- management of MLL's Opex works (creation and management of Opex tasks and information), including Preventative maintenance tasks; whereby future works are pre-determined and managed by the system;
- integration with MLL's financial system;
- outage and fault management and data recording; and
- GIS (map viewer) integration.

Most asset information is contained in EAM with the GIS (ESRI) containing the spatial (location) data. A third system, Milsoft, manages the connectivity of electrical assets and allows for engineering analysis of the Network. The three databases are synchronised, i.e. they contain data in common and new data is entered into each system simultaneously through a database interface.

The Network is inspected every five years and the condition and other asset information updated accordingly. MLL is now on the third cycle of asset inspections and accordingly has a high degree of confidence in the accuracy of the asset information and condition assessment.

Video surveillance of the HV network is ongoing where appropriate. This video capture supplements other data MLL captures on vegetation (around its potential to affect the Network assets). Tablets and other mobile devices are being further introduced for data capture in the field, thereby reducing transcription errors and improving work efficiency.

1.14.6 Key Information Locations

The following table provides a summary of the key information locations at MLL.

Repository	Information	Key users	Notes
Asset Information – Infor's EAM	• Network and non-Network equipment records (i.e. assets) • Location • Technical specifications • History • Test records • Network outages • Financial data • Asset Condition • Structural dependencies • Project and works records, including corrective and preventative maintenance regimes • Easement records	Most staff	Main asset data repository, also used for maintenance and capital works programs. Displays on the GIS and electrical equipment records also mostly replicated in Milsoft for connectivity and engineering analysis purposes.
GIS (ESRI)	• Line asset type • Line connectivity	Most staff	A map-based view of EAM data, as well as views of maps, and data relating to the environment such as roads, archaeological sites.
Design records and project files	Calculations, analysis of options, protection reviews.	Engineering staff	
Various maps	• Asset location	All staff as required	Mainly superseded by GIS.
SCADA	Network status e.g. loads, switch positions, tapchanger positions • Faults and outages • Inspection data	Engineering, operations and development staff	Current status as well as historical logs and graphs of loading etc.
Milsoft	• Outage management system • Engineering Analysis	Operations, engineering and administration staff	Network status/electrical connectivity
Fault record sheets	• Description and duration • Likely cause	Operations manager, Network management and staff	Reviewed regularly to look for systemic issues and ways to improve service.
Switching instructions and drawings	• Operating instructions	Network, operations and contracting staff	Used for daily operation of Network.
Finance 1	• Financial data • Inventory • Payroll	Administration, Stores	Keeps accounting records. NB EAM also maintains project- based costings for works.
Velocity (Gentrack)	• Connection data • Billing data • ICP management • Load control relays not owned by MLL	Operations and administration staff Commercial Manager	ICP based data, Milsoft also displays this data.

Repository	Information	Key users	Notes
ISO System Quality Health & Safety Environment Public Safety (Note – soon to be replaced by Mango)	• Policies and procedures	All staff	Procedures, policies and guidelines related to design, operation, health and safety, public safety and environmental practice.
Network Standards	• Design and policy information for design and construction of Network assets	Contractors, MLL design staff, operators	
Emergency Response Plan	• Information for use in civil emergencies, e.g. earthquake, major storms	Engineering, contracting and administration staff during severe events	

Table 8 - Information Repositories

1.14.7 Databases

All of MLL's core systems (GIS, Milsoft, EAM, Finance One and Gentrack) are used for a variety of reporting purposes, for example:

- project and work / job number analysis;
- circuit breaker technical settings (i.e. protection);
- inspection and testing results;
- defect reporting;
- logging database changes to signal changes required in Network models (i.e. load flow); and
- Network configuration changes.

Reports are generally prepared on an as needed basis from within the systems.

1.15 Communication and Participation processes

MLL has a suite of documentation relating to asset management practices and which sit within MLL's asset management system. Some of the key documentation is summarised in the Table below. Figure 5 (Section 1.12) highlights the interaction of the asset management system with other key components of MLL.

Processes/ systems/ plans within asset management system	Description and Purpose	Stakeholders and communication of processes/systems/plans	Management of processes/systems/plans
MLL ISO system	MLL has its own comprehensive ISO system. This includes a number of policies and procedures relating to asset management.	Generally MLL staff. Some policies and procedures contain content about the engagement and management of Consultants and	Each Policy/Procedure within the ISO system is internally reviewed on an annual basis.

		Contractors working on the Network. MLL staff attend regular meetings whereby a Policy/Procedure from the ISO system is reviewed. The ISO system is run through as part of new staff induction. Monthly senior management meetings review any issues arising from policies and/or procedures within the ISO system.	Similarly, an external audit is undertaken on the ISO system annually. The ISO system is managed by MLL's Quality Manager.
MLL Network Design Standard	MLL has its own Network Design Standard which is used by MLL staff primarily in designing infrastructure (assets) for and on the Network.	Internal design team, in-house Contracting department, external Consultants engaged by MLL. Network design standard made available to staff through intranet.	The standard is reviewed and updated internally on an as needed basis.
MLL Maintenance standard	MLL has its own Maintenance Standard which is currently still being developed. This is used to specify processes and procedures relating to the maintenance of assets on MLL's network.	The document is communicated to relevant staff by the Network team. Once finalized it will be available to staff from the intranet.	In-house management of the maintenance standard by MLL's engineering team.
MLL Construction Standard	MLL has its own Construction Standard which its own internal contracting company use for constructing (installing) and maintaining equipment on the Network. This standard is disseminated to external contracting staff also, as appropriate.	Internal design team, in-house Contracting department, external Contractors engaged by MLL. MLL will instruct external contractors as part of the procurement process that works are to be undertaken in accordance with applicable elements of MLL standard.	The standard is reviewed and updated internally on an as needed basis.
Other relevant industry Standards	Designs should be undertaken in accordance with relevant industry best practice (i.e. following current applicable standards). Examples of this are	Generally MLL staff work to applicable standards – the internal standards are formulated on the basis of applicable	MLL is a subscriber to Standards New Zealand. MLL receives electronic

	the construction of new switch room buildings, or foundations supporting sub-transmission poles in soft ground. Consultant engineers engaged by MLL will be required to undertake their designs in accordance with relevant industry standards, one such example would be the AS/NZS 1170.5: 2004 – Structural design actions, Part 5: Earthquake actions. Another would be AS/NZS 7000: 2010 – Overhead line design: Detailed procedures	national/international standards.	notification when relevant standards are updated.
Procurement Hub	MLL has recently developed and is in the early stages of implementing a procurement system. This system contains a suite of template documents for procuring contractors and consultants to work for MLL.	The procurement hub is accessed through MLL's Intranet. Templates are used by staff engaging contractors or consultants as appropriate.	The procurement hub is managed by MLL's Network Engineer. Documents (templates) are reviewed on an ongoing basis and updates are made where appropriate.
Asset Management Plan (including AMMAT)			
Public Safety Management System			

Table 9 - Summary of communication asset management processes/documentation

Key communication and participation aspects specifically pertaining to the AMP are presented in the below table:

Stakeholder	Communication method	Nature of participation
MLL engineering staff	Assigned tasks to complete	Review, preparation of technical studies, asset failure reviews, fault and reliability studies.
MLL board	included in board papers	Signatories
MLL internal contracting	Receives copy from Engineering Manager	Determines forward work load and resourcing requirements
Statutory bodies	Receives disclosure copy	Assess for compliance

Community at large	Download from website, relevant information included in quarterly newsletters	Varies – anything from understanding forecast reliability to noting location of planned lines

Table 10 - AMP Communication

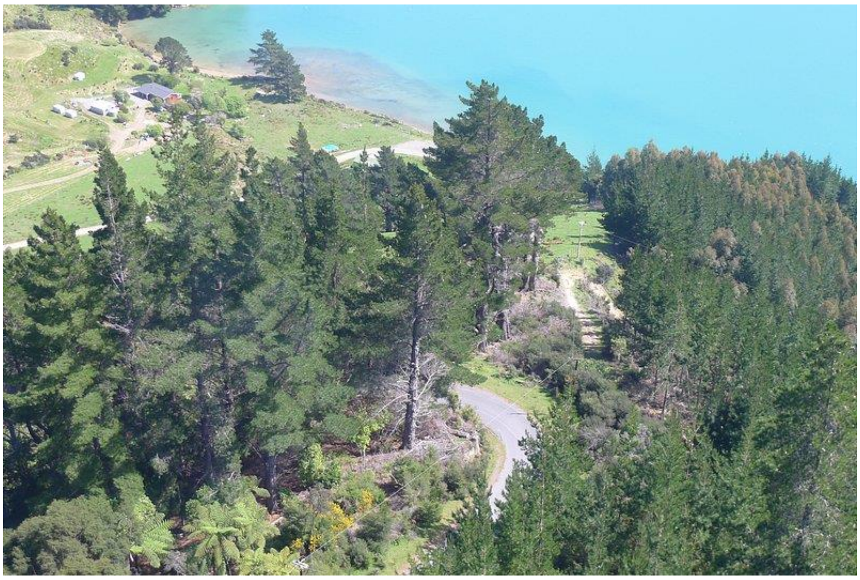


Photo 6 - 11kV line through trees

2. Assets Covered

2.1 Details of Assets

2.1.1 Background

MLL’s Network originally began as three historically distinct networks:

- The Marlborough Electric Power Board (M.E.P.B.), which was established in 1927 and began to supply the region from its own 1MW Waihopai River scheme.
- The Havelock Town Board electricity department, which commenced in 1917 with a 9kW Pelton Wheel, and was merged into M.E.P.B. in 1927.
- The Picton Borough Council electricity department, which commenced in 1917 with a 10kW Pelton Wheel, and was merged into M.E.P.B. in 1947.

These Networks have for some time now been electrically connected and operate as a single integrated system. The only surviving generation system from the three above individual networks is the Waihopai River scheme.

Nowadays, MLL’s integrated Network takes supply from the Transpower Grid via three 110kV circuits to a single point of supply (Grid Exit Point – GXP) in the Blenheim suburb of Springlands. Supply to the province then radiates out to a number of isolated rural areas including the majority of the Marlborough Sounds, the Molesworth Station and the southern Marlborough coast.

As there is only a single GXP, MLL operates an extensive 33kV Network in order to provide a reliable supply throughout the region.

The Network area is depicted on the following page in Figure 6, with the 33kV zone substations shown as blue triangles and the 11kV lines shown in red.

A key implication of Marlborough’s sprawling geography means that access to some areas is difficult, with many Sounds areas only accessible by boat or helicopter. Access can be particularly limited or constrained under civil emergency events such as storms, earthquake and major fires.

MLL’s electricity network conveys energy to approximately 25,000 customer connections with an after-diversity maximum demand of 73MW. MLL’s customers are predominantly domestic and small-to-medium commercial customers, with the largest customer representing approximately 3% of total energy volume.

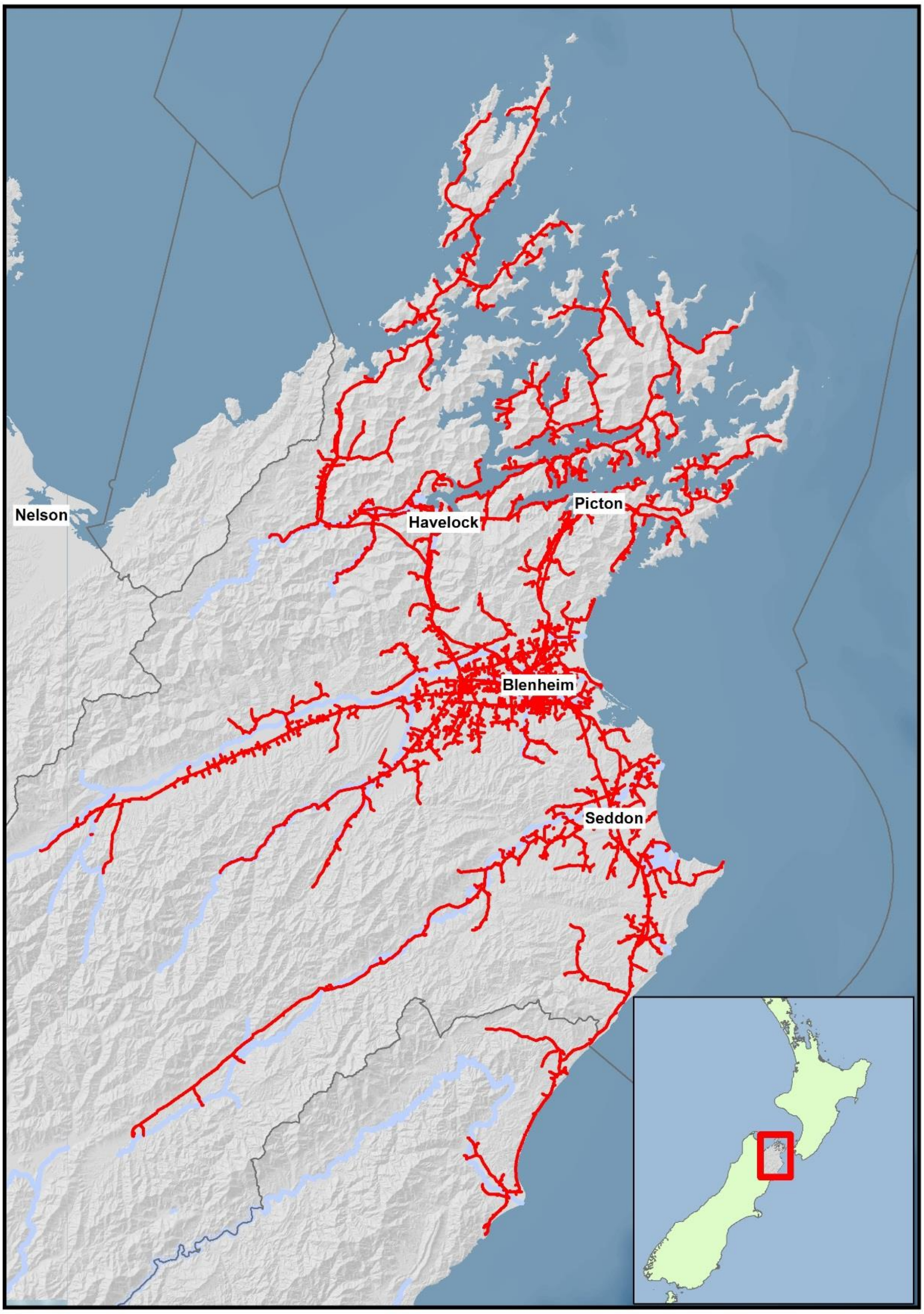


Figure 6 - MLL Network

2.1.2 Load Characteristics

In 2014/2015 FY, the Network delivered 376 GWh of electricity to 25,329 customers. The peak load was 72.6 MW. The five largest loads collectively used 26.9GWh (7.3% of total) of electricity, while the single largest used 9.2GWh (2.5%

of total). These loads are spread across a diverse range of activities from food processing to supermarkets.

2.1.3 Large Customers

The nature of MLL's five largest[1] electricity customers are:

Size	Nature of Business	Nature of Demand
1	Primary processing	Constant all year round
2	Government agency	Constant all year round
3	Winery	Cyclic with harvest season
4	Primary processing	Constant year round
5	Winery	Cyclic with harvest season

Table 11 - MLL's Five Largest Customers

Generally the load on the MLL Network consists of a large number of smaller customers and consequently, while the loss of any large load would affect operation of the Network, the affect would be relatively minor compared to the overall effect of changes to the economy, or a decline in one of the significant industries.

For example an overall downturn in the wine industry would have a much greater effect on the operation and development of MLL, than the loss/gain of two or three of the largest customers.

2.1.4 Supply Area Characteristics

MLL provides supply across a diverse area. This can be broken down into the main urban areas of Blenheim and Picton, Marlborough's East Coast, the Marlborough Sounds and the region's inland valleys (Awatere, Waihopai, and Wairau).

2.1.4.1 Urban Areas

Blenheim and Picton contain a mix of residential, commercial and small industrial customers. The maximum demands are predominately a result of winter heating and tend to occur at 7-11 am and 4-8 pm during cold and/or wet times. In total the towns of Blenheim and Picton represent approximately 60% of the total ICPs and 45% of the load. Note the reason for a lower percentage of the load is that there is a concentration of industrial and larger commercial customers located in the Riverlands industrial estate outside Blenheim (refer Section 2.1.4.2 below).

[1] Largest by capacity (kW)

Residential load growth is static or falling slightly due to a range of factors including increased use of energy efficient lighting, use of heat pumps rather than conventional heaters etc.

2.1.4.2 Wairau Plains

Significant features of this area include Woodbourne airbase and airport, the Riverlands industrial estate and a substantial horticultural/agricultural area with extensive vineyards. The load tends to be driven by wine processing (late March to early May) and the need for irrigation in the vineyards (December to March).

2.1.4.3 Inland Valleys

While vineyards and, to a lesser degree, dairy farms have moved into these areas, they are still largely pastoral (beef/sheep) with low ICP density. The inland valleys tend to be sheltered from storms and this combined with their topography, pastoral land use and MLL's lines being relatively clear of vegetation, makes supply in these valleys fairly reliable, especially given the long lengths of radial feeders.

Pastoral land use combined with some irrigation means that the load tends to peak in the winter months.

2.1.4.4 Marlborough Sounds

Reticulation in the Marlborough Sounds poses many unique construction and operational challenges. Most of the lines are constructed over rugged terrain, with access to many areas for construction and maintenance limited to foot, tracked vehicles or helicopter. Often spans are relatively large in length where valleys need to be traversed. Some areas do not have any road access and can only be accessed by boat and/or on foot. The Marlborough Sounds has a relatively high rainfall and a climate that encourages rapid vegetation growth, leading to the need for tree trimming and vegetation control on a short return basis.

Lines located near the sea coast are subject to salt spray. These lines require higher levels of maintenance, with special provisions required to minimise corrosion damage to conductors, salt build-up on insulators, and spalling on concrete poles. The reticulation includes significant spans across waterways utilised by shipping and these spans are subject to annual surveillance.

MLL has approximately 750km of 11kV distribution lines (in the order of 20% of the Network) in the Marlborough Sounds, supplying approximately 2,500 customers by way of 15,000kVA of distribution transformer capacity. There are on average around 3 customers/km of HV line compared with over 10 customers/km for the entire Network. Many of the installations are holiday homes with intermittent occupation - approximately 50% of customers in the Marlborough Sounds use less than 2,000kWh per annum (note, this compares to an average residential/domestic household consumption of approximately 7,500 kWh per annum).

These lines have low population density resulting in low load factor and therefore low distribution transformer capacity utilisation. The maximum demands on the various lines supplying the Marlborough Sounds generally occur over long weekends or public holiday periods – Easter, Christmas, Queens Birthday or Labour Weekend. This holiday occupation also leads to much lower diversity of demand than would usually be expected from most areas. In effect, the nature of the load drives demand in the opposite direction to what is desirable i.e. to a poorer load factor.

These various factors increase both the cost of construction and operation/maintenance of the distribution system. They also reduce the overall operating efficiency of the network relative to installed capacity. The situation is exacerbated by the fact that revenue from these customers does not meet the costs incurred and subsidies are required from other customers.

A significant issue facing MLL regarding reticulation in this area is associated with load growth or supply enhancement. Many of the existing lines are built on private or Government-owned land and constructed in the 1960s and 1970s, with access protected by the “existing works” provisions of the Electricity Act. MLL has limited easements over line routes. Therefore, upgrades which necessitate changes to the existing layout or create an injurious effect on the land require new easements to be created. This is a difficult and time-consuming process. Any future major developments in the Marlborough Sounds area will require very careful analysis and design of both asset and non-asset (e.g. demand control) alternatives to ensure the optimal solutions are found.

In addition, environmental regulations and considerations today are generally much more stringent than when the lines were built. This is likely to affect the construction of tracks and access to lines, thereby increasing cost.

A further issue with respect to lines in the Marlborough Sounds is that of supply reliability. The various lines supplying sections of the Marlborough Sounds are all radial/spur lines, with no interconnection to other parts of the Network.

MLL has installed automatic switching devices (sectionalisers, reclosers etc) at various points along each of the radial spurs, to minimise the areas affected by faults to the system. There is however a practical limit to the number of switching devices which can be installed. Over the last year the dedicated SCADA radio system linked to the devices has been expanded and will further increase to enable remote control of switching devices.

MLL has installed a ground fault neutraliser at its Havelock substation in an endeavour to further reduce loss of supply and has preliminary plans for installation of further neutralisers on both the Linkwater and Rai

Valley substations which, together with the Havelock substation, supply a significant portion of the Marlborough Sounds.

Many areas in the Marlborough Sounds are subject to severe windstorms. MLL has an on-going programme of vegetation control in an attempt to minimise interruptions caused by debris such as tree branches being blown across the lines. There are however practical limits to the amount of vegetation control which can be undertaken, particularly given the sensitive environment in which these lines are constructed and the distances that branches can be blown. In some areas the lines have been constructed in environmentally sensitive areas and in others the lines have been surrounded by forestry planted subsequent to the construction of the lines. The company has experienced significant disruption to the network by forestry, especially during harvesting operations or during severe storms when trees are not only blown over but in a number of cases have slid down hillsides. The current tree legislation severely restricts the ability of MLL to proactively remove potential hazards. For example, it only allows trimming of trees in very close proximity to the lines.

It is not realistic to expect that reliability to customers in the Marlborough Sounds area will be the same as that of urban areas. Lines in the Sounds are in a remote location, cannot be duplicated, and are subject to ongoing aging/wear and tear.

Reticulation in the Marlborough Sounds includes the aerial crossings of four navigable waterways with significant spans. Each of these spans has been in service for over 30 years. Because of the arduous environment in which they operate and the frequency of shipping, it was decided to replace the existing conductors and associated hardware. Tory Channel and French Pass crossings were replaced in January/February 2013.

Invariably the reticulation in the Marlborough Sounds has been constructed using treated pine poles because of considerations of weight and resilience to transport, which at the time of installation, were anticipated to have a useful life of 35 to 40 years. Over recent years, the treated pine poles have been routinely tested and proven to be in good condition. Accordingly MLL now considers their useful lifespan to be in the order of 55 years.

During 2011, it was determined that a small batch of poles from a particular manufacturer had failed and approximately 20 poles were replaced to maintain the integrity and reliability of the Network. Difficult access and the remote location mean that the cost of replacing poles in the Marlborough Sounds is markedly higher than other areas.

In a number of areas the tracks which were utilised for line construction cease to exist and parts of the reticulation can only be serviced by helicopter. The Marlborough Sounds reticulation was constructed to meet the requirements of customers and satisfy government regulation of the day but overall is uneconomic and is subsidised by other customers.

2.1.4.5 East Coast

The East Coast consists of a narrow strip of coastal land running down to Marlborough's southern boundary, with some sparsely populated river valleys running into the centre of the South Island. Much of the Network in this area was constructed in the late 1950s using concrete poles and copper conductors. The long radial nature of the area means there are no alternative supplies available during faults or planned outages. The low population density makes it difficult to justify the high levels of expenditure required to provide alternative supplies.

The sheltered nature of the land and pastoral land use, with relatively small areas of trees and vegetation, leads to high reliability of supply in these valleys.

2.2 Demographics

At the time of the 2013 Census, MLL's Network area had a normally resident population of about 43,500 people, which was a 2.0% increase from the 2006 Census. Of this population, about 23,000 live within the urban Blenheim area. Key demographic features of MLL's Network area resident population are:

- older than the national average, with a median age seven years greater than the national median, and about 21% of the population aged over 65. (for NZ 14% of the population is aged over 65);
- less educated population than the national average. (13% of people have at least a bachelor's degree, while for NZ 20% have a degree);
- average dwelling occupancy of about 2.5 people per household;
- low deprivation, with phone, mobile phone, internet penetration rates and access the motor vehicles comparable with the national averages;
- significantly lower unemployment than the national average, however the most common occupational class of labouring is almost twice the national average;
- wages slightly lower than the national median across all age groups;
- household spending levels slightly lower than the national median;
- a higher level of home ownership than the national average;
- lower than average percentage of people born overseas (16% compared to NZ average of 25.2%); and
- less people involved in manufacturing with more people involved in agriculture, forestry and fishing.

The key demographic implications for MLL therefore are: low population growth, lower levels of discretionary spending in the community at large, and an increasing proportion of connected customers shifting to retirement-level incomes.

2.3 Key Economic Activities

Marlborough's key economic activities include:

- Food (particularly vegetable) processing;
- Grape growing and winemaking;
- Fishing, shellfish farming and processing;
- Pastoral farming;
- Dairying;
- Forestry;
- Timber processing;
- Aviation: Woodbourne Air Force base, Safe Air;
- Tourism; and
- Engineering manufacturing.

The area's economy is therefore strongly influenced by:

- Markets for customer delicacies such as wine, mussels and salmon;
- Changes to the climate that alter grape growth;
- Markets for dairy products;
- Markets for processed timber;
- Government policies on land use, particularly in relation to forestry, climate change and nitrogen-based pastoral farming;
- Government policies on major defence installations;
- Access to water for crop and stock irrigation;
- Algae bloom and rough seas within shellfish farming areas; and
- The incidence and severity of frosts when grapes are flowering and the extent of rain when grapes are ready for harvest.

The impact of these issues is broadly as follows:

Issue	Impact
Shifts in market tastes for wines, mussels and salmon	May lead to an expansion/contraction of demand by these industries. The conversion of pastoral land into vineyards has recommenced after a period of relative inactivity and some significant plantings are occurring. This has led to increases in demand in areas where electrical load had been static for many years.
Government policy on nitrogen-based farming	May lead to contraction of dairy shed demand. May lead to contraction of dairy processing demand.
Milk prices	A return to higher prices may lead to further conversion of pastoral land to dairying and subsequent increases in demand. Current levels or reduction of prices are unlikely to have much effect unless prices fell to a level where production was uneconomic.
Access to water	May lead to increased irrigation demand.
Government policy on defence installations.	Could lead to a significant contraction of demand at a single site, followed by a knock-on decline in disposable income in the community.
Lack of generation and/or electricity supply nationally.	May lead to reductions in demand as alternative energy sources are more widely utilised.
Increase in distributed generation including photovoltaic installation of customer premises	MLL currently has the second highest uptake of photo voltaics on a per customer basis amongst New Zealand EDBs. This trend can be expected to continue especially as the costs reduce. This has the potential to diminish the

Issue	Impact
	energy transported over the network and ultimately may well necessitate changes to the company's pricing structure to ensure equity and fairness by greater recovery of costs on a fixed or capacity basis.

Table 12 - Impact of Key Economic Activities

2.4 Other Drivers of Electricity Use

Other drivers of electricity use include:

- Low temperatures during winter; -5°C frosts can occur in significant areas of Marlborough.
- The use of heat pumps as air conditioners in the summer time.
- Increased utilisation of electricity, as polluting sources of energy, such as coal and wood are replaced.

2.4.1 Disruptive Technologies

MLL is part of a national group considering the impact of disruptive technologies and the manner in which network assets will be operated and managed in the future.

Key disruptive technologies being considered are:

- ***Distributed Generation*, e.g. Photo Voltaic/Solar and Wind** – The reduction in the cost of PV systems and increased interest in this is resulting in significant increases in the number of PV installations. This is likely to continue. Because of the lack of diversity and the intermittent nature of this type of generation, it is likely this will increase the voltage swings in the Network and lead to the need to reinforce the network, in particular the LV Network.
- ***Electric Vehicles*** – The Transportation sector utilises a significant amount of energy. A move towards greater use of electric vehicles will affect both the need for generation and the electrical networks which distribute it. One of the key factors with electric vehicles is the current cost and capacity of batteries.
- ***Battery Technology*** – This is an important factor in both Electric Vehicles and in the uptake of PV. Low cost batteries will enable some installations to become independent of the Electrical Network, and provide others with a means to store the generation and use it at times which produce maximum benefit.

There are a number of ways that networks can adapt to these technologies. The use of 'smart' networks, i.e. principally gathering more accurate information and therefore getting more and better use out of existing assets is a one option being looked at. It should be noted that doing this provides a number of benefits even in the absence of any disruptive technologies.

It is generally accepted that the factors driving the uptake of the above technologies will not result in need for major change in Asset Management Practices within the period of this AMP. However, MLL will continue to look at the technologies and consider how they might affect the ways in which the Network can best be managed to give maximum benefit to all stakeholders. MLL does not anticipate any difficulty meeting requirements of electric vehicles when demand commences.

2.5 Description of Network Configuration

2.5.1 Overview

Supply to the region is provided by three 110kV Transpower lines. The Blenheim Grid Exit Point (GXP) has three 110kV/33kV transformers supplying three 33kV buses. This gives an n-1 capacity of 100MVA. From the Transpower 33kV circuit breakers, the 33kV sub-transmission Network distributes supply to the 33/11kV zone substations.

The 33/11kV zone substations transform the voltage level down to 11kV. Each of the 16 zone substations has between two and six 11kV feeders radiating outwards, with some meshing possible in urban areas. These feeders collectively supply close to 4,000 distribution transformers that range from pole-mounted 5kVA units to ground-mounted 1,000kVA units. In turn, each distribution transformer has a number of 400V feeders radiating outwards, again with some meshing possible in urban areas.

The majority of customers take supply at 230/400V, with eight of our larger customers taking supply at 11kV.

2.5.2 Transpower Point of Supply/Transmission Lines

MLL has a single Transpower GXP in Blenheim (on the corner of Murphys and Old Renwick Roads) where supply from the national grid enters MLL's Network. Blenheim's GXP is currently supplied by three separate Transpower-owned 110kV circuits, one from Kikiwa and two from Stoke. The Kikiwa line is an "H" structure hardwood pole line, although a number of structures have been replaced with PSC poles. This line has a summer rating of 56MVA, and winter rating of 68MVA.

There are two Stoke-Blenheim 110kV circuits installed on the same towers. These circuits are rated at 76MVA for the original circuit and 105MVA for the circuit added in 2005.

The 110/33kV transformer capacity at Blenheim GXP consists of two banks of three single phase 50MVA units and a third 60MVA three phase unit. The 60MVA unit was commissioned in January 2011.

The bulk supply characteristics are summarised below:

GXP	Demand	Voltage	GXP Rating		Line Rating	
			(n) rating	(n-1) rating	(n) rating	(n-1) rating
Blenheim	70MVA, controllable to about 64MVA	110/33kV	160/172 MVA	100/112 MVA	189/202 MVA	110/136 MVA

Table 13 - Blenheim GXP

Changes to the Transpower charging scheme mean that MLL's peak charges are based on its contribution to the 100 highest upper South Island Coincident Peaks. MLL works constructively with other Lines Companies in the upper South Island to manage the Upper South Peak. Changes were made to MLL's load control system and those of other upper South Island Lines Companies to allow control based on upper South Load. This system has been successfully used from 2010 to the present day.

2.5.3 Embedded Generation

TrustPower operates a 2.4MW 'run-of-river' generator at Waihopai which is embedded into MLL's 33kV Network. This plant was originally built in 1927 by the Marlborough Electric Power Board and upgraded by MLL's predecessor, Marlborough Electric in 1999. Output of this generator is dependent on rainfall in the catchment area.

Energy 3 has two wind farms: at Weld Cone, near MLL's Ward substation there are three 250kW turbines, while at Lulworth just north of the Ure River, four 260kW turbines are installed. The units at Weld Cone began generation in February 2010 and the Lulworth units commenced in January 2011. Both schemes are embedded into MLL's 11kV Network.

Photo 7 - Lulworth Wind Generation

Dominion Salt have installed a 600kW wind turbine which is embedded into their 11kV installation.

The potential wind resource in the Marlborough Sounds and on the East Coast is significant, however the development of substantial wind farms will require construction of new lines to convey the output to load centres.

TrustPower operates the Branch Power Scheme and has been granted resource consent to extend this scheme. Six new power stations are proposed with one connecting to the existing Branch scheme infrastructure, four connecting to a new substation on the 110 kV Kikiwa to Blenheim line and one connecting to MLL's existing Network in the Wairau Valley. MLL understands that TrustPower does not currently intend to proceed with construction of the scheme.

The Wairau Hospital and a number of wineries and local businesses have small diesel generators which are used for load management and emergency power supply. Some of these units are capable of embedded operation.

The current low cost of photovoltaic cells has seen an increase in interest in small scale solar distributed generation. At the time of compiling this AMP, there were 210 small solar installations, two installations with solar and wind, two small wind installations, one small hydro, seven large solar and 22 installations with embedded diesel generators. In 2012 there were 12 small solar installations.

There has been anecdotal public discussion concerning tidal power generators at the entrance to Tory Channel, however no resource consent has yet been applied for, and this type of generation is relatively unproven. The cost, efficiency and environmental impacts to the seabed and marine environment have yet to be accurately determined.

Utilisation of this resource would require the construction of a new transmission line from Tory Channel to a load centre. In practical terms the current possibility of significant tidal generation in Tory Channel is considered low.

Embedded generation produced 15.3GWh in the 2012 year, 15.0GWh in 2013, 14.0GWh in 2014 and 14.4GWh in 2015. This is mainly from the Waihopai scheme and larger wind farms. The variations in output are mainly due to changes in rainfall.

2.5.4 Sub-transmission System

The Transpower substation has three 110kV/33kV transformers supplying three 33kV buses. From the Transpower substation, MLL's 33kV sub-transmission Network distributes supply to MLL's 33/11kV zone substations. The 33kV sub-transmission Network uses radial duplicated feeders and provides n-1 security of supply to the 33kV bus at all zone substations, except Rai Valley, Linkwater, Leefield and Ward. About 6.9% (by length) of the 33kV Network is underground. MLL has 16 zone substations throughout its Network area, with four zone substations supplying Blenheim.

Of a total 300km of 33kV line, 278km is overhead, most of which has been constructed since 1960. Lines constructed earlier than 1960 include galvanised tower lines between Waihopai Power Station and Renwick and part of the line between Riverlands and Seddon.

The Blenheim/Waihopai line was commissioned in 1927 to transfer electricity from the Waihopai hydro-generation station to Blenheim. Much of this line remains unaltered from its original construction, however MLL is actively renewing parts of this line due to age/deterioration and to facilitate some road widening in places. Additionally, extra mid-span poles have been inserted to allow connection of 11kV spur lines and transformers. The aluminium conductor is mostly original, but with the addition of pre-formed line splices over each insulator to repair any conductor strand breakage. In 2005, below-ground deterioration was detected on a proportion of the towers between Waihopai and Blenheim and these have been replaced.

In the early 1970s, a double circuit 33kV and 11kV line was constructed between Okiwi Bay and Elaine Bay in the Marlborough Sounds, using a high proportion of larch poles treated with creosote. These poles are at the end of their useful lives and are being progressively replaced.

The following figure shows the overall 33kV sub transmission system (blue lines) together with zone substations and embedded generation (circles with a red centre). The graphs at each zone sub highlight our secure availability relative to maximum and average substation loading.

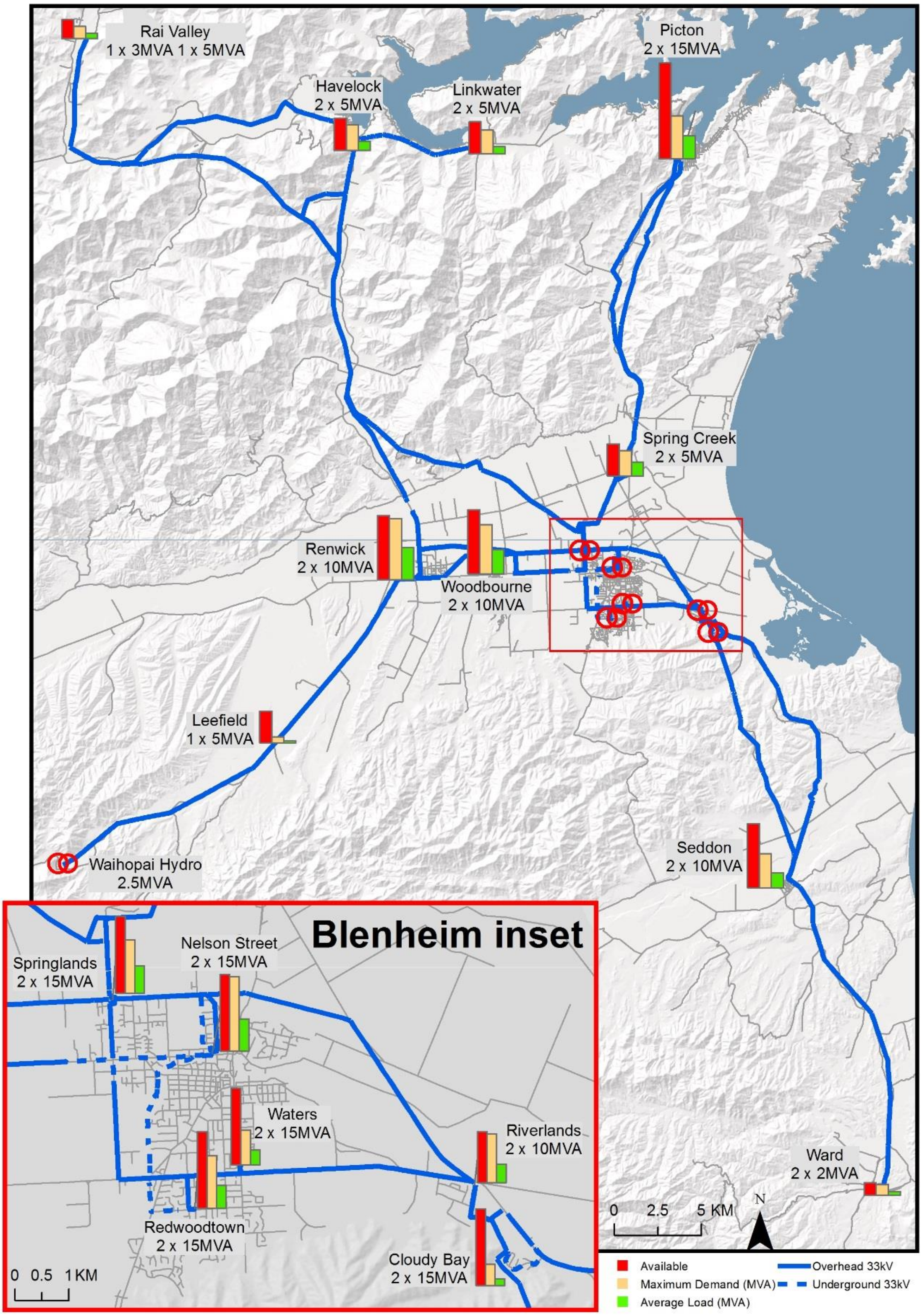


Figure 7 - 33kV Sub-transmission

A single line diagram is included in appendix E. All new 33kV line construction in rural areas is currently being insulated at 66kV or 110kV.

2.5.5 Zone Substations

Zone substations transform the 33kV down to 11kV for reticulation to 11kV/400V transformers. All of the zone substations are equipped with on-load tap changers and automatic voltage regulators to regulate the 11kV supply and maintain constant voltage.

The major components of the substations are transformers and switchgear.

Photo 8 - Waters Substation, Blenheim

2.5.5.1 2015 Zone Substation Loadings

Substation	T1 Capacity (MVA)	T2 Capacity (MVA)	Maximum Demand (MVA)	Average Load (MVA)	Security Level	Notes
Leefield	5		1.2	0.5	n	
Linkwater	5	5	3.5	1.1	n	Holiday homes with low occupancy over winter
Havelock	5	5	2.2	1.3	n-1	
Nelson Street	15	15	14.8	7.0	n-1	
Picton	15	15	7.3	3.7	n-1	
Rai Valley	3	5	2.2	0.9	n	
Redwoodtown	15	15	9.8	4.4	n-1	
Renwick	10	10	9.9	5.2	n-1	
Riverlands	10	10	10	3.1	n-1	Still experiencing strong growth during wine making period, load being moved to Cloudy Bay
Seddon	10	10	7.5	2.7	n-1	

Spring Creek	5	5	4.3	2.3	n-1	
Springlands	15	15	9.9	5.1	n-1	
Ward	2	2	1.6	0.6	n	The maximum loading on the transformers occurs when the load is low and the wind farms are producing full output.
Cloudy Bay	15	15	3.7	1.1	n-1	
Waters	15	15	6.8	2.7	n-1	
Woodbourne	10	10	8.7	3.9	n-1	

Table 14 - Zone Substation Loadings

Note load graphs are contained in Appendix C.

MLL has acquired three sites for three future substations. Their construction will potentially transfer load from substations in the Renwick/Blenheim areas and will be constructed to meet customer demand.

Consistent with its planning horizon MLL has recognised the potential need for the sites and that opportunities to purchase substation sites are limited. Accordingly, the sites have been purchased and typically have significantly escalated in value. At present, there are no plans in this AMP period to construct zone substations at these sites, however, loading and demand can change in a shorter timeframe and as such MLL will move to respond accordingly, if this eventuates.

All of MLL's substations other than Leefield have (n-1) security for the 33/11kV transformers, e.g. for a substation to have a firm (n-1) 16.5MVA rating it must have two transformers of 16.5MVA. Note Linkwater, Rai Valley, Leefield and Ward substations only have a single 33kV line supplying them, and consequently have an overall security of supply of (n).

2.5.6 Distribution System

MLL operates an 11kV distribution Network which is largely radial with some meshing in urban and higher density rural areas. Around 8% of the 11kV (by line length) is underground. The total length of cable and conductor operating at 11kV is in the order of 2,320km.

Generally speaking, underground cable is considerably more expensive than overhead. The decision on whether underground cable is more appropriate than overhead conductor involves several factors, for example surrounding land use, safety and available budget.

Some other key features of the 11kV system:

- Lightning protection is generally installed on all under-ground to overhead transitions and in areas prone to lightning.
- All new 11kV lines in rural areas are being insulated at 22kV to allow for possible future increases in supply voltage.

- Distribution substations are installed to step down the voltage from 11kV to 400V/230V in locations appropriate to service consumer's needs.
- Protection devices are installed across the network. The selection of locations for protection devices involves consideration of a number of factors such as downstream customers, location and cost, for example.

2.5.7 Distribution Substations

MLL has close to 4,000 distribution substations. Of these, 476 are ground mounted and the remainder are pole mounted. All transformers greater than 300kVA are ground mounted and in general smaller transformers are pole mounted.

Key features of MLL's distribution substations include:

- typically 200kVA or 300kVA in urban areas;
- fused on the HV side;
- LV cables with HRC fuses;
- LV typically runs along both sides of the street i.e. no multiple service lines crossing the street; and
- LV runs are typically limited to a maximum of 350m to reduce incidences of low voltage.

In rural areas, 11kV lines are generally built with 80m to 100m pole spacing's on the flat and greater distances depending on terrain. These distances make the installation of LV impractical in many situations and, combined with a low density of customers, necessitate many rural customers having their own transformers. This results in a lower coefficient of utilisation than would be achieved with fewer transformers, closer pole spacing and more LV conductor run, however it is the most cost effective solution to supply voltage at regulatory levels.

2.5.8 Low Voltage Network

MLL operates a 400V (LV) reticulation Network totalling approximately 797km. There is significant meshing in urban areas. About 47% (by length) of the LV is underground. As noted above, in general in many rural areas, pole spacing and customer locations result in customers having individual transformers and correspondingly, less use of LV conductor.

The LV Network supplies the bulk of the Networks connections, the majority of which are domestic customers (i.e. residential properties). The LV supply in most cases is single phase, but can be two or three phase depending on the supply for the area and the needs of the consumer.

2.5.9 Ripple Control, SCADA and Communications

MLL operates 217Hz and 1050Hz ripple injection systems. These both inject at 33kV with the injection equipment installed at the Springlands substation site. All ripple relays are owned by the energy retailers. The 1050Hz equipment was originally installed in 1967. All new ripple relays are at 217Hz.

SCADA covers all of the zone substations, voltage regulators and 33kV reclosers. This system allows staff to monitor and control the Network.

Communication for SCADA consists of dedicated radio equipment, as well as use of internet and cell phones. To ensure greater reliability in the event of major civil emergencies or wide spread power outages, the SCADA radio network is being extended.

Photo 9 - SCADA Controlled 11kV Recloser

MLL also operates a voice radio network which covers the whole region. This is used for operational control of the Network.

2.6 Asset Categories

This section presents in detail the MLL Network assets by major categories. It summarises systemic issues encountered with the asset categories, as well as providing a full description of the assets, their quantities, voltage levels and asset lives.

2.6.1 Major Asset Groups

The following table presents a summary of the major asset groups making up the MLL Network.

Type	Unit	Number	Average Age (years) 31/3/2016	Regulated asset Base $000
Subtransmission Lines	km	278	40.5	17,376
Subtransmssion Cables	km	21.75	8.1	7,477
Zone Substations	-	-	-	34,923
Buildings	each	16	15.5	
Switchgear	each	364	9.8	
Transformers	each	31	23.3	
Distribution and LV Lines	km	2566	37.4	48,081
Distribution and LV Cables	km	551	15.8	46,083
Distribution substations and transformers	each	3858	21	23,663
Distribution Switchgear	each	2424	12.0	16,613
Other Network assets	-	-		5,847
Non Network assets	-	-		14,962
				215,025

Table 15 - Major Classes of Assets

The values shown above are based on the Regulated Asset Base as at 31/3/2016 and the data contained in the Information Disclosure for 2015.

2.6.2 Systemic issues

The following table sets out the major asset categories within the MLL Network, and any systemic issues that are encountered within these asset categories. Where present, it also provides a description of the measures taken to address the issues.

Asset Category	Systemic issue(s)	Rectification measures
Subtransmission Lines	Poor condition of Cross-arms on Picton 1 & 2 Lines, Thompsons Ford Road to Tuamarina	Replacement
Subtransmssion Cables	none	
Zone Substations		
Buildings	Some of the older structures not up to current earthquake design standards	Active programme of reviewing structures, and where required, installing seismic strengthening structural elements. MLL is aiming to complete this by the end of FY17.
Switchgear	None	N/A
Transformers	None	N/A

Distribution and LV Lines	None	N/A
Distribution and LV Cables	none	N?A
Distribution substations and transformers	None	N/A
Distribution Switchgear	None	N/A
Poles	Some significant deterioration in Larch poles. Larch Poles near end of life	Active condition assessments and pole replacement in accordance with industry standard, where poles have been considered unsafe for current loadings or work (i.e. red tagged poles).
	Safety concerns with iron rail poles, inability to upgrade components on iron rail poles due to overloading	Active widespread programme to phase out and replace iron rail poles on the Network
Other Network assets		‘

Table 16 – Systemic issues of major asset categories on MLL Network

2.6.3 Poles

Poles are a major component of overhead lines. To a large extent, the condition of the poles determines whether a line needs to be replaced or can be maintained or upgraded unless in some instances additional capacity is required.

The Network has been constructed on a variety of different pole types. Current practice is to utilise pre-stressed concrete poles where good access is available, and treated pine in other areas. Where large spans of heavy conductors are required tubular steel poles are utilised. Since 1969 almost all of the lines constructed in the Marlborough Sounds have been on treated pine poles due to the difficult access tracks or the need to fly the poles to site by helicopter. Creosote-treated larch poles were used in the period 1971 to 1983. Iron rails have been used for minor works throughout the Network. In total MLL owns approximately 30,500 poles.

The breakdown of pole types used today is shown in the table below. Note some poles carry a mixture of voltage lines e.g. 33kV and 11kV. Poles have been classified according to the highest voltage carried.

Type	Voltage	Number	Average Age	Average Condition (4 = new, 1 = close to failure)	Condition Score					Condemned	Notes
					1	2	3	4	Unknown		
Galv Steel Column	33000	390	5.2	2.9	0	24	365	0	1	0	new, excellent condition
Hardwood	33000	3	71.2	3.7	0	0	1	2	0	0	need renewal, program for replacement .
Larch	33000	1	43.2	3.0	0	0	1	0	0	0	need renewal, program for replacement .
Pre-Stressed Concrete	33000	1172	35.4	3.1	0	7	1031	134	0	0	good condition
Reinforced Concrete	33000	819	54.3	3.8	0	0	198	621	0	0	older but good condition
Tanalised Pine	33000	159	43.2	3.0	0	0	158	1	0	0	good condition, being active monitored
Tower Galvanised Steel	33000	199	79.7	3.8	0	0	25	154	18	2	some renewal
Galv Steel Column	11000	28	3.6	2.7	0	9	19	0	0	0	new, excellent condition
Hardwood	11000	44	50.8	3.6	0	0	19	25	0	0	fair/good condition
Iron Rail	11000	1529	55.8	3.8	0	0	339	1190	0	0	EEA guide recommends no climbing. Will need renewal
Larch	11000	157	42.0	3.1	0	0	147	10	0	0	At end of life. Need renewa
Pre-Stressed Concrete	11000	5939	20.9	3.1	43	260	4899	723	6	8	good condition
Reinforced Concrete	11000	5911	58.0	3.8	0	1	1448	4443	17	2	older but good condition
Tanalised Pine	11000	7504	34.0	3.2	0	52	6199	1249	0	4	good condition, being active monitored
Tower Galvanised Steel	11000	21	59.0	3.3	0	0	9	3	9	0	some renewal
Hardwood	LV	179	57.6	3.7	0	0	52	126	1	0	need renewal
Iron Rail	LV	321	58.0	3.7	0	0	95	220	6	0	EEA guide recommends no climbing. Will need renewal program for replacement .
Larch	LV	62	48.3	3.5	0	0	33	29	0	0	need renewal
Pre-Stressed Concrete	LV	990	29.1	3.2	4	21	727	238	0	0	good condition
Reinforced Concrete	LV	2113	52.5	3.6	0	0	889	1219	5	0	older but good condition
Tanalised Pine	LV	2594	39.5	3.3	8	35	1710	839	0	2	good condition, being active monitored
Total		30438**	39.9	3.3	56	419	18614	11267	63	19	

This total is that which prevails at the time of the production of this report but will have been revised by the time of the report's publication.

** Note that there are also a number of Stay Poles which have not been included in the above table but are included in the Total.

Table 17 - Pole Types Used on MLL's Network

Any poles assessed as a hazard are red tagged and dealt with as soon as practical (current legislation stipulates that this is a maximum of 12 months from tagging date).

Regular monitoring of the condition of all poles is undertaken. Wooden poles which are older than five years are having their condition assessed using non-destructive testing. More information on this is given in the section on Lifecycle Planning.

Poles which are of the greatest concern are hardwood poles and iron rails and, in particular, those carrying 11kV or 33kV lines, as these affect the greatest number of customers. All poles identified as potential problems/safety hazards will be replaced irrespective of type and location.

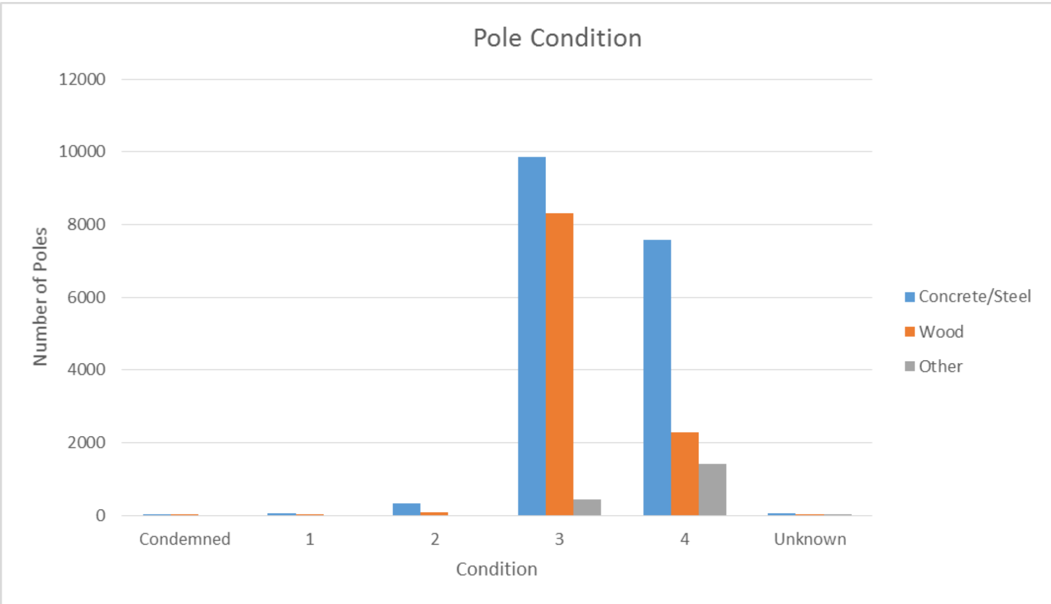


Figure 8 - Pole Condition

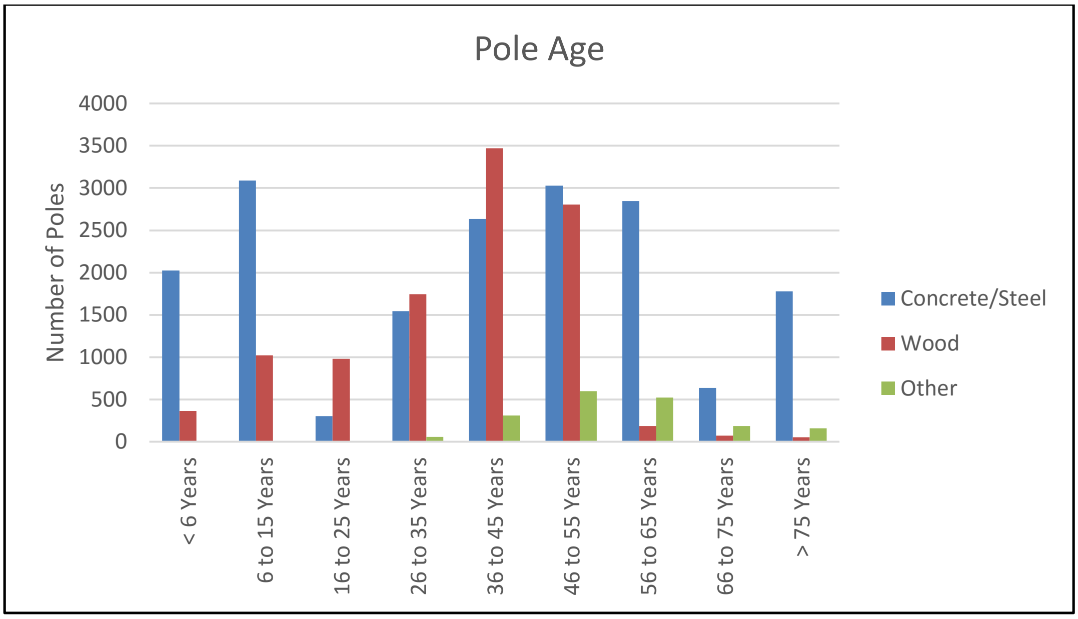


Figure 9 - Pole Age

The Optimised Deprival Valuation (ODV) handbook assigns maximum lives of 45 years for wooden poles and 60 years for concrete poles. The experience in Marlborough is that poles (in particular treated pine and concrete) last much longer than this. However, some hardwood poles, including larch, are showing significant deterioration, and 45 years seems a reasonable estimate of useful life for these poles.

Concrete poles are generally showing very little to no deterioration. In the last ten years, there have been fewer than 10 concrete pole failures and/or replacement due to signs of aging out of a total population of approximately 15,000. Most of the failures have been due to adverse environment, e.g. salt spray on concrete poles or external damage.

For concrete poles, 70 years is a conservative estimate, which may be extended as poles age and more data on actual failures is obtained.

Until recently, treated pine poles have shown few signs of aging. Continuous monitoring has revealed that one batch of poles (approximately 100) installed in 1969 has reached the end of its life. It is considered that this is due to a failure of treatment process rather than a systemic problem.

Accordingly it is considered that a life of 55 years for treated pine poles is still realistic.

Lines built in 1927 on steel towers are still in service, however some sections of the original lines have recently been replaced by steel poles, or are planned for replaced in the near future.

2.6.4 Bulk Supply Points

MLL has very few assets located within the Blenheim GXP. The demarcation point between the MLL Network and the Transpower-owned equipment is the outgoing terminals on the circuit breakers, hence the outgoing cables are part of the MLL

Network. In addition MLL has two control panels located within the GXP. These house check-metering equipment and a SCADA RTU which allows monitoring and ultimately operational control of the 33kV circuit breakers. A second cabinet houses differential protection on three of the 33kV cable supplies.

All of this equipment is less than five years old.

2.6.5 Sub-transmission Network

2.6.5.1 33kV Lines Overhead

There are 278 km of 33kV overhead lines, with an average age of 41 years compared with an expected average useful life of 69 years. The RAB of the 33kV overhead is $17.4 million.

The age profile of the 33kV overhead lines is shown below.

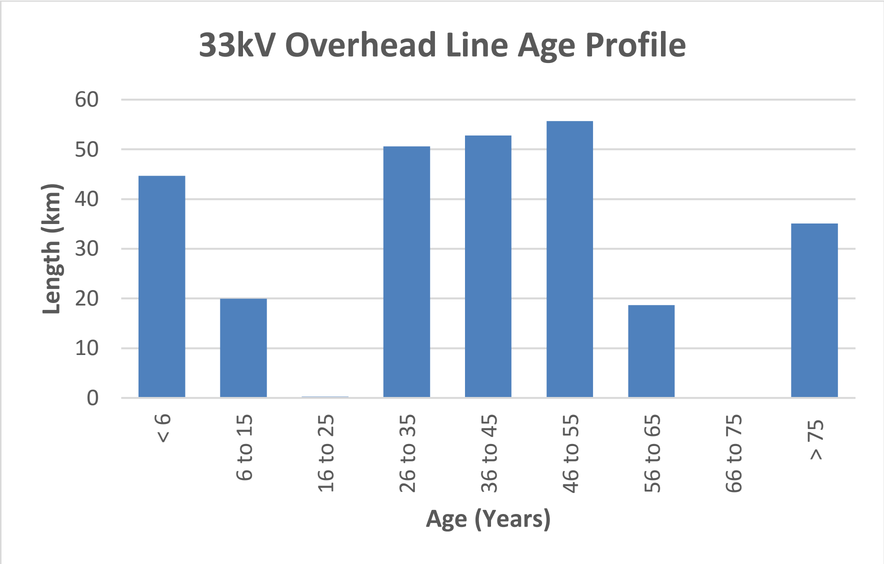


Figure 10 - 33kV Line Age Profile

Around 20% of the existing 33kV Network is currently older than the maximum life provided in the ODV handbook.

Extensive monitoring is carried out on the 33kV lines and in general, the condition of the 33kV lines is very good. In total there is less than 25km of the original 1926 33kV line still in service. Investigation has shown that some of the original 1926 33kV towers near bitumen roadways have significant corrosion just below ground level. These have been strengthened and/or replaced.

The 14.5km section of 1926 33kV line from Leefield substation to the Waihopai Dam services the embedded generation station. The sections from Leefield back to Renwick have recently been replaced or are planned for replacement in this AMP period. Redwood Pass contains 6.5km of the original 33kV 1926 tower line; this is also planned for replacement within this AMP period.

The 1956 hardwood 'Cobb' 33kV line has been fully replaced over the past five to six years. .

Data on the pole types and pole condition for the 33kV lines is contained in section 2.6.5.

2.6.5.2 33kV Underground

The 33kV sub-transmission cable underground assets are relatively new, as shown below. The total length of cable is 22 km and the average age is eight years compared with an expected life of 45 years. The RAB value of the cable is $7.5 million.

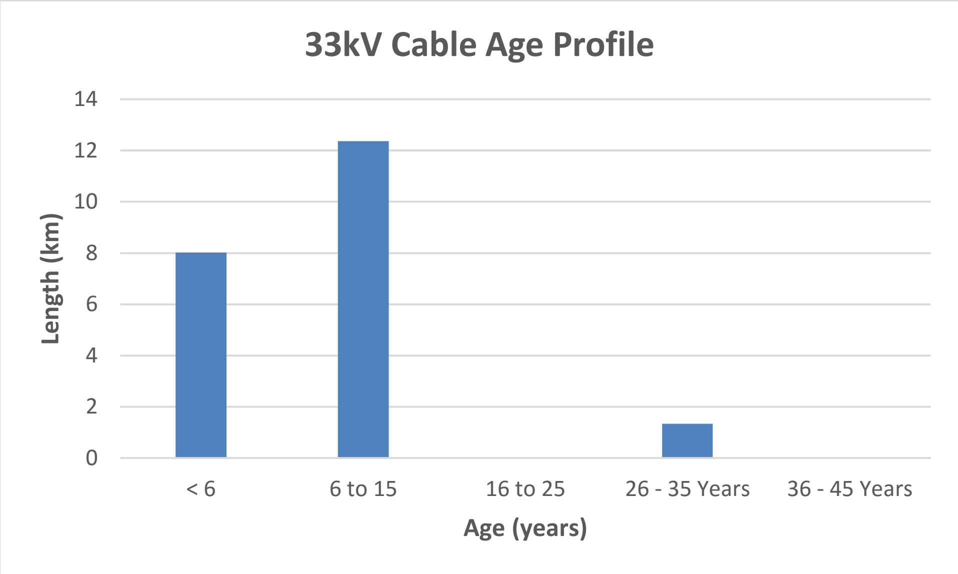


Figure 11 - 33kV Cables Age Profile

All of this cable will be less than 45 years old in 2025, and hence will not need renewal within the period of this AMP.

2.6.6 33/11kV Zone Substation Transformers

The RAB value of the Zone substations is $34.9 million of which approximately half is the value of the 33/11kV transformers.

Based on the expected life of 55 years, five transformers are due for renewal within the next ten years. The cost of replacing these transformers is relatively small yet will reduce overall transformer's age and reduce risk of failure. Because of the importance of the transformers they are carefully monitored and inspected and have regular maintenance and testing. The Woodbourne T1 transformer failed in 2011 at an age of 45 years, however, this is considered to be an anomaly with testing and monitoring on other similar aged transformers indicating that they are still performing well.

Zone substations are all monitored by SCADA. Monthly inspections are undertaken to ensure the integrity of the site and equipment. DGA testing is undertaken every 12 to 18 months. A summary of the 2016 DGA tests is shown in the following table. The next round of testing will occur in early-2017. Note that items in ***bold italics*** are those which require maintenance and/or re-inspection within the next year.

Location	Year	MVA	TCA	Transformer Condition	TASA	Tap Changer Condition
Cloudy Bay T1	2012	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Cloudy Bay T2	2012	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Havelock T1	1974	5	1	No abnormal gas generation is indicated. *Fluid Oxidation is advancing. Paper condition is reduced to 80% tensile strength.*	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***
Havelock T2	1972	5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is reduced to 50% tensile strength	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***
Leefield T1	1966	5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. **Paper condition is reduced to 70% tensile strength. Has developed a substantial Oil leak**	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***
Linkwater T1	1984	5	1	**Arcing is indicated. Tap-changer communication likely cause. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)**	1	LTC is operating satisfactorily. No special actions are recommended.
Linkwater T2	1984	5	1	**Arcing is indicated. Tap-changer communication likely cause. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)**	1	LTC is operating satisfactorily. No special actions are recommended.
Nelson St T1	2007	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Nelson St T2	2007	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Picton T1	2006	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Picton T2	2005	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.

Rai Valley T1	1961	3	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is reduced to 70% tensile strength	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***
Rai Valley T2	2013	5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Redwoodtown T1	. 2005	. 16.5	**. 4***	. **Arcing is indicated.** Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels). Scheduled for retest immediately	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Redwoodtown T2	. 2005	. 16.5	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Renwick T1	. 1995	. 10	. 1	. **Arcing is indicated. Tap-changer communication likely cause. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)**	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Renwick T2	. 1997	. 10	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Riverlands T1	. 1982	. 10	. 1	. **Arcing is indicated. Tap-changer communication likely cause. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)**	. 2	. ***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***
. Riverlands T2	. 1962	. 10	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is reduced to 80% tensile strength	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Seddon T1	. 2001	. 10	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	. 2	. ***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Partial discharge is indicated. Moisture is elevate*** . ***d. Dielectric is reduced.*** . ***Heating is indicated. Recommend retest within 150 days (5 months) for trending.***
. Seddon T2	. 2012	. 10	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	. 1	. LTC is operating satisfactorily. No special actions are recommended.
. Spring Creek T1	. 1985	. 5	. 1	. No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	. 1	. LTC is operating satisfactorily. No special actions are recommended.

Spring Creek T2	1987	5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Springlands T1	2005	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Springlands T2	2005	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Ward T1	1959	2	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Partial discharge is indicated. Recommend retest within 150 days (5 months) for trending.***
Ward T2	1960	2	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Waters T1	2009	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Waters T2	2009	16.5	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Woodbourne T1	2011	10	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is "as new" (based on furan levels)	1	LTC is operating satisfactorily. No special actions are recommended.
Woodbourne T2	1966	10	1	No abnormal gas generation is indicated. Fluid condition is within acceptable in-service parameters. Paper condition is reduced to 80% tensile strength	2	***Slightly abnormal dissipation of energy is noted. This is an early indication of fault or wear activity. Recommend retest within 150 days (5 months) for trending.***

Table 18 - Summary of 2011 DGA Tests

Fault levels at the Zone substations are given as follows:

Location	33KV 3Ø Fault Level (amps)	33kV 1Ø Fault Level (amps)	11kV 3Ø Fault Level (amps)	11kV 1Ø Fault Level (amps)
Transpower	6,500	1,500	n/a	n/a
Springlands	6,400	1,500	8,709	3,407 (NER)
Nelson Street	5,601	1,495	8,176	9,742
Redwoodtown	4,600	1,413	7,640	2,958
Spring Creek	4,194	1,363	4,936	2,673
Woodbourne	3,834	1,302	6,943	8,345
Waters	3,406	1,373	4,167	4,769
Riverlands	2,829	1,159	4,992	5,421
Cloudy Bay	2,820	1,213	3,831	4,402
Renwick	2,690	1,077	5,030	6,337
Picton	2,051	808	5,221	2,235
Seddon	1,763	832	3,807	4,985
Leefield	1,632	1,114	2,089	2,476
Havelock	1,165	577	1,921	2,382(GFN*)
Ward	979	507	1,648	2,015
Linkwater	898	467	2,059	2,753
Rai Valley	748	404	1,262	1,537

Table 19 - Fault Levels

All of the existing switchgear and equipment is suitable for the potential fault levels.

Note: The GFN at Havelock sub reduces the single phase earth fault level to close to zero while it is in service.

Graphs showing the zone substation loadings for the 2015 calendar year are included in Appendix B.

2.6.7 Distribution Network

2.6.7.1 11kV Overhead Lines

The 11kV overhead lines are the most significant asset class both in terms of quantity and value. The RAB value of the 11kV and LV overhead is $48 million, with an average age of 37 years, compared with an average expected life of 63.5 years.

The distribution Network is generally in good condition. Nearly half of the Network is constructed on concrete poles, and most of the balance on treated pine poles. Most conductors are aluminium, although some copper conductors remain in use on older lines. Additionally, some older spur lines have copper weld and galvanised steel conductors, typically located on short spur line sections of the Network where demand is relatively low and static. Replacement is subject to condition assessment

A programme is in place to identify those areas where changes in demand may require upgrades to the capacity of the Network, generally by way of increases in the conductor size.

The backbone of the Network system is constructed at three phase with some spur lines and lines at the extremities of the Network being single phase including 33 separate areas of single wire earth return. All of the distribution system currently operates at 11kV. New rural construction is generally insulated at 22kV and, within the period of this plan, it is considered likely that some areas will be operated at 22kV.

Most of the Network uses flat construction hardwood cross-arms, although some limited areas have been altered to triangular construction in an endeavour to reduce faults from large bird strikes.

Most of the central area of the 11kV Network is capable of being ring-fed with supply available from at least two zone substations. This arrangement provides flexibility in the operation of the system, and enables supply to be maintained to most customers in this area at times of emergencies or planned outages. However a significant portion of MLL's Network is supplied by way of long radial spur lines, which have no alternative supply capabilities.

Most of the overhead reticulation has been constructed since 1960. Significant growth in the number of connections and in demand for electricity occurred in the 1960s and 1970s, and consequently considerable sections of the Network were upgraded at that time.

The age profile of the overhead distribution lines is shown on the following chart:

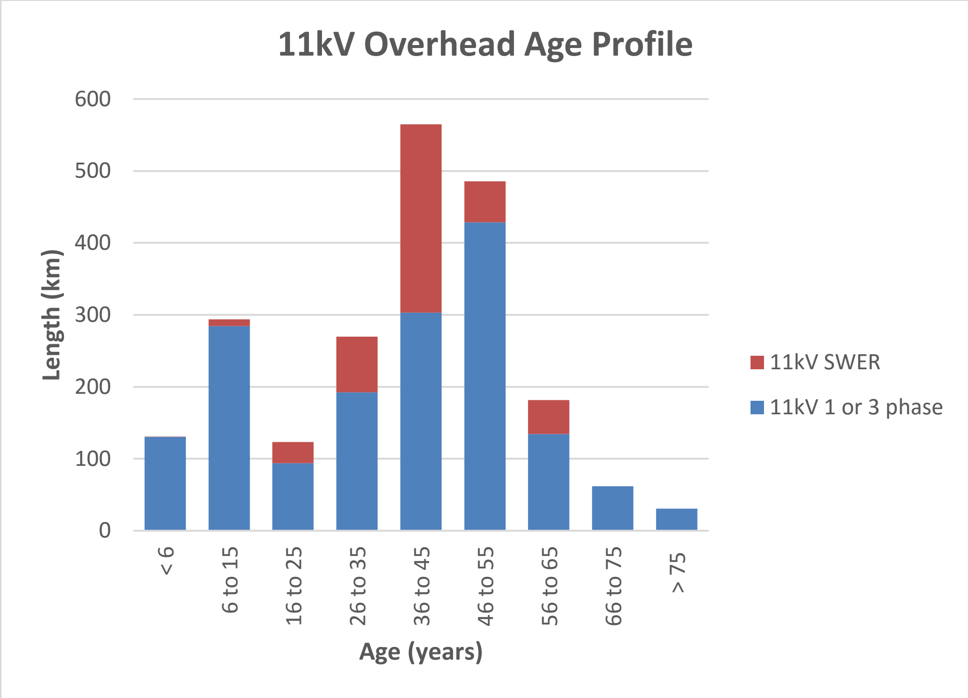


Figure 12 - 11kV Overhead Lines Age Profile

The above figure shows the age profile for 11kV overhead lines. Using useful lives of 45 years for wooden poles and 60 years for concrete and metal poles indicates that during the next 10 years, 1070km of 11kV overhead lines will reach the end of their useful lives. In the following ten years a further 356km will reach the end of their useful lives.

In Marlborough the environment is relatively benign and poles and lines do last longer than the useful lives given by the Information Disclosure requirements. Extending the useful lives by 10 years, i.e. using useful lives of 55 years for wooden pole lines and 70 years for concrete poled lines gives 303km in the next ten years and a further 706km in the following ten years.

Using the extended lives as the basis for renewal, MLL needs to replace 40km to 50km of the older lines each year. This will avoid lumps in expenditure and resource requirements. The targeting of the lines in poorest condition, and those requiring upgrade for capacity or to improve reliability, will ensure that renewal expenditure is allocated in ways that provides the most value to MLL and the community.

2.6.7.2 <u>11kV SWER Lines</u>

Single Wire Earth Return (SWER) lines have been used extensively throughout the more remote sections of MLL's Network, with a total of 482km of 11kV SWER lines currently in place. These lines can be constructed at significantly lower cost than the more traditional two and three wire systems, due to the ability to span longer distances without the possibility of mid-span wire clashing. This type of construction is ideally suited to areas of low population density, such as parts of the Marlborough Sounds and the upper Awatere Valley and especially where the terrain is undulating where pole numbers can be minimised.

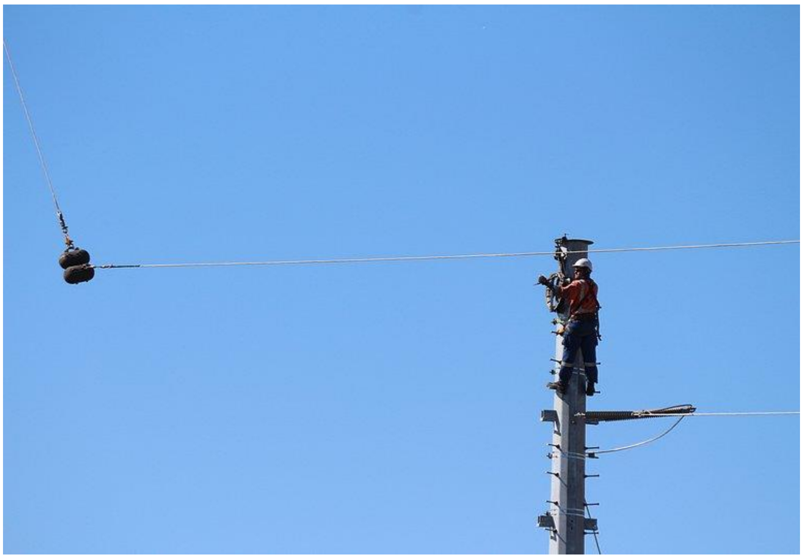


Photo 10 - Lineman placing rope from helicopter into pulley line roller

The primary disadvantage of this type of construction is that it provides a single phase supply which can only deliver relatively low capacity. Stringent conditions related to earthing and interference with telecommunication systems apply to this type of construction.

The Electricity Engineers Association (EEA) has prepared a guide on HV SWER earthing. MLL has reviewed SWER earthing and considers that it is consistent with the EEA guide.

Photo 11 - SWER lines in Tory Channel

The voltage between the wires and ground for SWER is 1.73 times higher than for a three phase system. This increases the risk of fire and consequently special attention needs to be given to ensuring that vegetation is free of the lines.

2.6.7.3 11kV Underground Cable

The 11kV underground reticulation is generally much newer than the overhead with an average age of 14 years and an average expected life of 47 years.

The age profile is shown on the following chart:

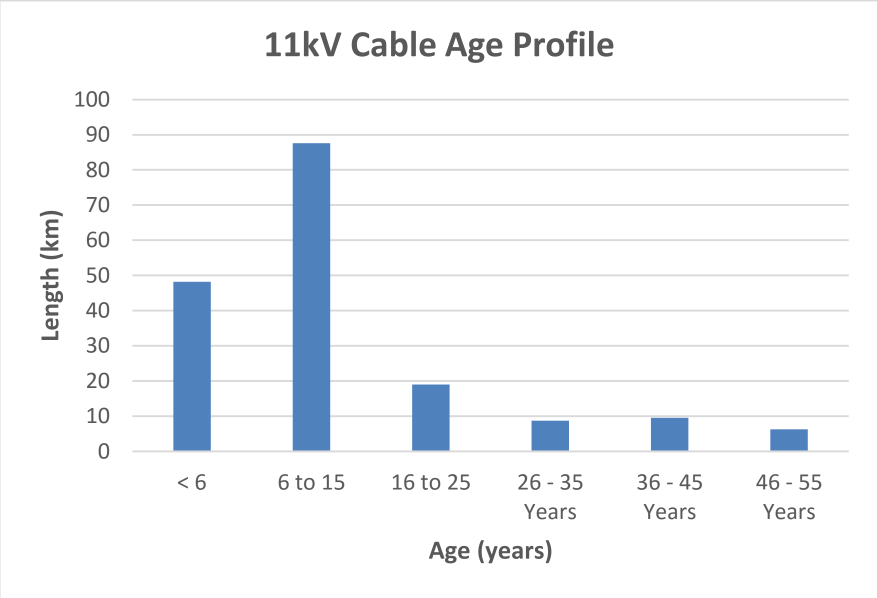


Figure 13 - 11kV Underground Cable Age Profile

The majority of these cables are XLPE (cross-linked polyethylene), the generally accepted useful life of which is 45 years, however there are reports of XLPE cables failing at 35 years. Based on 45 years for XLPE and 70 years for PILC, 5.5km of cable will reach the end of its useful life within the next 10 years and a further 20km in the subsequent 10 years. Replacement of these cables will be costly, and accordingly it is planned to use partial discharge testing to monitor critical cables and prioritise their replacement.

The earthquakes in Christchurch have shown that cable networks are particularly vulnerable to ground movements. Where practical this will be taken into account in design and new alternate routes constructed.

2.6.8 Distribution Substations

Distribution transformers reduce the 11kV down to 415/240V. The majority of installations connected to the Network take supply at 415/240V. The distribution substations, transformers and associated equipment (e.g. fuses) have a total RAB value of $23.7 million, with an average age of 21 years, compared to an estimated average useful life of 44 years. The age profile of MLL's 3,953 distribution transformers is shown in the figure below:

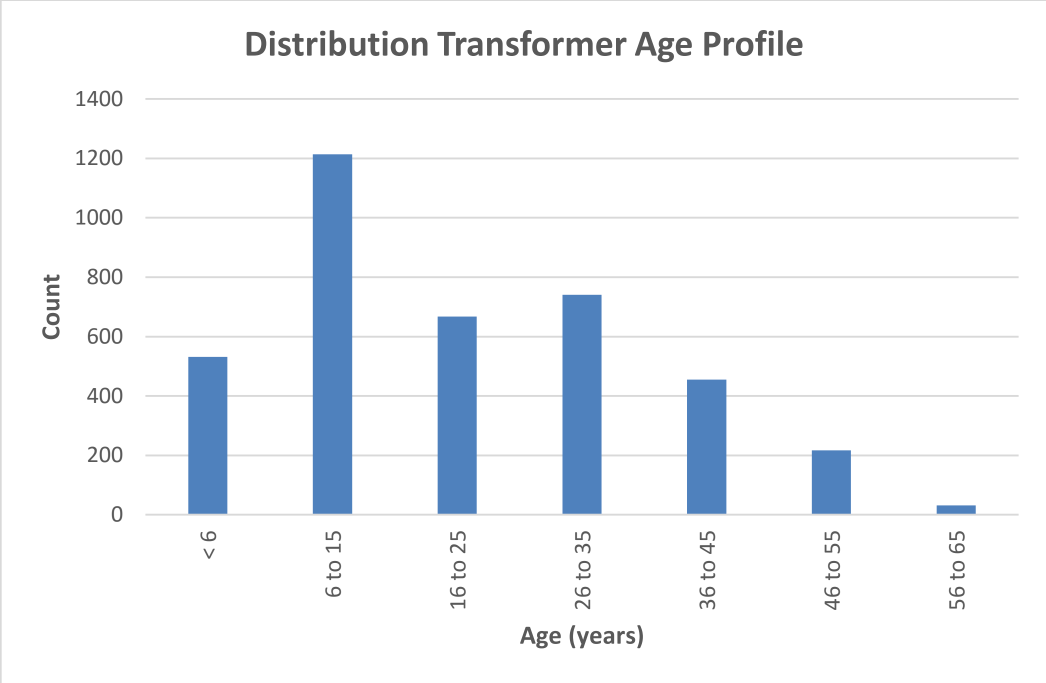


Figure 14 – Age Profile for Distribution Transformers

Using the Information Disclosure standard useful life of 45 years, there are currently 255 transformers due for replacement, with a further 455 due for replacement in the next 10 years. Using an extended life of 55 years, there are 35 due for replacement, with a further 220 due for replacement in the next 10 years. These numbers are consistent with current renewal rates.

Photo 12 – Distribution Transformers in Taylor Pass Yard

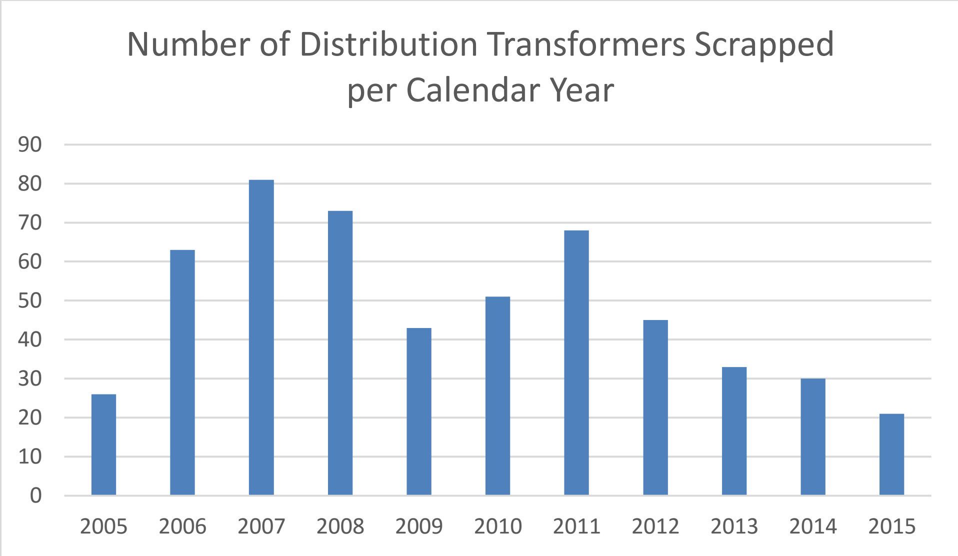


Figure 15 - Number of Transformers Scrapped

The condition of the distribution transformers is generally good. Transformers greater than 200kVA have annual load monitoring/silica gel checks/physical inspections. Earthing is checked on an annual basis for substations in urban areas with high foot traffic or close to schools (i.e. public places), three yearly for SWER substations and six yearly for all other substations. During the testing the transformer external condition is assessed.

Aside from this inspection/ maintenance transformers are generally run to failure unless potential problems are detected from network surveillance. Failure rates are monitored to look for any systemic problems with the transformer stock.

Photo 13- 11kV Transformer at Wind farm site

2.6.9 Distribution Switchgear

Distribution Switchgear covers a range of assets. The RAB value of these assets is $16.6 million with an average age of 12 years compared to an average expected life of 37 years, i.e. it is generally relatively new. This category can be further spilt into the various assets classes:

2.6.9.1 **Reclosers, Sectionalisers and Fusesavers**

The use of pole mounted circuit breakers and sectionalisers along feeders helps to minimise the areas affected by faults and to decrease the time required for fault location and supply restoration. A breakdown of these devices installed on the Network is shown in the table below:

Type	Manufacturer	Number	Notes
Reclosers	Noja	53	SCADA capable
Reclosers	Nulec	43	SCADA capable
Reclosers	McGraw Edison/Coopers	16	Older need renewal
Reclosers	Reyrolle	2	Older need renewal
Sectionalisers	McGraw Edison/Coopers	21	Older need renewal
Fusesavers	Siemens	5	Reduce fuse operations

Table 20 - Devices on MLL Network

The older reclosers and sectionalisers have a mixture of mechanical and electric actuators. Historically these devices have often been unreliable, i.e. not operating for faults and occasionally operating when it seemed there were no faults present.

Replacement of these by the newer Noja and Nulec reclosers has a number of advantages:

- Improvements in reliability;
- ability to operate and monitor remotely using SCADA;
- ability to use as part of smart grid, e.g. automatic re-livening schemes; and
- ability to remotely change protection setting and schemes, e.g. reclose blocks.
- Modern reclosers include a sectionalising function and often clever auto-reclose sequence options allowing better time grading between close devices.

Details of MLL plans for these devices over the next five years are shown in the following table:

Type	New Installations	Replace existing devices	Notes
Reclosers	15	16	Some older technology, some new devices to improve fault response.
Sectionalisers	0	21	Older technology, replace with reclosers
Fusesavers	30	0	Reduce fuse operations and improve reliability

Table 21 - Summary of MLL devices for next 5 years

2.6.9.2 Oil Switches, Ring Main Units

MLL has eleven 11kV/400V indoor substations. Some of these substations use Oil Circuit Breakers (OCBs) complete with over-current and earth fault protection. MLL have a programme underway to replace these oil filled OCBs in town substations. Elsewhere oil switches have been used throughout the underground system as they provide flexibility for switching at a lower cost than circuit breakers.

2.6.9.3 Air Break Switches

Air Break Switches are used to provide sectionalising and to allow for changes in configuration within the overhead Network. They are also used to provide visible breaks and enhance safety when undertaking work on the lines.

Where appropriate and where practicable, live line techniques will be used to replace switches when circumstances dictate replacement.

2.6.9.4 Fault Locators

These devices are located along overhead feeders and give indication of any observed fault currents. This assists in the location of faults and speeds up the restoration of supply. Advances in this technology have been rapid and a number of fault location devices with attachments, which allow their use on poles with multiple circuits, have been installed. There are currently 68 fault locators installed throughout the Network. A number of fault indicators have been connected to the radio network and when operated by faults, now radio a message back to base for faster, more accurate response by fault staff. There are plans to install fault indicators connected to the SCADA network for reporting line currents, temperatures and voltage fail alarms.

2.6.10 Low Voltage Network

MLL has 797km of LV reticulation, of which, 425km is overhead and 372km is underground. The overhead has a RAB value of $4.3 million and an average age of 37.4 years compared to a useful life of 58.7 years, while the underground is newer and has a RAB value of $10.1 million with an average age of 17.3 years compared to an estimated useful life of 45 years. The age profile for the 400V Network is shown in the chart below:

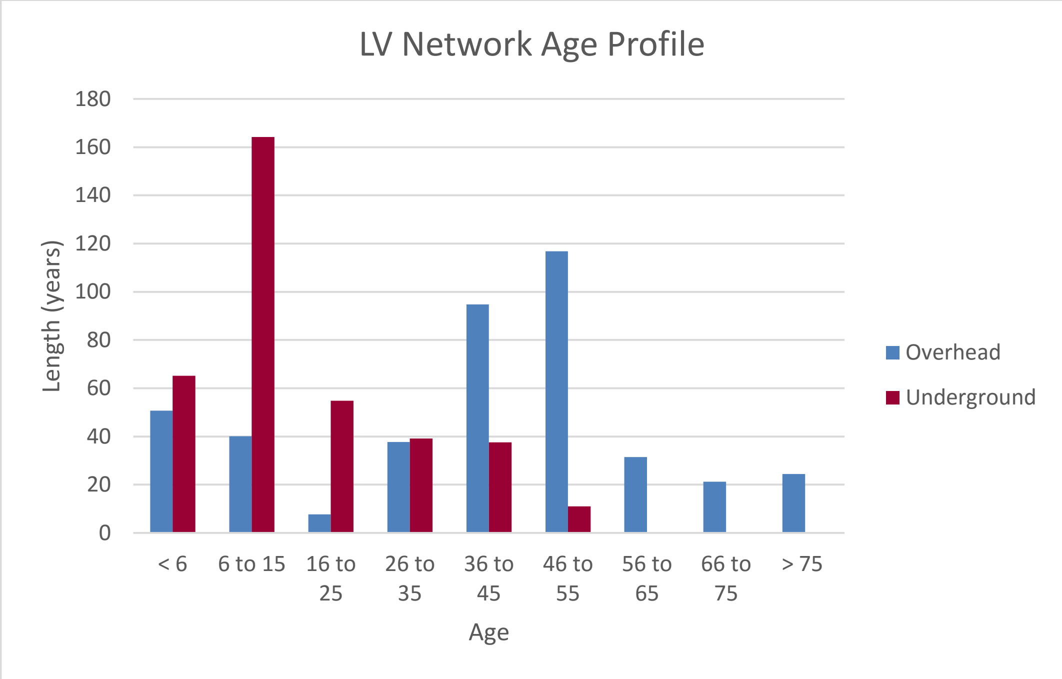


Figure 16 - LV Network Age Profile

One area of concern is the LV cables installed circa 1967 when the practice was to allow T-joints for ICP connections. This results in fault finding and isolation being difficult. Work is underway to install Distribution boxes every three to four houses to break the LV cable into manageable sections and remove Tee-Joints.

2.6.10.1 <u>Distribution Boxes and Service Fuse Boxes</u>

MLL has approximately 3,370 LV distribution boxes and service fuse boxes. These are mainly associated with the LV network and are in good condition. Recent data capture projects have resulted in boxes being labelled and information in the asset information systems (EAM and GIS, and previously WASP) being updated.

2.6.10.2 <u>Fusing</u>

Traditionally the overhead system used re-wireable LV service fuses. These fuses have a very wide tolerance and tend to fail for mechanical as well as electrical reasons. All new fuses are now HRC to provide better protection and accuracy as well as better mechanical life. MLL is retrofitting HRC fuses when it undertakes work on the LV. The underground LV Network has always used HRC fuses.

Photo 14 - Work on Renewal of Lansdowne to Riverlands 33kV line

2.6.10.3 **Ripple Injection**

The existing load control system uses Zellweger decabit telegrams. They are injected into the system at 1050Hz and 217Hz via 33kV coupling cells located at System Control. Unfortunately the frequency of 1050Hz gives rise to a number of problems. Due to the impedance and loading of the system (changed considerably since the plant was originally installed in the 1960s), signal amplification can occur in outlying areas. This can interfere with the operation of electronic equipment and manifest itself as noise in sound equipment, errors in clocks or malfunction of equipment such as microwaves, computers etc. The 217Hz frequency was introduced to overcome these problems. Once all new receivers are on the new frequency, it will be possible to phase out the 1050Hz signal system.

In the past year, changes to the Transpower South Island configuration have resulted in overloading of the 1050Hz injection plant on a number of occasions. Investigations by Enermet have shown that the coupling cells are badly overloaded and accordingly the level of output signal has been decreased. Ongoing changes to the nature of the network (e.g. load growth and increasing use of electronics) is likely to cause further decreases in impedance at 1050Hz and subsequent reductions in the level of signal available. This indicates that the 1050Hz relays may not be able to operate reliably within the short to medium term and should be phased out as soon as practical.

Compact Fluorescent Lamps (CFLs) produce harmonics. This is particularly the case for the lower cost lamps which have minimal in-built filtering. Testing and analysis has indicated that the harmonics produced are likely to interfere with the 1050Hz ripple signal, thereby hastening its demise.

Note the 1050Hz and 217Hz relays are owned by the Energy Retailers and accordingly MLL has no control over when this signal can be phased out.

2.6.11 Automation and Communication Assets

2.6.11.1 SCADA System

MLL operates an ODBC based SCADA system that is approximately 10 years old. It has undergone a recent upgrade with both new hardware and the latest version of software installed. The system has been designed to allow monitoring and remote control of devices in the Network, including circuit breakers, transformer tap changers, line reclosers, voltage regulators and the load management system.

The UHF radio network currently covers the Wairau, Kaituna, Awatere and Pelorus Valleys, as well as French Pass and the East Coast. Projects planned for 2016/17 will extend this coverage into Rai Valley, the Kenepuru Sound, Tory Channel, Port Underwood and the CBD. It is intended that by 2017, 88% of MLL 11kV Network will have SCADA communications through the UHF network. As of 31 March 2016, approximately 80% of the 11kV Network has SCADA radio coverage. The remaining 20% of our network is generally in very remote areas therefore an increase in SCADA coverage now requires more sites with a smaller result each time. Having more repeater sites also helps to provide additional paths around site specific obstacles such as trees or buildings.

The UHF radios in use are capable of both serial and IP communication, future proofing the Network for developments in power system monitoring and control technology, and any other requirements the Company may have. The radios will not need replacement or upgrading within the planning horizon of this Asset Management Plan.

Type	Fibre Optic	Licensed Radio	Public Frequencies	Cellular	ADSL	Not Connected	Not SCADA Capable
Zone Substations	6	5	4	-	1	-	-
Town Substations	-	-	-	-	-	2	4
33kV Reclosers	-	8	3	2	-	-	-
33kV Switching Sites	-	1	-	-	-	-	-
11kV Reclosers	1	20	2	13	2	3	8
SWER Reclosers	-	8	-	2	-	2	11
11kV Regulators	-	-	1	9	-	3	2

Table 22 – SCADA Connected Equipment/Communication Type

All zone substations have SCADA indication and control of their 11kV circuit breakers. 14 zone substations have SCADA indication and control of their 33kV circuit breakers.

Cost/benefit analysis is used to determine the priority sequence for SCADA connection of reclosers, and the upgrade of existing reclosers to new SCADA-capable models.

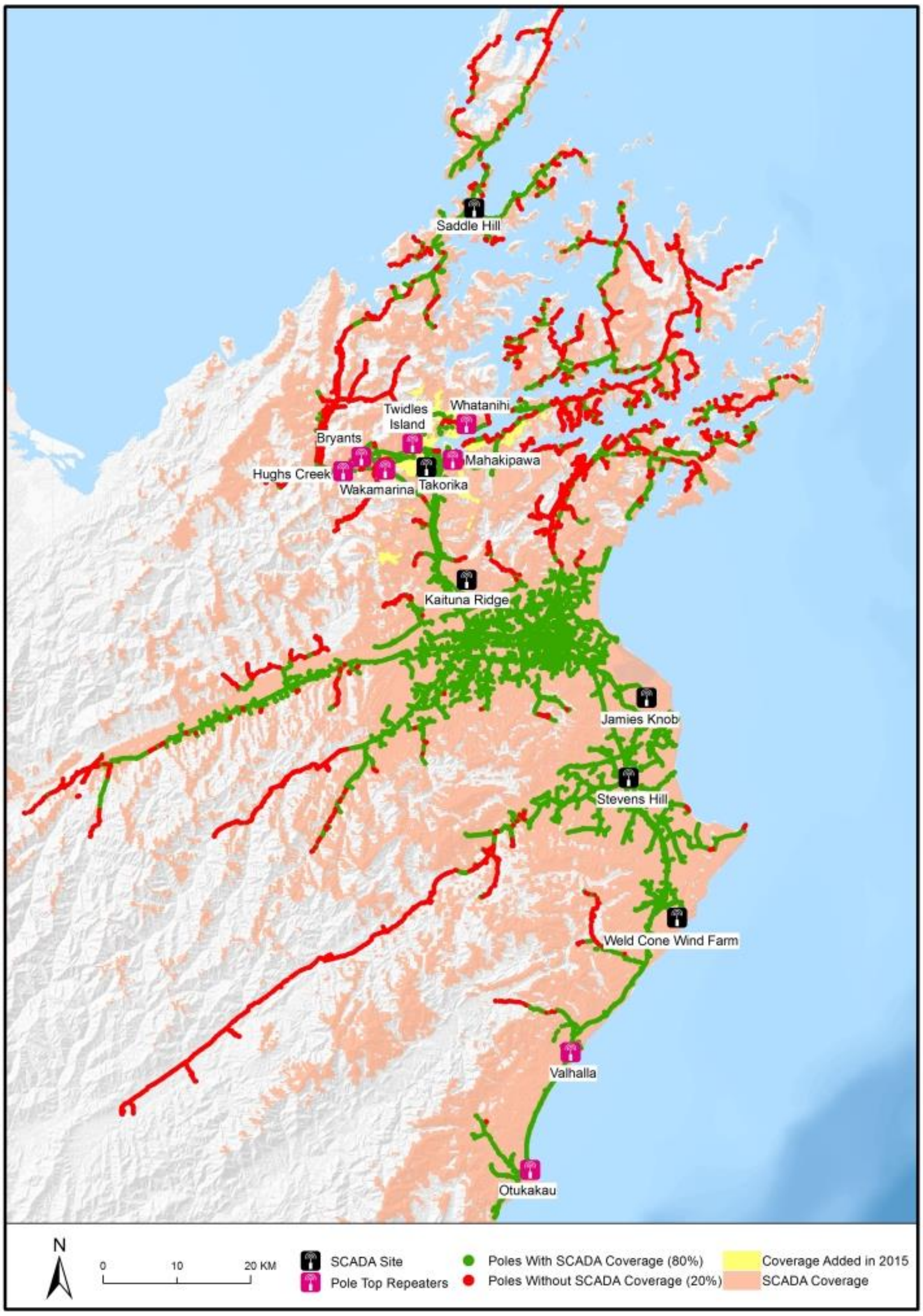


Figure 17 - MLL SCADA Network

2.6.11.2 Voice Communication Equipment

MLL owns and maintains its own UHF linked VHF radio voice communication system, which is used for switching and operational control of the Network. There are seven repeaters located on various hill tops throughout Marlborough. Each of these sites broadcasts in its local area using one of seven VHF E band frequencies. To enable all radio users to hear all conversations and to allow the remote hilltop repeaters to be reached from areas outside the normal coverage area, all repeaters are linked together using a UHF link.

The total system involves:

- seven repeater sites;
- vehicle mounted radios;
- radios fixed in buildings/depots/offices/staff homes; and
- handheld mobile radios & backpack mobile radios.

MLL has recently completed an upgrade of all analogue voice repeaters to ensure we now comply with the narrowband (12.5kHz) frequency regulations.

MLL has also made a commitment to construct a new Digital Mobile Radio (DMR) Tier III voice network in addition to the analogue voice network. Digital radio has a number of advantages over analogue, in particular the ability to easily interpose data, alter the operation of the radio and add encryption. DMR can also be used to connect SCADA equipment to the system with a low bandwidth IP connection. MLL see this as a good option for remote devices where typical SCADA coverage does not reach.

By the end of 2016 MLL plans to have eight DMR repeaters operating in the region, focusing on the central area first. All new vehicle radios are being installed DMR ready and the existing fleet has been upgraded ready for the digital roll out. The staff that will gain the most from DMR will be the first to have access to it. MLL's radio status as at 31 March 2016 is presented as follows:

Radio	Analogue Only	Digital Only	Digital & Analogue
Repeater	7	-	-
Handheld Radio	30	-	43
Vehicle Radio	-	-	120
Fixed Radio	27	-	-

Table 23 - Voice Communication Equipment

2.6.11.3 **Phone-in Devices**

To assist in locating faults and to ensure prompt attention to any unusual events in the Network, around 60 'phone-in' devices have been installed. These devices monitor the line voltage and report any brief interruptions (auto-reclosers), any permanent outages (faults or planned outages), and/or any out-of-limit voltages. They also phone in and advise when supply is restored to normal. The notifications are received by a PC which then advises appropriate staff of the event. This notification can be by email and/or cell phone text message. These devices have proved very useful in the early detection of abnormal conditions on the Network.

2.6.11.4 **Metering**

Metering in customer installations is owned by Energy Retailers. MLL only owns meters in zone substations and Network assets as part of the SCADA system.

2.6.11.5 **Power Factor Correction**

MLL currently has no power factor correction equipment, however MLL is currently installing a Static VAr compensator at Ward substation to mitigate the reactive loading affects resulting from the wind farms in the area.

2.6.11.6 **Mobile Substations/Generators**

MLL has several generators used for operational support. The mobile fleet consists of:

- a 900kVA/11kV trailer mounted generator;
- two truck mounted generators, a 330kVA/11kV and 550kVA/11kV; and.
- one skid mounted 200kVA/415V.

MLL also has three fixed sites:

- a 550kVA generator at Elaine Bay;
- three 550kVA generators at Kenepuru Heads; and
- the 165kVA backup generator at the Taylor Pass depot has been converted to generate into the network.

The larger units are used to reduce outages when work is required on radial lines. The sites installed at Elaine Bay and Kenepuru Heads, i.e. past the commercial forestry located in these areas allow supply during logging and other forestry operations close to the 11kV distribution line.

These units are used to improve service during faults as well as reduce the effect of planned work. Generators allow the area affected by planned work to be reduced to the minimum area needed for the work. As much of MLL's rural network is radial, without generators it is necessary to shutdown everyone past the point of work, not just those in the immediate area of the work. As a secondary function, the generators are also utilised to reduce Marlborough's contribution to regional peaks in power consumption.

The earthquakes of 2013, recent significant storms and critical asset renewal requiring large scale shutdowns have reinforced the need for a Network company to have some mobile generation available for immediate use.

2.6.11.7 Control Room

MLL has a control room for operation of the Network. This is staffed during normal business hours and after hours as required. Switching of the Network is managed through the Control Room.

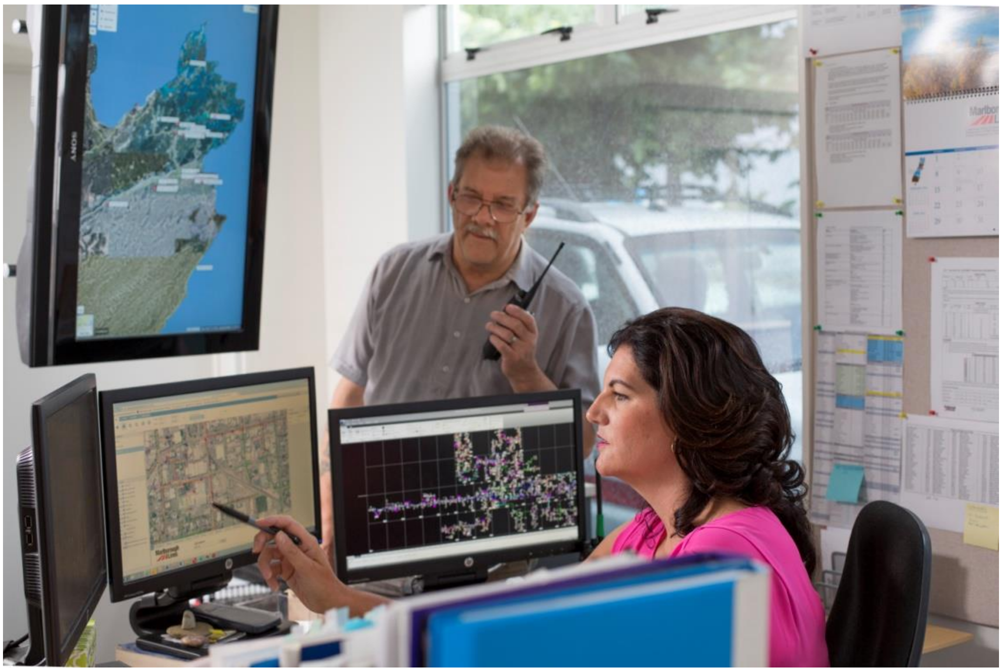


Photo 15 –Staff working in the Control Room at Alfred Street

2.6.12 Justification for Assets

Delivery of electricity to customers requires MLL to own and operate the classes of assets described in this section of the AMP. Electricity is an essential part of modern life and to a large extent is only noticed when it is not available.

MLL is owned by its customers who require a level of supply and service which, in turn, requires the assets to be in place.

A further indicative measure is the degree of optimisation applied by the ODV valuation methodology, and accordingly the ratio of ODRC to DRC reinforced the need for the MLL asset justification. This ratio is typically in excess of 98.8%, meaning that very little optimisation is necessary and that the assets deployed are justified.

Justifications for key classes of assets are outlined in the following table:

Asset Class	Justification
33kV circuit-breakers within GXP	Provide fault interruption and switching functionality at GXP end of 33kV lines.
33kV sub-transmission Network	Power transfer requirements beyond that of 11kV lines or cables.
33kV circuit-breakers within zone substations	Provide fault interruption and switching functionality at zone substation end of 33kV lines.
33/11kV transformers	Interface power transfer capability of 33kV Network with flexibility and safety of 11kV Network.
11kV distribution Network	Power transfer requirements beyond that of 400V lines or cables.
11kV SWER line	Low customer density does not justify more expensive configurations such as 2 or 3 phase. The single conductor configuration also eliminates conductor clashing enabling longer spans.
11kV distribution switches	Provide additional fault interruption and switching functionality on 11kV Network.
11/0.4kV transformers	Interface power transfer capability of 11kV Network with flexibility and safety of 400V Network.
400V reticulation Network	Most cost effective way of delivering supply to low capacity customers.
Load management equipment	Reduces load on Network and helps limit overall load on upper South Island, reducing Transpower charges.

Table 24 - Justification for Asset Classes

All current and projected levels of service can be justified by current ‘best power engineering’ practice.

3. Service Levels

MLL's Mission Statement is "To exceed our customer's expectations in all aspects of our operations and furnish our shareholder with a commercial return".

The supply of electricity has become an essential part of modern life and customers expect the electricity supply to deliver sufficient power of a sufficient quality to enable them to undertake their activities with certainty and convenience, i.e. they expect the electricity supply to:

- be available;
- stay on with a minimum number of interruptions;
- have sufficient capacity available (i.e. ensure a suitable voltage level is maintained);
- be of a quality which allows equipment to function reliably (i.e. surges, sags, spikes and harmonics do not affect equipment); and
- be provided at a reasonable cost.

3.1 Defined Performance Indicators

In order to achieve our consumer expectations and strive for continual improvement, MLL determines performance targets and measures its performance against those targets on an annual basis. Our performance measures can separated into four high level categories, these are:

- Network Reliability;
- Consumer Oriented Service Levels ;
- Asset Efficiency; and
- Financial.

3.1.1 Network Reliability

MLL recognises that the frequency and duration of interruptions to a consumers electricity supply is of major impact their overall satisfaction levels with regard to MLL's ongoing performance. As such, we measure our reliability of supply through three internationally recognised reliability indices, SAIDI, SAIFI and CAIDI on an annual basis, which is compared against a target threshold. This then provides valuable information for the design and planning of MLL's annual capex and opex programs over the coming planning period.

3.1.1.1 SAIDI

SAIDI (System Average Interruption Duration Index) is the average total duration of interruptions of supply that a customer experiences in the period. In essence, it is the average number of minutes that a customer has no supply for the year. SAIDI is calculated as:

$$SAIDI = \frac{\sum No.of\ Interrupted\ Consumers \times Interuption\ Duration}{Total\ No.of\ Connected\ Consumers}$$

In minutes/connected consumer/year

MLL measures SAIDI for planned and unplanned outages throughout the year. This data is then used to initiate systems investigations and where required, drive capital expenditure for the development of infrastructure including the installation of remote controllable pole mounted reclosers, distribution line rebuilds and the planning of new reticulation.

MLL strives to minimize the interruption of customer's electricity supplies when planned outages are required for maintenance on the network or the construction of new distribution assets. Over the last five years, there has been a significant decline in SAIDI attributable to planned outages through the regular use of alternate points of supply and the use of stationary and mobile diesel generators. The increased future annual target of 65 minutes per annum over the 55 minute target for FY16 is reflective of the need for maintenance and asset renewal of 11kV distribution assets in the remote Marlborough Sounds area where a single point of supply typically exists and access for mobile diesel generation plant is restricted.

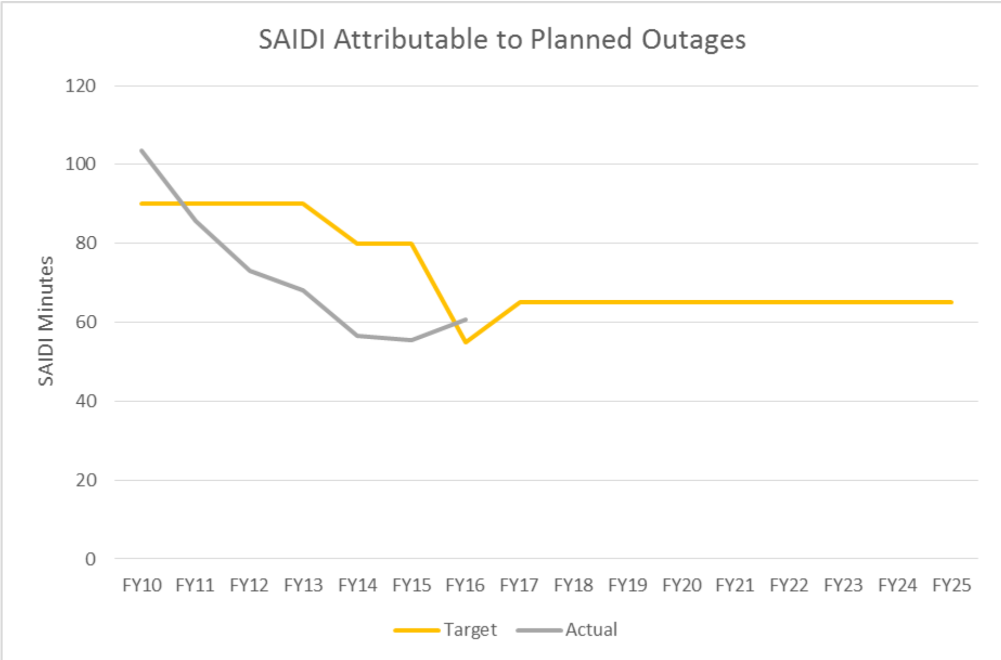


Figure 18 - MLL Class 'B' Planned Outage SAIDI FY10 to FY25

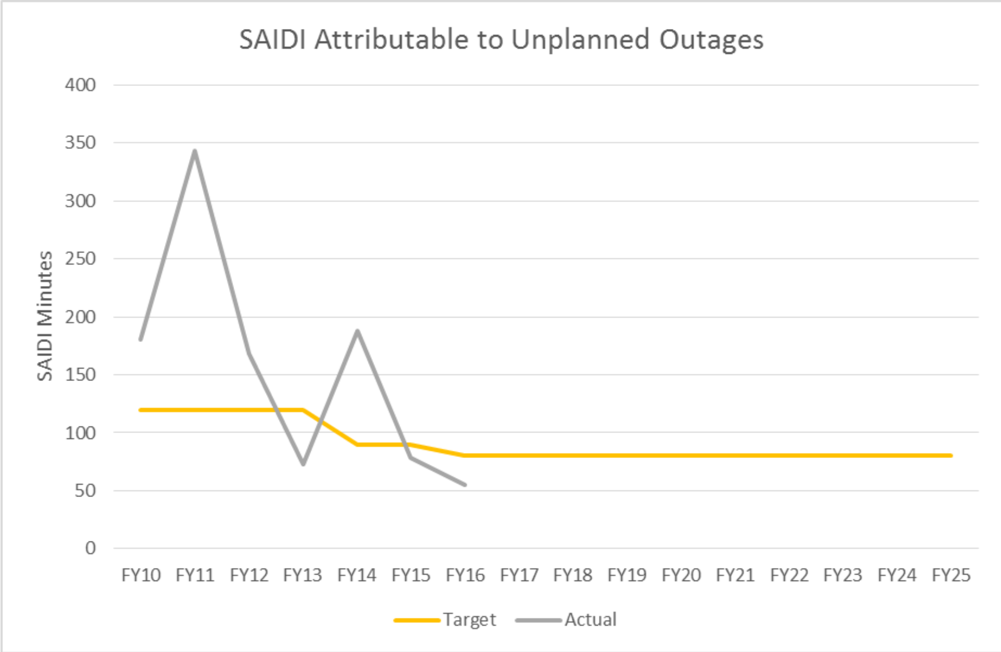


Figure 19 - MLL Class 'C' Unplanned Outage SAIDI FY10 to FY25

The MLL network consists of a dense asset base of 33kV and 11kV reticulation, largely installed underground, in urban zones such as Blenheim and Picton, and a sparse network consisting of long radial feeders that traverse rural remote areas where access is limited, such as the Awatere Valley and Marlborough Sounds. As such, interference to the network through severe weather events, vegetation encroachment and animal interference can impact annual network reliability indices considerably.

MLL is committed to improving network reliability though the installation of IEDs including pole mounted reclosers and a network of radio repeater sites such that in-field devices can be remotely monitored and controlled. The large roll out of IEDs, in conjunction with ongoing maintenance and an asset replacement program will result in increased network reliability, assisting MLL to achieve an unplanned SAIDI target of less than 80 minutes for FY2017 and the following five years. This figure does not allow for significant natural events such as earthquakes.

3.1.1.2 SAIFI

SAIFI (System Average Interruption Frequency Index) is the average number of interruptions of supply that a customer experiences in the period. In essence it is the average number of times that supply goes off for each customer. SAIFI is calculated as:

$$SAIFI = \frac{\sum No.of\ Interrupted\ Consumers}{Total\ No.of\ Connected\ Consumers}$$

In interruptions/connected consumer/year

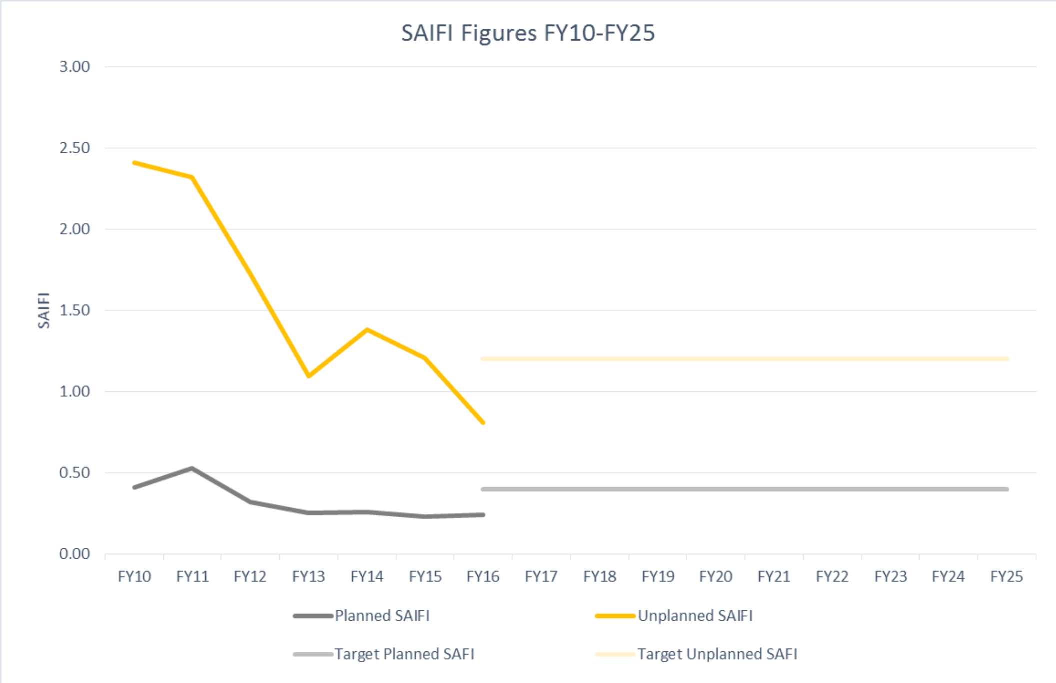


Figure 20 - MLL Planned and Unplanned SAIFI Indices FY10 to FY25

The downward trend of MLL's planned and unplanned SAIFI indices over the past financial years is indicative of MLL's efforts to increase network reliability. The continued installation of IEDs within the distribution network reduce the number of consumers affected during network faults, and the continued installation of isolation points and generator connection minimize affected customers during planned outages.

MLL intends to maintain an annual SAIFI for planned outages of less than 0.4, and unplanned SAIFI of 1.2 across the coming 10 year period.

3.1.1.3 CAIDI

CAIDI (Customer Average Interruption Duration Index) is the average outage duration that any given consumer would experience during a network outage. This figure is effectively the average restoration time for an average network outage. CAIDI is calculated as:

$$CAIDI = \frac{\sum No.of\ Interrupted\ Consumers \times Interuption\ Duration}{\sum No.of\ Interrupted\ Consumers}$$

In minutes per consumer/year

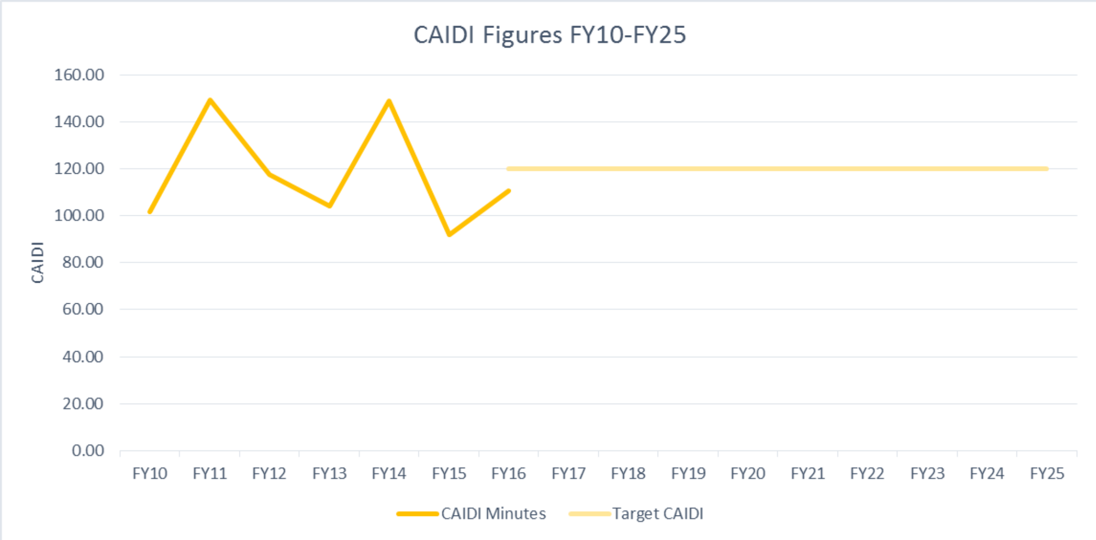


Figure 21 - MLL Combined (Planned and Unplanned) CAIDI Indices FY10 to FY25

3.1.2 Consumer Oriented Service Levels

In addition to total network SAIDI and SAIFI, four further customer-orientated performance indicators assist in monitoring performance from an end-user perspective. These are fault response times, the numbers of customers affected by long duration outages, customers affected by multiple outages and customer satisfaction.

Customer surveys are performed to measure customer satisfaction on an annual basis to justify that network expenditure to increase network reliability is providing benefit to electricity consumers.

3.1.2.1 Response Times

The targets for fault response and power restoration are:

- Blenheim Urban 1.0 hours
- Urban Other 1.5 hours
- Rural 4.0 hours
- Remote Rural 8.0 hours

This will be monitored by recording the percentage of time this is achieved, i.e. the target in each case is 100%. These values represent stretch targets for MLL, particularly the urban response times as identified in the performance evaluation section of this plan.

3.1.2.2 Long Duration or High Number of Outages

Targets for monitoring customers who experience more or longer outages than most customers are:

CELID-8 (Customers experiencing long interruption durations) is the number of customers who receive at least one outage of more than eight hours in the year.

CEMI-8 (Customers experiencing multiple interruptions) is the number of customers experiencing nine or more interruptions in the year.

The targets for these are:

Description	Target for FY16	Target for FY17-26
CEMI-8 (ICPs/year)	< 900	< 900
CELID-8(ICPs/year)	<2500	<2500

Table 25 - Summary of long outage targets

3.1.2.3 Customer Satisfaction

MLL undertakes an annual customer survey of 200 electricity consumers within Marlborough from commercial and residential sectors. The purpose of this is to gauge the general consumer's reaction to MLL's performance during the year, across all facets of the business including network reliability, quality, consumer discounts, community sponsorship and company management.

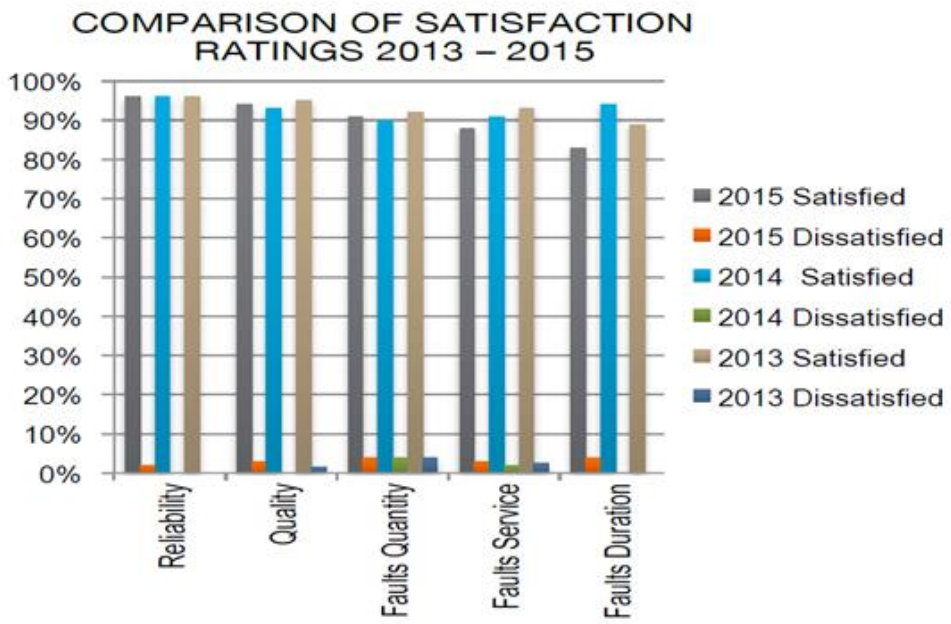


Figure 22 - Customer Satisfaction Levels relating to Network Performance.

Source: MLL Consumer Survey 2015

Considering the results from the 2015 customer survey directed at network performance, customers supplied by the MLL distribution are mostly satisfied with the overall reliability and quality of supply, with in excess of 90% of the survey participants declaring so. This is at a similar level to the levels seen in 2013 and 2014.

Satisfaction relating to MLL response to network faults and the duration of those faults has reduced relative to satisfaction of the years prior, despite the fact that network SAIFI and SAIDI figures are lower than they have been over the past three years. This may be a function of the fact that a relatively small sample of consumers take part in the survey annually, and satisfaction levels are likely to differ considerably between a customer in an urban centre and a customer in a rural remote area where response times are considerably longer. When considering other aspects of the consumer survey including shareholder discounts, community sponsorship, managerial and directorial performance, the majority of consumers are content with MLL's annual performance.

Recognising that the consumers connected the MLL distribution network are its shareholders, it is MLL's goal to continue to maintain consumer satisfaction at its highest level. As such MLL intends to target an overall level of satisfaction of >90% over future years. Although this figure is exposed to the inaccuracies of a relatively small sample size, it is MLL's belief that continued investment into the community, community sponsorship and a strong focus on improving network reliability through capex and the widespread installation of IEDs, should continue to drive consumer satisfaction in the future.

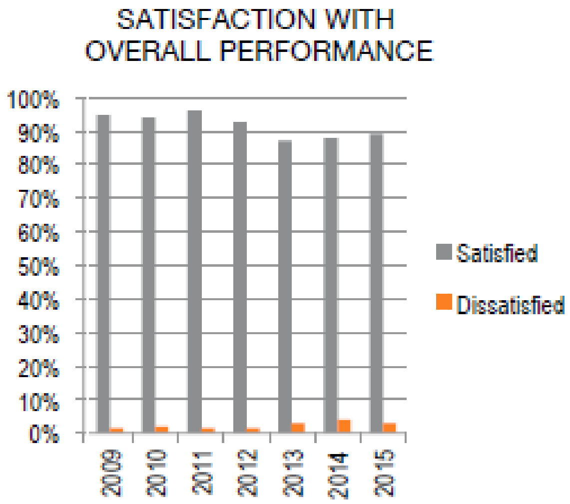


Figure 23 - Customer Satisfaction Levels relating to Overall Performance.

Source: MLL Consumer Survey 2015

3.1.3 Asset Efficiency

3.1.3.1 Asset Performance Indicators

The Asset Performance and Efficiency targets adopted by MLL are:

- **Load factor (ratio of average demand to maximum demand).**
  This is influenced by the manner in which load control, primarily hot water cylinders, is used. Currently, Transpower charges are based on the maximum demand on the Blenheim GXP at the time of maximum total demand of the upper South Island. This means that at other times, there is no financial incentive to cut hot water supply to houses. The result of this is to not limit maximum demand through load shedding, in turn reducing load factor, during high load periods within Marlborough that are not coincident with upper South Island maximum demand. This provides benefit to the customer as service is improved.
- **System losses (ratio of energy lost to total energy entering the system).**
  The volume of electricity sold, from which the volume lost is derived, is based on data provided by the electricity retailers trading on MLL's system. Because MLL has no control over the reliability of this data, the calculated volume of energy lost in any year may not be accurate. In general terms, the losses derived for the MLL Network are consistent with those expected for a Network of this kind i.e. a predominantly radial network supplied from a single point of supply and with fewer customers per transformer than in a purely urban area. Work is being undertaken to improve the reliability and accuracy of this data. As shown in the performance evaluation section, MLL plot just below the regression line expectation on this measure with relatively consistent performance at

approximately 5%. In this plan the target of 7% is retained but may be reviewed in future plans.

- **Capacity utilisation (ratio of maximum demand to installed transformer capacity).**
  MLL's Capacity of Utilisation (CoU) has declined and is expected to decline further in the coming years. This is expected to be the case due to the increased take up of energy efficient appliances, distributed generation and continued growth of electricity connections that do not typically contribute to maximum network demand within the Marlborough Region. For example, baches in the Sounds, wineries and irrigation all require transformer capacity, but these loads make little or no contribution to maximum demand set during winter months, thereby reducing capacity utilisation. As shown in the performance evaluation section of this plan, the capacity of utilisation plots close to the expectation line in comparison to other distribution companies, particularly after adjustment for non-standard loads. The current target of 21% is therefore retained in this plan.

Year	Load Factor	Loss Ratio	CoU	Max Demand (MW)
FY13	61.1%	4.81%	22.7%	72.9
FY14	61.4%	5.14%	21.6%	71.0
FY15	62.4%	5.19%	21.8%	72.6
Target *(FY17-26)*	65%	7%	21.0%	--

Table 26 - Summary of CoU target values

3.1.4 Financial

3.1.4.1 Distribution Pricing

The MLL distribution network services densely populated urban areas within Marlborough such as Blenheim, Renwick and Picton, as well as sparsely populated remote areas with minimal customer connections such as the Marlborough Sounds. Assets that service rural, remote connections were typically installed in the 60s and 70s with government subsidies. The result of this is that assets are approaching end of life and demand maintenance, however given the minimal revenue collected from the operation of these assets, these portions of the distribution network are often economically inefficient.

Current governing legislation demands that rural, remote lines charge may not increase at a rate unequal to that of urban areas, and lines companies may not cease supply to economically inefficient areas. The result of this is that lines charges are inflated such that urban consumers effectively subsidise the continued operation on the distribution network in remote areas. Although this is an issue experienced by most lines companies within New Zealand, this is of major impact to our lines charges due to the ratio of rural/remote to urban network.

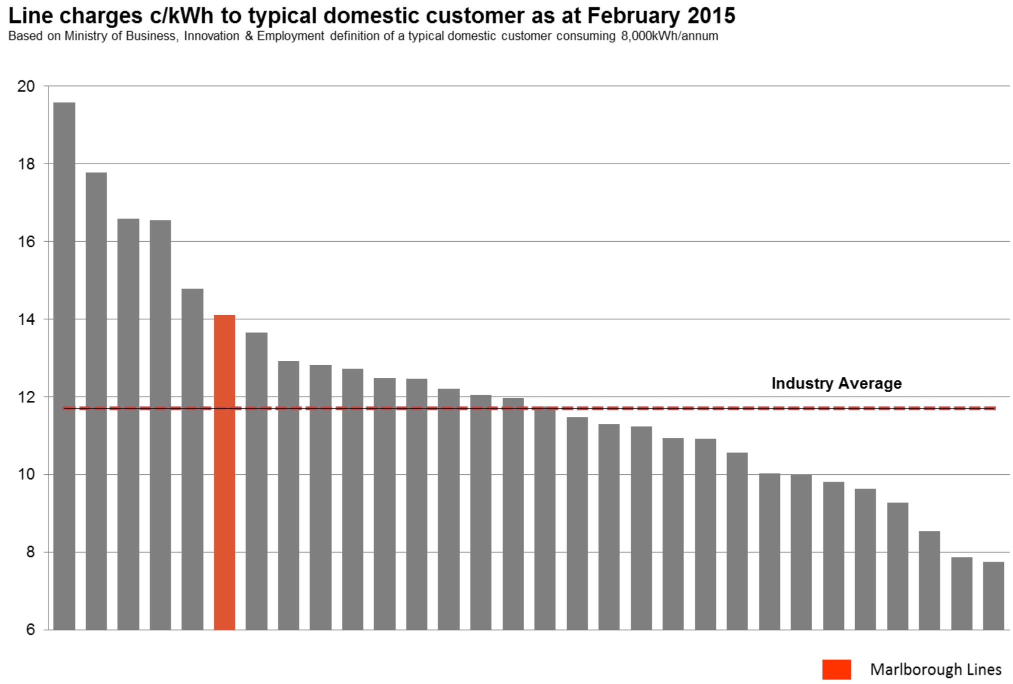


Figure 24 - National EDB lines charges for a typical consumer of 8,000kWh/annum

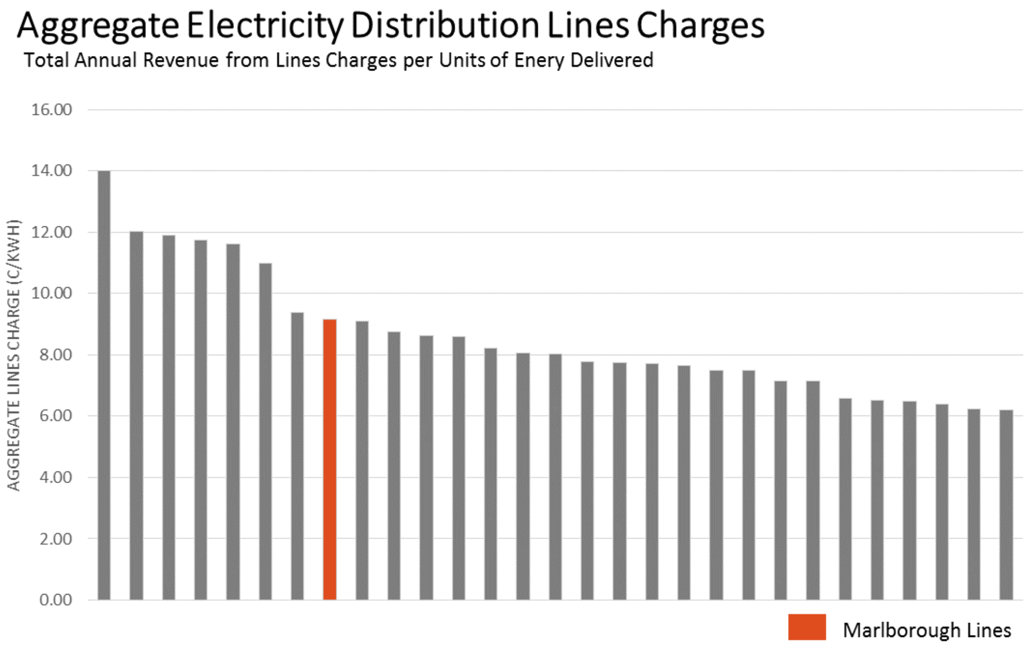


Figure 25 - National EDB total revenue from lines charges per unit of electricity supplied to ICPs

Considering the portion of the MLL network that is considered economically inefficient, a lines charge in excess of other typical lines companies that service both urban and remote customer bases is expected. It is important to note that given that MLL is a consumer owned electricity distribution business, the electricity consumers in Marlborough receive an annual rebate as well as a regular dividend. The pricing data provided here is calculated prior to any consumer rebates being applied, as is the case for other EDB revenue information.

It is MLL's intention to keep lines charges at a level sufficient to continue the required asset maintenance and renewal programs such that network reliability is preserved, whilst considering the cost of electricity to the consumer is a significant component of consumer satisfaction.

3.1.5 Summary

MLL key service level targets are:

Description	Target for FYE 2016	Target for FYE 2017 to FYE 2026
SAIDI (minutes/ICP/year)	< 185	< 145
SAIFI interruptions/ICP/year)	<1.6	<1.6
CEMI-8 (ICPs/year)	< 900	< 900
CELID-8(ICPs/year)	<2500	<2500
Customer Satisfaction	>90%	>90%

Table 27 - Key Service Level Targets

These targets are lower than those used across previous years and reflect both our customer's expectations and the desire to lock-in the performance improvements achieved to date, as identified in the performance evaluation section of this plan. Further reductions in these reliability targets will be dependent on identifying improvement projects that meet economic tests against the community value of lost load or MLL have clear signals from the community identifying higher service level requirements.

3.1.5.1 Justification for Targets

The Network performance and efficiency targets are based largely on historical and comparative performance and are likely to only change slowly.

Load factor, system losses and the capacity of utilisation are of less interest to customers than reliability. To a large extent, the performance measures are a direct consequence of customer requirements, design standards and previous decisions on system configuration and network expenditure.

MLL considers these factors in its decisions on network expenditure and how this provides benefits for stakeholders.

3.1.5.2 Changes to Performance Indicators

Changes and improvements to the set of performance indicators will mainly be from improvements to data collection and changes to the IT systems which hold the performance data and calculate the performance indicators. Additional performance measures may be introduced which would assist MLL in measuring and managing change initiatives that may arise.

4. Network development planning

MLL undertakes expenditure in a timely manner to ensure that appropriate levels of Network service and reliability are provided in accordance with customer expectation and in line with organisational strategies.

Photo 16 - Springlands Substation, Blenheim

4.1 Planning criteria and assumptions

MLL has adopted a range of planning processes and technical and engineering standards to ensure that the assets required to deliver service levels meet the following requirements, which is to:

- Prevent unnecessary investment.
- Minimise risk of long-term stranding.
- Comply with regulatory requirements.
- Maximise operational flexibility.
- Maximise the fit with organisational capabilities such as engineering and operational expertise and vendor support.
- Comply with environmental and public safety requirements.
- Be appropriate to environment, e.g. service in the Sounds fits within the context of low customer density.

For example, the key criteria considered for 11kV/415V transformers is the maximum demand and delivery of required voltage. Transformers of 200kVA, or greater, are monitored and any transformer where the indicated load exceeds the transformer rating is considered for upgrade. Other options such as rebalancing, and or moving load to other transformers are also considered. Other factors taken into account are the load duration, i.e. how often the transformer is close to, or above its ratings, and the time of day and year of the highest loadings.

Increases in load are then reflected upstream through the various classes of MLL assets back to the Transpower GXP. The load on all 11kV feeders, zone substations and the 33kV feeders is continuously monitored and the data is used for system modelling and project planning purposes. The planning criteria ("trigger points") for each asset class are described below.

4.2 Trigger Points for Planning Purposes

MLL has a broad range of criteria that represent trigger points for triggering remedial action across its varying classes of fixed assets. These are summarised in Table 28.

Asset Class	Capacity Criteria	Reliability Criteria	Security of Supply Criteria	Voltage Criteria
400V reticulation network	Conductor or fuse rating	Blenheim CBD – 50% of load restored within 0.5 hours of fault, 100% within 1 hour Elsewhere – restored within repair time	(n) security of supply for standard residential or commercial connection	Voltage falls below 0.94pu at customer's point of supply based on 1st percentile and 99 percentile.
11kV/400V distribution substation	Transformer rating (kVA)	Blenheim CBD – 50% of load restored within 0.5 hours of fault, 100% within 1 hour Elsewhere – restored within repair time	n security for most subs, with rapid transformer replacement, or use of mobile generator	
11kV distribution network	Current exceeds 90% of thermal rating for more than 15 hours per year	Meshed Feeder - 50% of load restored within 0.5 hours of fault, 100% within 1 hour Radial Feeder – repair time	(n-1) security for most of the urban 11kV network (n) security for rural 11kV Network	Voltage falls below 0.95pu for more than 100 hours per annum
11kV distribution hardware	As appropriate to equipment. Not to exceed maximum rating			
33/11kV zone substation	Firm capacity available 98% of the time, i.e. can exceed firm capacity for 2% of time.	50% of load restored within 2 hours of fault	(n-1) > 5MVA (n) < 5MVA	Able to cope with 0.85pu to 1.05pu on 33kV Network and provide 11.2kV on bus.
33kV sub-transmission network	Current exceeds 66% of thermal rating for more than 1500 hours per year		(n-1) > 5MVA (n) < 5MVA	>0.85pu at all zone substations connections with 1.0pu at GXP.

Table 28 - Summary of Planning Trigger Points

4.3 Strategies for standardising assets and designs

The Network Standards document the design and construction of Network assets. The Network Standards are used for all assets where ownership and/or maintenance responsibility will ultimately rest with MLL.

The Standards contain information and drawings to be used in designing Network assets and detail the procedures for design approval and construction. These standards and policies help to ensure that public safety is considered at the design phase and assist MLL in meeting its obligations under the Electricity (Safety) Regulations 2010. They also assist in providing assets of appropriate quality to ensure that the reliability of supply is maintained or improved, consistent with the requirements of the Commerce Commission.

MLL, along with a number of EDBs within New Zealand has access to, and the use of, the PowerCo Contract Works and Network Operations guide. Where it is suitable, material from these standards is used to develop MLL's own standards. This also increases the standardisation across the industry.

MLL is also part of a multi-company buying group for cable, line hardware and store items. This has led to cross-company standardisation and reduction in the number of store items, unit costs and inventory held.

Recently MLL has become a member of the Collective Network Operations Group which includes all south island lines companies. The purpose of the group is to work towards common access processes, documentation, competency training and assessment, consistent operational requirements and emergency plans.

The following table summarises some of the key strategies for standardising assets and designs at MLL.

Asset category	Standardised features	Standardising methods
Subtransmission Lines Subtransmission Cables Distribution and LV Lines Distribution and LV Cables	Conductor – standard suite of conductors/cables to be selected from – generally 'off the shelf' and bespoke conductor/cables rarely, if at all, utilised.	MLL Design Standard. Any deviation from standard suite of conductors/cables included in standard needs specific Network review and approval.
Distribution substations and transformers	Size of transformers (if pole mounted) generally dictate size of pole to support them. 'Off the shelf' models selected – nothing bespoke to ensure consistency across network.	MLL Design Standard.
Distribution Switchgear	Selection generally from preferred suppliers of off the shelf goods – bespoke options avoided unless exceptional circumstances warrant.	MLL Design Standard. MLL preferred suppliers list.
Poles	All new concrete poles to be pre-stressed Any loading changes to iron rail, hard wood, larch or lattice tower poles will result in the pole being replaced.	MLL Design Standard. Relevant utility pole standards.

	Select from approved pole manufacturers and from limited pole types only.	
Other Network assets	Generally procure from preferred (i.e. pre-approved) suppliers.	MLL preferred supplies list. MLL Design Standard.

Table 29 - Summary of standard strategies for assets/design.

4.4 Strategies for energy efficiency

MLL monitors losses and consider losses when looking at system configuration and Network development. In practice, the physical considerations (e.g. conductor size and pole spacing) and the requirement to deliver regulatory voltage tend to take priority at the asset design and construction phases of the lifecycle and this determines the losses.

Energy efficiency initiatives should also include electricity users. MLL has interposed Use of System Agreements (UoSA) with Energy Retailers. This means that MLL does not have direct access to customers and therefore has less ability to influence end-user behaviour than energy retailers.

MLL considers energy efficiency when purchasing and replacing transformers. Lines pricing is designed to incentivise customers to install transformers of an appropriate rating, however in many cases, customers and their consultants prefer to over specify transformer capacity.

Demand management also plays a part in energy efficiency. Where trends indicate future increases in demand for example, then this is factored into the installation of new or replacement transformers.

4.5 Determining capacity

The theoretical starting point for quantifying new capacity is to build "just enough, just in time", and then add a bit more over time. However MLL recognises the following practical issues:

- The standard size of many components, which makes investment lumpy.
- In terms of some items such as power transformers and underground cables, the marginal cost of providing additional capacity for the future is typically relatively small.
- The current regulatory constraints on investment, and the ability of MLL to obtain a commercial return on investment.
- The one-off costs of construction, consenting, traffic management, access to land and reinstatement of sealed surfaces, which may make it preferable to install additional capacity rather than have to return in the short to medium future. This is especially the case when it is considered that Network assets typically have long lives, far in excess of the regulatory period and the 10 year horizon of this Plan.
- The addition of extra capacity can, in some cases, require complete reconstruction, for example where larger conductor requires stronger poles or closer pole spacings, leading to considerable increases in total cost of ownership if an incremental approach is used at the outset.
- The need to avoid over-load risk. Over-load can lead to asset failure, reductions in service and reductions in asset lives.

MLL's guiding principle is therefore to minimise the level of investment ahead of demand while minimising the costs associated with doing the work. In recognition that typically the costs of investment in advance of requirements is far better than investment after failure has occurred or customer supply lost.

Generically in determining capacity requirements, MLL monitors and reviews loading data across the network (and specific areas depending on what is being considered) and assesses trends in data, liaises with other relevant stakeholders in the district (for example the Marlborough District Council around its development plans), whilst reviewing existing infrastructure and any current capacity restraints. Considering these (and other) factors in combination is generally the approach for determining capacity.

More specifically at the asset level, more detailed criteria are considered in determining asset capacity. Some of these are summarised in the below table.

Asset category	Criteria to determine capacity*
Subtransmission Lines	Surrounding land use (man-made or natural environment), climatic conditions, topography, loading, growth forecasting, health and safety considerations.
Distribution and LV Lines	
Subtransmission Cables	
Distribution and LV Cables	
Distribution substations and transformers	Expected demand within next five years, taking into account diversity.
Distribution Switchgear	Expected fault and load levels – generally only available in step sizes
Poles	Conductor loading (i.e. size of conductor and span lengths drive pole size), environment, loading from other sources (i.e. dead and/or dynamic loads).
Zone Substations - Transformers/ Switchgear/ Buildings	Current loading, future growth and demand forecasting.

* Note – not an exhaustive list.

Table 30 - Summary of criteria used to determine capacity of network assets

4.6 Prioritising Network development projects

In prioritising development work, MLL looks at the estimated cost and the benefits that the expenditure will bring. Consideration is given to why the work is required and accordingly, the benefits which undertaking it would provide. Work with the greatest benefits to costs are undertaken first. In assessing the benefits the various reasons are given a weighting as per the table below:

Description	Comments	Rating (10=highest)
Safety	MLL will not compromise the safety of staff, contractors and the public. Safety is fundamental to the way MLL undertakes any activity and accordingly it has top priority on all expenditure.	10
Capacity	Overloading can lead to overheating, reduction in asset life, fire, explosion and cascade tripping (security of supply is implicit within this).	9
Reliability	Customers want a reliable supply.	8
Voltage	Customers want equipment to operate well and this requires stable and appropriate voltage levels to be maintained.	7
Environmental	Minimising the impact on the environment is a key part of MLL's values, especially in highly sensitive areas.	5
Energy Efficiency	Primarily energy efficiency within the network is largely dependent on the network's configuration. The provision of supply at regulatory voltage and at a cost acceptable to customers means that energy efficiency cannot be the primary determinant of expenditure. Inherent in a low customer density network are an increased number of transformers, all of which incur losses regardless of consumption. Energy efficiency is taken into account during design and purchase of network components such as transformers. MLL also seeks to maximise the efficiency of its network through operations, notwithstanding the limitations imposed by the physical constraints of the network.	5
Renewal (end of useful life)	Lower priority assuming that it is safe, has adequate capacity, good voltage and low maintenance costs.	6

Table 31 – Development Work Prioritisation Criteria

In assessing the potential benefits of the work, consideration is also given to the number of affected customers, the total kW/kWh and the impact (if any) on revenue/ costs, e.g. reductions in maintenance/ increased line charges.

Potential projects come from a wide range of work including technical studies of the Network, e.g. load flow analysis, customer requests, consideration of load growth, information on proposed load changes, examination of existing constraints and limitations within the Network and asset monitoring e.g. large concentrations of maintenance work may result in line renewal and fault studies.

Projects are developed and budget pricing is undertaken on an annual basis. The benefits are assessed in terms of the criteria above and projects ranked accordingly. This is undertaken by the Engineering Manager in conjunction with engineering staff. From this information a draft plan and budget is developed. This is then discussed with, and approved, by the Managing Director before being submitted to the Board for approval or alteration. Once approved, it is included within MLL's annual budget. The programme of projects is then managed on an ongoing basis (both underway and planned projects) to track expenditure and to ensure that any planned projects are still relevant. The programme is then updated accordingly. Monthly reviews are undertaken by engineering and finance staff to manage the status of Capex projects and capitalise or expense costs when and where appropriate.

4.7 Demand forecasts

The following base assumptions and factors are used as part of the demand forecasting:

- The resident population will continue to grow at about the average rate of the last five years.
- Existing major loads will remain for the entire planning horizon.
- The Riverlands/Cloudy Bay industrial areas will continue to grow at approximately the current rate for the entire planning horizon.
- Vineyard conversions of land will gradually increase.
- The mussel and salmon industries will continue to grow at the average rate of the last five years for the planning horizon.
- The current level of forest harvest will continue.
- The ferry terminal will remain in Picton.
- Load control measures will continue to be used at the same level.
- Sufficient generation will be available to supply all load, and Transpower will provide and maintain the assets required to deliver supply to MLL.
- If further embedded wind generation proceeds it will not be sufficiently diverse or reliable to allow reductions in investment in the Network or reduce the demand forecast. It is possible this may be a driver for more investment as generation companies require additional capacity for the connection of generation.
- Solar (PV) installations will continue to increase over the next five years with a range of smaller units (0-5kW) installed in residential situations and larger units (25-100kW) at commercial and industrial locations, however the total will still be very small compared to wind and hydro (15GWh per annum). Unless these installations have appropriate storage, backup separate from MLL's network will typically be required.
- Demand-side management is assumed to have no real effect on load growth and Network capacity requirements. Until prices increase substantially, it is considered that load management will have little effect on load growth, which is mainly driven by economic factors.
- MLL is experiencing a small increase in demand in this relatively buoyant economic period. This increase needs to be monitored closely.

Consideration is also given to the general and regional economic outlook. Resource consent applications to Marlborough District Council are evaluated and recorded. These indicate the level of development in various areas for either subdivisions or specific land use such as irrigation. To date there has been good correlation between consents and short to medium term load growth.

Photo 17 – Vineyards; viticulture is a key driver of the local economy

Nevertheless, forecasting of future demands has a very high degree of uncertainty. Actual demands are the result of the complex interaction of a series of factors, some of which are impossible to predict. Primarily, demand and consumption is related to weather. A cold winter with increased levels of heating or a dry early summer with significant utilisation of irrigation are major factors which significantly alter demand and usage on a year to year basis.

The graph below shows the load duration curve for the total load on the MLL Network for the calendar years 2010 and 2015.

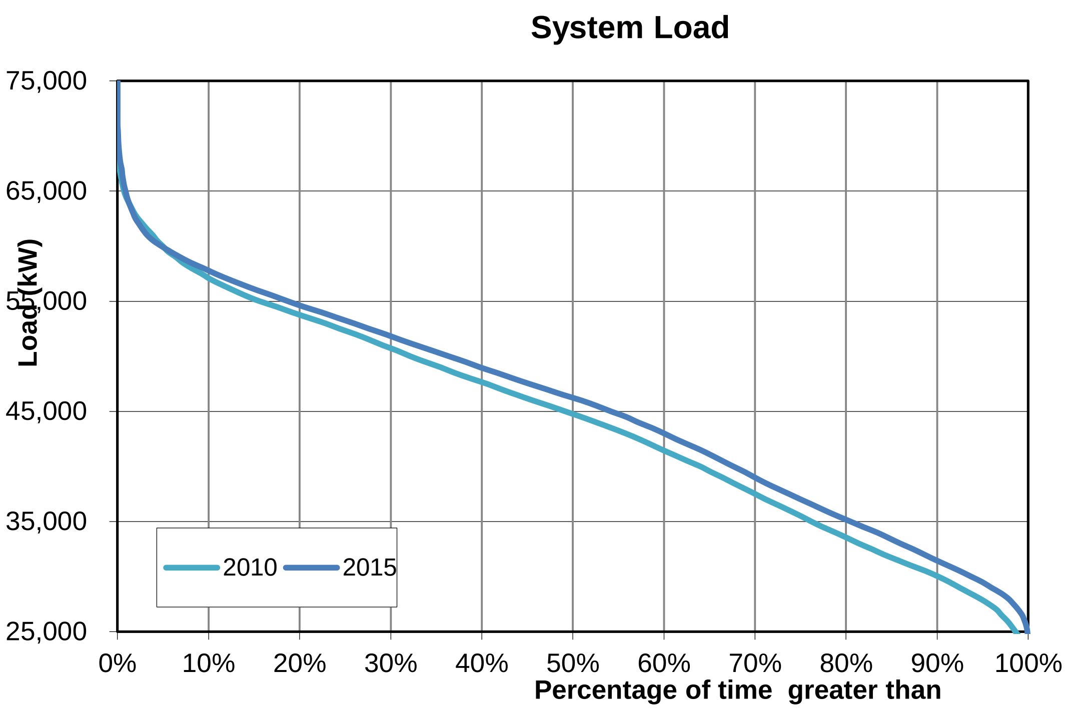


Figure 26 – Blenheim Load Duration

This graph shows the difference in load from 2010 to 2015. Since 2010 the maximum demand and energy has essentially been static, despite additional customers and transformers being connected. This is due in part to greater update of more energy efficient loads, such as compact fluorescent lamps and higher efficiency motors and partly a relatively flat economy.

The Table below shows historical growth rates and the rate used for planning purposes.

Description	Growth over last year	Annual Growth Over Last 5 Years	Annual Growth Over Last 10 Years	Rate Used for Planning Purposes
Maximum Demand	-0.4%	1.1%	3.2%	2%
Energy	3.6%	0.5%	2%	2%
Transformer capacity	2.3%	1.9%	3.2%	2%

Table 32 - Overall Growth Rates

Note that the rate used for planning is an average of the different growth rates over different periods. In the event that the actual rate is greater than this, the effect will be to bring forward work, i.e. it will generally only affect the timing of projects. MLL's historical demand and projected demand are shown in Figure 28, while Table 33 disaggregates the projected growth over the 16 zone substations.

The overall risk associated with Network investment is asymmetrical. It is better to have invested prior to the need for increased capacity than after customer supply or service has been restricted, i.e. to wait until the demand exists, is too late.

Further factors which may influence actual growth are:

- Energy demand associated with discretionary products such as salmon and wine may decline and impact on Marlborough as a result of the current economic conditions.
- The number of new connections may decline and/or existing installations disconnect as a result of the current economic conditions or utilisation of off grid systems.

Ongoing events in areas such as the Middle East, and varying fuel supplies are causing fluctuations in the price of petrol and diesel, which has a direct impact on the economy. Large increases in oil price may lead to further uptake of electric vehicles (particularly when combined with technological gains/lower prices for electric vehicles). However it is considered unlikely that electric vehicle use will increase markedly within the next five years. Should this occur, MLL does not expect to incur any difficulty in meeting demand. Likewise a decrease in oil price may defer investment/demand for electricity. At the time of writing we are currently seeing an overall gradual reduction in the price of oil, however, there is no guarantee of this trend continuing.

Figure 27 shows the average change in the total NZ load and the Marlborough load. This shows that the MLL load is affected by many of the same factors as the national load, in particular the national/international economy and the weather. But because of Marlborough's dependence on primary products, its economy can be disproportionate relative to areas such as Auckland, Wellington and Christchurch.

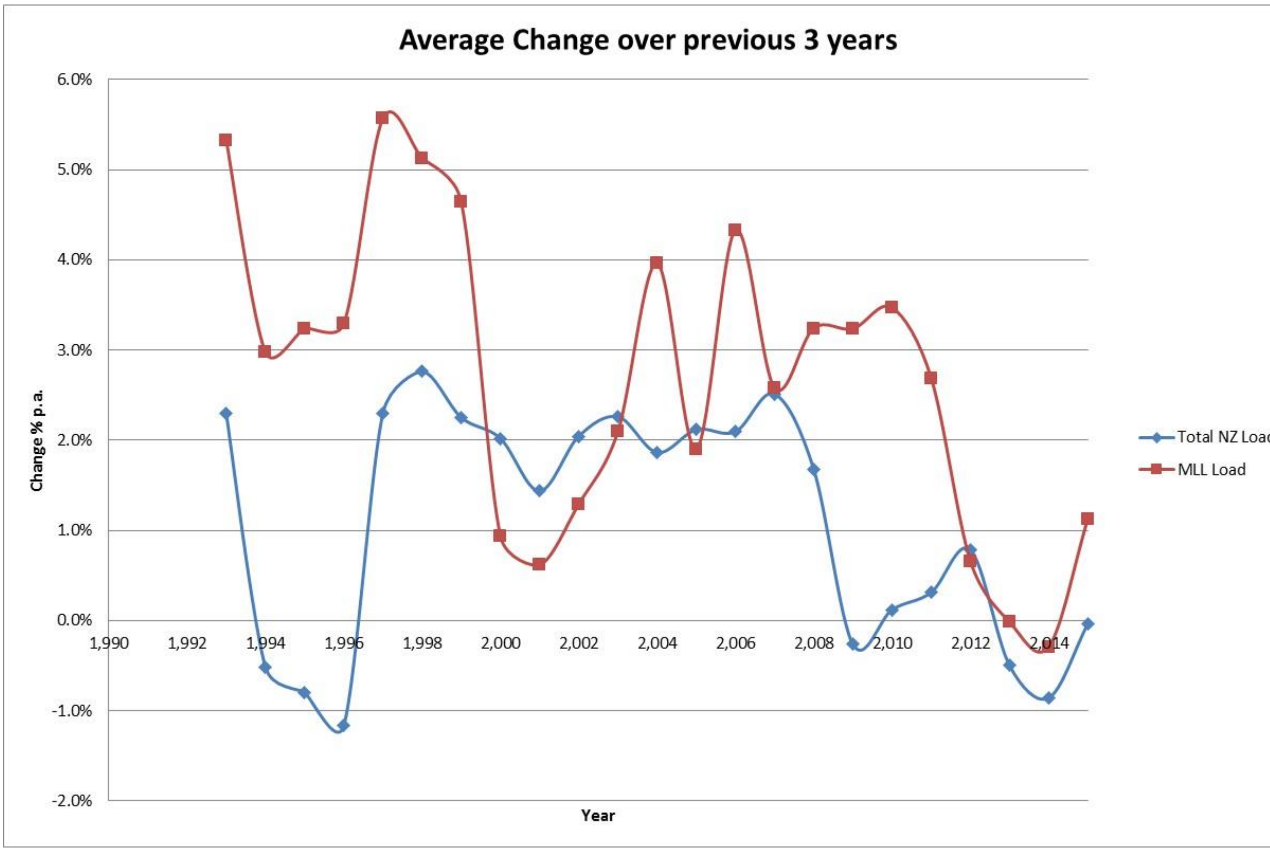


Figure 27 - Average growth rates for NZ and MLL load

Figure 28 shows the expected load and energy growth for the period of this AMP. The forecasted load growth is also based on consideration of the factors outlined at the beginning of this section.

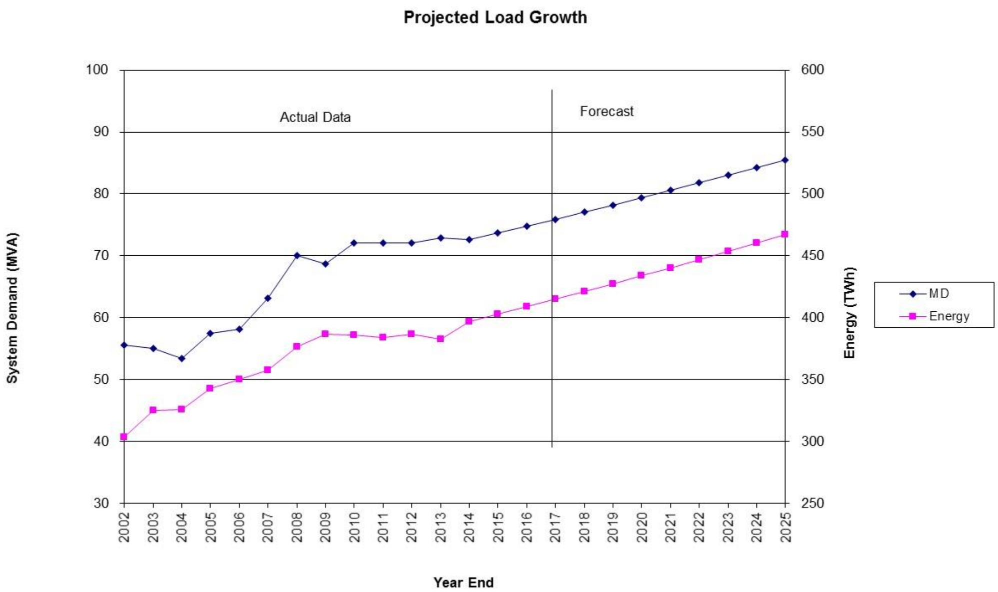


Figure 28 - Projected Load Growth

4.8 Zone Substation Demand Forecasts

The table on the following page shows the capacity of the 33kV/11kV zone substations and the effect of load growth on them. This information is also shown in Schedule S12c which is included in Appendix B.

Substation	T1 Capacity (MVA)	T2 Capacity (MVA)	Maximum Demand 2015	Estimated Demand (MVA) 2020	Notes
Cloudy Bay	16.5	16.5	3.7	9.0	Some load to be moved from Riverlands.
Leefield	5		1.2	1.7	
Linkwater	5	5	3.5	3.5	Maximum loading is for holiday periods only
Havelock	5	5	2.2	2.2	
Nelson St	16.5	16.5	14.8	15.0	
Picton	16.5	16.5	7.3	7.3	
Rai Valley	3	5	2.2	2.2	(n-1) of 3MVA. New TX installed 2014
Redwoodtown	16.5	16.5	9.8	9.9	
Renwick	10	10	9.9	13.3	May be reduced by moving open points, eventually new zone substation capacity required.
Riverlands	10	10	10	10.0	Approaching n-1 capacity - some load may be able to be moved to Cloudy Bay
Seddon	10	10	7.5	10.0	
Spring Creek	5	5	4.3	5.7	Some Load to be moved to Springlands
Springlands	16.5	16.5	9.9	9.9	
Ward	2	2	1.6	2.2	Transformers being renewed to 5MVA
Waters	16.5	16.5	6.8	6.8	
Woodbourne	10	10	8.6	11.6	Can be reduced by moving open points

Table 33 - Zone Substation Loadings and Growth

For planning purposes the growth figures used take into account the factors identified in section 4.7, while looking at changes in load, installed transformer capacity and projected demand, together with the type of loads and the local economy, as a basis for assessing future load growth.

A key implication of increasing demand is that the percentage of time for which a stated level of security is available will decline (assessed from load duration curves). When this percentage declines to a level that is considered unacceptable, security reinforcement will occur. What is regarded as unacceptable will depend on the precise circumstances, in particular customer requirements and the proximity of other assets from which additional security can be obtained.

From the table above Renwick and Riverlands will be loaded beyond their (n-1) level by 2020. Using the current growth rate of load at Renwick and allowing the (n-1) rating to be exceeded 5% of the time, then additional capacity is required to be commissioned in five to 10 years time.

Load can be transferred from Riverlands Sub to Cloudy Bay Sub by the installation of a new feeder tie cable into the Liverpool street area. This will defer the need to install more capacity at Riverlands during this AMP period.

Ward substation has 1790kVA of wind driven induction generators connected, i.e. more than the connected load and close to the n-1 capacity of the substation. MLL does not consider it necessary to maintain (n-1) security for distributed generation unless negotiated by the owner of the wind generator.

MLL currently has land available for future construction of Zone Substations at Hammerichs Road, Waihopai River/SH63, Marlborough Ridge Development and Budge Street. Development of zone substations at these sites is not anticipated within the timing of this AMP, although, if demand increases at a greater rate that than anticipated above, development may be required. .

4.9 Significant development options available

A range of options are available when trigger level are exceeded (or approaching exceedance), the options include:

- 'Do nothing', and simply accept that one or more criteria has exceeded a trigger point. In reality, 'do nothing' options would only be adopted if the benefits were deemed relatively minimal with respect to the costs for all reasonable options were unacceptably low and if it was considered that the 'do nothing' option did not represent an unacceptable increase in either safety, commercial or regulatory risk to MLL. The low customer density and low kWh consumption in many parts of the Sounds typify such occurrences of low benefit/cost ratios. The cost benefit ratio involved in correcting minor mismatches (e.g. low voltage for a few hours per annum) are simply too low.
- Construct new distribution assets that will move (generally increase) an asset's trigger point to a level at which it is not exceeded. An example would be to construct an additional new 300kVA distribution transformer/substation to reduce loading on an existing 300kVA transformer.
- Modify distribution assets so that the asset's trigger point will move to a level that is not exceeded. This is essentially a subset of the above approach, but will generally involve less expenditure. An example would be installing additional cooling on a 33/11kV transformer to allow a greater maximum demand at a lower cost than installing a bigger transformer that might be under-utilised a lot of the time.

- Retrofitting high-technology devices that can exploit the features of existing assets through careful monitoring which moves the asset's trigger point. Examples might be SCADA monitoring of transformer core temperatures to enable higher cyclic loadings instead of installing a higher rated transformer, or using remotely switched air-breaks to improve reliability.
- Operational activities that alter the asset's activity level relative to the trigger point, in particular switching on the 11kV to shift load from heavily-loaded to lightly-loaded zone substations to avoid new investment. The downside to this approach is that it may increase line losses, reduce security of supply, or compromise protection settings.
- Construct distributed generation so that the performance of neighbouring distribution assets is restored to a level below their trigger points. Distributed generation would be particularly useful where energy is currently going to waste e.g. steam from a process. It should be noted that distributed generation such as wind or solar is unlikely to reduce capacity required on the Network, as it lacks sufficient diversity/storage in this context i.e. on a still, cold winter's night, the effect of wind/solar on the Network asset's capacity is likely to be insignificant. The most likely application for distributed generation in MLL's context is diesel generators in the Sounds.
- Influence customers to alter their consumption patterns so that assets perform at levels below the trigger points. Examples might be to shift demand to different time zones, negotiate interruptible tariffs with certain customers so that overloaded assets can be relieved, or assist a customer to adopt a substitute energy source to avoid new capacity. It is noted that the required separation of lines and energy functions makes demand management very difficult, if not impossible.

Table 34 summarises these approaches.

Approach	**Effect on Asset's Activity Level**	**Effect on Asset's Trigger Point**
Do-nothing	Activity level exceeds trigger point	Nil
Construct new assets	Nil	Move, typically upwards
Modify assets	Nil	Move, typically upwards
Retrofit hi-tech devices	Nil	Move, typically upwards
Operational activities	Reduce activity level to below trigger point	Nil
Install distributed generation	Reduce activity level to below trigger point	Nil
Influence customer behaviour	Reduce activity level to below trigger point	Nil

Table 34 - Summary of Approaches to Trigger Points

In identifying solutions for meeting future demands for capacity, reliability and security of supply, MLL considers options that cover the above range of categories. The costs and benefits of available options are considered (taking into account the benefits of environmental compliance and workplace/public safety) and the option which returns the greatest benefits with respect to costs will generally be adopted.

4.10 Issues affecting development options

MLL has identified the following issues in regard to its current use of 33kV, 11kV and 11kV SWER configurations:

- The continuing growth of vineyards and dairying into remote areas is likely to exceed the distance over which 11kV lines can adequately supply. To address this and the overall problems associated with load growth in rural areas and the difficulties of constructing new lines, all distribution renewals or extensions outside of urban areas will be at 22kV.
- Load growth in some areas supplied by SWER may merit conversion to single or three phase 11kV or conversion to 22kV. In some cases conversion is also driven by the requirements of regulations.
- The need to rebuild 11kV lines at the end of life or to increase capacity requires consideration of alternative line routes or other options.
- The existing 33kV system is adequate for the life of this plan, however continued load growth beyond this will eventually require an increase in this voltage, or construction of new lines. This is particularly true for longer 33kV lines such as to Rai Valley and Ward. Fortunately these areas are relatively lightly loaded at present. Where appropriate all future 33kV reconstruction overhead or new lines will be built to 66kV. Cabling in central areas will remain at 33kV.
- Further increases in embedded generation are likely to bring some assets to maximum loading, and may require increases in capacity or changes to system configuration.
- Future system development and enhancement is dictated by a number of factors, many of which are outside MLL's control. These include, but are not limited to: changing land use, expansion of the wine and marine farming industries, processing of the significant forestry resource in Marlborough, and general economic growth. It is difficult to predict with any degree of accuracy where and when future system development and capacity enhancements will be required. Accordingly, this plan is revised at least annually and whenever significant change occurs.
- The ten-year capital investment forecasts are based on: in the shorter term, known system expansion requirements, and in the longer term, historic growth in demands.
- Projects will be considered, and options, including non-assets solutions such as distributed generation, will be assessed prior to final budget approval.
- Non-asset solutions, beyond those currently used such as water heating control, are generally easy to implement in the context of a distribution network with a large number of end-users and affected parties. These solutions are generally more effective at deferring capital expenditure rather than negating the need for expenditure.
- The need for further zone substation capacity is driven directly by the load. Should no further increases occur, then this expenditure will be able to be deferred. There are few easy alternatives to providing more capacity, however where practical, these are taken (e.g. moving load from one substation to another, increasing cooling/capacity of existing transformers). Distributed generation is not sufficiently reliable, diverse or cost effective to be substituted for zone substation transformer capacity. For example, Ward substation has more wind generation connected than load, however its maximum demand is relatively unchanged from before the connection of the wind generation. Further connection of wind

generation may require increases in transformer capacity to cope with the generation.

- Most of the capital work relates to renewal of the existing Network, albeit with lines of higher capacity. In practice, there are few viable alternatives to replacing the line as the need for renewal is primarily a function of aging, rather than capacity. Consideration has been/is given to relocating the line, to deferring the cost where practical, and to changing the voltage. The further development of embedded/distributed generation, is not a viable alternative to renewing the lines as it is not sufficiently diverse (i.e. mainly wind with very small percentage of solar) to provide a reliable alternative to grid supply.
- Line renewal is considerably more expensive than green field construction. Most existing lines were constructed before 1993 and do not have easements. Renewal is only possible with the agreement of the landowner and creation of easements or where it has no adverse effect (greater than existing) on the land.
- The predictions are based on the assumption that the regulatory regime will be such that MLL will be able to earn an appropriate commercial return on all capital expended. If the future regime is such that achieving a commercial return is not possible, then this plan will require revision.

The above points highlight that network solutions are required in almost all cases. Generally speaking, the do-nothing and non-network solution options are not optimal.

4.11 Embedded generation policies

Aside from the need to meet increased customer demand in the utilisation of electricity, it also may be necessary for MLL to extend or increase the capacity of its Network to provide for new sources of generation, particularly hydro and wind.

MLL has already extended its Network to enable the connection of wind generation and discussions with further potential generators occur from time to time.

MLL is committed to facilitating the connection of new generation to its Network subject to generators meeting appropriate technical and commercial criteria. MLL's policies are on the website under "Get Connected". Guidance for embedded/distributed generation is set out in separate categories – generation of 10kVA or less, and generation of greater than 10kVA.

Embedded or Distributed generation with solar and or wind as the primary energy source is not considered to be sufficiently diverse or reliable enough to reduce or defer capital expenditure. Solar has limited production during the winter months, where MLL's peak loads and highest energy flows occur, while the production from wind is highly variable.

Dark (no sun), windless days occur despite Marlborough being one the sunniest regions of NZ and accordingly it is necessary to have sufficient capacity within the Network to cope with days where solar and wind generation is limited.

4.12 Non-network solutions

MLL has historically implemented a range of non-network solutions including ripple control of water heating, night-store heaters, peak demand tariffs and reactive power tariffs. These legacy solutions have become less applicable as the line and energy segments of the electricity supply chain have been vertically disaggregated. Price signals are sometimes masked by retailers or distorted by government policies on supply and pricing.

MLL recognises the very limited applicability of non-network solutions to growth in constrained areas of the Network. This can be a double-edged sword in that, any reduction of demand (to avoid network Capex and reduce Transpower charges) also reduces MLL's revenue.

In the 2014 year, MLL introduced a demand component charge for customer with more than 140kVa of capacity which is focused on the periods which generally result in chargeable peaks on the Transpower system.

The Transpower charges to MLL are based on MLL loads during the 100 highest Upper South Island loads. In an ideal world, this signal would be passed on to customers "as is", in practice it is difficult to follow changes due to factors beyond MLL 's control and consequently a more averaged form is being used to encourage customers to move their load from the periods most likely to result in peak charges.

This type of non-network solution is a longer term solution and if effective generally results in deferral of expenditure rather than removing the need for capital expenditure.

5. Capital Expenditure

This section contains details of proposed capital expenditure and the projects and expenditure being considered. Note all values given in this section are shown in today's dollars, i.e. they do not allow for inflation. Figures showing the values in nominal dollars are shown in the disclosure information included in Appendix C.

Photo 18 - Cloudy Bay Substation

5.1 Network Capital Expenditure Budget FY2017 to FY2026

The capital budget, based on the information in this Plan and the projects identified for FY 2017 to 2026 is shown in Table 35 – Network Capital Expenditure Budget. More detailed information on the 2017 financial year is shown in Section 5.2 and in the disclosure information included in Appendix C. The values are shown in today's dollars, with a total forecast spend on Network Assets over the ten year period of $96.5 million.

Note that while all projects have been grouped under the main driver in accordance with the disclosure requirements, in practice most projects have a number of drivers and considerations. For example when looking at renewals, priority is given to lines that have poor reliability or where additional capacity offers advantages, such as increased transfer capacity between zone substations.

Financial Year Ending	2017 ($000)	2018 ($000)	2019 ($000)	2020 ($000)	2021 ($000)	2022 ($000)	2023 ($000)	2024 ($000)	2025 ($000)	2026 ($000)
Consumer Connection	475	400	400	400	400	400	400	400	400	400
Quality of Supply	1280	2225	2000	1300	1600	1050	1050	1050	1050	1050
System Growth	0	0	0	0	0	0	0	0	0	0
Other Reliability/ Safety /Environment	1425	670	745	745	745	1000	500	500	500	500
Asset Replacement/Renewal	6520	4250	5800	6125	6025	6600	7100	7100	7100	7100
Asset Relocation	400	2200	950	1400	600	600	200	200	200	200
Legislative / Regulatory	300	50	50	50	50	50	50	50	50	50
Non System	1800	1450	1600	1450	1450	1450	1450	1450	1450	1450
Total	12200	11245	11545	11470	10870	11150	10750	10750	10750	10750

Table 35 – Network Capital Expenditure Budget

5.2 Network Capital Expenditure Programme 2017

The network capital expenditure budget for FY 2017 is summarised in the below table. In determining the projects listed, the option of 'do nothing' has been considered and has generally been assessed as non-preferable.

Type	Proposed Projects	Budget ($000)
Consumer Connection	General Distribution Transformer and Subdivision Contributions	475
Quality of Supply	Distribution Substations, Distribution Switchgear	1280
System Growth	Nothing planned for FY 2017	0
Other Reliability/ Safety /Environment	Network	1425
Asset Replacement/Renewal	11kV OH lines, 33kV Network, Power Transformer upgrade (Leefield)	6520
Asset Relocation	Nothing planned for FY 2017	400
Legislative / Regulatory	Low conductor span rectification works	300
Total		***10400****

* Excludes Non-System capex

Table 36 - Capital Expenditure Budget 2017

5.3 Consumer Connection

The expenditure for customer connection is mainly that associated with the supply of new transformers and increasing transformer capacity in urban settings.

The possible development of central Blenheim may require alterations to existing 11kV/400V substations. This has been discussed with developers, however no firm plans have been agreed on.

The budget for expenditure related to Consumer Connection is set at $475,000 for FY2017.

5.4 System Growth

MLL has invested in its 33kV system and 33/11kV zone substations over the past 10 years. This investment has placed the Network in a strong position to accept further load and development. Because of this, there is no expenditure directly relating to system growth anticipated for FY2017. Note prior to that point renewal expenditure or quality of supply expenditure may also provide further scope for system growth and/or remove any constraints in the Network.

Should substantial load beyond that allowed for in this plan unexpectedly arise, MLL will move to meet the demand and accordingly MLL has made provision for new 33/11kV zone substations at locations including Fairhall, Hammerichs Road, Budge Street and Wairau Valley. MLL anticipates that any of these substations (should the need arise) could be constructed within a period of 18 to 24 months.

5.5 Asset Replacement and Renewal

Asset replacement and renewal is the area of greatest capital expenditure. One alternative to renewal is to defer the expenditure, i.e. adopt a 'do-nothing' approach. This type of approach can lead to loss of safety and reliability while generating very high future demands for expenditure and resources, and at the same time reducing the ability of the business to provide these resources.

The approach favoured by MLL is to target renewal expenditure to the older parts of the Network where maximum benefits can be achieved. Examples of this include:

- Increases in capacity in areas where loads are limited.
- Areas with small or unusual conductor.
- Lines which can be used to provide interconnection between zone substations of 'n' security in particular between Seddon and Ward, Havelock and Linkwater.
- Lines with pole types which are difficult to maintain e.g. iron rails
- Lines with high numbers of poles at the end of life and/or red tags and/or conductor prone to failure, i.e. lines with higher maintenance costs.
- Lines which affect the greatest numbers of customers, i.e. 33kV and the beginnings of feeders.

MLL is intending to invest approximately$6.5 million in FY2017 for renewing the Network. This makes up a significant portion of the FY2017 capital expenditure for the Network. For the ten year period covered by this AMP, over $60 million has been allocated to Asset Replacement and Renewal works.

5.5.1 Sub transmission

5.5.1.1 Redwood Pass Line

The 33kV line to Seddon was constructed in 1927. The section of line from Cloudy Bay Substation to past the Vernon Lagoons is close to the sea and prone to faults due to swans impacting the line. To reduce the number of faults, this section will be reconstructed in triangle construction at 110kV which increases the spacing between conductors. This will reduce both the number of swan strikes, as well as the number of faults from strikes, thereby improving the quality of supply. This job will also remove the last of Mink conductor from the Redwood Pass line, thereby increasing its overall current rating (i.e. capacity).

A section of this work is nearing completion at the time of writing, The next section should be completed in FY2017 and a total budget of $400,000 has been allowed for this.

5.5.1.2 Long Valley Switching Structure

MLL has 33kV switching structures at Long Valley, Tuamarina, Jacksons Ford, Renwick, Riverlands and Seddon where the equipment nearing or at the end of its useful life. These structures were designed and built when it was relatively easy to arrange extended outages for maintenance. They are constructed in ways which don't allow live line work and/or maintenance on one 33kV circuit with the second circuit alive. It is planned to replace the existing 33kV air break switches with 33kV RMUs. This will allow maintenance as well as remote indication and operation. MLL is proposing to replace the Long Valley Switching Structure in FY2017 for which $0.5 million has been allocated.

5.5.1.3 Renwick to Leefield Substation Steel Tower Replacement

The transmission line from Waihopai to Renwick was constructed approximately 90 years ago on lattice steel towers. Due to the age and condition of these towers, MLL initiated a replacement programme which has been staged over various sections.

The next section of replacement along this Replacing the next 4km section of the 33kV line from Renwick to Leefield substation; $0.6m has been allocated for this to be undertaken in FY 2017.

5.5.1.4 33kV Cross-arm replacements

Due to their poor age and condition, and the criticaility of these sub-transmission lines, renewing the crossarms on sections of the 33kV Lines between Springlands to Spring Creek and Pelorus to Rai Valley is proposed to be carried out in FY 2017. For this work, over $1m has been allocated.

5.5.1.5 Redwood Street to Riverlands 33kV replacement

The 33kV along this road provides the second 33kV supply to Riverlands, Cloudy Bay and the East Coast. The line was constructed in the 1960s using reinforced concrete poles and using concrete poles to 'brace' the poles across the deep culvert. Given the importance of the line, its age and its vulnerability to damage from earthquake (including lateral spread), it is intended to renew this line using more resilient construction. A budget of $800,000 has been allowed for this project, a relatively significant portion of this will be dedicated to the foundations of the poles adjacent to the open drainage channel.

5.5.2 Distribution and LV Lines

This is the largest single area of expenditure which is consistent with Distribution and LV Lines making up the largest part of MLL's Network. The age of the Network means that MLL is targeting renewal of 35km of 11kV line per annum. Priority is given to the oldest sections of line, those with weak or unusual conductor (e.g. No 8 galvanised wire), lines with poor reliability, lines with iron rail poles where access for vehicles is limited, or those where other benefits can be obtained (e.g. transfer capacity to zone substations).

This work generally consists of a number of smaller projects. Examples of some of these projects are:

5.5.2.1 Mahakipawa iron rails

The 11kV line between Havelock and Linkwater was built circa 1940 and was originally constructed on iron rails poles. Since then, many of the poles have been replaced with tanalised pine. The line traverses hilly terrain and has poor access. It is proposed to renew the section of this line from Linkwater to Moenui Ridge, i.e. approximately 7.5 kilometres. The remaining section of this work is intended to be undertaken in FY2017 with a budget of $400,000.

5.5.2.2 Wairau Valley

This line was voltage-constrained and originally built in the early 1950s. It originally had a mixture of reinforced concrete poles with some iron rails. The need to maintain supply at regulation voltage, along with the age and ability to provide additional capacity for dairy farming and vineyard development, made renewal of this line a priority. This line has now been renewed from Renwick and past the Wairau Valley Township . A section of iron rails near Birch Hill is still in place which MLL intends to replace in FY2017. $250,000 has been allocated to carry out one of two remaining lengths in FY2017.

5.5.2.3 SH1 – Ward to Seddon

This section of line is exposed to the weather. It was originally constructed in 1928 on reinforced concrete poles and provides the transfer capacity to Ward substation from Seddon. The first stage of this was completed in 2013/2014 with further work planned in the next three years. The next stage of this is anticipated to be constructed in FY2017 with $350,000 allowed for this.

A SWER line running from SH1 to Marfell's Beach is also proposed to be replaced in FY2017 with a budget of approximately $200,000.

5.5.2.4 Havelock to Rai valley

This line was originally built in the 1970s on a mixture of iron rails, reinforced concretes and tantalised pine poles with light conductor (e.g. galvanised steel). It provides an important backup supply to Rai Valley and Havelock, but is constrained because of it low current capacity. Much of the rest of the route line has now been renewed with a small section of line in the Canvastown area remaining. A budget of $0.9 million has been provided for the remaining sections to be constructed in FY2017.

5.5.3 Distribution and LV Cables

In general, the Distribution and LV cables are much younger and have more remaining life than the overhead lines. Assuming 45 years of life for XLPE cables, then less than one kilometre of cable will need replacement within the next 10 years. Some concern has been expressed that some generations of XLPE cable may have a maximum useful life of 35 years. If this proves to be true, then MLL will need to renew 13 kilometres of 11kV line within the next 10 years. LV cable will generally be renewed on failure or when the 11kV cables are renewed.

Part of the work being undertaken to improve quality and reliability of supply will involve removing tee-joints from 11kV cabling and installing RMUs as well as additional cabling to ensure, as much as is practical, that all significant 11kV cables have n-1 security.

5.5.4 Distribution Substations and Transformers

In addition to the annual budget for renewing old transformers, this AMP includes provision to renew three of the 11kV/415 substations which supply central Blenheim, i.e. Wynen St, Kinross St, and Arthur St substations (note that Seymour St is scheduled to be completed by FY2016 end). These substations have older, less safe technologies such as open bus 415V switchboards and oil filled circuit breakers. They are important in maintaining supply to Blenheim's central business district.

It is intended to upgrade the 11kV switchgear to modern equivalents, the switchboards to metal-clad boards with circuit breakers, and where possible, to install dual 11kV/415V transformers. The total budget for upgrading these substations is $1.2 million and the expenditure is spread over the first five years of this plan. Of these, Kinross Street is intended to be the first to be replaced and this is expected to be completed in FY2017 at a budget of $450,000.

5.5.5 Distribution Switchgear

There is a small allowance for renewal of Distribution switchgear under renewal, however much of this expenditure is included under Quality of Supply, as the main driver for replacement is better reliability (older switchgear is much less reliable) and the ability to remotely monitor and control the switchgear (SCADA).

The total budget for renewal of Distribution and LV switchgear for the next 5 years is approximately $2.8 million.

5.6 Asset Relocations

There are three main sub-categories within this area of expenditure: roading authority relocations, forestry relocations and conversions from overhead to underground The total budget allocated to this is $7.2 million for the period of this AMP. For FY2017, the following asset relocation projects have been allowed for:

a) An allowance of $100,000 is budgeted within FY2017 in the event that overhead to underground conversion opportunities arise (these can be driven by external stakeholders, e.g. other utility replacement allowing for installation of cable ducting while a trench is open). Further details are presented as follows.
b) Port Marlborough distribution transformer relocation (currently located in a basement and will be moved outdoors for safety and accessibility reasons). $200,000 has been allocated for this proposed work.
c) Undergrounding of the overhead structures at a Dillons Road corner (within road reserve). $100,000 has been allocated for this proposed work.

5.7 Quality of Supply

MLL places great emphasis on reliability of supply and systematically investigates all interruptions to identify the source of interruption. Trees and vegetation are one of the main causes of faults, in particular plantation forests. An increase in harvesting activities as forests mature has led to loss of supply for two main reasons: trees, ropes etc contacting lines during harvesting and, trees falling over as harvest results in increased exposure to wind loadings. The latter occurrences can typically result in prolonged outages.

The current tree legislation only provides for minimal, and sometimes impractical, distances between lines and trees. In many situations the trees are close to and considerably higher than the lines.

With ever increasing customer expectations of improving service against a backdrop of lines and cables with an increasing average age means that expenditure needs to be directed towards, at least, maintaining reliability and preferably improving service.

Expenditure around safety will primarily be associated with operational expenditure (to remove immediate hazards) or line renewal (where line age means that its integrity is compromised and it needs renewal).

Environmental expenditure tends to be associated with projects with other main drivers, e.g. line renewals. Where Marlborough District Council is prepared to contribute towards converting overhead to underground, this work will proceed, however there is currently no agreement to undertake any further work of this type. The last project of this type is the undergrounding from Murphys Road to the new Outer Limits Development, on the main road into Blenheim from Nelson.

An amount of close to $1.3m is forecast for Quality of Supply projects for FY2017. Where applicable, information on sub-categories and forecast expenditure for these is outlined in the following sections.

5.7.1 SCADA

Supervisory Control and Data Acquisition (SCADA) provides the ability to remotely control and monitor equipment. There are three essential parts of a SCADA system:

- central computers which provide the Human Machine Interface (HMI) giving alarms, graphs, data, control etc
- communication system which talks from the central computer to devices
- remote terminal units (RTUs) which interface the communications from the remote equipment to the central computers.

Of the above, the communication system is the highest value and provides the greatest challenges in maintaining a reliable, functional and secure SCADA. Traditionally MLL has used cellphone technology to provide SCADA to remote sites, however in the event of a widespread emergency, the cell network has proven to be vulnerable to overloading. This occurs at precisely the time when a SCADA system has maximum value.

To overcome this, MLL has been developing a high bandwidth reliable licensed radio system. Currently repeaters are operational at Kaituna, Jamies Knob, Takorika, Saddle Hill, Stevens Hill, Weld Cone, Vahalla Ridge and Otukakau. Further extension of the SCADA network requires repeaters to be installed at Bulford Ridge, Manaroa, Rahotia, Hawkesbury, Northbank, Ronga Saddle, Bulwer and Kenepuru Heads. MLL is working to obtain all of the required approvals to allow development of these repeaters.

The total budget for the extensions of the SCADA system to cover the existing and new reclosers is approximately $1million for the next five years with close to $200,000 allocated for FY2017.

5.7.2 Network Automation

Network automation allows for the supply of electricity to be made more reliable, while reducing the costs of operating and the time to restore faults. Better control and information improves safety and, with accurate information on Network performance, allows improvements in asset management. Note the investment in SCADA is important in gaining maximum value from investment in Network Automation. The total budget allocated to network Automation over the next fiveyears is $4.85 million.

5.7.2.1 Reclosers

Reclosers are an essential part of an overhead distribution system. They automatically restore power following a transient fault (such as lightning or possum contact). Since approximately 90% of faults are transient, reclosers help maintain a reliable supply.

Renewing older reclosers with more reliable modern equivalents offers a number of advantages such as better reliability, and ability to remotely monitor and control (e.g. applying reclose blocks), better information of faults and the ability to have co-ordinated operation (referred to as "smart networks" or Network Automation). Remote control also offers the ability to alter settings remotely. This is useful when work is being undertaken in the area, e.g. vegetation control and/or if conditions such as fire risk require changes. It also allows settings to be changed when the Network configuration is altered.

Consideration is also being given to new technologies, such as pulse reclosers which check for faults with short duration pulses before relivening lines.

In addition, the ability to remotely operate the reclosers allows them to be installed in better locations as the need to access them for operation was often a determining factor in their location.

In total, $2.0 million is allocated to new or replacement reclosers, providing 30 reclosers within the next five years. $400 is allocated to FY 2017 to provide up to eight reclosers controlled by the SCADA system.

5.7.2.2 Spur Line fuses/Fuse-savers

Additional spur line fuses allow for faults to be more localised, i.e. areas affected to be reduced, while at the same time offering better isolation for fault finding. Fuse-savers limit fuse operation for transient faults, i.e. they save the fuse and reduce visits to install new fuses. In total $1.25 million is allocated to spur lines fuses and fuses-savers over the five year period of this plan, i.e. $250,000 per annum.

5.7.2.3 Fault Indicators/Power Alarms/Smart Meters

Fault indicators indicate fault currents in lines. This allows for better fault finding and sectionalising. Power alarms provide an alarm if the voltage goes out of bounds or fails.

The fault indicators currently installed within MLL's Network are aging. They flash when they detect a fault and are therefore only provide information when visited just after a fault has occurred.

The power alarms rely on the phone to ring a central computer and advise of abnormal voltages. This equipment is also aging. Consideration is being given to replacing these with smart meters which could directly interface with MLL's outage management system.

With the further spread of the SCADA system, it is planned to upgrade these devices to allow communication with the SCADA and the provision of more timely information. A total budget of $1.6 million is allocated to upgrading these devices for the next five years.

5.7.3 Digital Radio Network

MLL is currently implementing a programme on extending and improving its digital radio network. This will see the creation of new radio repeater sites and the installation of state of the art radio componentry throughout Marlborough. In FY2017, it is anticipated that 8 sites will be constructed and equipped.

5.7.4 Quality of Supply – Other.

Close to $600,000 has been allowed for Other projects under Quality of Supply for FY 2017. Other projects classified as Quality of Supply and forecast for FY2017 include ground mount switch installations and undertaking seismic strengthening works on a number of zone and distribution substation structures.

> MLL is currently undertaking a programme of works to assess key structures and their vulnerability to failure under severe seismic loading. In accordance with current and relevant structural design standards, detailed seismic assessments will be carried out on structures to determine their rating in accordance with the National Building Standard. Many of these structures are at zone and distribution substations and house critical network assets.
> Where structures are deemed to be Earthquake Prone (i.e. NBS <34%), seismic strengthening works will likely be undertaken to improve the structural performance and conform to current design levels. Strengthening works may still be undertaken on structures that are rated as Earthquake Risk (i.e. >34% NBS) – this will depend on the actual rating and the function of the structure.
> Other MLL building structures (those that don't hold Network assets) are also part of this programme but are covered under Section 5.10.

5.8 Other Reliability, Safety and Environment

This area of expenditure is related to safety, environment or reliability and not covered by earlier sections such as supply quality. A total budget of $18 million spread over the next ten years has been provided for this and a budget of approximately $1.4m for FY 2017. There are three main activities, Substation earthing, tee-joint removal and SWER re-insulation under this classification type.

5.8.1 Tee Joint Removal

This stream of work is to remove tee-joints from the LV network and to break any subdivisions reticulated in this manner down into more manageable sections.

The budget for this work is a total of $575,000 for the next 5 years, with $100,000 budgeted for FY2017.

5.8.2 SWER Reinsulation

A tragic fault in north Canterbury resulted in the death of a farmer tending to his livestock. The line was damaged due to an earth fault allowing the live SWER conductor to drop. One way to reduce the risk of this occurring is to increase the separation between the live conductor and the wooden poles. MLL are planning to do this, with priority given to areas with higher risk, i.e. those with greater nearby population and/or more intensively farmed. A total budget of $ almost $500,000 has been provided for the next five years.

5.8.3 Substation Earthing

In 2015 MLL commissioned a ground fault neutraliser at Havelock substation.

This type of earthing reduces fault currents and EPRs, while allowing the feeder to remain alive with a single fault. This also reduces EPR and the risk of starting a fire. The Havelock GFN has been successful and accordingly it is planned to install GFNs at Spring Creek, Linkwater and Rai valley substations over the next six years. The total budget provided for this is $1.5 million. The GFN at Linkwater is proposed for FY2017 with an estimated cost of $500,000.

5.9 Legislative and Regulatory

This area of expenditure is related to the need to comply with legislation and/or regulations and in particular where these change and require expenditure. MLL's Network is compliant with existing legislation and regulations. Safety and the need for compliance is integral to the way we operate and any non-conformances are dealt with as a priority.

$400,000 has been allocated for projects falling under this category in FY2017. This generally includes works for rectifying relatively low conductor spans.

5.10 Non Network

Non Network expenditure consists of expenditure on office buildings, plant, tools, test equipment, vehicles and information technology. Over the next five years approximately $8 million is allocated to this, i.e. approximately $1.5 million per year.

The forecast for next five years is based on actual spend over the previous 5 years and includes allowance for:

- **Software.**
  The replacement of the Asset Management software took place in FY2016. Beyond that (i.e. within the period of this AMP), further allowance has been made for smaller developments of standard software and mobility solutions. $500,000 has been allowed for this for FY2017.
- **Land and Buildings.**
  This area includes seismic strengthening of required non-network buildings as well as other developments of new and/or extensions to existing buildings. $400,000 has been allocated to this for FY2017.
- **Vehicles.**
  The projection allows for the cyclical replacement of the existing Network Fleet. Many of MLL's vehicles (i.e. field vehicles) travel considerable distances covering the Network, often on unmetalled and rough roads. Typically a budget in the order of $400,000 to $500,000 is set for annual vehicle replacement costs.
- **Plant and Equipment.**
  The projections allow for the replacement of computer server infrastructure ($400,000) each five years, and the cyclical replacement of other computer hardware. The regular replacement of plant, test and office equipment is also allowed for. A total of $300,000 has been allocated for FY2017 for this and $1.65m for the next five years.

5.11 Network Capital Expenditure Programme – Years 2 to 5

Specific project details with respect to the various classifications/categories are provided for Year 2 in the following sections. Forecast costings for the remaining years are presented in Table 35.

5.11.1 Asset Replacement and renewal

5.11.1.1 Waihopai Line Renewal

Further to section 5.5.1.3, additional sections of the Renwick to Leefield 33kV transmission/sub transmission line will be replaced in the coming years. Generally the sections are split to approximately 3km to 4km and each is anticipated to cost in the order of $600,000.

5.11.1.1 Redwood Street to Riverlands 33kV replacement

The 33kV along this road provides the second 33kV supply to Riverlands, Cloudy Bay and the East Coast. The line was constructed in the 1960s using reinforced concrete poles and using concrete poles to 'brace' the poles across the deep culvert. Given the importance of the line, its age and its vulnerability to damage from earthquake (including lateral spread), it is intended to renew this line using more resilient construction.

The section in Year 2 will carry on from the eastern extent of the FY 2017 works (at the 90° bend of Alabama Road) traversing vineyards towards Riverlands Industrial Estate. Note that the replacement work is proposed to follow the existing line route.

5.11.2 Distribution and LV Lines

This work generally consists of a number of smaller projects. Examples of some of these projects forecast for Years 2 include:

5.11.2.1 Wairau Valley

This line has now been renewed from Renwick and past the Wairau Valley Township. A section of iron rails near Birch Hill is still in place which MLL intends to replace in FY2017. The remaining section west of this is proposed to be replaced in FY2018 for which a budget of $250,000 has been allocated.

5.11.2.2 Hawkesbury area conductor replacement

Aged and unreliable conductor still exists in parts of the Hawkesbury area. This is forecast to be replaced within Year 2 at an estimated cost of approximately $400,000.

5.11.3 Asset Relocations

Consideration has also been given to the following major projects which may be undertaken within the 2 to 5 year period of this AMP.

5.11.3.1 Undergrounding of Redwood St from Horton Park to Ida Street

Redwood St has one of the highest traffic densities in Blenheim. The estimated cost of undergrounding this section is $1.0 million. Undergrounding offers improved public safety, a cleaner visual environment, and better reliability. This work is contingent on the participation of the Marlborough District Council.

5.11.3.2 **Murphys Rd Undergrounding**

Murphys Rd has high traffic volumes and is used by heavy trucks to avoid the Grove Rd Bridge. The street contains a primary school and pre-school. The poles in Murphys Rd carry two 33kV circuits supplying a large portion of MLL's Network, as well as an 11kV feeder and 415V circuits. Damage to any of these poles may severely compromise the ability of the Network to deliver service. In addition undertaking maintenance or work on poles is very difficult. To improve public safety, and reduce the risks to the Network consideration is being given to undergrounding the overhead lines. The estimated cost of this project is $1.2 million. Note $1.2 million has also been allocated to the renewal of the 33kV circuits, making the total budget for this project $2.4 million.

5.11.3.3 **SH1 Bridges – Wairau River and Opawa River**

A budget of $0.8 million has been allocated to converting the existing overhead lines to higher capacity underground cables attached to the bridges as part of the bridge redevelopment work proposed by New Zealand Transport Agency.

5.11.3.4 **Havelock North and South End**

A budget of $0.7 million has been allocated to converting the existing overhead lines to underground cables at the north and south ends of Havelock, i.e. extending the area of undergrounding. The lines at the north end are located close to the road and are considered to be vulnerable to damage from vehicles

5.11.4 **Quality of Supply**

This item of expenditure is where the main driver is the provision of an alternative supply or improved security of supply. The alternatives to this are to accept a lower security of supply (i.e. do nothing) or provide security of supply in other ways, such as through the provision of reliable distributed generation of sufficient capacity. Major projects in this sub-grouping are:

5.11.4.1 **Waikawa cable**

The Waikawa feeder from Picton supplies 1,985 customers, this is more than any other single feeder. This feeder is radial and relies on a single line. The next largest radial feeder is the Kenepuru feeder, which has a total of 1,105 customers. By way of comparison, the Waikawa feeder has 1,447 customers using more than 3,000kWh per annum, while the Kenepuru has 471 customers using more than 3,000 kWh, i.e. the Kenepuru has more holiday homes.

While the precise use of an installation is irrelevant to the performance figures such as SAIDI, clearly feeders with more people in residence are more affected by faults than those where people are absent. For this reason, development of an alternative supply to Waikawa is important in maintaining overall Network performance as well as reducing disruption to the community.

Consideration has been given to a number of possible routes and also to the installation of diesel generators. The load is such that very large diesel generators would be required and this is not considered to be a good alternative to the installation of cable.

MLL intends to install a 33kV cable to the far end of Waikawa in conjunction with MDC plans to install additional water/wastewater services in Waikawa road. In addition, provision has been allowed for the installation of a 33/11kV substation and 11kV circuit breakers.

The total budget allocated to this is $1.5 million spread across the 2018 to 2021 financial years.

5.11.4.2 **Fibre Network Extension**

$750,000 has been allocated to extend the Fibre Network for Woodbourne and Renwick. This allows more modern and reliable communications to be set up to control key assets on the Network, and ties existing communications infrastructure together.

5.11.4.3 **Off Grid Supplies**

There are a number of circumstances where long lines, often through difficult and/or forested terrain supply 3 or less customers. One such line is 10km long on iron rails through commercial forestry and it supplies a single installation which only has occasional occupancy. Where practical MLL are looking at moving these customers to a hybrid off-grid supply using PV arrays and diesel backup generators.

There is a budget of $80K allocated to this type of project which is anticipated to be undertaken within Years 2 to 5.

5.11.5 Legislative/Regulatory

A nominal budget of $50K per annum (on average) has been allowed for minor activities. This is to cover activities such as rectifying any low spans alongside or crossing roads for example.

5.12 Network Capital Expenditure Programme – Years 6 to 10

Forecast amounts for Years 6 to 10 are generally deduced from current year spend, forecast years 2 to 5 and extrapolating this information out. These are presented in Table 35. A small ample of possible projects that may occur within this period are presented below.

5.12.1.1 **New Renwick Road widening**

MLL understands that Marlborough Roads intends to widen New Renwick Road, but that no timeframe has yet been set for this. MLL has allowance for undergrounding the infrastructure along New Renwick Road where widening works are proposed. This will also allow for an additional 33kV tie line

5.12.1.2 **New Seddon Substation switchroom**

Seddon Zone Substation has an overhead switching structure which is nearing the end of its asset life. Replacement of this structure would involve procuring new indoor switchgear, which would be housed in an internal building structure. The new switchgear would also allow better (and safer) monitoring and operation.

6. Lifecycle planning

Deterioration of assets can be caused by a number of factors, some of which include:

- Number of operations (e.g. switchgear, tap changers).
- Loading and duty cycle (e.g. transformers).
- Natural disaster (e.g. earthquakes)
- Environment (such as salt laden air), wind, snow, ice.
- Age (typically embodying number of operations, exposure to environment and weathering).
- Lack of prudent maintenance.

Critical assets must be maintained to minimise the effects of this deterioration, and extract maximum benefit from their continued operation. This involves assessing asset condition and performing corrective action based on these assessments.

In addition to work on assets, it is also necessary to maintain access to the assets and the environment around the assets (for example keep trees clear of overhead power lines). For MLL, a part of the maintenance budget is allocated to the maintenance of access tracks and vegetation control.

6.1 Key Drivers

MLL undertakes a condition-based maintenance programme centred on regular inspection and testing of Network equipment. The programme has the following major aims:

- To ensure the safety of staff and the general public.
- To achieve a reliable, secure system in accordance with service levels and customer expectations.
- To comply with all aspects of our environmental policy.
- To identify required corrective maintenance before failure.
- To minimise the total cost of ownership of assets.

MLL endeavours to achieve these aims, while ensuring that unnecessary maintenance is avoided. It is a process of continuous improvement, and one that will become more effective over time, as more history is collected about equipment and failure modes. MLL also endeavours to buy quality new equipment with minimal maintenance requirements to assist with future reliability.

Typical maintenance tasks on critical equipment include the following classes of activities:

- Checking and replenishment of oil, grease and insulation components such as oil, SF6, vacuum and grease.
- Checking, minor repairs or replacement of semi-consumable components e.g. brushes, contacts, gaskets, seals.
- Checking and minor repairs to breakable components e.g. sight glasses.
- Calibration of components such as thermo-couples, relays.

The key criteria for these tasks are that they restore the original service capacity - they do not increase that capacity.

6.2 Key Assumptions

This plan assumes:

- That customers will continue to want and be willing to pay for a reliable power supply based on the MLL Network. The amount of maintenance is consistent with the objectives of maintaining a safe and reliable Network which meets the needs of customers and stakeholders.
- That the current regulatory framework will continue, albeit with some changes and refinements.
- That no major disasters or widespread systemic problems will occur and that load growth will be consistent with values elsewhere in this plan and spread across the region.
- Introduction of distributed generation in the next 10 years will not affect asset deployment.
- That no major new loads or major generation will be installed.

6.3 Asset replacement and renewal policies

When assets near the end of their useful lives, the costs of operating and maintaining them increase quickly. The risks associated with the assets also increase as the number of asset failures increase.

MLL policy is to obtain maximum value from each asset, without compromising safety and reliability. Much of the existing Network was developed in the 1960s and 1970s and accordingly would, without prudent maintenance, reach the end of its useful life over a short span of time. MLL recognises this and its policy is to spread expenditure so as to minimise the variations year to year. It is possible to defer this type of expenditure, however that runs the risk of large scale failures with inadequate resources available to correct the problem.

MLL must maintain the capability to replace its assets if it is to remain a viable business into the future. It should also be noted that replacement of assets is not always straightforward, and that consultation with stakeholders is important. It can take considerable time to reach agreements with stakeholders such as land owners.

In general, asset replacement and renewal is targeted towards areas where other drivers exist, for example low capacity or low strength lines, ties between substations without (n-1) reliability, safety concerns, and/or assets that are expensive or difficult to maintain (e.g. iron rail poles).

Consideration is given to making assets 'smarter' on renewal. Developments in smart grid technologies are making new assets easier to monitor and operate remotely. In general, remotely monitored and operated equipment assists in achieving all the aims of the maintenance programme described in section 6.1.

Looking at the remaining useful lives of the assets, the renewal requirements for major asset categories are shown in the table below:

Asset Category	Quantity in next ten years	Quantity for 10 to 20 years	Quantity 20 to 30 years	Notes
11kV Distribution Lines	363km	470km	556km	LV renewed at same time
Distribution transformers	257	453	753	Done as required
11kV Distribution Cable	13.7km	10km	15km	LV renewed at same time
Zone substations	None	none	none	Historically upgraded due to load, rather than age
Zone substation transformer stock	5	2	5	Older units are mainly smaller and are at substations with (n-1) reliability

Table 37 – Renewal requirements for major asset categories

6.4 Routine Maintenance and Inspection Policies

Where possible, MLL prescribes time based condition monitoring over time based servicing. Benefits of condition monitoring are:

- Increased visibility of an asset's health.
- Ability to identify trends across asset groups.
- Maintenance actions become more efficient as they are driven by asset health.
- Ability to identify, plan, prioritise and defer preventative maintenance works.
- Ability to assist in planning future CAPEX work.

Monitoring schedules are prescribed tasks designed to detect potential failure conditions. The schedule is determined by balancing inspection frequencies against potential failure interval and the cost of the monitoring activity against the cost of asset failure.

Most of the preventative maintenance is planned with EAM's Work Order Planning module. Each asset type has a preventative maintenance plan defined for it.

A plan is made up of a list of assets the plan applies to and series of schedules. A schedule is a set of tasks undertaken on a regular interval. The inspection interval may be based on time between inspections or other units of measure like run hours or number of operations. For efficiency, tasks with similar intervals at the same site are packaged together.

Breakdowns of the preventative maintenance plans for major assets are detailed in sub-section 6.6.

The due date for each task is updated based on one of two methodologies:

1. **Variable:** The task is due in one period from the previous occurrence's completion date. This method is generally used for schedules that have a high cost per task occurrence e.g. out of service tests on a power transformer.
2. **Fixed:** The task is due in one period from the previous occurrence's original due date. This method is preferred for schedules with high task occurrence rates, due to either large asset populations or relatively short task frequency. In this case there is greater efficiency to be gained by grouping tasks in a similar geographical area rather than strict adherence to maintenance frequency.

During routine maintenance, field staff undertake a condition assessment on each asset. The condition scored based off the definitions[2] in the following table.

Condition	Definition
Grade 1-Faulty	Asset has failed or is likely to fail within a short period of time. - Immediate intervention required.
Grade 2 - Poor	Asset is showing signs of aging - intervention likely to be required prior to next scheduled inspection.
Grade 3 – Normal	Asset condition is well within operational requirements – continue with regular monitoring
Grade 4 – Excellent	New or as new condition

Table 38: Condition Assessment Scoring

6.5 Corrective Maintenance Policies

Asset conditions scored Grade 1 are reported immediately through to the Control Room. A brief risk assessment is undertaken and appropriate reactive work actioned. This may include emergency shutdowns.

Defects on assets scored Grade 2 and corrective tasks identified in the field staff are assessed by the maintenance team. Corrective tasks are raised as a "work request" work order in EAM.

[2] Condition scoring and definitions from Commerce Commission

These tasks are prioritised based off a risk assessment. The criteria used in the risk assessment is derived from the lifecycle planning drivers identified in section 6.1:

Consequence of functional and/or secondary failure in terms of:

- Risk to reliability (number customers affected, restoration time, availability of alternate supply);
- Risk to public safety;
- Risk to environment; and/or
- Cost of asset replacement.

Probability of failure in terms of:

- Known asset health;
- Defect severity;
- Asset environment; and/or
- Predicted "time to fail" based on field experience.

The risk based approach gives priority to serious defects, assets serving large numbers of customers, specific high-value customers, or places where public safety is a concern. It also results in low-priority assets effectively being operated on a "run-to-failure" regime. This system ensures that at all times, corrective maintenance is being performed efficiently and the most critical tasks are the ones being focused on.

The corrective action to be undertaken is determined by:

- Risk to operator safety (during action);
- Risk to service levels (during action);
- Labour and material cost of action; and/or
- Remaining asset life (post-action).

MLL uses GIS to plan and schedule maintenance. Outstanding corrective maintenance tasks are plotted within a GIS viewer, on top of the affected asset. This enables corrective maintenance to be grouped geographically and scheduled alongside known planned outages, thereby improving efficiencies.

MLL is in the process of installing a mobile module into EAM. This will allow field assessments to be recorded on electronic tablets rather than the current paper based system. This shift to 'go mobile' will see a decrease in overheads associated with data processing and allow for faster communication of asset health through to management.

6.6 Preventative Maintenance Plans

A review of maintenance regimes is currently being undertaken. This has been timed to coincide with the upgrade to Infor EAM. As a part of this review, our testing and inspections regimes are being documented in what will become the MLL Maintenance Standard. The following sub-section summarises maintenance plans for major asset types.

6.6.1 Maintenance Levels

The schedules described in this chapter are categorised by a maintenance level. These levels act as a rough guide to the complexity of the maintenance task. Maintenance levels also provide an indication to the level of access required to complete the task is required. Maintenance Levels are described in the following table.

Maintenance Level	**Level Code**	**Description**	**Definition**
1	SHI	Security and Hazard inspection	Examples include: • Zone Substation Building inspection • Distribution Transformer visual inspection
2	ISCA	In Service Condition Assessment	Assessment or testing of an asset based off a predetermined criteria whilst the asset is in service. Examples include: • Earthing System resistance test • SF_6 switch pressure gauge reading.
3	OSCA	Out-of-Service Condition Assessment	Assessment or testing of an asset based off a predetermined criteria whilst the asset is out of service. Dependant on task, may require an access or test permits. Examples include: • HV cable Tan delta Testing • Circuit Breaker Functional Test
4	NIM	In Service / Out of Service Non-intrusive Maintenance	Maintenance activity where access to compartments containing HV conductors is not required. I.E access/test permit not required Operational control or NESS may be required. Examples include: • Substation cleaning • Ground Mount Switch Operational Test
5	OSIM	Out of Service intrusive Maintenance	Maintenance activity where access to compartments containing HV conductors is required. Access or test permits required. • Circuit Breaker Maintenance • Tap Changer Overhaul

6	SS	In Service / Out of Service Specialist Survey	Surveys undertaken by specialists generally external to MLL. Task is usually non-standard and will require a dedicated health and safety plan approved by the Operations Manager. May require Access or Test Permits. Examples Include: • Partial Discharge Survey. • Earthing System Review
7	PFM	Post Fault Maintenance	Assessments, testing or maintenance required on an asset after a fault has occurred
8	OSM	Other Specific Maintenance	Other Items that don't fit into the above categories. Systemic reviews fit in this category. Examples include: • Earthing system classification review.

Table 39: Maintenance Level Definitions

6.6.2 Poles and Overhead Lines

All poles in the Network are visited on a regular basis and a visual assessment is done to assess the condition of each pole and the other equipment on it. This data is essential for detecting areas of the Network that are showing the effects of age, and also to detect problems before they become serious.

Field trials have determined the success and cost effectiveness of helicopter video assessment. As part of this process the video is linked to GPS data so that any remedial work can be readily affected.

MLL is also trialling the use of UAV drones and hot stick mounted "go-pro" cameras for the use of pole top inspections. These inspections are considered to be safer and more efficient as they do not require staff to work at height or near energised conductors. The inspections have already successfully identified areas with failing pole top equipment that wasn't able to be detected from ground level.

Item	Action	Period	Maintenance Level
Sub transmission Poles	Visual inspection	1 Year	ISCA
Distribution Poles	Visual inspection	4 Years	ISCA

Table 40: Overhead Line Routine Maintenance Plan

6.6.3 Cables

MLL has no specific routine maintenance plans for cables. Condition assessment testing is undertaken on cables when a cable is disconnected from the network for other works (e.g. switch replacement).

In general, cables in the MLL network have a low failure rate. The three dominant failure modes for cables are:

1. External interference (e.g cable hit by a digger);
2. Terminations failure; and
3. Joint failure.

External interference is difficult to manage through traditional maintenance. It is mitigated with public engagement including an MLL cable location service for external organisations intending to dig near underground assets.

The health of terminations is monitored through the partial discharge testing regimes of the assets that the cables are connected to. Issues with cable joints can be found during these tests.

6.6.4 Zone Substation Building and Grounds

Zone Substations house high value assets including 33kV/11kV transformers, circuit breakers, switches and protection that are critical to network reliability. It is essential that equipment at the substation is not obscured and in ready to operate state. See following sub-sections for maintenance details for other asset classes.

A significant driver for regular checks on Zone Substations is security. Unrestricted access to these areas would pose high risk to both operations and public safety. Overhead structures within zone substation compounds are often built with reduced clearances.

No systemic problems have been uncovered in recent history. Various minor defects are often identified, including vegetation growth and earthing issues caused by neighbouring fencing. These tasks are given to contractors to investigate and repair as and where required.

Item	Action	Period	Maintenance Level

Substation General	Inspection	1 Month	SHI
Building	Fire Protection and Security Check	1 Year	ISCA
Building	Minor Structural and Security Inspection	1 Year	SHI/PFM
HV Switchyard	Thermal Imaging	1 Year	ISCA
HV Switchyard	Partial Discharge Survey	3 Years	SS
Building	Major Structural Inspection	6 Years	SS/PFM
HV switchyard	Structural Inspection	6 Years	ISCA/PFM

Table 41: Zone Substation Building and Grounds Routine Maintenance Plan

6.6.5 33/11kV Zone Substation Transformers

Power transformers at MLL's zone substations transform voltages on the sub-transmission network to voltages suitable for distribution. They also typically provide voltage regulation by means of an on load tap changer (OLTC). Given the criticality of power transformers to the distribution system, as well as the wear OLTCs are exposed to through operation, regular maintenance of both transformers and OLTCs is critical. This section describes the frequency and requirements of visual inspections, tests and component replacements deemed mandatory by MLL Network in order to ensure the safe and reliable operation of the power transformer assets within the network.

Issues like saturated silica gels, oil leaks and faulty indication are occasionally identified during visual inspection. These tasks are given to contractors to investigate and repair as and where required.

Dissolved Gas Analysis (DGA) testing is used to monitor condition of Zone Substation Transformers and Tap-changers. It is one of the tools used to assess the internal health of the equipment and provides a basis for scheduling maintenance. Transformers with poor DGA readings are scheduled for refurbishment or oil filtering, and Tap-changers with poor DGAs are scheduled for overhaul. An increase in the frequency of DGA testing can also be used to trend the aging of a poorly performing transformer.

Note the results of most recent DGA testing are included in section of this plan.

Item	Action	Period	Maintenance Level
Zone Substation Transformer + OLTC	Visual Inspection	1 Month	SHI

Zone Substation Transformer + OLTC	Dissolved Gas Analysis (DGA) Sampling	Annually	ISCA
OLTC	Operational Test	Annually	NIM
Zone Substation Transformer +OLTC	Transformer Condition Test	3 Years	OSCA
Zone Substation Transformer + OLTC	Transformer Major Service	On condition only	OSIM

Table 42: Zone Substation Transformer Routine Maintenance Plan

6.6.6 HV Circuit Breakers

Circuit breakers provide primary protection and facilitate fast and safe disconnection and reconfiguration of large parts of the network. Correct maintenance significantly reduces the probability of breaker mal-operation. While low probability, breaker failure can have catastrophic consequences including explosion, arc flash and the release of environmentally harmful materials.

Circuit breakers have mechanical components that require lubrication to keep them fit for purpose.

Item	Action	Period	Maintenance Level
Zone Substation Circuit Breakers	Visual Inspection	1 Month	SHI
Distribution Substation Circuit Breakers	Visual Inspection	3 Months	SHI
HV circuit breakers	Operational Test	1 Year	NIM
HV Circuit Breakers	Partial Discharge Survey	3 Years	ISCA
All HV Circuit Breakers	General Service	5 Years	OSIM

Table 43: Circuit Breaker Routine Maintenance Plan

Pole mounted reclosers are a difficult asset to inspect, and therefore little more than visual checks can be done. If the circuit breaker can be bypassed, inspection staff by-pass it and perform a trial operation to ensure that the mechanisms are operating correctly. MLL keeps a service history of circuit breakers and this is used alongside visual inspection results and operational information to assess whether circuit breakers need to be replaced.

MLL is currently undertaking a programme to remove all remaining Coopers KF and KFE reclosers from the Network. These circuit breakers are approaching the end of their lives, and, in some instances, are becoming quite unreliable. They are being replaced with newer model circuit breakers with remote operation and monitoring.

6.6.7 Earthing Systems

In general, earth testing is performed on a six yearly basis. Zone substations and assets in/near public areas, such as shopping centres and schools, are tested every year. SWER substations are tested every three years. Testing is done by area and environmental conditions are recorded at the time of testing. Results are used to detect unsatisfactory readings and poor earthing areas so that future corrective action may be taken. MLL has recently rolled out new testing procedures to better measure the earth resistance at SWER substations.

An engineering review of Zone substation earthing systems is undertaken every eight years, the most recent was undertaken in 2015. This review identifies earth grid voltage rise, the location of earth potential rise (EPR) contours, touch and step voltages within and around the substation and the effects of EPR on nearby telecommunications systems.

Item	Action	Period	Maintenance Level
Zone Substation Earthing Systems	Inspection/Earth test	1 Year	ISCA
Earthing systems in public places	Inspection/ Earth Test	1 Year	ISCA
Earthing systems in public places	Classification review	3 years	OSM
SWER earthing systems	Inspection/Earth Test	3 Years	ISCA
Other earthing Systems	Inspection/Earth Test	6 Years	ISCA
Zone Substation Earthing Systems	Earthing System Review	8 Years	SS

Table 44: Earthing System Routine Maintenance Plan

6.6.8 Distribution Transformers

With a large percentage of revenue coming from major customers, it is important that their electrical assets are kept in good condition. Transformers used for large industrial loads are generally exposed to harsher operating conditions than residential transformers, making it even more critical that they are regularly visited and tested. MLL's routine inspections involve visual checks and data capture, as well as oil testing for transformers greater than 500kVA. This combined information gives a strong indicator as to the internal health of the transformer, enabling planning to be done for future transformer changes.

Generally the inspections have revealed the population of large transformers to be in relatively good condition. A few transformers have failed crackle tests, and some have had oil leaks which ultimately (if left) could have had significant consequences. These transformers have either been replaced, or are in the corrective maintenance Task Pool and will be replaced in the near future when they reach the top of the priority list.

Maximum Demand Indicator (MDI) readings are performed on all large distribution transformers to assess capacity usage. The frequency of the readings increases as the transformer capacity margin decreases. Recently MLL has bought some advanced electronic loggers which will provide load profile data rather than peaks only. MDIs are gradually being replaced by these new loggers.

Item	Action	Period	Maintenance Level
Distribution transformers in public places	Distribution Transformer Visual Inspection	1 Year	SHI
All other distribution transformers	Distribution Transformer Visual Inspection	6 Year	SHI

Table 45: Earthing System Routine Maintenance Plan

6.6.9 HV Ground Mount Switches

Being an operable asset, it is important that ground mount switches (sometimes referred to as ring main units) are regularly visited to ensure the safety of the staff who operate them. Small tolerances within ground mount switches mean that oil level or SF_6 gas pressure becomes a critical component to the safety of the operator. MLL recognises this, and as a consequence, has set up a regime to regularly inspect ground mount switches. In locations where a ground mount switch neighbours a transformer, the two are inspected together.

Item	Action	Period	Maintenance Level

Switches with Motor Drives	Switch Operation	2 Years	NIM
Oil Switches	Oil Switch Visual Inspection	3 Years	SHI
Gas Switches	Gas Switch Visual Inspection	3 Years	SHI
Switches with Batteries	Battery Test	3 Years	OSCA
All Switches	Partial Discharge Survey	8 Years	SS

Table 46: HV Ground Mount Switch Routine Maintenance Plan

6.6.10 Diesel Generators

MLL's mobile generator fleet has a variable usage profile throughout a year. This can cause added wear on some components compared to a typical backup generator. Being an assembly of large pieces of mechanical plant, they require regular servicing to keep the fleet in operational condition.

Item	Action	Period	Maintenance Level
All Generators	Visual Inspection and loaded run.	1 Month	ISCA
All Applicable Generators	250 Hour Service	6 Months or 250 Running Hours	NIM
All Generators	Electrical Inspection	1 Year	OSCA
All Generators	500 Hour Service	1 Year or 500 Running hours	NIM
All Generators	2000 Hour Service	2 Year or 2000 Running hours	NIM
All Generators	3000 Hour Service	3 Years or 3000	NIM

		Running hours	
All Generators	4500 Hour Service	4500 Running Hours	NIM
All Generators	12000 Hour Service	6 Years or 12000 Running Hours	NIM

Table 47: Diesel Generator Routine Maintenance Plan

A review of maintenance regimes is currently being undertaken. This has been timed to coincide with the upgrade to EAM. As a part of this review, our testing and inspections regimes are being documented in what will become the MLL Maintenance Standard.

6.7 Public Safety and Environment Driven Programmes

MLL has a number of plans programmes that are not driven by a particular asset, but the environment surrounding the asset's location.

6.7.1 Safety Inspections

Regular safety inspections of all aerial crossings and boat ramps are done to ensure that signage is visible and that clearances are at safe levels. This is carried out annually prior to the summer boating season.

6.7.2 Public Places Inspections

MLL has an inspection regime to visit public places where there is high foot traffic, such as shopping areas, to ensure that all electrical equipment in the vicinity of these areas is safe and in good working order. Similarly, inspections of lines and network equipment near schools are undertaken at least annually. This is part of MLL's Public Safety Management System.

6.7.3 Road and Rail Crossings

During the last year, all road and rail crossings in the Network have been measured. Crossings which did not meet ECP requirements were identified and corrected. An ongoing programme is in place to monitor all crossings.

6.7.4 Trees

The current tree legislation[3] requires all trees to be kept to a certain distance from overhead power lines. The legislation requires lines companies to advertise suitable safety

[3] Electricity (Hazards from Trees) Regulations 2003

information to tree owners as well as contacting tree owners when their trees are close to power lines.

Each tree owner has the option of taking ongoing responsibility for keeping the tree outside the minimum distance, or granting the line owner approval to keep the tree outside the minimum distance by appropriate pruning or removal. The cost of first pruning is to be met by the lines company, as is the cost of the record keeping, liaison and advertising.

In practice, this legislation is not leading to good outcomes. The growth limit zones are barely adequate for ensuring safety of the public in relation to trees, however in many cases they do not protect the lines from trees and or inhibit the risk of fire. In addition, the complex formulas require detailed and costly survey work to be undertaken if landowners require strict adherence to the legislation.

The inadequacy of the Tree Regulations in rural and forestry areas is of real concern to MLL to the extent that MLL filed proceedings seeking a Declaratory Judgment in relation to various aspects of the Regulations and to protect the Network from interference from trees to maximise reliability and prevent fires.

In 2011 and 2012, MLL inspected all lines annually for tree interference, typically using a video / GPS system from a helicopter together with ground inspections. Since 2012, 33kV lines are inspected annually and other lines are inspected on a rotational basis dependant on priority.

Trees are one of the significant causes of outages on the Network. The current tree legislation only permits minimal clearances and removal of vegetation. In areas of high growth, this means that the limits are quickly exceeded after trimming, thereby requiring frequent return visits and high ongoing costs. These costs are further exacerbated in the remote area of MLL’s network where access is difficult and expensive.

Despite the inadequacies of the tree legislation, MLL has directed its efforts to minimising outages and where possible obtaining greater clearances than those provided by the legislation.

Trees that present a risk to lines are recorded and tracked within EAM in a similar way to an asset.

Upon advice from the Rural Fire Authority, MLL inhibits the automatic reclosing of supply at times of specified high fire risk. This action has the potential to result in prolonged outages but such is in the best interest of the public overall if fires in high risk areas can be avoided.

6.7.5 Access Tracks

Part of the expense with the remote locations of the MLL Network is the maintenance of access tracks to pole and switch sites. MLL is creating a new database which will identify all the tracks with the GPS points associated with the track. Based on the priority of the track, a maintenance program will be established to keep the tracks operational. Included in the track maintenance program will also be the establishment and up keep of helicopter landing sites.

6.8 Systemic Failure Identification

MLL records component failures and investigates possible systemic or type faults if recurring patterns are identified. To assist in this, regular meetings are held to review and debrief faults and equipment failures. Known systemic failures in the MLL network detailed below.

6.8.1 Ground Mount Switches

MLL's partial discharge testing program has revealed issues with the cable terminations inside some oil ring main units. These units were installed in the between 1990 and 2005. It is a cable installation issue where the clearance between cable cores was not sufficient. The resulting partial discharge will prematurely age the cable termination and the acidic by-products can be corrosive to the switch enclosure.

Ground mount switches that fit into this age group are prioritised for partial discharge testing. The tests identify if the defect does exist. A shutdown is then planned to inspect the switch and assess the severity. Minor repairs can be made at this time. Any units showing signs of significant wear are scheduled for replacement.

6.8.2 Poles and Overhead Lines

Over the last 12 months, the insulators on a number of 33kV air break switches (ABS) have had cracks identified during the undertaking of planned works.

33kV ABS are being programmed for a pole top visual inspection with hot stick mounted cameras. When found the switches are bypassed and scheduled for repair. Planned replacement of 33kV switching structures with indoor switchgear will assist in eliminating the issue.

6.9 Operational Expenditure

Maintenance expenditure is planned consistent with prudent and timely maintenance of all elements of the Network. It is MLL's firm view that deferral of prudent maintenance will generally incur much greater costs overall.

Our maintenance programme is determined in conjunction with best industry practice, regulatory requirements, manufacturer's recommendations, and continuous surveillance of the Network. Overall we anticipate similar maintenance levels each year, but because the magnitude and frequency of unforeseen events cannot be predicted, estimation of expenditure is determined relative to previous history and can be subject to significant variation from one year to the next.

The estimated maintenance expenditure for the next five years is shown in the table on the following page, and is based on current estimates. These estimates factor in previous history, growth expectations and known condition of assets.

The values given in Table 48 are in today's NZ dollars, i.e. no allowance for inflation has been included.

Item	2016/17 ($000)	2017/ 18 ($000)	2018/19 ($000)	2019/20 ($000)	2020/21 ($000)	2021/22 ($000)	2022/23 ($000)	2023/24 ($000)	2024/25 ($000)	2025/26 ($000)
Service interruptions and emergencies	900	900	900	900	900	900	900	900	900	900
Vegetation management	2,440	2,440	2,440	2,440	2,440	2,440	2,440	2,440	2,440	2,440
Routine and corrective maintenance and inspection	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Asset replacement and renewal	215	215	215	215	215	215	215	215	215	215
Network Opex	6,235	6,235	6,235	6,235	6,235	6,235	6,235	6,235	6,235	6,235
System operations and network support	1,925	1,925	1,925	1,925	1,925	1,925	1,925	1,925	1,925	1,925
Business support	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Non-network opex	5,425	5,425	5,425	5,425	5,425	5,425	5,425	5,425	5,425	5,425
Op. expenditure	11,660	11,660	11,660	11,660	11,660	11,660	11,660	11,660	11,660	11,660

Table 48 – Estimated Operational Expenditure 2015 to 2025

6.10 Renewal Expenditure

Renewal expenditure consists of capital expenditure associated with asset replacement as well as operational expenditure. In general the difference is determined by whether a complete asset, e.g. 4km of 11kV line, is being renewed (capital) or just parts of an asset, e.g. a single pole is being replaced (operational). These values are also given elsewhere in this plan; however the table below shows the total renewal expenditure:

Renewal Expenditure	2015/2016 ($000)	2016/2017 ($000)	2017/2018 ($000)	2018/2019 ($000)	2019/2020 ($000)
Operational Expenditure	215	215	215	215	215
Capital Expenditure					
Total					

Table 49 - Renewal Expenditure

Photo 19 - Maintenance work being undertaken on steel pole components

7. Risk Management

7.1 MLL Risk Introduction

Risks can be highly variable in their nature and scale – the conveyance of electricity (MLL's core function) involves significant health and safety risks, but MLL is also exposed to considerable business related and other forms of risk. To ensure that risks are managed and exposure remains within acceptable levels, MLL has adopted the systemic approach to risk management through the following Australian/New Zealand standards ISO 31000:2009 *Risk Management* and NZS 7901:2014 *Electricity and gas industries – Safety management systems for public safety.*

The below figure shows the risk management process suggested by ISO 31000:

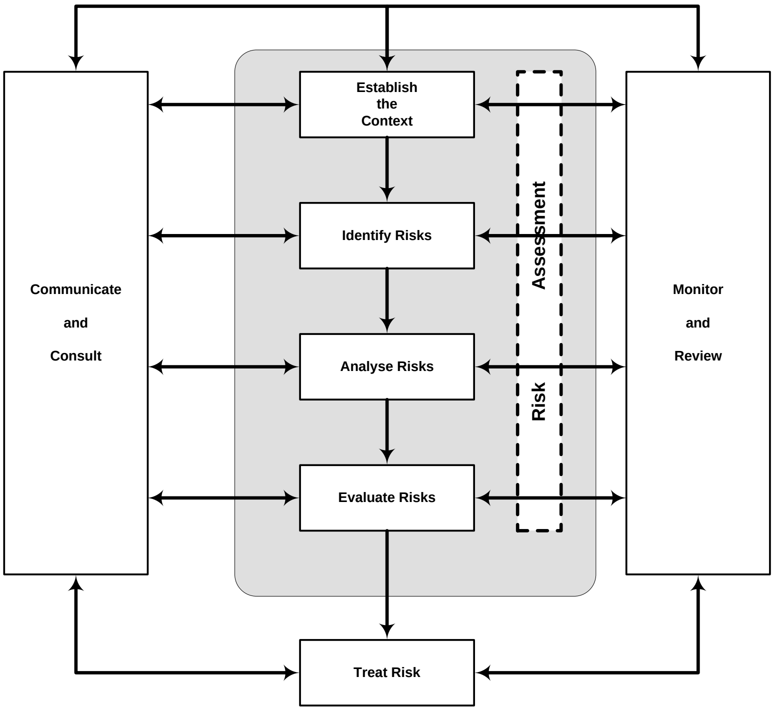


Figure 29 – Risk Management Process Overview

This process has five key steps:

1. Establish the risk context
2. Risk identification
3. Risk analysis
4. Risk evaluation
5. Risk treatment

These are supported by a framework for:

- Risk monitoring and review, and
- Communication and consultation with stakeholders.

The above process allows for the effective management of all risk types affecting MLL. The definition of risk based on ISO 31000 is the effect of uncertainty on objectives. So when considering risk and risk management at MLL, it is important to understand the organisation's objectives.

7.2 Risk Context

The management of Network-related risks is ultimately the responsibility of the Directorate which sets the Companies strategy for effective risk management. The risk management strategy is implemented through MLL's policies and procedures which are managed by key staff including the Engineering Manager and Network Operations Manager, with oversight provided by MLL's Managing Director.

The MLL risk management process considers all credible electricity conveyance risks associated with the MLL Network including Network operational and safety risks as well as Network-related risks to the business, the environment and the general public. These are broadly grouped into the following risk category types:

- Electricity network risks
- Environmental risks
- Electricity business risks
- Regulatory compliance risks

Table 50 below provides further definition.

Risk Category Type	Definition
Electricity Network Risks	Risks associated with all aspects of electricity Network construction, operation and maintenance, including health and safety risk to staff and the public, electricity supply, Network access, operational control and vegetation management.
Environmental Risks	Risks associated with the natural environment's potential impact on MLL's distribution Network and MLL's potential impact on the environment.
Electricity Business Risks	Network-related risks, including financial, which can adversely impact on MLL future viability and profitability e.g. the Commerce Commission's threshold regulatory regime, disruptive technologies, reputation, data and knowledge management.
Regulatory Compliance Risks	Risks associated with all statutory requirements compliance, including complaints, health and safety issues, land access issues and Resource Management Act issues.

Table 50 – Risk Category Types

The range of credible risks to the MLL electricity Network is very broad and ranges from vermin damage and minor vandalism to major natural disasters such as a severe storm event(s), earthquake(s) or flooding. Similarly, the impact of these possible events can vary significantly. For example, a car versus pole incident on a lightly populated rural feeder has far less impact (and therefore loss/risk) than the same incident would at a pole carrying one or more sub transmission circuits

The distributed nature of MLL's asset base means that individual assets are less susceptible to any one event – unless of course that event is region wide. Conversely, however, as the assets are dispersed over a large number of sites, the likelihood that a portion of the assets will be affected by any one event is increased. Maintenance costs are also comparably higher due to the dispersed nature of MLL's asset base.

MLL has carefully evaluated the impact of various categories of risk and is confident that other than under an extreme event, such as a widespread severe earthquake, it has the capacity to deal with the impacts of such risks from engineering, operational, financial and environmental perspectives. The company has developed an Emergency Preparedness Plan and this is regarded as a dynamic document which is reviewed by senior staff at least annually.

Naturally the key factor in dealing with any risk is to seek avoidance through prior identification and through a range of treatment methodologies. MLL undertakes (not less than) annual reviews to assess current risks and risk management. This review process includes taking account of lessons learned by others (such as assessing the effects of a major event(s) like the Christchurch Earthquake Sequence) as well as from events that we have experienced locally (for example the 2013 Seddon earthquakes). Any lessons learned from these experiences are incorporated into modifying and updating MLL's risk management plan as and where appropriate.

7.3 Risk Management Tools

A major revision of MLL risks was completed during the 2010/2011 planning year. This was then reviewed in 2014/2015. This involved key staff at MLL discussing the existing risk register to determine any modifications required. Although few risk additions or deletions were made, many risk ratings increased or decreased as a result of thorough discussion during the exercise. A number of clarifications to risk descriptions were also made. It is now procedural that this risk register is reviewed annually and after any major relevant events.

7.3.1 Central Risk Register

This centralised operational risk register has proved to be a very effective tool for the identification, analysis, evaluation, treatment and communication of risk. It also provides a means for ongoing monitoring and review of risks. It has provided a standardised framework (compliant with ISO 31000) and has meant that MLL's multiple risk memos and hazard registers have been superseded.

ISO 31000 suggests five levels of likelihood and consequence for risk analysis. MLL, however, has chosen to go to nine levels as this provides a far greater level of granularity. The five level analyses also have a tendency to allocate risks to higher levels as the gradation scale is coarse.

7.3.2 Risk Categories

The risk categories from were retained in the risk register which has been carried through to this plan. They are presented in Table 51 below.

Risk Category	Risk Category Type	Description
Regulatory breach	Business	A Commerce Commission threshold regime breach, leading to investigation and possible targeted control of MLL (price setting).
Data management	Business	Issues relating to the availability and accuracy of MLL Network data (assets and asset performance / condition).
Disruptive technology	Business	The impact of disruptive technologies on the MLL asset base and business value (i.e. technical obsolescence and Network bypass).
Fire damage	Business	Damage to MLL buildings and equipment caused by fire (Network and support infrastructure).
Knowledge management	Business	Knowledge management issues (e.g. skill gaps) relating to the MLL asset base.
Vandalism	Business	Disruption to the operation of MLL electricity distribution Network through acts of vandalism and public nuisance.
Access and Control	Electricity	The inability of the MLL distribution Network to safely convey electricity within the supply regulations, due to the breakdown of the MLL Network access and control systems i.e. unlawful or unsafe Network connection.
Distribution failure	Electricity	The inability of the MLL distribution Network assets to safely convey electricity within the supply regulations.
Generation fail	Electricity	Major generation failure causing the unavailability of electricity, within the supply regulations, to the Marlborough region.
Transpower fail	Electricity	The inability of the Transpower transmission Network assets to safely convey electricity within the supply regulations.
Vegetation control	Electricity	Vegetation impacting on live lines can result in serious outages or environmental damage (i.e. fire). Constant effort is required to keep trees clear from the MLL overhead distribution assets and tracks clear so that assets can be accessed in the Marlborough Sounds.
MLL causes Environmental Impact	Environment	Major natural environment impact caused by MLL distribution assets i.e. fallen lines cause a fire or an oil spill pollutes a waterway.
Environment impact on MLL	Environment	Major natural environment impact on MLL distribution assets causing the unavailability of electricity supply to part, or all, of the Marlborough region.
Complaints and/or disputes	Regulatory and business	Complaints and/or disputes resulting in reputational damage to MLL.

Risk Category	Risk Category Type	Description
Health and Safety issue	Regulatory	Situations or events in relation to the MLL electricity distribution Network which lead to health and safety issues for MLL staff and the general public.
Land access	Regulatory	MLL is unable to access land to site its equipment or get access across to service / upgrade existing assets.
RMA issues	Regulatory	MLL is unable to progress Network expansion / maintenance or upgrade project due to RMA related issues.

Table 51 - Risk Categories

7.3.3 Risk Register

At the date of this plan a total of 85 key Network-related risks are documented in the MLL risk register. All of these risks were found to have treatments in place. Most treatments had multiple effects (i.e. staff training, emergency spares, ISO system procedures) with the effectiveness of these varying with the nature of the risk they were applied to. The division of these 85 risks across the four risk category types is presented in Table 52 below. Predictably, the majority of the identified risks relate to the distribution of electricity across the MLL Network.

Risk Category Type	Number of Risks
Electricity network risks	56
Environmental risks	8
Electricity business risks	15
Regulatory compliance risks	6

Table 52 - Risk Division Across Types

A list showing the complete risk register is included in Appendix A with the highest ranked risks set out in Section 7.3.6.

7.3.4 Risk Treatments and Initiatives

A risk's likelihood and/or consequence of occurring are generally reduced through the application of risk treatments that may either avoid, transfer, reduce, remove or modify (or in rare instances, accept) the likelihood and/or consequence of risk(s).

MLL actively implements risk treatment through a number of forms. An example of risk removal is through network re-design to underground a section of line vulnerable to vehicle damage. A risk modification example is asset inspections to identify incipient material failures and therefore reduce the likelihood of the asset progressing to failure, or, having mobile generation to reduce the customer impact and therefore consequence of a network failure.

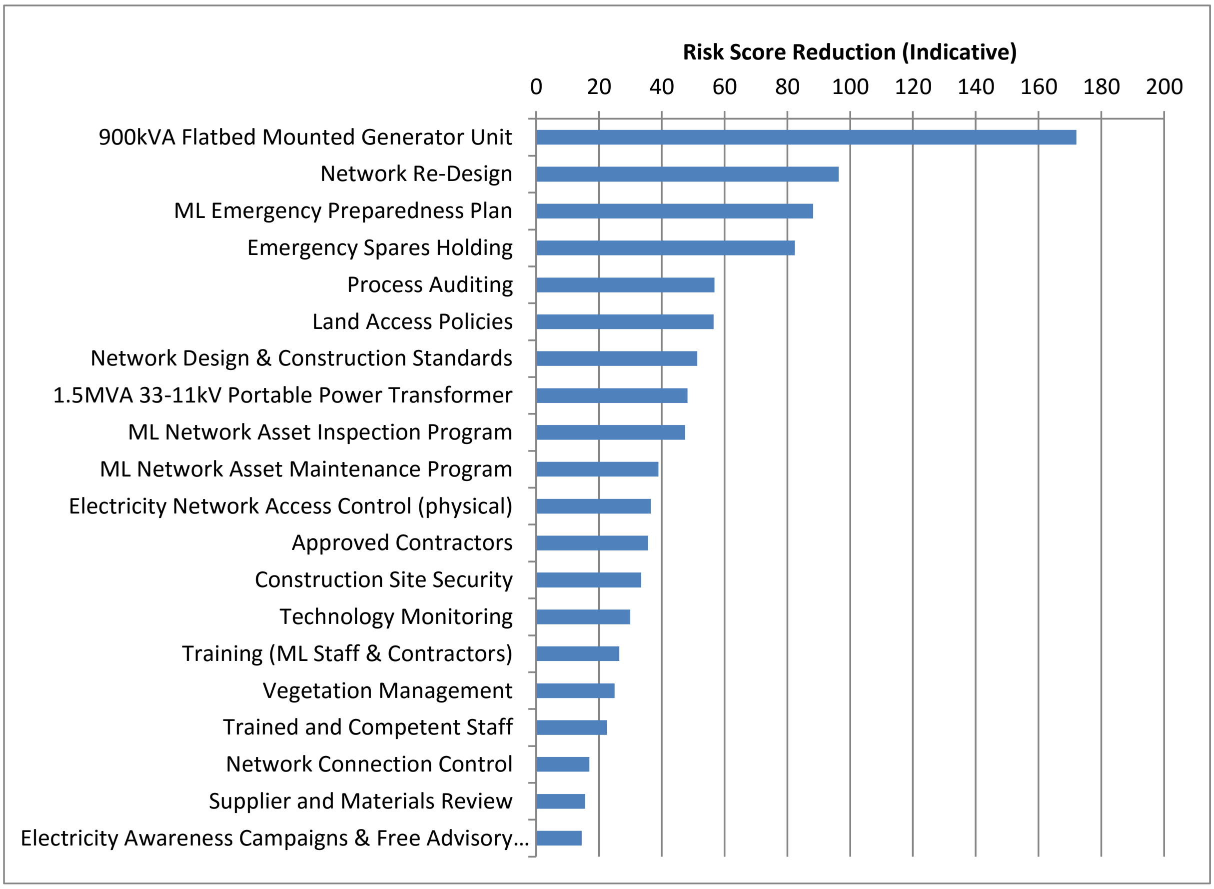


Figure 30 - Summary of Risk Score Reduction

The chart of the above figure provides an indicative measure of the value returned by the risk treatments undertaken by MLL through allocating the assessed risk score reductions resulting from the application of the various risk treatments. As shown, the provision of mobile generation achieves the highest risk reduction as it finds application in mitigating a number of the supply related risks. Asset management processes such as asset inspection, critical spares management and process auditing also rank highly in this assessment underscoring the importance of these business-as-usual processes in modifying the potential likelihood and/or consequence of risk.

Initiatives through the introduction of new risk treatments and the enhancement of existing processes generally look to address the highest ranked risks or where the treatment bears improvement across a large number of the lesser risks. Initiatives set down for this asset management plan are set out in Table 53.

Table 53 presents a summary of current risk treatments implemented by MLL (note that this is a summary of the key treatments and is not an exhaustive list; other treatments may be in place that are not listed)

Control Name	Description
Vehicle Training	Vehicle training for staff in four-wheel-drive terrain
Contractor Auditing	Random audit visits at external contractor construction sites to investigate site safety and the level of workmanship
1.5MVA 33-11kV Portable Power Transformer	This power transformer has been refurbished and can be installed as a portable package to allow rapid recovery in the event of a transformer failure, particularly for the smaller single transformer zone subs i.e. Ward and Rai Valley.
900kVA Flatbed Mounted Generator Unit	This flatbed mounted genset can be installed as a portable package to allow rapid recovery in the event of distribution asset failure.
Accept Risk	Overall risk rating means the appropriate action for ML is to accept the risk
Approved Contractors	The exclusive use of approved contractors on MLL's network as well as ISO system defined procedures for network access and operation.
Close Approach Permit Issue & High Load Escorting	ML: has a process (free to individuals) for handling the issue of close approach permits and assessment of the need for high load escorting. This ensures that access to expert electrical advice for the general public.
Construction Site Security	The securing of expensive or hard to source construction items so that they are either unavailable or not easily accessed.
Electricity Awareness Campaigns & Free Advisory Service	MLL runs numerous electricity awareness campaigns and has a free electricity advisory service to heighten awareness of the efficient use but also potential dangers of electricity.
Electricity Network Access Control (physical)	Access to MLL electricity network assets is restricted to authorised (trained) personnel through the use of design, preventive barriers, keys, tooled fittings and monitored security systems. The intention is to prevent accidental access.
Emergency Spares Holding	Emergency network spares held to ensure that adequate stocks are on-hand for corrective maintenance
Incident Reporting & Investigation	MLL has an ISO procedure for incident reporting and investigation, which allows the timely investigation of ML network incidents and accidents so that the key issues are understood, allowing remedial action to be undertaken.
ISO System With Defined Procedures	Well designed, auditable systems representing best practice, leading to customer satisfaction, loss minimisation and productive efficiency.
Land Access Policies	MLL has ISO system procedures for securing the right to occupy space on private property.
Load Control	The use of MLL load control plant to reduce (control) load, for demand target management in normal operation as well as during periods of supply shortage.
ML Emergency Preparedness Plan	This plan provides documentation, key contacts and background information that would be useful in a range of emergency situations. Its aim is to limit damages and speed the

Control Name	Description
	recovery of the MLL electricity network from an emergency situation.
ML Network Asset Inspection Program	MLL has processes and business systems in place to manage the identification of defective electricity network assets i.e. zone sub monthly inspections, MDI readings, earth testing, OH & UG asset inspection, etc.
ML Network Asset Maintenance Program	MLL has processes and business systems in place to manage the identification of defective electricity network assets i.e. zone sub monthly inspections, MDI readings, earth testing, OH & UG asset inspection, etc.
Network Design & Construction Standards	The development and use of the MLL design and construction manuals to ensure that the ML electricity network is engineered to the highest appropriate standard. This also extends to the locating of equipment i.e. not in floodway or on known fault line, etc.
Network Re-Design	This involves the re-design of any aspect of the MLL electricity supply network, it includes network layout /configuration as well as equipment and construction standard re-design.
Oil Spill kits and Site Bunding	To minimise the potential for an environmental issue oil spill kits and bunding arrangements are installed as appropriate. Procedures and training for their use are in place.
Process Auditing	Internal and external auditing of MLL's business systems, policies and procedures
Regulatory Environment Monitoring	Scanning of the regulatory environment in which ML is operating to look for issues / changes which will impact on the operations of MLL
Resource Management Act Mitigations	Resource Management Act issues are mitigated against in three ways; 1. a good working relationship with the Marlb. District Council, 2. defined procedures, 3. trained staff (aware of the district plan and RMA issues generally).
Site Access Control	MLL has procedures to ensure that visitors to sites are aware of the hazards that exist and have the appropriate PPE. Physical barriers and signage are used to keep the general public clear of such sites.
Supplier and Materials Review	MLL has ISO system procedures for supplier and materials review to ensure that the electricity network is constructed and maintained to the highest appropriate level.
System or Procedure Re-Design	This involves the re-design of any system or procedure affecting the MLL electricity supply network, it includes everything from ISO system polices to business processes to work site instructions.
Technology Monitoring	This involves the monitoring of innovative technology development as well as its analysis to assess its potential impact on the MLL electricity distribution network
Trained and Competent Staff	MLL staff are required to become qualified in their own right (as appropriate for their role) and undergo regular / ongoing competency assessment.

Control Name	Description
Training (ML Staff & Contractors)	The delivery of training to MLL staff and contractors to reduce the likelihood and or consequences of a risk
Use of Best Practice Industry Guidelines & Manuals	Training materials to reduce the likelihood and or consequences of a risk.
Vegetation Management	The MLL vegetation management team, co-ordinate the activities of MLL staff, MLL contractors and private individuals in accord with the Electricity (Hazards from Trees) regulations 2003.
Network Connection Control	The development and use of the MLL network connection control systems to ensure that the MLL electricity network is engineered to the highest appropriate engineering and safety standards.
Insurance	Insurance to cover risks such as fire damage or professional indemnity, etc.
Staff succession planning	Assessment of staff age brackets, resourcing needs and forward planning.

Table 53 - Risk Treatments implemented by MLL

7.3.5 Treated Risk Matrix

Once the identified risks were entered into the register they are grouped into a risk matrix to allow further, more detailed assessment of MLL's risk exposure and this is presented in **Error! Reference source not found.** below.

Likelihood	Insignificant	Very low	Minor	Some	Moderate	Considerable	Major	Severe	Catastrophic
Almost certain	0	0	0	0	0	0	0	0	0
Very Likely	0	0	0	0	0	0	0	0	0
Likely	0	1	0	0	0	0	0	0	0
Very possible	2	0	0	0	0	0	0	0	0
Possible	0	1	0	0	3	1	0	0	0
Somewhat possible	1	2	2	2	0	1	1	1	0
Unlikely	1	5	3	16	1	0	0	0	0
Very unlikely	2	3	9	6	4	1	0	0	0
Rare	2	5	5	2	2	0	0	0	0

Figure 31 - Count of post-treatment risks

The highest ranked post-treatment risks fall under the category "Moderate" (having a risk score between 24 and 33). The four highest ranked risks relate to either failures at the single Transpower GXP or failures of Retailer generation, which are risks that MLL has limited capacity to mitigate. The highest risk fully within MLL's span of control is failure of single structures carrying multiple 33 kV subtransmission circuits for which MLL has specific contingency plans. Major natural disaster events such as earthquake and floods also list within the highest ranked risks.

Where possible, it is attempted to design identified Network risks out of the system, and mitigate or eliminate other risks through Network capital investment or changes to asset maintenance or work practices. Non-asset based solutions are also considered in these evaluations such as staff training and business system development.

However, it is not always possible or even feasible to eliminate risk altogether. Aside from natural disaster preparation (including considered placement of equipment and contingency plans), MLL also faces supply risk due to the nature of electricity and its position in the supply chain. For example, the risk of non-supply through the complete or partial unavailability of generation or transmission assets has an immediate effect on MLL's operations but is a risk beyond its direct control.

7.3.6 Highest Rated Risks

The ten highest assessed risks, following treatment(s), are presented in Table 54 below.

Risk Name	Description	Rank	Rating	Pre-treatment Rating
Full Supply Outage - Transpower Transmission Network Failure	The inability of the Transpower transmission network assets to safely convey electricity within the supply regulations, through the loss of key equipment at the Blenheim GXP or multiple transmission line failures.	1	Moderate	Considerable
Full Supply Outage - Retailer Major Generation Failure	Major generation failure causing the unavailability of electricity within the supply regulations to the Marlborough region.	2	Moderate	High
Partial Supply Only - Transpower Transmission Network Failure	The inability of the Transpower transmission network assets to safely convey electricity within the supply regulations, due to the loss of transmission assets i.e. a supply constraint (above the Blenheim GXP).	3	Moderate	Moderate
Partial Supply Only - Retailer Major Generation Failure	Major generation failure causing diminished supply availability of electricity (within the supply regulations) to the Marlborough region.	4	Moderate	Considerable
Multiple 33kV circuits on single structure	Waihopai and Redwoodtown feeders along Murphy's Road	4	Moderate	Moderate
Major Earthquake Damage to MLL Distribution Assets	Major natural environment impact on MLL distribution assets causing the unavailability of electricity supply to part or the entire Marlborough region.	4	Moderate	Considerable
Price Path Threshold Regime Breach	Price Path threshold regime breach, leading to investigation and possible targeted control of MLL (price setting)	7	Moderate	Considerable

Risk Name	Description	Rank	Rating	Pre-treatment Rating
MLL Staff Injury / Incident	A network incident or personnel injury, due to the breakdown of the MLL network access and control systems.	8	Some	Considerable
Quality Threshold Regime Breach	Quality threshold regime breach, leading to investigation and possible targeted control of MLL (price setting)	8	Some	Considerable
33kV Overhead Line Failure	The inability of the MLL distribution network assets to safely convey electricity within the supply regulations. Highest risk - high wind speed activity or snow loading.	10	Some	Moderate

Table 54 - Highest Risks

7.3.7 General Risk Commentary

From the risk study analysis presented in Table 54 the following conclusions are drawn:

1. The overall post-treatment risk profile of MLL is presently constrained to acceptable levels.
2. The annual review of the risk register and its associated treatments will allow ongoing monitoring of this profile.
3. MLL faces a broad range of Network- related risks, but the technical expertise and operational experience of MLL has allowed the development of an equally broad range of effective treatments.
4. The most significant risks identified are in many cases inherent to the industry. There are many treatments already in place for these risks and more treatments are investigated and implemented as the business develops.
5. MLL's 33kV lines and zone substations carry some operational risk, but these are minimised by the diversity of the loads and the security offered by the existing configuration. At the time of this plan, all but one zone substation (rural), has 'n-1' transformer security. As the 11kV Network is rebuilt and upgraded, the configurations available for interconnecting other substations to liven part of a failed substation 11kV Network will be increased.
6. Double 33kV circuits on common poles are another source of risk, particularly on lengths of the circuits supplying the Spring Creek and Picton zone substations. A single motor vehicle accident in these areas could result in multiple zone substations losing supply. Customers in the immediate vicinity of any such vehicle accident could have supply interrupted for the duration of the time required to repair the damage. However, alternative supply routes available within MLL's 33kV and 11kV Networks would allow supply to be restored to all other customers by manual switching to alternative feeds. Contingency plans to recover from loss of these critical structures is also in place.

7. Earthquake: A programme of assessing critical structures for their compliance with relevant current structural design codes is continuing. Structures that are assessed as having unacceptable risk will be structurally strengthened to reduce the risk of failure.
8. Generally, the MLL Network is well constructed and maintained, with ongoing asset inspection and testing regimes in place. Monitoring of these systems and routine Network operation has not identified any significant untreated risks.

7.4 High impact, low probability events

Whilst of low probability, events of high consequence form a special group of risks generally dealt with through the Emergency Preparedness Plan. These risks are summarised in the below table.

Description	Treatment	Notes
Earthquake resulting in major damage to Network	Emergency Response Plans	Network is predominately overhead and is therefore relatively resilient, and quick to repair once access can be obtained.
	Seismic strengthening	Where appropriate, strengthening structures (such as key buildings and zone substations) to improve resilience to seismic events
Weather event resulting in major damage to Network	Emergency Response Plans	Network has proven resilient to flood damage, widespread wind damage, repairs generally quick: use of contractors and staff from other unaffected regions of NZ key part of solution.
Loss of Grid Exit Point due to aircraft accident or deliberate destruction	Rebuild temporary 110/33kV sub site	GXP is resilient against equipment failure and/or fire, with three transformers and two switch-rooms. MLL's Network configuration allows a temporary GXP to be established at alternative locations.
Loss of Transmission capacity	Use of generators to keep emergency services operational	No real alternatives. Transpower Network is vulnerable to damage in the Rainbow area and Hira Forests.
Forest fire resulting in loss of both 33kV lines to Picton for extended period of time.	Use of generators to provide supply	Generator connection points are installed but generators could only provide limited supply for limited hours.
Tsunami damage to Network	Emergency Response Plans	The parts of the Network at risk from tsunami have been identified and consideration given to dealing with effects of tsunami.

Table 55 - High Impact Low Probability Risks

The most significant high impact, low probability event is a major earthquake causing widespread damage. Earthquakes are difficult to predict and severe damage is considered to be a very low probability, hence the inclusion of this in the high impact, low probability events.

In any earthquake scenario the most significant damage (and most expensive to repair) is likely to be to underground cables. MLL has relatively few kilometres of underground cables and can cope with widespread damage by undertaking repairs, installing temporary overhead or new underground cables relatively quickly.

Overhead lines have proven to be relatively resilient to even quite strong earthquakes and can be repaired relatively easily.

The final areas of vulnerability associated with a major earthquake are the zone (33/11kV) substations. Currently the buildings are insured but the plant is not. It is possible that a major earthquake event could damage multiple zone substations. If this occurs the duration of the recovery process is less likely to be limited by funding than by the provision of spare transformers, switchgear and the time and resources necessary to reconstruct the sites or establish temporary new sites. In the case of the Christchurch Earthquake Sequence, although a number of the Christchurch substations experienced liquefaction, actual damage to transformers and switchgear was slight. Upon review this has largely been put down to seismic strengthening works that were undertaken on substations prior to the Christchurch Earthquake Sequence.

Figures showing the likely liquefaction zones and tsunami zones for Marlborough are included in Appendix F. These figures were produced as part of a detailed study and report commissioned by MLL to better understand the risks associated with major earthquakes to the Network.

7.5 Emergency response plans

MLL's Emergency Preparedness Plan documents procedures for use in the event of major damage to the Network. It contains information on Transpower, the 33kV system, the zone substations, the 11kV lines, supplier's contact details, staff, customers and other information which may be useful at times of emergency. Contingency planning is regularly reviewed with consideration given to various "what-if" scenarios. This helps to ensure that the Network is prepared and that staff are well trained for any eventuality.

MLL operates a 24/7 fault service, with sufficient staff levels to ensure appropriate responses to any foreseeable event on the Network.

MLL is involved in Civil Defence and emergency management activities in conjunction with the Marlborough District Council and other key community groups. Liaison is, in the first instance, through the emergency services groups of each organisation. Regular meetings between MLL and the other groups are held to review and assess current plans.

Civil Defence involvement is not restricted to natural disasters, but includes any event – planned or unplanned – which disrupts the Marlborough area and may limit MLL's capability to respond. For example a large festival may place a high peak load on local infrastructure for a short duration.

Following on from the Christchurch Earthquake Sequence, MLL has reviewed the Emergency preparedness plan and the location of the control room. An emergency control room is available at our Springlands site, and could be quickly setup at the Taylor Pass site. An emergency repeater has been purchased to allow communications to be quickly re-established in the event of loss of existing systems.

MLL is part of a group of South Island lines companies that have agreed to a Mutual Aid Cooperative in the event of major disruption to individual or multiple Networks. MLL sent staff and diesel generators to Kaiapoi and Christchurch following the Christchurch Earthquake Sequence.

8. Performance Evaluation

This section examines the comparative performance of MLL in relation to other Electricity Distribution Businesses (EDBs) operating in New Zealand and then examines the Network's achieved performance against MLL's service level targets. [4]

The comparative assessment shows MLL at, or better than, expectation levels compared to other EDBs with the noted exception of operational costs, which, although higher than expectation levels, are commensurate with an above average reliability performance in accordance with the service level target that has been set for this.

The comparative assessment together with the evaluation of performance against service level targets set the basis for the asset management strategies and plans set out in the remainder of this document.

8.1 Comparative Assessment

This section benchmarks MLL against other New Zealand distribution businesses under a variety of cost and service level criteria.

8.1.1 Operational Expenditure (Opex)

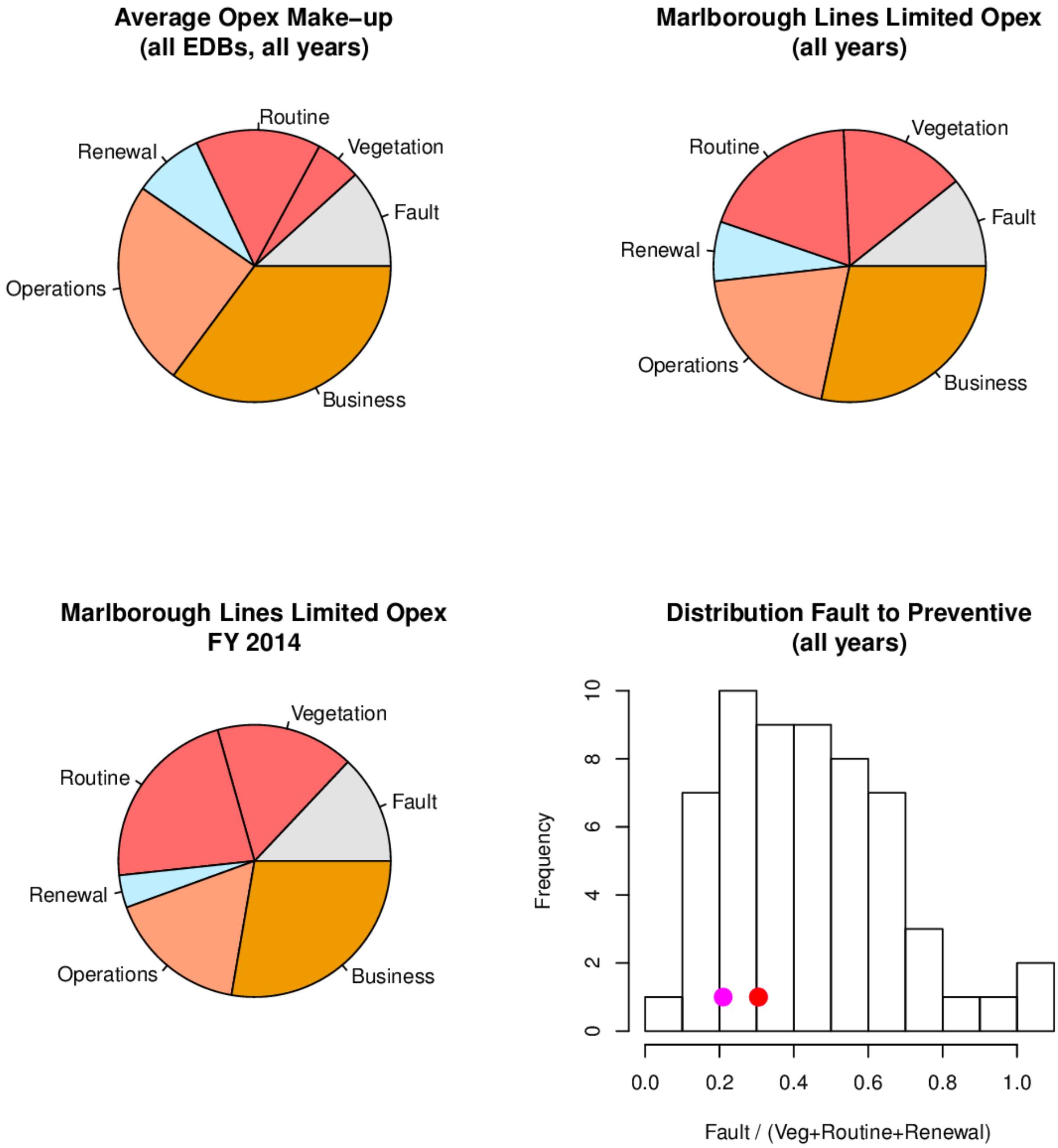
The chart of Figure 32 describes the proportions of MLL's operational costs in relation to the average of all EDBs taken together. This shows MLL's operational costs apportion much like other distribution businesses apart from a higher relative cost in vegetation management. Placing emphasis on vegetation management is a deliberate asset management policy and contributes to the better than expectation reliability performance of the Network discussed later.

The emphasis on preventive maintenance is also reflected in the lower than average 'ratio of fault to preventive maintenance' expenditure, also charted in Figure 32.

8.1.1.1 Direct Opex

Direct Opex is that proportion of operational expenditure spent directly on Network assets (as opposed to expenditure operating the Network and associated business support costs). The chart of Figure 33 shows a regression of direct opex in relation to the size of the assets being serviced – expressed in terms of a combination of the total circuit length and the transformation capacity. This shows MLL's direct opex is relatively high, although still within the confidence bounds of the regression model. Of note is the high direct opex cost in FY2014

[4] The comparative charts in this section apply the following convention unless otherwise noted: Red dot = FY2014 year performance; All years = FY2013 to FY2014; Purple dots = all years performance other than FY2014; blue line = regression expectation; blue dotted line = 95% confidence bounds on regression line; orange dotted line = 95% confidence on regression prediction; orange squares = outlier points; green points = exempt (trust-owned) EDBs.



compared to FY2013 which arose from wind storms and the Seddon earthquakes occurring within that financial year.

Figure 32 - Comparison of Opex

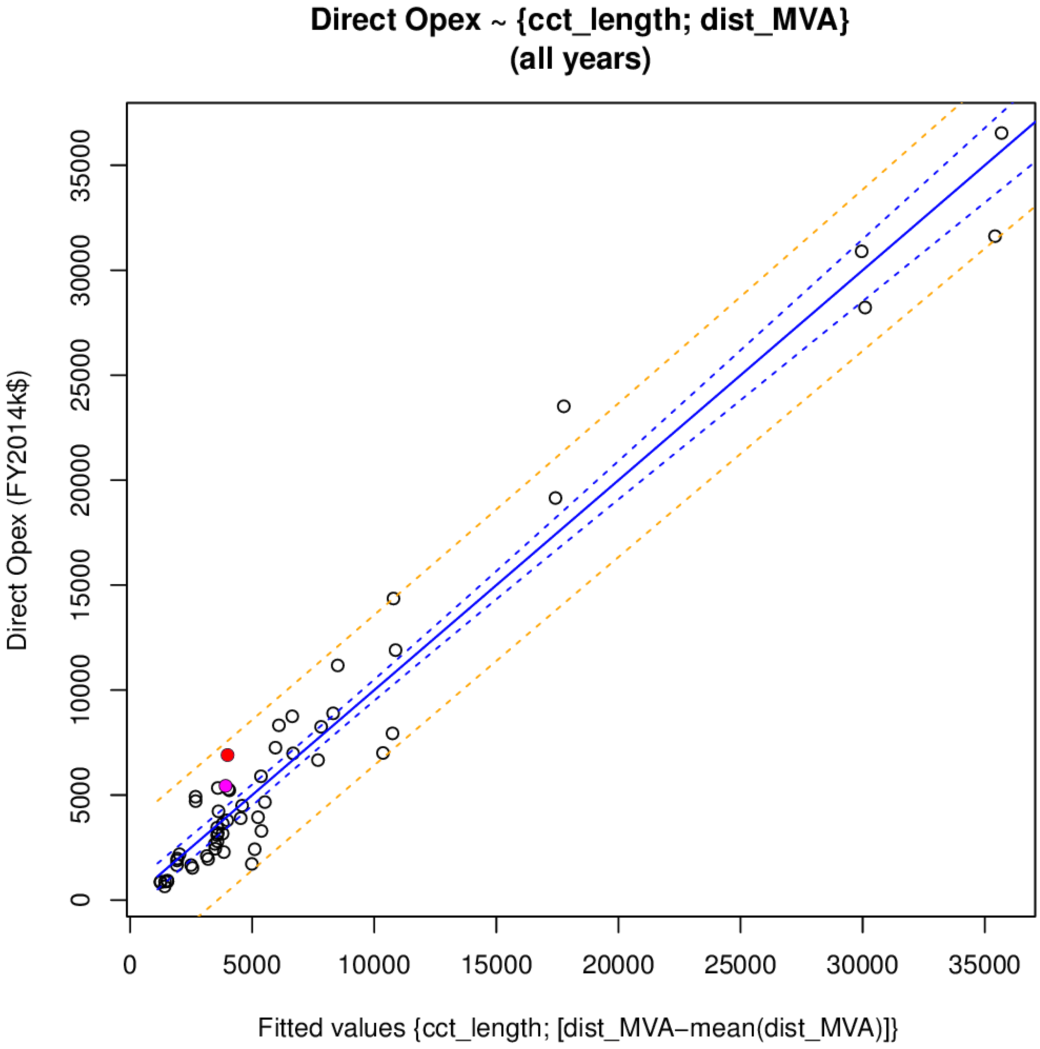


Figure 33 - Regression for Direct Opex

The higher than average direct operational costs again arise from the emphasis MLL places on preventive maintenance in achieving its Network reliability targets.

8.1.1.2 Vegetation Management Costs

As noted previously, vegetation management makes up a large part of the MLL direct costs. This is also revealed in the regression of vegetation management cost versus overhead line length, illustrated in the chart of Figure 34, which shows higher than expectation costs compared to other distribution businesses. Closer examination shows the degree by which vegetation management costs are above the expectation line is close to that by which the direct opex is over the direct opex expectation line – that is, the vegetation management costs alone largely account for the opex variance.

As noted previously however, emphasis on vegetation control is a deliberate asset strategy to meet the reliability targets set for the Network. As discussed later, the increased direct costs are balanced by the community value being created.

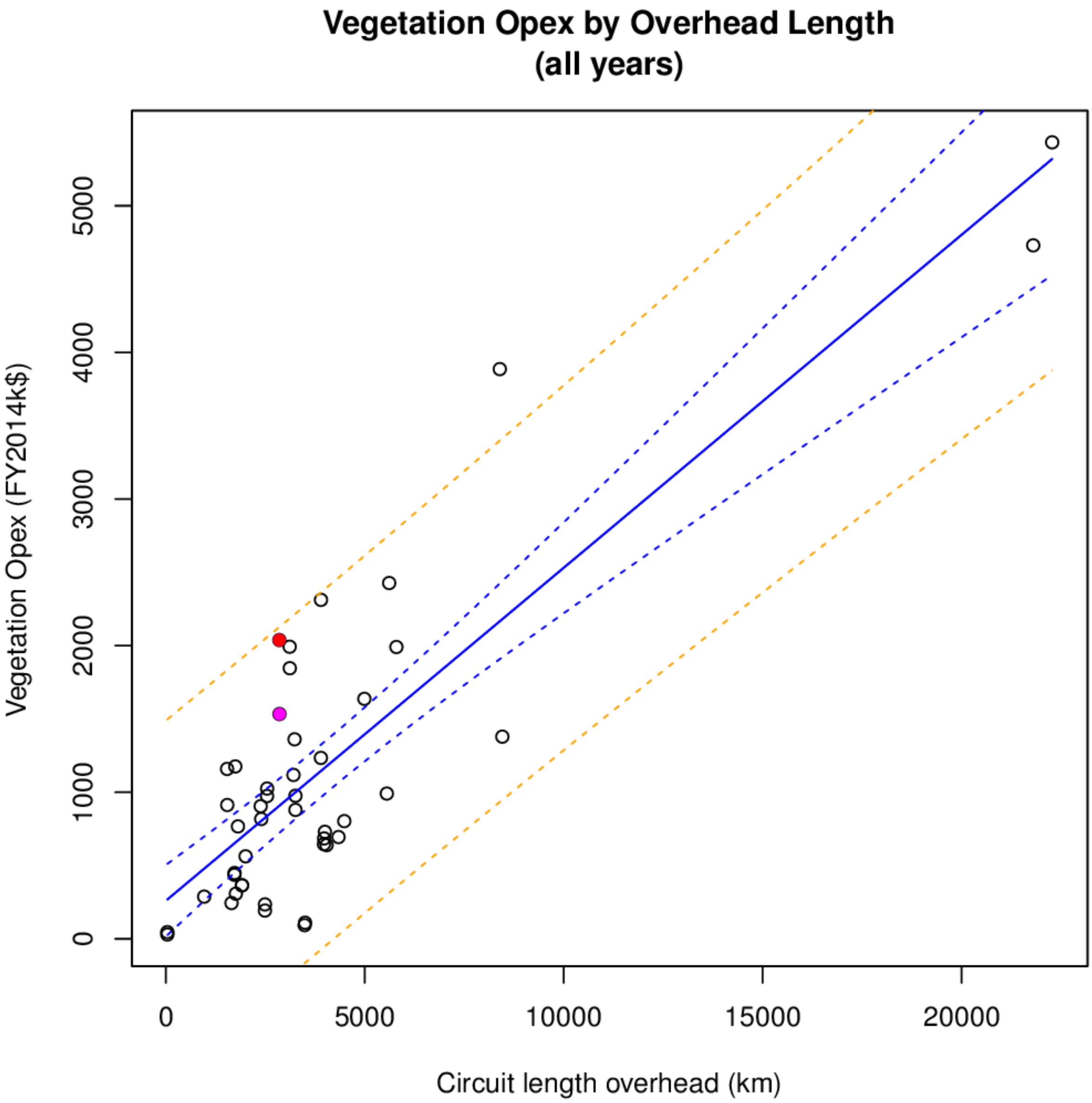
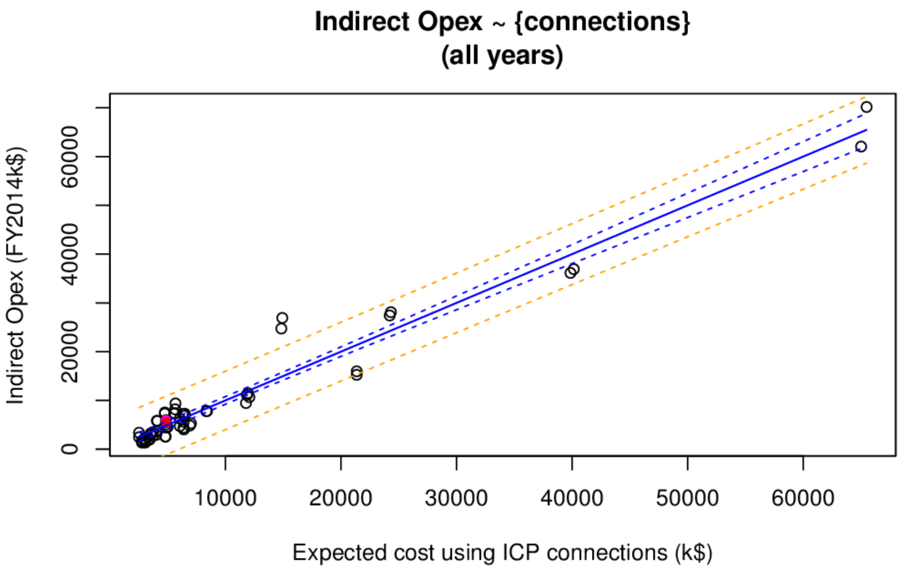


Figure 34: Regression Expectation for Vegetation Opex

8.1.1.3 **Indirect Opex**

Indirect opex is that portion of operational expenditure accounted to the operation of the Network (i.e. switching and system control etc.) and to the business support functions associated with running a Network business. The comparative indirect opex of MLL in relation to other New Zealand distribution businesses is illustrated in Figure 35 below, where the costs are compared against the number of customers and against the regulatory value of the Network assets. Under both measures, MLL plot close to the regression expectation indicating expenditure in this category is at appropriate levels.



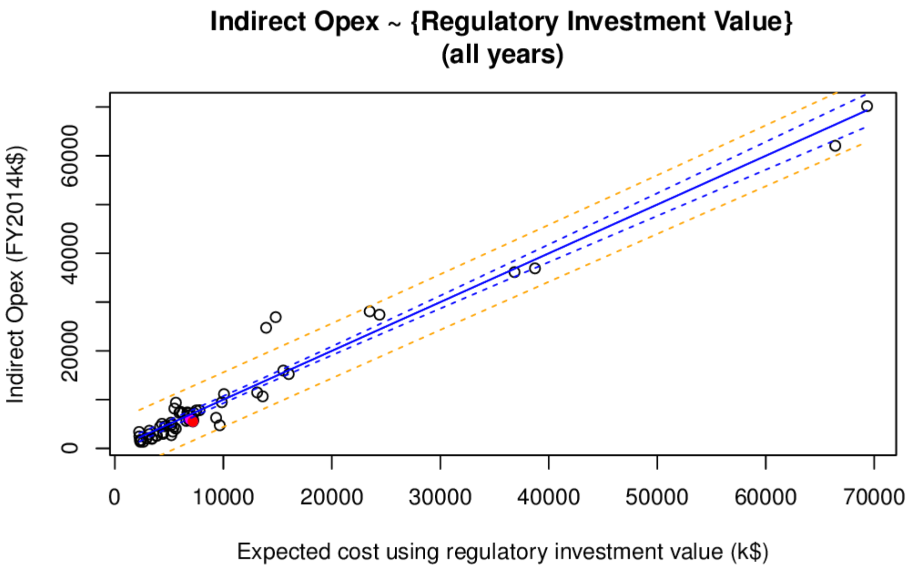


Figure 35: Expectation for Indirect Opex

8.1.2 Capital Expenditure (Capex)

Capex is accounted, for regulatory purposes, under five categories: connections, growth, renewal and replacement, reliability and safety, and non-network. Categories of growth, reliability and safety and non-network are not readily amendable to comparative assessment; as capital projects in these categories are highly circumstantial for each business and expenditure control relies on the capital governance processes in place –i.e. each project is supported on its own business case. Connection Capex (the cost of establishing new load connections onto the Network) is more amenable to comparative assessment as discussed next. Renewal and replacement work is also highly circumstantial but, as age is a major driver of renewal and replacement, this category of capital expenditure may be broadly compared through modelling of the asset populations and this aspect is also discussed.

8.1.2.1 **Connections Capex**

The comparative regression for connections Capex is provided in the chart of Figure 36. A large scatter is evident arising from the significant approximations in this regression. [5] However, MLL plot on or below the regression line indicating, prime-facie, that MLL's costs in this category are not excessive.

[5] In particular that the information disclosure only identifies the change in connections numbers so is net of disconnections (hence the large negative point which is for Orion in FY2013 being a consequence of the Christchurch earthquake). Also, the apportionment of urban and rural connections in the regression relationship assumes these split as per the urban/rural line length ratio which will not be true is all cases. The accounting of capital contributions will also be a factor.

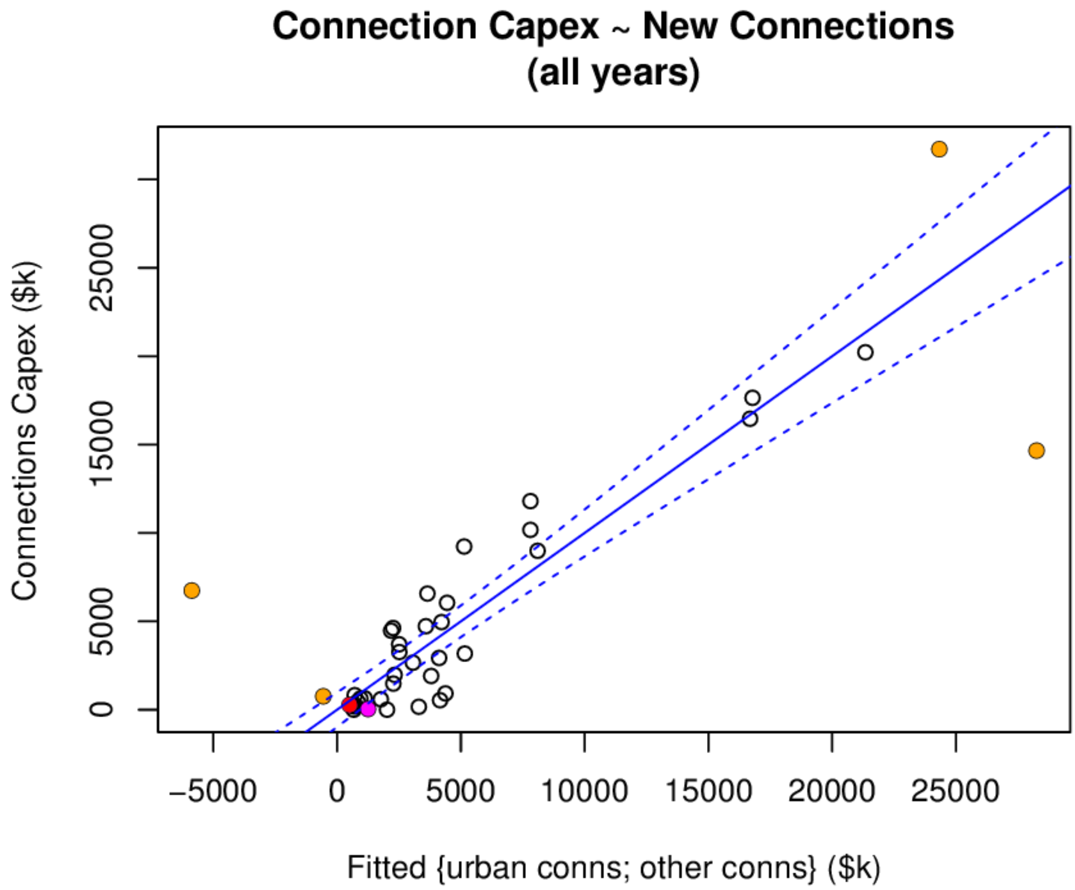


Figure 36: Expectation for Connections Capex

8.1.2.2 **Renewal and Replacement Capex**

This section is based on extracts from the Hyland McQueen Ltd comparative benchmarking review of electricity distribution businesses for FY2014. The model applied considered the replacement probabilities with age of Network assets under 51 categories and is calculated using the combined age profiles of asset classes over all distribution businesses in New Zealand. When applied to each business separately, the model indicates, in broad terms, the expected renewal and replacement Capex forecast of the "average" business in the circumstances of the asset numbers and asset ages of the particular business.

When applied to MLL, the model agreement is reasonable, as illustrated in Figure 37 below, indicating MLL's forecasts for replacement expenditure is not unreasonable in comparison to what other businesses might spend in its particular circumstances. More detailed breakdown shows the main area of difference is in sub-transmission lines' expenditure where it is known that MLL's practice of building replacement sub-transmission lines at higher voltage rating will increase the effective replacement rate. However, MLL undertakes this form of re-construction to improve Network reliability and to build future provision for the load transfer capability of its sub-transmission circuits.

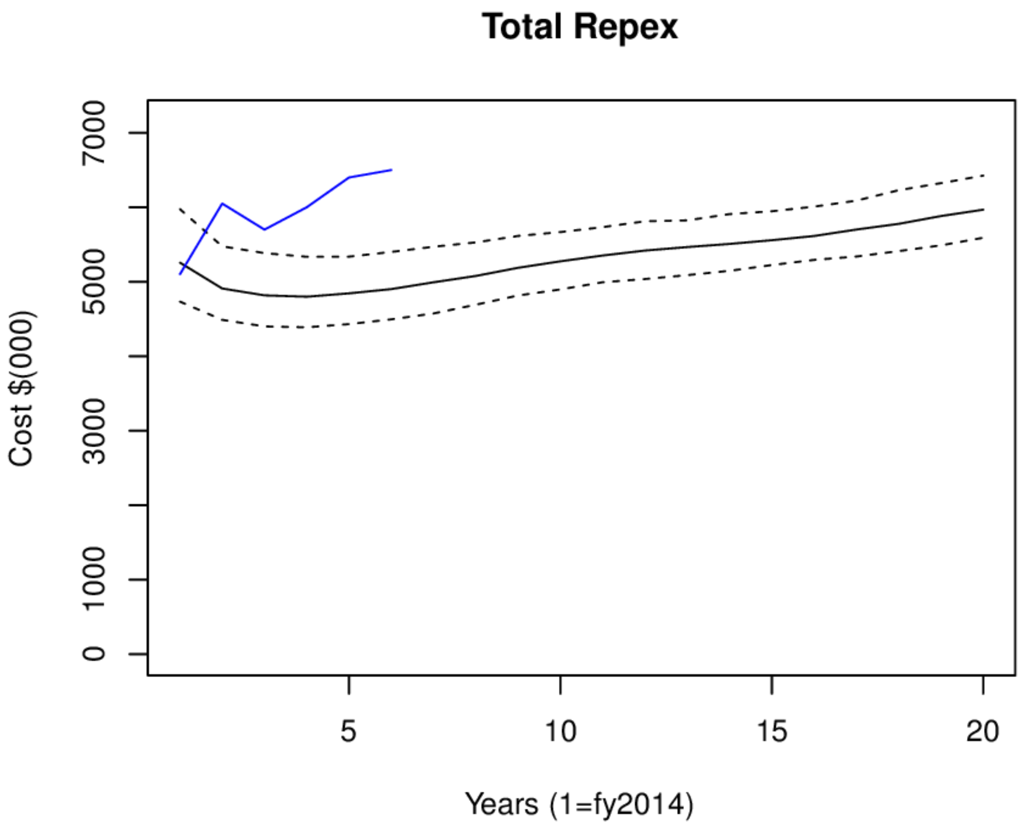


Figure 37: Replacement Capex Forecast (blue) and Model (black)

Further analysis of the individual asset age profiles for MLL assets in relation to the all-NZ average age profiles for the same asset classes reveals no evidence of a building "backlog" of over-age assets on the Network, as further detailed in Appendix B.

8.1.3 Regulatory Asset Base (RAB)

The charts of Figure 38, Figure 39 and Figure 40 compare the MLL regulatory asset base (RAB) value in relation to other Network businesses. Figure 38 shows the comparative composition where MLL shows much like the "average" business, apart from a higher proportion of Non-Network assets which derives from the inclusion of the contractor business assets. These are mainly vehicles and plant and would be excluded from other companies where maintenance and construction resources are contracted from external providers.

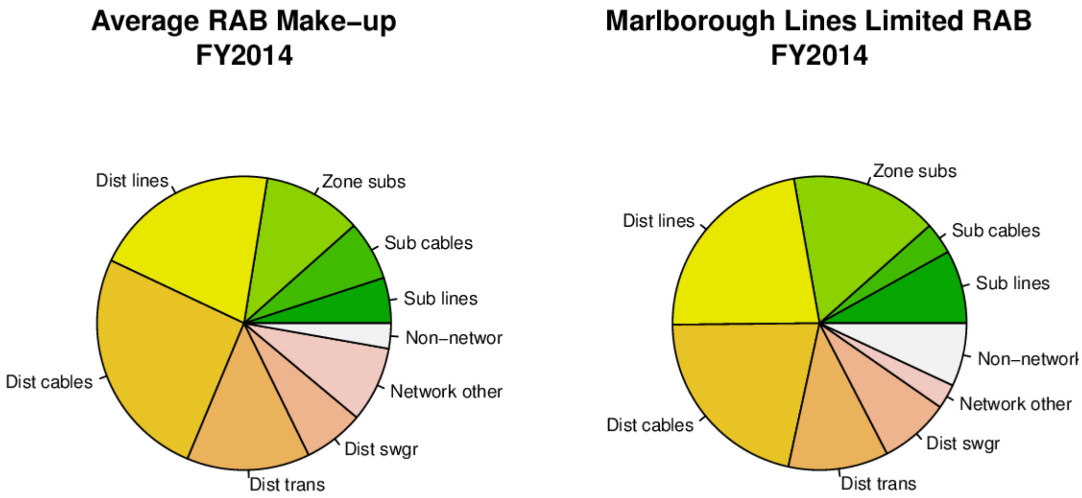


Figure 38: Comparative Composition of RAB

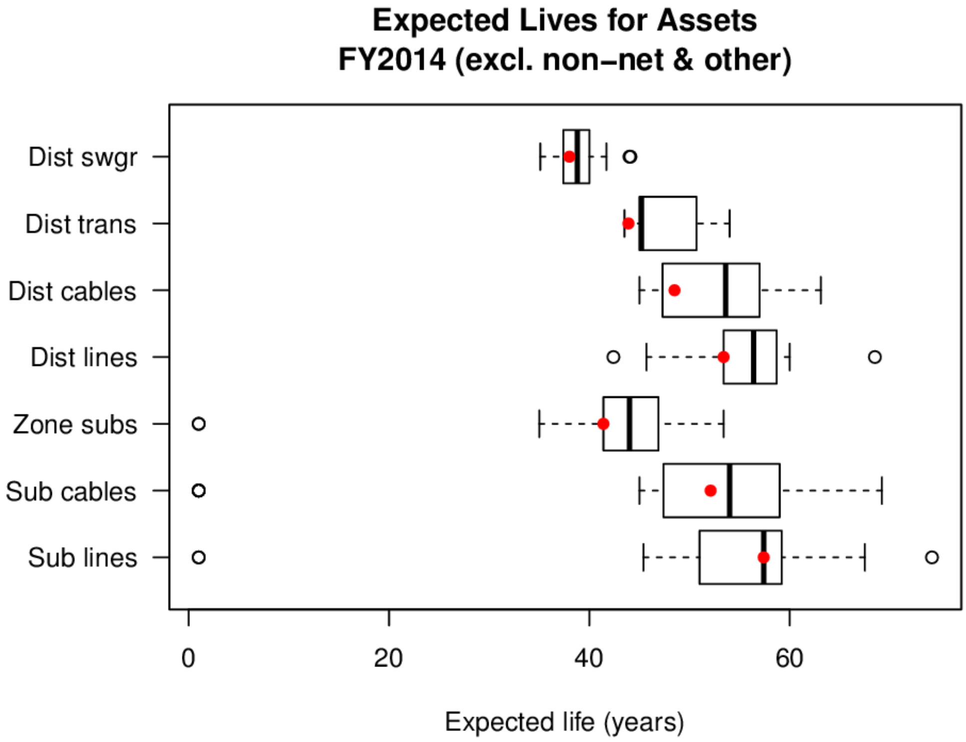


Figure 39: Depreciation-based Lives and Consumption of Life

The chart of Figure 39 (above) describes the cost-weighted depreciation-based lives and life consumption of MLL's assets compared to other businesses. MLL show within the +/- 50 percentile for expected lives apart from distribution transformers. In the comparison of consumption of life, MLL show as having a relatively low consumption of life (i.e. on a cost-weighted basis MLL is a relatively young Network) although again, most asset classes plot within the +/- 50 percentile boxes.

The chart of Figure 40 regresses the FY2014 RABs for all New Zealand distribution businesses against a measure of the Network total circuit length and transformation capacity adjusted to the weighted remaining life of the assets using standard regulatory lives. Essentially this is a comparison of the Network depreciated valuations against the size, capacity and age of the different Networks. As shown, MLL plots above the regression but within the confidence bounds of this regression. As noted previously, MLL includes the value of the internal contractor plant and vehicles which, together with the relatively low depreciated age of the assets will contribute to the above regression line position. The built value of the Network therefore appears in line with what might reasonably be expected based on the values of other businesses and in consideration of the size and age of the MLL Network.

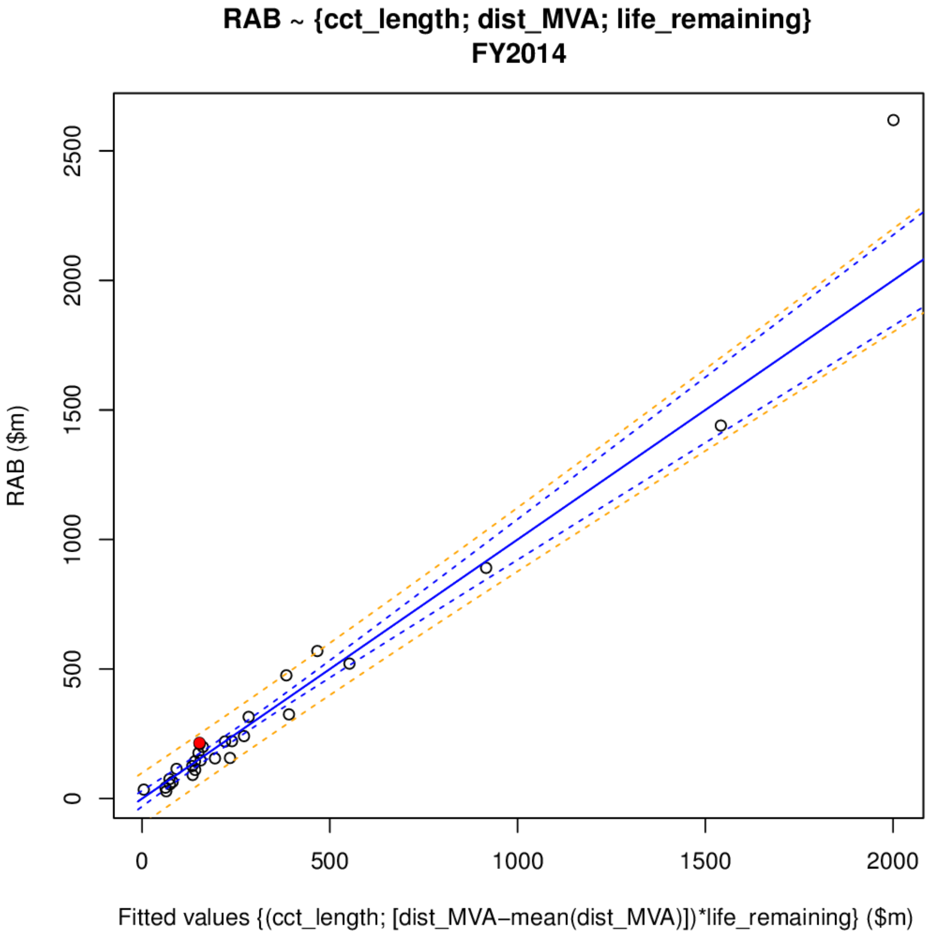


Figure 40: Regression for Expected RAB

8.1.4 Network Reliability

The average duration of non-supply per annum (SAIDI) is the key measure of the "average" customer's experience of supply reliability. SAIDI is derived from the multiplication of the average number of interruptions (SAIFI) and the average duration of an interruption (CAIDI). Comparative performance of both SAIFI and CAIDI measures are examined within this section of the AMP, with SAIDI looked at in section 0.

8.1.4.1 Comparative SAIFI

For comparison purposes, SAIFI is further divided between planned and un-planned (fault) SAIFI, both of which are regressed against Network size and type and plotted in Figure 41 and Figure 42 respectively.

Planned SAIFI is regressed against the length of non-urban overhead line (the rational being that within urban Networks the closer meshing of the Network allows back-feeding reducing the impacts of planned outages). As the explanatory power of this regression is not high (the point scatter is very large), meaningful comparisons should be avoided, but it is at least worthy to note that MLL plots close to the regression line indicating the performance in number and impact of planned outages is, on the face of it, not unreasonable in this comparison.

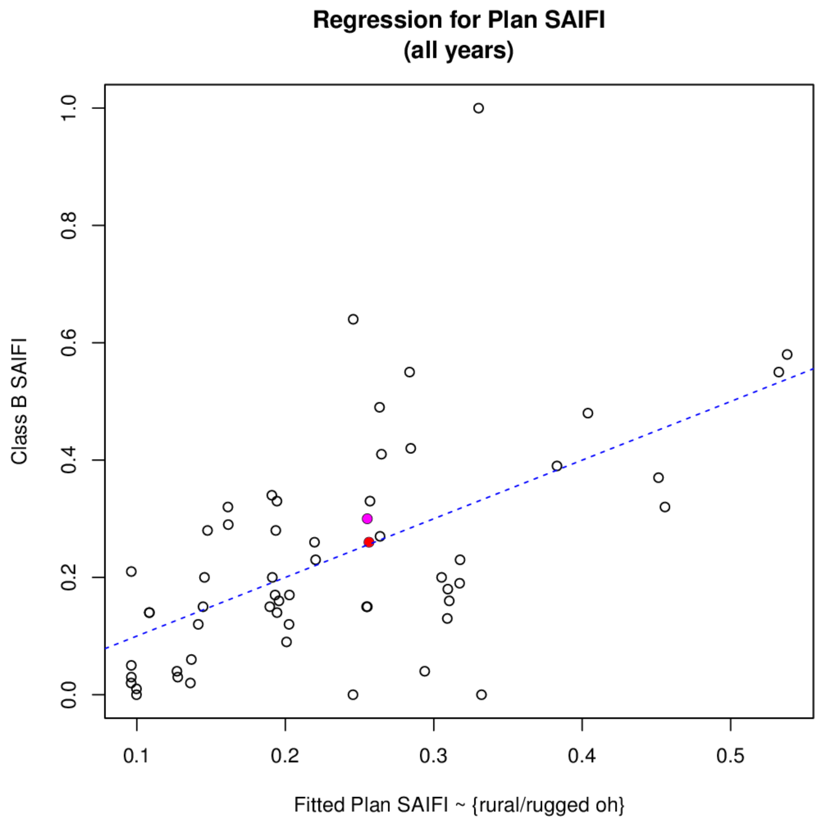


Figure 41: Regression for Plan SAIFI

Unplanned (fault) SAIFI is also regressed on the basis of the scale of exposure (Figure 42). The explanatory power of the regression is mildly better and shows MLL plotting below the expectation line for frequency of fault outages, even for FY2014 which was a particularly onerous year for storms and unavoidable events (such as the Seddon earthquakes).

Taking FY2013 as a more representative year, MLL shows at near frontier performance being approximately 0.5 below expectation SAIFI. This would translate to a community value of approximately $0.9m per annum in avoided power losses.[6]

[6] This calculation assumes average CAIDI of 120 minutes per interruption; a loss per connection of 1.5 kW; 24,500 network customers; and a value of lost load of $24/kWh.

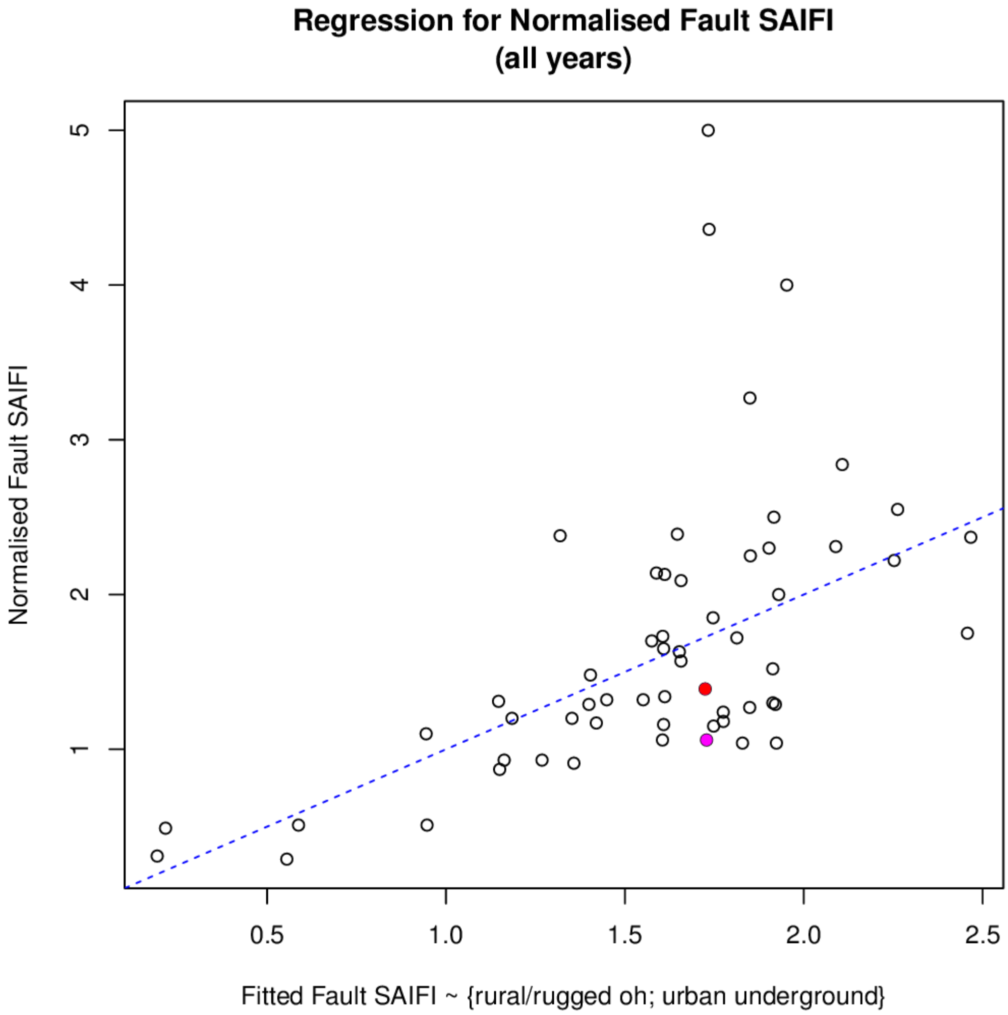


Figure 42: Regression for Normalised Fault SAIFI

The trend in overall SAIFI is also downward for MLL compared to a relatively flat trend for all distribution businesses combined, as illustrated in Figure 43 following. This, together with the lower than expectation unplanned interruption frequency, shows the MLL Network is responding to the reliability strategies being applied.

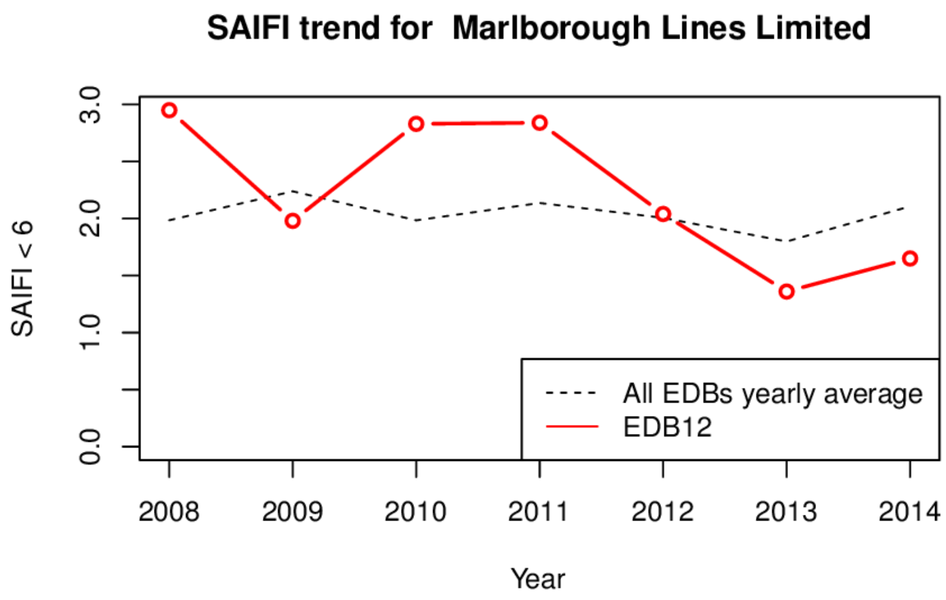


Figure 43: Total Normalised SAIFI Trend

8.1.4.2 **<u>Comparative Fault Rates</u>**

SAIFI is also affected by Network design changes such as the installation of reclosers that reduce the number of customers affected by a fault. It is therefore useful to also examine the underlying fault rate as a better measure of the underlying susceptibility of the Network to faults. The charts of Figure 44 compare the fault rates per length of Network exposure in both sub-transmission and distribution (excluding LV), for overhead line and underground cable circuits. On all measures, MLL plots within the confidence bounds and mostly on the regression line apart from sub-transmission cable circuits in FY2014 which reflect faults caused by the Seddon earthquake.

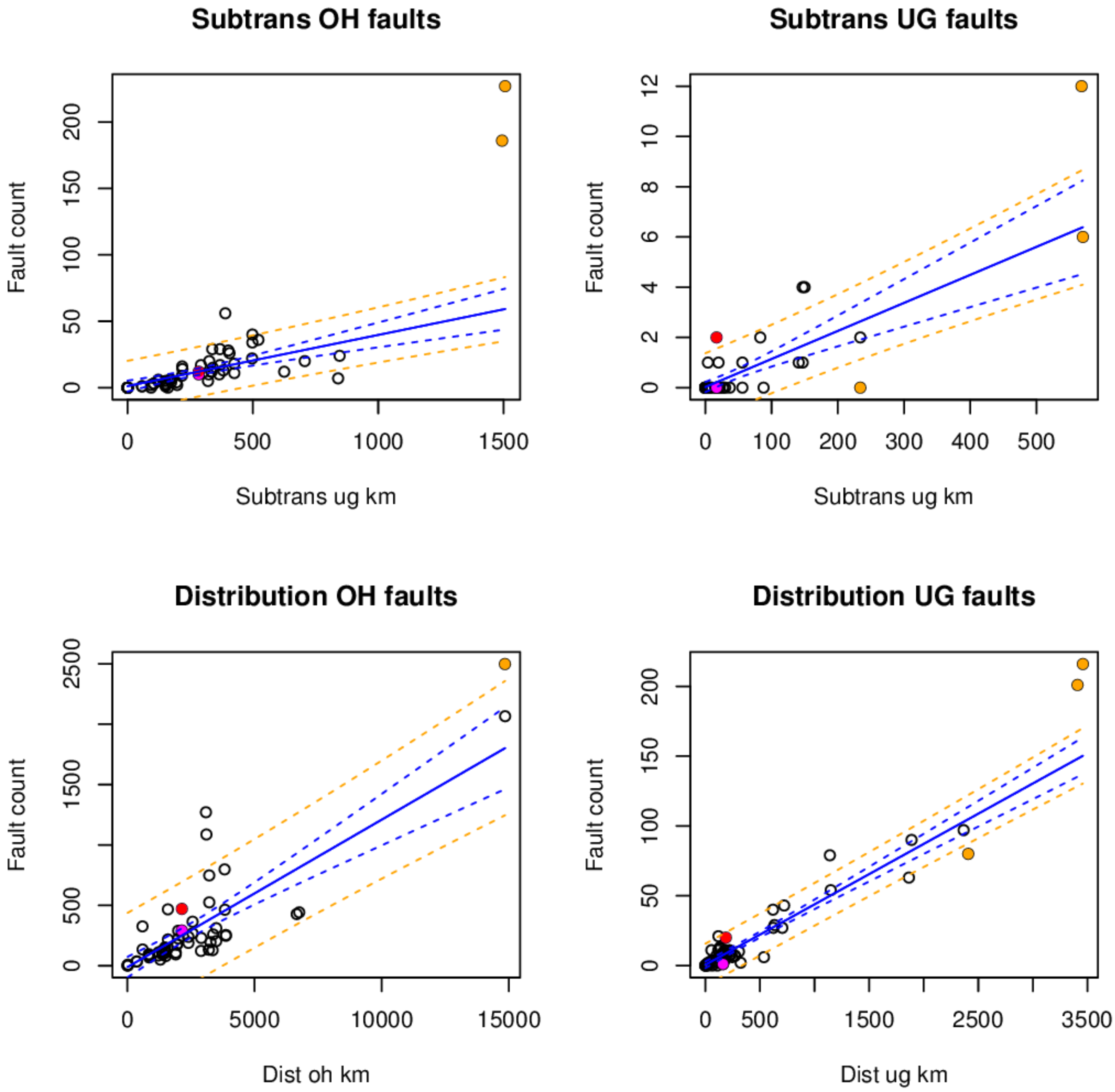


Figure 44: Fault Counts by Network Exposure

8.1.4.3 Comparative CAIDI

CAIDI of itself is not a particularly useful comparative measure as it does not correlate with Network exposure or other Network characteristics. Indeed, the most useful comparison is how the spread of CAIDI across time compares to the all-NZ CAIDI distribution. Even an increasing CAIDI trend is not of itself concerning as this can simply be a reflection of a Network addressing the more dominant shorter duration faults leaving a smaller number of larger duration faults to increase this average duration measure. Indeed, a gradually rising CAIDI trend is to be expected with a falling SAIFI trend and this is the case with MLL.

The distribution of CAIDI compared to the New Zealand-wide experience is illustrated in Figure 45 following and shows MLL consistently plotting within the characteristic distribution for all EDBs. The comparative CAIDI trend is presented in Figure 46 and shows a gradually increasing trend as discussed above. Given the lower than expectated SAIFI, the CAIDI performance is well within the bounds of expectation on a comparative basis.

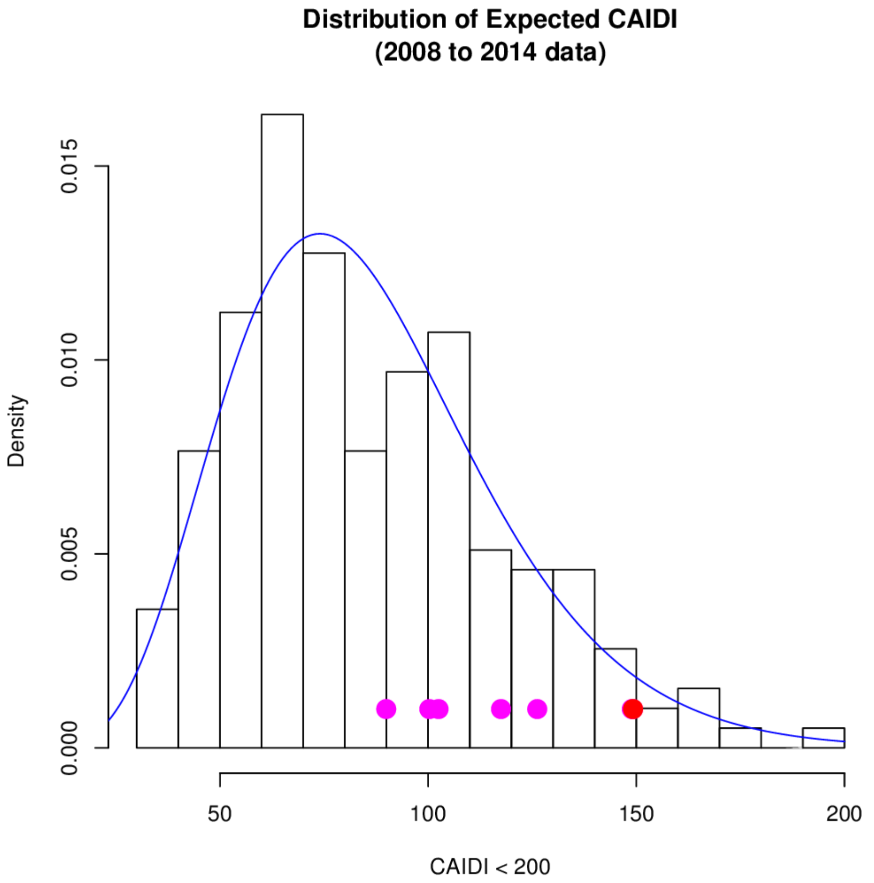


Figure 45: Distribution of CAIDI (all EDBs [bars] + MLL performance [dots])

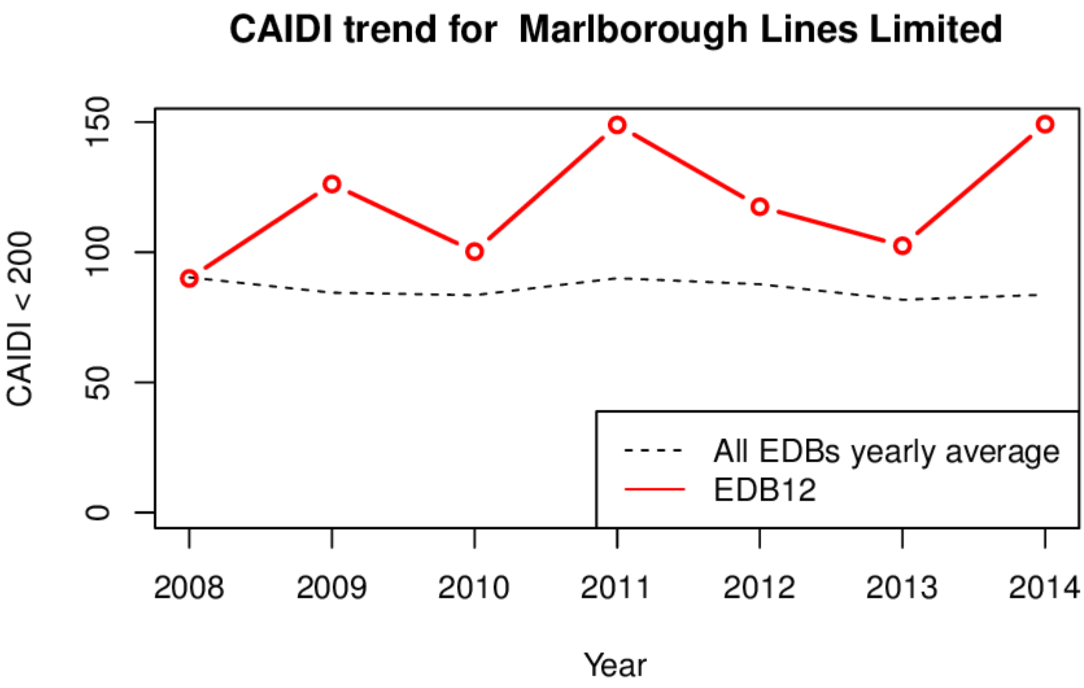


Figure 46: CAIDI Trend

8.1.5 Comparative Technical Performance

8.1.5.1 Network Losses

Figure 47 regresses the disclosed Network losses against the energy through-put and circuit length (on a log-log scale). This shows MLL plots close to and slightly below the Network losses expectation given its circuit length and energy through-put in this comparative assessment. This indicates there no reason for concern in terms of MLL's Network conductor sizing and circuit loading arrangements.

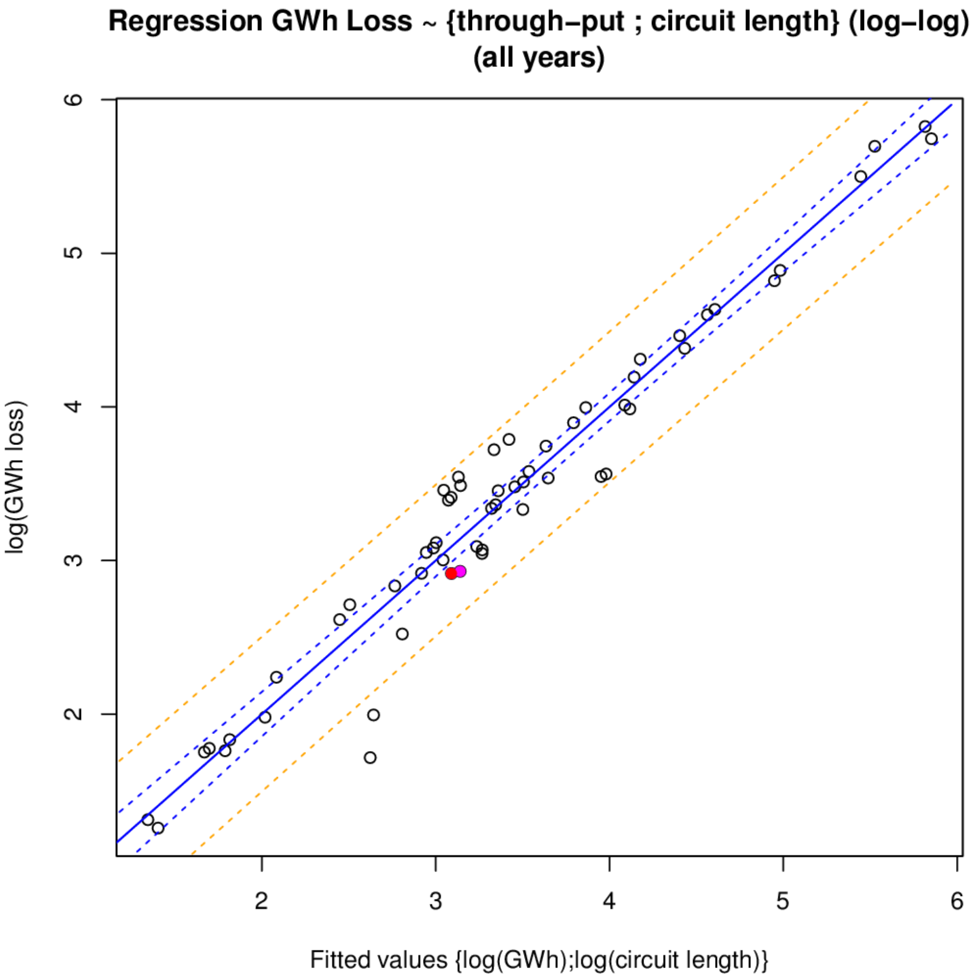


Figure 47: Expectation of Network Losses

8.1.5.2 <u>Comparative Transformer Utilisation</u>

Figure 48 regresses the disclosed distribution transformer utilisation (measured as the ratio of system maximum demand to the installed distribution transformer capacity) under three scenarios: nominal utilisation regressed against the total energy through-put per km; utilisation adjusted to remove the effect of non-standard (large industrial) loads; and utilisation adjusted to remove the effects of both non-standard loads and the non-business owned distribution transformer capacity. [7] In all three measures, MLL plots close to the regression expectation, particularly where the effect of non-standard load is removed. The charts indicate that, within the limitations of this

[7] The points marked with orange squares are EDBs where the ratio of non-standard energy delivered is greater than 25% as this degree of non-standard load may lead to misinterpretation under this measure.

performance measure, MLL's design practices for transformer sizing and loading appear reasonable.

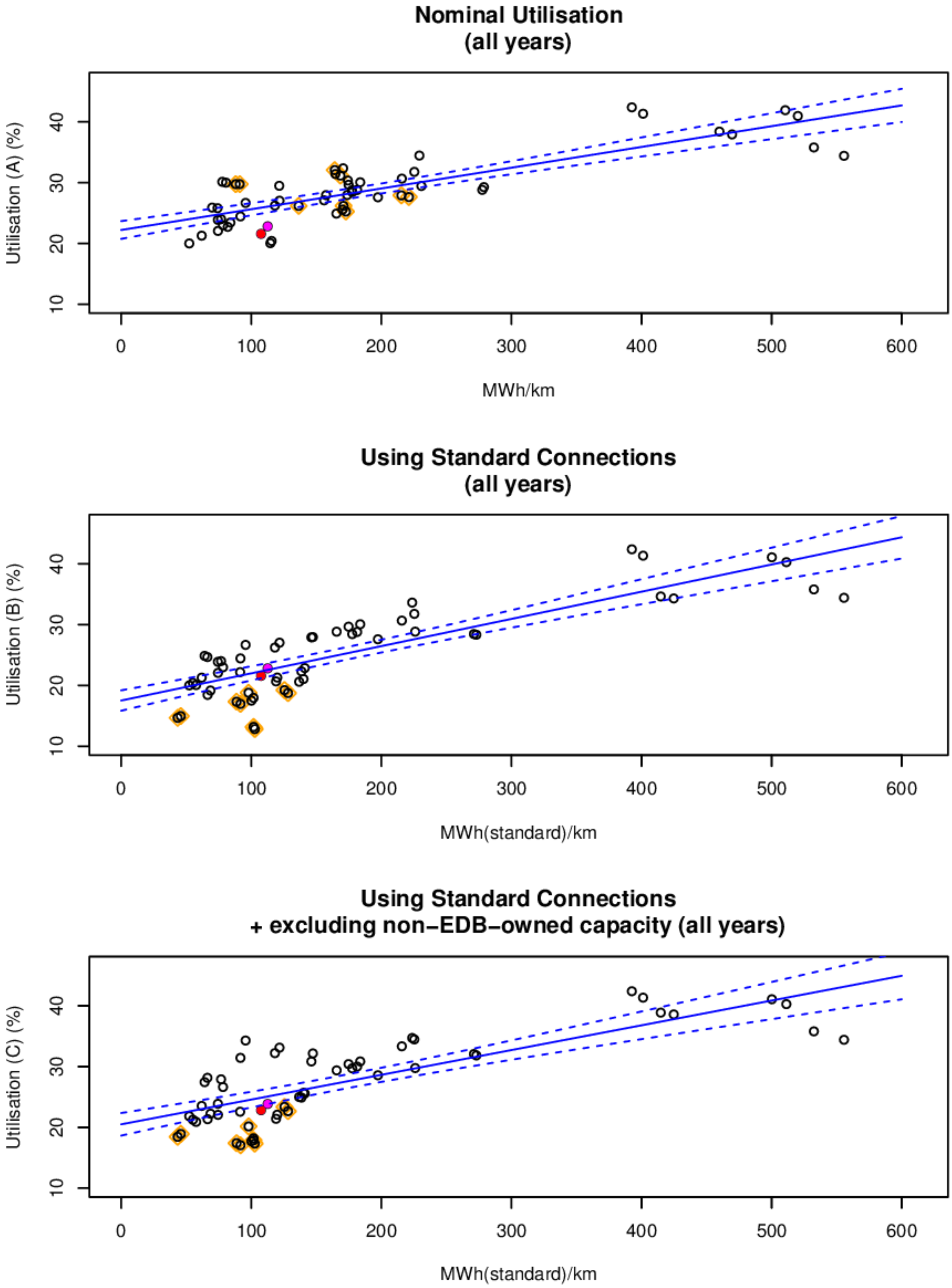


Figure 48: Distribution Transformer Utilisation

8.2 Performance against Service Level Targets

This section examines MLL's performance in comparison to its own service level targets.

8.2.1 Customer Satisfaction by Survey

Customer perception is an important component in considering business performance. This aspect of performance is measured based on informal communications with customers as well as a formal independent survey of customer views.

In addition to direct customer communication methods, MLL has several other mechanisms for indirect customer communication through its operations and commercial transactions. These include customer feedback from retailers, negotiated Use of System Agreements, negotiated Tariff schedules and Trust ownership governance.

An independent telephone survey of randomly selected Marlborough electricity customers was conducted in April 2014 to measure satisfaction with a range of performance measures, current attitudes towards MLL and customer preferences regarding company ownership and electricity industry regulation.

8.2.1.1 Results

Of the sample surveyed, 90% were satisfied with reliability and quality and 90% were satisfied with the fault service. Overall, 88% of the sample was satisfied with MLL's performance against a target of greater than 90%. This indicates a general acceptance of the asset management practices of MLL. The margin of error is ±3.5% at the 95% confidence level.

8.2.1.2 Discussion

As seen from the survey results and the high levels of satisfaction generally, Network performance and customer expectations are well aligned.

Customer feedback is utilised at many levels in MLL's asset management planning processes. For example, at a higher level the customer's desire for improved reliability helps to set MLL's overall service level targets for system and customer supply interruption frequency and duration (SAIDI, and SAIFI). At a lower level, this customer input is used to shape asset maintenance and replacement policies, as well as to develop and analyse system reliability improvement initiatives.

In summary, MLL considers that the customer feedback received reinforces its intention to pursue incremental improvement of its Network performance justified through cost-benefit analysis, as opposed to 'step change' solutions which would involve significant additional cost.

8.2.2 Network Performance – Planned Outages

For the FY2014 year, MLL set a service target of planned outages being less than 80 SAIDI minutes with less than 260 planned interruptions over the Network. The historic and FY2014 performance for planned outages is illustrated in the six charts of Figure 49 below. The top left chart shows the performance and trend in planned SAIDI and shows MLL outperformed its target in this area, with a consistent downward trend on this measure, particularly in the rural and urban areas.

The top right chart shows the distribution of planned outage times where the median outage in all areas is close to six hours. The middle left chart shows 95% of the planned outages are less than 450 minutes. The middle right chart shows the distribution of customers affected per outage and indicates that most outages affect relatively small numbers of customers. This arises from MLL's policy of supporting planned outage load through Network re-configuration and placing mobile generation for outages affecting large numbers of customers, where it is economically viable to do so.

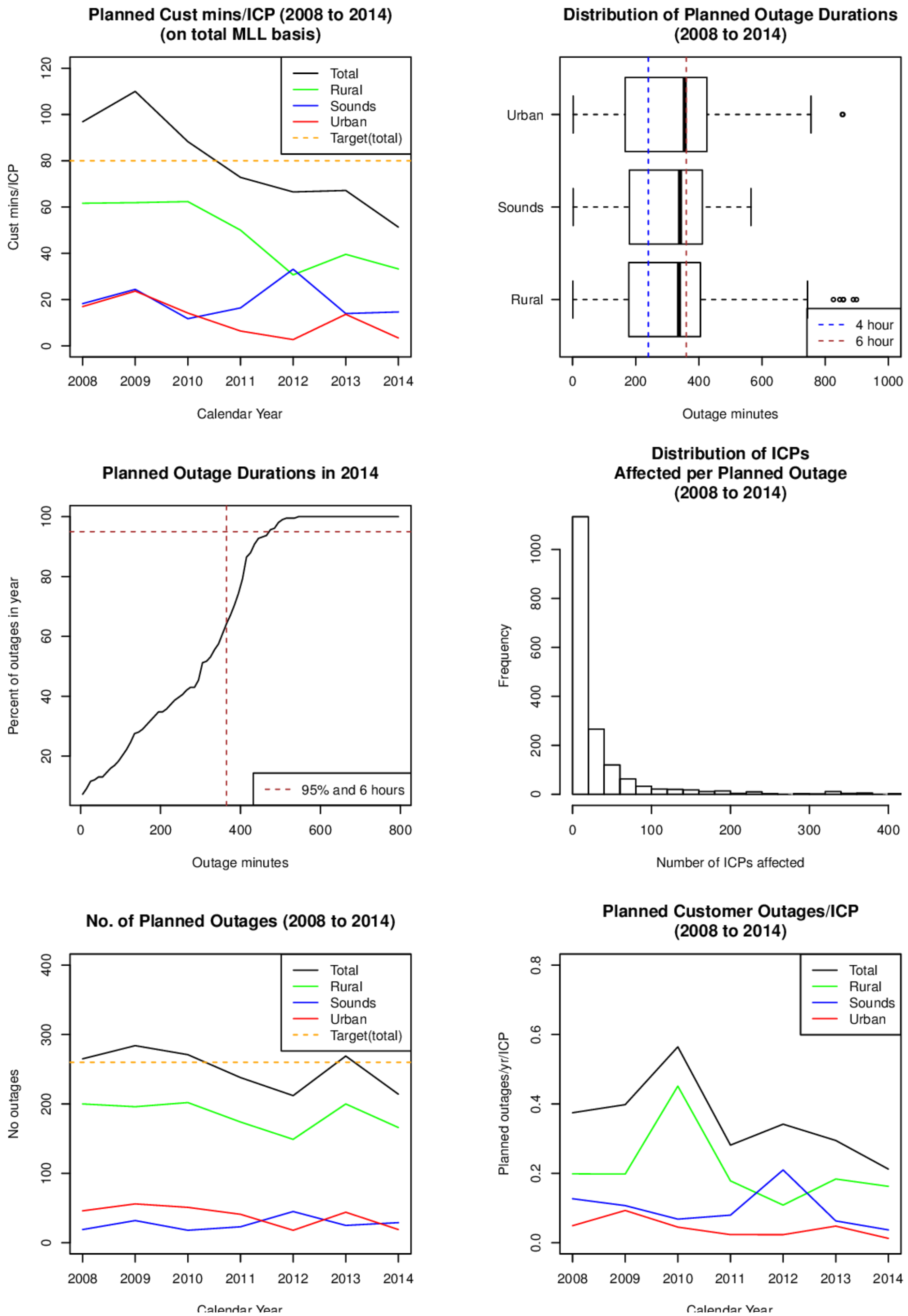


Figure 49 : Planned Outage Performance

The bottom left chart shows the performance and trend in number of planned outages per year and compares the total number of outages to the service target of less than 260. MLL's performance oscillates about this target indicating it remains a stretch target for MLL. The bottom left chart plots the number of planned outages per ICP (viz plan SAIFI) and shows a decreasing trend much like the plan SAIDI trends of the top left chart. This indicates the gains made in plan outage performance have arisen largely through reducing the average number of customers affected per planned outage, rather than a reduction in the average time per outage. Again, this is a result of asset management policies employing mobile generation and Network re-configuration to support customer load.

Given the comparative assessment of cost, further improvements in planned outage performance will only come from initiatives that show a strong cost benefit. In this context, seeking further reductions in planned outage SAIDI is more likely through innovation in planning and work processes that reduce the average outage duration.

8.2.3 Network Performance – Forced Outages

For the FY2014 year, MLL set service targets for unplanned (forced) outages of:

1. Fault response times of less than or equal to:
   a. Blenheim Urban 1.0 hours
   b. Urban Other 1.5 hours
   c. Rural 4.0 hours
   d. Remote Rural 8.0 hours

2. Customers experiencing at least one outage lasting more than 8 hours: <1000

3. Customers experiencing 9 or more interruptions in the year; <2500

4. Momentary interruption [less than 1 minute] (MAIFI): < 3

5. Total SAIFI < 1.8 (average number of interruptions/ICP/yr)

6. Total SAIDI < 90 minutes with sub-targets of:
   e. Urban SAIDI < 12 (equivalent to a SAIDI of 23 on an area population basis)
   f. Rural SAIDI < 57 (equivalent to a SAIDI of 124 on an area population basis)
   g. Sounds SAIDI < 21 (equivalent to a SAIDI of 252 on an area population basis)

7. *Total number of fault interruptions as:*
   h. Urban area < 30
   i. Rural area < 250
   j. Sounds area < 60

The performance and trend in forced outages is set out in the six charts of Figure 50 below, which also identify the relevant targets. The top left chart illustrates the unplanned SAIDI over time and reveals a falling trend in all areas, although the internal SAIDI target for the Sounds was not met. The top left chart shows the distribution of outage duration times (the boxes represent the 50 percentile bounds) and also plots the associated targets. As shown, the outage times are most varied for the remote (ie Sounds) customers as might be expected due to the time and difficulty of getting work crews to the sites. It is also noted that the internal maximum response times remain stretch targets for MLL as they are not met in all cases by any means.

The middle left chart shows the distribution of all outage times noting that approximately 95% of all outages are restored within six hours. The middle right chart shows the distribution in number of customers affected per outage. Comparison to the planned outages chart reveals the impact individual Network faults produce.

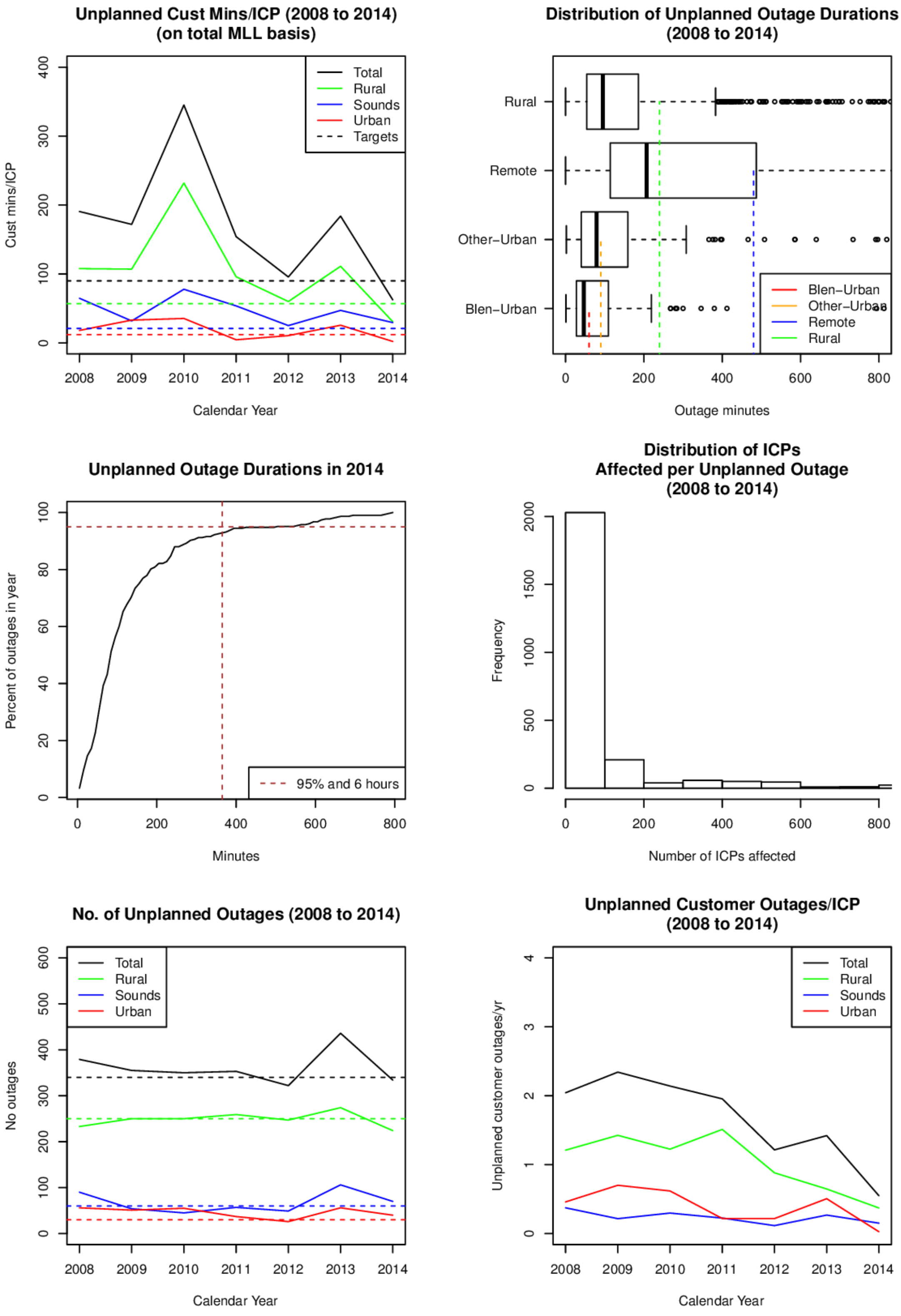


Figure 50: Unplanned outages performance

The bottom left chart shows the trend in the number of unplanned outages, which is relatively flat

The bottom left hand chart shows the number of unplanned outages per annum and where MLL's internal targets are met only in average. That is, the targets for numbers of forced outages remain as stretch targets for MLL. Further analysis of the fault categorisations shows that many faults are caused by weather and/or wind-blown materials, which is a result of the "natural" environment the overhead Network exists within. These types of faults are difficult to deal with, without resorting to expensive redesign of the Network.

The bottom right hand chart illustrates the trend in the average number of outages per customer, which shows a downward trend much like the unplanned SAIDI trend of the top left chart. Taken together with the essentially flat trend seen in the total number of outages, this reveals that the effect of the reliability measures implemented has been to reduce the numbers of customers affected by the outages which are occurring. This is largely due to the operation of the automatic re-closing switches which have been strategically placed within the Network.

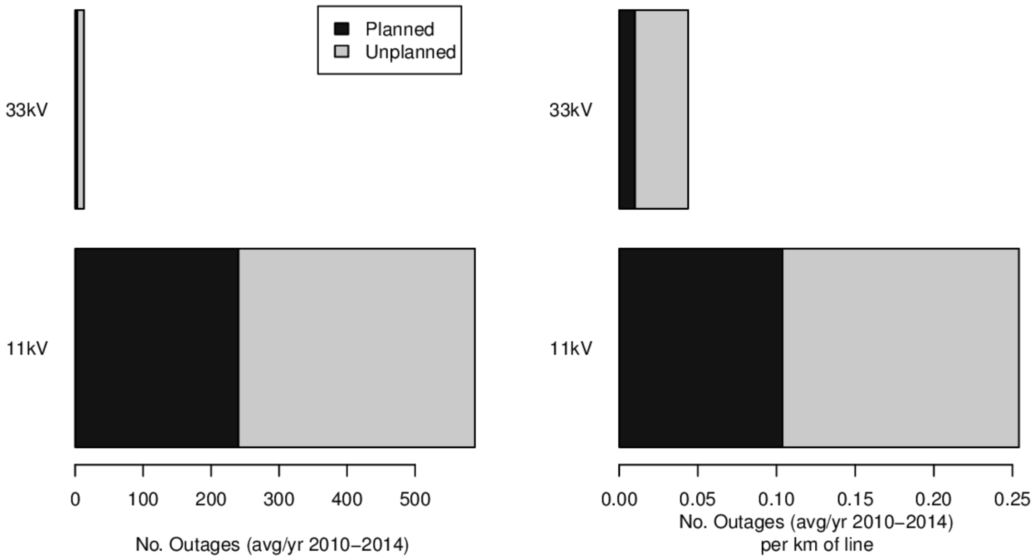
8.2.4 Network Outages Analysis

Analysis of the makeup and characteristic of outages helps inform planning for future reliability initiatives.

8.2.4.1 Subtransmission-Distribution Split

The four charts of Figure 52 illustrate the split in outage performance between the 33 kV sub-transmission lines and the 11 kV distribution lines. The top row charts illustrate the number of outages by category and bottom row charts show the customer minutes by category. The left-hand charts give the average per year values (2008 to 2014) and the right hand chart shows the average per year per circuit km values. Clearly outages on the 33 kV sub-transmission have greater impact on customers but the relatively equal customer minutes per year per circuit km values indicate that MLL is managing the Network in a logical manner in terms of the reliability performance of these different parts of the Network.

The lower number of forced outage events per circuit km for the sub-transmission circuits results from both a higher maintenance emphasis on these circuits, as well as a naturally lower susceptibility to faults due to the higher insulation level. Where it is economically viable to do so, rebuilding lines at higher voltage levels is one of the strategies MLL employs, for both reliability improvement as well as "future proofing" for load growth.



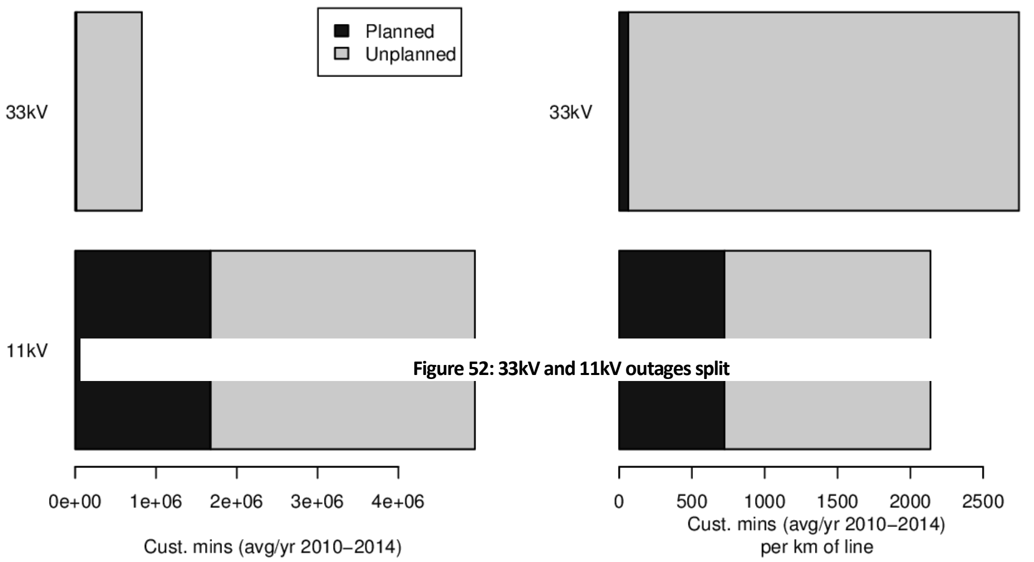


Figure 52: 33kV and 11kV outages split

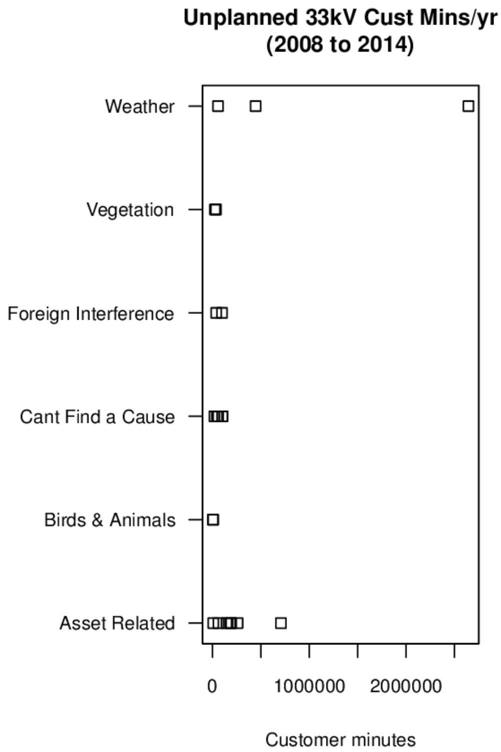
Figure 51 - Fault Causes

8.2.4.2 <u>Fault Make-up</u>

The charts of Figure 53 and Figure 54 show the makeup of fault causes for 33 kV and 11 kV circuits respectively. The charts show the spread in annual customer minutes, illustrating the natural variance in these measures, and the distribution in the outage minutes from each outage. As shown, weather is the major cause of extended outages on the sub-transmission circuits, and weather and vegetation are major causes of high impact outages on the 11 kV distribution circuits.

MLL will continue with its programme of enhanced vegetation cutting as a primary means to manage Network reliability. However, it is noted from in-depth analysis of the vegetation faults that approximately 50% of these faults now arise where the vegetation is outside the growth limit zones (usually associated with wind and wind-blown vegetation), so there will be a natural limit to the reliability gains achieved from further emphasis on vegetation management.

The incidence of animal related faults is pleasingly low and may be associated to the retro-fitting of longer possum guards on Network poles.



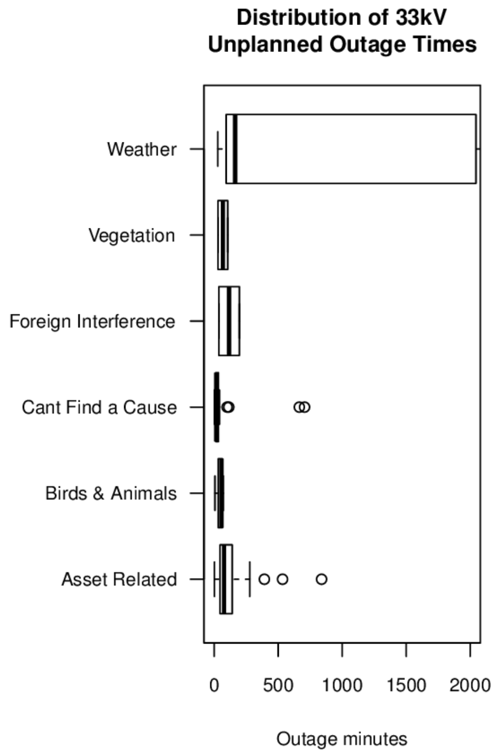


Figure 53: 33 kV outages makeup

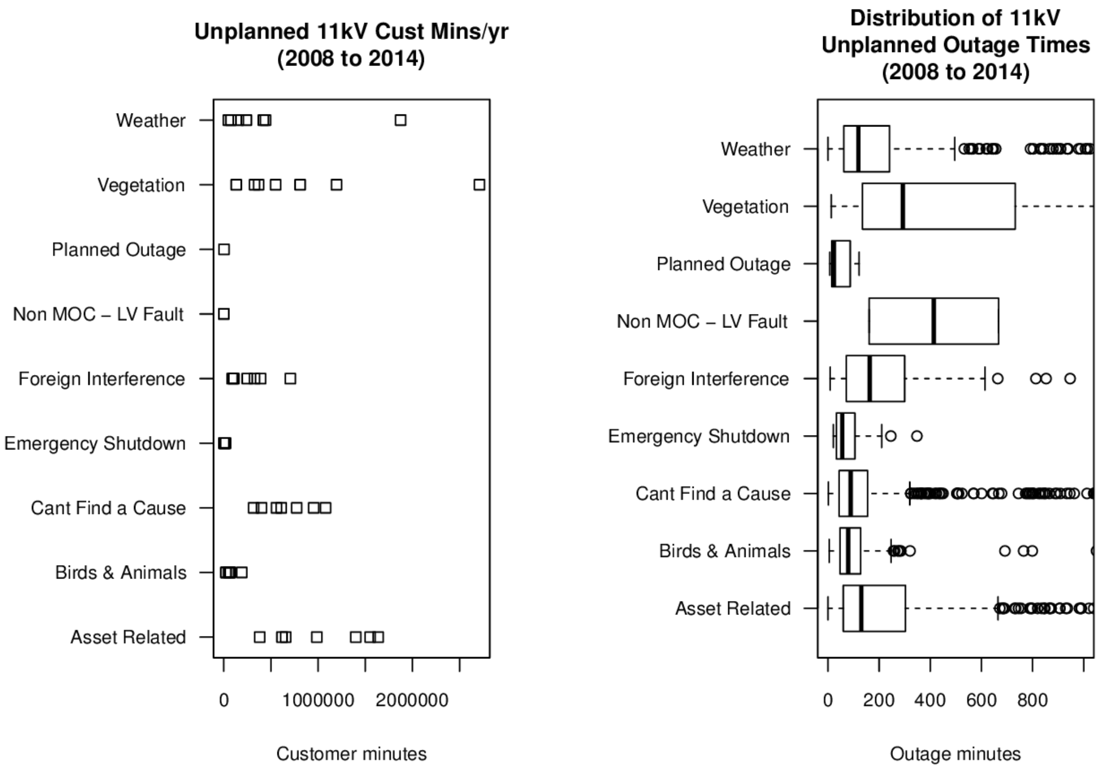


Figure 54: 11 kV outages makeup

8.2.4.3 **Asset Related Faults**

Examining the trend in the asset related fault count gives a useful indication on the management of the aging deterioration of the Network. This is illustrated in Figure 55 below and shows a declining trend in the asset related fault count indicating that MLL's processes of asset inspection, maintenance and replacement are proving effective in managing the condition of the Network.

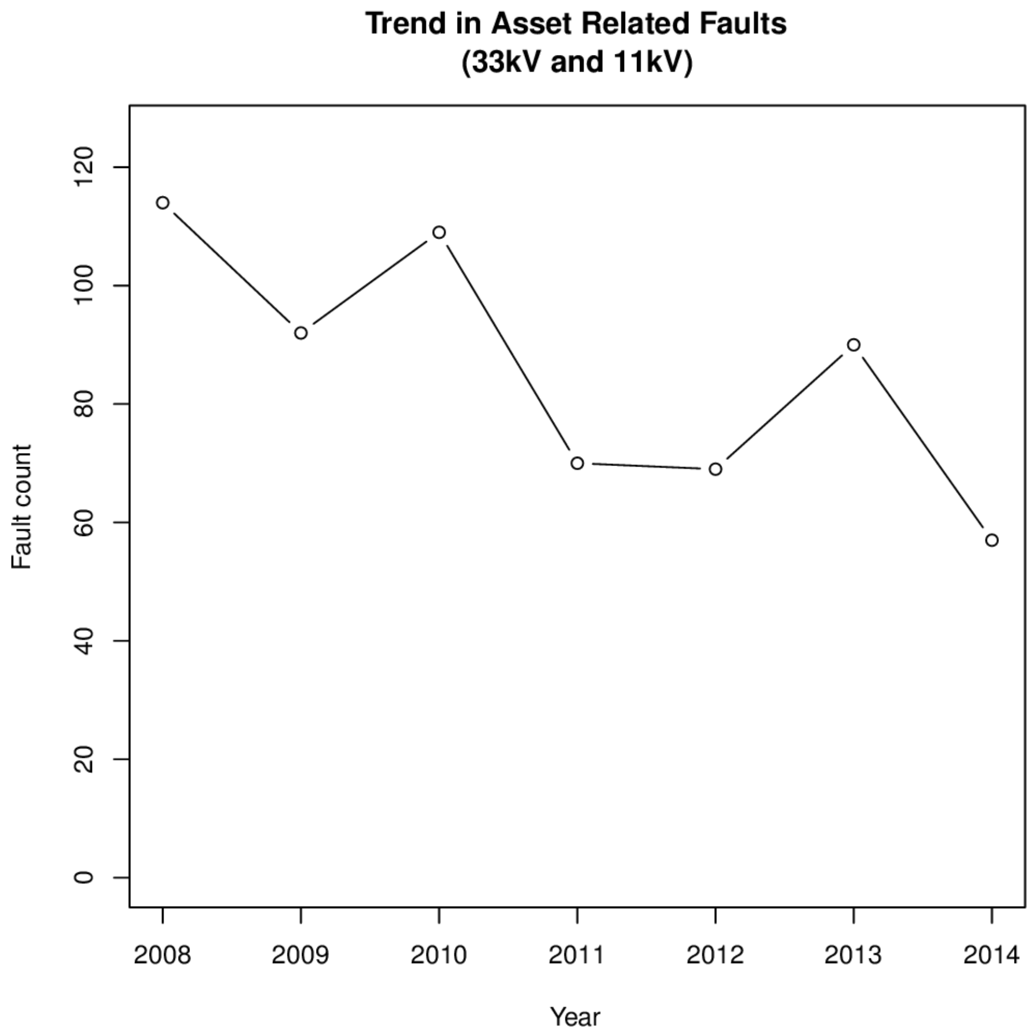


Figure 55: Asset related faults per annum

8.2.5 Technical Efficiency

MLL set internal targets for load factor, system losses and capacity utilisation for measuring its technical efficiency with targets and performances as listed following:

Measure	Target	2010/2011	2011/2012	2012/2013	2013/2014
Load factor	65%	62%	60%	61%	61%
System losses	7%	5.1%	5.2%	4.8%	5.1%
Capacity utilisation	21%	23%	23%	23%	22%

Table 56 - Efficiency Measures Results

The load factor is influenced by the manner of load control. Historically, the load control plant was used to limit the maximum demand on MLL's Network. In recent years, load control has only been used to limit the maximum demand when the upper South Island (USI) demand is also high. This has led to an apparent reduction in load factor as, when the USI load is low, the MLL load is allowed to rise creating a higher maximum demand and lower load factor.

The Capacity of Utilisation (CoU) is largely determined by customer requirements and patterns of use but can be influenced to a limited extent by design and operation of the Network. Every effort is made to limit the unnecessary installation of transformers and keep the CoU as high as possible. The comparative benchmarking on utilisation, set out in section 8.1.5.2, shows MLL plotting close to the regression expectation particularly where the effect of non-standard load is removed. This indicates that, within the limitations of this performance measure, MLL's design practices for transformer sizing and loading appear reasonable.

System losses are monitored and considered when designs are undertaken and transformers are purchased. It should be noted that with a large number of ICPs on annual reading only, the accuracy of the system losses figure is heavily dependent on the accurate estimation of usage for these ICPs by the Electricity Retailers. The comparative benchmarking of system losses set out in section 8.1.5.1 shows MLL's losses are close to and slightly below the regression expectation indicating MLL's conductor sizing practices appear reasonable.

8.3 Financial Performance Compared to Plan

The expenditure against budgets for the 2014-2015[8] financial year is shown in the table below:

Item	Actual for 2014/2015 ($000)	Budget for 2014/2015 Year ($000)	% Variance
Capital Expenditure: Customer Connection	503	300	+40%
Capital Expenditure: System Growth	52	500	-860%
Capital Expenditure: Reliability, Safety and Environment	2857	3400	-19%
Capital Expenditure: Asset Replacement and Renewal	4362	6050	-39%
Capital Expenditure: Asset Relocations	508	450	+11%
Subtotal - Capital Expenditure on Asset Management	**8282**	**10700**	**-29%**
Operational Expenditure: Routine and Preventative Maintenance	2612	2741	-5%
Operational Expenditure: Refurbishment and Renewal Maintenance	406	218	+46%
Operational Expenditure: Fault and Emergency Maintenance	1130	914	+19%
Operational Expenditure: Vegetation Management	2271	2456	-8%
Operational Expenditure: System Operations and Network Support	2387	1954	+18%
Operational Expenditure: Business Support	3680	3553	+3%
Subtotal - Operational Expenditure on Asset Management	**12486**	**11835**	**+5%**
Total Direct Expenditure on Distribution Network	**20768**	**22535**	**-9%**

Table 57 – Budget and Actual Expenditure 2013/2014

There are significant variations against plan within individual expenditure categories and the overall expenditure was 9% lower than budgeted. This was primarily a result of a few major Capex projects (Asset Replacement and Renewal) being delayed. This resulted in resources being deployed from Capex to Opex and consequently Opex costs being increased. The overall result was lower as the smaller jobs tend to have much higher labour/travel/overhead costs to larger Capex projects.

8.4 Summary of AMMAT assessment

The AMMAT (Asset Management Maturity Assessment Tool) assessment is included in Appendix B. MLL undertakes some aspect of Asset Management without having detailed written procedures. In some cases this reduces the score obtained in the AMMAT. MLL

---

[8] Taken from 2011 disclosures

recognises that as a small company, with engineering staff (many of whom are long-term employees) in an open-plan office, communication is good. Accordingly it does not have the same need for detailed formal procedures for all aspects of its Asset Management systems as some of the larger EDBs might.

Areas targeted for improvement in the short-term include:

- The procedures and documentation associated with the disposal of assets.
- Communication and consultation on the Asset Management Plan to staff.
- Management of communications, including better contact information for staff, and communications surrounding major events.
- Project sign-off/de-brief/close out – to improve this aspect of project management

Overall the AMMAT provides a high degree of confidence that robust procedures are being carried out.

8.5 Performance Evaluation and Initiatives

This performance evaluation section has shown that:

- Reliability performance is very good on a comparative basis and is close to frontier performance given the type and length of Network. However, costs of vegetation management in particular appear at a threshold in relation to the value of the reliability achieved, indicating that further increases in either operational or capital expenditure to further improve reliability must be carefully evaluated. It is salient that aside from reliability considerations, Marlborough Lines also has an obligation to minimise the risk of fire and such is a factor to be considered as part of vegetation management costs.

- Reliability improvements over the last five years have largely come from reductions in the numbers of customers affected by individual outages. A shift in focus in now indicated towards reducing the average outage durations for both planned and forced outages. What can be achieved in this area is uncertain however, as the improved safety regimes that have been developed for both staff and the public which often require longer work set-up times.

- Service level targets set by MLL for reliability remain stretch targets. The next set of target values will seek to lock-in the trend line gains made to date but further reductions are not being forecast as it appears a point of diminishing returns has been reached.

- Network performance measures (losses, utilisation and load factor) meet comparative expectations against other companies' performances and therefore the current target levels for these performance measures will be retained.

While the asset age profiles in relation to New Zealand company averages indicates MLL does not have any over-hang of aged assets, a future challenge for MLL, and indeed all NZ distribution businesses, will be managing the higher capital costs of replacement compared to the initial greenfield installed values. These higher costs arise from higher equipment performance requirements, increased worker safety standards, traffic management costs, community desire for undergrounded services, pressure to remove line routes not in road reserves, and load support costs of replacing in-service equipment while managing total service reliability measures. These pressures could ultimately lead to higher Network valuation, which in turn forms the key component in determining the service costs to customers.

9. Capability to deliver

9.1 Confirmation AMP can be delivered

Marlborough Lines Limited's expenditure plans for the next five years are consistent with the levels of expenditure over the past five years. Maintaining an even flow of expenditure helps ensure that the appropriate levels of resources are available to complete work programmes.

With long life assets, in a well managed electricity network, it is possible to defer some expenditure without any obvious detrimental effects in the first few years, however longer term this strategy results in loss of reliability and service and the need for large increases in expenditure. MLL's strategy is to try and maintain an even and appropriate level of expenditure, taking into account the longer term needs of the Network, and prioritising expenditure to areas where the most benefit can be obtained.

Accordingly as the level of proposed expenditure is consistent with the levels actually achieved, it is considered that the proposed expenditure is realistic and can be achieved with current levels of resources.

9.2 Organisational structure

Marlborough is geographically remote from other regions and does not have sufficient population or industrial base to support multiple contractors capable of providing the plant, people and resources to operate, develop and maintain the electricity network. In addition, Marlborough can be isolated from other areas at times of severe storms and/or earthquake.

Because of these reasons, Marlborough Lines has elected to maintain an "in-house" contracting division. This helps to ensure that appropriate levels of resources are available on a 24hr/365 days basis, gives good control over contracting operations without the disadvantages of tendering in a market with low levels of competitive pressure.

The levels of resources within the contracting division have been maintained and are slightly up on historical levels.

The levels of resources within the Network to plan and manage work are at, or above, the levels available historically.