Report on the reliability performance of Aurora Energy Limited

Produced for

The Commerce Commission

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Preface

Strata Energy Consulting Limited specialises in providing services relating to the energy industry and energy utilisation. The Company, which was established in 2003, provides advice to clients through its own resources and through a network of Associate organisations. Strata Energy Consulting has completed work on a wide range of topics for clients in the energy sector both in New Zealand and overseas.

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This report has been prepared to assist the Commerce Commission with its assessment of the quality performance of the Aurora Energy electricity distribution network.

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Table of Contents

Figures

1 Introduction and background

1.1 Purpose of this review

1 The Commerce Commission (the Commission) engaged Strata Energy Consulting (Strata) to review the network performance of Aurora Energy Limited's (Aurora) electricity distribution network over the period 1 April 2010 to 31 March 2012. During this period Aurora has exceeded the regulatory quality standard and the Commission required Strata to provide expert advice as to whether this performance trend is indicative of a sustained deterioration of the network.

1.2 Scope and objectives

2 This review is intended to inform the Commission of the underlying causes of Aurora's under-performance and to identify whether or not exceeding the regulatory quality standard was the result of a sustained deterioration of the network.

3 In particular, the Commission has asked Strata to provide its advice on the following matters:

(a) whether current management practices are leading to, or are likely to lead to deterioration in network reliability;

(b) the reasons for the non-compliance with the Electricity Distribution Services Default Price-Quality Path Determination 2010 quality standard;

(c) any issues with organisational practices, individually or collectively, and whether or not those issues are likely to be successfully addressed by Aurora; and

(d) recommendations for the Commission's consideration in response to any concerns identified during Strata's assessment.

1.3 Review approach

4 The Commission set out the following two-stage approach for this review:

	Task
Stage 1	**Desk-top review**

	Task
	Objective: Establish an understanding of and assess Aurora's asset management framework. Inform the on-site review. Carry out a desk-top review of Aurora's electricity distribution network giving consideration to the following: – examine quality and reliability performance management and reporting; – consider the extent of asset planning and operational management (e.g. fault response planning) and its impact on annual reliability performance; – assess asset management principles and practices, as well as procedures and processes; – assess asset management plans and methodologies; – examine asset condition, assessment monitoring, and reporting; – perform trend analysis against comparable peers / industry benchmarks on condition of assets, asset availability and asset age; – assess asset management cost management; – examine the extent of proactive and reactive asset management planning and practice; – consider organisational capability (management, technical and operational) to deliver asset management objectives; – examine system loadings, demand forecasting, asset capacity planning and asset condition information (e.g. asset age profiles); – consider capital expenditure and maintenance budgets and plans at an aggregate level; and – assess historical performance against budgets and plans for relevant capital expenditure and maintenance.
	Initial report Strata provided the Commission with a briefing on initial issues and observations from the desktop review.
Stage 2	**On-site assessment** Objectives: Assess the extent to which Aurora applies its asset management framework in practice. Establish compliance with and the appropriateness of the regulatory standards. Inform the assessment of likely future reliability performance. Establish a

	Task
	view of the reliability and accuracy of the information used by Aurora to manage its assets. Complete an on-site assessment of Aurora's electricity distribution network and asset management practices, based on the following: – examine compliance with policies, procedures and processes; – examine systems outage management processes including the appropriateness of both the process and the system controls for recording SAIDI and SAIFI; – review the implementation of annual asset management plans; – examine how performance against budgets and plans is monitored; – review organisation and contractor management practices; – review the accuracy and reliability of asset data and information systems; – review asset age, condition monitoring and reliability assessment practice; and – review system loadings, demand forecasting and asset capacity measurement and reporting.
	Final report Objective: Provide the review findings and justification for conclusions and recommendations.

5 A table linking the sections of this report related to each of the above tasks is provided in Annex 2.

1.4 Structure of this report

6 The sections of this report are structured to provide a high level overview of the information gathered in the review and to provide the key points relevant to the review objectives. A summary of the sections of the report is set out in the following table.

Section	Content
Findings	Provides a summary of the main observations and findings of the review and the key findings, observations and recommendations.

Section	Content
Overview of Aurora	Provides a brief overview of Aurora, its governance structure and key statistics.
The remaining sections provide supporting analysis for the headlines and key findings	
Aurora's Reliability Performance	Provides the historical performance against regulatory standards. Provides Strata's assessment of Aurora's explanations for the network's historical reliability performance.
How Aurora is addressing performance	Provides an assessment of the actions that Aurora is taking to correct any issues with network performance
Strata's assessment of Aurora's actions to address performance issues	Provides Strata's views on the adequacy of Aurora's response to address network performance issues Provides information on the age and condition of assets and an assessment of the adequacy of key components of Aurora's forecast capex and opex. Gives an assessment of Aurora's asset management framework including policies, strategies and operational procedures. The assessment identifies areas of concern and/or deficiencies in the framework. Provides a high level assessment of the capabilities of Aurora management.
Expected future network performance	Provides Strata's assessment of future network performance based on the findings of the review. Discusses historical levels of expenditure (capex and opex) in the network and provides an assessment of the implications for future performance against the reliability standard limits

1.5 Data and information sources

7 The key data and information that this review has relied upon are set out in the following table.

Information/data	Source
SAIDI and SAIFI values	Aurora annual compliance statements for 2011 and 2012. Aurora's analysis of worst performing feeders.
Historical and forecast capex and opex	Aurora responses to Strata information requests. Aurora 2013 Asset Management Plan (AMP).
Asset age and condition	Aurora responses to Strata information requests. Strata sample asset and report review and Aurora information obtained at the on-site visit. Aurora 2011 AMP.
Asset management framework and practices	Aurora Report on asset management maturity (AMMAT 2012/13) (i.e. Aurora's self-assessment of the maturity of its asset management practices). Aurora responses to Strata information requests. Information obtained from Aurora management during the on-site visit. Aurora 2012 AMP. Aurora Draft 2013 AMP. Aurora annual reports.
References for good industry asset management practice	PAS 55-1: 2009 and PAS 55-2: 2009 Asset Management Standard and Guidelines. International Infrastructure Management Manual – International Edition 2006. AS/NZS ISO 31000: 2009 Risk Management Principles and Guidelines.

2 Findings

2.1 Headlines

8 On the basis of the information and explanations we have obtained during the course of this review, we have formed the view that the reasons provided to the Commission by Aurora for its breach of the SAIDI boundary levels in 2010/11 and 2011/12 do not fully reflect the underlying causes because:

(a) while the SAIDI breaches could be considered (as Aurora has) to have occurred at times of extreme weather events in both of the years in which regulatory standards were exceeded, we consider that there have been other contributing factors;

(b) the increasing trend in tree contacts is likely to have been the result of lower than necessary investment in vegetation control which is also likely to have amplified the impact of extreme weather events;

(c) the condition of some assets (mainly poles) is also likely to have contributed to the impact of extreme weather events; and

(d) there are apparent and serious inconsistencies between Aurora's published and disclosed assert condition data and the information on asset condition that Strata obtained on site. Pending Aurora's reconciliation of the data issues the findings in this report are based on the asset condition data and information obtained from Aurora specifically for this review.

2.2 Findings

9 We have concluded that on reliability performance:

(a) the reliability standard limit values set by the Commission were not unreasonable and that the breaches could have been avoided with alternative asset management strategies;

(b) had Aurora maintained adequate levels of vegetation management in the past and addressed the increasing incidence of equipment failure by a targeted asset replacement programme, exceeding the reliability standard limits would likely not have occurred;

(c) both the results for 2012/13 and Aurora's targets for 2013/17 suggest that Aurora's management team has implemented appropriate asset management measures to address the performance issues on the network; and

(d) network performance within the reliability standard limits (SAIDI limit = 98.29 and SAIFI limit = 1.67) should be achievable in the future.

10 We found that a significant personnel change has occurred in Aurora's management team over the past four years. Changes are also occurring in the methodologies and systems through which the assets are managed. A transition from an individual knowledge-based to an organisational knowledge- based business is clearly taking place. This transition presents challenges that are likely to have contributed to some extent to network performance. However, we found that Aurora appears to be fully aware of the challenges and are managing these issues proactively.

11 In our opinion, in the short term, network performance is likely to comply with the Commission's regulatory standards. Beyond the short term, the achievement of good network performance will depend on Aurora's continued commitment to:

(a) adequate resourcing to provide the level of vegetation control required to maintain tree contact risk at manageable levels;

(b) understanding, managing and addressing the variability of the contribution to SAIDI due to equipment failure; and

(c) successfully completing the transition to and implementation of the proposed asset management framework including:

(i) the development of a strategy to address the aging 33 kV subtransmission network in Dunedin; and

(ii) broadening the gathering of reliable asset condition data across all asset categories.

12 The main sections of this report provide information, findings and observations that support the above headline and key findings. Further observations and findings relevant to the section topics are provided in the final section of this report.

2.3 Recommendations

13 Strata makes the following recommendations:

(a) Aurora must urgently undertake a review of its asset condition/health data to ensure that its asset management decisions and plans are based on an accurate data set and that statutory disclosures are accurate;

(b) Following assurance that the asset condition data is accurate and reliable Aurora should review their asset strategies and planned expenditure (this may require the issue of a revised AMP and/or revisions to the information memorandum in Appendix A.2);

(c) Aurora should publish a comprehensive vegetation management plan (probably as part of its AMP) and report annually to its Board on delivery of the plan.

(d) Aurora should develop a strategy to address the aging 33 kV subtransmission network in Dunedin and include this in the 2014 AMP (if not published before).

(e) Quantification of the expected benefits, both realised and forecast, arising from Aurora's improvements in asset management methods and asset condition information should be included in, or as an addendum to, the 2014 AMP.

3 Brief overview of Aurora

3.1 Introduction

14 Aurora manages electricity assets in three geographically separate networks (Dunedin, Central Otago and Te Anau), with both rural and urban characteristics, as shown in Figure 1 below. On behalf of Aurora, Delta Utility Services (Delta) operates the network, carries out network planning and develops the maintenance plans and programmes.

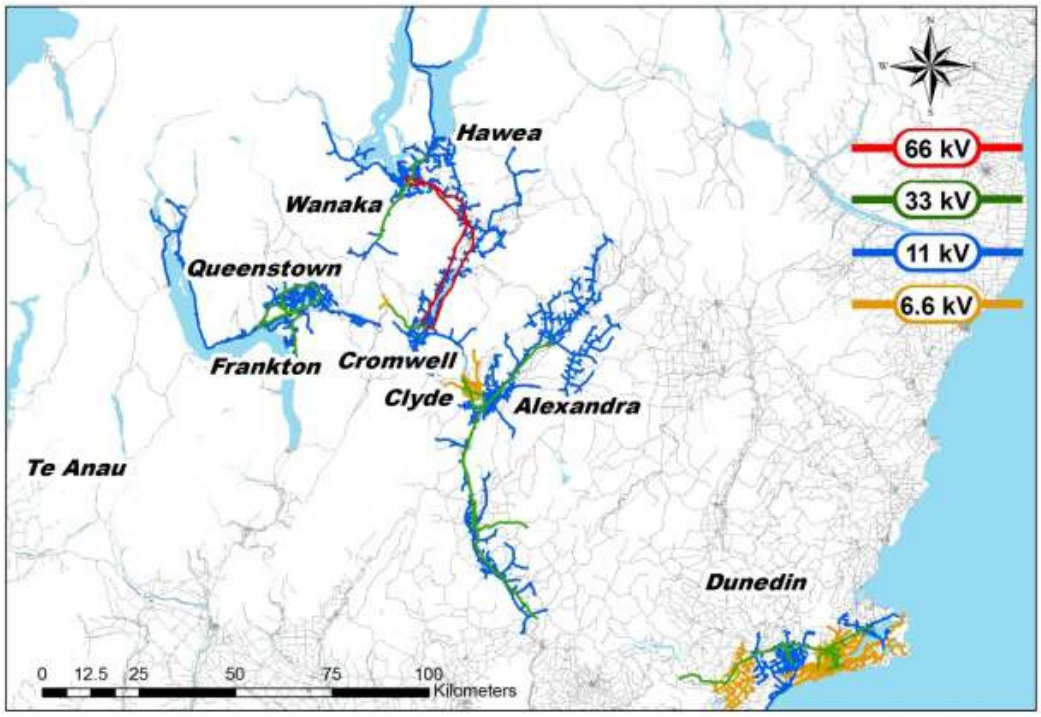
15 Aurora's network service area covers approximately 10,000 square kilometres in Otago. Approximately 60% of Aurora's overhead circuit length is located in rural/rugged terrain and approximately 40% in urban areas. The three separate network areas are as follows:

16 The Dunedin network includes the urban areas of Dunedin, the Otago Peninsula, Mosgiel, and the inner reaches of the Taieri Plains, supplying 53,777 customer connections. The Dunedin area is supplied from two grid exit points (GXPs) at Halfway Bush and South Dunedin, between which Aurora has significant interconnection at 6.6 kV, 11 kV and 33 kV.

17 The Central Otago network stretches from Raes Junction in the south to Lakes Wakatipu and Wanaka in the northwest, and St Bathans and Makarora in the northeast. This network supplies 29,050 customer connections. The Central region is characterised by its separate river valley areas, mandating a radial network supplied from three GXPs. Aurora has no high voltage interconnections between the Central GXPs.

18 A small embedded network, connected to The Power Company network, was installed in Te Anau in 2005. This network supplies 81 customer connections.

Figure 1 - Aurora network areas



Source: Aurora 2013 AMP

3.2 Governance and management

19 Aurora has contracted asset management to Delta under a performance-related contract that was renewed for a further 10 years on 1 July 2007. Under this contract Delta is required to:

(a) deliver annually specified network performance and customer service, subject to significant financial penalties for non-performance; and

(b) deliver detailed development plans covering periods during and beyond the contract period.

20 Up until the latter part of 2011, the Delta Engineering Services and Network Services Managers were responsible for carrying out asset management. These managers, together with the Aurora Commercial Manager, formed the Network Management group within Delta.

21 Changes to this structure since 2011 have seen the establishment of a specific Asset Management business unit, consisting of five core teams: Asset Management, Infrastructure Performance, Asset Systems, Delivery and Commercial. These teams report to the General Manager for Asset Management.

22 The General Manager for Asset Management reports to the Aurora Board, along with the CEO. The Board reviews and authorises the AMP from which annual and 5 yearly budgets are set. Reports on significant projects are provided to the Board on

a monthly basis, including regular reporting of key performance indicators (KPI's) and related asset management objectives.

23 Under the Aurora/Delta contract, the responsibility for the management of the network is primarily through Delta's Chief Executive, the General Manager Asset Management, and managers within the Asset Management business unit.

3.3 Key statistics

24 The following statistics are sourced from the Aurora 2013 AMP.

Replacement value of assets	$653M
Sub transmission lines	513 km
Zone substations	36
Distribution lines	2,260 km
Distribution cables	904 km
Distribution transformers	6,677
Low voltage lines & cables	1,863 km
Customer connection points	82,000
Energy delivered annually	1,392 GWh
Distributed generation	130 MW

Asset Category	RC	% by $
Subtransmission	$56,225,175	8.6%
Zone substations	$106,405,460	16.3%
Distribution and LV lines	$138,766,783	21.3%
Distribution and LV cables	$193,748,491	29.7%
Distribution substations and transformers	$97,288,303	14.9%
Distribution switchgear	$54,025,963	8.3%
Other	$6,466,821	1.0%
Total (rounded)	**$652,927,000**	100%

25 Aurora's largest customers include the following:

(a) In Central Otago: QLDC, CODC, NZ Ski, Queenstown Airport and other large hotels such as Novotel and Corpthorne.

(b) In Dunedin: Otago University, Port of Otago, Turners and Growers, DCC, Cadbury, Fonterra, NZ Wood Mouldings, Southern DHB, KiwiRail and Ravensdown.

3.4 Network configuration

26 Subtransmission is not interconnected between the three Central areas – each GXP effectively supplies a separate network area. In contrast, subtransmission is highly interconnected between the two Dunedin area GXPs.

27 Details and drawings of the network are provided in Annex 1.

4 Aurora's reliability performance

4.1 Introduction

28 SAIDI and SAIFI regulatory standards were calculated by the Commission for the reference period 1 April 2004 to 31 March 2009 to be:

SAIDI limit: 98.29

SAIFI limit: 1.67

29 Aurora's Compliance Statements show that actual network performance against the above SAIDI and SAIFI limits were:

Year ending 31 March 2011

SAIDI: 110.95

SAIFI: 1.48

Year ending 31 March 2012

SAIDI: 115.88

SAIFI: 1.79

30 Aurora exceeded the regulatory standards for SAIDI in both 2010/11 and 2011/12 and for SAIFI in 2011/12.

4.2 Aurora's explanations for the breaches

31 Aurora's 2012 Compliance Statement states the cause of the breaches of the regulatory standard limits were due to two major windstorms that occurred in May and October 2011. Both of these events triggered the replacement of SAIDI with boundary values (B SAIDI).

32 In its draft 2013 AMP, Aurora provides the following overview of its network performance and identifies the main causes it considers have led to the breaches of the SAIDI and SAIFI limits:

> *Excluding planned shutdowns, the main causes of outages over both years were due to equipment deterioration, tree contact and weather. Of the 484 unplanned interruptions on the network in 2011/12, approximately 73% were restored within 3 hours.*

33 Prior to our on-site visit, we requested that Aurora provide additional detail on what it considered to be the underlying causes of the limit breaches. Through Delta, Aurora informed us that it considers the events that led to the breaches of the SAIDI and SAIFI limits in 2011 and 2012 to be:

(a) tree contacts;

(b) extreme weather; and

(c) equipment failure.

34 Aurora's assessment is that:

> *While extreme weather was a significant contributor to outage statistics, it ranks second in both years to tree contacts.*
>
> *The incidence of interruptions caused by tree contacts has shown a sharply increasing trend over the past three years.*
>
> *Equipment failure is the third most significant cause. While the absolute contribution of equipment defects was fairly flat from 2003 to 2011, a significant increase was observed in 2012.*[1]

35 However, notwithstanding the above, Aurora considers that extreme weather events led to the SAIDI and SAIFI limit breaches:

> *In both the non-conforming years (2011 and 2012) the Aurora network was struck by extreme weather events, which resulted in boundary limit substitutions being triggered. In the context of Aurora's quality path, this means that on the day of the extreme weather event, SAIDI (for that day) exceeded 11.93 minutes. One boundary substitution occurred in the 2011 regulatory year (21 December 2010), and two occurred in the 2012 regulatory year (on 12 May 2011 and 25 October 2011).*[2]

36 The above statements appear to have a degree of inconsistency as both extreme weather and tree contact is given as the cause of the events that led to the limit breaches. In reality it is likely to be an underlying cause such as unmanaged vegetation or a weakness in equipment that is the underlying cause with high winds being the trigger but not the cause.

4.3 Assessment of Aurora's explanation

37 In this section we make a number of observations in relation to Aurora's performance against SAIDI and SAIFI limits. In relation to SAIDI performance, the 10 worst performing feeders can be seen to include the more remote and exposed 11 kV feeders. Figure 2 shows the impact of the 2010/11 and 2011/12 years on the long rural feeder to Glenorchy at the head of Lake Wakatipu.

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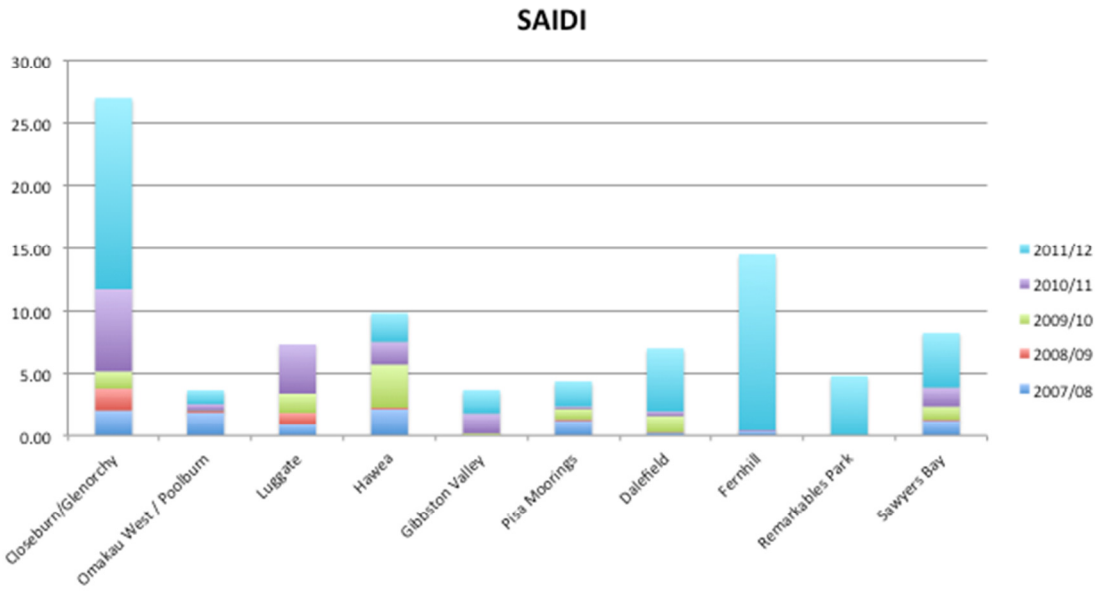
[1] Delta Memo to Strata, 11th March 2013, '2110 and 2012 Quality Breach – Underlying Reasons'

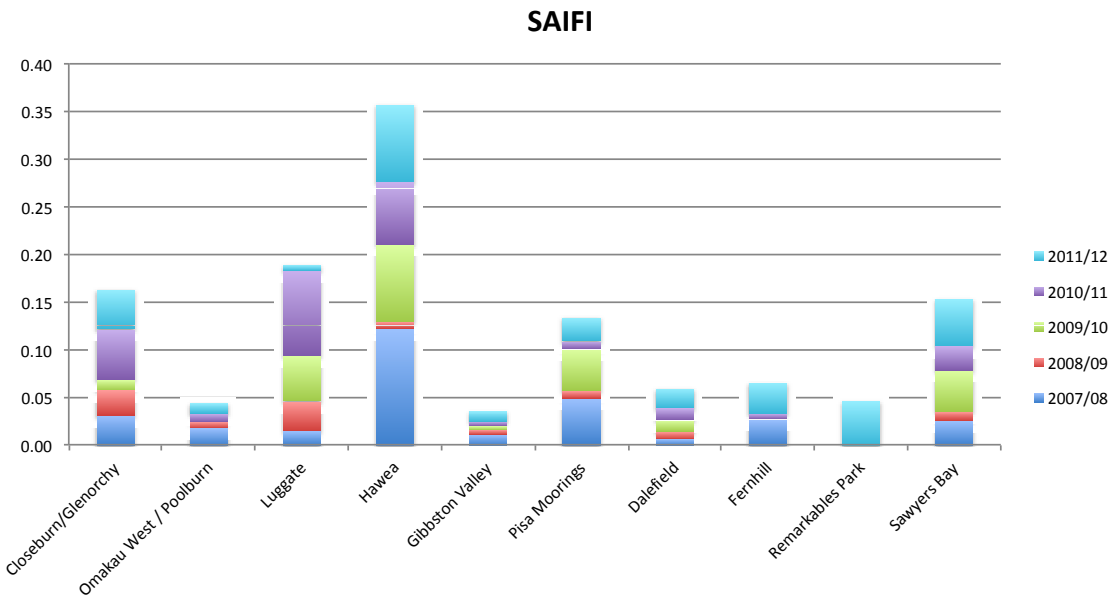
[2] ibid

Figure 2 - Worst performing feeders SAIDI



38 The top ten worst performing feeders in respect of SAIFI are generally the same as those for SAIDI. It is also apparent that the SAIFI performance has been deteriorating over the longer term for these feeders, which suggests that outage incidence has been increasing.

Figure 3 - Worst performing feeders SAIFI



4.3.1 Extreme weather

39 The three extreme weather events in 2010/11 and 2011/12 caused boundary values to be triggered for three days. If these events had not occurred Aurora would not have breached the SAIDI limits.

40 We consider that the extreme weather events of 2010/11 and 2011/12, on their own, do not account sufficiently for the limit breaches and that there are additional underlying factors.

4.3.2 Tree contact

41 During the site visit we observed that the vegetation control had not been maintained at a sufficient level to prevent significant build up of trees encroaching line clearance tolerances. We consider it likely that this situation has contributed to both the frequency and duration of outages during periods of high winds.

42 In many areas we visited, vegetation management is clearly an enduring primary maintenance challenge. High amenity values are placed on trees in many areas of Central Otago, in particular in and around the Queenstown area. Some of the worst performing feeders are in this area and we inspected sections of the following feeders:

(a) Closeburn/Genorchy

(b) Fernhill

(c) Dalefield

(d) Remarkables Park

43 The Dalefield feeder highlights the challenge of vegetation management. In many places it runs alongside or through tall hedgerows and shelterbelts. Landowners frequently declare interest in these trees and allow only a trim but not complete removal of encroaching trees. After an initial trim, landowners then frequently neglect their obligations under the tree regulations for on-going maintenance and many current line encroachments were observed.

44 Lines inspected along the Otago Peninsula demonstrated similar vegetation management issues to those observed in Central Otago.

45 While there is evidence of vegetation management having been carried out in many places, feeders with similar issues will remain fault-prone from tree encroachment. Superficially, it appears that significantly more resource in both the arboreal and administrative workforces will be needed to catch up and keep on top of this perennial issue.

46 In our discussions with management, Aurora attributed this situation to:

(a) changes to legislation, principally the Electricity (Hazards from Trees) Regulations 2003 that set out rights and processes for managing vegetation near lines;

(b) difficulties gaining agreement of residents to tree cutting, this is particularly seen as an issue in the Queenstown area where some of the worst performing feeders are located; and

(c) previous cost saving initiatives in the organisation.

4.3.3 Equipment failure

47 In the 2011/12 year, a single significant event caused a widespread unplanned outage on two feeders in the Queenstown region (Glenorchy and Fernhill). While Aurora attributed this event to extreme weather, the root cause of the failure was due to the poor below ground condition of two poles at Fernhill.

48 We observed that, subsequently, Aurora has undertaken a comprehensive condition assessment on all poles on the feeder to identify if the problem was likely to recur. Through the condition assessment, Aurora found that the poles that failed were the only ones with the footing problem. We consider that the action taken by Aurora was an appropriate response to the failure event; it demonstrates that the business identifies and corrects network defects based on knowledge of asset condition.

49 We agree with Aurora that the number of incidents attributable to equipment failure is a concern. In rural areas the 11 kV network is relatively old and will require on-going asset management attention. We found evidence that Aurora is addressing this issue appropriately and has implemented a targeted pole replacement programme. This is discussed further in the following section.

50 In Dunedin City, Aurora is relying on the relatively new 11 kV distribution network to provide security for the aging 33 kV subtransmission network (particularly the cables, some of which are around 50 years old).

51 This is allowing Aurora time to consider and develop a strategy for the management of the 33 kV assets. The completion and application of this strategy will be important as the condition of the 33 kV cables is largely unknown and, given their age, failures may increase significantly with little notice.

5 How Aurora is addressing performance

5.1 Capital works programme

52 Aurora has established a response that identifies the worst performing feeders and establishes an expenditure allocation within the capital programme considered to be sufficient to remedy the causes that have led to supply interruptions.

53 In the 2012 financial year, Aurora has completed $1.6m of capital projects targeted at increasing the reliability of feeders on the Dunedin and Central Otago networks. These works include:

(a) $335k on pole replacement on the Wanaka 2752 feeder

(b) $402k for pole replacement on Port Charmers 4 feeder

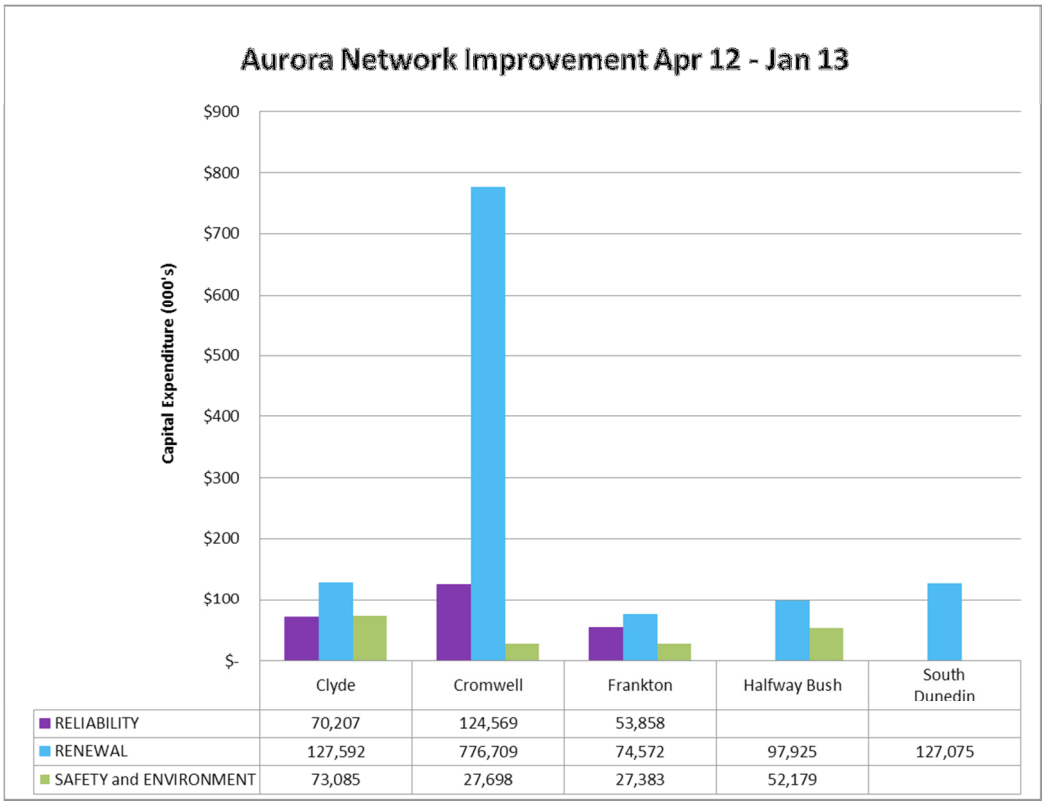
(c) $12k on pole replacement for remaining feeders

(d) $16k on ground mounted transformers on Wanaka 2752[3]

54 It can be seen from Figure 4, provided by Aurora, that the business has been targeting the main focus of its reliability improvement expenditure in the Cromwell area. We saw some evidence of this during our on-site inspection of network assets. We also saw evidence of more widespread pole replacement work having been undertaken in the Queenstown (Frankton) area.

[3] Delta - Improving Aurora's Worst Performing Feeders v3.1 26 April 2013

Figure 4 - Reliability targeted expenditure



	Clyde	Cromwell	Frankton	Halfway Bush	South Dunedin
RELIABILITY	70,207	124,569	53,858		
RENEWAL	127,592	776,709	74,572	97,925	127,075
SAFETY and ENVIRONMENT	73,085	27,698	27,383	52,179	

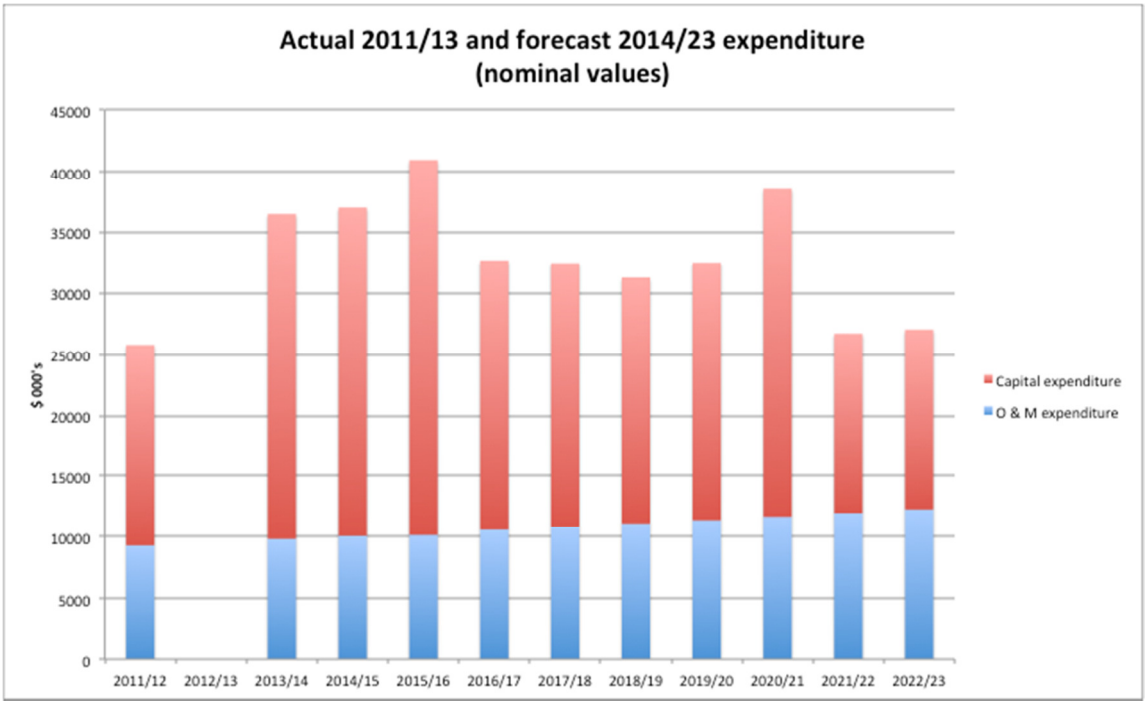
Source: Delta

55 On our field inspections in Central Otago we found evidence that Aurora is undertaking a significant pole replacement programme. We found that the programme was being prioritised to address the worst performing feeders first and poles that had been inspected and "red tagged". It is likely that, if resourced adequately over time, this programme will address the network performance issues that have led to the performance breaches in recent years.

56 Figure 5 sets out Aurora's actual capex and opex for the two years 2011/13 and the forecast expenditure for the following ten years to 2023. The variable expenditure is driven by capex, which is in turn driven by demand growth and the target age and replacement profiles of the network assets.

57 The capital expenditure profile shows Aurora's view of the level of commitment and investment that will be necessary to maintain network performance within required levels.

Figure 5 - Forecast expenditure



58 Based on our observations of Aurora's developing asset management framework and practices, we consider it is likely that the proposed programmes and levels of expenditure will address the network performance issues that have led to the performance breaches in recent years. This view is supported by the results that Aurora has achieved during its 2012/13 worst feeder targeted programme of works.

Area	Improve Reliability	Measure	Target Level	Results
Closeburn	QT5202	Reduce SAIDI and No. of Interruptions	Reduce by 25%	73% SAIDI reduction 50% Interruption reduction
Fernhill	FH5308	Reduce SAIDI minutes	Reduce by 15%	83% SAIDI reduction
Dalefield	DA7828	Reduce SAIDI minutes	Reduce by 15%	54% SAIDI reduction
Remarkables park	FK7783	Reduce SAIDI minutes	Reduce by 10%	47% SAIDI reduction
Sawyers Bay	PC4	Reduce SAIDI minutes	Reduce by 10%	58% SAIDI reduction
Hawea	MA260	Reduce SAIDI and No. of Interruptions	Reduce by 10%	56% SAIDI reduction 92% Interruption increase
Luggate	WK2752	Reduce SAIDI and No. of Interruptions	Reduce by 10%	51% SAIDI reduction 77% Interruption reduction
Pisa Moorings	CM891	Reduce SAIDI and No. of Interruptions	Reduce by 10%	86% SAIDI reduction 69% Interruption reduction
Gibbston Valley	AT765	Reduce SAIDI and No. of Interruptions	Reduce by 10%	80% SAIDI reduction 36% Interruption reduction
Omakau west	OM679	Reduce SAIDI and No. of Interruptions	Reduce by 10%	36% SAIDI reduction 54% Interruption reduction

Source: Aurora 2013 AMP

59 Taking into account that 2012/13 has been a relatively calm weather period, the results Aurora has obtained from the targeted works programmes have been significantly above expectations. Only one area (Hawea MA2752) failed to meet targeted expectations.

60 These results tend to support the view that, on the worst performing feeders, the network had been under maintained because the recent focus has been able to significantly improve performance.

61 An important input into forming views on the adequacy of Aurora's actions to address performance issues is asset condition data. If the data is inaccurate or unreliable the above findings will be revised. The following section sets out important issues regarding asset condition data.

5.2 Asset condition monitoring practice

62 Aurora undertakes routine asset inspections and has policies covering various types of equipment. We investigated how Aurora operates these processes and reviewed a sample of documentation covering routine overhead line and substation inspections.

63 The policy governing overhead line inspections is documented in QP1504 *Overhead Lines Inspection.* This policy was issued in June 2009 and was due for review in June 2011. We understand the policy has not been reviewed as planned.

64 From our brief review of its contents, the policy is frequently unclear on basic inspection requirements. For example, section 2.1 provides re-inspection criteria for detailed inspections such as "1, within the past year". It is not clear whether the comma means "or" or "and".

65 The policy covers ground-level "drive-by" inspections of all overhead line components on a five-year cycle by external contractors. Additionally, 33 kV lines (but not 66 kV lines, as apparently the policy predates the acquisition of the Central Otago network) are to be "patrolled" annually. It is not clear from the policy document if a patrol is the same as an inspection or what explicit access a drive-by requires (e.g. is it only what can be observed from a vehicle or is close-up access to view the asset required?).

66 Drive-by inspections require completion of a Drive-by Inspection Checklist and a Drive-by Inspection Report.

67 Detailed inspections require access to a pole at ground level and completion of a *Pole Inspection Report.* A sample report is included in QP1504 and we note that this version differs from a sample of an actual report we obtained during the site visit that was completed in June 2012. This lack of alignment likely reflects the overdue revision status of the policy document, as noted above.

68 We reviewed two sample Pole Inspection Reports and visited these assets as part of our physical inspection of the network. The two poles are adjacent and shown on the location map included in Annex 3.

69 The pole hardware component descriptions aligned with the physical assets we observed in the field. Pole 19651 is a red-tagged pole (condition = 0) and is scheduled for replacement. The Pole Inspection Report specifies that condition 0

red-tagged poles must be replaced within 3 months of inspection, as required under Electricity Safety Regulation 66(4). Our visit in early April 2013 occurred about 10 months after the inspection report was completed and it is not clear why the pole had not been replaced by this date.

70 Condition assessment as part of a detailed pole inspection uses a 7 point scale, with 0 meaning a pole incapable of supporting normal loads, 1 meaning an item (pole, crossarm or conductor) requiring replacement within 1 year and 6 meaning a pole requiring replacement within 20 years.

71 In our view, applying the 7-point assessment scale requires a significant level of subjectivity on the part of the inspector. It is likely that two experienced inspectors could award different ratings to the same item. It is not clear how conductors and crossarms can be reasonably assessed based on the information provided in the policy documentation. We therefore suspect that condition assessment ratings will be heavily reliant on the experience and approaches adopted by individual inspectors over time.

72 We also briefly reviewed the process for undertaking routine inspections of zone substations and visited the Port Chalmers zone substation. A sample completed Zone Substations Check List (form RS25) is included in Annex 3. In contrast to the pole inspection report, the assessment criteria in the zone substation checklist are more objectively stated.

73 We did not sight the relevant policy document that covers routine inspections of zone substations but would expect that best practice would require explicit criteria for each point of assessment that sets out the conditions for an "OK" rating. In some cases, ranges of acceptable measurements (e.g. battery voltage levels) and photographs showing acceptable and unacceptable conditions (e.g. intact seals) would be appropriate.

74 Our external observation of the Port Chalmers switchyard and control building generally left an impression of an old but tidy and secure installation.

75 It is important to note that the above observations were made on a small sample of records and assets. Aurora's network covers a relatively large area. The scope of this review did not provide for a detailed review of the condition of Aurora's network assets and our findings should be taken as indicative only.

5.3 Asset condition data reliability

76 Strata understands that Aurora is developing improved asset condition data and that some historical data, such as red tags on poles is likely to be incorrectly rated. However, apparent differences have been identified between the information Strata gathered from observations, obtained in on-site and in Aurora's regulatory disclosures (AMP Appendix A.2). In particular the following issues are concerning:

(a) In Appendix A.2 all subtransmission cables are given a 100% Grade 4 condition rating – this is quite different to the understanding we gained on

site and is set out in the asset condition section 5.5.5 of the AMP. Our understanding is that the 33kV gas and PILC cables are at the end of life and expected to be in variable condition.

(b) 33% of the 33kV pole mounted switches, 59% of 3.3 – 22kV pole mounted CBs and 64% 3.3 – 22kV indoor CBs of are Grade 1 meaning that they 'are at the end of their serviceable life and require immediate intervention'. Figure 5.16 page 87 of the 2013 AMP appears to show a quite different picture of the average age of HV distribution voltage switchgear. The average age of pole mounted and ground moulted switchgear would appear to be around 25 years.

(c) 30% 0f OH/UG consumer service connections are rated to be at Grade 1. It would be surprising if this was the case as it ,means that 30% of connections are in a condition that requires immediate intervention and this does not appear to be reflected in planned expenditure.

77 If the data in appendix A.2 is considered to be reliable we would conclude that a significant proportion of the network assets, particularly switchgear and consumer connections are in a condition that requires urgent attention. At grade 1 we would expect that safety concerns would arise if corrective action were not undertaken within 3 months.

78 If the above conclusion is correct we find it difficult to consider the planned replacement capex and opex set out in the 2013 AMP as being adequate. For HV distribution switchgear, the AMP (page 87) states that; *provision has been made for replacement of some oil based switchgear on an annual basis and circuit breakers supplying critical circuits will be renewed during the planning period (10 years).* If 60% of CBs are at grade 1 condition the plan seems to allow the continuing operation of substantial numbers of assets at grade 1 condition. On this basis Aurora's expenditure forecasts would seem to be far too low to deal with the backlog of assets in poor condition.

79 Additionally, Aurora's 2013 AMP supports the view that some budgeted amounts are inadequate. For example; at page 5 Aurora estimates a cost in *tens of millions* to address Condition 0 vegetation management areas. At page 48 the AMP states there are 6,059 current vegetation management areas that represent an immediate danger to person or property.

80 The 2013 AMP provides a cost estimate of many *millions of dollars* to address the situation yet a budget of only $1.3m pa has been provided. The opex budget will therefore only allow the current backlog to be cleared over several years, while the statutory obligation is to complete Condition 0 "without delay" (Clause 14.1, Electricity (Hazards from Trees) Regulations 2003).

81 The 2013 AMP (pages 5 and 48) estimates a cost in the order of *several millions of dollars* for renewal of 1367 Condition 0 poles. A pole replacement budget of $3m pa for Y/E 2013 to 2016 and $2m pa thereafter has been allocated. The budget is likely

to only allow the backlog to be cleared over several years, while the statutory obligation is to complete this in 3 months.

82 At the time of drafting this report Aurora has been requested to provide the following:

(a) Confirmation that the data contained in Appendix A2 of the 2013 AMP is correct.

(i) If the data is incorrect provide revised data;

(ii) If the data is correct then provide analysis that demonstrates the time frames over which the proposed expenditure (capex and opex) will rectify all Condition 0 and Grade 1 assets. Also explain the apparent inconsistences within the body of the AMP and the data.

(b) Confirmation that Aurora considers its planned expenditure set out in the 2013 AMP to be sufficient to ensure the network will be compliant with Clause 14.1, Electricity (Hazards from Trees) Regulations 2003) and the Electricity (Safety) Regulations 2010 at Regulations 41(4).

5.4 Maintenance

83 The two network areas we inspected provide a contrast in the level of recent and obvious maintenance activity. Around the Central Otago network, particularly around Queenstown, there is evidence of significant pole and hardware replacement activity having been recently completed. Long rows of poles have been completely renewed in several instances. However, it is not evident that significant re-conductoring has been carried out in association with the pole replacements.

84 In general, the Central Otago network appears to have received significant recent focus. Most of the zone substations are relatively new or significantly refurbished. An example of recent subtransmission development is the 66 kV line to the Cardrona zone substation.

Figure 6 - Cardrona zone substation and 66 kV line

85 In contrast, the network we inspected on the Otago Peninsula is only just starting to receive detailed attention. For example, while there is some evidence of recent maintenance activity on feeders around the Port Chalmers area, there remains significant work to do (e.g. Sawyers Bay, which is one of the top 10 worst performing feeders). We inspected much of a single wire, earth return (SWER)

feeder in this area and noted recent and current refurbishment activity. Vegetation management is again a significant issue in the rugged terrain.

Figure 7 - Severe vegetation issues – Otago Peninsular 33 kV lines

5.5 Vegetation control

86 It is clear that changes to legislation have produced increased challenges for electricity distribution businesses (EDBs) in managing trees. For Aurora this is particularly the case in semi/rural areas where residents can resist tree management where this is seen as having an adverse visual impact.

87 Also, the legislation requires tree owners to undertake, and pay for, future tree cutting following the first cut completed by the EDB. This means that the EBD is likely to undertake a reasonably severe first cut because of uncertainty that the owner will adequately manage the trees in the future. The best outcome from the EDB's perspective would be to remove the trees completely (root cut). However, this may be difficult to get owner agreement.

88 Aurora's approach to managing the issues created by tree contact vegetation management can be considered to have two components:

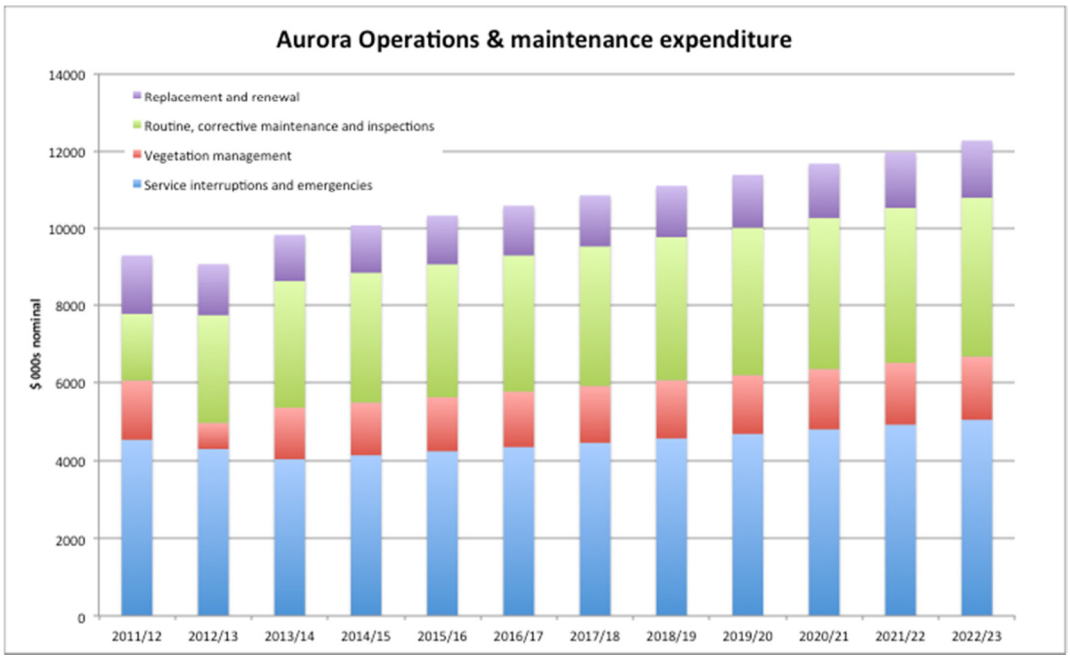
(a) catch up; and

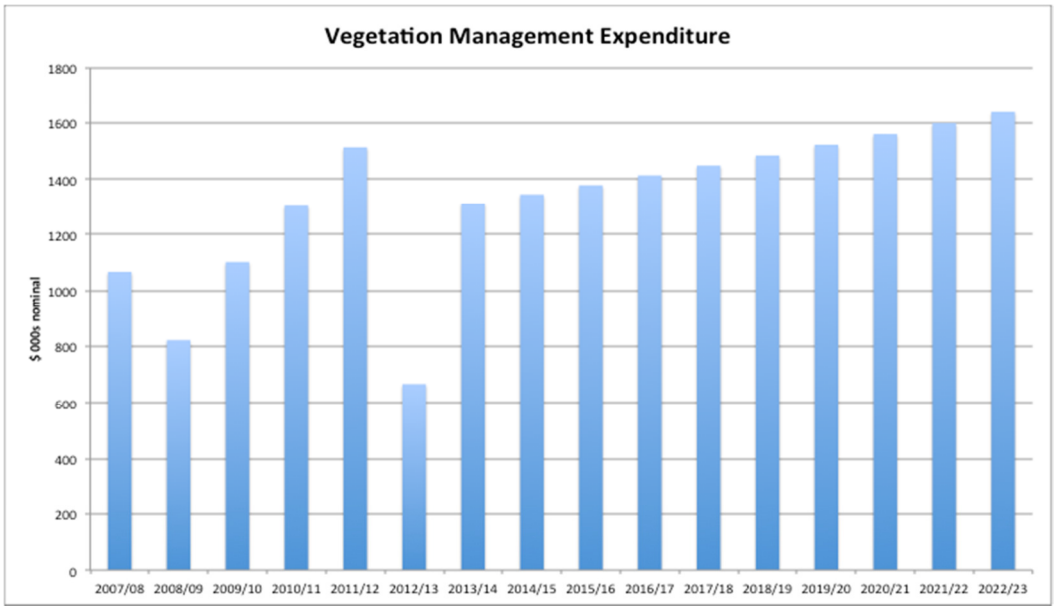
(b) on-going programme.

89 In terms of catch up Aurora will increase annual average expenditure on vegetation management by 27% (average actual annual expenditure 2007/08 – 2012/13 compared to forecast annual average expenditure 2013/14 to 2018/19) ($real 2013).

90 For the ongoing programme, the forecast vegetation management expenditure will remain constant in real terms for the next ten years at 13% of total Operational and Maintenance expenditure (see Figure 8).

Figure 8 - O & M expenditure forecast and vegetation management category





Source: Aurora 2013 AMP

Aurora has provided the following commentary on the above data:

(a) the financial information regarding the 2012/13 is provisional and unaudited;

(b) to date, Aurora has not separately budgeted vegetation management (the 2013/14 financial year onward will separately track vegetation

expenditure). For vegetation management, the historical values have been obtained from job-costing records and, where necessary, have deducted the vegetation spend from the general routine, corrective maintenance and inspections expenditure;

(c) while the vegetation management expenditure for 2012/13 appears low, Aurora explains this is due to aggressive vegetation clearing being undertaken as part of the capital feeder renewals;

(d) Aurora notes that it has just obtained capital approved for a new EPV and crew equipment to establish an additional vegetation management crew in Central Otago.

5.6 Asset age

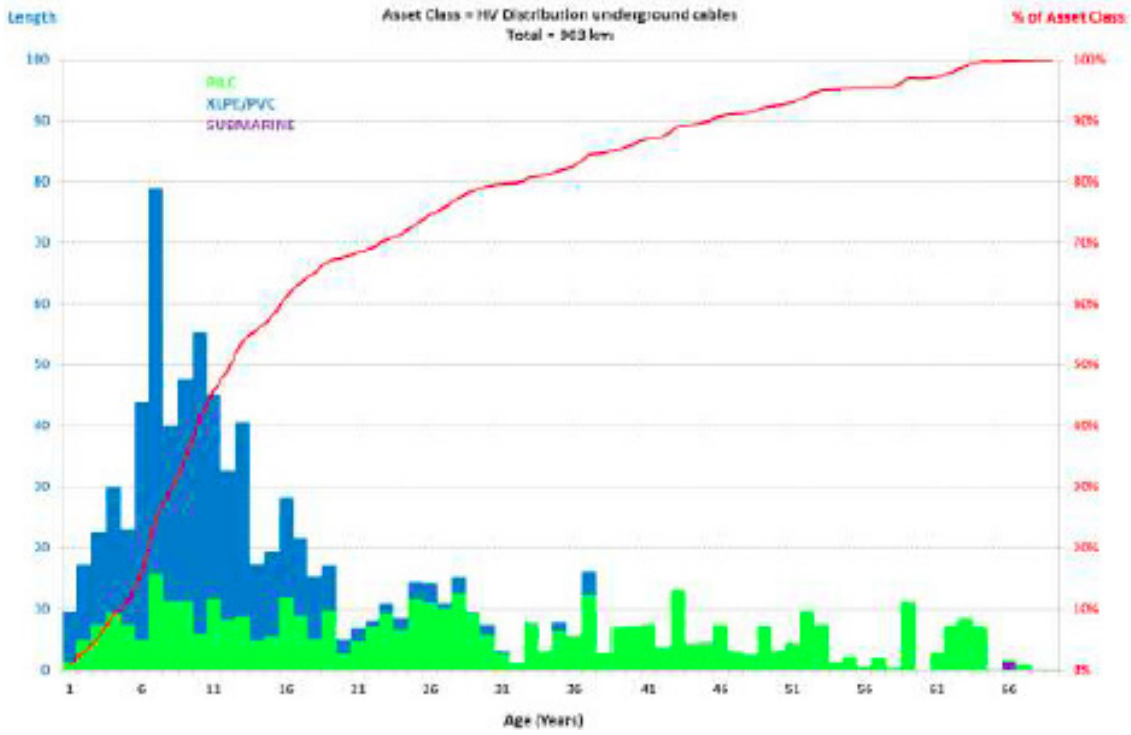
91 Section 5.5 of Aurora's 2013 AMP contains Asset Lifecycle Management Strategies that it has developed using information and data on the age and condition of major asset categories. Aurora takes into account the asset information and data when developing its maintenance, asset replacement and disposal plans.

92 The age profiles of Aurora's overhead subtransmission and distribution assets (lines and poles) display typical characteristics consistent with periodic phases of network development. While the profiles show some concentration of asset ages in the 40 to 50 year age group, we consider that for subtransmission and distribution poles, conductors, switchgear and transformers, Aurora's asset age was consistent with that normally expected to be seen in New Zealand.

93 Aurora's distribution cables (11 and 6.6 kV) have a relatively young age profile with Aurora experiencing no problems with deterioration to date[4]. Approximately 47% of the distribution cables are PILC and 53% XLPE cables. The XPLE cables generally being under 20 years old.

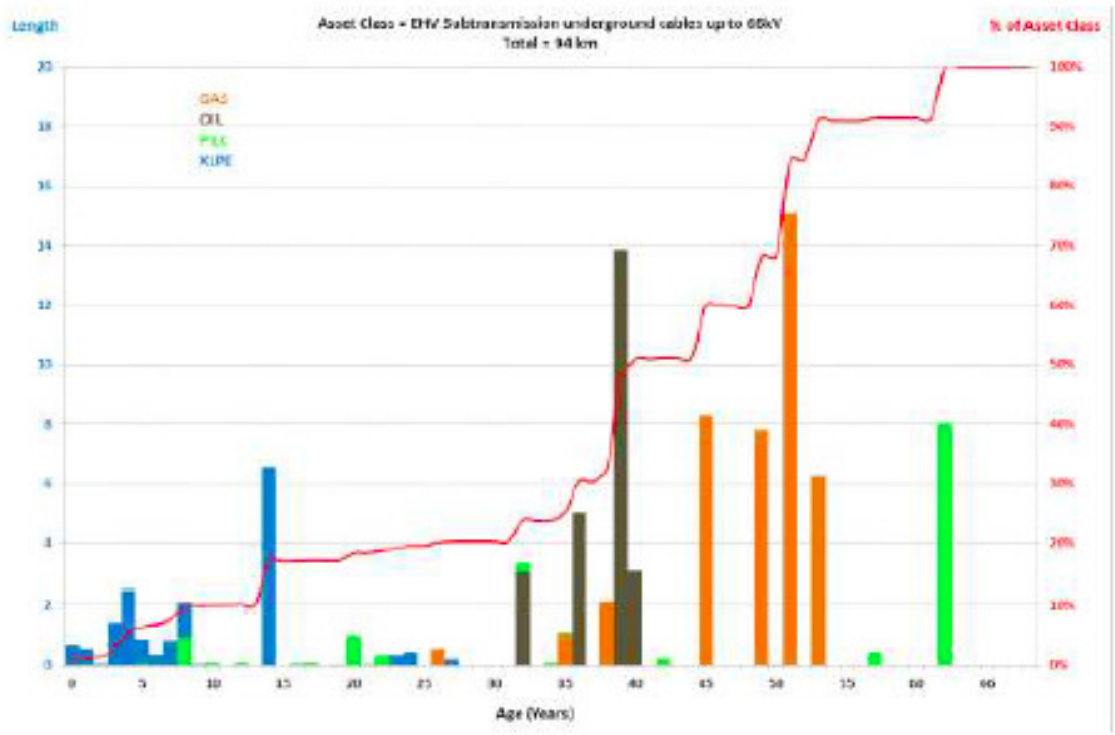
[4] Section 5.5.9 Aurora 2013 AMP

Figure 9 - Age profile of 11 and 6.6kV distribution cables



94 The age profile and condition of the distribution cables are important because Aurora is relying on these assets to support its aging 33 kV subtransmission cables. This is particularly relevant to the security and reliability of electricity supply in Dunedin. The age profile of the 33 kV subtransmission cables is shown in figure 10.

Figure 10 - Age profile 33 kV subtransmission cables



Source: Aurora 2013 AMP

95 A key area of focus for Aurora is the gas insulated cables that, at 50 years and above, are at the end of expected life. We questioned Aurora on their strategy for monitoring condition of the cables and contingency management if faults began to occur more frequently. Aurora's plan is to utilise the switching capability of the 11 kV network to provide alternative supply pathways should 33 kV cable failures occur.

96 Aurora's strategy is appropriate and should provide sufficient backup if sporadic faults occur. However, if failure rates increase significantly and concurrently across a number of cables, system reliability could suffer and the risk of major power outages will increase. Aurora has informed us that it intends to develop a strategy to deal with replacement of the aging 33 kV cables. We consider that the development and implementation of this strategy will be important for the long-term reliability performance of the subtransmission network.

6 Our assessment of Aurora's actions to address performance issues

97 We have considered if the actions being taken by Aurora are likely to lead to improvements in network performance sufficient to ensure that SAIDI and SAIFI does not exceed the limits.

98 The Operations and Maintenance expenditure 10-year forecasts appear to be a CPI adjusted extrapolation of the 2013/14 values. Each of the four main categories of Operations and Maintenance expenditure increases by 2.5% each year, which means that, in real terms, the expenditure will remain level at 2013/14 values. This suggests that Aurora management is confident that the current level of annual O & M is appropriate for the next ten years.

99 Given that:

(a) there is a catch up component in vegetation management;

(b) Aurora is continuing to develop improved asset management practices and systems which may increase the level of condition data required;

(c) costs should decrease due to the younger asset ages through the pole replacement programme; and

(d) the new management team and improved asset management practices would be expected to secure gains though prudent decision-making and efficiency;

we would have expected to have seen a more considered ten year forecast with a profile that better fitted expectations and demonstrated a return on the investment being made in improved asset management.

100 While the CPI adjusted approach to O & M forecasting may be a legitimate approach for a network that is relatively stable in terms of asset age, condition and performance, for a network undergoing significant asset replacement and asset management practice changes a more considered opex profile would be useful. However, we found no reason to conclude that, overall the opex forecast was insufficient.

101 We observed Aurora management commitment to increasing the effort to clear rather than trim trees on first cut. We have also witnessed increasing effort to gain the cooperation of the residents/tree owners to deal with the tree issues. On our field inspections we saw several examples of the intensified tree management programme in operation.

102 Aurora will need to maintain and possibly increase the focus and expenditure on vegetation control to restore the situation to a steady manageable state. Once at

this point we expect that the situation will return to 'business as usual' levels. Until this point is reached, it is difficult to conclude what 'business as usual' levels will actually be. However, we consider that the overall O & M expenditure forecasts proposed by Aurora appear to be adequate to ensure network performance remains within the regulatory limits.

103 We consider that Aurora's response to the breaches of the SAIDI and SAIFI limits by focusing asset replacement capex on worst performing feeders is an appropriate response to the network performance issues that occurred in 2010/11 and 2011/12. However, we consider that it is important to give attention to other assets. In particular, focus on 33 kV sub transmission assets should be maintained and the development of the 33 kV cable replacement strategy is critical to this outcome.

104 We consider that the actions taken by Aurora should resolve performance issues on the 11 kV distribution network. However, aging 33 kV subtransmission cables may prove to be a challenge if time runs out and mode type failures begin to occur concurrently.

6.1 Other relevant observations

6.1.1 Assessment of Aurora's outage management processes relating to the recording of SAIDI and SAIFI

105 Aurora's process for collecting outage information starts with the onset of a fault involving high voltage (HV) or subtransmission equipment and ends when supply has been restored to all interrupted consumers. We investigated the process from end to end and reviewed sample documentation relating to an actual fault.

106 In line with common EDB practice, Aurora's control room operator drives the process. The operator compiles an *HV Outage Report* (form F2104) or a *Distribution Outage Report* (form F2105) as the outage progresses and completes outage statistics once supply is restored. Exact switching times can be checked from SCADA logs showed evidence of this having been done for the sample reviewed. The number of affected consumers is correctly derived from the Geographical Information System (GIS) connection data and progressive supply restorations.

107 The process is documented in Manual M769 *Outage Reporting Oracle Database*, which sets out reporting requirements and includes the transfer of handwritten records into the Aurora's electronic database.

108 The outage record sample we reviewed was for a significant outage near Queenstown that was experienced during high winds in October 2011 (see sample documents in Annex 3). A broken pole caused the outage and it took more than 24 hours to completely restore supplies to all consumers. The handwritten records appear to properly implement Aurora's outage management process.

109 Process consistency between Aurora's two non-contiguous Dunedin and Central Otago network areas has been enhanced in recent years by having staff in both control rooms report to a single manager with overall responsibility for system

control. Sample auditing carried out in accordance with information disclosure requirements provides quality assurance.

110 The documentation reviewed and the descriptions provided by the manager responsible for system control provided an overall impression of a routine and well-managed process. In line with typical EDB operating practice, outage performance recording is a highly manual process that relies on an operator compiling clear and accurate forms and accurately transferring this data into an electronic database. Inaccuracies in the manual part of the process will naturally have a ripple-through effect into the electronic records from which network-wide SAIDI and SAIFI statistics are compiled.

6.1.2 Aurora's asset management framework

111 Aurora is in the final stages of a transition from an organisation where individuals held knowledge of the network and asset management; to one where asset knowledge is held by the organisation and asset management is effected through strategies, procedures and processes. The asset management framework being implemented is consistent with good industry practice standards such as PAS 55. Aurora management is conscious of the requirements of good industry practice standards and appears to be willing to benchmark its performance against these.

112 We found that the asset management framework is well structured and documented. Asset policies and strategies were linked to Aurora and Delta's corporate strategies and objectives. Procedural documentation was seen to be in place to cover key areas of asset management.

113 Aurora's 2013 Asset Management Plan sets out clear strategies and develops these, through a logical process, into projects and programmes that make up the ten year plan. We saw evidence that Aurora was taking into account asset age, condition and performance and using basic asset life cycle management techniques when making asset expenditure decisions.

114 Aurora management demonstrates that it is aware of the critical and high-risk areas of the network and showed that it has in place strategies to deal with these. An example of this is the aging 33 kV subtransmission cables in Dunedin where the condition is uncertain and the risk and consequence of failure is high. Aurora has put in place a contingency plan using the 11 kV network, condition assessment programme and is developing a replacement strategy.

115 In general, we consider that Aurora has responded appropriately to the changes in management and personnel and that the asset management framework being implemented should serve the organisation well into the future.

6.1.3 Compliance with policy and procedures

116 Aurora's asset strategies and procedures had clear linkages to the corporate policies and objectives. It was found that management's intention to align practices with PAS 55 was producing a logical and coordinated asset governance framework.

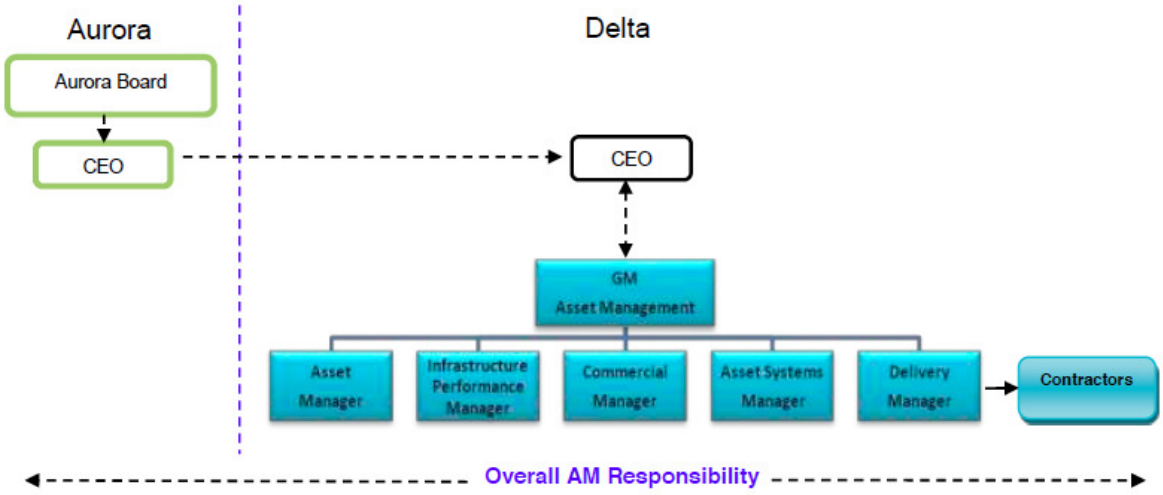
117 During our site visit we examined samples of asset records and control documentation. We also reviewed the methodology and practices for collection of asset condition and performance data.

118 The sampled practices and records that we inspected were compliant with the relevant processes and procedures.

6.1.4 Organisational capability

119 As noted above, Aurora has undergone significant changes in its management team and personnel over the past five years. The need to capture knowledge and experience in the organisation has been realised and addressed appropriately. The current senior management team has been recruited across a range of infrastructure businesses and this has brought new concepts and working practices to the organisation.

Figure 11 - Aurora/Delta governance and management structure



Source: Aurora 2013 AMP

120 We found the combined Aurora and Delta structure confusing. While the lines between the two seemed relatively clear we found that several managers spoke for both organisations and the different roles were not always clearly explained.

121 Where asset management responsibility lies with two organisations it is very important that clarity and very formal documentation exists to govern the relationship. We saw evidence of this through the network performance targets and expenditure planning process.

122 Assessment of the effectiveness of the Aurora/Delta structure is outside the scope of this review. However, we would expect that the Aurora Board and management would undertake periodical reviews to assess whether sufficient benefits exist to justify the complexity of the two-tier structure.

123 Delta's management team structure covers all the key asset management responsibilities and functions. In particular, the inclusion of an Infrastructure Performance Manager shows that the business has a commitment to measuring and

reporting performance. This role will be a key function in driving Aurora's continuous improvement programme.

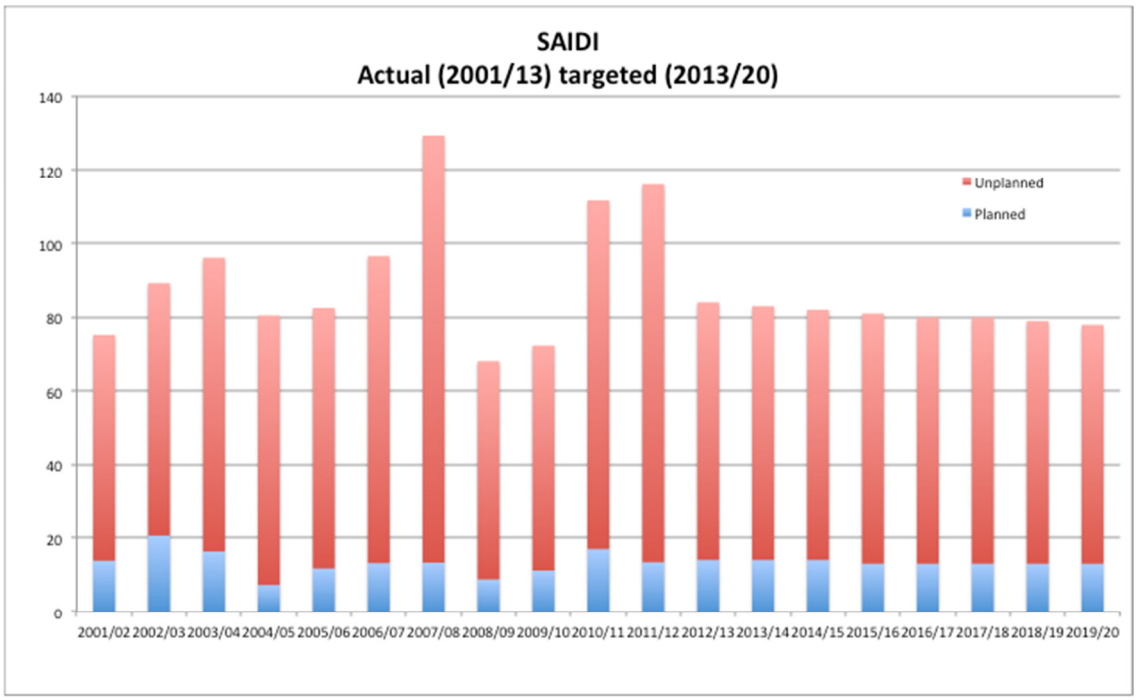
124 In summary, we consider that Aurora, through Delta, has a capable management team that is structured logically with clear roles and responsibilities. Despite being a new team, we saw clear signs that it is performing well and is continuing to develop.

7 Forward views on performance

7.1 2012/13 performance figures

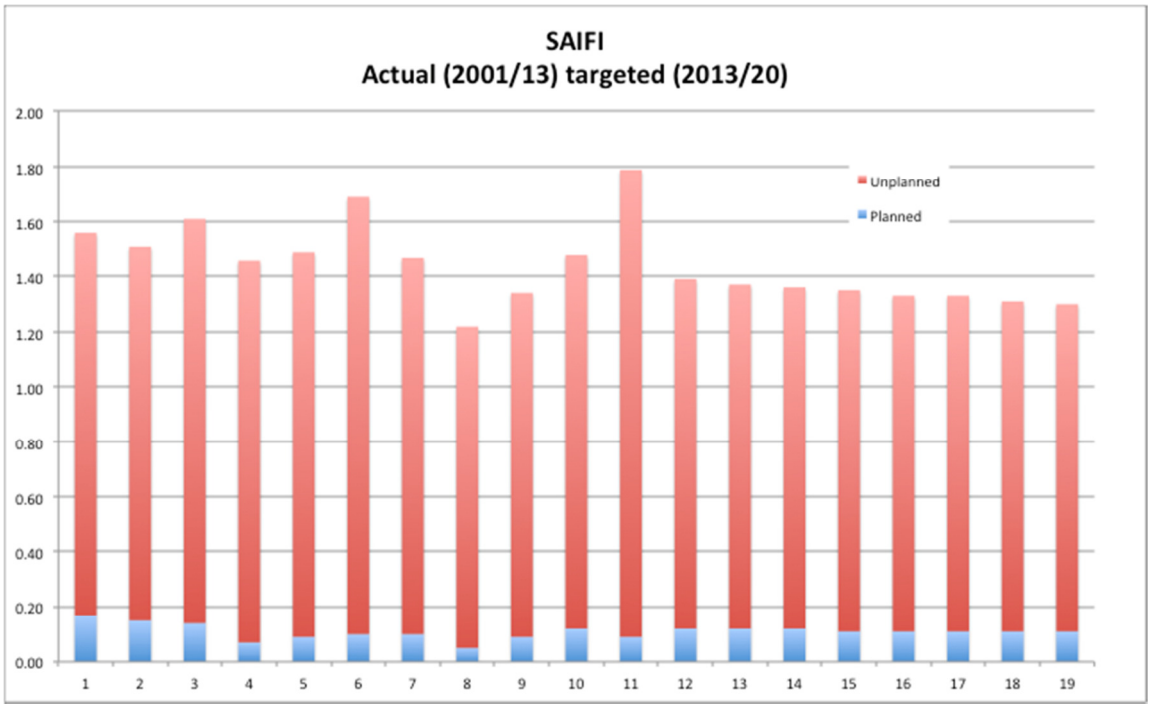
125 Aurora has established targets for future SAIDI and SAIFI that are below the current regulatory standard limits. Figures 12 and 13 below set out the targets in the context of historical performance.

Figure 12 - Network performance SAIDI



Source: Aurora 2013 AMP

Figure 13 - Network performance SAIFI



Source: Aurora 2013 AMP

126 Through the reliability targets the Aurora management team is clearly backing itself to achieve performance at levels below the current regulatory standard limits of SAIDI limit 98.29 and SAIFI limit 1.67.

127 Aurora has provided the following, as yet unaudited, SAIDI and SAIFI values for the 2012/13 year.

Year ending 31 March 2013

SAIDI = 75.61

SAIFI = 1.05

128 It can be seen that network performance in terms of both the average duration and frequency of outages has improved significantly compared with the previous two periods. The improvement is likely to be due in part to the focus and work programme that Aurora has undertaken on the worst performing feeders, also because the increased vegetation management programme is beginning to show results.

129 A major contributing factor to the improved network performance will be attributable to the lower incidence of extreme weather during the current period relative to previous years. However, as discussed in section 5.1, the capital works programmes targeted at worst performing feeders is making a significant contribution to the improvement in network performance.

130 While Aurora's reliability targets and the 2012/13 network performance figures are encouraging and are indicating that the network may now perform within the SAIDI

and SAIFI limits, we consider that achieving the planned asset replacement programme and maintaining the appropriate levels of vegetation management will be required to achieve this.

8 Key findings and recommendations

131 The findings of the review are provided in section 2, the key findings and conclusions on reliability performance are that:

(a) the reliability standard limit values, (SAIDI and SAIFI) set by the Commission were not unreasonable and that the breaches could have been avoided with alternative asset management strategies;

(b) had Aurora maintained adequate levels of vegetation management in the past and addressed the increasing incidence of equipment failure by a targeted replacement programme, exceeding the reliability standard limits would likely not have occurred;

(c) we have concerns that Aurora's asset condition data is not reliable and should be urgently reviewed. This review must include a reconciliation of asset condition data in the Information Memorandum, the AMP and that provided by Aurora for this review;

(d) subject to the results of the asset condition data review concluding that asset condition information provided by Aurora for this review can be relied upon, both the results for 2012/13 and Aurora's targets for 2013/17 suggest that Aurora's management team has implemented appropriate asset management measures to address the performance issues on the network; and

(e) performance within the reliability standard limits (SAIDI limit = 98.29 and SAIFI limit = 1.67) should be achievable in the next and future years.

8.1 Recommendations

132 Strata recommends the following actions are undertaken:

(a) Aurora must urgently undertake a review of its asset condition/health data to ensure that its asset management decisions and plans are based on an accurate data set;

(b) Following assurance that the asset condition data is accurate and reliable Aurora should review their asset strategies and planned expenditure (this may require the issue of a revised AMP and/or revisions to the information memorandum in Appendix A.2);

(c) Aurora should publish a comprehensive vegetation management plan (probably as part of its AMP) and report annually to its Board on delivery of the plan.

(d) Aurora should develop a strategy to address the aging 33 kV subtransmission network in Dunedin and included this in the 2014 AMP (if not published before).

(e) Quantification of the expected benefits, both realised and forecast, arising from Aurora's improvements in asset management methods and asset condition information should be included in, or as an addendum to, the 2014 AMP.

8.2 Concluding comments

133 This review was conducted within a relatively short timeframe and relied on the cooperation of Aurora management and its responsiveness to our requests for information. Aurora took a positive approach to the review and cooperated fully and transparently with the reviewers.

134 While the primary objective of this review was to inform the Commission, the open approach we took was intended to provide Aurora with an external perspective on the reasons for historical reliability performance and where opportunities for improved asset management exist. We hope that Aurora management found our observations, insights and advice to be of value.

Annexures

Annex 1 - Aurora's network configuration

The Aurora network has five Transpower GXPs, three of which are in the Central network (Frankton, Cromwell and Clyde) and two in Dunedin (Halfway Bush and South Dunedin). These GXPs are shown in the following figures.

Figure 14 - Frankton GXP and subtransmission

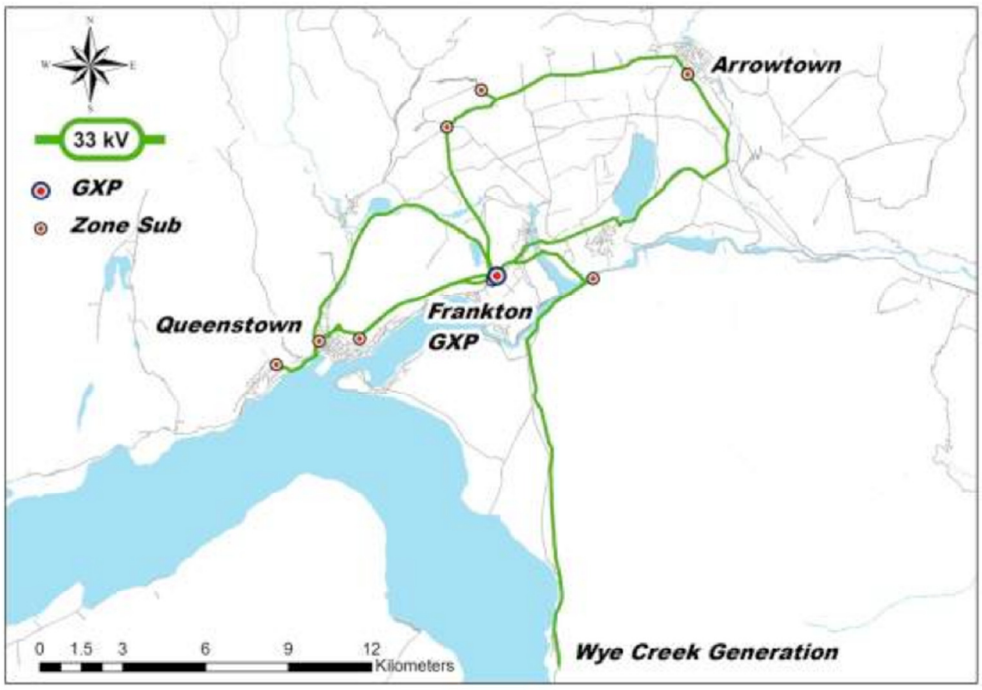


Figure 15 - Cromwell GXP and subtransmission

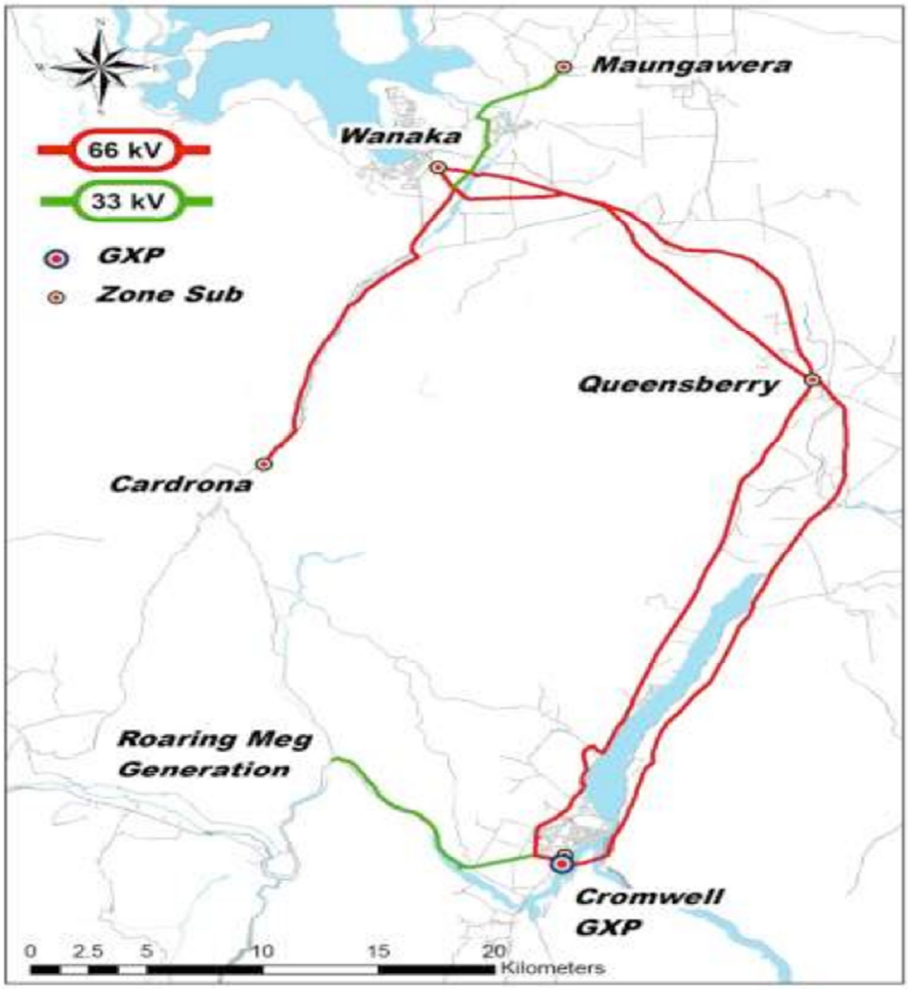


Figure 16 - Clyde GXP and subtransmission

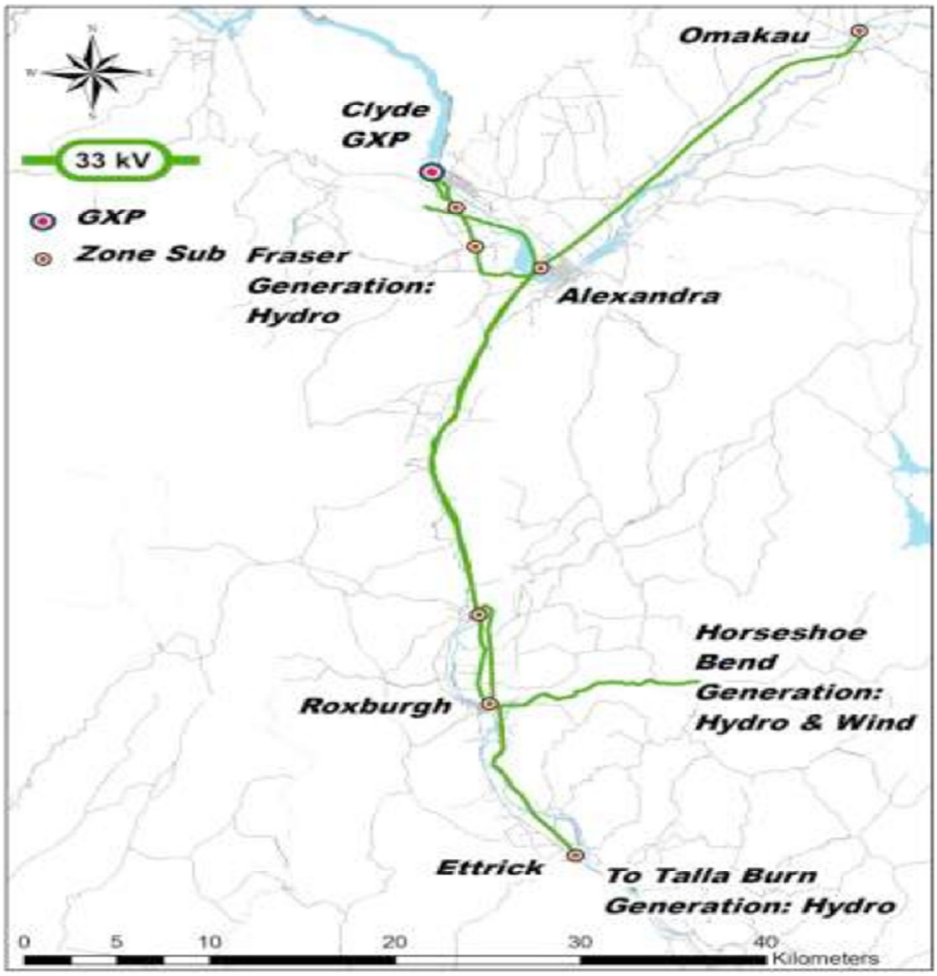
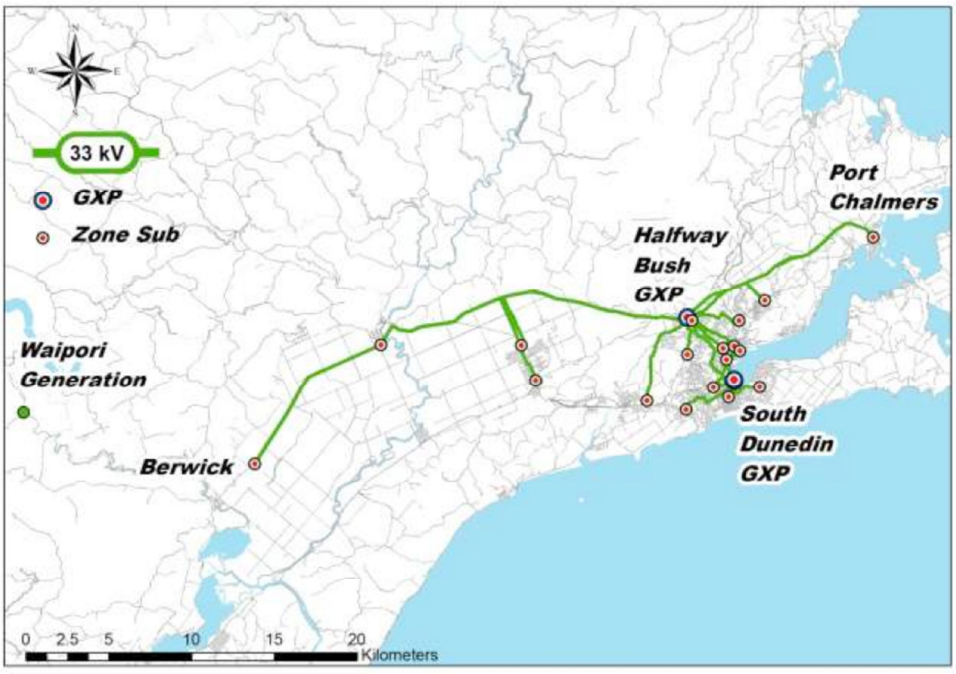


Figure 17 - Dunedin GXPs and subtransmission



Annex 2 - Check list against TOR tasks

Task	Report section
Examine quality and reliability performance management and reporting. Review the accuracy and reliability of asset data and information systems.	On site review included an inspection of how information was gathered in the field and input into management systems. Section 4 provides overview of reliability performance. Section 6.1.1 provides details of our review of the methodology for capture and management of quality and reliability data.
Consider the extent of asset planning and operational management (e.g. fault response planning) and its impact on annual reliability performance. Review the implementation of annual asset management plans.	Section 4.3 provides our assessment of the impact of asset strategies, planning and historical and proposed future expenditure on network reliability performance. Section 5.2 discusses asset condition and monitoring practice. Section 5.3 provides and assessment of vegetation management planning.
Assess asset management principles and practices, as well as procedures and processes. Examine compliance with policies, procedures and processes;	Undertaken as part of both the desktop and on-site views. Section 6.1.1 and 6.1.2 provides our assessment of the asset management framework and the level of compliance with those procedures.
Assess asset management plans and methodologies Review system loadings; demand forecasting and asset capacity measurement and reporting.	On site and desktop assessment undertaken of asset management strategies, plans and procedures including field assessment of actual practices. Section 5 provides our assessment of the relevant components of asset management to the improvement of reliability and quality performance. Section 6 provides our assessment of the application of the asset management plans and

Task	Report section
	practices targeted at improving network performance. The review of system loadings, demand forecasting and asset capacity measurement was undertaken as part of our review of the asset management planning discussed in section 6.
Examine asset condition, assessment monitoring, and reporting Examine systems outage management processes including the appropriateness of both the process and the system controls for recording SAIDI and SAIFI. Review asset age, condition monitoring and reliability assessment practice.	On site assessment undertaken across a sample of assets. Section 5.2 Discusses condition monitoring practices
Perform trend analysis against comparable peers / industry benchmarks on condition of assets, asset availability and asset age	Section 4.3 provides a discussion on the reasons for equipment failure and on asset age. Section 5.2 covers the assessment of asset condition.
Assess asset management cost management Examine how performance against budgets and plans is monitored. Review organisation and contractor management practices.	Section 6 discusses our views on the adequacy of proposed expenditure levels to address the network performance issues. In section 5 we discuss the historical expenditure levels relevant to the breaches of SAIDI and SAIFI limits. Section 6.1.1 provides our assessment of the asset management framework and practices.
Examine the extent of proactive and reactive asset management planning and practice	Section 5 provides our assessment of the asset management planning relevant to network performance improvement.
Consider organisational capability (management, technical and operational) to deliver asset management objectives	Section 6.1.3 discusses our findings on organisational capability.
Examine system loadings, demand	Sections 4, 5 and 6 cover this range of subjects.

Task	Report section
forecasting, asset capacity planning and asset condition information (e.g. asset age profiles)	
Consider capital expenditure and maintenance budgets and plans at an aggregate level	In section 5 we discuss the historical expenditure levels relevant to the breaches of SAIDI and SAIFI limits. Section 6 considers the proposed level of capex and opex and the likely impact on network performance.
Assess historical performance against budgets and plans for relevant capital expenditure and maintenance.	Sections 4, 5 and 6 take into account historical performance, and proposed levels of expenditure as inputs into our assessment of the likely levels of future network performance.

Annex 3 - Process documents

Sample outage management documents

PAGE 1 OF 2

F2104

HV OUTAGE REPORT

Originator:	Oper. Order No: F24109	Record No: 10232	Incident No: C11/491
Affected Equipment:	CB 5308		Sub Site No: 70017
Relay Flags:			Date: 24.10.11

Restoration Stage		Interruption Time	Restoration Time	Outage Time (Minutes)	No of Restored Consumers	Consumer Outage Minutes	Load Lost Amps	Load Lost kW	Load Lost kWh
	1	24/10 19:24	25/10 07:39	735	309	227115		309	3785
25/10	2	14:49	21:57	428	64	27392		64	457
24-25.	3	19:24	14:49	1165	429	499785		429	8330
	4								
	5								
	6								
TOTALS					737	754292		802	12572

FAULT ZONE

	1	Subtransmission
	2	Zone Substation
✓	3	High Voltage Feeder
	4	~~Distribution Substation~~
	5	~~Low Voltage Feeder~~
	6	Generation
	7	Transpower
	8	Other
	9	External

FAULT TYPE

	0	Planned Outage
✓	1	Earth Involved
	2	Phase To Phase
	3	Phases Unknown
	4	Emergency Isolation
	5	Accidental Isolation
	6	Open Circuit
	7	Overload
	8	External

UNPLANNED

VOLTAGE

	66	66 kV
	33	33 kV
✓	11	11 kV
	6.6	6.6 kV
	~~.4~~	~~400 v~~

STRUCTURE

✓	O	Overhead
	U	Underground

EQUIPMENT

Code: 104

CAUSE

Code: 6C

LOCATION

Code	Site no.	Nearest transformer	Name	Nearest Pole No.
	73486	WQ165		

NATURE OF FAULT

✓	1	Permanent
	2	Transient
	3	Non System
	4	External
	5	Auto-Reclose

DESCRIPTION

BROKEN POLE

COMMENTS

#34009

CB Protection Operation

No of Trips:	Fault Duty:	Comments:
1		

Completed	Date	Oracle	Initials	Comments
System Control Manager	1-11-11	✓		9.19 Said.

ISSUED: 25 March 2010 Review: 25 March 2012 Page 1 of 1
Document Reference: Network Outage Reports (QP2109)

F2104

HV OUTAGE REPORT

Originator:	Oper. Order No: 174109	Record No: 10233	Incident No: C11/491
Affected Equipment: CB 5202.			Sub Site No: 70016
Relay Flags:			Date: 24/10/11

Restoration Stage		Interruption Time 24/10/11	Restoration Time 25/10/11	Outage Time (Minutes)	No of Restored Consumers	Consumer Outage Minutes	Load Lost Amps	Load Lost kW	Load Lost kWh
	1	19:24	21:52	1588	175	277900		175	4632
	2	19:24	22:12	1608	34	54672		34	911
	3	19:24	22:17	1613	255	411315		255	6835
	4								
	5								
	6								
TOTALS					464	743887		464	12348

FAULT ZONE

	1	Subtransmission
	2	Zone Substation
✓	3	High Voltage Feeder
	4	~~Distribution Substation~~
	5	~~Low Voltage Feeder~~
	6	Generation
	7	Transpower
	8	Other
	9	External

FAULT TYPE

	0	Planned Outage
✓	1	Earth Involved
	2	Phase To Phase
	3	Phases Unknown
	4	Emergency Isolation
	5	Accidental Isolation
	6	Open Circuit
	7	Overload
	8	External

UNPLANNED

VOLTAGE

	66	66 kV
	33	33 kV
✓	11	11 kV
	6.6	6.6 kV
	~~.4~~	~~400 v~~

STRUCTURE

✓	O	Overhead
	U	Underground

EQUIPMENT

Code: 105

CAUSE

Code: 6C

LOCATION

Code	Site no.	Nearest transformer	Name	Nearest Pole No.
	73486	WQ165		

NATURE OF FAULT

✓	1	Permanent
	2	Transient
	3	Non System
	4	External
	5	Auto-Reclose

DESCRIPTION

BROKE POLE

COMMENTS

CB Protection Operation

No of Trips:	Fault Duty:	Comments:
1		

Completed	Date	Oracle	Initials	Comments
System Control Manager	1-11-11	✓		

ISSUED: 25 March 2010 Review: 25 March 2012 Page 1 of 1
Document Reference: Network Outage Reports (QP2109)

CENTRAL

OPERATING ORDER

O/O NUMBER F 24109

RELEASE REQUEST NO:	CFR NO:	DATE: 24/10/11 TIME:

Mobile Sub Check Sheet

OBJECTIVE:	CB 5308 tripped (Fernhill) @ 19:24 Also 5202 (Otaon) @ 57 Pole.

COMPILED BY:	DATE	CHECKED BY:	DATE	ACTIONED BY:	DATE COMPLETE

ITEM NO	OPERATOR	AT	TIME STARTED	34007 34005 **Action** 34001	TIME COMPLETE
1.			19:35	Police report wires down @	19:35
2.				cnr Watt & Fernhill Rd.	
3.		Otaon	21:30	Check open & racked out CB 5202 Apply ML/DT	2131
4.				Check open ABS 578 apply ML/DT	22:20
5.			22:19	Open ABS 577 apply ML/DT	22:20
6.				open ABS 591 apply ML/DT	22:35
7.				Issue A/P 24109	22:44
8.				Returned A/P 24109	00:21.
9.				Cancell A/P. 24109	00:21.
10.	Badger		00:30	close ABS 591 ML & DT Off	00:54
11.	Notes			Circuit on 5202 & FH 5308 have gone.	
12.				break at Poles 34007 & 34005.	
13.				Earths applied at Pole 34001.	
14.	control.			CLOSE CB 5308	0739
15.				OPEN MFX SWITCH 5333X	11:15
16.	cont			ISSUE A/P 24109A CABLE ONLY	11:17.
17.				RETURN A/P 24109A	14:38
18.	Cont.			CANCEL A/P 24109A.	14:38
19.			14:46	OPEN ABS 591 Apply ML/DT.	14:49
20.				ISSUE A/P 24109B	14:59.
21.				RETURN A/P 24109B	2131

LAST PRINTED 3/10/11 14:20:00LAST SAVED BY CENTRAL.CONTROL\\CMLDC-1\COSYSCON\OPERATING ORDER\NEW Operating Order.Doc

Untitled

```
19:24:35  S059015 Fernhill Sub 5308 Open
19:24:35  S059113 Fernhill Sub 5308 E/F Start
19:24:35  AQ: S059113 [0104] Entered on Queue
19:24:35  S059129 Fernhill Sub 5308 E/F Trip
19:24:35  AQ: S059129 [0105] Entered on Queue
19:24:40  AQ: Global Alarm Acknowledgement
19:24:40  AQ: S059113 [0104] Acknowledged by Operator
19:24:40  AQ: S059129 [0105] Acknowledged by Operator
19:24:47  M059025 Fernhill Sub 5308 Red O/C: 76 Amps OVER HIGH LEVEL
19:24:47  M059041 Fernhill Sub 5308 Yellow O/C: 64 Amps OVER HIGH LEVEL
19:24:47  M059057 Fernhill Sub 5308 Blue O/C: 66 Amps OVER HIGH LEVEL
19:24:47  M059073 Fernhill Sub 5308 EF3: 14 Amps OVER HIGH LEVEL
```

Sample asset condition assessment documents

DELTA F2119

Pole Inspection Report (Red Tagged)

Inspected By:	Graeme Wells / Robyn Murdoch,	Inspection Date:	13/6/12
Pole No:	19651	Pole Material:	Hwd
Manufactured Date:	1/67		
Location:	SH 8 / Conroys Rd corner		

Pole Equipment (Y or Blank)

Transformer	
Earth	
HV Fuse	
Pacific HV Fuse	
LV Fuse	
Airbreak Switch	
Links	
HV Cable	
LV Cable	
Lightning Arrestor	
LV Open Point	
Street Light	
Pilot Cable	
3rd Party Signs	
Telecom	
Possum Guard	Y
Pole steps	Y
Guys	Y (Angle)
Number of Services	

Pole and Xarm Conditions

Pole (0-6)	0				
Xarm Level (1,2..)	1	2	3	4	5
Xarm Type (EHV, HV..)	33kV				
Xarm Material (HW, Steel..)	Hwd				
Xarm Use (Inline, Angle..)	Angle				
Insulators (Pin, Strain..)	6 Pin				
Xarm Condition (0 – 6)	3				
Xarm Double (Y/N)	Y				
Conductor Condition (0-6)	6				

Current Defects/Comments:
Bloodwood, - Red Tagged

Trees menacing lines (Y or blank):		Conductor Clearance issue (Y or blank)	

Condition Assessment

Points are to be allocated for the condition of equipment of the following basis

Points Criteria

0 Poles incapable of supporting normal loads (must be replaced within 3 months – Electricity regulation 66 (4) applies). These poles shall be "red tagged".
1 Items requiring replacement within 1 year.
2 Items requiring replacement in 1 – 3 years.
3 Items requiring replacement in 3 – 5 years
4 Items requiring replacement in 5 – 10 years
5 Items requiring replacement in 10 – 20 years.
6 Items requiring replacement beyond 20 years

Pole Inspection Report

Inspected By:	Robyn Murdoch/Graeme Wells	Inspection Date:	13 / 06 /2012

Pole No:	19644	Pole Material:	HWD	Manufactured Date:	/ /

Location:	Cnr Conroys & SH8

Pole Equipment (Y or Blank)

Transformer	
Earth	
HV Fuse	
Pacific HV Fuse	
LV Fuse	
Airbreak Switch	
Links	
HV Cable	
LV Cable	
Lightning Arrestor	
LV Open Point	
Street Light	
Pilot Cable	
3rd Party Signs	
Telecom	
Possum Guard	Y
Pole steps	Y
Guys	1
Number of Services	

Pole and Xarm Conditions

Pole (0-6)	3				
Xarm Level (1,2..)	1	2	3	4	5
Xarm Type (EHV, HV..)	EHV	HV			
Xarm Material (HW, Steel..)	HW	HW			
Xarm Use (Inline, Angle..)	Angle	Angle			
Insulators (Pin, Strain..)	6 pins	2 pins			
Xarm Condition (0 – 6)	4	4			
Xarm Double (Y/N)	Y	N			
Conductor Condition (0-6)	6	6			
	Dog	Sq			

Current Defects/Comments:

Pole has bore.
33kv insulators leaning

Trees menacing lines (Y or blank):		Conductor Clearance issue (Y or blank)	

Condition Assessment

Points are to be allocated for the condition of equipment of the following basis

Points Criteria

0 Poles incapable of supporting normal loads (must be replaced within 3 months – Electricity regulation 66 (4) applies). These poles shall be "red tagged".
1 Items requiring replacement within 1 year.
2 Items requiring replacement in 1 – 3 years.
3 Items requiring replacement in 3 – 5 years
4 Items requiring replacement in 5 – 10 years
5 Items requiring replacement in 10 – 20 years.
6 Items requiring replacement beyond 20 years

Report to: DELTA Substations Inspector

ZONE SUBSTATIONS CHECK LIST

Substation: PORT CHALMERS

	OK	Needs Attenti
Building		
◦ Doors and windows secure	✓	
◦ Automatic closing Doors (South City Switchgear)	✓	
◦ Lighting operating (230V)	✓	
◦ Emergency lighting operating and signs legible	✓	
◦ Clean and tidy	✓	
◦ Emergency exits clear and signs legible	✓	
◦ Water Leaks	✓	
Inside Equipment		
◦ Indication lamps checked and replaced as necessary	✓	
◦ RT / phone operating	✓	
◦ Alarm test	✓	
◦ Fire extinguisher seal intact	✓	
◦ First aid kit seal intact	✓	
◦ Oil spill kit seals intact	✓	
◦ All relays checked and reset	✓	
◦ Sub volts OK	✓	
◦ Ripple program indication correct	✓	
◦ Earthing gear available and correct for sub	✓	
◦ Unusual smells or signs of heating	✓	
◦ Relay flagging sheets	✓	
◦ Battery check (visual only)	✓	
Outside Equipment		
◦ Compound fence and gates secure	✓	
◦ Transformer bund wall water released & valve reclosed	✓	
◦ Electric fence working	✓	
◦ Pumps and fans checked (where applicable)	✓	
◦ Mechanism box heaters on	✓	
◦ Oil levels on — Transformers	✓	
Tapchangers	✓	
Switches	✓	
CT's PT's etc	✓	
◦ Oil or compound leaks on — Transformers	✓	
Switches	✓	
CT's PT's etc	✓	
◦ Note all Silica gel breathers serviced		
Tapchanger cycle readings	T1 86250	T2 17815

Comments: YARD MOWED WEEDED

Checked by: [signature] Date: 220213