Nelson, Marlborough and Tasman

Spare Capacity and Load Characteristics Report

EECA

22132 / 22132-RPT-0003 / Revision B / 29-Jun-2023

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Document history and status

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Revision details

Revision	Details
A	Draft for client review/comment
B	Updated following EECA and Transpower comments

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1. Executive Summary

Transpower maintains/manages the transmission network in New Zealand and supplies the Nelson, Marlborough and Tasman region (as described in this report) via five GXP's.

Three Electrical Distribution Businesses (EDB's), Nelson Electricity Ltd, Network Tasman Ltd and Marlborough Lines Ltd then take supply from Transpower and distribute the electricity to end customers in the region.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called Regional Energy Transition Accelerator (RETA)[1]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions.

As part of the RETA program, EECA has developed a set of Load Sites for the Nelson, Marlborough and Tasman region. The Load Sites involve existing consumers/plant that use fossil fuel and which could potentially be converted to using electricity, resulting in an overall lower carbon footprint.

EECA contracted Ergo to determine the following (for the Nelson, Marlborough and Tasman region):

- The existing spare supply capacity at the major electrical substations.
- The load characteristics at the major electrical substations.
- A capital cost estimate to supply electricity to each of the Load Sites.

The purpose of the Load Site cost analysis is to provide options for investment that will provide significant reduction in the use of fossil fuels.

[1] https://www.eeca.govt.nz/co-funding/regional-decarbonisation/about-reta/

1.1 Network Spare Capacity

The following Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Nelson, Marlborough and Tasman region.

Nelson, Marlborough and Tasman region: GXP Substations: Spare (N) and (N-1) Capacity

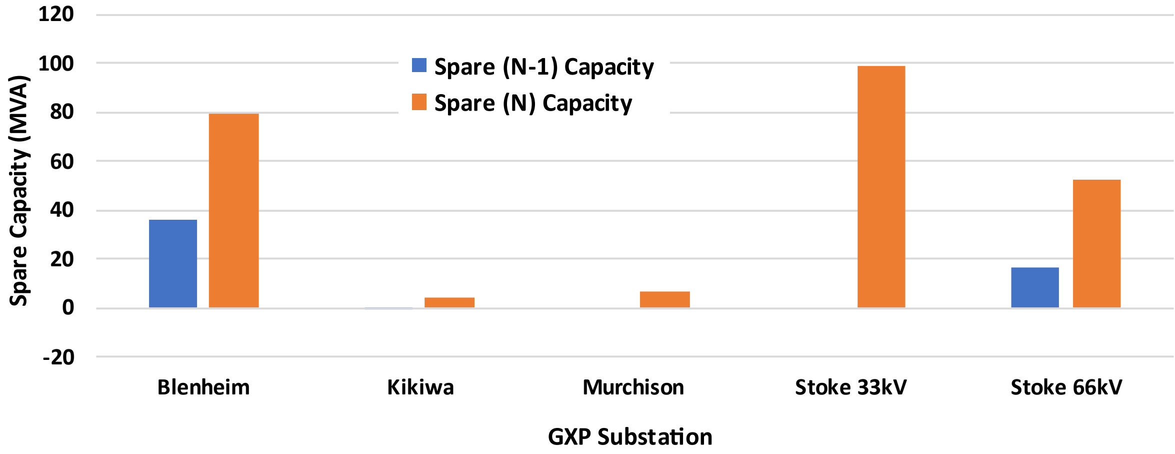


Figure 1 Summary: Approximate (N) and (N-1) spare capacity at GXP substations

The following figures illustrate the (N) and (N-1) spare capacity at the EDB Zone Substations in the Nelson, Marlborough and Tasman region. These figures are based off the maximum loadings and the EDB 2021 disclosures.

Nelson Electricity Zone Substation: Spare (N) and (N-1) Capacity

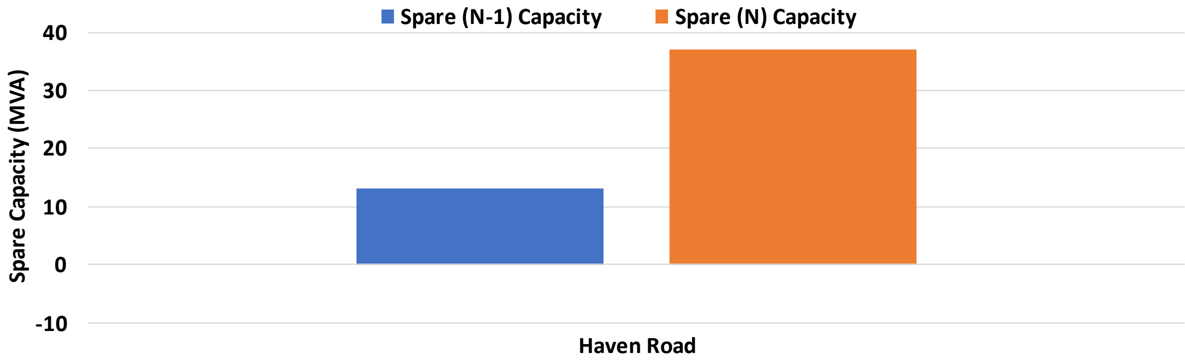


Figure 2 Summary: Approximate (N) and (N-1) spare capacity at Nelson Electricity zone substation

Network Tasman Zone Substations: Spare (N) and (N-1) Capacity

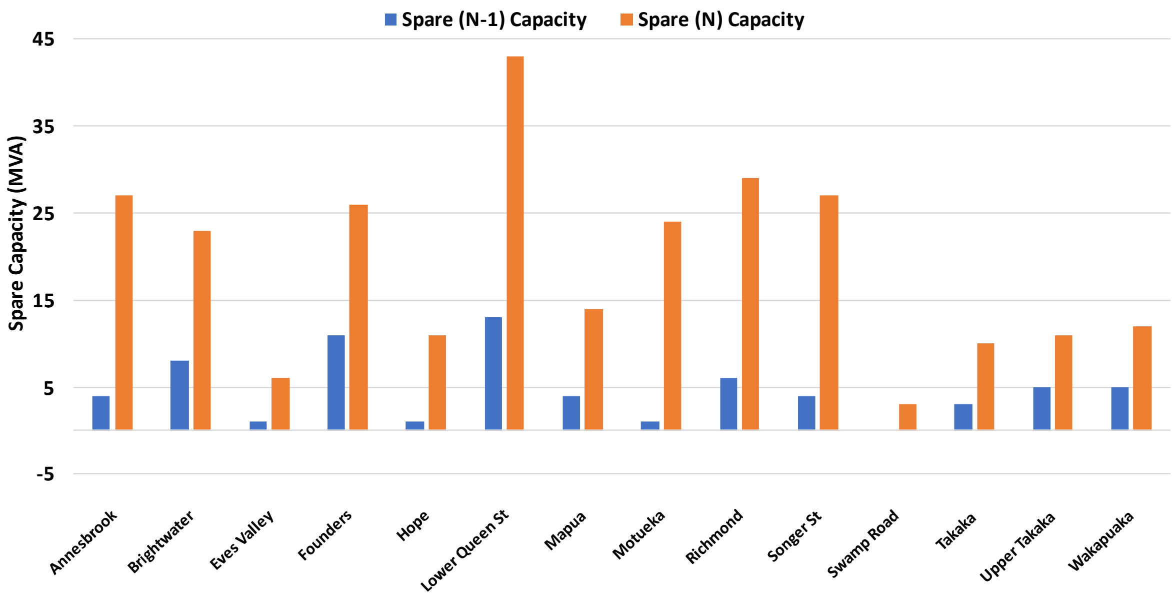


Figure 3 Summary: Approximate (N) and (N-1) spare capacity at Network Tasman's zone substations

Marlborough Lines' Zone Substations: Spare (N) and (N-1) Capacity

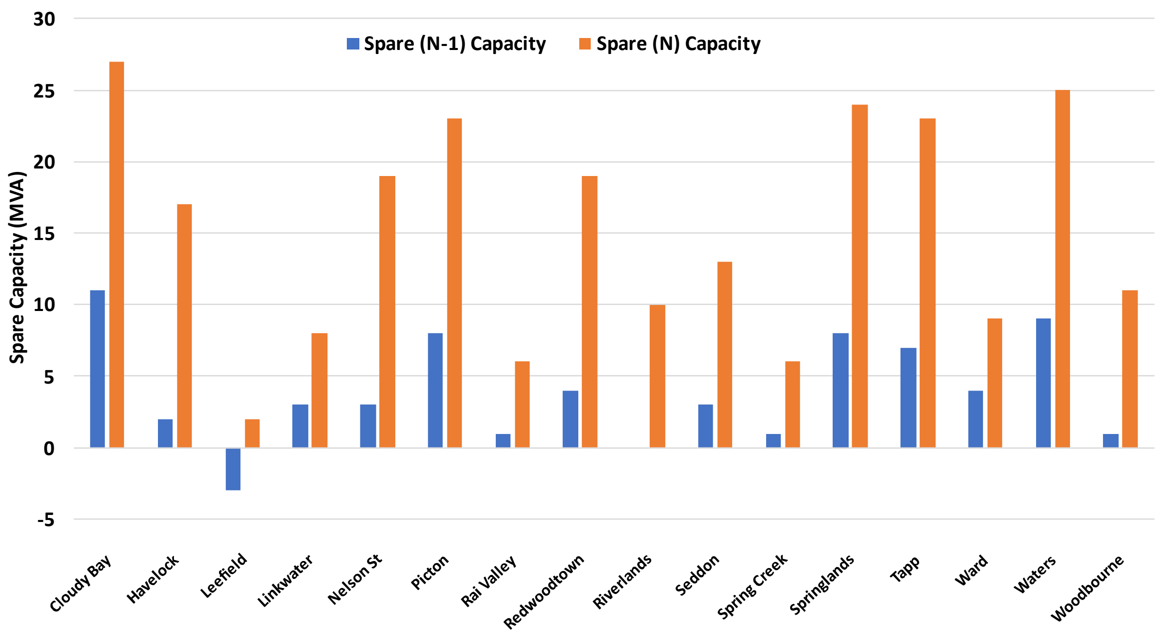


Figure 4 Summary: Approximate (N) and (N-1) spare capacity at Marlborough Lines' zone substations

1.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 22132-RPT-0004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Blenheim GXP* – Predominantly rural residential/irrigation loading including large processing/manufacturing plants and wineries. GXP loading peaks in winter due to residential loads, and in summer due to irrigation loads. Several embedded generators contribute to the GXP loading.
- *Kikiwa GXP* – Loading is predominantly a mix of residential and dairying. GXP loading peaks in summer due to irrigation as well as a hop growing operation.
- *Murchison GXP* – Loading is predominantly a mix of residential and dairying. GXP loading peaks in late summer/early autumn.
- *Stoke 33kV GXP* – A typical mix of residential and commercial/industrial loads. GXP loading peaks in winter due to space heating loads.
- *Stoke 66kV GXP* – Loading is a mix of domestic, horticulture and food processing. GXP loading peaks from February through September.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators.

1.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[2], which is only suitable for concept screening. (Refer to the assumptions outlined in Section 8.2 for more details)

[2] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Summary: Load Sites vs transmission/distribution capital cost estimates

Table 1 Summary of Load Sites and estimated capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
1	Fulton Hogan Renwick	4.90	Blenheim	$0.00	Tapp	$0.96	$0.96	$0.20	Minor	2
2	Picton/Blenheim EV Charging Station (3.8 MW option)	3.80			Picton or Nelson St	$0.90	$0.90	$0.24	Minor	2, 3
3	Shonrei Products	2.91			Springlands	$0.82	$0.82	$0.28	Minor	2
4	Pernod Richard	2.73			Cloudy Bay	$1.38	$1.38	$0.51	Minor	2
5	Dominion Salt Lake Grassmere	2.55			Seddon	$2.80	$2.80	$1.10	Minor	2
6	Sanford Havelock (N-1) subtransmission supply	2.29			Havelock	$2.74	$2.74	$1.20	Moderate	2
7	Delegat Marlborough	1.73			Tapp	$0.00	$0.00	$0.00	Minor	1
8	Villa Maria Estate Ltd Blenheim	1.27			Woodbourne	$0.00	$0.00	$0.00	Minor	1
9	PH Kinzett Ltd	1.21			Woodbourne	$0.00	$0.00	$0.00	Minor	1
10	NZDF Woodbourne	1.15			Woodbourne	$0.00	$0.00	$0.00	Minor	1
11	Indevin Ltd	1.09			Cloudy Bay	$0.00	$0.00	$0.00	Minor	1
12	Wairau Hospital	0.98			Redwoodtown	$0.00	$0.00	$0.00	Minor	1
13	Kim Crawford Winery	0.86			Woodbourne	$0.00	$0.00	$0.00	Minor	1
14	Marlborough Girls College	0.51			Springlands	$0.00	$0.00	$0.00	Minor	1
15	ANZCO Foods Marlborough	0.47			Waters	$0.00	$0.00	$0.00	Minor	1
16	Thymebank Ltd	0.29			Woodbourne	$0.00	$0.00	$0.00	Minor	1
17	Waihopai River Vineyard	0.22			Leefield	$0.00	$0.00	$0.00	Minor	1
18	Marlborough Lines Stadium 2000	0.20			Nelson St	$0.00	$0.00	$0.00	Minor	1
19	Ariki New Zealand Ltd	0.14			Springlands	$0.00	$0.00	$0.00	Minor	1
20	WineWorks Marlborough	0.09			Riverlands	$0.00	$0.00	$0.00	Minor	1
21	Murchison EV Charging Station	1.50	Murchison	$0.00	Murchison	$0.00	$0.00	$0.00	Minor	1
22	J S Ewers Appleby	4.68	Stoke 33kV	$32.20	Hope	$1.54	$1.54	$0.33	Minor	1
23	Sealord Nelson	3.91			Haven Road	$0.90	$0.90	$0.23	Minor	2
24	Richmond EV Charging Station	2.30			Richmond	$0.50	$0.50	$0.22	Minor	2
25	McCashins Brewery	2.28			Songer St	$0.74	$0.74	$0.32	Minor	2
26	Nelson Hospital	2.19			Haven Road	$1.10	$1.10	$0.50	Minor	2
27	NMIT Nelson	0.35			Haven Road	$0.00	$0.00	$0.00	Minor	1
28	Waimea College	0.33			Richmond	$0.00	$0.00	$0.00	Minor	1
29	Alliance Nelson	0.23			Richmond	$0.00	$0.00	$0.00	Minor	1
30	Nelson Girls College	0.16			Haven Road	$0.00	$0.00	$0.00	Minor	1
31	Broadgreen Intermediate	0.12			Songer St	$0.00	$0.00	$0.00	Minor	1
32	Garin College	0.12			Richmond	$0.00	$0.00	$0.00	Minor	1
33	Nelson Intermediate School	0.12			Haven Road	$0.00	$0.00	$0.00	Minor	1
34	Nelson Central School	0.09			Haven Road	$0.00	$0.00	$0.00	Minor	1
35	Nayland College	0.27			Songer St	$0.00	$0.00	$0.00	Minor	1
36	Fonterra Takaka	5.81	Stoke 66kV	$0.00	Takaka	$3.34	$3.34	$0.57	Moderate	2
37	Talleys Motueka	4.00		$0.00	Motueka	$1.34	$1.34	$0.34	Moderate	2
38	Motueka High School	0.23		$0.00	Motueka	$0.00	$0.00	$0.00	Minor	1
39	Golden Bay High School	0.08		$0.00	Takaka	$0.00	$0.00	$0.00	Minor	1
	TOTAL =>	58.2	TOTAL =>	$32.2	TOTAL =>	$19.06	$19.06			

Notes
1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.
2 Assumes supply is taken from the EDB at either 33kV or 11kV. Costs will vary depending on size, security and site requirements
3 Picton and Blenheim EV charging station are not both planned, rather, either one or the other will be installed, at this stage. The price presented is for the Picton option, which is more expensive.

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites.

2. Introduction

The consumers in the Nelson, Marlborough and Tasman region are supplied with electricity via electrical networks that are owned by the following Electrical Distribution Businesses (EDB):

- Nelson Electricity Ltd – 1 zone substations
- Network Tasman Ltd - 14 zone substations
- Marlborough Lines Ltd – 16 zone substations

The franchise areas of the EDBs are shown in Figure 5.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called the Regional Energy Transition Accelerator (RETA)[3]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions.

As part of the ETA program, EECA contracted Ergo to determine the existing spare supply capacity and the load characteristics at the major electrical substations within the Nelson, Marlborough and Tasman region.

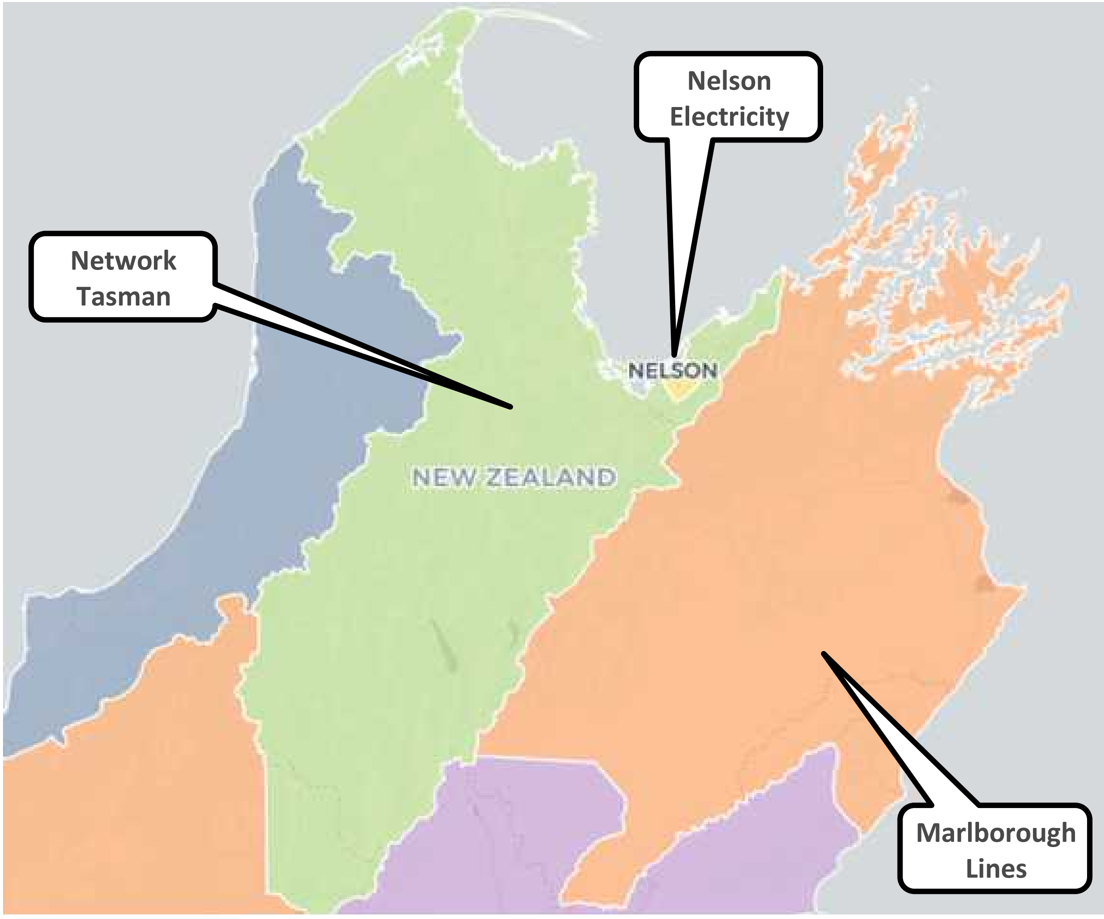


Figure 5 Electrical Distribution Business (EDB) franchise areas[4]

[3] https://www.eeca.govt.nz/co-funding/regional-decarbonisation/about-reta/

[4] https://www.ena.org.nz/lines-company-map/

3. Scope of Work

The scope requested of Ergo was to assess the existing capacity (both (N-1) and (N) security) and supply characteristics (peak and average supply and seasonality information) for the major electrical infrastructure in the Nelson, Marlborough and Tasman regions. This included reviewing both the GXP's and local distribution zone substations along with their associated lines/cables within the Nelson, Marlborough and Tasman regions.

In addition to the above, EECA provided a number of Load Sites in which Ergo were asked to assess:

1) Whether the existing electrical infrastructure was likely able to supply the additional load, and
2) If upgrades were required, outline option(s) and estimate capital costs for the necessary electrical infrastructure upgrades from both a transmission and distribution perspective.

Ergo's assessments and analysis were based on the following information sources:

- Transpower's 2022 Planning Report
- Nelson Electricity's 2023 Disclosures and Asset Management Plan
- Network Tasman's 2023 Disclosures and Asset Management Plan
- Marlborough Lines' 2023 Disclosures and Asset Management Plan
- GXP metering data extracted from the Electricity Authority's website[5].

[5] https://www.emi.ea.govt.nz/Wholesale/Datasets

4. Nelson, Marlborough and Tasman Network

The following sections describes (at a high level), the locations of the relevant substations and lines. For the purposes of this document the franchise areas supplied by Nelson Electricity, Network Tasman and Marlborough Lines are referred to as the Nelson, Marlborough and Tasman region.

4.1 Transmission/GXP Substations

The following Figure 6 illustrates the relevant transmission substations (GXPs) within the Nelson, Marlborough and Tasman regions, which include the following:

- Blenheim GXP.
- Kikiwa GXP.
- Murchison GXP.
- Stoke 33kV GXP.
- Stoke 66kV GXP

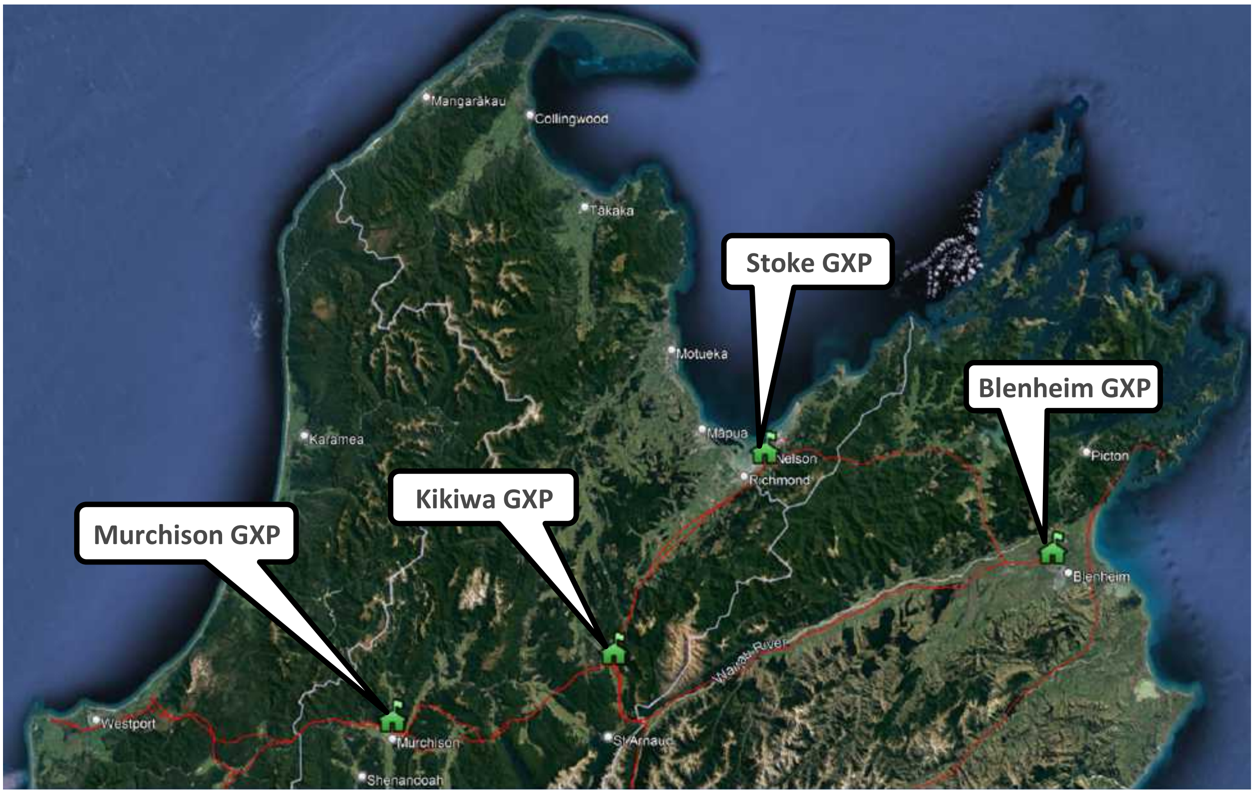


Figure 6 Transmission/GXP substations (red lines are Transpower's transmission lines)

The transmission network in the Nelson, Marlborough and Tasman regions is also shown diagramatically in Figure 7 and Figure 8. The transmission networks is supplied via 220 kV circuits from Islington (to the south) that supply Stoke, and parallel 110 kV circuits forming a 'triangle' between Kikiwa, Stoke and Blenheim. Interconnection between the 220 kV and 110 kV networks within the region is provided by a single transformer at Stoke, and a second transformer at Kikiwa, which together provide n-1 security to the 110 kV transmission network.[6] Reactive power support in the region is provided by 40MVAr and 20MVAr capacitor banks at Stoke and Blenheim respectively.

[6] There is a second 220/110kV inter-connector at Kikiwa that is not normally in service, but in "hot standby".

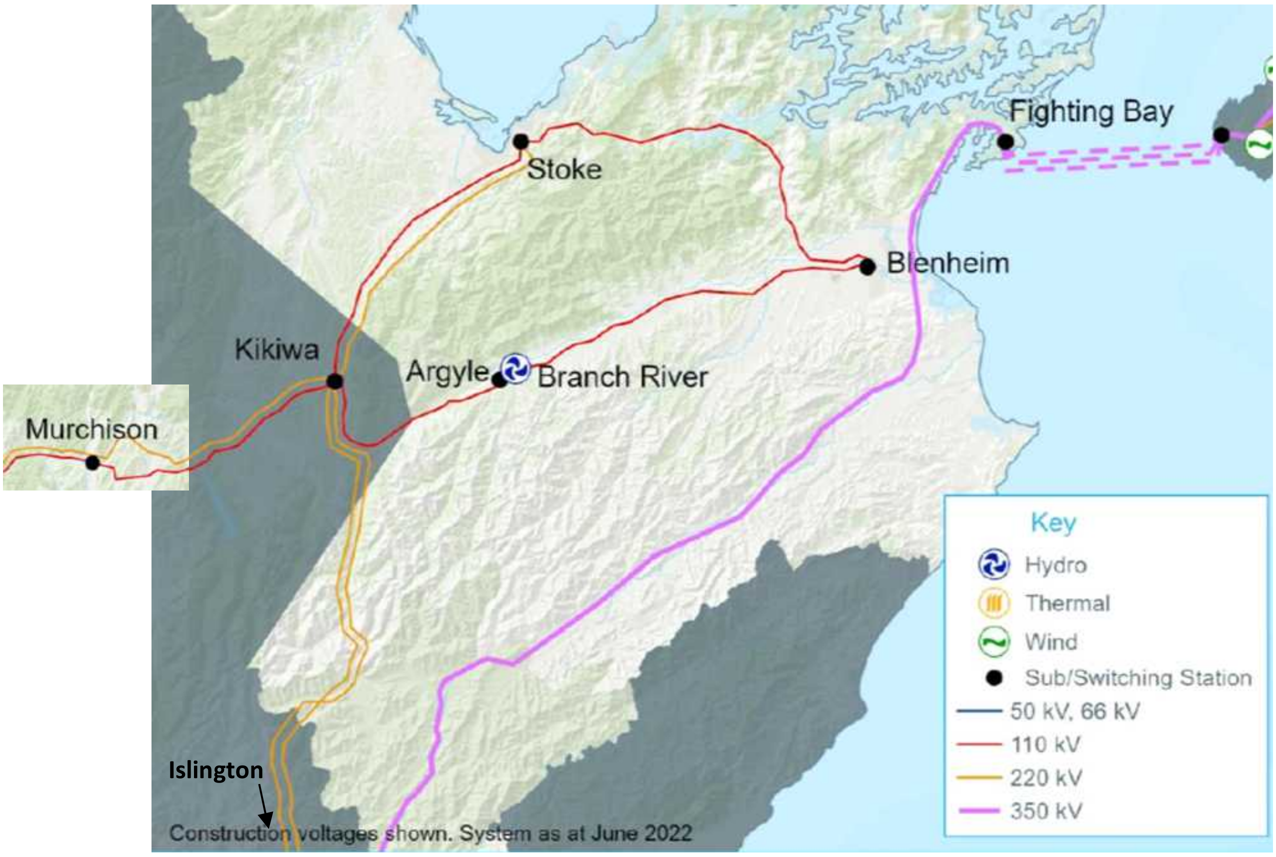


Figure 7 Transmission/GXP substations[7]

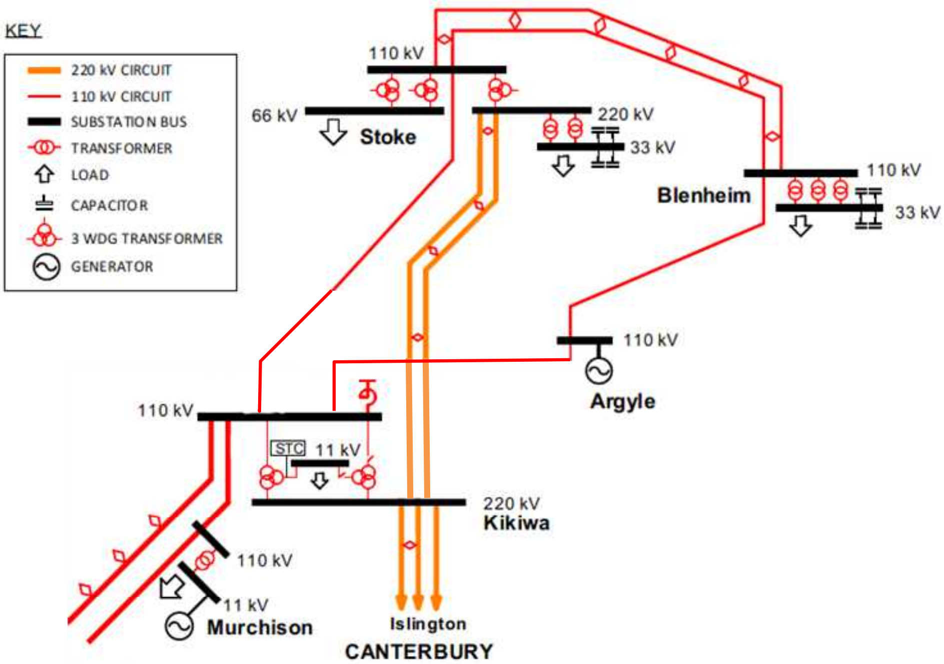


Figure 8 Existing transmission/GXP substations[7]

7 https://www.transpower.co.nz//Transmission Planning Report 2021.

4.2 Zone Substations

Zone substations are categorised by the Electrical Distribution Business (EDB) that owns and operates the network. As mentioned earlier, in the area investigated, there are three relevant EDB's – Nelson Electricity, Network Tasman and Marlborough Lines. Table 2 below gives an overview of the number of Zone Substations managed by each investigated EDB, and the number of Transpower GXPs they take power from.

Table 2 Overview of substation numbers for each EDB investigated

EDB Name	Three-letter acronym	Number of Zone Substations	Number of GXPs
Nelson Electricity	NEL	1	1 [8]
Network Tasman	TAS	14	3 [8]
Marlborough Lines	MAR	16	1

4.2.1 Nelson Electricity

Nelson Electricity owns/operates a single 33/11kV zone substation that is called Haven Road substation. The following Figure 9 shows the location of the Haven Road zone substation coupled with a section of the four 33kV cables/lines that supply the substation from Transpower's Stoke GXP.

Figure 9 Nelson Electricity: Haven Road 33/11kV substation supplied by four 33kV circuits

[8] Nelson Electricity and Network Tasman both take supply from Transpower's Stoke GXP.

4.2.2 Network Tasman

The following Figure 10 through Figure 12 shows the zone substations on Network Tasman's network diagrammatically. The substations include:

- Annesbrook 33/11kV zone substation
- Brightwater 33/11kV zone substation
- Eve's Valley 33/11kV zone substation
- Founders 33/11kV zone substation
- Hope 33/11kV zone substation
- Lower Queen Street 33/11kV zone substation
- Mapua 33/11kV zone substation
- Motueka 66/11kV zone substation
- Motupipi 66/33kV zone substation
- Richmond 33/11kV zone substation
- Songer St 33/11kV zone substation
- Swamp Rd (Collingwood) 33/11kV zone substation
- Takaka 33/11kV zone substation
- Upper Takaka 33/11kV zone substation
- Wakapuaka 33/11kV zone substation

Figure 10 Network Tasman: Stoke region sub-transmission and distribution diagram[9]

[9] https://networktasman.co.nz/asset-management-plans/

Figure 11 Network Tasman: Golden Bay and Moteuka region sub-transmission and distribution diagram[9]

Figure 12 Network Tasman: Kikiwa and Murchison region sub-transmission and distribution diagram[9]

4.2.3 Marlborough Lines

The following Figure 13 shows zone substations on Marlborough Lines' network diagrammatically. Figure 13 also illustrates the substation maximum demands and the available capacities. The substations include:

- Cloudy Bay 33/11kV zone substation
- Havelock 33/11kV zone substation
- Leefield 33/11kV zone substation
- Linkwater 33/11kV zone substation
- Nelson Street 33/11kV zone substation
- Picton 33/11kV zone substation
- Rai Valley 33/11kV zone substation
- Redwoodtown 33/11kV zone substation
- Riverlands 33/11kV zone substation
- Seddon 33/11kV zone substation
- Spring Creek 33/11kV zone substation
- Springlands 33/11kV zone substation
- Tapp 33/11kV zone substation
- Ward 33/11kV zone substation
- Waters 33/11kV zone substation
- Woodbourne 33/11kV zone substation
- Waitohi 33/11kV zone substation (planned with 17 MVA firm capacity)[10]
- Kaituna 33/11kV zone substation (substation planned, dependent on the demand from a large customer)

[10] As Waitohi substation is in the design+build stage presently, loading data is unavailable, and therefore it is excluded from capacity tables

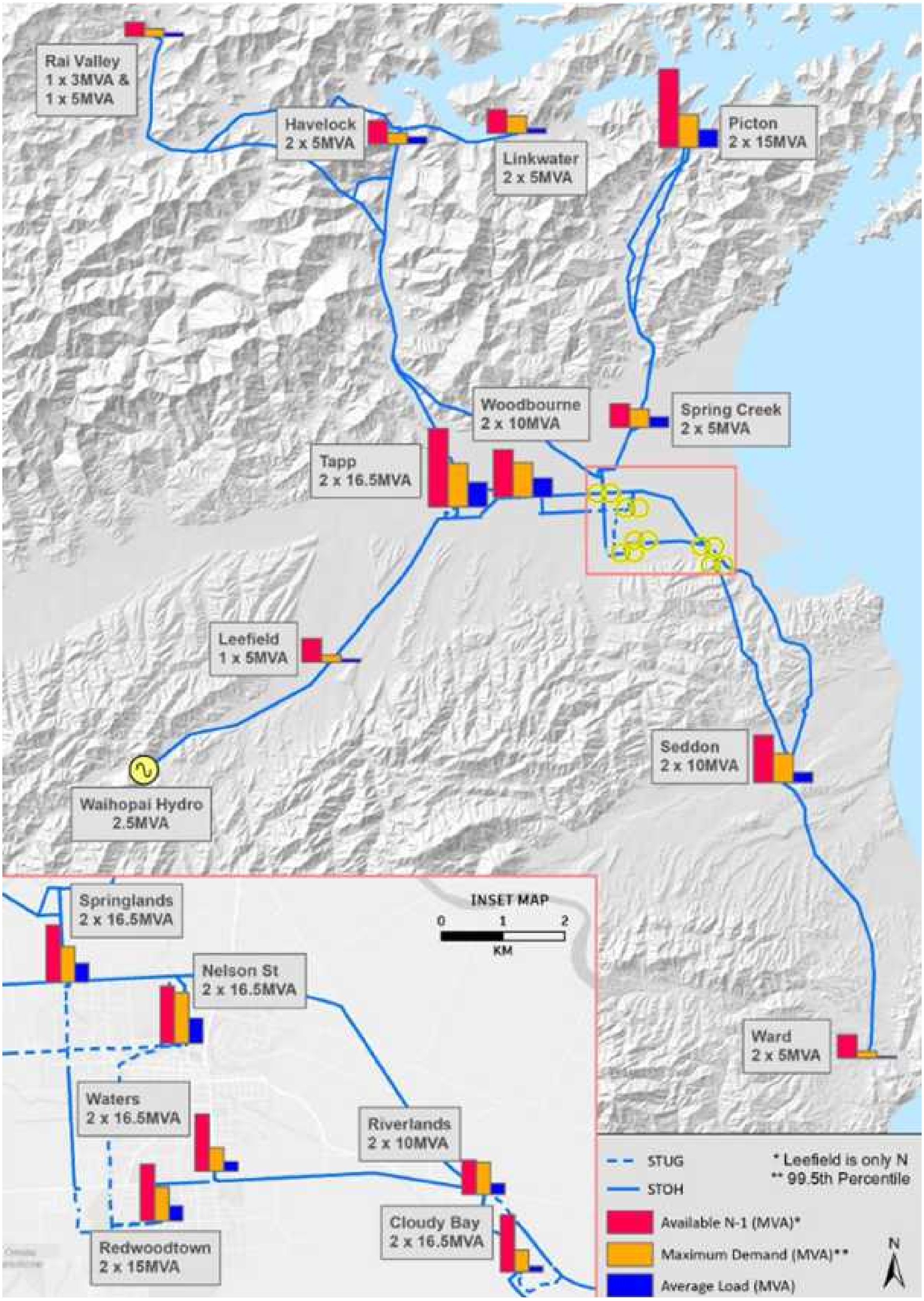


Figure 13 Marlborough Lines' Zone Substation Geospatial Sub-transmission Diagram (showing substation loads and capacities)[11]

[11] https://www.marlboroughlines.co.nz/corporate-information#asset-management-plan

5. (N) and (N-1) Security Classifications

Both Transpower and the EDB's develop and operate their networks in accordance with a set of reliability standards. In the context of Transpower it is required to meet the grid reliability standards that are outlined in the Electricity Industry Participation Code (EIPC)[12]. In contrast, EDBs are required to publish a network security criteria, which is used to plan/develop its network.

In both cases, these standards are usually quantified in terms of the following terminology:

- (N) security: The network is designed and operates such that it will be unable to supply load in the event of a single asset failure (i.e. a line, transformer or other primary assets). This is equivalent to a single-engine airplane, which in the event of engine failure will result in the aircraft crashing.
- (N-1) security: The network is designed and operates such that it can continue to supply load uninterrupted in the event of a single asset failure. Again, can be compared with an aircraft, but in this case with two engines, which in the event of single engine failure will not crash.

The decision around whether to develop/operate a network supply with (N) or (N-1) security is typically driven by the size and criticality of the load versus the investment costs.

Typically, in New Zealand, this results in the following:

- Transmission GXP substations and lines being designed and operated with (N-1) security of supply.
- Distribution zone substations are designed and operated as follows:
  - Loads ≥ 12MW designed and operated with (N-1) security of supply.
  - Loads <12MW designed and operate with (N) security of supply.

As per the EIPC, Transpower is required to provide (N-1) for "core grid" (i.e. 220kV and >150MVA loads) interconnected assets (i.e. transmission lines that supply multiple GXP substations). For "non-core grid" assets (i.e. <220kV and <150MVA loads), the decision to supply (N-1) is still made by Transpower but must be economically justified.

For connection assets that are dedicated to a single consumer the decision regarding security is made by the consumer/customer. The customer can be an industrial consumer, but in most cases is an EDB and usually (N-1) security of supply is specified. However, for GXPs that supply small consumer load or where a large industrial customer does not want to pay for (N-1) security, an (N) security connection is not uncommon.

The Transpower points of supply discussed in this report are considered connection assets and therefore decisions around their security classifications lie with their end customers (i.e. Nelson Electricity, Network Tasman or Marlborough Lines). For those substations that are supplied via dedicated incoming lines, the lines are also considered to be connection assets. The remaining lines that are not dedicated to a single substation are interconnection assets.

The distribution networks owned/operated by EDBs generally supply multiple consumers and thus, in most cases, EDBs have to make security of supply decisions on behalf of their consumers. These decisions are based on the EDB's disclosed network security criteria, that have been ratified by their respective board of directors.

Both Transpower and EDBs have taken advantage of technology to make the above mentioned standards more flexible, by managing consumer demand where possible. Initially this involved the use of mains borne ripple injection equipment to manage the load drawn by consumer's hot water cylinders. But more recently this has involved, for example, special protection systems (SPS) that, in the event of the loss of specific network equipment will shed specific consumer loads and also the development of a market for

[12] https://www.ea.govt.nz/code-and-compliance/the-code/

interruptible load[13]. There are examples of this at both transmission and distribution levels. This has allowed Transpower and EDB's to operate some sections of their networks well beyond their (N-1) limits, whilst still maintaining sufficient security of supply to the majority of their consumers.

There is potential to significantly reduce the costs associated with electrical network upgrades if Load Sites can be designed to:

- Operate during times of minimum network loading (typically late in the evening and early in the morning) such that they do not significantly increase existing peak network loading.
- Swiftly and safely disconnecting from the relevant electrical network during periods of peak loading.

[13] https://www.transpower.co.nz/system-operator/electricity-market/instantaneous-reserve.

6. Spare Capacity – Transmission Substations

The following sections document the spare capacity that is individually available on the GXP's that take supply from within the Nelson, Marlborough and Tasman regions.

Transpower has identified the following "*core grid issues*" that result from increasing electrical demand in the Nelson, Marlborough and Tasman region including:

- The Nelson, Marlborough and Tasman regions rely on generation from several hundred kilometres away. As load increases there will be an ongoing need for investment in reactive support equipment to support regional network voltages.
- The 220/110 kV interconnecting transformer at Stoke in the Nelson, Marlborough and Tasman regions and at Kikiwa in the West Coast region effectively operate in parallel through the two 110 kV circuits connecting these regions:
  - Kikiwa–Stoke–3 circuit rated at 56/68 MVA (summer/winter)
  - Kikiwa–Argyle–Blenheim–1 circuit rated at 56/68 MVA (summer/winter).

  The 110 kV Kikiwa–Stoke–3 circuit may overload for an outage of:
  - The Stoke 220/110 kV interconnecting transformer during the summer period when Nelson, Marlborough and Tasman regional load is high coupled with low local generation at Cobb.
  - The Kikiwa 220/110 kV interconnecting transformer, towards the end of the 2022 Transmission Planning Report forecast period, when West Coast load is high coupled with low generation in the region and at Coleridge.

  An outage of the Stoke 220/110 kV interconnecting transformer may also cause low voltages at Blenheim when the Nelson, Marlborough and Tasman regional load is high. As load continues to grow, an outage of the Stoke 220/110 kV transformer during periods of low Cobb generation and high load at Stoke 66 kV and Blenheim is predicted to result in voltage collapse towards the end of the 2022 Transmission Planning Report forecast period.
- There is a single 110kV bus section at the Kikiwa substation. This means that a bus outage will disconnect both 110kV circuits that supply the region.

Figure 14 below illustrates Transpower's view of a possible 2037 configuration for the Nelson, Marlborough and Tasman transmission network. It includes:

- A new 220/33kV substation called Brightwater GXP.[14]
- Replacement of the 33kV switchgear at the Blenheim GXP.
- Replacement of the 33kV capacitor bank at Blenheim GXP.
- Replacement of T1 220/110/11kV interconnecting transformer at the Kikiwa GXP.
- Midlife refurbishment of the STATCOM at the Kikiwa GXP.

[14] Network Tasman has bought and consented the site.

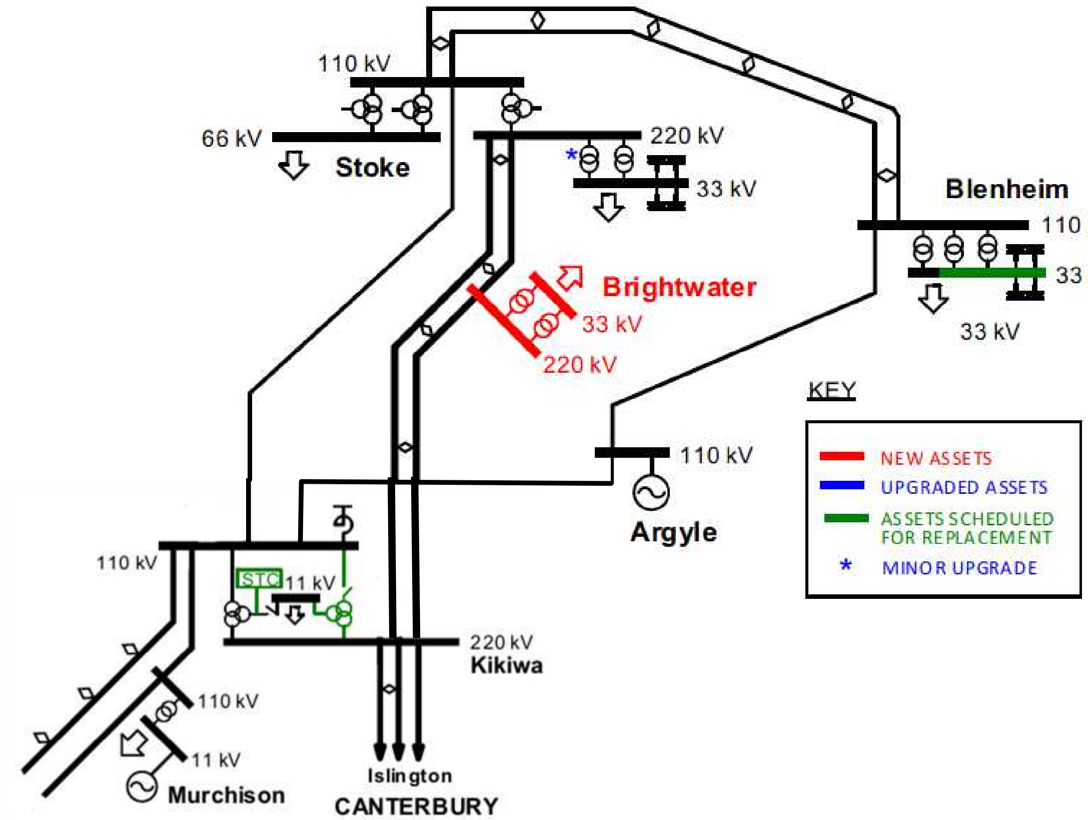


Figure 14 Existing transmission/GXP substations together with future proposed upgraded/new assets[7]

6.1 Demand Forecast

The following Table 3 illustrates Transpower's forecast demand at the transmission substations in the Nelson, Marlborough and Tasman regions from its 2022 Transmission Planning Report[7]. The forecast predicts the demand growing at an average of 2% per annum over the next fifteen years which is marginally lower than the national average growth rate of 2.1% per annum.

Table 3 Transpower demand forecast (Active Power)

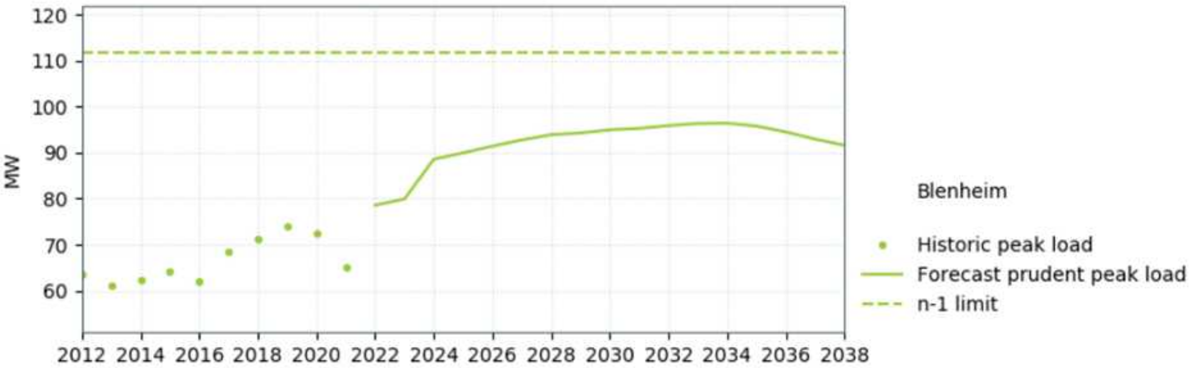
No.	Substation / GXP	Power Factor	Demand (MW)											
			2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2037
1	Blenheim	0.98	79	80	88	90	91	92	93	94	95	95	95	93
2	Kikiwa	-0.98	4	4	4	4	4	4	4	4	4	5	5	5
3	Murchison	0.99	3	3	3	3	3	3	3	3	3	3	3	3
4	Stoke 33kV	1.00	141	143	146	149	151	154	157	159	161	164	166	177
5	Stoke 66kV	0.98	27	28	29	30	30	32	33	33	34	35	36	39
		TOTAL	**254**	**258**	**270**	**276**	**279**	**285**	**290**	**293**	**297**	**302**	**305**	**317**

1. The Blenheim forecast includes the public transport electrification upgrade in 2024.
2. The loading on Stoke 66kV is a gross value and excludes the generation from Cobb generation.
3. Kikiwa GXP has a leading power-factor during periods of peak loading.

6.1.1 Blenheim GXP

Transpower's demand forecast (refer Table 3) indicates that the Blenheim GXP was expected to have a 2022 peak demand of 79MW at 0.98pf. This value corresponds well with the historical SCADA data that indicates the Blenheim GXP experienced a peak load of 75MVA during the 2022 year.

The following graph compares Blenheim GXP's supply capacity with the historical loading and Transpower's demand forecast (sourced from Transpower's 2022 TPR).



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The Blenheim GXP is equipped with three 110/33kV transformers giving a total (N) capacity of 160MVA. The substation has an (N-1) capacity of 117/122MVA (summer/winter), which means the loading is well below the substation's (N-1) capacity.

The Blenheim GXP supplies electricity to Marlborough Lines', whose network supplies a diverse area that can be broken up into:

- The main urban areas of Blenheim and Picton.
- Marlborough's east coast.
- The Marlborough Sounds.
- The regions inland valleys of Awatere, Waihopai and Wairau.

Major consumers are typically located outside Blenheim, and include food processing, wineries, timber processing and manufacturing. Most of the load is related to the residential connections peaking in winter, as well as growth over recent years in wineries processing grapes at the time of vintage, typically April. Similarly, high demand in summer has resulted from an increase in irrigation load resulting in relatively high summer maximum demands, particularly during prolonged dry and hot periods.

The following generators are embedded in Marlborough Lines' network (that connects to the Blenheim GXP):

- Manawa Energy's Waihopai 2.5MW "run-of-the-river" hydro.
- Energy3's 3 x 250kW wind turbines located at Weld Cone.
- Energy3's 4 x 250kW wind turbines located at Ure River.
- Dominion Salt's 660kW wind turbine.
- Kea Energy's Wairau Valley 1.85MW solar farm.

The following Figure 15 illustrates Blenheim's 2022 loading in comparison to its substation capacity.

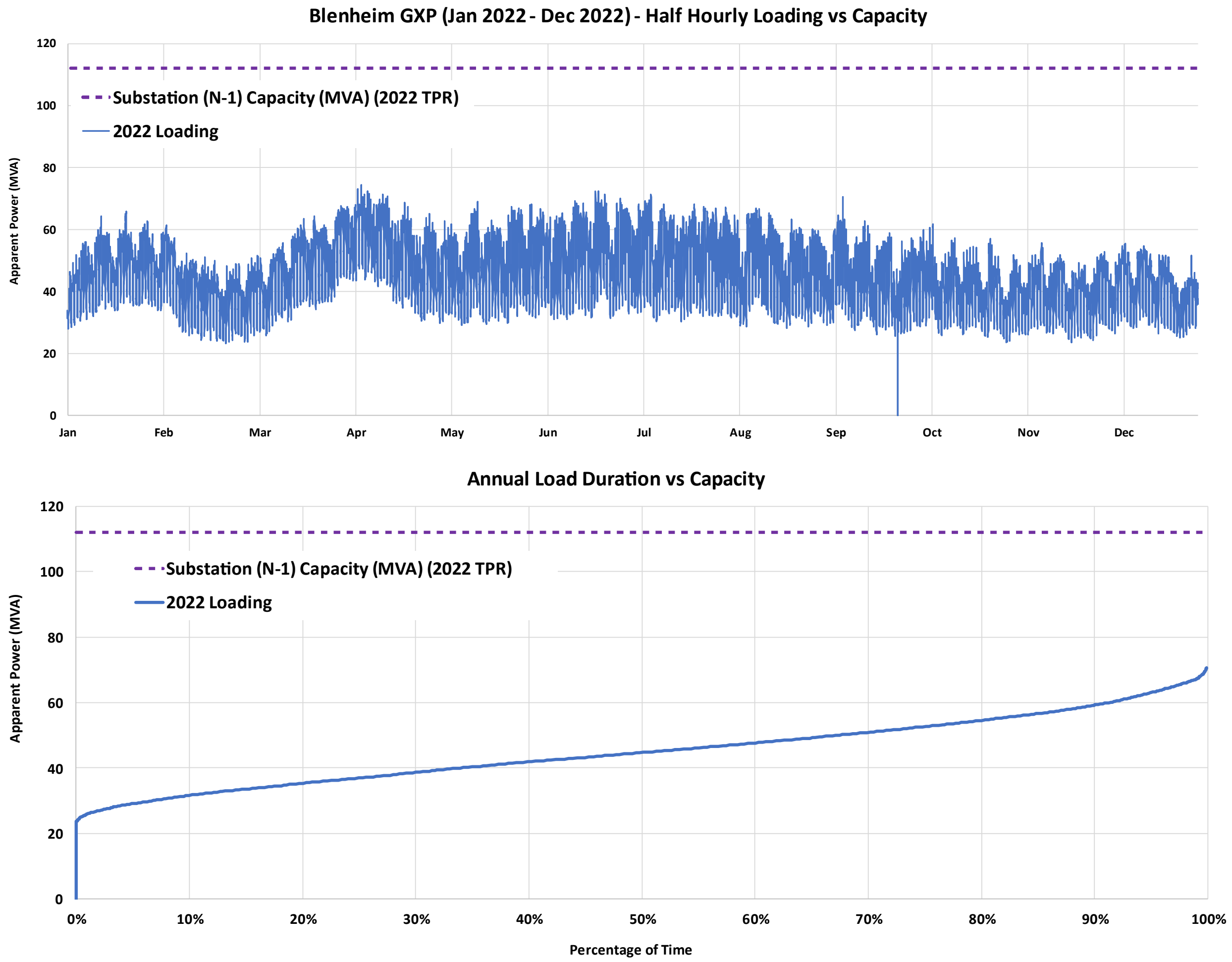
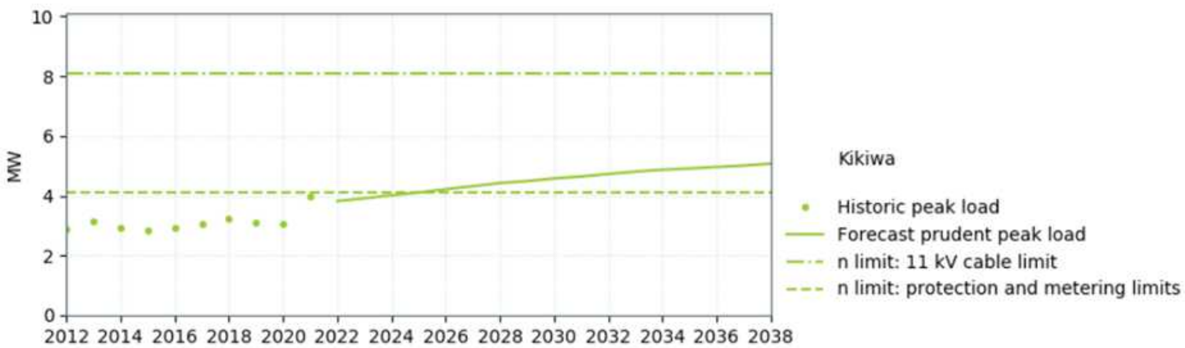


Figure 15 Blenheim GXP: 2022 Loading: Substation capacity

6.1.2 Kikiwa GXP

Transpower's demand forecast (refer Table 3) indicates that the Kikiwa GXP was expected to have a 2022 peak demand of 4.0MW at -0.98pf (leading power factor). This aligns well with the historical SCADA data that indicates that, in 2022 the Kikiwa GXP experienced a peak load of 4.1MVA.

The following graph compares Kikiwa GXP's supply capacity with the historical loading and Transpower's demand forecast (sourced from Transpower's 2022 TPR).



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

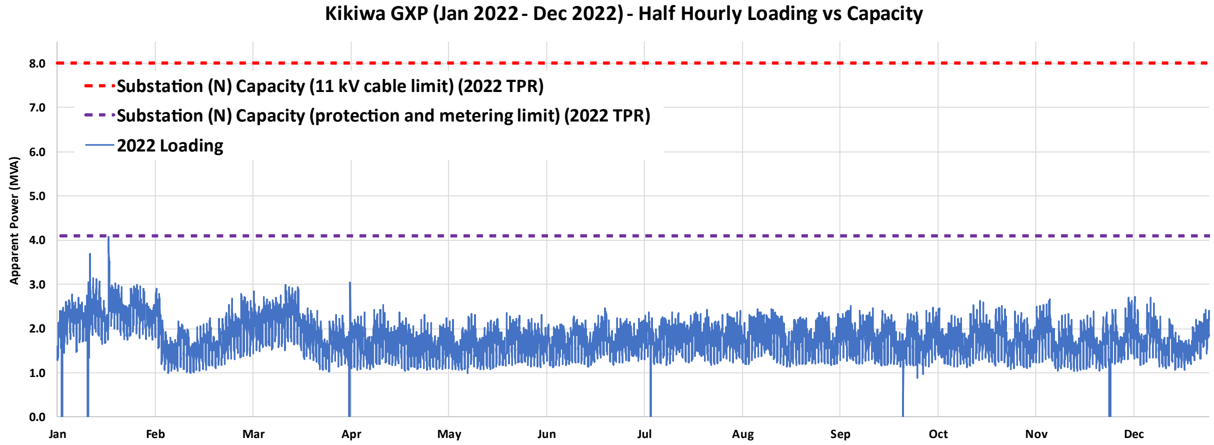
Network Tasman is supplied, at 11kV, from the Kikiwa GXP and the load characteristic is a mix of domestic and dairying operations including significant irrigation during dry summers and a timber processing factory. Recently hop growing has become prominent in the area. This load has a short operating period during February for the kiln drying of harvested hops. There are two small centres at Tapawera and St Arnaud which are 20km and 40km respectively from the GXP and supplied via three overhead 11kV line feeders. The country traversed by these feeders is mountainous and remote.

The Kikiwa load is normally supplied from the 11 kV tertiary winding of a 220/110/11kV interconnecting transformer (T1) that is normally energised from the 220 kV side only and with the 110 kV side open. There is a backup supply from the adjacent interconnecting transformer (T2). Transferring the 11kV load between T1 and T2 requires a short interruption to the 11kV load.

An outage of the 11 kV switchgear, fault limiting reactor or voltage regulator results in a total loss of supply, as these assets have (N) security. The 20 MVA voltage regulator is limited to 4 MVA.

The following Figure 16 illustrates Kikiwa's 2022 loading in comparison to its substation capacity.

There are no EECA Load Sites close to the substation.



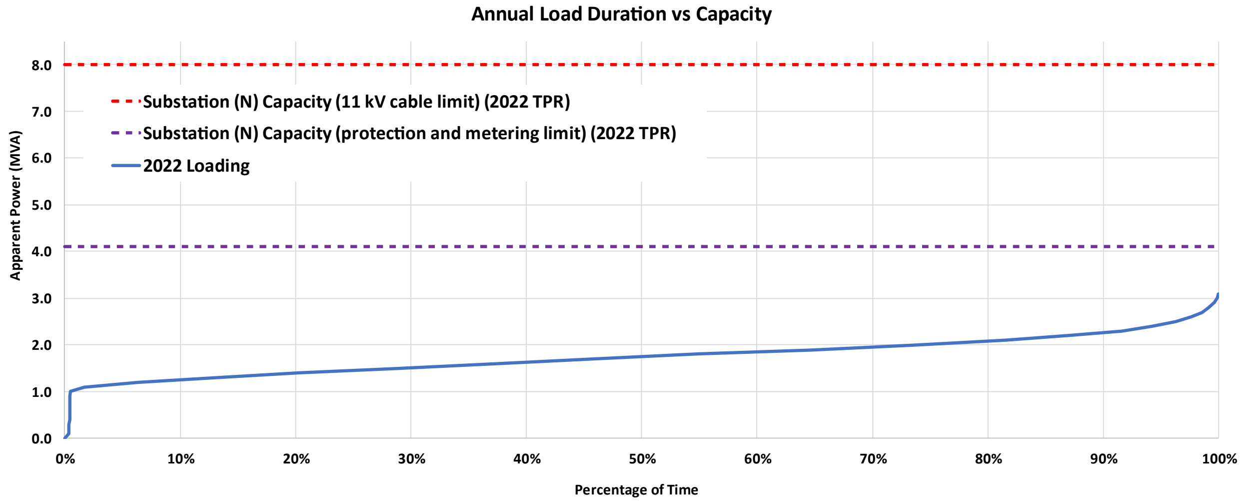


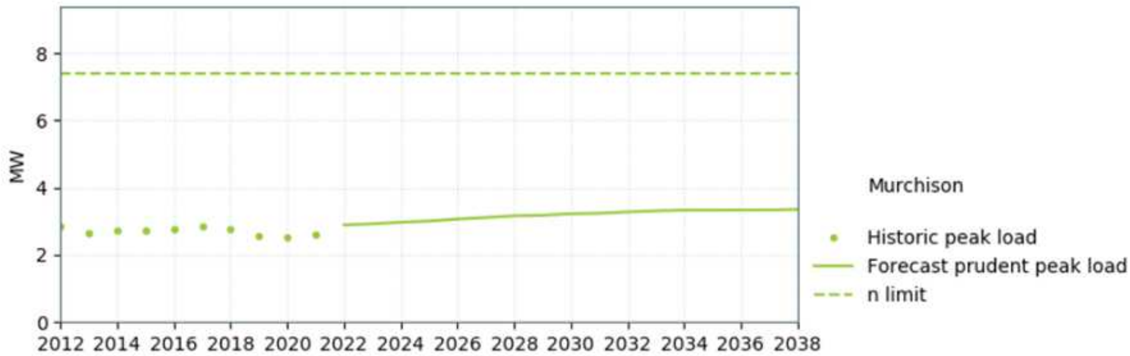
Figure 16 Kikiwa GXP: 2022 Loading: Substation capacity

6.1.3 Murchison GXP

Transpower's demand forecast (refer Table 3) indicates that the Murchison GXP was expected to have a 2022 peak demand of 3.0MW at 0.99pf. This aligns relatively closely with the historical SCADA data that indicates that during 2022 the Murchison GXP experienced a peak load of 3.8MVA.

Network Tasman is supplied, at 11kV, from the Murchison GXP and the load characteristic is relatively similar to the Kikiwa GXP with a mix of domestic and dairy farming being the dominant drivers. Although, irrigation is less prominent when compared to that of Kikiwa. The peak loading typically occurs in late summer and early autumn.

The following graph compares Murchison GXP's supply capacity with the historical loading and Transpower's demand forecast (sourced from Transpower's 2022 TPR).

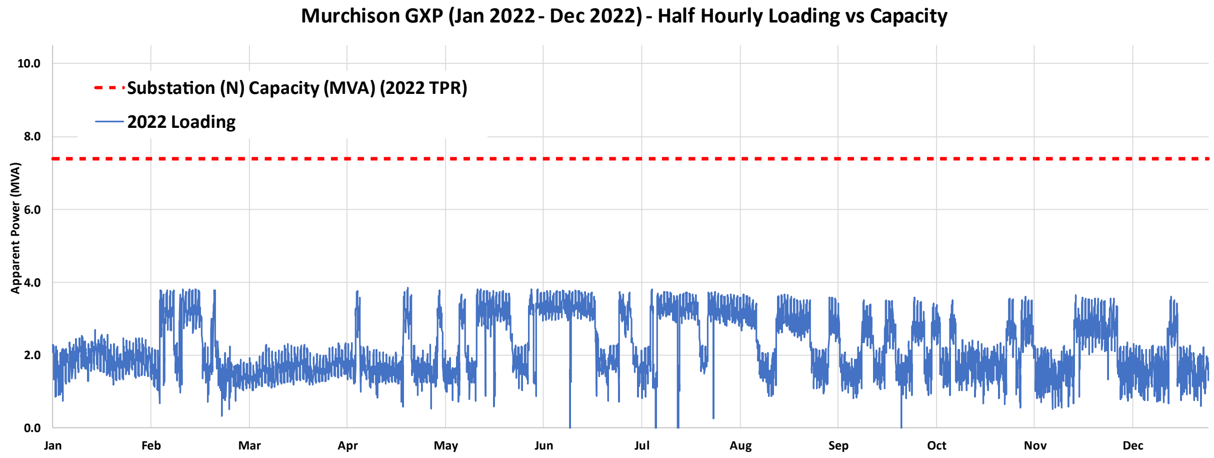


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

A 5MW hydro scheme (located at Lake Matiri) that is owned/operated by Southern Generation Ltd is embedded in Network Tasman's network that connects to the Murchison GXP.

The Murchison GXP is equipped with a single, 10MVA, 110/11 kV supply transformer and the two incoming 110kV circuits do not have line protection. This means that a fault on either 110kV circuit or the supply transformer will cause a loss of supply to Murchison.

The following Figure 17 illustrates Murchison GXP's 2022 loading in comparison to its substation capacity. The load profile is relatively unusual and primarily due to the intermittent operation of the 5MW embedded hydro station.



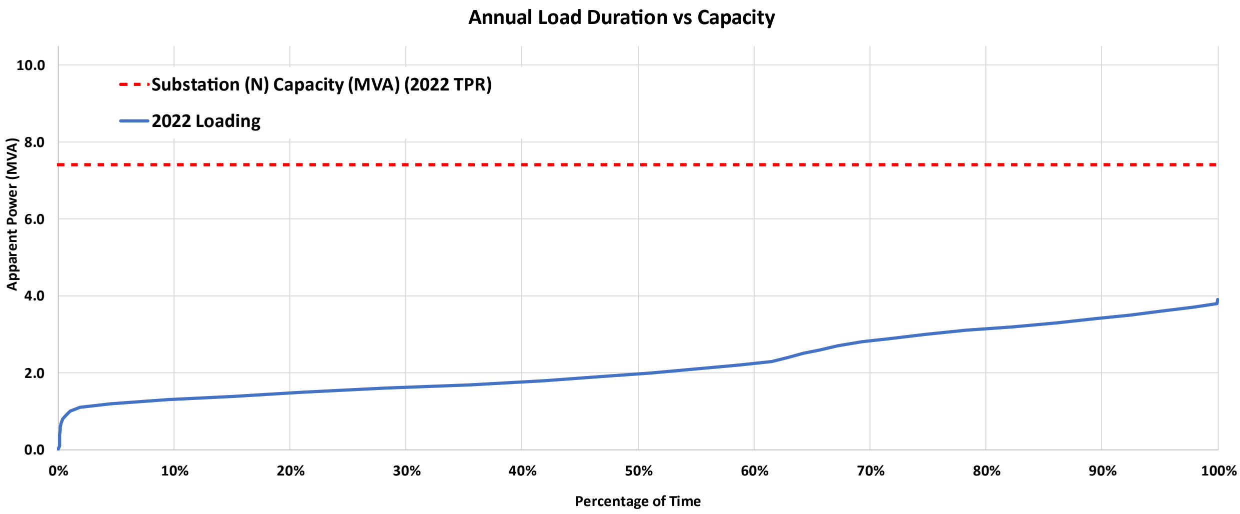


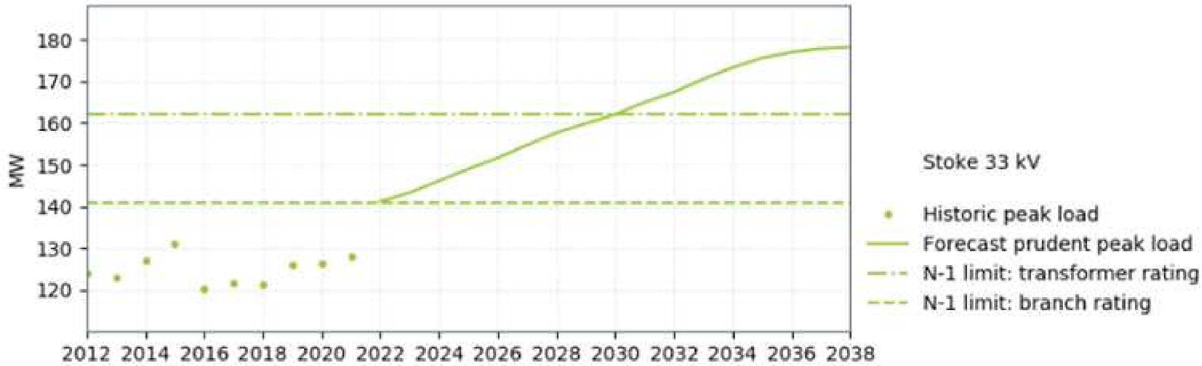
Figure 17 Murchison GXP: 2022 Loading: Substation capacity

6.1.4 Stoke 33kV GXP

Transpower's demand forecast (refer Table 3) indicates that the Stoke 33kV GXP was expected to have a 2022 peak demand of 141MW at unity power-factor. This contrasts with the historical SCADA data that indicates that, during 2022, the Stoke 33kV GXP experienced a peak load of 131MVA.

Network Tasman (≈96MW) and Nelson Electricity (including Nelson Pine Industries Ltd at ≈20MW, as well as other consumer loads ≈33MW) take supply from the Stoke 33kV GXP.

The following graph compares Stoke 33kV GXP's supply capacity with the historical loading and Transpower's demand forecast (sourced from Transpower's 2022 TPR).



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Stoke 33kV GXP's load characteristic includes a continuous base load that results from the 24/7 operation of the Nelson Pines Industries plant. The remaining load results from a mix of industrial/commercial and domestic consumers that are located in the city of Nelson and the surrounding area. The peak load period is driven by winter domestic space heating with a peak period occurring in June and July.

The Stoke 33kV GXP is equipped with 2 x 220/33kV, 120MVA transformers (nominal capacity) that afford the load with an (N-1) capacity of 141/141 MVA (summer/winter). Based on Transpower's demand forecast (refer Table 3) the peak load at the Stoke 33kV GXP is predicted to exceed the (N-1) capacity of the supply transformers in 2023. However, the capacity is presently limited by the existing protection, switchgear, and cables – once resolved, the GXP (N-1) capacity will increase to 155/162 MVA (summer/winter), which is not expected to be exceeded until ~2031, according to the forecasting (refer Table 3).

The following Figure 18 illustrates Stoke 33kV GXP's 2022 loading in comparison to its substation capacity.

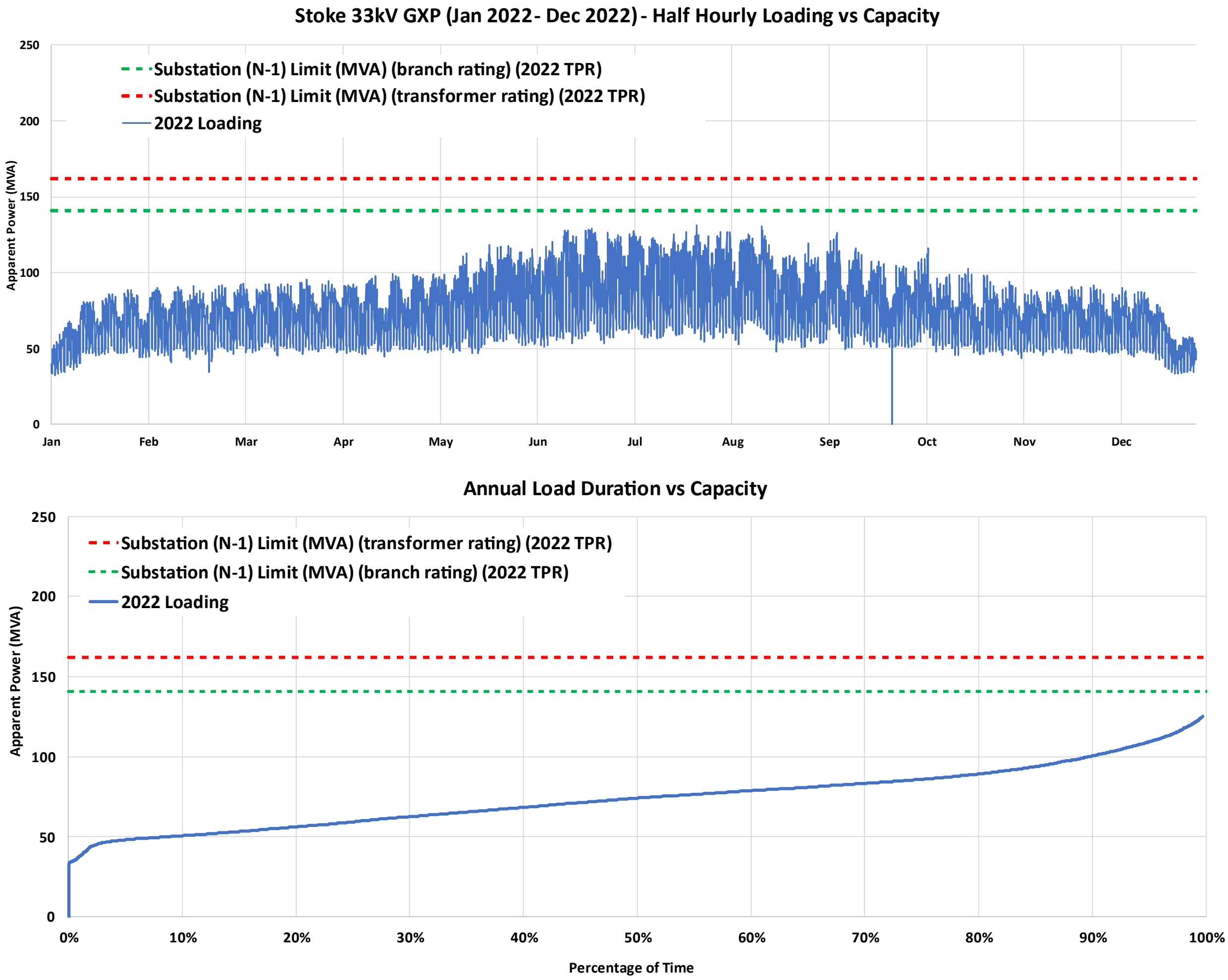
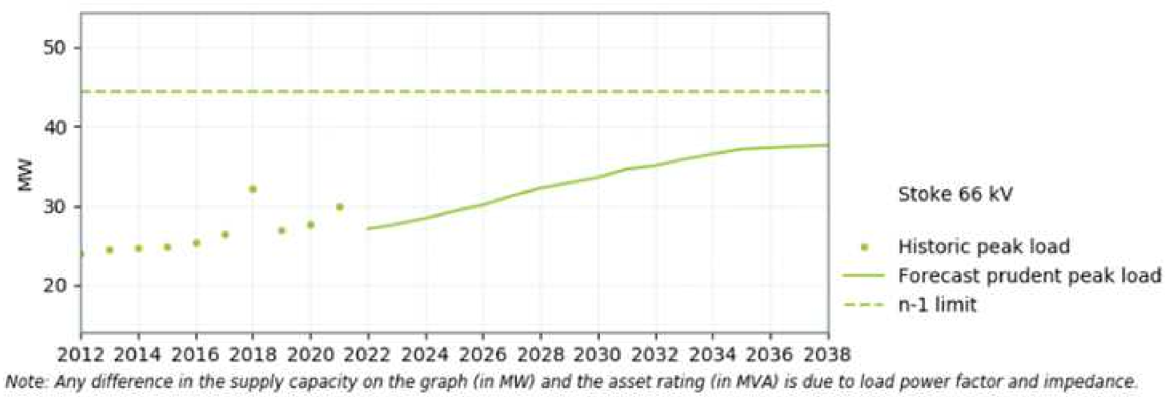


Figure 18 Stoke 33kV GXP: 2021 Loading: Substation capacity

6.1.5 Stoke 66kV GXP

Transpower's demand forecast (refer Table 3) indicates that the Stoke 66kV GXP was expected to have a 2022 peak demand of 27MW at 0.98pf. This value aligns closely with the historical SCADA data that indicates that during 2022 the Stoke 66kV GXP experienced a peak load of 27MVA.

The following graph compares Stoke 66kV GXP's supply capacity with the historical loading and Transpower's demand forecast (sourced from Transpower's 2022 TPR).



Network Tasman takes supply from the Stoke 66kV GXP and supplies the Motueka and Golden Bays region that encompasses the town of Motueka and its environs. The load is a mix of domestic, horticulture and food processing. The combination results in a long peak loading period running from February through to September.

A number of embedded hydro generators are located in the Golden Bay and Motueka regions, as follows:

- Cobb hydro (32MW).
- Pupu Valley (250kW).
- Onekaka (900kW).
- Brooklyn (200kW).
- Upper Takaka (400kW).
- Mt Ella (200kW).

The Cobb Power station is directly connected to the 66kV sub transmission network and generation from it generally exceeds the offtake load with the result that there are times when the powerflow through the Stoke 66kV GXP reverses (i.e. active power is exported onto the South Island Grid).

The Stoke 66kV GXP is afforded with 2 x 110/66 kV, 40MVA transformers (nominal capacity) that afford the load with an (N-1) capacity of 44/44 MVA (summer/winter).[15]

The following Figure 19 illustrates the Stoke 66kV GXP's 2021 loading in comparison to its substation capacity. The sporadic influence of the hydro generation is clearly evident in Figure 19.

[15] The transformers' capacity is limited by 66 kV cables; with this limit resolved, the N-1 capacity will be 60/60 MVA (summer/winter).

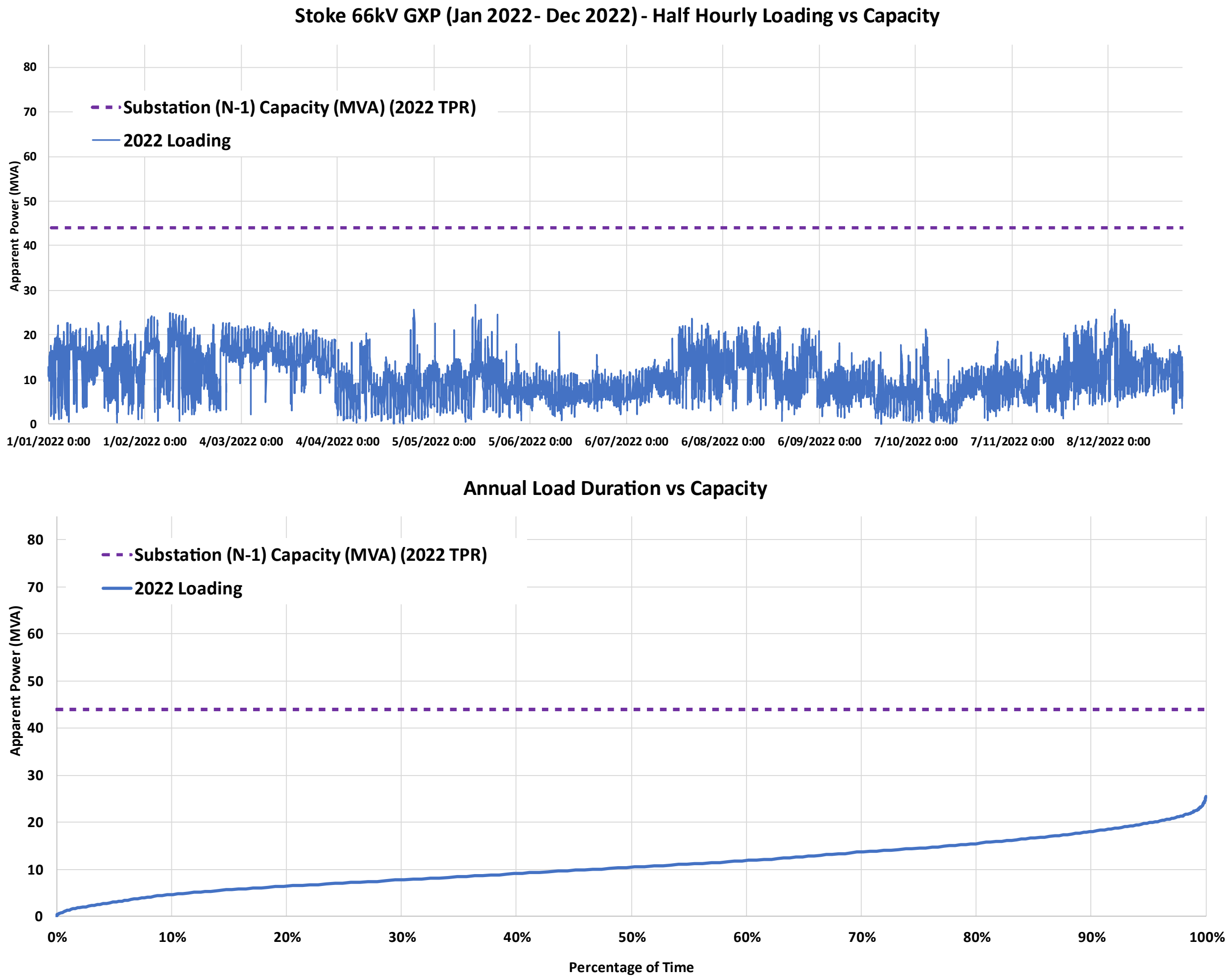


Figure 19 Stoke 66kV GXP: 2021 Loading: Substation capacity

6.2 Summary - Spare Capacity based on Transpower's 2022 Forecast

The following Figure 20 summarises the approximate, all year, (N-1) and (N) spare capacities at each GXP based on:

- The substation capacity disclosed in Transpower's 2022 Transmission Planning Report or disclosed in the asset management plan of the relevant EDB.
- The 2022 forecast load provided in Transpower's 2022 Transmission Planning Report (refer to Table 3).

Negative values are only possible for (N-1) capacities and indicate that there is no spare (N-1) capacity. The negative amount indicates the capacity increase that is required to achieve a secure firm capacity at the substation.

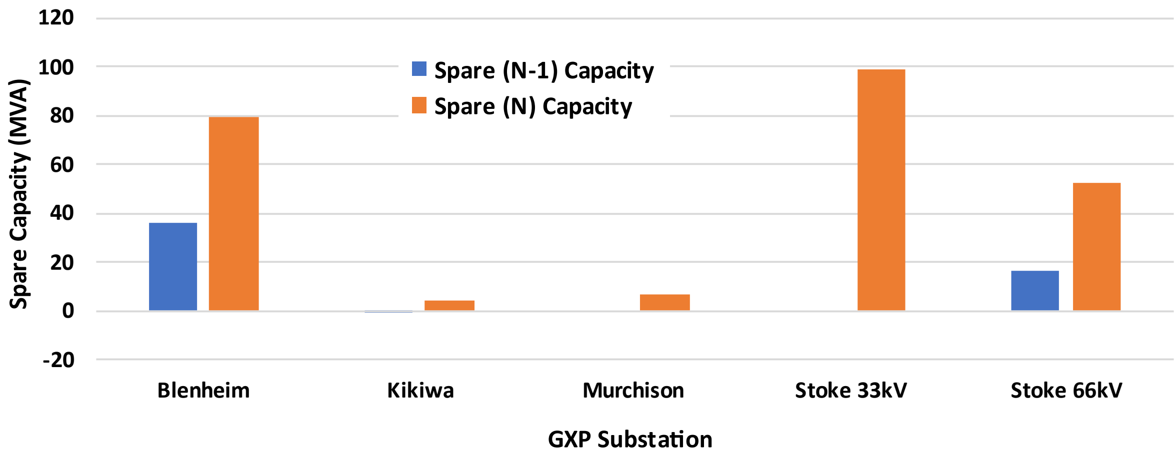


Figure 20 - Summary: GXP Spare Capacity based on Transpower's 2022 Load Forecast

It should be noted that the capacities have been calculated based on the transformer bay ratings disclosed by Transpower and information in the EDB asset management plans. Also, the spare capacities do not include any voltage constraints or upstream transmission constraints, which would need to be confirmed by Transpower or the relevant EDB. We note the following:

- The negative values in Figure 20 indicate that there is no capacity and consumer load cannot be supplied (for (N) and (N-1) conditions).
- Figure 20 infers that there are relatively high levels of (N) spare capacity at Blenheim and Stoke, but we note that these values do not consider the transmission line constraints and the voltage constraints into the region (discussed in introductory paragraphs of Section 6).

7. Spare Capacity – Zone Substations

In determining the (N) and (N-1) spare capacities for the zone substation, Ergo reviewed the EDB 2023 disclosure data. Historical loading data has not been provided by the EDBs.

7.1 Nelson Electricity

Table 4 Nelson Electricity: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data[16]	Historical Data
1	Haven Road	37.0	38.1	13.0	14.1

7.2 Network Tasman

Table 5 Network Tasman: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data[16]	Historical Data
1	Annesbrook	27.00		4.0	
2	Brightwater	23.00		8.0	
3	Eves Valley	6.00		1.0	
4	Founders	26.00		11.0	
5	Hope	11.00		1.0	
6	Lower Queen St	43.00		13.0	
7	Mapua	14.00		4.0	
8	Motueka	24.00		1.0	
9	Richmond	29.00		6.0	
10	Songer St	27.00		4.0	
11	Swamp Road	3.00		0.0	
12	Takaka	10.00		3.0	
13	Upper Takaka	11.00		5.0	
14	Wakapuaka	12.00		5.0	

[16] Negative values indicate the relevant power transformer is likely overloaded from time to time. EDBs often disclose capacity in terms of the transformers ONAN capacity, but transformers can often be overloaded for short periods or have an ONAF capacity (i.e. fan cooled). The exact transformer ratings are very specific.

7.3 Marlborough Lines

Table 6 Marlborough Lines: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data[16]	Historical Data
1	Cloudy Bay	27.00		11.0	
2	Havelock	17.00		2.0	
3	Leefield	2.00		-3.0	
4	Linkwater	8.00		3.0	
5	Nelson St	19.00		3.0	
6	Picton	23.00		8.0	
7	Rai Valley	6.00		1.0	
8	Redwoodtown	19.00		4.0	
9	Riverlands	10.00		0.0	
10	Seddon	13.00		3.0	
11	Spring Creek	6.00		1.0	
12	Springlands	24.00		8.0	
13	Tapp	23.00		7.0	
14	Ward	9.00		4.0	
15	Waters	25.00		9.0	
16	Woodbourne	11.00		1.0	

7.4 Summary

7.4.1 Nelson Electricity

7.4.1.1 (N-1) Capacity Summary

The following Figure 23 illustrates the approximate (N-1) spare capacity at Nelson Electricity's zone substation, for the disclosed 2022 peak demand estimates[17]. It should be noted that these have been calculated based on the transformer ratings disclosed by Nelson Electricity.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

The negative (N-1) ratings represent either a single bank transformer or that the (N-1) rating is already exceeded at times throughout the year.

7.4.1.2 (N) Capacity Summary

The following Figure 24 illustrates the approximate (N) spare capacity at Nelson Electricity's zone substation, for the disclosed peak demand estimates. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Nelson Electricity.

The spare capacities shown do not include any upstream or downstream conductor or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

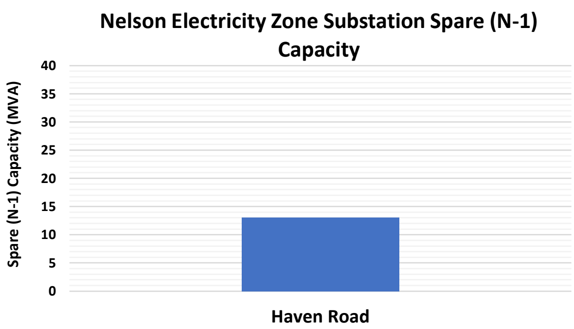


Figure 21 Summary: Approximate (N-1) spare capacity at Nelson Electricity's zone substations

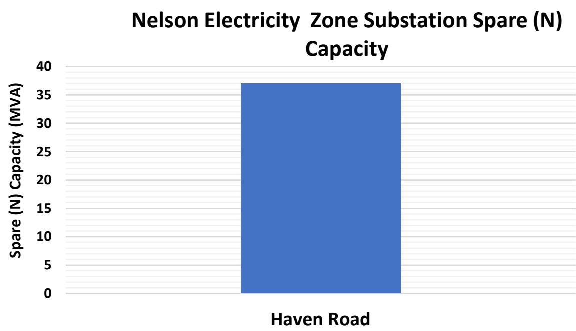


Figure 22 Summary: Approximate (N) spare capacity at Nelson Electricity's zone substations

7.4.2 Network Tasman

7.4.2.1 (N-1) Capacity Summary

The following Figure 23 illustrates the approximate (N-1) spare capacities at Network Tasman's zone substations, for the disclosed 2022 peak demand estimates[18]. It should be noted that these have been calculated based on the transformer ratings disclosed by Network Tasman.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

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[17] Nelson Electricity's 2023 information disclosure (https://www.nel.co.nz/regulatory-disclosure/).

[18] Network Tasman's 2023 information disclosure (https://networktasman.co.nz/disclosures/).

The negative (N-1) ratings represent either a single bank transformer or that the (N-1) rating is already exceeded at times throughout the year.

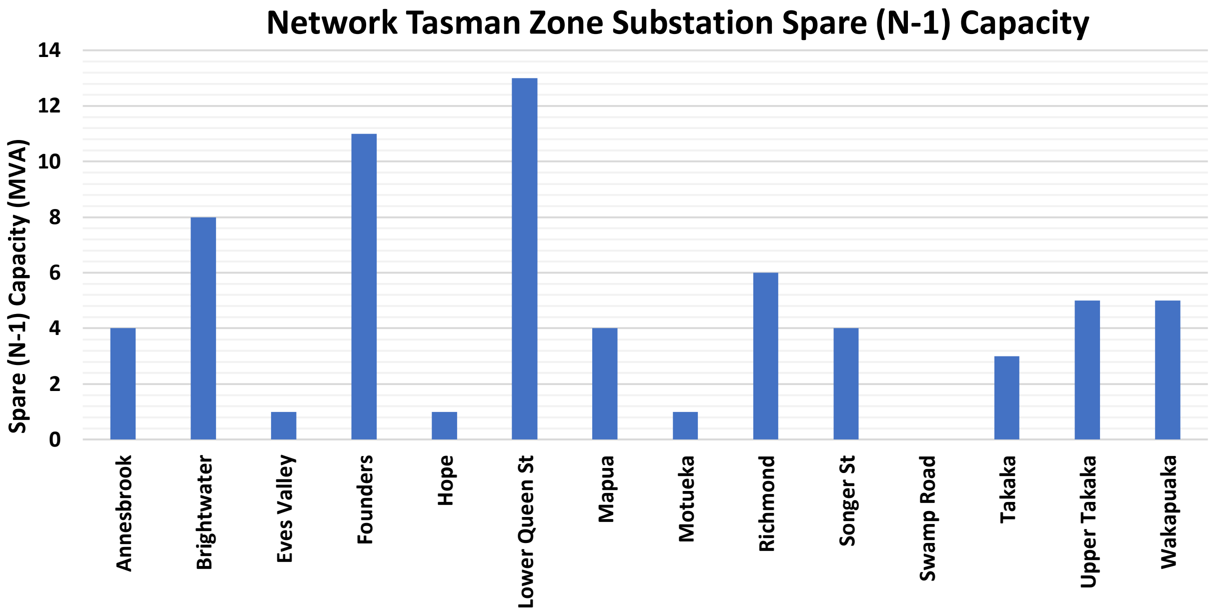

Figure 23 Summary: Approximate (N-1) spare capacity at Network Tasman's zone substations

7.4.2.2 (N) Capacity Summary

The following Figure 24 illustrates the approximate (N) spare capacities at Network Tasman's zone substations, for the disclosed peak demand estimates. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Network Tasman.

The spare capacities shown do not include any upstream or downstream conductor or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

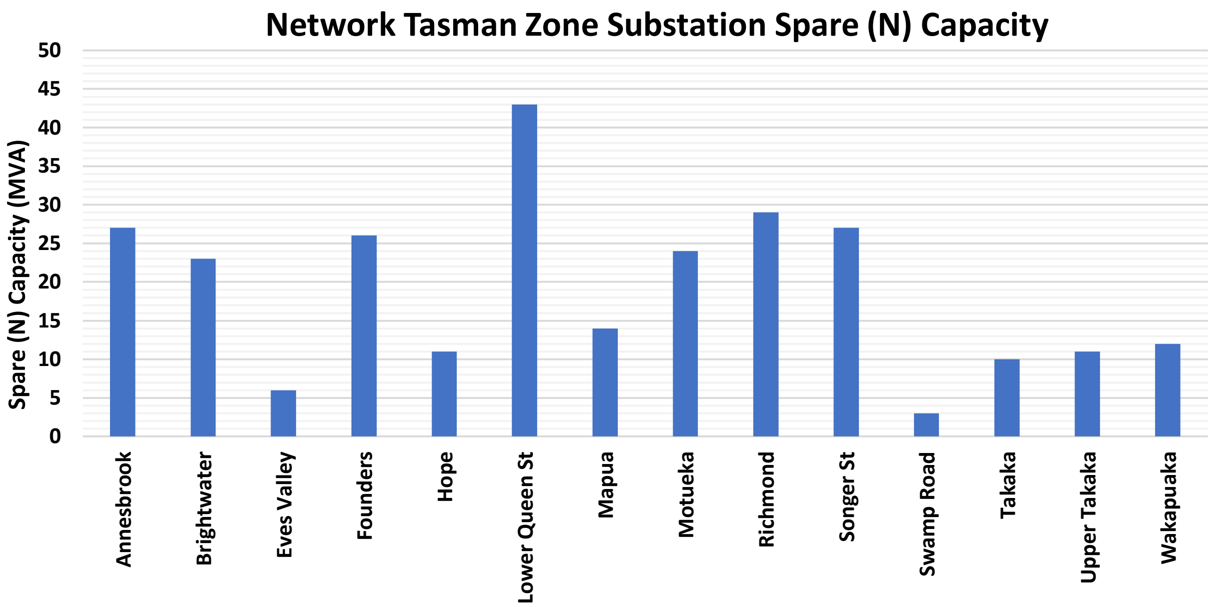

Figure 24 Summary: Approximate (N) spare capacity at Network Tasman's zone substations

7.4.3 Marlborough Lines

7.4.3.1 (N-1) Capacity Summary

The following Figure 25 illustrates the approximate (N-1) spare capacities at Marlborough Lines' zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Marlborough Lines.

The spare capacities shown do not include any upstream or downstream conductor or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

The negative (N-1) ratings represent either a single bank transformer or that the (N-1) rating is already exceeded at times throughout the year.

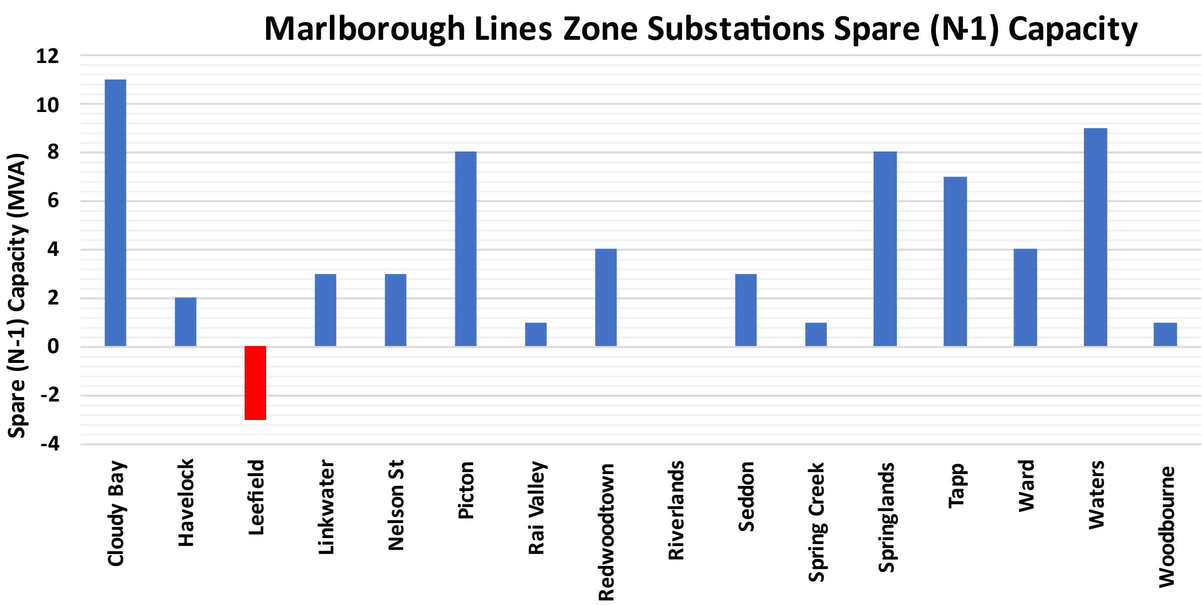

Figure 25 Summary: Approximate (N-1) spare capacity at Marlborough Lines' zone substations

7.4.3.2 (N) Capacity Summary

The following Figure 26 illustrates the approximate (N) spare capacities at Marlborough Lines' zone substations, for the disclosed peak demand estimates[19]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Marlborough Lines.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

[19] Marlborough Lines' 2023 information disclosure (https://www.marlboroughlines.co.nz/corporate-information).

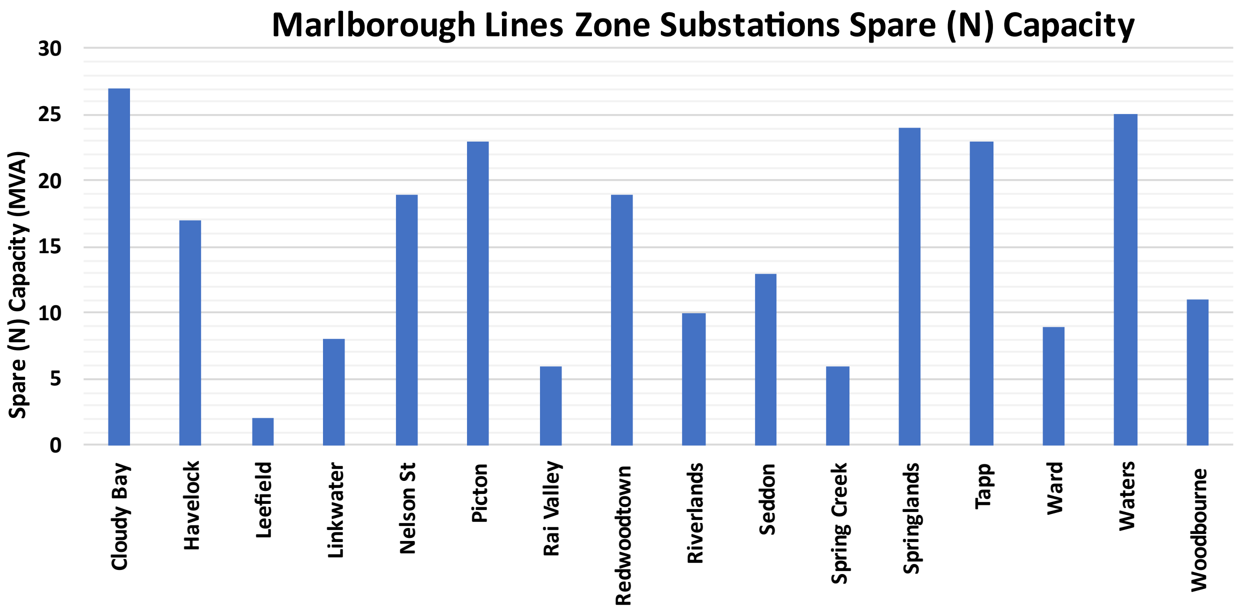

Figure 26 Summary: Approximate (N) spare capacity at Marlborough Lines' zone substations

8. Connection Options

The following sections describe the potential connection options for EECA's Load Sites. For simplicity Ergo has categorised (and discusses) the connection options for the Load Sites in terms of the local substations, as follows:

- Transpower GXP substations (shaded blue colour in diagrams).
- The Nelson Electricity, Network Tasman and Marlborough Lines zone substations (shaded yellow in diagrams).

The purpose of this section is to provide a high-level assessment to the feasibility of connecting the Load Sites to the existing electrical infrastructure (both transmission and distribution) and where upgrades would be needed, provide an indication of potential scope, capital costs and timeframes.

The assessments made have involved a desk-based assessment using the various information provided to Ergo. Where information was not available, we have used engineering judgement. If the Load Sites are progressed further, Ergo recommends more detailed engineering assessments are undertaken in consultation with Transpower and Nelson Electricity / Network Tasman / Marlborough Lines. This would likely entail powerflow modelling, optioneering and concept designs to provide more refined cost estimates.

8.1 Assessment Methodology

The assessment of each individual Load Sites uses a top down approach where the Load Site peak load is used to determine whether there appears to be spare capacity at:

- The incoming transmission lines
- The GXP substation
- The sub-transmission lines feeding the nearby zone substation
- The nearby zone substation
- The adjacent 11kV or 22kV feeder

The spare capacity across each asset type has been determined using the information provide by Transpower and the relevant EDB or in the absence of information, assumptions made based on the asset type/voltage and typical capacity expectations.

Once the load implications across the supply network are understood, Ergo has been able to determine the implications of connecting that load i.e. the necessary infrastructure upgrades. Ergo has used a building block approach to the costing of the necessary upgrades where typical assets have a unit rate associated with them.

In terms of upgrades, these can typically be classified as:

- **Minor** – The "as designed" electrical system can likely connect the Load Site with minor distribution level changes and without the need for substantial infrastructure upgrades costs
- **Moderate** – The "as designed" electrical system requires some infrastructure upgrades including new connections into the local zone substation and/or upgrades at the local zone substation or sub-transmission network
- **Major** – The "as designed" electrical system requires substantial upgrades at both the transmission and distribution level, likely requiring significant investment

8.2 Engineering Assumptions:

Specific engineering assumptions in this section include:

- We have used the spare capacities of both the GXP and zone substations based on the publicly disclosed loading and capacity information (instead of the 2021 loading data provided by Transpower, Nelson Electricity, Network Tasman and Marlborough Lines). Ergo's view is that these are typically more conservative than the actual loading and are therefore appropriate for this sort of high level assessment.
- We have assumed the existing site security should be maintained (unless otherwise stated). For example, if the site currently presently has (N-1) security, we have recommended infrastructure upgrades to maintain this.
- The upgrades and costs of individual Load Sites are considered in isolation of the adjacent Load Sites. We have not considered the scope and costs associated with connecting multiple Load Sites at this stage .
- The Load Site loads will have unity power factor which is reasonable considering the preliminary nature of the assessment.
- Unless otherwise stated, we have assumed the existing incoming sub-transmission line/cable capacities exceed the capacity of the existing zone substation(s) they supply.
- Unless capacity information is available, we assumed existing 33kV and 11kV feeders are capable of supplying up to 12 MVA and 4.5 MVA respectively which is generally accepted as a conservative capacity limit in the absence of detailed information.
- Cost estimates have a Class 5[20] accuracy - suitable for concept screening. Appendix 2 outlines accuracy of the cost estimates and the general assumptions.
- Cost estimates exclude land purchase, easements and consenting. These costs are difficult to estimate without undertaking a detailed review of the available land (including a site visit) and the local council rules in relation to electrical infrastructure. For example, the upgrade of existing overhead lines or new lines/cables across private land does require utilities to secure easements to protect their assets. Securing easements can be a very time consuming and costly process. For this reason, Ergo's estimates for new electrical circuits are generally based on assuming they are installed in road reserve and involve underground cables in urban locations and overhead lines in rural locations. We note that, as a general rule, 110kV and 220kV lines cannot be installed in road reserve due to wide corridor requirements. In some locations the width of the road reserve is such that 66kV and 33kV lines cannot be installed. This issue only becomes transparent after a preliminary line design has been undertaken.
- Cost estimates only include the incumbent network operator's distribution/transmission equipment and do not include onsite equipment that may be required to supply the Load Sites (for example, MV switchboards/cabling and LV switchboards/cables within the respective Load Site sites are not included).
- The time estimates provided are based on Ergo's experience. These can vary significantly depending on the scope of the project and the appetite for expediting. These should be used as a guide only.

[20] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used be used for final budgeting purposes in order to connect the respective Load Sites.

8.3 Blenheim GXP

The EECA Load Sites include:

- Fulton Hogan Renwick (4.90 MW)
- Picton/Blenheim EV Charging Station (1.5 to 3.8 MW) (charging station location to be determined between two options: Blenheim and Picton)
- Shonrei Products (2.91MW)
- Pernod Richard (2.73 MW)
- Dominion Salt Lake Grassemere (2.55 MW)
- Sanford Havelock (2.29 MW)
- Delegat Marlborough (1.73 MW)

The “Small” Load Sites include (refer to Sections 8.3.10 and 8.3.12):

- Villa Maria Estate Ltd Blenheim (1.27 MW)
- PH Kinzett Ltd. (1.21 MW)
- New Zealand Defence Force Woodbourne (1.15 MW)
- Indevin Ltd. (1.09 MW)
- Wairau Hospital (0.98 MW)
- Kim Crawford Winery (0.86 MW)
- Marlborough Girls College (0.51 MW)
- ANZCO Foods Marlborough (0.47 MW)
- Thymebank Ltd. (0.29 MW)
- Waihopai River Vineyard (0.22 MW)
- Marlborough Lines Stadium 2000 (0.20 MW)
- Ariki New Zealand Ltd. (0.14 MW)
- Wineworks Marlborough (0.09 MW)

The geographic locations of the Load Sites are shown on the following Figure 27 (wider region) and Figure 28 (Blenheim city enlargement) in relation to the local transmission and distribution substations.

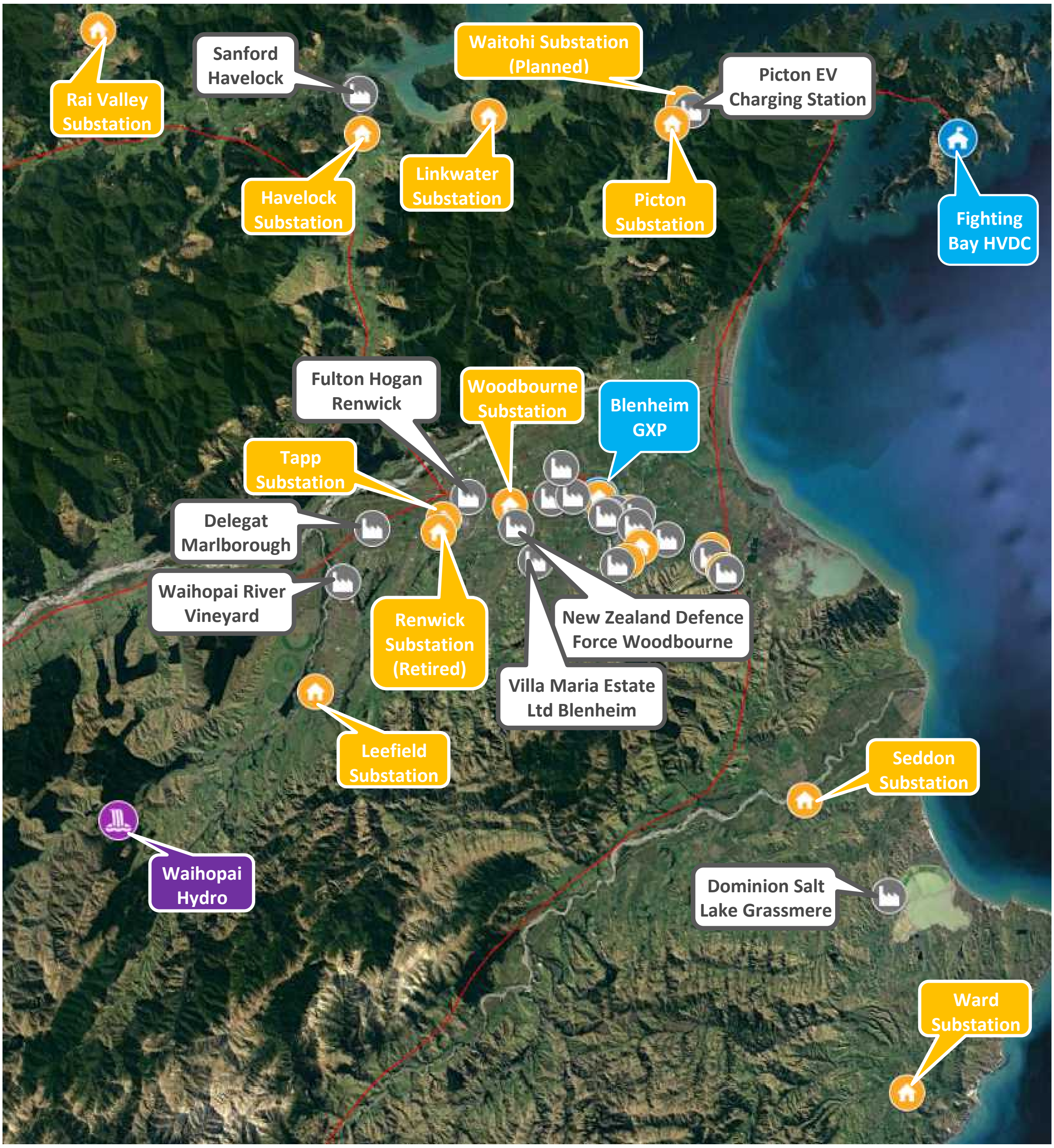

Figure 27 Blenheim GXP: EECA Load Sites vs local substations (wider region)

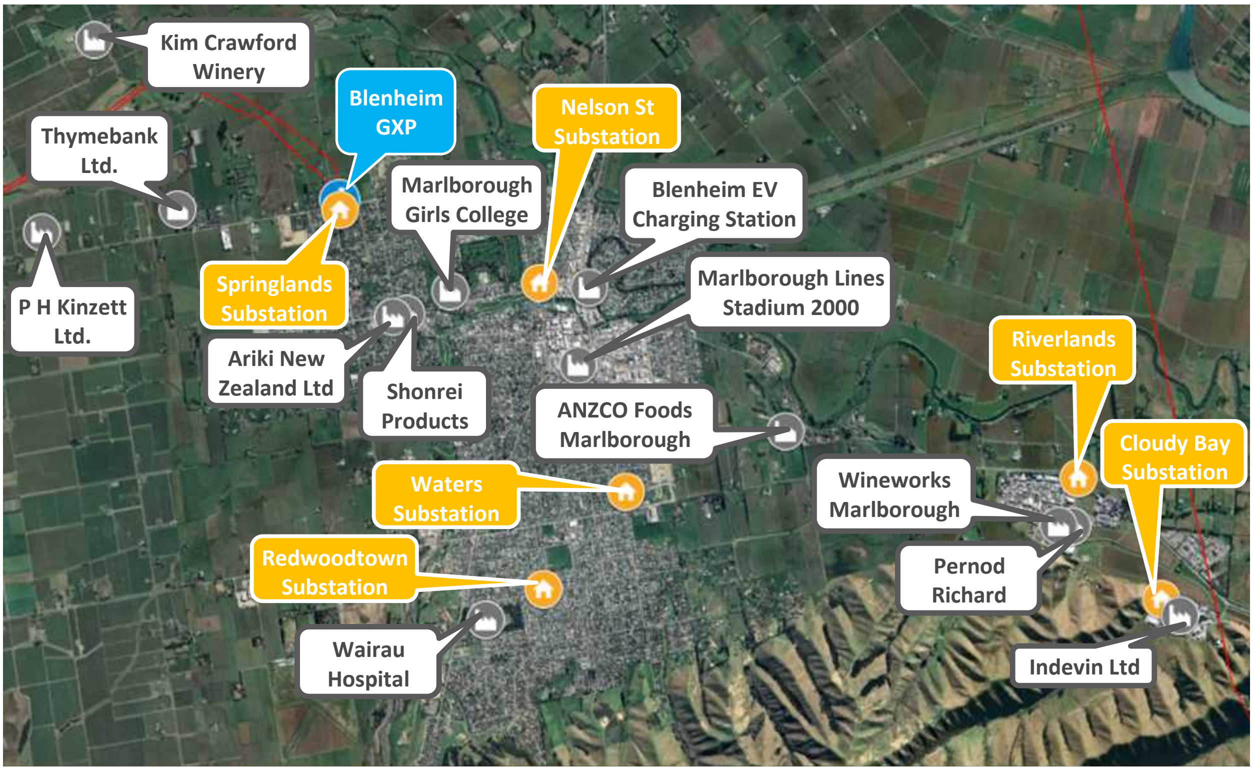

Figure 28 Blenheim GXP: EECA Load Sites vs local substations (Blenheim city enlargement)

8.3.1 Blenheim GXP Upgrade

As shown in Section 8.3.13, with all of the proposed loads connecting to Blenheim GXP, the (N-1) capacity of the GXP is not expected to be exceeded. As such, Ergo has not considered the costs of upgrades at Blenheim GXP.

8.3.2 Fulton Hogan Renwick

		FULTON HOGAN REMWICK
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	4.90 MW	Blenheim

Existing Electrical Supply to the Plant

The Fulton Hogan Renwick plant is presently supplied by either Marlborough Lines' Tapp zone substation, or Marlborough Lines' Woodbourne zone substation. Tapp zone substation is supplied at 33 kV by Blenheim GXP, directly and via Springlands Zone substation. Both 33 kV connections to Tapp zone substation also supply Woodbourne zone substation, with one also teeing off to feed Havelock zone substation.

The plant is ≈2.0 km (straight line) from Tapp substation, and ≈2.6 km (straight line) from Woodbourne substation.

Figure 29 Fulton Hogan Renwick geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP and Tapp zone substation have sufficient (N-1) spare capacity, and Woodbourne zone substation has sufficient (N) spare capacity, to accommodate the additional load of 4.90 MW.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Tapp substation (chosen as it has more capacity that Woodbourne zone substation) would be required. This feeder would likely be underground cabled within Renwick town, and overhead line in the rural area. Ergo estimates that this feeder would involve ~0.7 km of underground cable, and ~2.9 km of overhead line.

Ergo notes that Marlborough Lines have an additional substation planned nearby, in Kaituna, which will help with the capacity in the area.

Capital Cost Estimate

Table 7 Fulton Hogan Renwick: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.70	$0.28
Distribution	Single overhead 11kV line	2.90	$0.58
		TOTAL	**$0.96**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.3 Picton/Blenheim EV Charging Station (Picton Option)

		PICTON EV CHARGING STATION
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
Chargers for electric vehicles	1.50 to 3.80 MW	Blenheim
Existing Electrical Supply to the Plant		

Shown below is a potential site for the proposed Picton/Blenheim EV Charging Station, within an existing public parking lot near the centre of Picton town.

The area is presently supplied by Marlborough Lines' Picton zone substation, which is supplied at 33 kV by Blenheim GXP, via two overhead line circuits, which both tee off to also supply Spring Creek zone substation.

The plant is ≈1.4 km (straight line) from Picton substation, and ≈0.7 km (straight line) from the planned Waitohi substation.

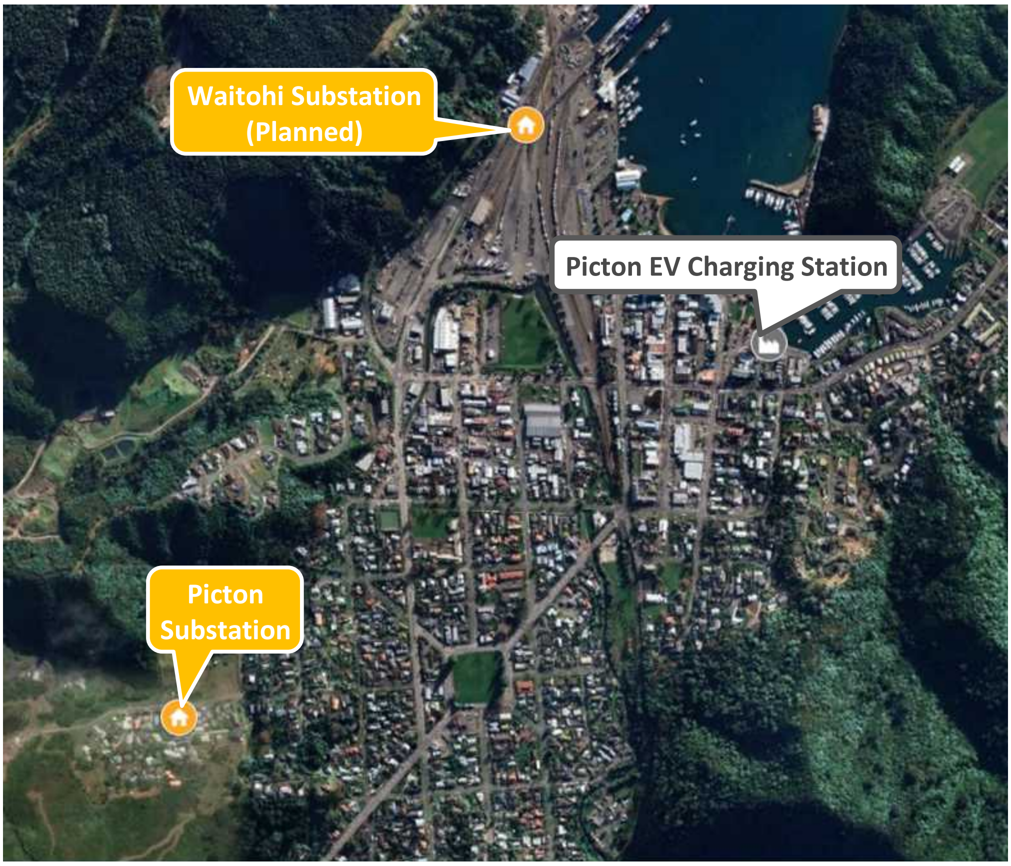

Figure 30 Picton EV Charging Station geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP and Picton zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 1.5 to 3.8 MW.

In order to connect the proposed load, Ergo expects the following upgrades would be required:

PICTON EV CHARGING STATION

- For the 1.5 MW connection: Ergo expects that Marlborough Lines would be able to shift load between the existing feeders leaving Picton substation to ensure capacity at the site of 1.5 MW, with only distribution transformer/RMU costs to connect the supply.
- For the 3.8 MW connection: one new 11 kV feeder would be installed to the site from Picton substation. This feeder would be underground cabled within Picton. Ergo estimates that this feeder would involve ~2 km of underground cable.

Ergo notes that the Waitohi zone substation (shown in an approximate location within the Picton Ferry terminal) is presently scheduled for commissioning in 2025. Upgrades will involve reconfiguration and upgrades of the 33 kV network to form a ring configuration involving Spring Creek, Waitohi, and Picton zone substations.

Capital Cost Estimate

For the 1.5 MW connection, Ergo expects that a cost of ~$0.35M could be associated with an RMU and distribution transformer to supply the site.

For the 3.8 MW connection, expected costs are summarised in the following table:

Table 8 Picton EV Charging Station: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.00	$0.80
		TOTAL	**$0.90**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 3 – 6 months for the initial 1.5 MW load, and 12 – 18 months for the final 3.8 MW load.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.4 Picton/Blenheim EV Charging Station (Blenheim Option)

BLENHEIM EV CHARGING STATION		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
Chargers for electric vehicles	1.5 to 3.8 MW	Blenheim
Existing Electrical Supply to the Plant		

Shown below is a potential site for the proposed Picton/Blenheim EV Charging Station, in an empty lot near the Blenheim main street.

The area is presently supplied by Marlborough Lines' Nelson St zone substation (which is also a 33 kV switching station), which is supplied at 33 kV by Blenheim GXP, via two direct circuits (one of which continues on to Riverlands substation), as well as a third circuit from the GXP to Nelson St, via Springlands zone substation. Normally Nelson St substation is operated with the Springlands circuit supplying both transformers.

The plant is ≈0.5 km (straight line) from Nelson St substation.

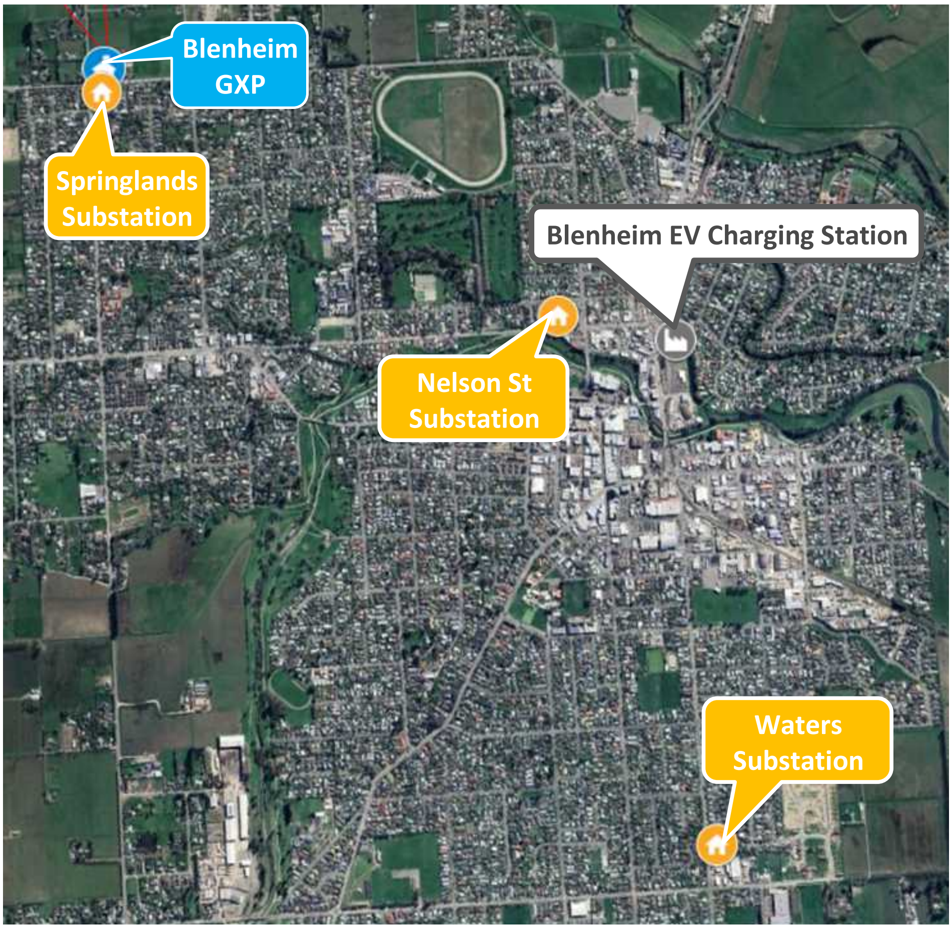

Figure 31 Blenheim EV Charging Station geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP has sufficient (N-1) spare capacity to accommodate the additional load of 1.5 to 3.8 MW. Nelson St substation has (N-1) capacity for the 1.5 MW of additional load, but not the increased 3.8 MW

BLENHEIM EV CHARGING STATION
of load. While Nelson St substation presently only has (N) capacity for the additional 3.8 MW load, upgrades (discussed in Section 8.3.11.3) may be carried out to increase the capacity of the transformers to 20 MVA each, resulting in an additional 3 MVA of spare (N-1) capacity. This upgrade would therefore allow Nelson St substation to supply the proposed 3.8 MW of load with (N-1) security. If the transformer upgrades do not occur, Marlborough Lines has plans to shift load from Nelson St to adjacent substations. In order to connect the proposed load, Ergo expects the following upgrades would be required: ▪ For the 1.5 MW connection: Ergo expects that Marlborough Lines would be able to shift load between the existing feeders leaving Nelson St substation to ensure capacity at the site of 1.5 MW, with only distribution transformer/RMU costs to connect the supply. ▪ For the 3.8 MW connection: one new 11 kV feeder would be installed to the site from Nelson St substation. This feeder would be underground cabled within Blenheim due to the urban topography. Ergo estimates that this feeder would involve ~0.6 km of underground cable.
Capital Cost Estimate
For the 1.5 MW connection, Ergo expects that a cost of ~$0.35M could be associated with an RMU and distribution transformer to supply the site. For the 3.8 MW connection, expected costs are summarised in the following table:

Table 9 Blenheim EV Charging Station: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.60	$0.24
		TOTAL	**$0.34**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure
Estimated to take 3 – 6 months for the initial 1.5 MW load, and 12 – 18 months for the final 3.8 MW load. To Plan, Design, Procure, Construct and Commission the works. Excludes the work required to establish the Load Site. Excludes land acquisition and consenting, if required.

8.3.5 Shonrei Products

SHONREI PRODUCTS		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	2.91 MW	Blenheim

Existing Electrical Supply to the Plant

The Shonrei Products plant is presently supplied by either Marlborough Lines' Springlands zone substation, or Marlborough Lines' Nelson St zone substation, both of which are also 33 kV switching stations. Springlands zone substation is fed at 33 kV by Blenheim GXP, via four circuits, one of which normally supplies the 33/11 kV transformers at Springlands.

The plant is ≈1.2 km (straight line) from Springlands substation, and ≈1.3 km (straight line) from Nelson St substation.

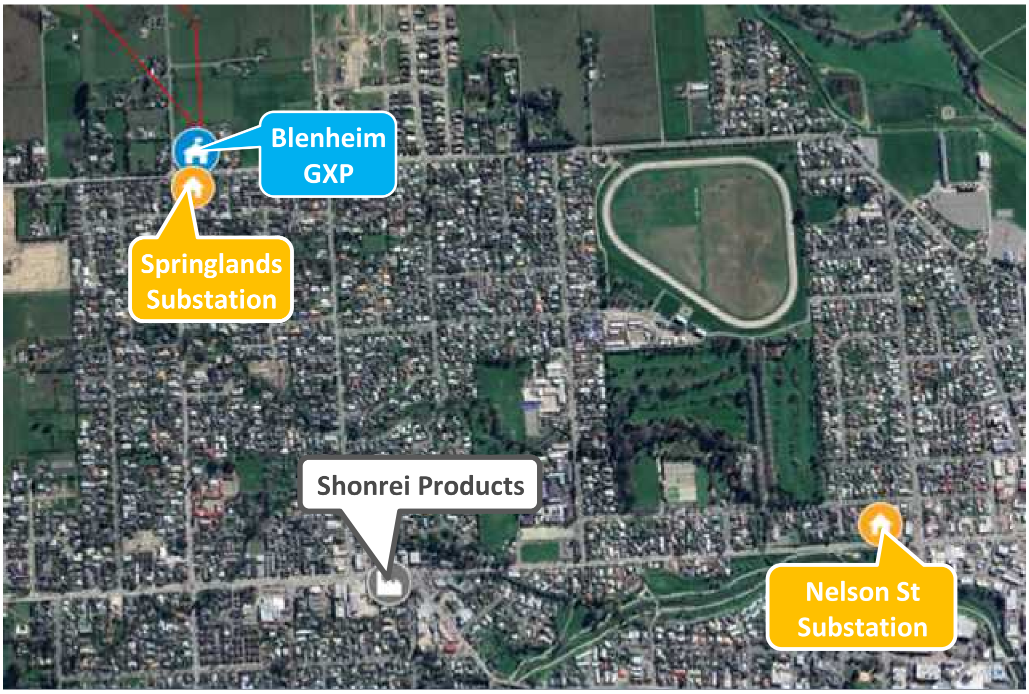

Figure 32 Shonrei Products geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP, Springlands zone substation, and Nelson St zone substation have sufficient (N-1) spare capacity, to accommodate the additional load of 2.91 MW. Ergo notes that adding this load to Nelson St would bring the substation close to its (N-1) capacity, prior to the planned transformer upgrades. Because of this, and because Springlands substation supplies Nelson St, and is therefore electrically "closer" to the load, connection to Springlands substation is assumed as the best option for this load.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Springlands substation would be required. This feeder would likely be underground cabled due to the urban topography. Ergo estimates that this feeder could involve ~1.8 km of underground cable.

SHONREI PRODUCTS

Capital Cost Estimate

Table 10 Shonrei Products: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.80	$0.72
		TOTAL	**$0.82**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.6 Pernod Richard

		PERNOD RICHARD
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	2.73 MW	Blenheim

Existing Electrical Supply to the Plant

The Pernod Richard plant is presently supplied by Marlborough Lines' Riverlands zone substation. Riverlands zone substation is fed at 33 kV by Blenheim GXP, via one circuit which also tees off to Nelson St's 33 kV switching station. An open point at Waters substation may also be closed, allowing Riverlands to be supplied from a second circuit, via Nelson St.

The plant is ≈0.5 km (straight line) from Riverlands substation, and ≈1.1 km (straight line) from Cloudy Bay substation, which is fed by a line leaving Riverlands substation.

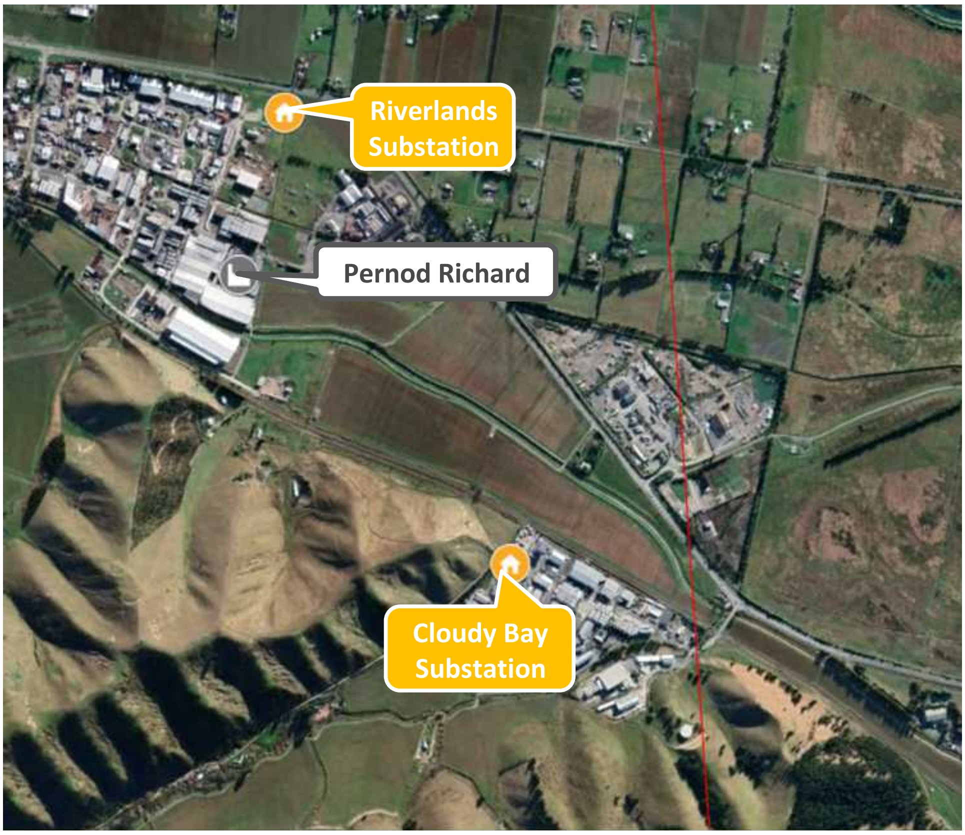

Figure 33 Pernod Richard geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP, and Cloudy Bay zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 2.73 MW. Presently, Riverlands zone substation has (N) capacity for the additional load, but not (N-1) capacity. With no upgrades planned at Riverlands substation to increase the capacity at present, besides potentially some load transfer from Riverlands substation to Cloudy Bay substation, Ergo is of the view that the proposed load would most likely be supplied from Cloudy Bay substation.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Cloudy Bay substation would be required. This feeder would likely be underground cabled due to the urban topography/industrial nature of the area. Ergo estimates that this feeder could involve ~3.2 km of underground cable.

Capital Cost Estimate

Table 11 Pernod Richard: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N)	Distribution => (N)	
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	3.20	$1.28
		TOTAL	**$1.38**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.7 Dominion Salt Lake Grassmere

DOMINION SALT LAKE GRASSMERE		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pump and electrical boilers	2.55 MW	Blenheim
Existing Electrical Supply to the Plant		
The Dominion Salt Lake Grassmere plant is presently supplied by Marlborough Lines' Seddon zone substation. Seddon zone substation is fed via two radial 33 kV lines from Riverlands substation, with tees to Cloudy Bay substation and Stockyard Switchroom. Riverlands zone substation is fed at 33 kV by Blenheim GXP, via one circuit which also tees off to Nelson St's 33 kV switching station. An open point at Waters substation may also be closed, allowing Riverlands to be supplied from a second circuit from the GXP, via Nelson St. The plant is ≈7.6 km (straight line) from Seddon substation, and ≈12 km (straight line) from Ward substation, which is fed via a 33 kV line from Seddon substation.  Figure 34 Dominion Salt Lake Grassmere geographic location in relation to the surrounding zone substations		
Supply Option(s) for New Load		
Blenheim GXP and Seddon zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 2.55 MW, however it is noted that the addition of this load will bring Seddon		

substation near its (N-1) capacity. Outside of the completion of a line upgrade project in 2024, no upgrades are presently planned at Seddon substation.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Seddon substation would be required. This feeder would likely be overhead lines due to the rural topography. Ergo estimates that this feeder could involve ~12 km of overhead lines. Due to the length of the line, Ergo expects that voltage support will be required at the site, in the form of an 11 kV capacitor bank.

Capital Cost Estimate

Table 12 Dominion Salt Lake Grassmere: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	11kV Capacitor Bank	1.00	$0.30
Distribution	Single overhead 11kV line	12.00	$2.40
		TOTAL	**$2.80**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.8 Sanford Havelock

SANFORD HAVELOCK		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pump and electrical boilers	2.29 MW	Blenheim
Existing Electrical Supply to the Plant		

The Sanford Havelock plant is presently supplied by Marlborough Lines' Havelock zone substation. Havelock zone substation is fed via one 33 kV circuit from Blenheim GXP, and via network switching, could be supplied by a second.

The plant is ≈2.5 km (straight line) from Havelock substation.

Figure 35 Sanford Havelock geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Blenheim GXP has sufficient (N-1) spare capacity to accommodate the additional load of 2.29 MW, while Havelock has sufficient (N) spare capacity to accommodate the additional load, which narrowly exceeds the substation's (N-1) spare capacity. As such, connection of the proposed load would likely trigger upgrades to Havelock substation, with no upgrades planned at present.

SANFORD HAVELOCK

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Havelock substation would be required. This feeder would likely be overhead lines, matching those existing in Havelock, with a short, cabled section where the feeder approaches the marina. Ergo estimates that this feeder could involve ~2.8 km of overhead lines, and ~0.2 km of underground cables. In order to supply the site with (N-1) security, transformer replacements would be required at Havelock.

Capital Cost Estimate

Table 13 Sanford Havelock: Capital cost estimate to supply the Load Site with (N) subtransmission security

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.20	$0.08
Distribution	Single overhead 11kV line	2.80	$0.56
		TOTAL	**$0.74**

Table 14 Sanford Havelock: Capital cost estimate to supply the Load Site with (N-1) subtransmission security

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Medium supply transformer (ZSS)	2.00	$2.00
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.20	$0.08
Distribution	Single overhead 11kV line	2.80	$0.56
		TOTAL	**$2.74**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months for (N) and 18-24 months for (N-1) options

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.3.9 Delegat Marlborough

DELEGAT MARLBOROUGH		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	1.73 MW	Blenheim
Existing Electrical Supply to the Plant		
The Delegat Marlborough plant is presently supplied by Marlborough Lines' Tapp zone substation. Tapp zone substation is supplied at 33 kV by Blenheim GXP, directly and via Springlands Zone substation. Both 33 kV connections to Tapp zone substation also supply Woodbourne zone substation, with one also teeing off to feed Havelock zone substation. The plant is ≈4.4 km (straight line) from Tapp substation.		

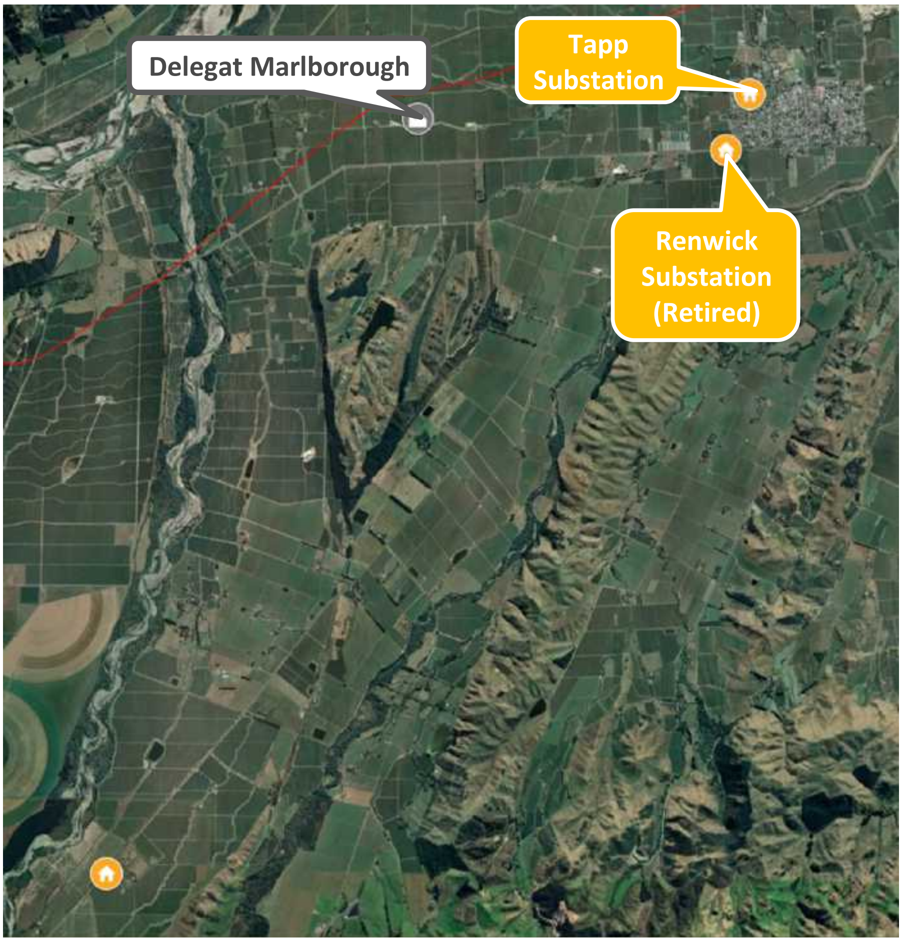

Figure 36 Delegat Marlborough geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load
Blenheim GXP and Tapp zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 1.73 MW. In order to connect the proposed load, Ergo expects that Marlborough Lines would be able to shift load between the existing feeders leaving Tapp substation to ensure capacity at the site of 1.73 MW, with only distribution transformer/RMU costs to connect the supply.

DELEGAT MARLBOROUGH
Capital Cost Estimate
Ergo expects that a cost of ~$0.35M could be associated with an RMU and distribution transformer to supply the site.
Timeframe to Establish New Electrical Infrastructure
Estimated to take 3 – 6 months. To Plan, Design, Procure, Construct and Commission the works. Excludes the work required to establish the Load Site. Excludes land acquisition and consenting, if required.

8.3.10 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide an RMU and distribution transformer to supply the site.

Table 15 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Villa Maria Estate Ltd Blenheim	Woodbourne	1	11	Unknown	1.27	350
PH Kinzett Ltd	Woodbourne	1	11	Unknown	1.21	350
New Zealand Defence Force Woodbourne	Woodbourne	1	11	Unknown	1.15	350
Indevin Ltd	Cloudy Bay	11	27	Unknown	1.09	350
Wairau Hospital	Redwoodtown	4	19	Unknown	0.98	260
Kim Crawford Winery	Woodbourne	1	11	Unknown	0.86	260
Marlborough Girls College	Springlands	8	24	Unknown	0.51	200
ANZCO Foods Marlborough	Waters	9	25	Unknown	0.47	130
Thymebank Ltd	Woodbourne	1	11	Unknown	0.29	130
Waihopai River Vineyard	Leefield	-3	2	Unknown	0.22	130
Marlborough Lines Stadium 2000	Nelson St	3	19	Unknown	0.20	80
Ariki New Zealand Limited	Springlands	8	24	Unknown	0.14	80
WineWorks Marlborough	Riverlands	0	10	Unknown	0.09	50

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.3.11 Combined Load on Zone Substations

8.3.11.1 Woodbourne

Five of the "small" loads on Blenheim GXP are expected to connect to Woodbournel zone substation. These loads are Villa Maria Estate Ltd Blenheim, PH Kinzett Ltd, New Zealand Defence Force Woodbourne, Kim Crawford Winery, and Thymebank Ltd. The sum of peaks of these loads is 4.79 MVA, which the zone substation does not have (N-1) capacity for, however does have (N) capacity for, before considering the diversity between loads.

Transformer replacements are planned for Woodbourne zone substation, replacing both of the existing 10 MVA transformers with 16.5 MVA transformers. Once these upgrades are complete, the zone substation will have (N-1) capacity for these proposed loads.

8.3.11.2 Springlands

Three of the loads on Blenheim GXP are expected to connect to Springlands zone substation. These are Shonrei Products, Marlborough Girls College ("small" load), and Ariki New Zealand Ltd ("small" load). The sum of peaks of these loads is 3.56 MVA, which Springlands substation does have (N-1) capacity for. Therefore, upgrades of Springlands zone substation are not considered.

8.3.11.3 Nelson St

Two of the loads on Blenheim GXP may connect to Nelson St substation (pending confirmation of the location of the Picton/Blenheim EV charging station). The loads are the EV charging station, and the Marlborough Lines Stadium 2000 ("small" load). The sum of peaks of these loads is 4 MVA, which Nelson St substation does not have (N-1) capacity for. However, upgrades to the transformers (installation of cooling fans) may be carried out, which would increase the substation spare capacity by 3 MVA, meaning the substation would have capacity for the proposed loads. As such, further upgrades to Nelson St zone substation are not considered.

8.3.11.4 Tapp

Two of the loads on Blenheim GXP are expected to connect to Tapp substation. The loads are Fulton Hogan Renwick and Delegat Marlborough. The sum of peaks of these loads is 6.63 MVA, which Tapp substation does have (N-1) capacity for. Therefore, upgrades of Tapp zone substation are not considered.

8.3.11.5 Cloudy Bay

Two of the loads on Blenheim GXP are expected to connect to Cloudy Bay zone substation. These are Pernod Richard, and Indevin Ltd ("small" load). The sum of peaks of these loads is 3.82 MVA, which Cloudy Bay substation does have (N-1) capacity for. Therefore, upgrades of Cloudy Bay zone substation are not considered.

8.3.12 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on Blenheim GXP gives a combined load of 7.85 MVA. However, when the load shapes are combined, they result in the following load shape (Figure 37), with a maximum load of 6.76 MVA, with a diversity factor of 0.86.

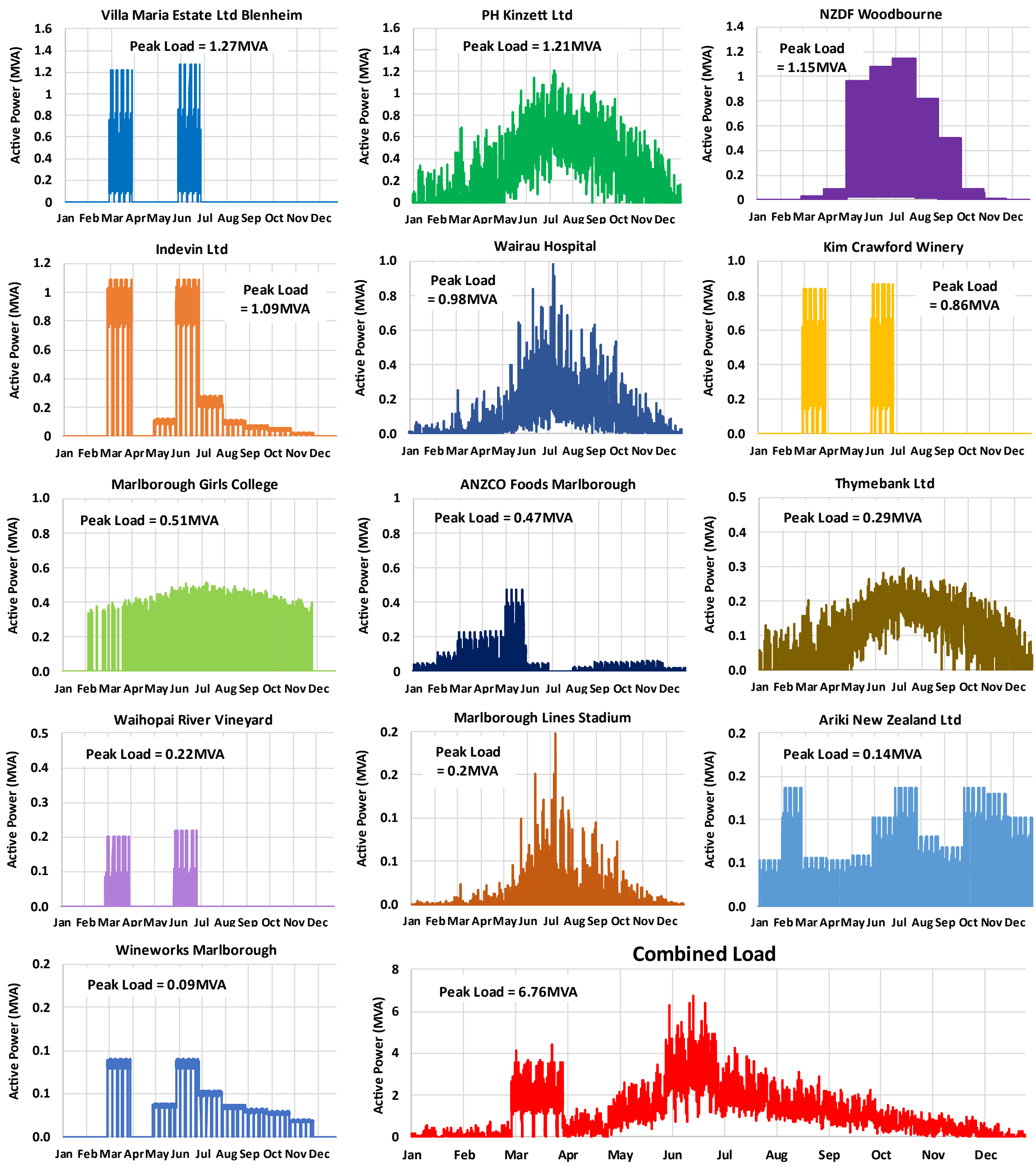

Figure 37 Loading Profiles: Blenheim GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.3.13 Effect of all Load Sites Connecting to Blenheim GXP

The following Figure 38 illustrates the Blenheim 2022 load profile together with the load profiles of all the Load Sites within the Blenheim GXP region[21]. Also shown in Figure 38 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Bromley GXP would increase to 87.6 MVA, a difference of 14.6 MVA. Given that the independent sum of the individual loads is 102.2 MVA there is a diversity factor of 0.86 between the loads.
- Based on Ergo's analysis, the Blenheim GXP's (N-1) limit is not expected to be exceeded.

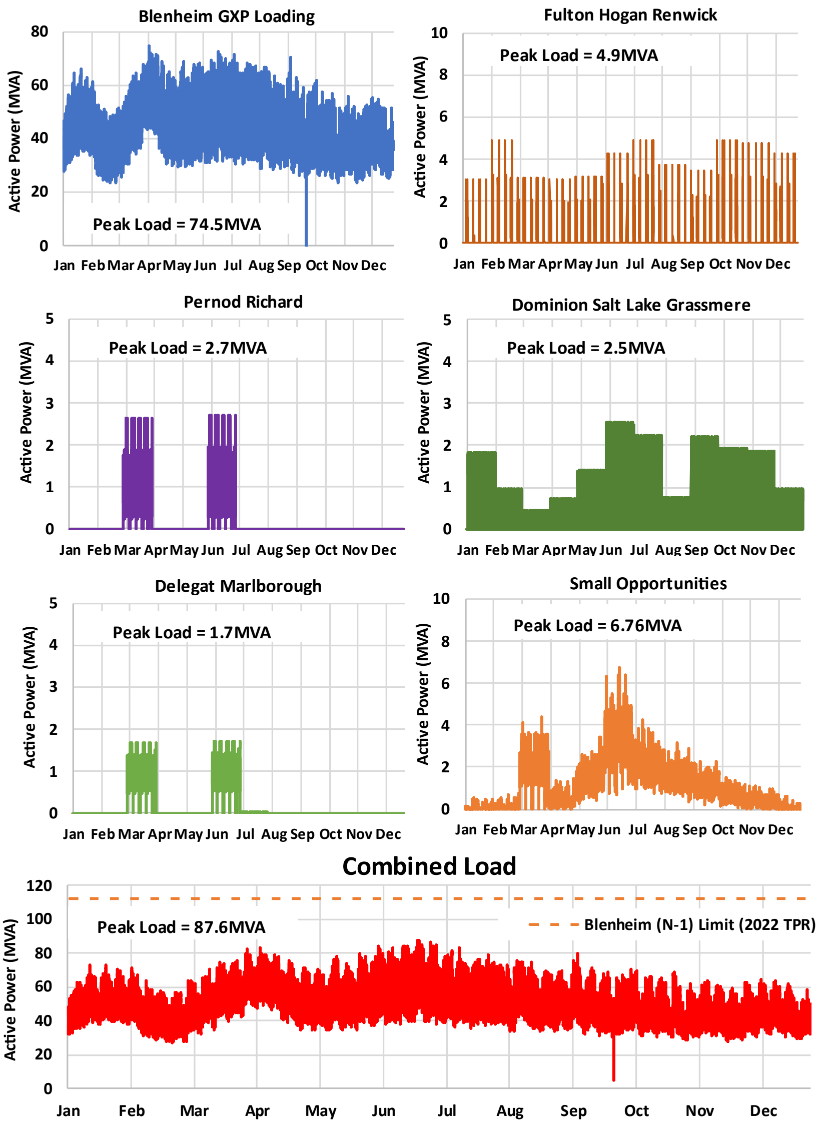

Figure 38 Loading Profiles: Blenheim GXP 2022 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

[21] Although not shown in the individual load graphs, a flat load profile at 3.8 MW has been conservatively assumed for the Picton/Blenheim EV charging station.

8.4 Kikiwa GXP

None of the Load Sites identified by EECA are geographically close to the Kikiwa GXP. Hence, Ergo is of the view that the Kikiwa GXP is not a viable option for supplying any of the Load Sites, and thus we have not considered the upgrade of the GXP or any zone substations.

8.5 Murchison GXP

The EECA Load Sites include:

- Murchison EV Charging Station (0.6 to 1.6 MW)

The geographic location of the Load Site is shown on the following Figure 39 in relation to the local transmission substation. There are no distribution substations in the area.

Figure 39 Murchison GXP: EECA Load Sites vs local substations

8.5.1 Murchison GXP Upgrade

As shown in Section 8.5.3, with all of the proposed loads connecting to Murchison GXP, the (N) capacity of the GXP is not expected to be exceeded. The GXP can only operate with (N) security, not (N-1), as there is only one transformer at the site. As such, Ergo has not considered the costs of upgrades at Murchison GXP.

8.5.2 Murchison EV Charging Station

MURCHISON EV CHARGING STATION		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
Chargers for electric vehicles	0.6 to 1.6 MW	Murchison
Existing Electrical Supply to the Plant		

Shown below is a potential site for the proposed Murchison EV Charging Station, near the town centre of Murchison.

The area is presently supplied directly from Murchison GXP.

The plant is ≈1.8 km (straight line) from Murchison GXP.

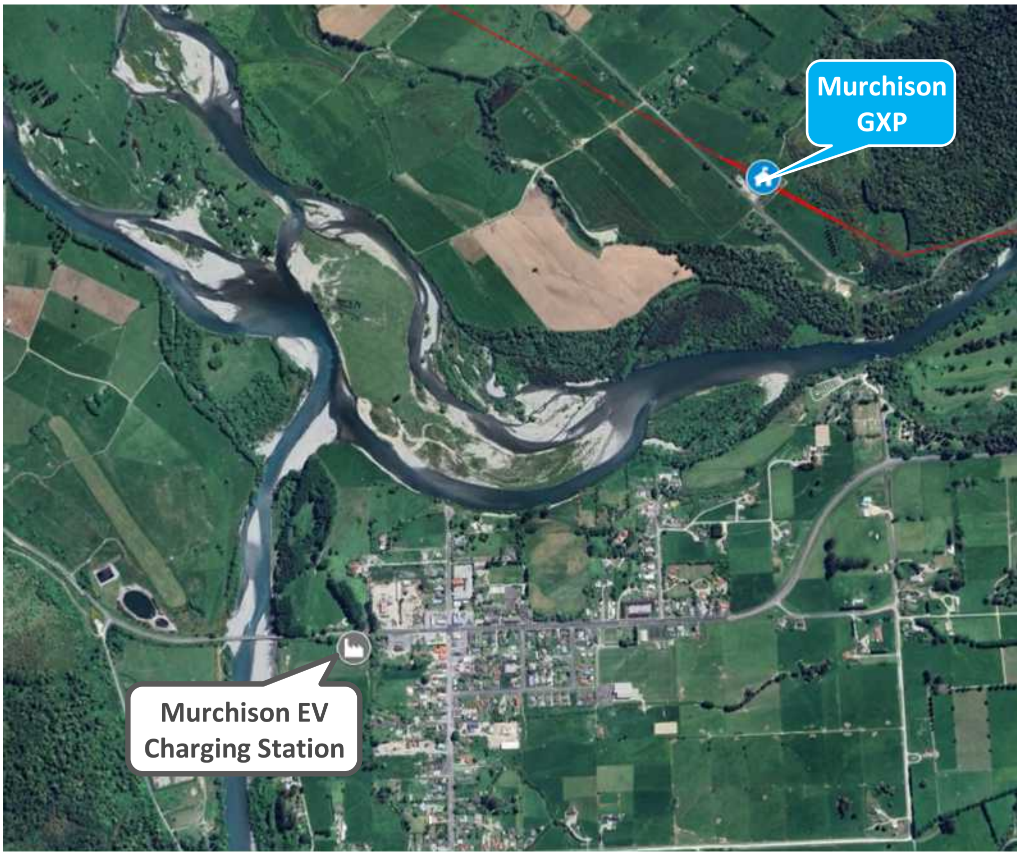

Figure 40 Murchison EV Charging Station geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Murchison has sufficient (N) spare capacity to accommodate the additional load of 1.6 MW.

In order to connect the proposed load, Ergo expects that Network Tasman would be able to shift load between the local feeders to ensure capacity at the site of 0.6 or 1.6 MW, with only distribution transformer/RMU costs to connect the supply.

MURCHISON EV CHARGING STATION
Capital Cost Estimate
Ergo expects that a cost of ~$0.35M could be associated with an RMU and distribution transformer to supply the site, for the 1.6 MW connection, or ~$0.2M for the 0.6 MW connection.
Timeframe to Establish New Electrical Infrastructure
Estimated to take 3 – 6 months. To Plan, Design, Procure, Construct and Commission the works. Excludes the work required to establish the Load Site. Excludes land acquisition and consenting, if required.

8.5.3 Effect of all Load Sites Connecting to Murchison GXP

The following Figure 41 illustrates the Murchison 2022 load profile together with the load profiles of all the Load Sites within the Murchison GXP region[22]. Also shown in Figure 41 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Murchison GXP would increase to 5.4 MVA, a difference of 1.6 MVA (equal to the EV charging station load).
- Based on Ergo's analysis, the Murchison GXP's (N) limit is not expected to be exceeded.

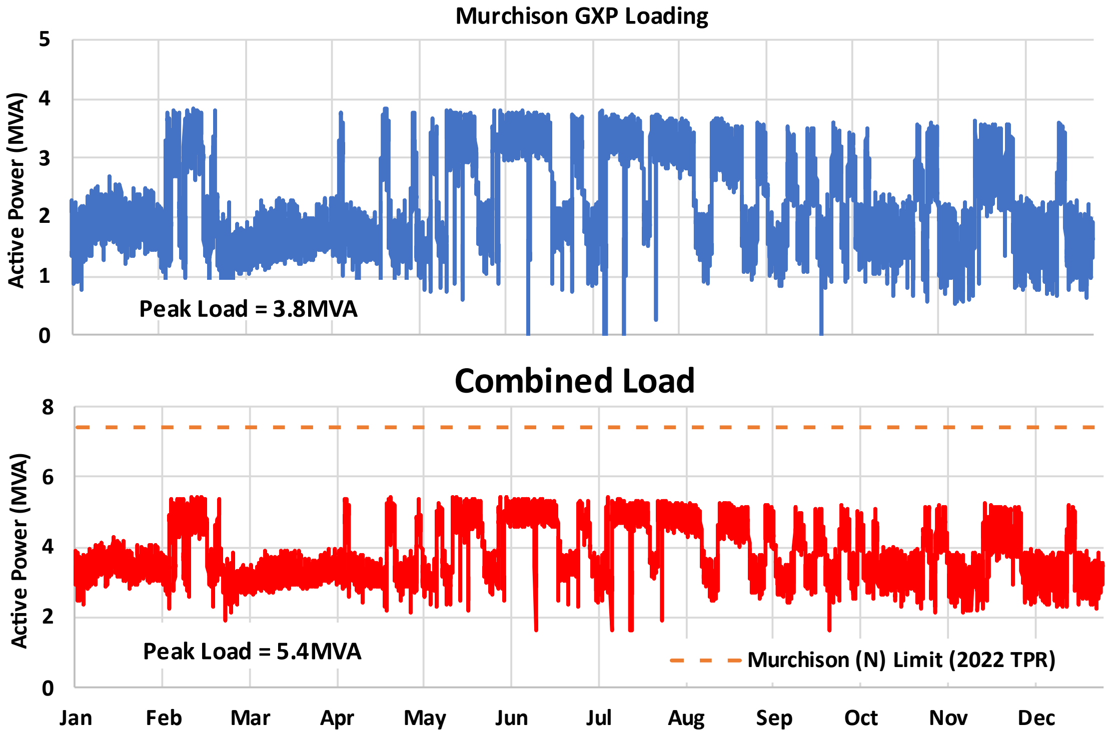

Figure 41 Loading Profiles: Murchison GXP 2022 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

[22] Although not shown in the individual load graphs, a flat load profile at 3.8 MW has been conservatively assumed for the Murchison EV charging station.

8.6 Stoke 33kV GXP

The EECA Load Sites include:

- J S Ewers Appleby (4.68 MW)
- Sealord Nelson (3.91 MW)
- Richmond EV Charging Station (0.9 to 2.30 MW)
- McCashins Brewery (2.28 MW)
- Nelson Hospital (2.19 MW)

The “Small” Load Sites include (refer to Sections 8.6.7 and 8.6.9):

- NMIT Nelson (0.35 MW)
- Waimea College (0.33 MW)
- Alliance Nelson (0.23 MW)
- Nelson Girls College (0.16 MW)
- Broadgreen Intermediate (0.12 MW)
- Garin College (0.12 MW)
- Nelson Intermediate School (0.12 MW)
- Nelson Central School (0.09 MW)
- Nayland College (0.27 MW)

The geographic locations of the Load Sites are shown on the following Figure 42 in relation to the local transmission and distribution substations.

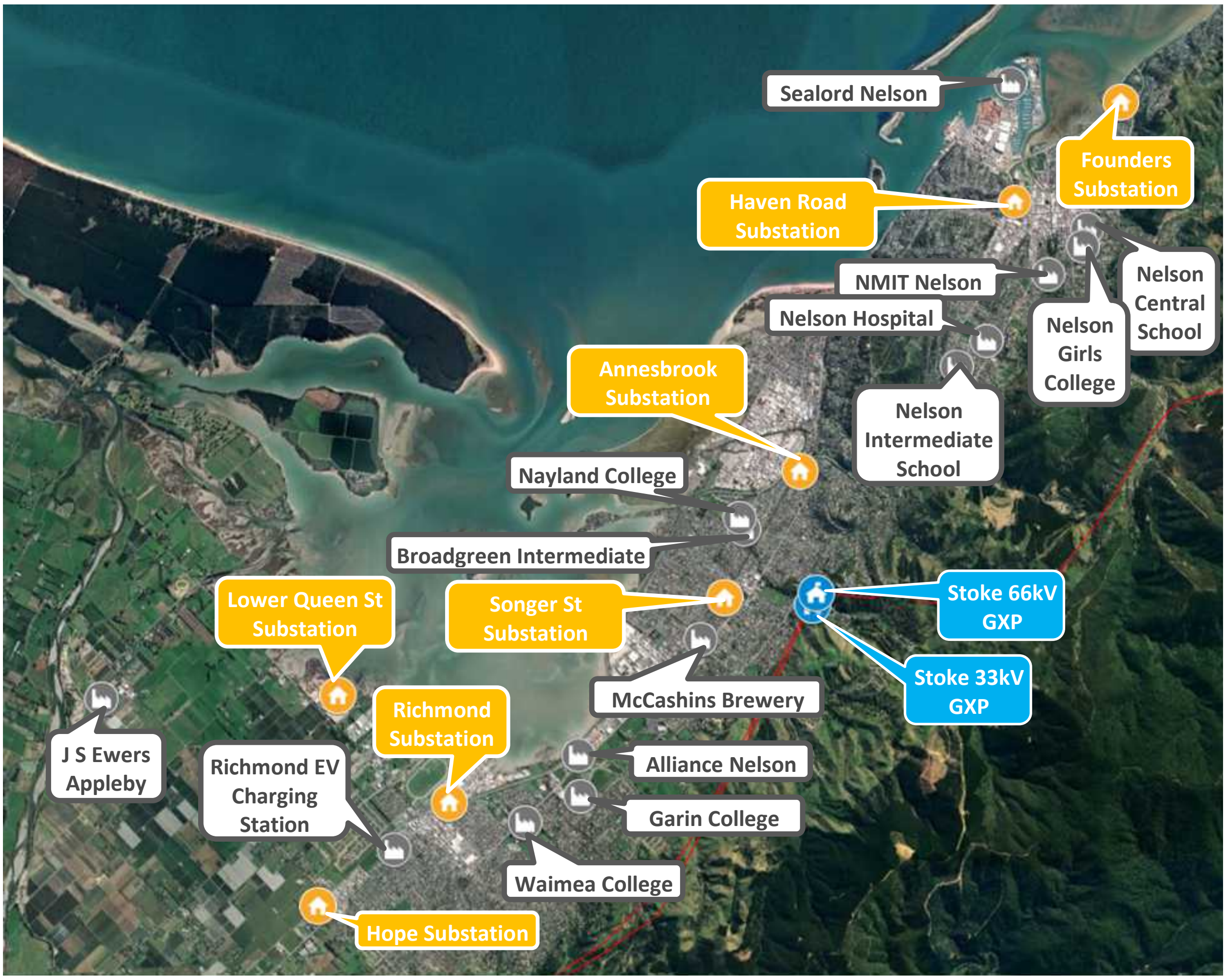

Figure 42 – Stoke 33kV GXP: EECA Load Sites vs local substations

8.6.1 Stoke 33kV GXP Upgrade

As shown in Section 8.6.10, with all of the proposed loads connecting to Stoke 33 kV GXP, the (N-1) capacity of the GXP is not expected to be exceeded, when the proposed loads are added to the historical data. Considering the actual 2022 loading on the Stoke 33 kV GXP, there is 10 MVA (N-1) of spare capacity at the GXP.

However, Ergo notes that Transpower's forecast shows that the (N-1) capacity will likely be reached soon (refer Table 3). Because of this, the addition of the proposed loads could trigger upgrades to the 33 kV protection, switchgear, and cables which are presently limiting the capacity, increasing the GXP's (N-1) capacity to 155/162 MVA (summer/winter). The costs associated with this have not been indicated by Transpower or Network Tasman.

Additionally, Network Tasman is presently working with Transpower to build a new GXP at Brightwater, which could be commissioned at the earliest in 2027. Some load from Stoke 33 kV GXP is expected to be transferred to the new Brightwater GXP (which may include some of the load sites described in this section) which will ensure security of supply at Stoke 33 kV GXP.

Network Tasman has estimated the cost of cable connections to the new GXP to be $7.2M, while Transpower has estimated the cost to build the new GXP at $25M. As these are not upgrades dedicated to one site, or triggered by the Load Sites, Ergo expects that the costs of these upgrades will be shared among all network customers, in the form of the transmission costs included in electricity bills. As such, Ergo has assumed no major contribution to these costs by any of the Load Sites.

Ergo has not considered any further upgrades at Stoke 33 kV GXP.

8.6.2 J S Ewers Appleby

J S EWERS APPLEBY		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pump	4.68 MW	Stoke 33kV
Existing Electrical Supply to the Plant		

The J S Ewers Appleby plant is presently supplied by Network Tasman's Hope zone substation. Stoke 33 kV GXP supplies Richmond zone substation at 33 kV, which in turn supplies Hope substation at 33 kV.

The plant is ≈4 km (straight line) from Hope substation.

Figure 43 J S Ewers Appleby geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 33 kV GXP has sufficient (N-1) spare capacity to accommodate the additional load of 4.68 MW. Hope zone substation does not presently have sufficient (N-1) spare capacity for the proposed load, however, Ergo notes that Network Tasman plan to replace the transformers at the site, upgrading from 10 MVA units to 23 MVA units, in 2024-2025. Ergo expects that once the transformers are replaced, Hope substation will have sufficient capacity for the additional load. It is unlikely that the existing feeders from Hope substation have capacity of the proposed load.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder would be installed to the site from Hope substation. This feeder would be underground cabled within Nelson due to the urban topography, then overhead conductor through the rural area. Ergo estimates that this feeder would involve ~2.4 km of underground cable and ~2.4 km of overhead line.

Capital Cost Estimate

Table 16 J S Ewers Appleby: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.40	$0.96
Distribution	Single overhead 11kV line	2.40	$0.48
		TOTAL	**$1.54**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.6.3 Sealord Nelson

		SEALORD NELSON
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps and electrical boilers	3.91 MW	Stoke 33kV

Existing Electrical Supply to the Plant

The Sealord Nelson plant is presently supplied by Nelson Electricity's Haven Road zone substation. Haven Road zone substation is fed via four 33 kV circuits from Stoke 33 kV GXP. The plant is supplied by a dedicated 11 kV feeder, which is rated at 300 A (5.7 MVA), and presently loaded at ~150 A (2.9 MVA). The Sealord feeder can be backfed by the nearby Vickerman St feeder.

Ergo notes that Sealord have an existing 11 kV switchboard which is due for replacement in 2025/2026.

The plant is ≈1.6 km (straight line) from Haven Road substation.

Figure 44 Sealord Nelson geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 33 kV GXP and Haven Road zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 3.91 MW. The existing feeder to Sealord would not be able to support the proposed load.

In order to connect the proposed load, Ergo expects that a new 11 kV feeder to the site from Haven Road substation would be required. This feeder would likely be underground cables due to the urban topography. Ergo estimates that this feeder could involve ~2 km of underground cables.

Capital Cost Estimate

Table 17 Sealord Nelson: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.00	$0.80
		TOTAL	**$0.90**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.6.4 Richmond EV Charging Station

RICHMOND EV CHARGING STATION		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
Chargers for electric vehicles	0.9 to 2.3 MW	Stoke 33kV
Existing Electrical Supply to the Plant		

Shown below is a potential site for the proposed Richmond EV Charging Station, near the main business area of Richmond in Nelson.

The area is presently supplied by either Richmond zone substation or Hope zone substation, both owned by Network Tasman. Stoke 33 kV GXP supplies Richmond zone substation at 33 kV, which in turn supplies Hope substation at 33 kV.

The plant is ≈0.9 km (straight line) from Richmond substation, and ≈1.2 km (straight line) from Hope substation.

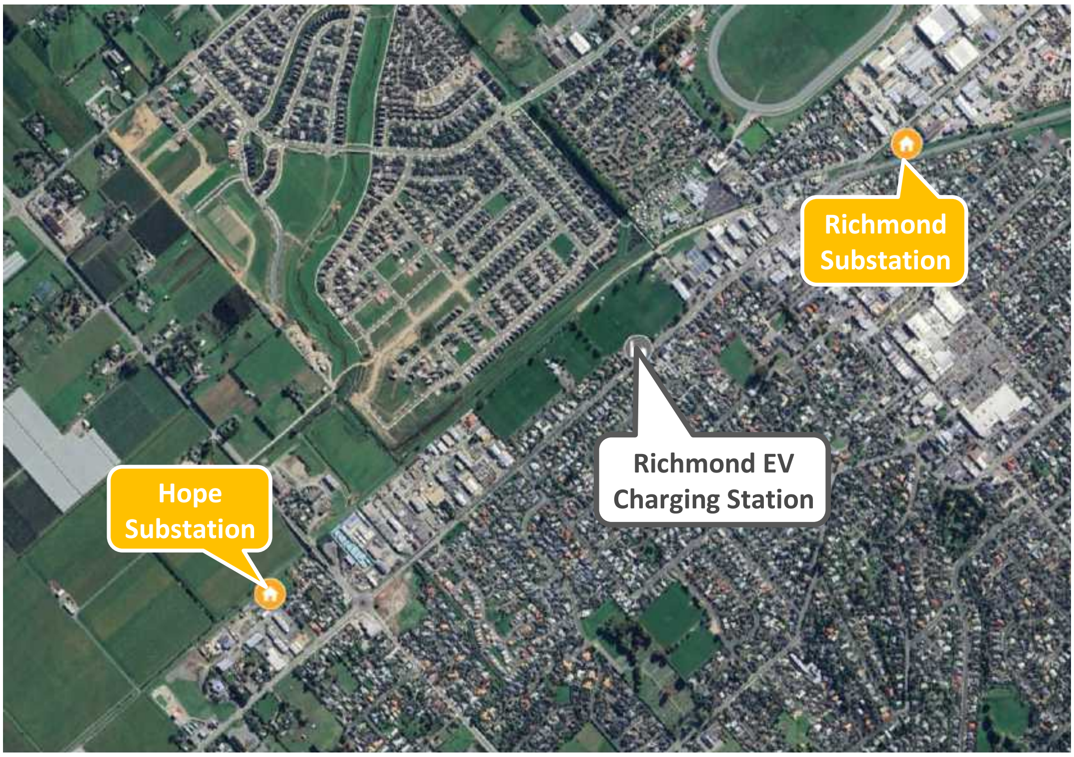

Figure 45 Richmond EV Charging Station geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 33 kV GXP and Richmond zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 2.3 MW. Hope zone substation has sufficient spare (N-1) capacity for the initial 0.9 MW of load, but not for the 2.3 MW load (however it does have sufficient (N) capacity). Because of this, Ergo expects that the load would most likely connect to Richmond substation.

In order to connect the proposed load, Ergo expects the following upgrades would be required:

- For the 0.9 MW connection: Ergo expects that Network Tasman would be able to shift load between the existing feeders from Richmond or Hope substations to ensure capacity at the site of 0.9 MW, with only distribution transformer/RMU costs to connect the supply.
- For the 2.3 MW connection: one new 11 kV feeder would be installed to the site from Richmond substation. This feeder would be underground cabled within Nelson due to the urban topography. Ergo estimates that this feeder would involve ~1 km of underground cable.

Capital Cost Estimate

Table 18 Richmond EV Charging Station: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.00	$0.40
		TOTAL	**$0.50**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 3 – 6 months for the initial 0.9 MW load, and 12 – 18 months for the final 2.3 MW load.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.6.5 McCashins Brewery

MCCASHINS BREWERY		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps and electrical boilers	2.28 MW	Stoke 33kV
Existing Electrical Supply to the Plant		

The McCashins Brewery plant is presently supplied by Network Tasman's Songer St zone substation. Songer St zone substation is supplied at 33 kV by Stoke 33 kV GXP, via two circuits giving an (N-1) switched supply to the zone substation.

The plant is ≈0.6 km (straight line) from Songer St substation.

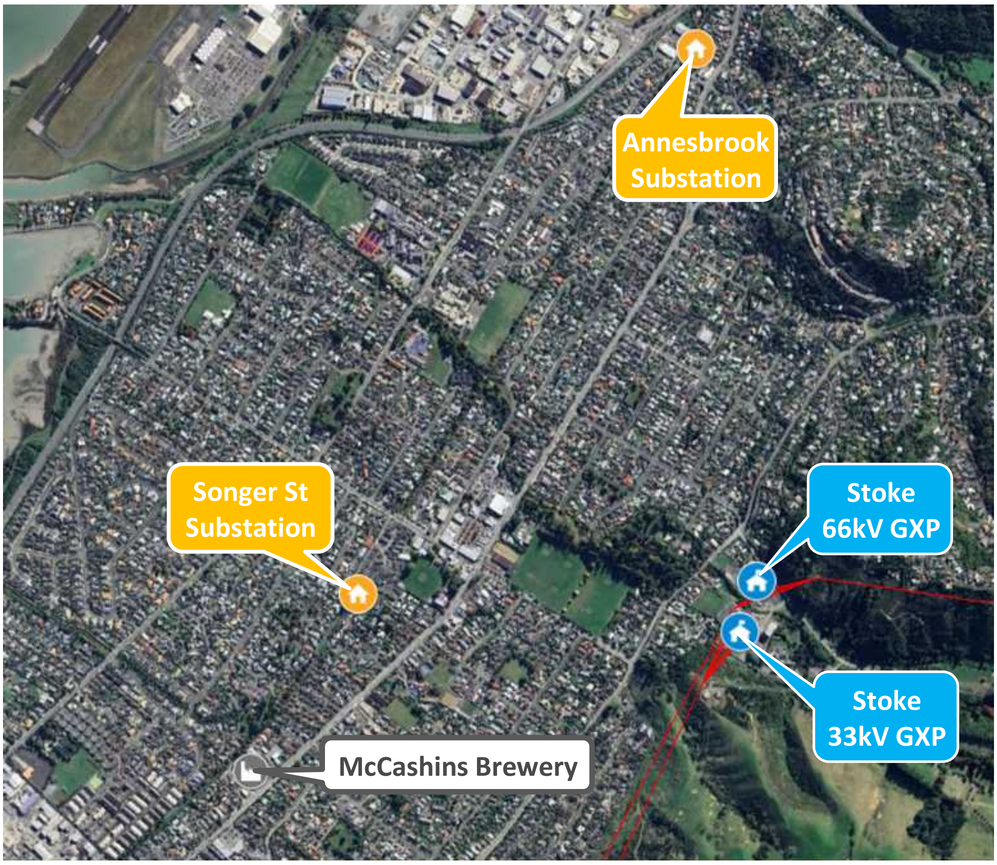

Figure 46 McCashins Brewery geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 33 kV GXP and Songer St zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 2.28 MW.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Songer St substation would be required. This feeder would likely be underground cables due to the urban topography. Ergo estimates that this feeder could involve ~1.6 km of underground cables.

Capital Cost Estimate

Table 19 McCashins Brewery: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.60	$0.64
		TOTAL	**$0.74**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.6.6 Nelson Hospital

NELSON HOSPITAL		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps and electrical boilers	2.19 MW	Stoke 33kV
Existing Electrical Supply to the Plant		

The Nelson Hospital is presently supplied by Nelson Electricity's Haven Road zone substation. Haven Road zone substation is fed via four 33 kV circuits from Stoke 33 kV GXP. The plant is supplied by the 11 kV Victory Square feeder, which is rated at 300 A (5.7 MVA), and presently loaded at ~200 A (3.8 MVA) (Ergo notes that 200 A is the feeder's limit for (N-1) security). The feeder can be backed up by the Emano Street and Anzac Park feeders. Ergo notes that there are upgrades planned to replace some of the cables on the Victory Square feeder.

The plant is ≈1.9 km (straight line) from Haven Road substation.

Figure 47 Nelson Hospital geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 33 kV GXP and Haven Road zone substation have sufficient (N-1) spare capacity to accommodate the additional load of 2.19 MW. The existing feeder to Nelson Hospital would not be able to support the proposed load, however.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Haven Road substation would be required. This feeder would likely be underground cables due to the urban topography. Ergo estimates that this feeder could involve ~2.5 km of underground cables.

Capital Cost Estimate

Table 20 Nelson Hospital: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.50	$1.00
		TOTAL	**$1.10**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 12 – 18 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.6.7 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide an RMU and distribution transformer to supply the site.

Table 21 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
NMIT Nelson	Haven Road	13	37	Unknown	0.35	130
Waimea College	Richmond	6	29	Unknown	0.33	130
Alliance Nelson	Richmond	6	29	Unknown	0.23	130
Nelson Girls College	Haven Road	13	37	Unknown	0.16	80
Broadgreen Intermediate	Songer St	4	27	Unknown	0.12	80
Garin College	Richmond	6	29	Unknown	0.12	80
Nelson Intermediate School	Haven Road	13	37	Unknown	0.12	80
Nelson Central School	Haven Road	13	37	Unknown	0.09	50
Nayland College	Songer St	4	27	Unknown	0.27	130

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.6.8 Combined Load on Zone Substations

8.6.8.1 Haven Road

Six of the loads on Stoke 33 kV GXP are expected to connect to Haven Road zone substation. These are Sealord Nelson, Nelson Hospital, and "small" loads NMIT Nelson, Nelson Girls College, Nelson Intermediate school, and Nelson Central School. The sum of peaks of these loads is 6.83 MVA, which Haven Road substation does have (N-1) capacity for. Therefore, upgrades of Haven Road zone substation are not considered.

8.6.8.2 Songer St

Three of the loads on Stoke 33 kV GXP are expected to connect to Songer St zone substation. These are McCashins Brewery, Broadgreen Intermediate ("small" load), and Nayland College ("small" load). The sum of peaks of these loads is 2.67 MVA, which Songer St substation does have (N-1) capacity for. Therefore, upgrades of Songer St zone substation are not considered.

8.6.8.3 Richmond

Four of the loads on Stoke 33 kV GXP are expected to connect to Richmond zone substation. These are Richmond EV Charging Station, Waimea College ("small" load), Alliance Nelson ("small" load), and Garin College ("small" load). The sum of peaks of these loads is 2.97 MVA, which Richmond substation does have (N-1) capacity for. As such, upgrades of Richmond zone substation are not considered.

8.6.9 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on Stoke 33kV GXP gives a combined load of 1.8 MVA. However, when the load shapes are combined, they result in the following load shape (Figure 37), with a maximum load of 1.5 MVA, with a diversity factor of 0.85.

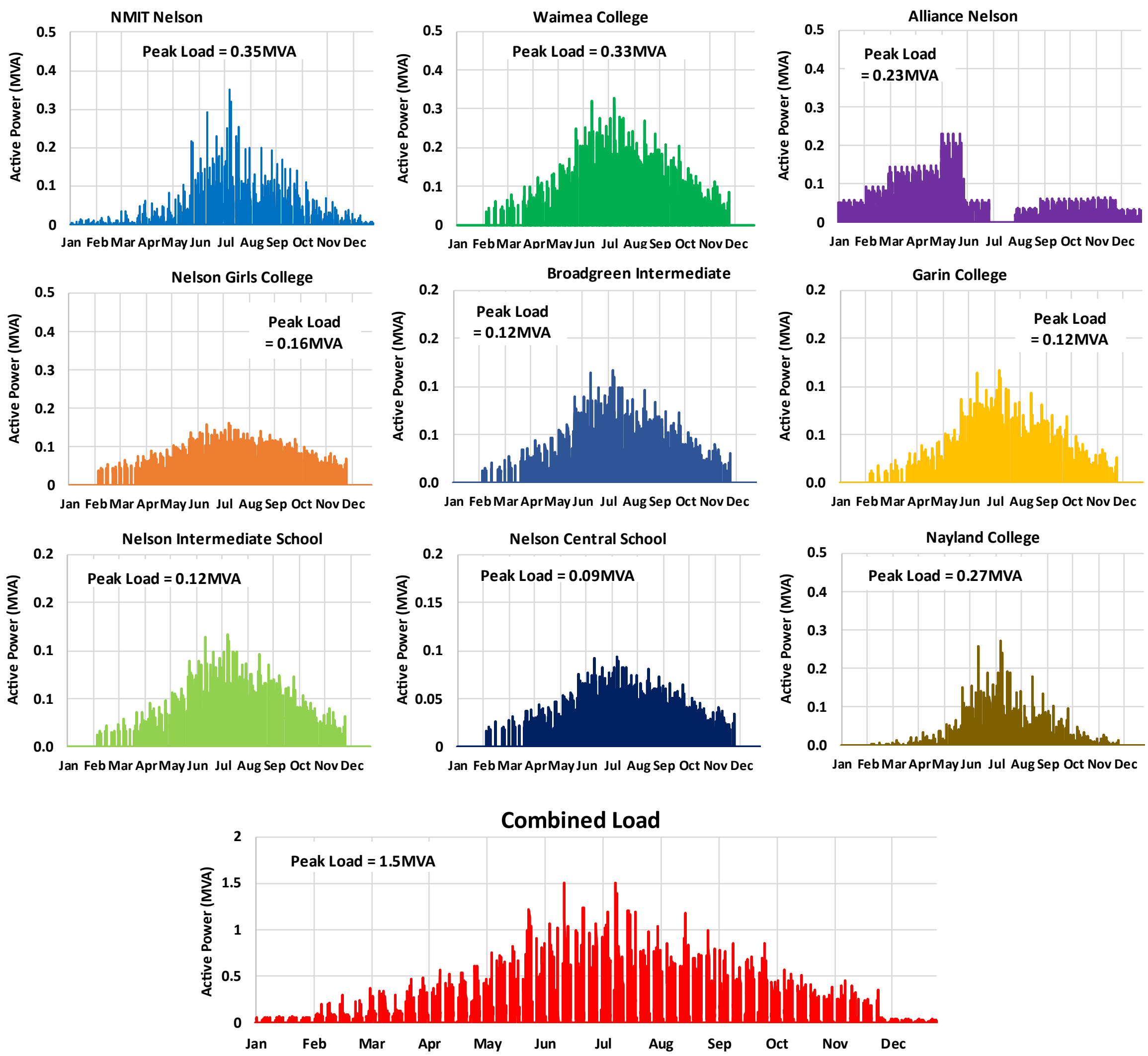

Figure 48 Loading Profiles: Stoke 33kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.6.10 Effect of all Load Sites Connecting to Stoke 33kV GXP

The following Figure 38 illustrates the Stoke 33kV 2022 load profile together with the load profiles of all the Load Sites within the Stoke 33kV GXP region. Also shown in Figure 38 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Stoke 33kV GXP would increase to 139.3 MVA, a difference of 8.1 MVA. Given that the independent sum of the individual loads is 148.1 MVA there is a diversity factor of 0.94 between the loads.
- Based on Ergo's analysis, the Stoke 33kV GXP's (N-1) limit is not expected to be exceeded.

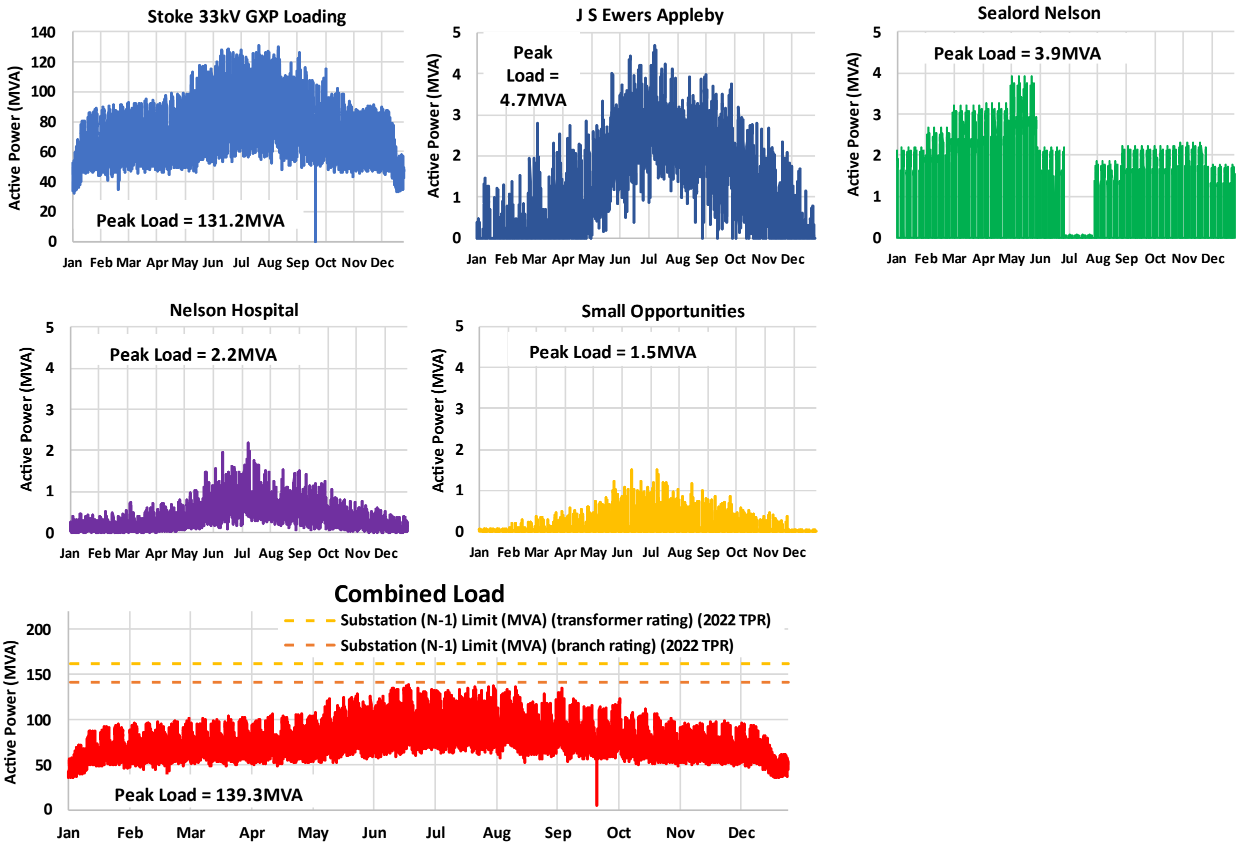

Figure 49 Loading Profiles: Stoke 33kV GXP 2022 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.7 Stoke 66kV GXP

The EECA Load Sites include:

- Fonterra Takaka (5.81 MW)
- Talleys Motueka (4.00 MW)

The “Small” Load Sites include (refer to Sections 8.7.4 and 8.7.6):

- Motueka High School (0.23 MW)
- Golden Bay High School (0.08 MW)

The geographic locations of the Load Sites are shown on the following Figure 50 in relation to the local transmission and distribution substations.

Figure 50 Stoke 66kV GXP: EECA Load Sites vs local substations

8.7.1 Stoke 66kV GXP Upgrade

As shown in Section 8.7.7, with all of the proposed loads connecting to Stoke 66kV GXP, the (N-1) capacity of the GXP is not expected to be exceeded. As such, Ergo has not considered the costs of upgrades at Stoke 66kV GXP.

8.7.2 Fonterra Takaka

		FONTERRA TAKAKA
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps and electrical boilers	5.81 MW	Stoke 66kV

Existing Electrical Supply to the Plant

The Fonterra Takaka plant is presently supplied by Network Tasman's Takaka zone substation. Takaka zone substation is supplied at 33 kV by Motupipi 66/33kV substation which is fed by Stoke 66 kV GXP via two 66 kV lines to Upper Takaka substation (via Motueka substation), and a single line from Upper Takaka substation to Motupipi. A single 33 kV line connects Motupipi substation to Takaka substation, giving the substation (N) security supply. It is noted that Takaka substation has two 33/11 kV transformers which provide the substation (N-1) security of the transformers.

Ergo notes that the short length of the 33 kV line feeding Takaka substation means that repairs to the line can be carried out quickly when required.

The plant is ≈0.7 km (straight line) from Takaka substation.

Figure 51 Fonterra Takaka geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 66 kV GXP has sufficient (N-1) spare capacity to accommodate the additional load of 5.81 MW, however the load would exceed the transformer (N-1) capacity of Takaka substation.

In order to connect the proposed load, Ergo expects the following upgrades would be required:

- Installation of one new 11 kV feeder to the site from Takaka substation. This feeder would likely be overhead lines in the rural area, which would be ~1.2 km long.
- To maintain the transformer (N-1) security, replacements of the substation transformers would be required.

FONTERRA TAKAKA

Ergo notes that the 66 kV lines supplying the site are reaching their capacity. However, Network Tasman has identified that the constraint is voltage-based and therefore can be improved by installation of voltage support at Motupipi and Motueka substations, at a cost of $2M for a static VAr compensator (SVC) at Motupipi and $0.6M for a capacitor bank at Motueka. Addition of this load to the network may trigger this upgrade for Motupipi substation.

Capital Cost Estimate

Table 22 Fonterra Takaka: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub transmission	Static VAr Compensator	1.00	$2.00
Distribution	Small supply transformer (ZSS)	2.00	$1.00
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single overhead 11kV line	1.20	$0.24
		TOTAL	**$3.34**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 18-24 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.7.3 Talleys Motueka

		TALLEYS MOTUEKA
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps and electrical boilers	4.00 MW	Stoke 66kV

Existing Electrical Supply to the Plant

The Talleys Motueka plant is presently supplied by Network Tasman's Motueka zone substation. Motueka substation is fed by Stoke 66 kV GXP via two 66 kV lines. Motueka substation has two transformers and four existing 11 kV feeders which feed Motueka township, plus a further four feeders which supply the local rural areas.

The plant is ≈3.4 km (straight line) from Motueka substation.

Figure 52 Talleys Motueka geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Stoke 66 kV GXP has sufficient (N-1) spare capacity to accommodate the additional load of 4 MW, however the load would exceed the (N-1) capacity of Motueka substation, which does presently have (N) capacity.

Ergo notes that there were recently transformer replacements at Motueka substation. The removed transformers were refurbished and there are plans to return them to the site as third and fourth transformers. Once this upgrade is carried out, the substation will have (N-1) capacity for the additional load. There are also plans for a new 11 kV switchboard/feeders to be added to the substation.

In order to connect the proposed load, Ergo expects that one new 11 kV feeder to the site from Motueka substation would be required. This feeder would likely be overhead lines in the rural area, which would be ~6.2 km long (taking an indirect route to avoid the coastal terrain near the site as much as possible).

Ergo notes that the 66 kV lines supplying the area are reaching their capacity, however Network Tasman has identified that the constraint is voltage-based and therefore can be improved by installation of voltage support at Motupipi and Motueka substations, at a cost of $2M for a static VAr compensator (SVC) at Motupipi and $0.6M for a capacitor bank at Motueka. Addition of this load to the network may trigger this upgrade for Motueka substation.

Capital Cost Estimate

Table 23 Talleys Motueka: Capital cost estimate to supply the Load Site

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub transmission	Capacitor Bank	1.00	$0.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single overhead 11kV line	6.20	$1.24
		TOTAL	**$1.34**

Does not include the costs of any distribution transformers/switchgear on the plant site.

Timeframe to Establish New Electrical Infrastructure

Estimated to take 18-24 months.

To Plan, Design, Procure, Construct and Commission the works.

Excludes the work required to establish the Load Site.

Excludes land acquisition and consenting, if required.

8.7.4 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide an RMU and distribution transformer to supply the site.

Table 24 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Motueka High School	Motueka	1	24	Unknown	0.23	130
Golden Bay High School	Takaka	3	10	Unknown	0.08	50

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.7.5 Combined Load on Zone Substations

Both Motueka and Takaka have two load sites expected to connect to them, one large load site and one “small” load site each. While the small load sites are not expected to make a material effect on the network, the upgrades required to connect the two larger loads, Fonterra Takaka and Talleys Motueka, are described in their respective Sections 8.7.2 and 8.7.3, and are not expected to effect the smaller load sites being connected. As such, further upgrades to the two substations are not considered.

8.7.6 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Stoke 66kV GXP gives a combined load of 0.31 MVA. When the load shapes are combined, they result in the following load shape (Figure 37), with a maximum load of 0.31 MVA, with a diversity factor of 1.

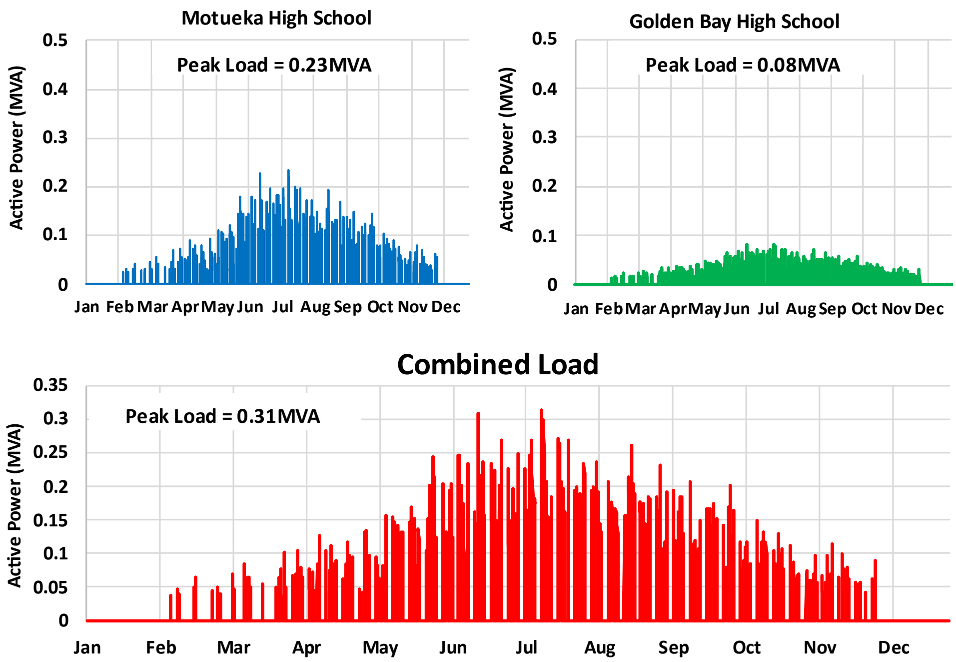

Figure 53 Loading Profiles: Stoke 66kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.7.7 Effect of all Load Sites Connecting to Stoke 66kV GXP

The following Figure 38 illustrates the Stoke 66kV 2022 load profile together with the load profiles of all the Load Sites within the Stoke 66kV GXP region. Also shown in Figure 38 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Stoke 66kV GXP would increase to 30.2 MVA, a difference of 6.6 MVA. Given that the independent sum of the individual loads is 36.8 MVA there is a diversity factor of 0.82 between the loads.
- Based on Ergo's analysis, the Stoke 66kV GXP's (N-1) limit is not expected to be exceeded.

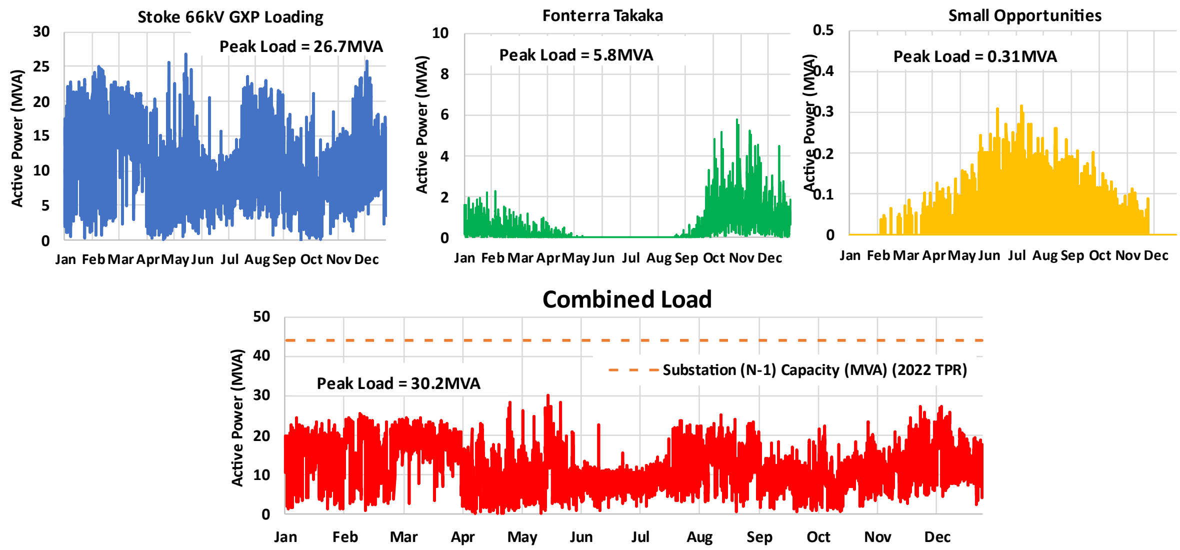

Figure 54 Loading Profiles: Bromley GXP 2022 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

9. Conclusions

9.1 Network Spare Capacity

The following Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Nelson, Marlborough and Tasman region.

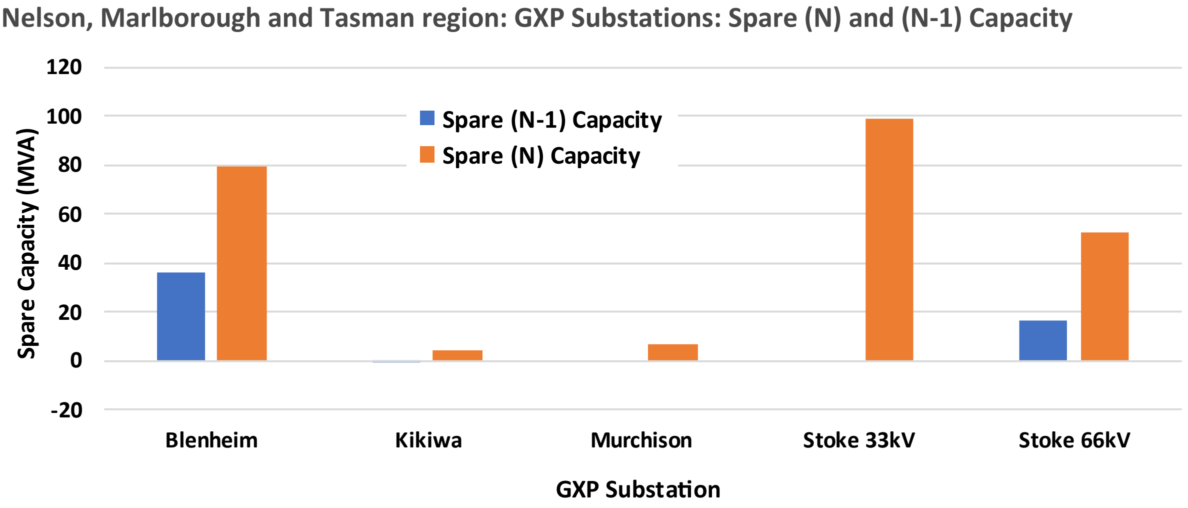

Figure 55 Summary: Approximate (N) and (N-1) spare capacity at GXP substations

The following figures illustrate the (N) and (N-1) spare capacity at the EDB Zone Substations in the Nelson, Marlborough and Tasman region. These figures are based off the maximum loadings and the EDB 2021 disclosures.

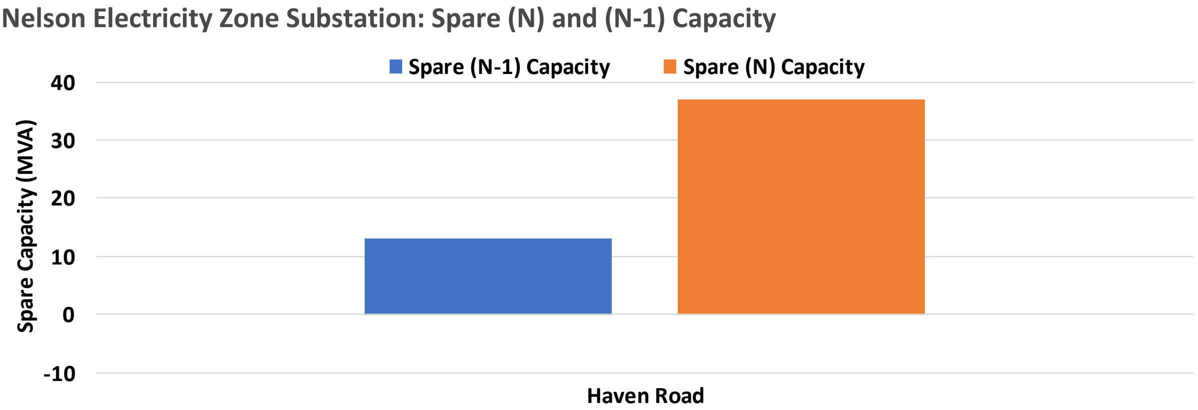

Figure 56 Summary: Approximate (N) and (N-1) spare capacity at Nelson Electricity zone substation

Network Tasman Zone Substations: Spare (N) and (N-1) Capacity

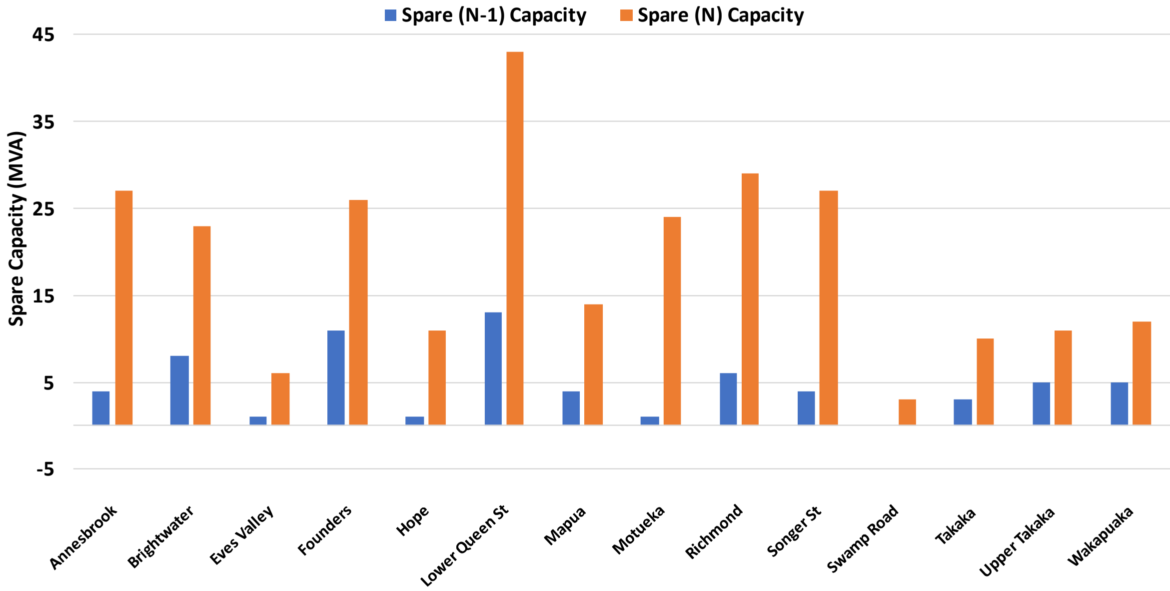

Figure 57 Summary: Approximate (N) and (N-1) spare capacity at Network Tasman's zone substations

Marlborough Lines' Zone Substations: Spare (N) and (N-1) Capacity

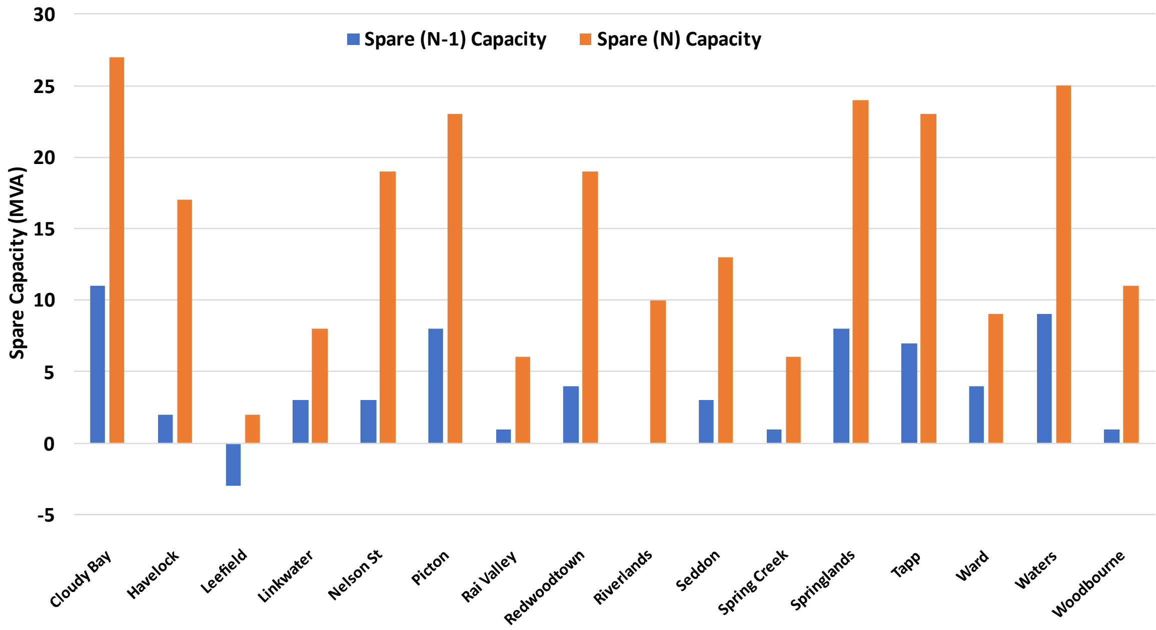

Figure 58 Summary: Approximate (N) and (N-1) spare capacity at Marlborough Lines' zone substations

9.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 22132-RPT-0004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Blenheim GXP* – Predominantly rural residential/irrigation loading including large processing/manufacturing plants and wineries. GXP loading peaks in winter due to residential loads, and in summer due to irrigation loads. Several embedded generators contribute to the GXP loading.
- *Kikiwa GXP* – Loading is predominantly a mix of residential and dairying. GXP loading peaks in summer due to irrigation as well as a hop growing operation.
- *Murchison GXP* – Loading is predominantly a mix of residential and dairying. GXP loading peaks in late summer/early autumn.
- *Stoke 33kV GXP* – A typical mix of residential and commercial/industrial loads. GXP loading peaks in winter due to space heating loads.
- *Stoke 66kV GXP* – Loading is a mix of domestic, horticulture and food processing. GXP loading peaks from February through September.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators.

9.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[23], which is only suitable for concept screening. (Refer to the assumptions outlined in Section 8.2 for more details)

[23] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Summary: Load Sites vs transmission/distribution capital cost estimates

Table 25 Summary of Load Sites and estimated capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
1	Fulton Hogan Renwick	4.90	Blenheim	$0.00	Tapp	$0.96	$0.96	$0.20	Minor	2
2	Picton/Blenheim EV Charging Station (3.8 MW option)	3.80			Picton or Nelson St	$0.90	$0.90	$0.24	Minor	2, 3
3	Shonrei Products	2.91			Springlands	$0.82	$0.82	$0.28	Minor	2
4	Pernod Richard	2.73			Cloudy Bay	$1.38	$1.38	$0.51	Minor	2
5	Dominion Salt Lake Grassmere	2.55			Seddon	$2.80	$2.80	$1.10	Minor	2
6	Sanford Havelock (N-1) subtransmission supply	2.29			Havelock	$2.74	$2.74	$1.20	Moderate	2
7	Delegat Marlborough	1.73			Tapp	$0.00	$0.00	$0.00	Minor	1
8	Villa Maria Estate Ltd Blenheim	1.27			Woodbourne	$0.00	$0.00	$0.00	Minor	1
9	PH Kinzett Ltd	1.21			Woodbourne	$0.00	$0.00	$0.00	Minor	1
10	NZDF Woodbourne	1.15			Woodbourne	$0.00	$0.00	$0.00	Minor	1
11	Indevin Ltd	1.09			Cloudy Bay	$0.00	$0.00	$0.00	Minor	1
12	Wairau Hospital	0.98			Redwoodtown	$0.00	$0.00	$0.00	Minor	1
13	Kim Crawford Winery	0.86			Woodbourne	$0.00	$0.00	$0.00	Minor	1
14	Marlborough Girls College	0.51			Springlands	$0.00	$0.00	$0.00	Minor	1
15	ANZCO Foods Marlborough	0.47			Waters	$0.00	$0.00	$0.00	Minor	1
16	Thymebank Ltd	0.29			Woodbourne	$0.00	$0.00	$0.00	Minor	1
17	Waihopai River Vineyard	0.22			Leefield	$0.00	$0.00	$0.00	Minor	1
18	Marlborough Lines Stadium 2000	0.20			Nelson St	$0.00	$0.00	$0.00	Minor	1
19	Ariki New Zealand Ltd	0.14			Springlands	$0.00	$0.00	$0.00	Minor	1
20	WineWorks Marlborough	0.09			Riverlands	$0.00	$0.00	$0.00	Minor	1
21	Murchison EV Charging Station	1.50	Murchison	$0.00	Murchison	$0.00	$0.00	$0.00	Minor	1
22	J S Ewers Appleby	4.68	Stoke 33kV	$32.20	Hope	$1.54	$1.54	$0.33	Minor	1
23	Sealord Nelson	3.91			Haven Road	$0.90	$0.90	$0.23	Minor	2
24	Richmond EV Charging Station	2.30			Richmond	$0.50	$0.50	$0.22	Minor	2
25	McCashins Brewery	2.28			Songer St	$0.74	$0.74	$0.32	Minor	2
26	Nelson Hospital	2.19			Haven Road	$1.10	$1.10	$0.50	Minor	2
27	NMIT Nelson	0.35			Haven Road	$0.00	$0.00	$0.00	Minor	1
28	Waimea College	0.33			Richmond	$0.00	$0.00	$0.00	Minor	1
29	Alliance Nelson	0.23			Richmond	$0.00	$0.00	$0.00	Minor	1
30	Nelson Girls College	0.16			Haven Road	$0.00	$0.00	$0.00	Minor	1
31	Broadgreen Intermediate	0.12			Songer St	$0.00	$0.00	$0.00	Minor	1
32	Garin College	0.12			Richmond	$0.00	$0.00	$0.00	Minor	1
33	Nelson Intermediate School	0.12			Haven Road	$0.00	$0.00	$0.00	Minor	1
34	Nelson Central School	0.09			Haven Road	$0.00	$0.00	$0.00	Minor	1
35	Nayland College	0.27			Songer St	$0.00	$0.00	$0.00	Minor	1
36	Fonterra Takaka	5.81	Stoke 66kV	$0.00	Takaka	$3.34	$3.34	$0.57	Moderate	2
37	Talleys Motueka	4.00		$0.00	Motueka	$1.34	$1.34	$0.34	Moderate	2
38	Motueka High School	0.23		$0.00	Motueka	$0.00	$0.00	$0.00	Minor	1
39	Golden Bay High School	0.08		$0.00	Takaka	$0.00	$0.00	$0.00	Minor	1
	TOTAL =>	58.2	TOTAL =>	$32.2	TOTAL =>	$19.06	$19.06			

Notes
1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.
2 Assumes supply is taken from the EDB at either 33kV or 11kV. Costs will vary depending on size, security and site requirements
3 Picton and Blenheim EV charging station are not both planned, rather, either one or the other will be installed, at this stage. The price presented is for the Picton option, which is more expensive.

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites.

Appendix 1 Glossary

BLN	Blenheim GXP
CT	Current transformer
DG	Distributed generator
EDB	Electrical Distribution Business
EIPC	Electricity Industry Participation Code
ENA	Electricity Network Association
ESA	Electricity Supply Authority
GXP	Grid exit point substation
KIK	Kikiwa GXP
kV	Kilovolts
MCH	Murchison GXP
MW	Megawatts
MVArs	Mega volt amps reactive
MVA	Mega volt amps
ONAN	Oil natural air natural (the methods used to cool the windings and body of the transformer)
ONAF	Oil natural air forced (the methods used to cool the windings and body of the transformer)
SCADA	Supervisory control and data acquisition
STK	Stoke GXP

Appendix 2 Accuracy of Cost Estimates and Assumptions

The amount of time available and effort expended to prepare a capital cost estimate has a significant bearing on the expected accuracy range. Accordingly the accuracy of capital cost estimates should be based on the amount and quality of information available at the time the estimate is developed. The Association for the Advancement of Cost Engineering (AACE) has developed a framework for the accuracy of cost estimates as a project progresses, which is illustrated below.

Table 26 Cost estimate classification matrix[24]

ESTIMATE CLASS	*Primary Characteristics*	*Secondary Characteristic*		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence level
Class 5 (Order of Magnitude)	***0% to 2%***	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	**L: -20% to -50%** **H: +30% to +100%**
Class 4 (Preliminary)	***1% to 15%***	Study or Feasibility	Equipment Factored or Parametric Models	**L: -15% to -30%** **H: +20% to +50%**
Class 3 (Early Budget)	***10% to 40%***	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	**L: -10% to -20%** **H: +10% to +30%**
Class 2 (Budget/Control)	***30% to 70%***	Control or Bid / Tender	Detailed Unit Cost With Forced Detailed Take-off	**L: -5% to -15%** **H: +5% to +20%**
Class 1 (Definitive/Construction)	***50% to 100%***	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	**L: -3% to -10%** **H: +3% to +15%**

Assumptions

Ergo is of the view that the capital cost estimates developed in this report are Class 5 and we note the following:

- Costs exclude land and/or land easements.
- Costs exclude planning/consenting.
- It is assumed there is sufficient space/land in switchrooms/switchyards to accommodate the new equipment.
- The estimates are based on the connection of Load Sites and do not consider the connection of multiple Load Sites.

[24] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.