Hawke's Bay

Spare Capacity and Load Characteristics Report

EECA

23163 | 23163-RPT-003

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Document History & Status

Revision	Date	Author	Reviewed by	Approved by	Status
A	05-03-2024	Caitlin Bergervoet	Willem Rawlins	Kane Morison	Draft
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Revision	Details
A	Stage 1 Draft for client review/comment
B	Stage 2 Draft for client review/comment
C	Updated for Transpower, EECA, Unison, and Centralines comments
D	Added Progressive Leathers Limited and minor updates following Sapere comments

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1. Executive Summary

Transpower maintains/manages the transmission network in New Zealand and supplies the Hawke's Bay region (as described in this report) via five GXP's (supplying Centralines' network, Firstlight's network, and the Hawke's Bay region of Unison's network). Ergo notes that these EDBs also supply areas of other EECA RETA regions, for example, Unison supplies some of the Bay of Plenty and Waikato regions, and Firslight supplies the Tairawhiti region. Reports with analysis for those regions are available on the EECA website.

The three Electrical Distribution Businesses (EDBs), Centralines, Firstlight, and Unison, then take supply from Transpower and distribute the electricity to end customers in the various regions.

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, and seeks to identify the barriers involved and opportunities available.

As part of the RETA program, EECA has developed a set of Load Sites for the Hawke's Bay 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 Hawke's Bay region:

- The current supply demand characteristics (peak & average supply and seasonality information) at the major electrical substations.
- The (N) and (N-1) capacity available for each grid exit point and 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.

1.1 Network Spare Capacity

The following Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Hawke's Bay region. This figure is based on historical maximum loadings and the *Transpower Planning Report 2023* and does not incorporate any future load growth. It is important to note that these spare capacities also do not include any voltage constraints or upstream transmission constraints (which would have to be confirmed by Transpower or the relevant EDB). As such, it is highly likely that those constraints would prevent all the spare capacity shown below being available.

[1] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

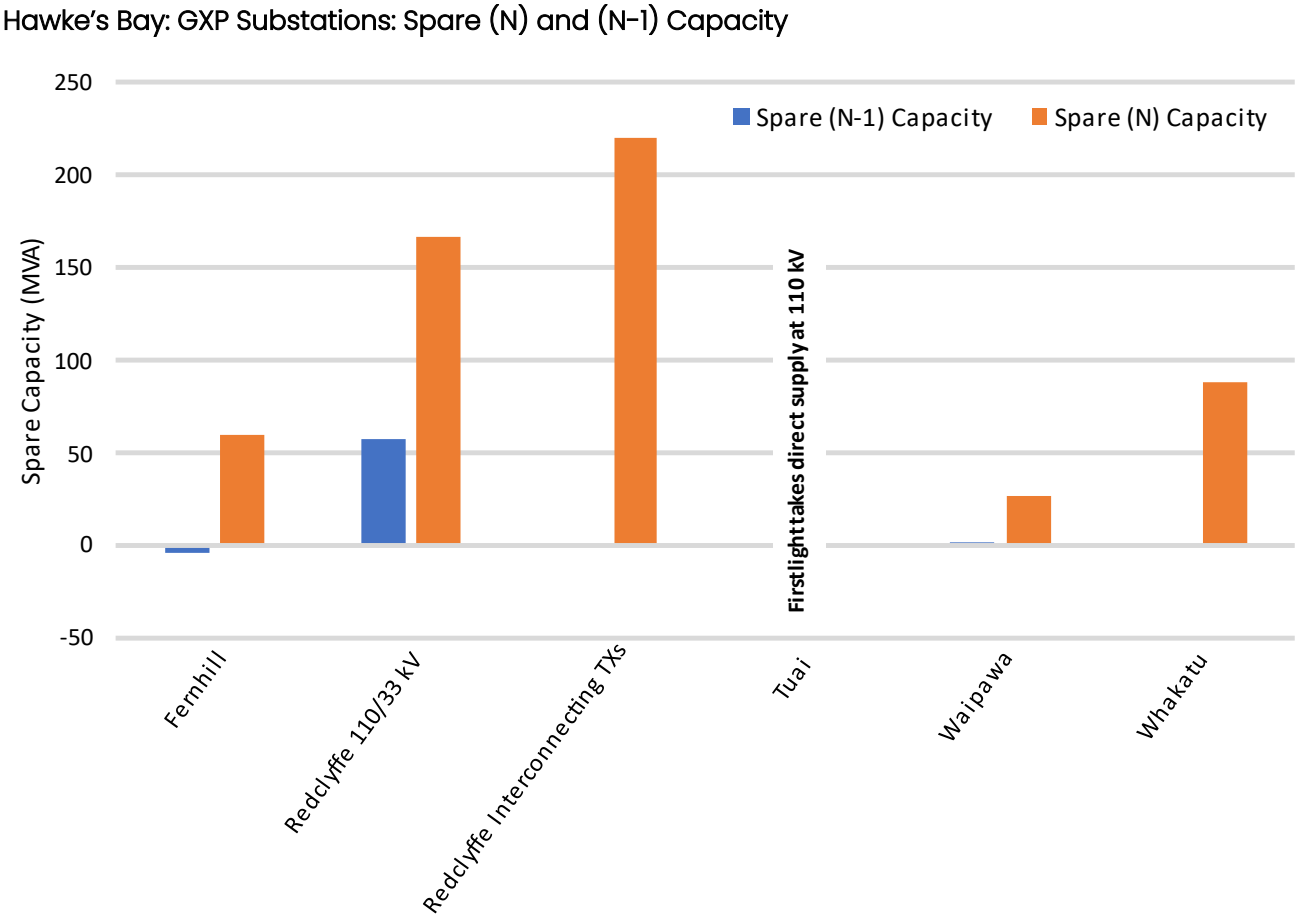


Figure 1. Summary: Approximate N and N-1 spare capacity at GXP substations.

The following Figure 2, Figure 3, Figure 4 illustrate the (N) and (N-1) spare capacity at the three EDBs (Centralines, Firstlight, and Unison respectively) zone substations in the Hawke's Bay region. These figures are based on the maximum loadings and the EDBs' 2023 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

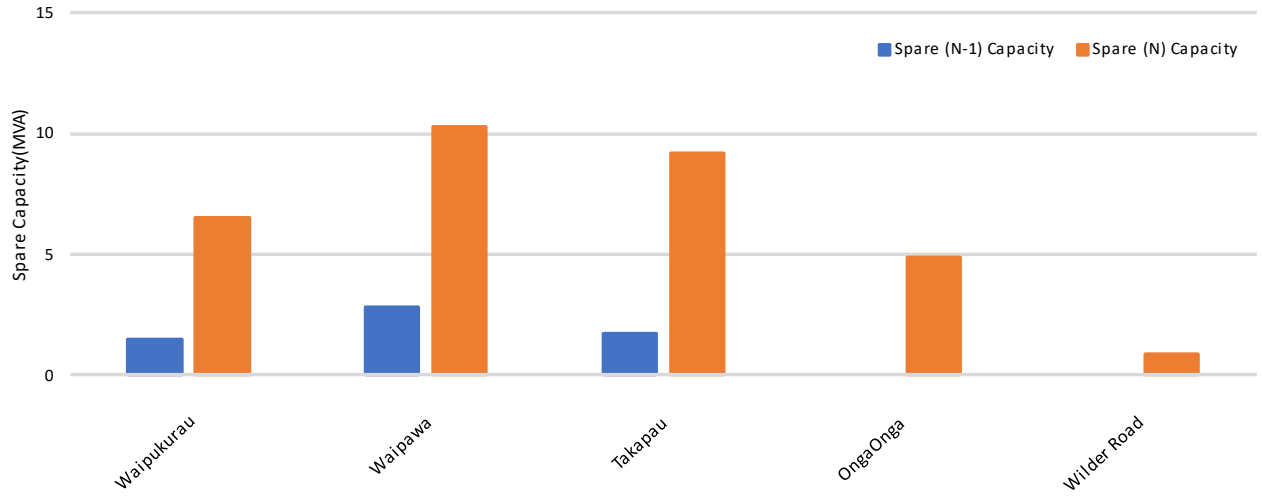


Figure 2. Summary: Approximate (N) and (N-1) spare capacity at Centralines' zone substations.

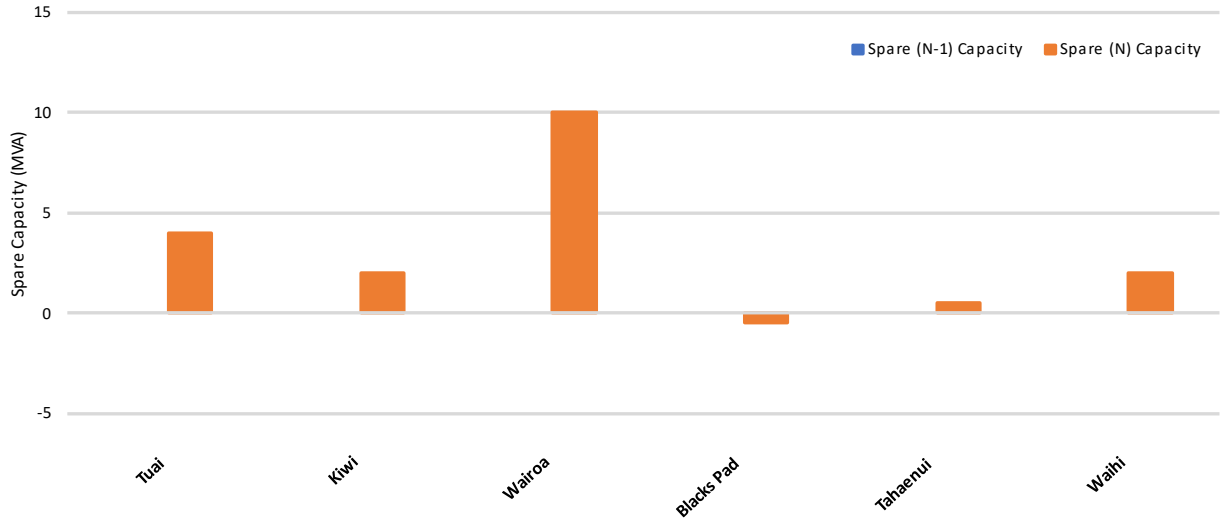


Figure 3. Summary: Approximate (N) and (N-1) spare capacity at Firstlight's zone substations.

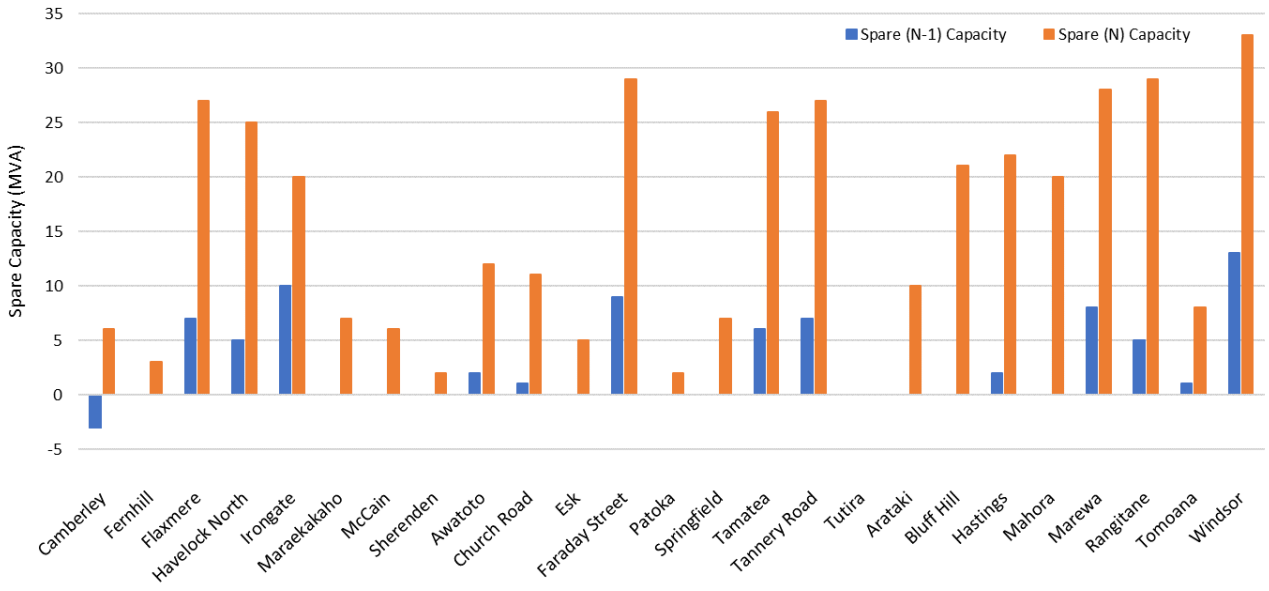


Figure 4. Summary: Approximate (N) and (N-1) spare capacity at Unison's zone substations.

1.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 23163-RPT-004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Fernhill GXP* – Supplies Hastings township, and the surrounding agricultural areas, resulting in the dominant load being residential with some commercial, industrial, and agricultural loads. Load peaks in late summer/early spring due to high irrigation and cold storage demand. Daily load has typical morning and evening peaks in winter, and is more flat during summer, which is again likely due to irrigation loads.
- *Redclyffe GXP* – Load is dominated by that of Napier township, resulting in a mix of residential, commercial, and industrial loads, with some agricultural. The GXP is winter peaking with typical daily morning and evening peaks (though again with a flatter daily profile over summer). The winter peak is offset slightly by increased generation at the nearby Esk Hydro Power Scheme.
- *Tuai GXP* – Supplies Gisborne and Wairoa townships as well as a number of small townships and low density rural areas, resulting in a mix of residential, commercial, agricultural, and industrial loads. Load peaks during winter, though the net load is influenced greatly by the nearby Tuai hydro generation.
- *Waipawa GXP* – Supplies a number of small townships and the surrounding agricultural region, being a mix of agricultural, industrial, residential, and commercial. Summer peaking, which is driven by irrigation loads. Daily load has typical morning and evening peaks.
- *Whakatu GXP* – Supplies Hastings township, resulting in the dominant load being residential with some commercial, industrial, and agricultural loads. Winter peaking. Daily load is reasonably flat in summer however has typical morning and evening peaks in winter.

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 ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
HB23	Russell Asphalt	5.82	Fernhill	$9.00	McCain	$5.60	$14.60	$2.51	Major	1, 2
HB6	Webster's Hydrated Lime Company Havelock North	5.15	Fernhill	$9.00	Havelock North	$12.46	$21.46	$4.16	Major	1, 2
HB24	McCain Foods Hastings	4.09	Fernhill	$9.00	McCain	$0.82	$9.82	$2.40	Major	1, 2
HB10	Hawke's Bay Fallen Soldiers Memorial Hospital	3.47	Fernhill	$9.00	Camberley	$0.28	$9.28	$2.68	Major	1, 2
HB21	Profruit (2006) Limited Hastings	1.54	Fernhill	$9.00	McCain	$5.18	$14.18	$9.21	Major	1, 2
HB33	Hawke's Bay Regional Prison	1.14	Fernhill	$9.00	Irongate	$0.39	$9.39	$8.24	Major	1, 2
HB28	Tumu Timbers Limited	0.73	Fernhill	$0.00	Irongate	$0.00	$0.00	$0.00	Minor	1
HB34	Humes Hastings	0.45	Fernhill	$0.00	Fernhill	$0.00	$0.00	$0.00	Minor	1
HB35	Progressive Meats Limited Hastings	0.19	Fernhill	$0.00	Camberley	$0.00	$0.00	$0.00	Minor	1
HB14	Havelock North Village Pool	0.07	Fernhill	$0.00	Havelock North	$0.00	$0.00	$0.00	Minor	1
HB19	Hawke's Bay Protein	3.89	Redclyffe	$0.00	Awatoto	$4.26	$4.26	$1.10	Moderate	1, 2
HB1	WoolWorks Awatoto	3.24	Redclyffe	$0.00	Awatoto	$4.47	$4.47	$1.38	Moderate	1, 2
HB30	Higgins Napier	0.90	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB4	Bremworth Napier	0.89	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB29	Fresh Meats NZ Limited Napier	0.63	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB37	Eastern Institute of Technology Hawke's Bay Campus	0.39	Redclyffe	$0.00	Springfield	$0.00	$0.00	$0.00	Minor	1
HB25	AFFCO Napier	0.28	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB11	Napier Health Centre	0.26	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB42	ZIWI Limited Napier	0.25	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB40	Oceania Healthcare Atawhai	0.09	Redclyffe	$0.00	Springfield	$0.00	$0.00	$0.00	Minor	1
HB12	Wairoa Hospital	0.66	Tuai	$0.00	Kiwi	$0.00	$0.00	$0.00	Minor	1
HB8	Silver Fern Farms Takapau	2.56	Waipawa	$7.00	Takapau	$10.17	$17.17	$6.70	Major	1, 2
HB45	Ovation & Pasture Petfoods - Stage 1	5.50	Waipawa	$7.00	Waipukurau	$3.80	$10.80	$1.96	Major	1, 2
	Ovation & Pasture Petfoods - Stage 2	1.50	Waipawa	$0.00	Waipukurau	$1.00	$1.00	$0.67	Minor	1, 2
HB41	Pukeora Estate Limited Waipukurau	0.38	Waipawa	$0.00	Waipukurau	$0.00	$0.00	$0.00	Minor	1
HB36	Central Hawke's Bay College	0.20	Waipawa	$0.00	Waipukurau	$0.00	$0.00	$0.00	Minor	1
HB16	Heinz Watties Limited King St (N) Stage 1	11.00	Whakatu	$0.00	Mahora	$2.72	$2.72	$0.25	Minor	1, 3
	Heinz Watties Limited King St (N) Stage 2	13.17	Whakatu	$0.50	Mahora	$6.80	$7.30	$0.55	Moderate	1, 3
	Heinz Watties Limited King St (N-1) Stage 1	11.00	Whakatu	$9.00	Mahora	$7.32	$16.32	$1.48	Major	1, 3
	Heinz Watties Limited King St (N-1) Stage 2	13.17	Whakatu	$0.25	Mahora	$11.60	$11.85	$0.90	Major	1, 3
HB9	Cedenco Foods Fresh Fields	10.00	Whakatu	$9.00	Tomoana	$4.40	$13.40	$1.34	Major	1, 2
HB18	Heinz Watties Limited Tomoana	5.64	Whakatu	$9.00	Tomoana	$3.96	$12.96	$2.30	Major	1, 2
HB44	Diamond Apparelmaster	4.09	Whakatu	$9.00	Rangitane	$0.64	$9.64	$2.36	Major	1, 2
HB31	Higgins Port of Napier	4.02	Whakatu	$9.00	Bluff Hill	$2.02	$11.02	$2.74	Major	1, 2
HB22	Lowe Corporation Hastings Tannery	3.73	Whakatu	$9.00	Tomoana	$4.26	$13.26	$3.56	Major	1, 2
HB5	Hawk Group	3.64	Whakatu	$9.00	Rangitane	$0.82	$9.82	$2.70	Major	1, 2
HB7	Silver Fern Farms Pacific	1.70	Whakatu	$9.00	Rangitane	$0.88	$9.88	$5.81	Major	1, 2
HB2	WoolWorks Clive	2.46	Whakatu	$9.00	Rangitane	$1.24	$10.24	$4.17	Major	1, 2
HB46	Progressive Leathers Limited	2.20	Whakatu	$9.00	Rangitane	$0.28	$9.28	$4.22	Major	1, 2
HB27	Liqueo Bulk Storage Port of Napier	0.28	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB32	William Colenso College	0.22	Whakatu	$0.00	Marewa	$0.00	$0.00	$0.00	Minor	1
HB13	Splash Planet	0.14	Whakatu	$0.00	Windsor	$0.00	$0.00	$0.00	Minor	1
HB38	Oceania Healthcare Gracelands	0.13	Whakatu	$0.00	Mahora	$0.00	$0.00	$0.00	Minor	1
HB26	MTG Hawke's Bay	0.11	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB39	Oceania Healthcare Eversley	0.07	Whakatu	$0.00	Mahora	$0.00	$0.00	$0.00	Minor	1
HB3	Scenic Hotel Te Pania	0.07	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB15	Clive War Memorial Pool	0.02	Whakatu	$0.00	Rangitane	$0.00	$0.00	$0.00	Minor	1
	TOTAL =>	131.14	TOTAL =>	$158.75	TOTAL =>	$95.36	$254.11			

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 (N-1) scenario cost shown

3 (N-1) scenario cost included in totals only

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 Hawke's Bay region are supplied with electricity via electrical networks that are owned by the following EDBs:

- Centralines Ltd - 5 zone substations
- Firstlight Network – 6 zone substations
- Unison Networks Ltd (Hawke's Bay area only) – 25 zone substations

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

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called 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, and seeks to identify the barriers involved and opportunities available.

As part of the RETA program, EECA contracted Ergo to determine the existing spare supply capacity and the load characteristics at the major electrical substations within the Hawke's Bay region.

Ergo previously developed similar reports for the South Island (separated into several regions), Northland, and Bay of Plenty regions.

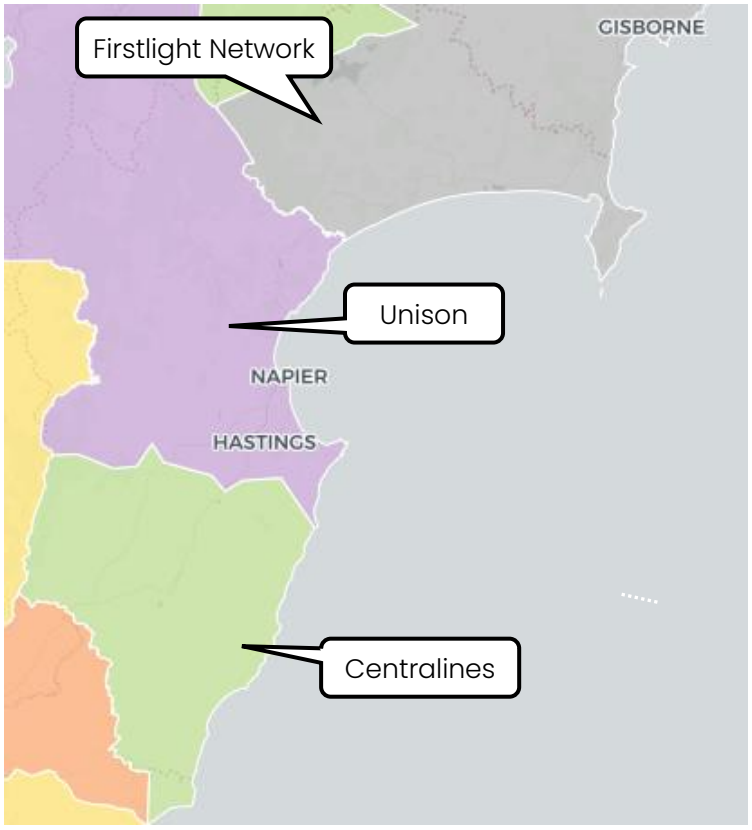


Figure 5. EDB franchise areas[4]

[3] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

[4] ENA Lines Company Map: 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) and (N-1) security) and supply characteristics (peak and average supply and seasonality information) for the major electrical infrastructure in the Hawke's Bay region. This included reviewing both the GXP's and local distribution zone substations along with their associated lines/cables within the Hawke's Bay region.

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

- Transpower's *Transmission Planning Report 2023* (TPR).
- Centralines' 2023 regulatory information disclosures[5] and *Asset Management Plan* (AMP).
- Firstlight's 2023 regulatory information disclosures[6] and AMP.
- Unison's 2023 regulatory information disclosures[7] and AMP.
- SCADA substation loading data provided by Unison.
- GXP metering data extracted from the Electricity Authority's website[8].
- Network diagrams provided by Centralines, Firstlight, and Unison.
- Geographic Information System (GIS) asset and location data provided by Centralines, Firstlight, and Unison.

[5] https://www.centralines.co.nz/tell-me-about/about-us/publications-disclosures/
[6] https://www.firstlightnetwork.co.nz/tell-me-about/firstlight-network/regulatory-information/
[7] https://www.unison.co.nz/tell-me-about/unison-group/publications-disclosures/
[8] https://www.emi.ea.govt.nz/Wholesale/Datasets

4. Hawke's Bay Network

The following sections describe (at a high level), the locations of the relevant substations and lines. For the purposes of this document the franchise areas defined above and supplied by Centralines, Firstlight, and Unison, are referred to as the Hawke's Bay region.

4.1 Transmission/GXP Substations

The following Figure 6 illustrates the relevant transmission substations (GXPs) within the Hawke's Bay region, which include the following:

- Centralines:
    - Waipawa GXP.
- Firstlight:
    - Tuai GXP.
- Unison:
    - Fernhill GXP.
    - Redclyffe GXP.
    - Whakatu GXP.

Additionally, there are a number of large generation plants connected to Hawke's Bay's electricity supply system at present, which connect at dedicated GIPs (Grid Injection Points), or at the GXPs listed above. These include:

- Tauhara (geothermal generation) (225 MW) – dedicated GIP
- Harapaki (geothermal generation) (176 MW) – dedicated GIP
- Whirinaki (gas generation) (156 MW) – dedicated GIP
- Pan Pac (cogeneration) (13 MW) – connects at the same dedicated GIP as Whirinaki
- Waikaremoana hydro generation scheme – connects at Tuai GXP:
    - Tuai (60 MW)
    - Kaitawa (36 MW)
    - Piripaua (44 MW)
- ESK (hydro generation) (4 MW) – connects at Redclyffe GXP
- Gisborne, Matawai, and Waihi (hydro generation) (5, 2, and 5 MW respectively) – connects at Tuai GXP

The transmission network in the Hawke's Bay region is also shown schematically in Figure 7. As generation capacity in the Hawke's Bay region is lower than its maximum demand, the deficit is imported through the National Grid during peak load conditions.
The region connects to the national grid through two 220 kV circuits which run north-west from Redclyffe to Wairakei with interconnecting 220/110 kV transformers located at Redclyffe.
Two additional 110 kV circuits run south from Waipawa to Dannevirke, however these are normally not utilised (disconnectors on the lines between Fernhill and Waipawa are usually open).

February 2023's Cyclone Gabrielle caused considerable flooding and infrastructure in the region, with some substations becoming completely submerged. Transpower is restoring the region to its previous configuration (which is that shown in this report and the TPR) and investigating improvements which could be made to the region's resilience, particularly at Redclyffe. Transpower's investigations in the TPR assume that the region is restored to its previous configuration, with this report aligning with the TPR view of the transmission network for consistency.
Ergo understands that Unison is likewise underway with restoration works in the region, which are considered to have a minimal impact on the analysis in this report.

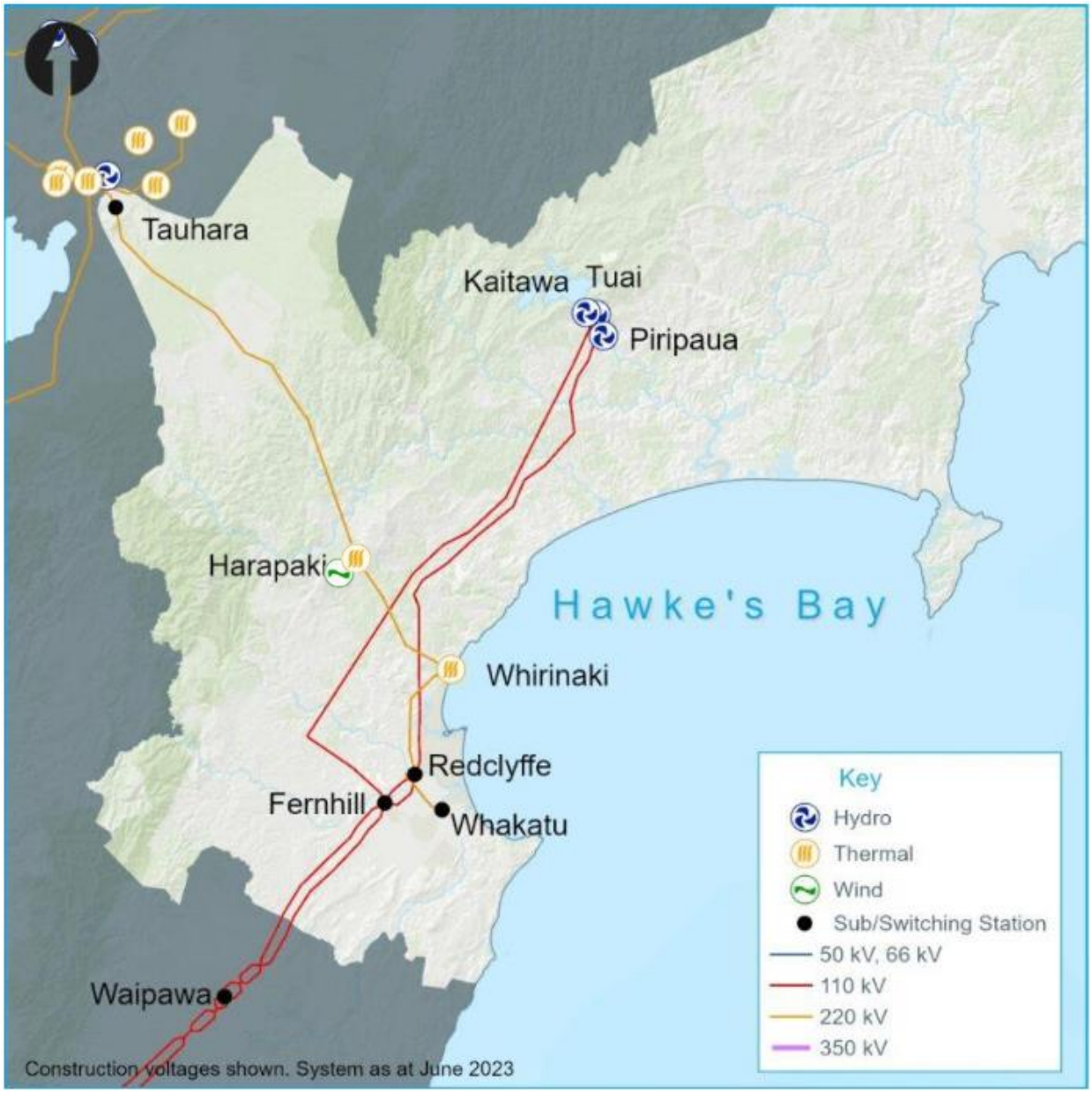


Figure 6. Transmission/GXP substations[9]

[9] *Transmission Planning Report 2023*.

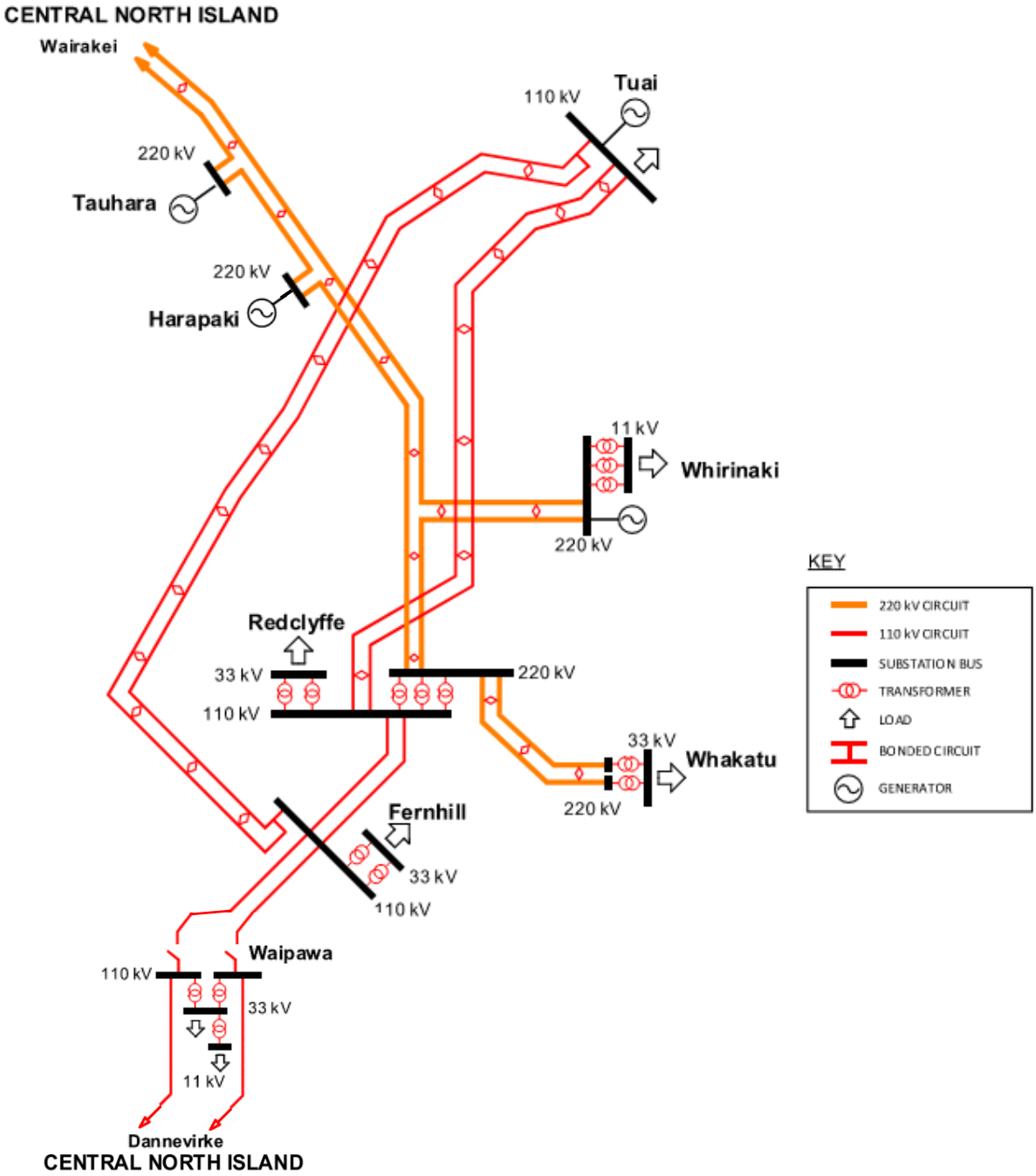


Figure 7. Existing transmission/GXP substations[9]

4.2 Zone Substations

Zone substations are categorised by the EDB that owns and operates the network. As mentioned earlier, in the Hawke's Bay area, there are three relevant EDB's – Centralines, Firstlight, and Unison. Table 2 below gives an overview of the number of zone substations managed by each EDB, and the number of Transpower GXPs they take power from.

Table 2. Overview of substation numbers for each EDB under review.

EDB Name	Number of zone substations	Number of GXPs
Centralines	5	1
Firstlight	6	1
Unison (Hawke's Bay area)	25	3

4.2.1 Centralines

The following Figure 8 shows the subtransmission network, zone substations, and GXPs in Centralines' region. The substations include:

- Waipawa GXP:
    - Waipukurau 33/11 kV zone substation
    - Waipawa 33/11 kV zone substation
    - Takapau 33/11 kV zone substation
    - OngaOnga 33/11 kV zone substation
    - Wilder Road 33/11 kV zone substation

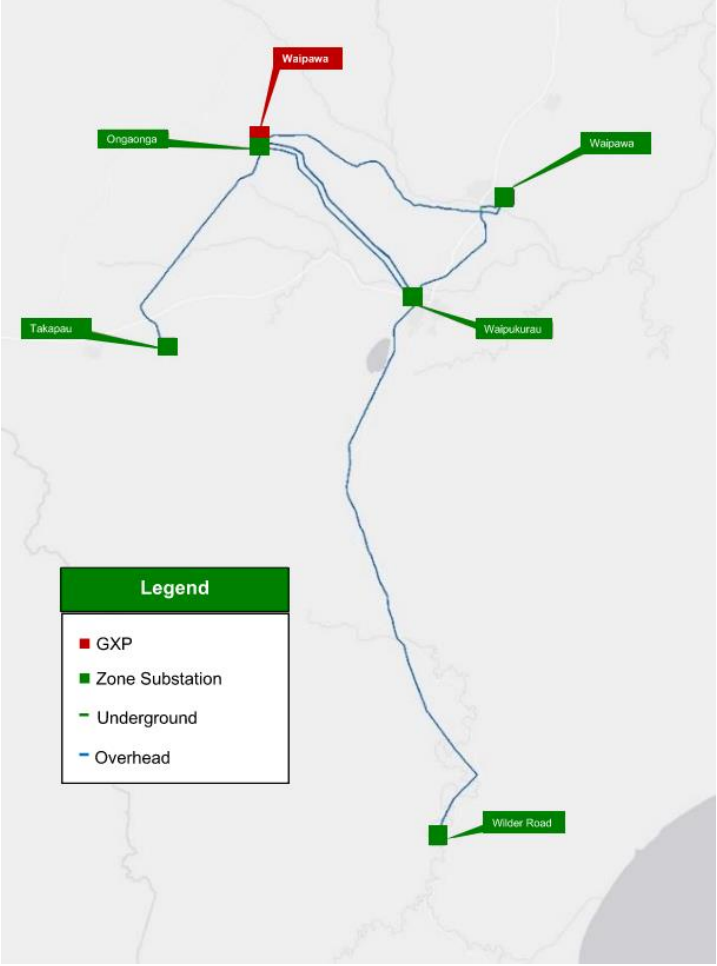


Figure 8. Centralines zone substations and interconnecting subtransmission circuits [10]

4.2.2 Firstlight

The following Figure 9 shows the subtransmission network, zone substations (locations but not names), and GXPs for the relevant section of Firstlight's network. The substations include:

- Tuai GXP:
    - Tuai 33/11 kV zone substation
    - Kiwi 33/11 kV zone substation
    - Wairoa 33/11 kV zone substation
    - Blacks Pad 33/11 kV zone substation
    - Tahaenui 33/11 kV zone substation
    - Waihi 33/11 kV zone substation

[10] Centralines' 2023 Asset Management Plan found here: https://www.unison.co.nz/tell-me-about/unison-group/publications-disclosures/asset-management-plan/

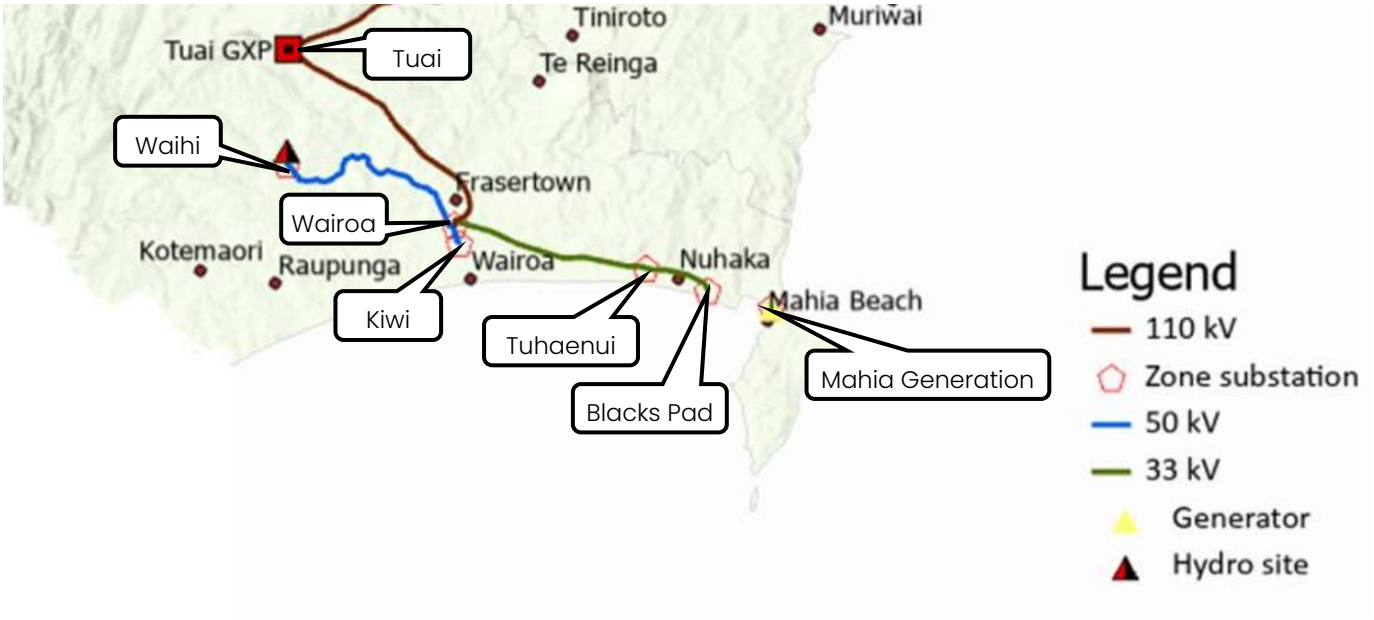


Figure 9. Firstlight zone substations and interconnecting subtransmission circuits in the Hawke's Bay region [11]

4.2.3 Unison

The following Figure 10 shows the subtransmission network, zone substations, and GXPs for Unison's Hawke's Bay region. The substations include:

- Fernhill GXP:
    - Camberley 33/11 kV zone substation
    - Fernhill 33/11 kV zone substation
    - Flaxmere 33/11 kV zone substation
    - Havelock North 33/11 kV zone substation
    - Irongate 33/11 kV zone substation
    - Maraekakaho 33/11 kV zone substation
    - McCain 33/11 kV zone substation
    - Sherenden 33/11 kV zone substation
- Redclyffe GXP:
    - Awatoto 33/11 kV zone substation
    - Church Road 33/11 kV zone substation
    - Esk 33/11 kV zone substation
    - Faraday Street 33/11 kV zone substation
    - Patoka 33/11 kV zone substation
    - Springfield 33/11 kV zone substation
    - Tamatea 33/11 kV zone substation
    - Tannery Road 33/11 kV zone substation
    - Tutira 33/11 kV zone substation

[11] Firstlight's 2023 Asset Management Plan found here: https://www.firstlightnetwork.co.nz/tell-me-about/firstlight-network/regulatory-information/

- Whakatu GXP:
    - Arataki 33/11 kV zone substation
    - Bluff Hill 33/11 kV zone substation
    - Hastings 33/11 kV zone substation
    - Mahora 33/11 kV zone substation
    - Marewa 33/11 kV zone substation
    - Rangitane 33/11 kV zone substation
    - Tomoana 33/11 kV zone substation
    - Windsor 33/11 kV zone substation

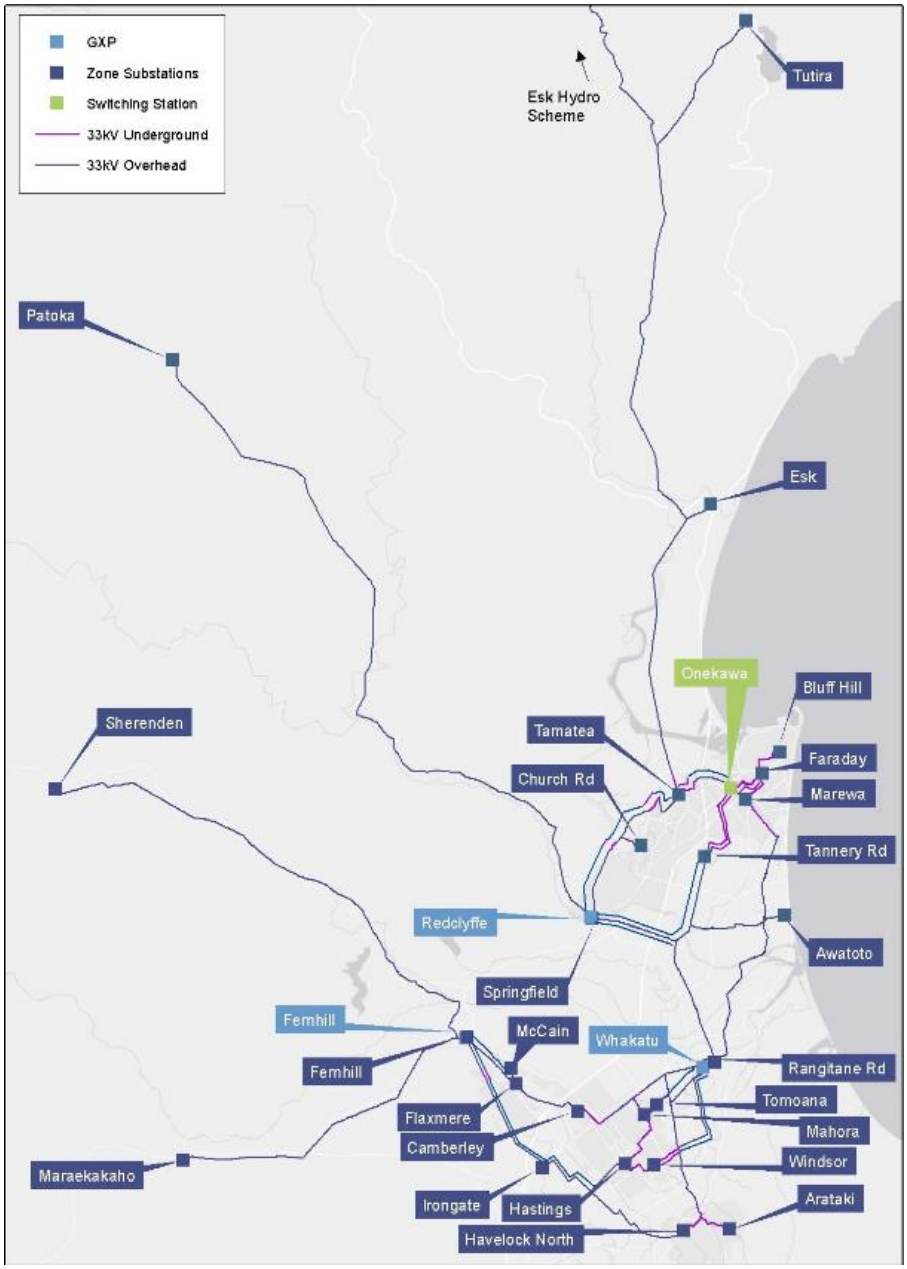


Figure 10. Unison's Hawke's Bay region zone substations and interconnecting subtransmission circuits [12]

[12] Unison's 2023 Asset Management Plan found here: https://www.unison.co.nz/tell-me-about/unison-group/publications-disclosures/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)[13]. In contrast, EDBs are required to publish an annual AMP which often details a network specific security standard, 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 asset). 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, this scenario 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 (some variation is expected across different EDBs and substations supplying different types of customer):
    - Loads ≥ 12 MW designed and operated with (N-1) security of supply.
    - Loads < 12 MW designed and operate with (N) security of supply.

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

For Transpower 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 GXPs discussed in this report are considered connection assets and therefore decisions around their security classifications lie with their end customers (i.e., Centralines, Firstlight, or Unison). For those substations that are supplied via dedicated incoming lines, the lines are also

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

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 boards 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. More recently, the development of a market for interruptible/dispatchable load[14] has been initiated. 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 disconnect from the relevant electrical network during periods of peak loading.

[14] Demand side participation | Transpower

6. Spare Capacity – Transmission Substations (GXPs)

The following sub-sections document the spare capacity that is available at the GXP's that supply the Hawke's Bay region.

Transpower has identified the following "*(N-1) security issues*" that result from increasing electrical demand and generation in the Hawke's Bay region including:

- During periods of high load and low Waikaremoana generation, an outage of either of the 220/110 kV interconnecting transformers at Redclyffe would overload the remaining online interconnecting transformer. Similarly, an outage of one of the 110 kV Fernhill-Redclyffe circuits would overload the other circuit which remains online.
- Loading on the 220/110 kV interconnecting transformers at Redclyffe was expected to exceed their (N-1) capacity by ~79 MW in 2023.
- Loss of a 220 kV circuit into Redclyffe during periods of high load and low Waikaremoana generation results in a large voltage step that is experienced throughout the region, together with low network voltages particularly at the Fernhill supply bus.
- One trigger for a low generation case (risks above) is the loss of a 110 kV bus section at Tuai which disconnects four generators plus the Redclyffe-Tuai 1 & 2 circuits.
- Typically, the Waikaremoana generation is constrained on to manage some of the system constraints (particularly those discussed above). However, during a dry period this is not plausible..
- Connection of new generation at Fernhill or along the Fernhill-Waipawa circuits may also overload the 110 kV Fernhill-Redclyffe circuits.
- Peak load at Fernhill is expected to exceed the (N-1) rating of the transformers from 2023. Similarly, peak load at Whakatu already exceeds the (N-1) winter capacity of the transformers.
- The two 220 kV Wairakei to Whirinaki circuits which supply the region are strung on the same structures over harsh terrain. These lines are also particularly exposed to the elements in some sections. This makes the lines susceptible to a double circuit outage and loss of supply to Hawkes Bay due to, e.g. ice unloading or lightning.
- In the case of a Waipawa-Dannevirke-Woodville single circuit outage, voltage changes larger than 5% may occur. Low 33 kV voltages in this scenario also limit the load at Waipawa. The transformers at Waipawa have off-load tap changers, so they cannot be used to manage post-contingent voltages.

Figure 11 below illustrates Transpower's view of a possible 2038 configuration for the Hawke's Bay region's transmission network. It includes:

- Replacement of the 33 kV bus and 110/33 kV transformers at Waipawa GXP.
- Upgrades of the 11 kV bus at Whirinaki GXP/GIP.
- Upgrade of the 220 kV bus and installation of a third 220/110 kV interconnecting transformer at Redclyffe GXP.
- Upgrade of the 220/33 kV transformers at Whakatu.
- Installation of a new 110/33 kV transformer at Fernhill.
- Upgrades of the 110 kV Fernhill-Tuai lines (which are presently connected at either end and operated as one "line", the upgrades will make it so that these lines are operated as two separate lines).
- Commissioning of a new generator at Harapaki GIP (it is noted that this generator is now commissioned and generating).

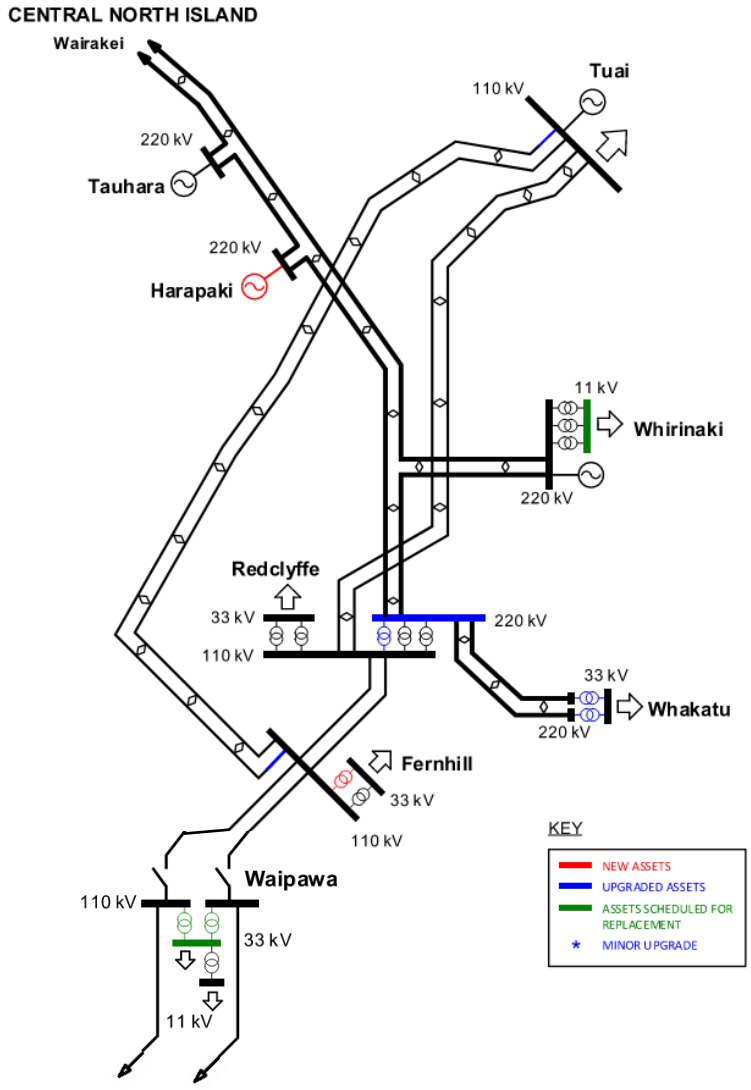


Figure 11. Existing transmission/GXP substations together with future possible upgraded/new assets[15]

6.1 Demand Forecast

The following Table 3 illustrates Transpower's forecast demand at the transmission substations in the Hawke's Bay region from its annual *Transmission Planning Report 2023*[16]. The forecast predicts the demand growing at an average of 1.1% per annum over the next fifteen years which is lower than the national average of 2.0%.

Table 3. Forecast prudent annual peak demand (MW) at Hawke's Bay grid exit points to 2038.

GXP	Power factor	Peak demand (MW)											
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2038
Fernhill	0.99	77	80	85	88	91	92	93	94	95	96	97	98
Redclyffe	1.00	78	80	82	84	86	87	87	88	89	90	91	91
Tuai[1]	-0.96	67	68	70	72	74	77	79	80	84	86	88	95
Waipawa	0.99	26	26	27	27	28	29	30	30	31	31	32	34
Whakatu	0.98	117	120	124	125	127	128	129	130	131	132	134	135

Notes:

1. Leading power factor

[15] Transmission Planning Report 2023

[16] Transmission Planning Report 2023

6.1.1 Fernhill GXP

Transpower's demand forecast indicates that the Fernhill GXP was expected to have a 2023 peak demand of 77 MW at 0.99 power factor (77.8 MVA). This contrasts with the historical SCADA data that indicates that, in 2023 the Fernhill GXP experienced a peak load of 70.3 MVA. Ergo suspects that the 2023 peak load was impacted by the Hawke's Bay flood events which occurred in early 2023.

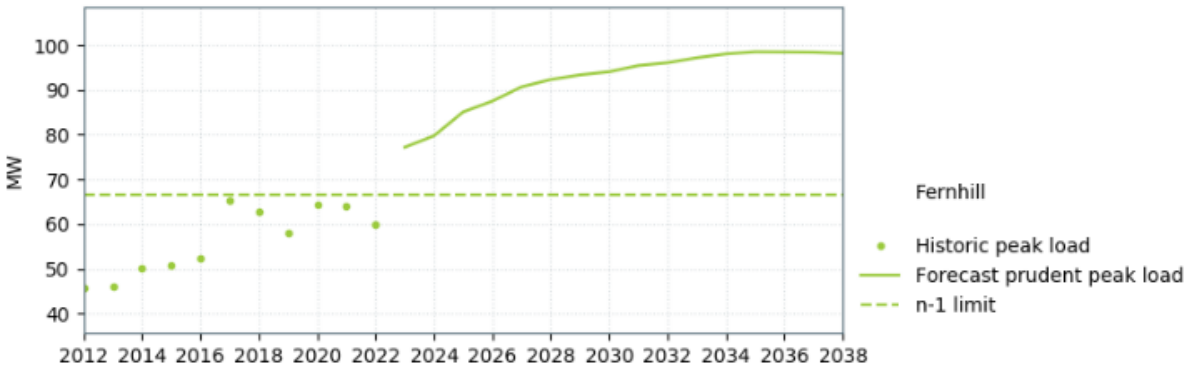
The Fernhill GXP is equipped with two 110/33 kV transformers (rated at 80 MVA and 50 MVA) providing:

- (N) secure capacity of 130 MVA and
- (N-1) capacity of 66.6 MVA.

Fernhill is part of an 110 kV ring with Redclyffe and Tuai. In this loop, the two Tuai-Redclyffe circuits are rated to 57/70 MVA (summer/winter), the single Tuai-Fernhill circuit is rated to 101/123 MVA (summer/winter), and the two Fernhill-Redclyffe circuits are rated to 51/62 MVA (summer/winter). Fernhill is supplied from Tuai by the connected generation, and also from Redclyffe via the interconnecting transformers (import from the rest of the North Island grid). If one of the Fernhill-Redclyffe circuits is lost during a period of low Waikaremoana generation and high load, the remaining Fernhill-Redclyffe circuit would be overloaded. At present, this issue is managed by constraining on Waikaremoana generation, however this generation is not always available (e.g. in a dry period). Alternatively, load may be shifted within Unison's network from the 110 kV supply to a 220 kV supply to reduce line loading.

Transpower is investigating possible options to mitigate this line capacity constraint. In the short term, a special protection scheme (SPS) may be used to manage post-contingency loads (at a cost of $0.5M), while in the longer term the Fernhill-Redclyffe lines may be reconductored to thermally upgrade them (at a cost of $17M).

The peak load was forecast to exceed the (N-1) capacity of the transformers from 2023. In the short-term, this is being managed by load shifting within Unison's network following a transformer outage, with no upgrades to the transformers planned at present (to be customer-driven). The following graph[17] compares Fernhill GXP's supply capacity with the historical loading and Transpower's demand forecast.



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.

[17] Sourced from Transpower's *Transmission Planning Report 2023*.

The following Figure 12 illustrates Fernhill's 2023 loading in comparison to its substation capacity.

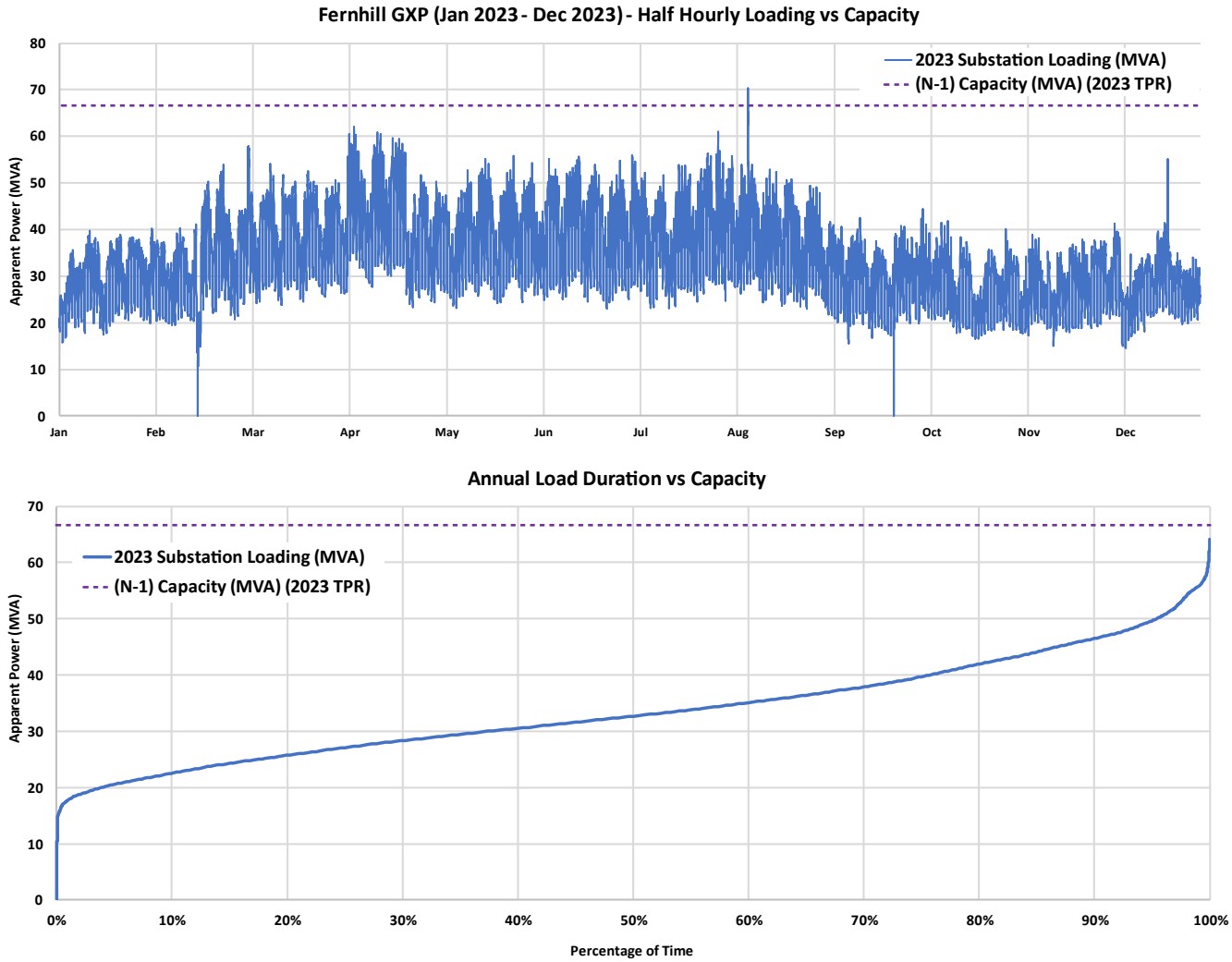


Figure 12. Fernhill GXP: 2023 Loading: Substation capacity

6.1.2 Redclyffe GXP (110/33 kV)

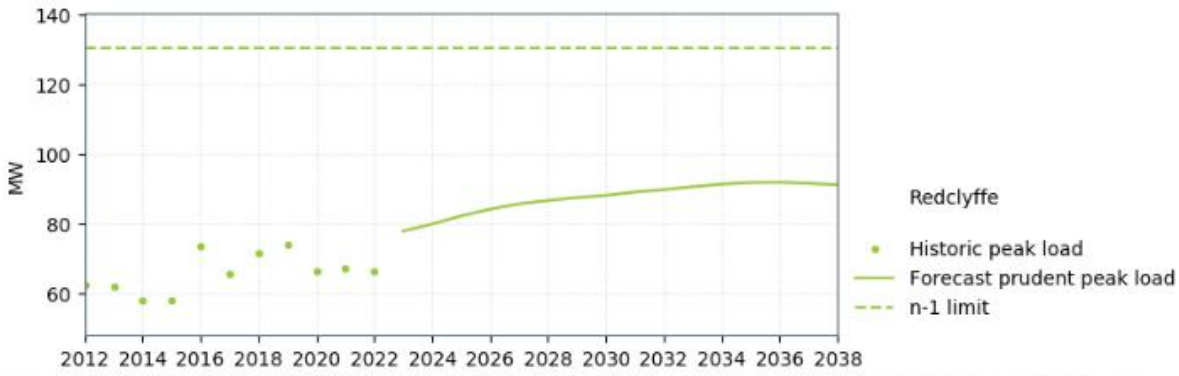
Transpower's demand forecast indicates that the Redclyffe GXP was expected to have a 2023 peak demand of 78 MW at 1.00 power factor (78 MVA). This value compares to the historical SCADA data that indicates the 33 kV supply at the Redclyffe GXP recorded a peak load of 73.1 MVA during the 2023 year.

The Redclyffe GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 240 MVA and
- (N-1) capacity of 140.8 MVA.

The transformer capacity is limited by the incoming 33 kV circuit breakers.

The peak load is not forecast to exceed the (N-1) capacity of the transformers within the planning period. The following graph[18] compares Redclyffe GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 following Figure 13 illustrates Redclyffe's 2023 loading in comparison to its substation capacity.

[18] Sourced from Transpower's *Transmission Planning Report 2023*.

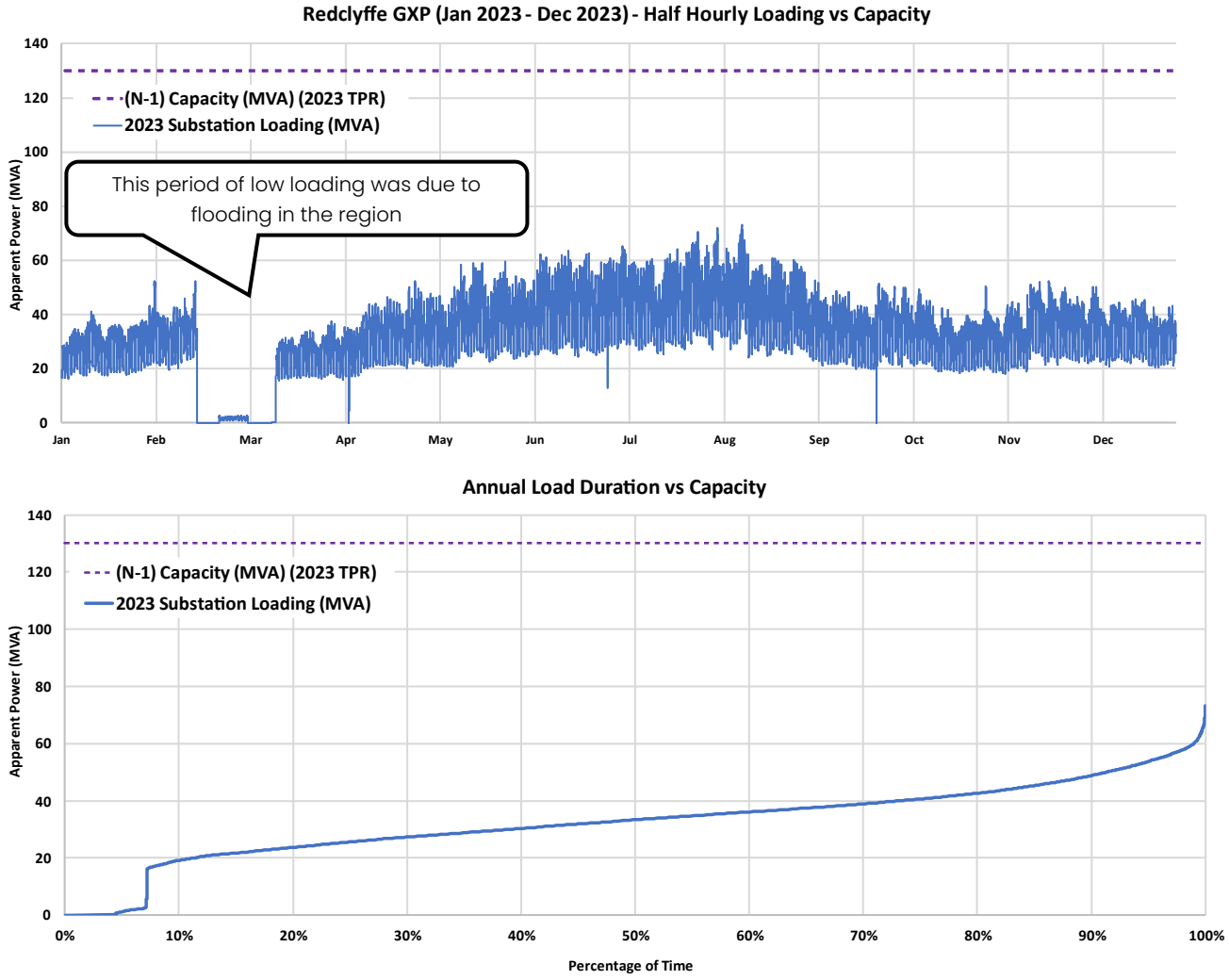


Figure 13. Redclyffe GXP: 2023 Loading, capacity, and load duration.

6.1.3 Redclyffe GXP (Interconnecting Transformers)

The Redclyffe GXP is equipped with two 220/110 kV interconnecting transformers which supply the 110 kV Hawke's Bay network (loads of Fernhill, Redclyffe, and Tuai GXPs) providing:

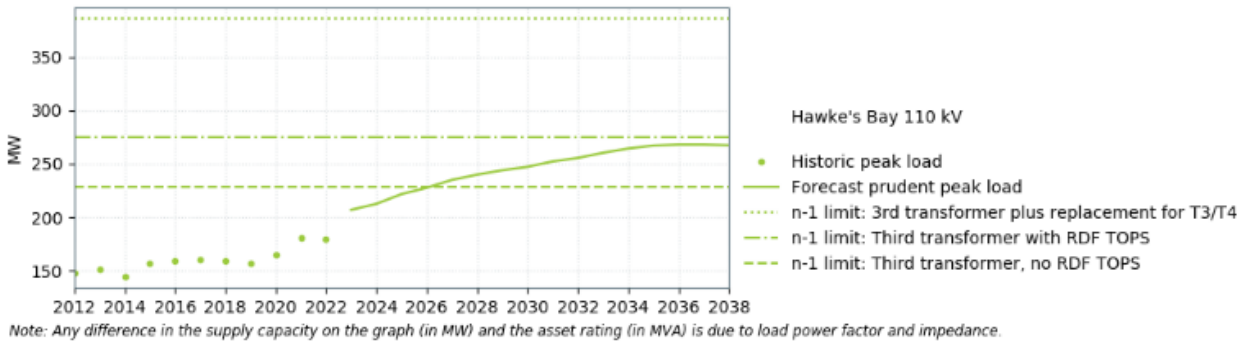
- (N) capacity of 170 MVA and
- (N-1) capacity of 104 MVA.

The two 220 kV lines from Wairakei to Redclyffe are sized at approximately 478/583 MVA each (summer/winter), well above the capacity of the interconnecting transformers.

An outage of either interconnecting transformer during periods of high load and low Waikaremoana generation will overload the remaining online interconnecting transformer. At present, a Transformer Overload Protection Scheme (TOPS, a type of special protection scheme (SPS)) helps to manage this issue, allowing pre-contingency loading up to 190 MVA and tripping the Redclyffe 33 kV load if one of the interconnecting transformers trips.

The peak load was forecast to exceed the (N-1) capacity of the transformers from winter of 2023 (this forecast includes 25 MW of Waikaremoana generation, which as discussed earlier is not able to be relied upon during dry periods). This is backed up by historical SCADA data which indicates that the Redclyffe interconnecting transformers experienced a peak load of 200.1 MVA. In the short-term, the overloading on the interconnecting transformers is managed with the TOPS, as well as by constraining on generation at Waikaremoana and/or transferring load within Unison's network from the 110 kV to the 220 kV transmission network. In the longer term, a third interconnecting transformer will be installed around 2024, with a 250 MVA capacity, which will raise the interconnecting transformer capacity to 420 MVA (N) and 200 MVA (N-1), however the TOPS scheme will still be required. Fully removing the constraint on these transformers will require a replacement of the two existing transformers with another single 250 MVA transformer. It is expected that each 250 MVA interconnecting transformer will cost ~$16M.

The following graph[19] compares Redclyffe GXP's interconnecting transformer supply capacity with the historical loading and Transpower's demand forecast (with 25 MW Waikaremoana generation and interconnecting transformer upgrades).



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.

[19] Sourced from Transpower's *Transmission Planning Report 2023*.

The following Figure 14 illustrates Redclyffe GXP's interconnecting transformer 2023 loading in comparison to their capacity.

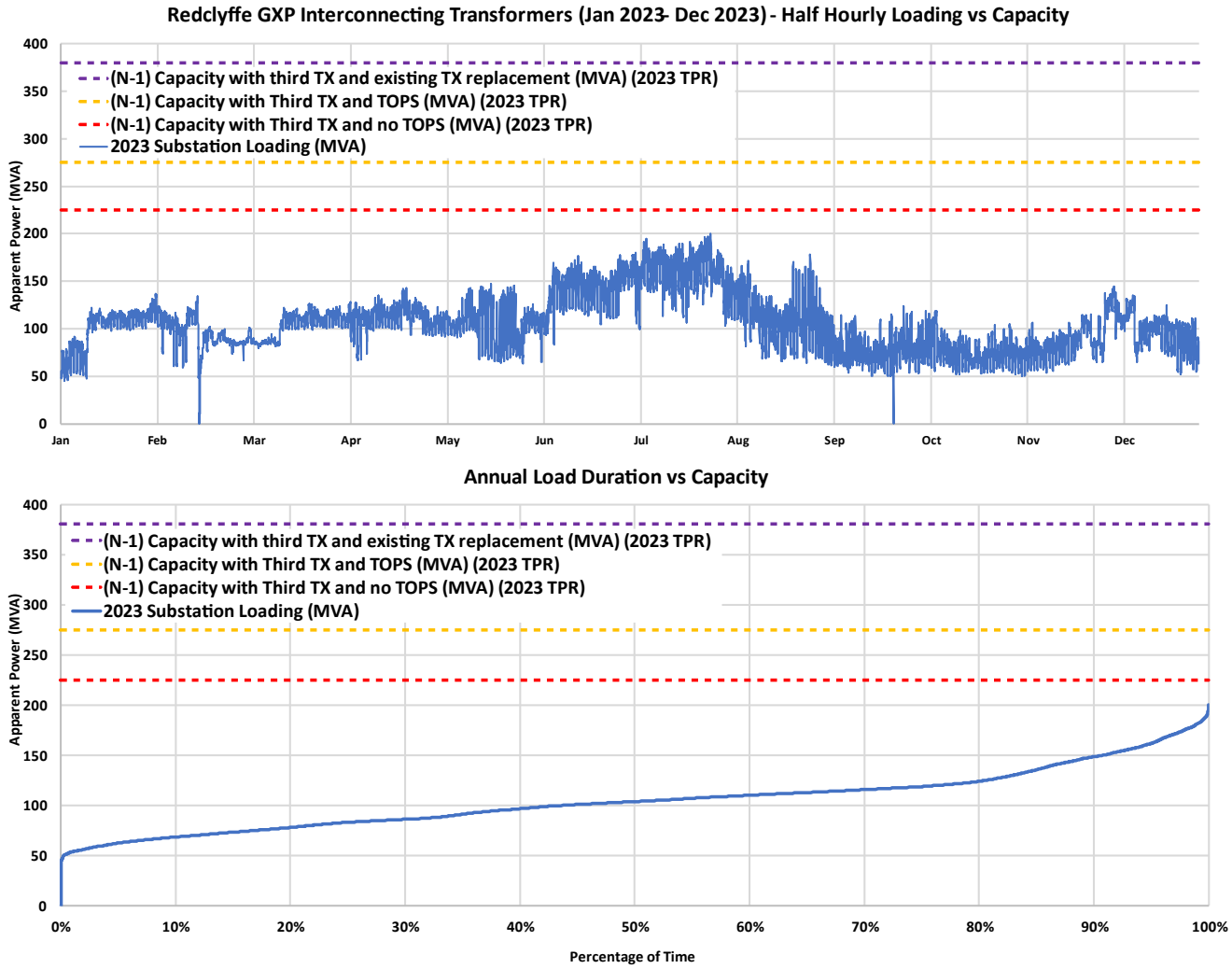


Figure 14. Redclyffe GXP Interconnecting Transformers: 2023 Loading, capacity, and load duration.

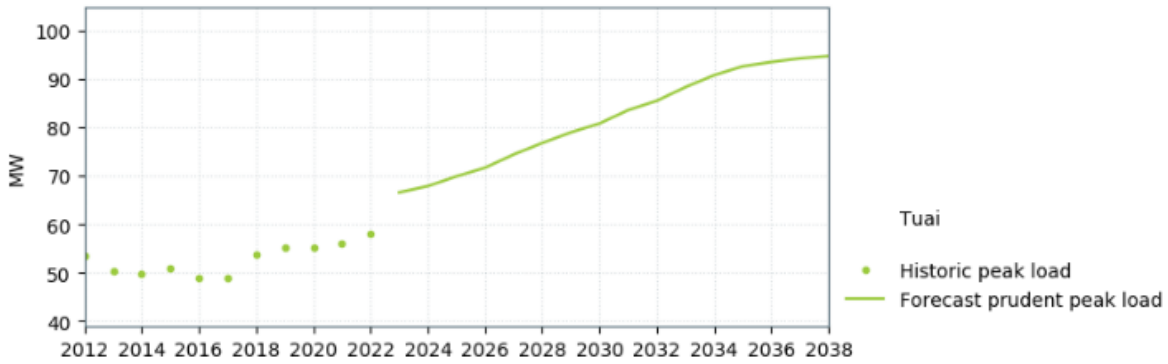
6.1.4 Tuai GXP

Transpower's demand forecast indicates that the Tuai GXP was expected to have a 2023 peak demand of 67 MW at 0.96 leading power factor (~69.8 MVA). This compares well with the historical SCADA data that indicates that during 2023 the Tuai GXP experienced a peak load of 64.9 MVA.

Firstlight takes supply directly from the 110 kV bus at Tuai and so the capacity of any transformers or Firstlight-owned lines are not reported in the TPR.

Tuai is part of an 110 kV ring with Redclyffe and Fernhill. In this loop, the two Tuai-Redclyffe circuits are rated to 57/70 MVA (summer/winter), the single Tuai-Fernhill circuit is rated to 101/123 MVA (summer/winter), and the two Fernhill-Redclyffe circuits are rated to 51/62 MVA (summer/winter). Fernhill is supplied from Tuai by the connected generation, and also from Redclyffe via the interconnecting transformers (import from the rest of the North Island grid). If one of the Fernhill-Redclyffe circuits is lost during a period of low Waikaremoana generation and high load, the remaining Fernhill-Redclyffe circuit would be overloaded. This supply issue is discussed further in Section 6.1.1.

The following graph[20] compares Tuai GXP's supply capacity with the historical loading and Transpower's demand forecast.



The following Figure 15 illustrates Tuai's 2023 loading.

[20] Sourced from Transpower's *Transmission Planning Report 2023*.

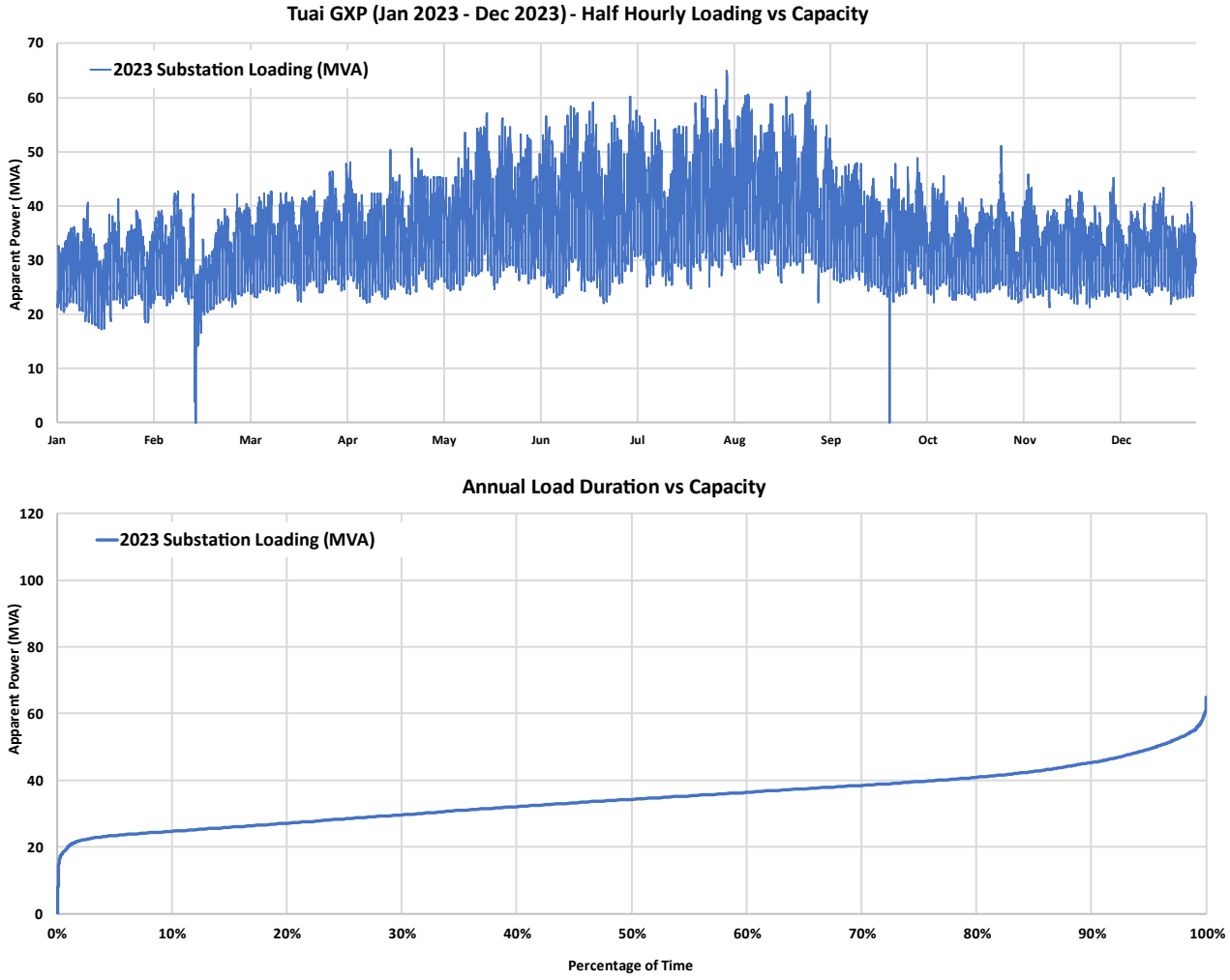


Figure 15. Tuai GXP: 2023 Loading

6.1.5 Waipawa GXP

Transpower's demand forecast indicates that the Waipawa GXP was expected to have a 2023 peak demand of 26 MW at 0.99 power factor (~26.3 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Waipawa GXP experienced a peak load of 23.6 MVA.

The Waipawa has loads connected at both 33 kV and 11 kV.

The Waipawa GXP is equipped with two 110/33 kV transformers (one rated to 30 MVA, the other 20 MVA) providing:

- (N) capacity of 50 MVA and
- (N-1) capacity of 26.2 MVA.

The two 110 kV lines which supply Waipawa from Dannevirke are rated to approximately 51/62 MVA (summer/winter) each, which is well above the installed transformer capacity.

The 110/33 kV transformer capacity is presently limited by the 33 kV protection settings. This protection limit will be removed as part of the outdoor to indoor (ODID) 33 kV bus upgrades at Waipawa in 2024-2025.

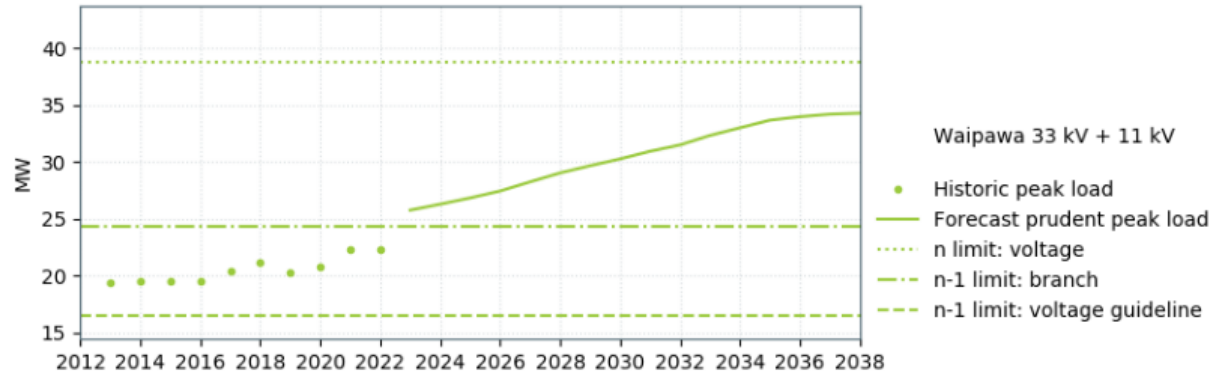
The Waipawa GXP also provides supply at 11 kV, via one 33/11 kV transformer, providing the 11 kV load with (N) security at a capacity of 10 MVA. Transpower expects that Centralines will manage the lack of (N-1) security for the 11 kV load operationally and has no plans to upgrade the 11 kV supply at this stage.

Peak load was forecast to exceed the (N-1) capacity of the transformers from winter of 2023. Peak load at Waipawa is also limited by low 33 kV bus voltage for an outage of one of the Waipawa-Dannevirke-Woodville circuits, which also causes a voltage step change greater than 5%. The Waipawa 110/33 kV transformers are equipped with off-load tap changers, so they cannot be used to manage the bus voltages in contingency conditions. The transformers at Bunnythorpe do have on-load tap changers and can assist with but not eliminate the issue. Another option to manage low voltages in this contingency scenario is to switch the 110 kV disconnectors at Waipawa to transfer Waipawa's load from the Central North Island grid zone to the Hawke's Bay grid zone.

Transpower is investigating several options to relieve the low voltage and capacity issues mentioned above, which include:

- Installation of a capacitor bank on the Waipawa 33 kV bus (cost not stated at this stage);
- Installation of a special protection scheme (SPS) to manage post-contingency load on the 110/33 kV transformers (cost of $0.5M);
- Bringing forward the replacement of one or both of the 110/33 kV transformers. The new transformer/s would have on-load tap changers (cost not stated at this stage).

The following graph[21] compares Waipawa GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 following Figure 16 illustrates Waipawa's 2023 loading in comparison to its substation capacity.

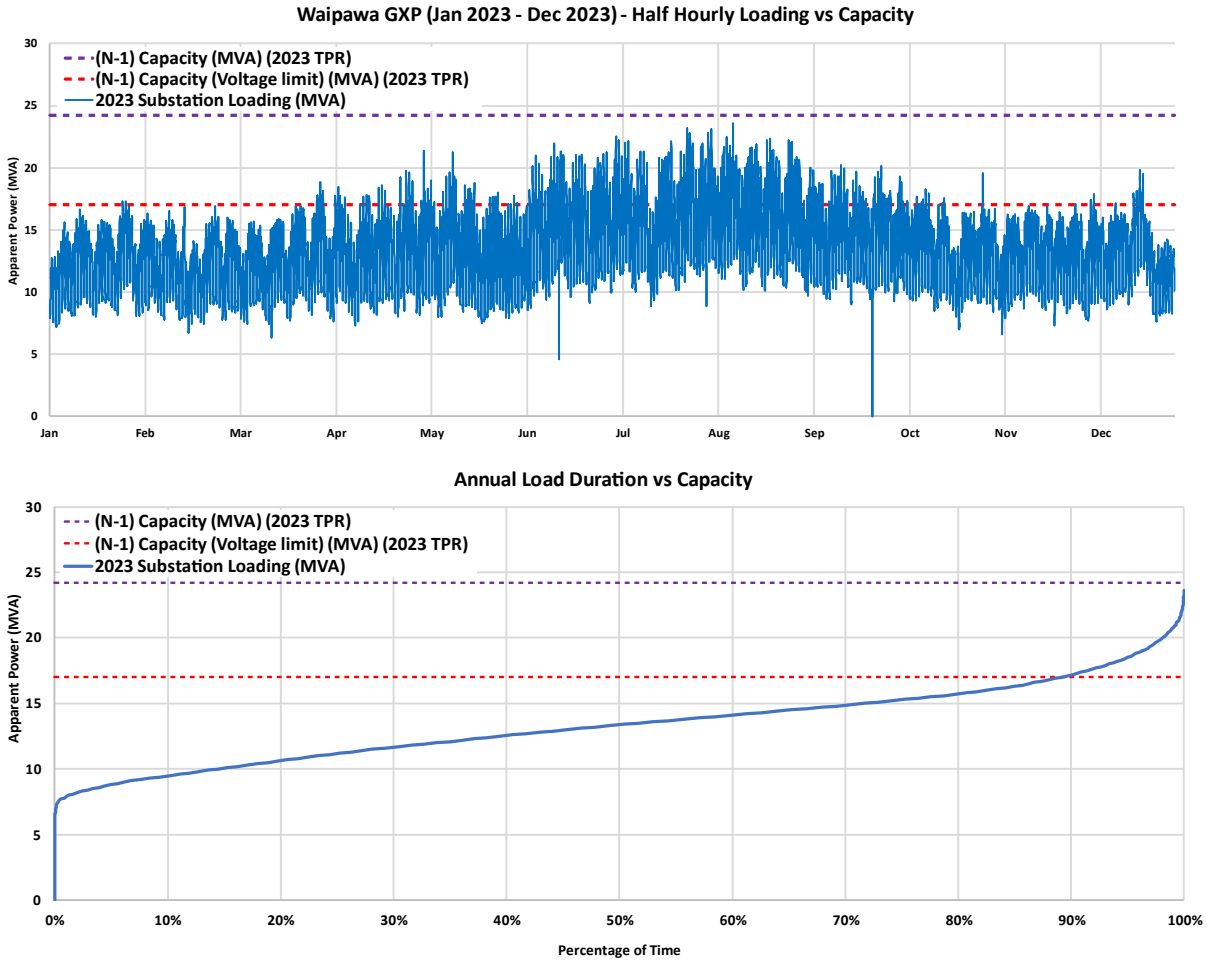


Figure 16. Waipawa GXP: 2023 Loading: Substation capacity

[21] Sourced from Transpower's *Transmission Planning Report 2023*.

6.1.6 Whakatu GXP

Transpower's demand forecast indicates that the Whakatu GXP was expected to have a 2023 peak demand of 117 MW at 0.98 power factor (~119.4 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Whakatu GXP experienced a peak load of 88.8 MVA.

The Whakatu GXP is equipped with two 220/33 kV transformers providing:

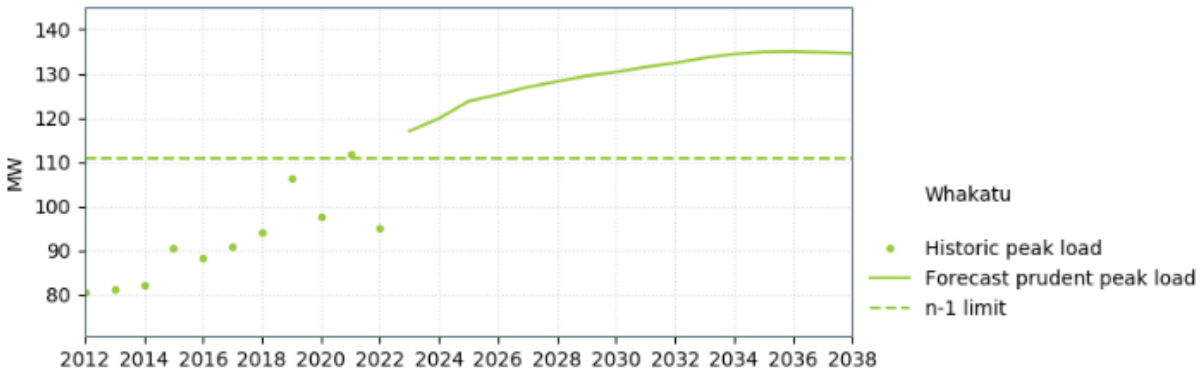
- (N) secure capacity of 200 MVA and
- (N-1) capacity of 116/121 MVA (summer/winter).

Whakatu GXP is supplied by two Redclyffe-Whakatu 220 kV transmission lines which are rated at 347/382 MVA (summer/winter), which exceeds the present capacity of the transformers.

Peak load at Whakatu is already close to the (N-1) capacity of the transformers, and has exceeded the capacity in the past. This constraint will worsen if Unison shifts load to Whakatu to manage the 110 kV transmission constraints at Fernhill and Redclyffe during peak loads. Transpower is monitoring this risk and will investigate options for mitigation with Unison. Some options include:

- Shifting load post-contingency
- Upgrading the existing Whakatu transformers
- Upgrading the Whakatu 220 kV bus and installing a third supply transformer .

The following graph[22] compares Whakatu GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 following Figure 17 illustrates Whakatu's 2023 loading in comparison to its substation capacity.

[22] Sourced from Transpower's *Transmission Planning Report 2023*.

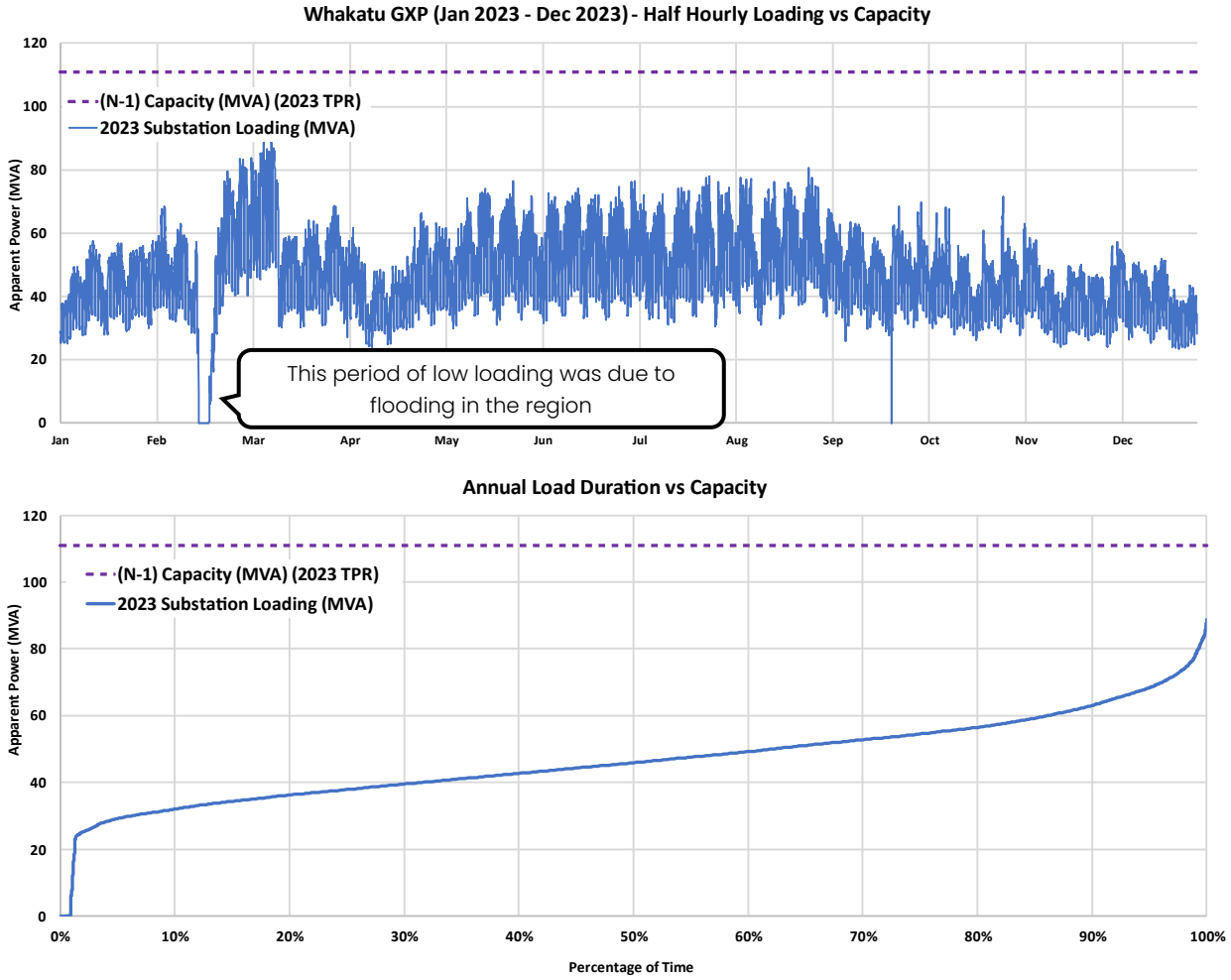


Figure 17. Whakatu GXP: 2023 Loading: Substation capacity

6.2 Spare Capacity based on Transpower's 2023 Forecast

The following Figure 18 summarises the approximate, all year, (N-1) and (N) spare capacities at each GXP based on:

- The substation capacity disclosed in Transpower's *Transmission Planning Report 2023*
- The 2023 forecast load provided in Transpower's *Transmission Planning Report 2023* (refer to Table 3).
- Half hourly load data from the Electricity Market Information (EMI) website.
- The 2023 Centralines, Firstlight, and Unison *Asset Management Plans.*

Negative values are only possible for (N-1) capacities and indicate that there is no spare (N-1) capacity, and that consumer load cannot be supplied for (N-1) conditions. The negative amount indicates the capacity increase that is required to achieve a secure firm capacity at the substation.

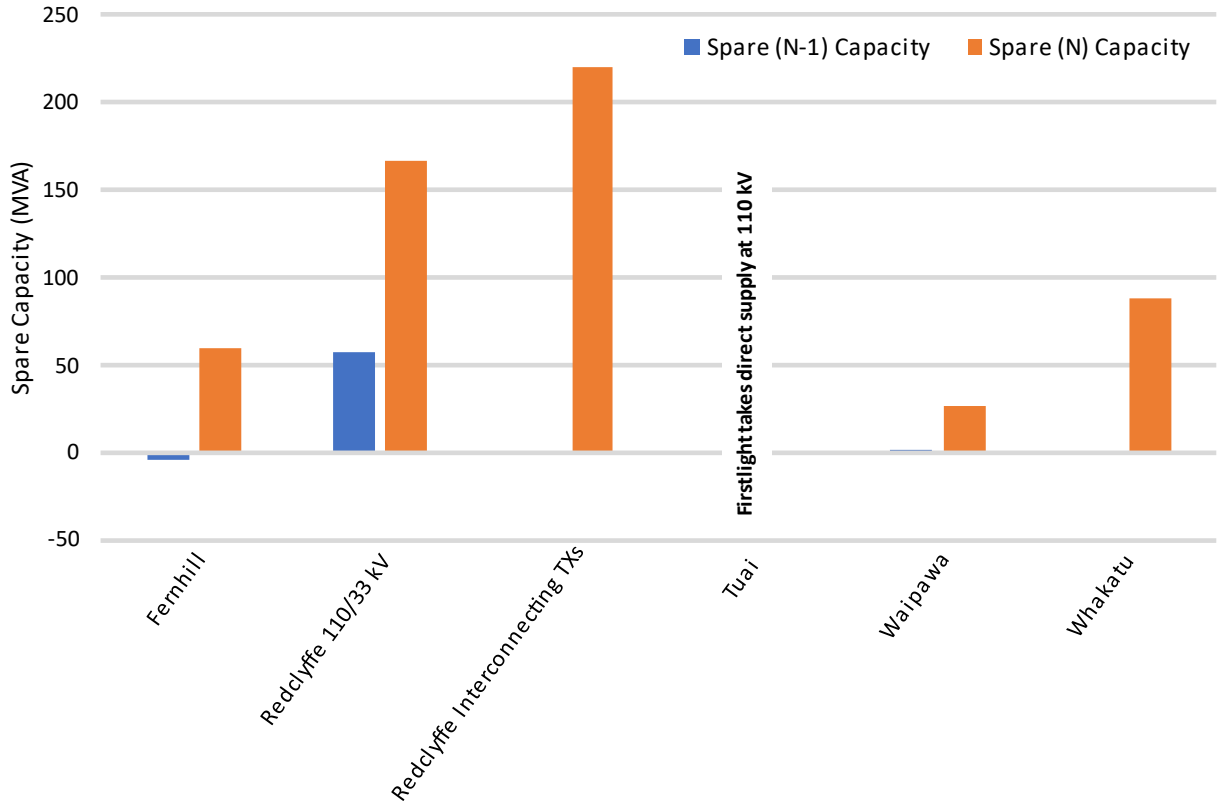


Figure 18. Summary: GXP Spare Capacity based on GXP 2023 EMI loading data.

It should be noted that the spare capacities are based on the asset rating values disclosed by Transpower, and the actual 2023 load data as recorded and presented on The Electricity Market Information website. **Also, the spare (N) capacities do not include any voltage constraints or upstream transmission constraints, which would need to be confirmed by Transpower or the relevant EDB. These are however considered in the individual load assessments in Section 8, particularly for larger loads.**

Ergo additionally notes that the figure above assumes that the third Redclyffe interconnecting transformer (presently planned for installation in 2024) has been installed before any of the Load Opportunities covered in this document are likely to connect.

7. Spare Capacity – Zone Substations

In determining the (N) and (N-1) spare capacities for the zone substations (ZS's), Ergo reviewed the EDB 2023 disclosure data and the historical substation loading data for 2023. Actual historical loading data was provided by Centralines, Firstlight, and Unison, and all data is shown in Table 4, Table 5, and Table 6.

7.1 Centralines

Table 4. Centralines: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Waipukurau	6.50	5.5	1.5	0.5
2	Waipawa	10.30	9.7	2.8	2.2
3	Takapau	9.20	7.7	1.7	0.2
4	OngaOnga	4.90	Not Supplied	N/A	N/A
5	Wilder Road	0.90	-0.5	N/A	N/A

7.2 Firstlight

Table 5. Firstlight: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Tuai	4.00	Not Supplied	N/A	Not Supplied
2	Kiwi	2.00	Not Supplied	N/A	Not Supplied
3	Wairoa	10.00	Not Supplied	0.0	Not Supplied
4	Blacks Pad	-0.50	Not Supplied	N/A	Not Supplied
5	Tahaenui	0.50	Not Supplied	N/A	Not Supplied
6	Waihi	2.00	Not Supplied	N/A	Not Supplied

Note: The negative (N-1) space capacity represents a zone substation where the (N-1) rating is already exceeded at times throughout the year.

7.3 Unison

Table 6. Unison: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Camberley	6.00	5.5	-3.0	-3.5
2	Fernhill	3.00	3.5	N/A	N/A
3	Flaxmere	27.00	24.2	7.0	4.2
4	Havelock North	25.00	25.3	5.0	5.3

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
5	Irongate	20.00	18.2	10.0	8.2
6	Maraekakaho	7.00	7.5	N/A	N/A
7	McCain	6.00	Not Supplied	N/A	N/A
8	Sherenden	2.00	2.1	N/A	N/A
9	Awatoto	12.00	Not Supplied	2.0	Not Supplied
10	Church Road	11.00	10.8	1.0	0.8
11	Esk	5.00	2.0	N/A	N/A
12	Faraday Street	29.00	26.1	9.0	6.1
13	Patoka	2.00	Not Supplied	N/A	N/A
14	Springfield	7.00	7.8	0.0	0.8
15	Tamatea	26.00	25.5	6.0	5.5
16	Tannery Road	27.00	26.7	7.0	6.7
17	Tutira	0.00	-0.2	N/A	N/A
18	Arataki	10.00	10.3	0.0	0.3
19	Bluff Hill	21.00	20.4	N/A	N/A
20	Hastings	22.00	20.8	2.0	0.8
21	Mahora	20.00	16.9	0.0	-3.1
22	Marewa	28.00	26.1	8.0	6.1
23	Rangitane	29.00	30.4	5.0	6.4
24	Tomoana	8.00	6.2	1.0	-0.8
25	Windsor	33.00	32.1	13.0	12.1

Note: The negative (N-1) spare capacity represent a zone substation where the (N-1) rating is already exceeded at times throughout the year.

7.4 Summary

7.4.1 Centralines

Two of Centralines' zone substations in the region (namely: OngaOnga and Wilder Road) have (N-1) switched security rather than full (N-1) security. These substations each have one transformer only. However, backfeed is available through the local network in the case that the transformer is out of service. For these substations, the total (N) capacity is typically taken as the transformer capacity, while, due to uncertainties on availability of backfeed and the resulting constraints on the adjacent zone substations, the total (N-1) capacity is taken as 0 MVA – i.e., for the purposes of this assessment, these substations are treated as having (N) security.

(N-1) Capacity Summary

The following Figure 19 illustrates the approximate (N-1) spare capacities at Centralines' zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Centralines.

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.

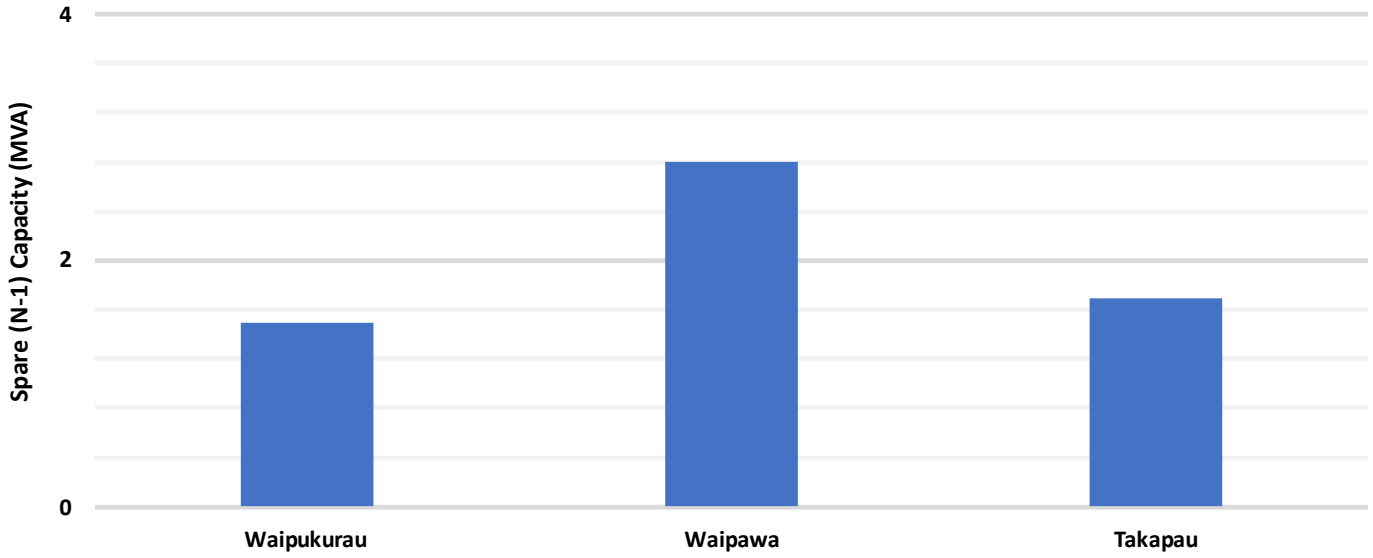


Figure 19. Summary: Approximate (N-1) spare capacity at Centralines' zone substations

The zone substations with spare (N-1) capacity vary from 15% (for Waipukurau) to 69% (for Waipawa) available capacity.

(N) Capacity Summary

The following Figure 20 illustrates the approximate (N) spare capacities at Centralines' zone substations, for the disclosed peak demand estimates[23]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Centralines.

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. Figure 20 indicates that there is a significant volume of spare (N) capacity, more than 43%, at Centralines' substations, although we note that these may be in locations where (N-1) security of supply would be a standard requirement.

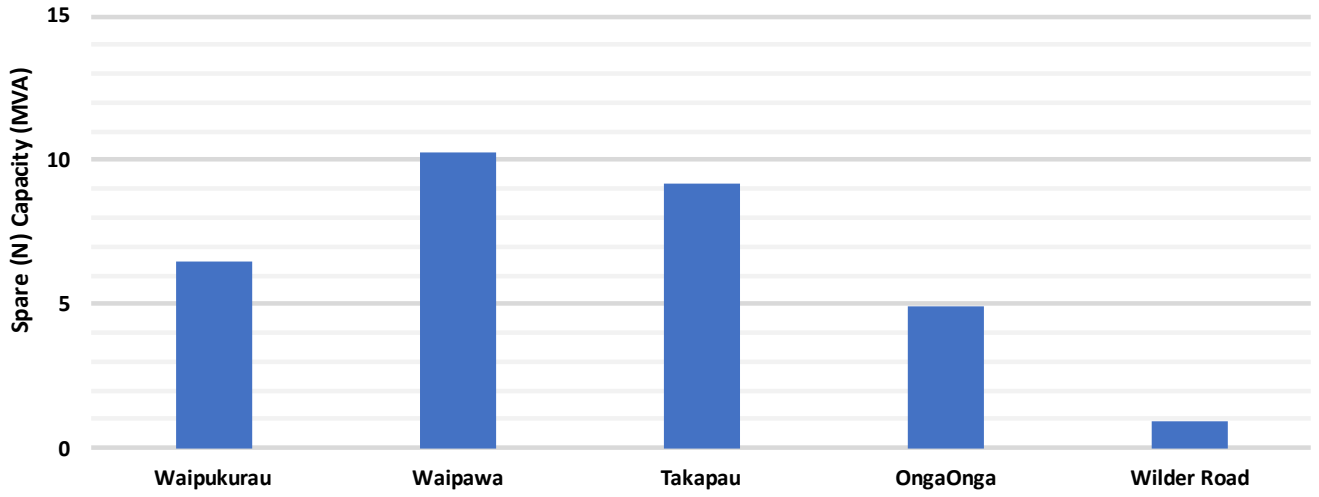


Figure 20. Summary: Approximate (N) spare capacity at Centralines' zone substations

7.4.2 Firstlight

Two of Firstlight's zone substations in the region (namely: Blacks Pad and Tahaenui) have (N-1 switched) security rather than full (N-1) security. These substations each have one transformer only, however, backfeed is available through the local network in the case that the transformer is out of service. For these substations, the total (N) capacity is typically taken as the transformer capacity, while, due to uncertainties on availability of backfeed and the resulting constraints on the adjacent zone substations, the total (N-1) capacity is taken as 0 MVA – i.e., for the purposes of this assessment, these substations are treated as having (N) security.

(N-1) Capacity Summary

Only one of Firstlight's substations has firm (N-1) security, Wairoa. This substation is presently loaded at its 10 MVA firm capacity, meaning it has no spare (N-1) capacity.

[23] Centralines' 2023 AMP available here: https://www.centralines.co.nz/tell-me-about/about-us/publications-disclosures/asset-management-plan/

(N) Capacity Summary

The following Figure 20 illustrates the approximate (N) spare capacities at Firstlight's zone substations, for the disclosed peak demand estimates[24]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Firstlight.

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. Figure 20 indicates that there is a significant volume of spare (N) capacity, with most substations having at least 29%, although we note that these may be in locations where (N-1) security of supply would be a standard requirement.

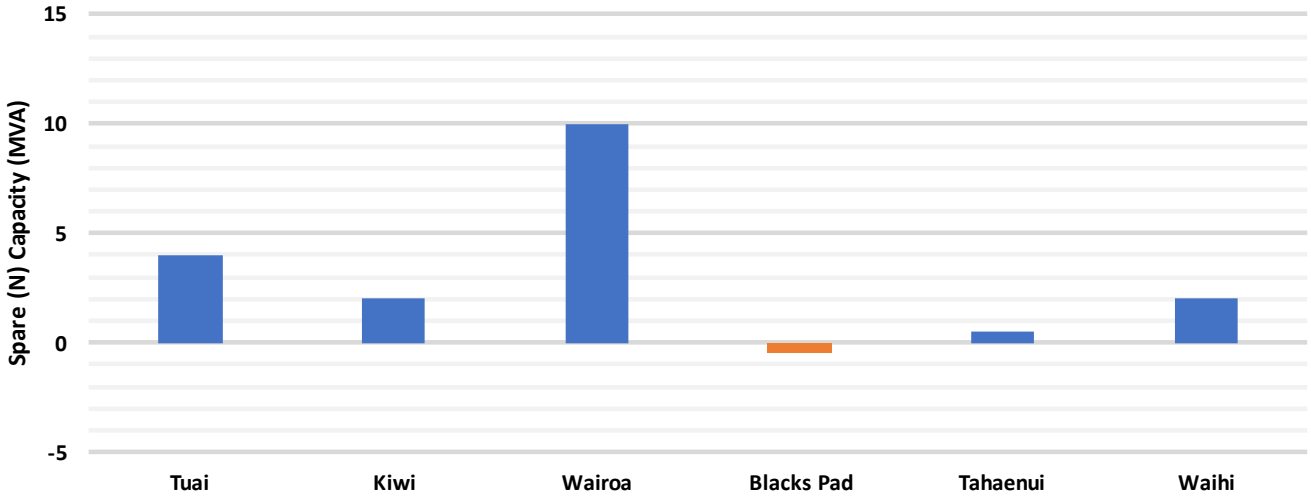


Figure 21. Summary: Approximate (N) spare capacity at Firstlight's zone substations

7.4.3 Unison

Ergo notes that Unison's Camberley substation is presently being rebuilt and is expected to be back online in early 2025.

(N-1) Capacity Summary

The following Figure 19 illustrates the approximate (N-1) spare capacities at Unison' zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Unison.

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 a zone substation where the (N-1) rating is already exceeded at times throughout the year. This means there is no spare (N-1) capacity left and the red graph indicates

[24] Firstlight's 2023 AMP available here: https://www.firstlightnetwork.co.nz/tell-me-about/firstlight-network/regulatory-information/

the extent that the (N-1) secure capacity has been exceeded in the past. Zone substations with (N) security have been omitted from this graph. This means that eight of the twenty five zone substations (Fernhill, Maraekakaho, McCain, Sherenden, Esk, Patoka, Tutira, and Bluff Hill) do not have (N-1) security with respect to the supply transformers. At one of the zone substations, the (N-1) supply capacity has been exceeded in 2023.

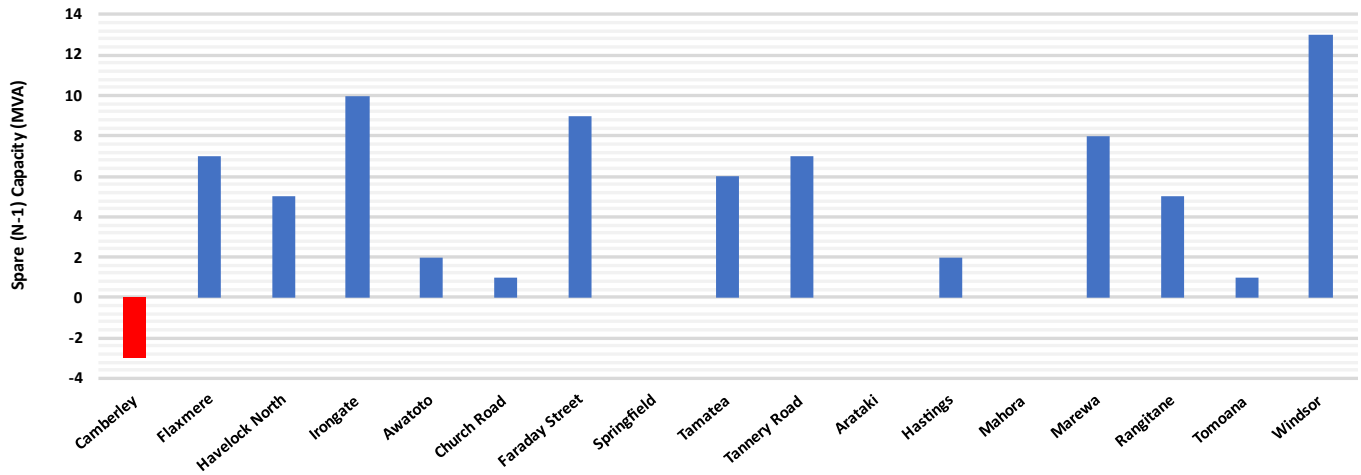


Figure 22. Summary: Approximate (N-1) spare capacity at Unison's zone substations

The zone substations with spare (N-1) capacity left vary from 10% (for Church Road and Hastings) to 65% (for Windsor) available capacity.

(N) Capacity Summary

The following Figure 20 illustrates the approximate (N) spare capacities at Unison's zone substations, for the disclosed peak demand estimates[25]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Unison.

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. Figure 20 indicates that there is a significant volume of spare (N) capacity, with most substations having at least 30%, although we note that these may be in locations where (N-1) security of supply would be a standard requirement.

[25] Unison's 2023 AMP available here: https://www.unison.co.nz/tell-me-about/unison-group/publications-disclosures/asset-management-plan/

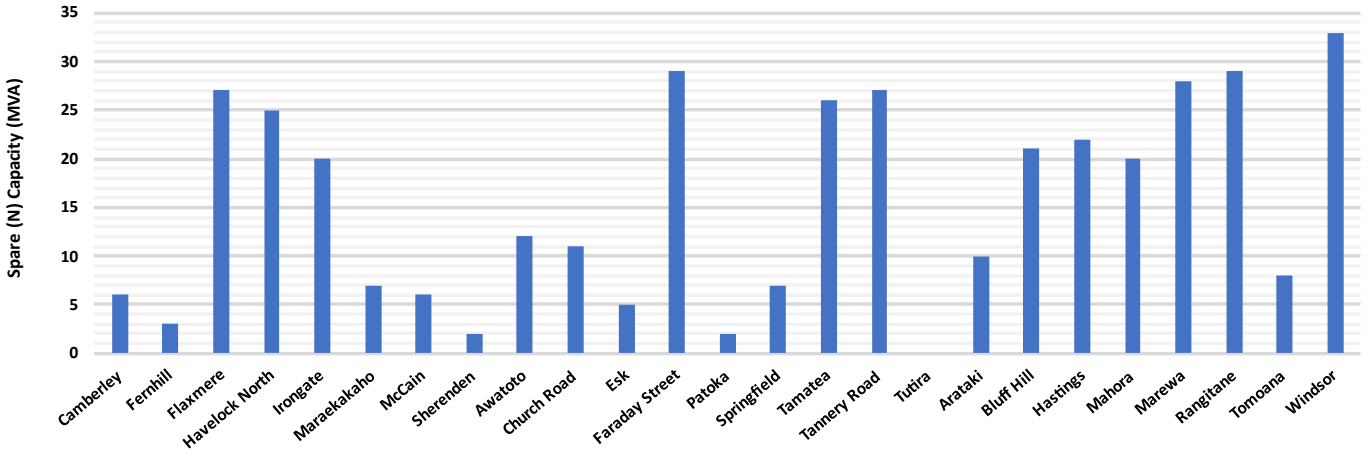


Figure 23. Summary: Approximate (N) spare capacity at Unison's zone substations

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 Site's in terms of the local substations, as follows:

- Transpower GXP substations (shaded blue colour in diagrams).
- The EDB zone substations (shaded yellow in diagrams).

The purpose of this section is to provide a high-level assessment regarding 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 the relevant EDB. 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 22 kV feeder.

The spare capacity across each asset type has been determined using the information provided 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 data (instead of the 2022 loading data provided by Transpower, Centralines, Firstlight, and Unison). 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.
  For larger loads, where appropriate, both an (N) supply option and an (N-1) supply option have been investigated.
- 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 33 kV and 11 kV 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[26] 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, 110 kV and 220 kV lines cannot be installed in road reserve due to wide corridor requirements. In some locations the width of the road reserve is such that 66 kV and 33 kV 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).

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

- There is space available in zone substation buildings to accommodate new circuit breakers to supply medium size loads. For example, a single 11 kV breaker can be accommodated without having to extend the relevant zone substation switchroom.
- 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.

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. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate.

8.3 Fernhill GXP

The "Large" EECA Load Sites connecting to the Fernhill GXP include:

- Russell Asphalt (5.82 MW)
- Webster's Hydrated Lime Company Havelock North (5.15 MW)
- McCains Foods Hastings (4.09 MW)
- Hawke's Bay Fallen Soldiers Memorial Hospital (3.47 MW)
- Profruit (2006) Limited Hastings (1.54 MW)
- Hawke's Bay Regional Prison (1.14 MW)

The "Small" Load Sites connecting to the Fernhill GXP include (refer to sections 8.3.8 and 8.3.10):

- Tumu Timbers Limited (0.73 MW)
- Humes Hastings (WITT) (0.46 MW)
- Progressive Meats Limited Hastings (0.19 MW)
- Havelock North Village Pool (0.07 MW)

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

Figure 24. Fernhill GXP: EECA Load Sites vs local substations

8.3.1 Fernhill GXP Upgrade

The Fernhill GXP presently has no spare (N-1) capacity and 60 MVA of spare (N) capacity, based on the transformer ratings.

To establish (N-1) security for any of the loads connecting, transformer upgrades would be required at the Fernhill GXP, as discussed in their relevant sections below. If multiple of the loads connect, they may share the cost of the required transformers.

Discussion in Section 8.3.11 indicates that if all of the proposed loads at Fernhill connect, a total load increase at the GXP of 7.41 MW is expected. This is a relatively small increase in load and is not expected to necessitate upgrades of the lines supplying the GXP.

8.3.2 Russell Asphalt

		RUSSELL ASPHALT
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.818	Fernhill
Existing Electrical Supply to the Plant		

Russell Asphalt is presently supplied by Unison Networks' Flaxmere substation via an 11 kV feeder consisting of underground cable. Flaxmere is in turn supplied from Fernhill GXP by one 33 kV sub-transmission circuit which it shares with the McCain Zone Substation. This subtransmission circuit is rated to approximately 540 A (30.9 MVA). There is a second subtransmission circuit which runs in parallel with the main supply from Fernhill GXP which the substation can be switched onto if required.

This site is located approximately 0.3 km from McCain ZS. In turn, McCain ZS is approximately 2.4 km from Fernhill GXP. It is also located approximately 0.8 km from Flaxmere ZS. Flaxmere ZS is approximately 3.0 km from Fernhill GXP.

It is assumed that due to the location of the load, that it would be supplied directly from McCain substation if the proposed 5.8 MW is added. As such, analysis focuses on a connection to McCain.

There is currently a maximum loading of 10 MVA on McCain zone substation, with 6 MVA of spare (N) capacity, with no (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

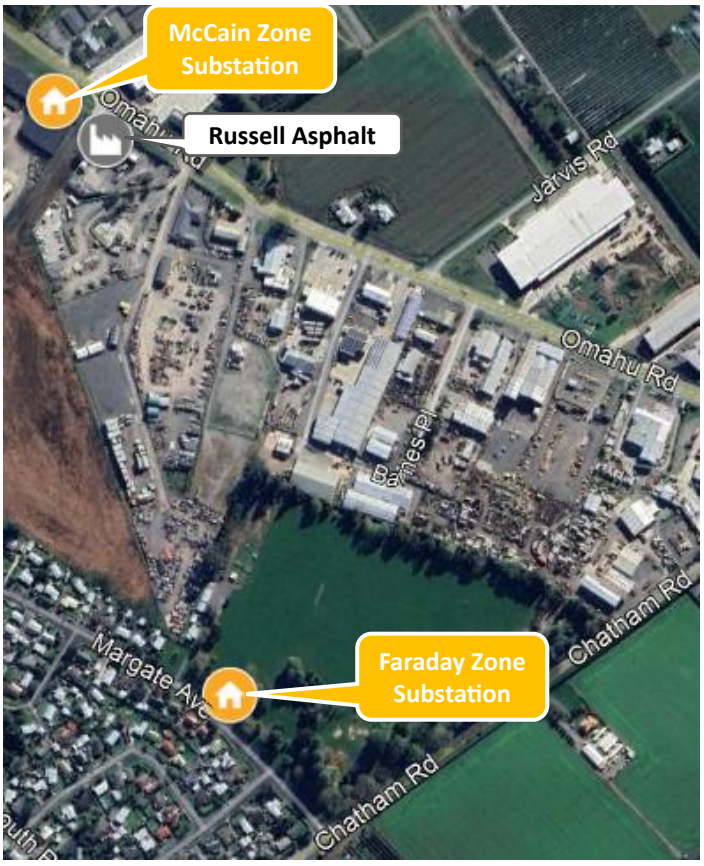


Figure 25. Russell Asphalt geographic location in relation to the surrounding zone substations

RUSSELL ASPHALT

Supply Option(s) for New Load

Both McCain ZS and Fernhill GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity.

For McCain ZS to achieve the required spare (N-1) capacity, a new supply transformer would be required, which will also require installation of associated circuit breakers and a new 33 kV feeder from the GXP.

To accommodate an (N) capacity connection, it is expected that a special protection scheme would be required for the transformers at Fernhill 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage.

For Fernhill 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded/replaced to accommodate the additional load.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker has been allowed for to supply the load. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.3 km.

Capital Cost Estimate

Table 7. Russell Asphalt: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.30	$0.18
		TOTAL	**$0.78**

Table 8: Russell Asphalt: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Medium supply transformer (ZS)	1.00	$1.90
Subtransmission	33kV circuit breaker (ZS)	2.00	$0.60
Subtransmission	Single underground 33kV cable	2.80	$2.52
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.80	$0.48
		TOTAL	**$14.60**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

RUSSELL ASPHALT
It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) subtranmsmission security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.3.3 Webster's Hydrated Lime Company Havelock North

		WEBSTER'S HYDRATED LIME COMPANY HAVELOCK NORTH
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.152	Fernhill
Existing Electrical Supply to the Plant		

Webster's Hydrated Lime Company Havelock North is presently supplied by Unison Networks' Havelock North substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Havelock North is in turn supplied from Fernhill GXP by two 33 kV subtransmission circuits. These subtransmission circuits are rated to approximately 250 A (14.3 MVA) and 437 A (25.0 MVA).

This site is located approximately 6.2 km from Havelock North ZS. In turn, Havelock North ZS is approximately 12.5 km from Fernhill GXP.

There is currently a maximum loading of 15 MVA on Havelock North zone substation, with 25 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

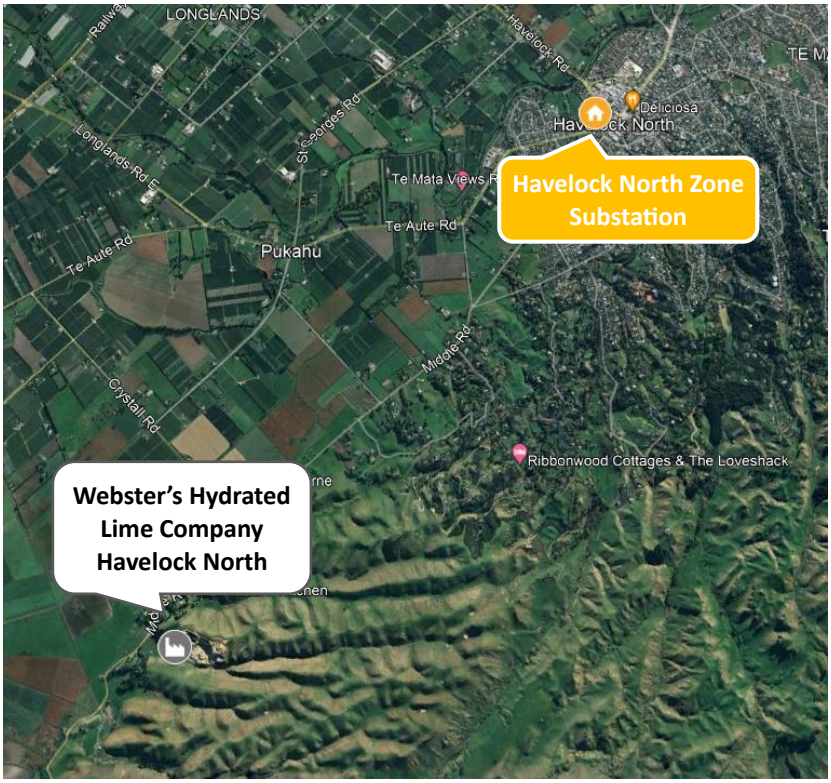


Figure 26. Webster's Hydrated Lime Company Havelock North geographic location in relation to the surrounding zone substations

WEBSTER'S HYDRATED LIME COMPANY HAVELOCK NORTH

Supply Option(s) for New Load

Both Havelock North ZS and Fernhill GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity.

For Havelock North to achieve the required spare (N-1) capacity, upgrading the existing transformers would be required. Additionally, one of the subtransmission lines (rated at 14.3 MVA from Arataki ZS) would likely need to be replaced to allow for the increased load.

To accommodate an (N) capacity connection, it is expected that a special protection scheme would be required for the transformers at Fernhill 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage.

For Fernhill 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded/replaced to accommodate the additional load.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker has been allowed for to supply the load. Due to the mixed topography of the area, this would likely be a mixture of overhead line and underground conductor, at a length of 0.7 km of underground line and 6.5 km of overhead line.

Due to the size of the load and distance from the zone substation, it is expected that voltage support (i.e. an 11 kV capacitor bank) would be required at the load site.

Capital Cost Estimate

Table 9. Webster's Hydrated Lime Company Havelock North: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single overhead 11kV line	6.50	$1.63
Distribution	Single underground 11kV cable (CBD)	0.70	$0.56
Distribution	11kV Capacitor Bank	1.00	$0.30
		TOTAL	**$2.59**

Table 10: Webster's Hydrated Lime Company Havelock North: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

WEBSTER'S HYDRATED LIME COMPANY HAVELOCK NORTH

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Single underground 33kV cable	0.90	$0.81
Subtransmission	Single overhead 33kV line	13.60	$4.76
Subtransmission	33kV circuit breaker bay	2.00	$0.50
Subtransmission	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single overhead 11kV line	6.50	$1.63
Distribution	Single underground 11kV cable (CBD)	0.70	$0.56
Distribution	11kV Capacitor Bank	1.00	$0.30
		TOTAL	**$21.46**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.4 McCain Foods Hastings

		MCCAIN FOODS HASTINGS
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	4.087	Fernhill
Existing Electrical Supply to the Plant		

McCain Foods Hastings is presently supplied by Unison Networks' McCain substation via an underground 11 kV cable.

McCain is in turn supplied from Fernhill GXP by a single 33 kV subtransmission circuit. This subtransmission circuit is rated to approximately 540 A (30.9 MVA).

This site is located approximately 0.2 km from McCain ZS. In turn, McCain ZS is approximately 2.4 km from Fernhill GXP. Alternatively, the site is located approximately 1.0 km from Flaxmere ZS. Flaxmere ZS is approximately 3.0 km from Fernhill GXP.

There is currently a maximum loading of 10 MVA on McCain zone substation, with 6 MVA of spare (N) capacity, with no (N-1) capacity. Flaxmere ZS has 27 MVA of spare (N) capacity, and 6 MVA of (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

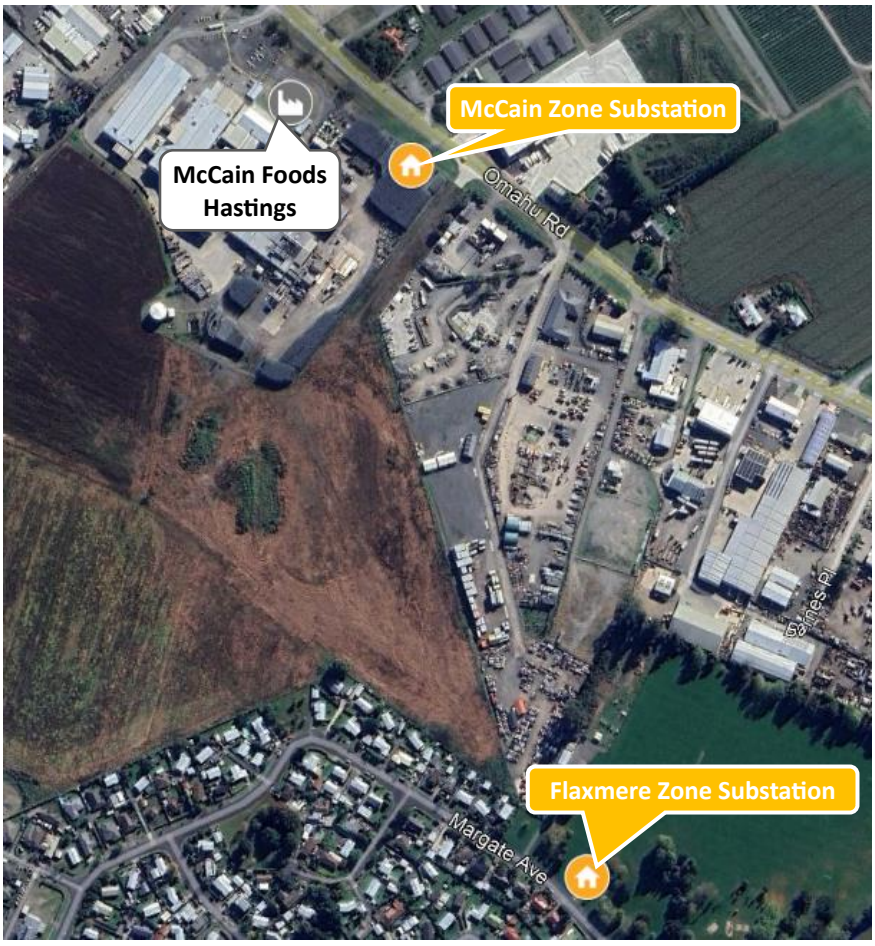


Figure 27. McCain Foods Hastings geographic location in relation to the surrounding zone substations

MCCAIN FOODS HASTINGS

Supply Option(s) for New Load

Both McCain ZS and Fernhill GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity.

For McCain ZS to achieve the required spare (N-1) capacity, an additional supply transformer would be required. This will also require installation of associated circuit breakers and an additional 33 kV feeder from the Fernhill GXP. Instead, it has been assumed that a dedicated 11kV feeder would be installed from Flaxmere ZS, which does have (N-1) capacity for the load.

To accommodate an (N) capacity condition, it is expected that a special protection scheme would be required for the transformers at Fernhill 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage. Matching the (N-1) case, it has been assumed that a dedicated 11kV feeder would be installed from Flaxmere ZS.

For Fernhill 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded/replaced to accommodate the additional load.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker has been allowed for to supply the load. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.1 km from McCain ZS or 0.9 km from Flaxmere ZS.

Capital Cost Estimate

Table 11. McCain Foods Hastings: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable (CBD)	0.90	$0.72
		TOTAL	**$1.32**

Table 12: McCain Foods Hastings: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable (CBD)	0.90	$0.72
		TOTAL	**$9.82**

MCCAIN FOODS HASTINGS
Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.3.5 Hawke's Bay Fallen Soldiers Memorial Hospital

HAWKE'S BAY FALLEN SOLDIERS MEMORIAL HOSPITAL		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	3.469	Fernhill
Existing Electrical Supply to the Plant		

Hawke's Bay Fallen Soldiers Memorial Hospital is presently supplied by Unison Networks' Camberley substation via 3 underground 11 kV feeders. Camberley is in turn supplied from Fernhill GXP by a single 33 kV subtransmission circuit. This subtransmission circuit is rated to approximately 630 A (36 MVA).

This site is located approximately 0.7 km from Camberley ZS. In turn, Camberley ZS is approximately 5.8 km from Fernhill GXP. Alternatively, the site is located approximately 3.9 km from Flaxmere ZS, which is in turn approximately 3.0 km from Fernhill GXP.

Camberley zone substation is currently undergoing a capacity upgrade and is expected to be in service in Q1 of 2025. This will extend its (N-1) capacity to 28.5 MVA. The current maximum loading of Camberley Zone Substation is 12 MVA, with 6 MVA of spare (N) capacity and no (N-1) capacity. After the upgrade, Camberley will have ~16 MVA of spare (N-1) capacity and Flaxmere ZS has 27 MVA of spare (N) capacity, and 6 MVA of (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

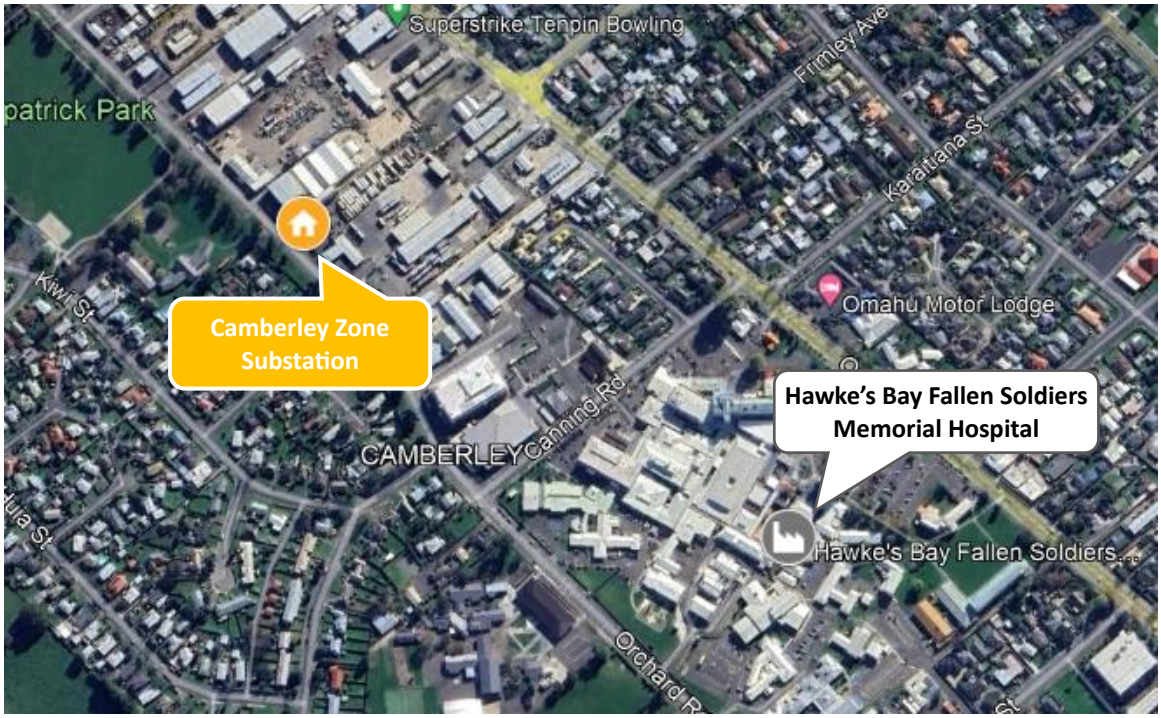


Figure 28. Hawke's Bay Fallen Soldiers Memorial Hospital geographic location in relation to the surrounding zone substations

HAWKE'S BAY FALLEN SOLDIERS MEMORIAL HOSPITAL

Supply Option(s) for New Load

Both Camberley ZS and Fernhill GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity. However, it is expected that once the Camberley substation upgrade is complete, the substation will have adequate (N-1) capacity for the additional load.

For Fernhill GXP to achieve the required (N-1) capacity, the existing supply transformers will need to be upgraded/replaced to accommodate the additional load.

To accommodate an (N) capacity connection, it is expected that a special protection scheme would be required for the transformers at Fernhill 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker has been allowed for to supply the load. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.3 km from Camberley ZS.

Capital Cost Estimate

Table 13. Hawke's Bay Fallen Soldiers Memorial Hospital: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable (CBD)	0.30	$0.24
		TOTAL	**$0.84**

Table 14. Hawke's Bay Fallen Soldiers Memorial Hospital: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.30	$0.18
		TOTAL	**$9.28**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

HAWKE'S BAY FALLEN SOLDIERS MEMORIAL HOSPITAL
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.3.6 Profruit (2006) Limited Hastings

PROFRUIT (2006) LIMITED HASTINGS		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	1.540	Fernhill

Existing Electrical Supply to the Plant

Profruit (2006) Limited Hastings is presently supplied by Unison Networks' McCain substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. McCain is in turn supplied from Fernhill GXP by a single 33 kV subtransmission circuit. This subtransmission circuit is rated to approximately 540 A (30.9 MVA).

This site is located approximately 0.7 km from McCain ZS. In turn, McCain ZS is approximately 2.4 km from Fernhill GXP.

There is currently a maximum loading of 10 MVA on McCain zone substation, with 6 MVA of spare (N) capacity, with no spare (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

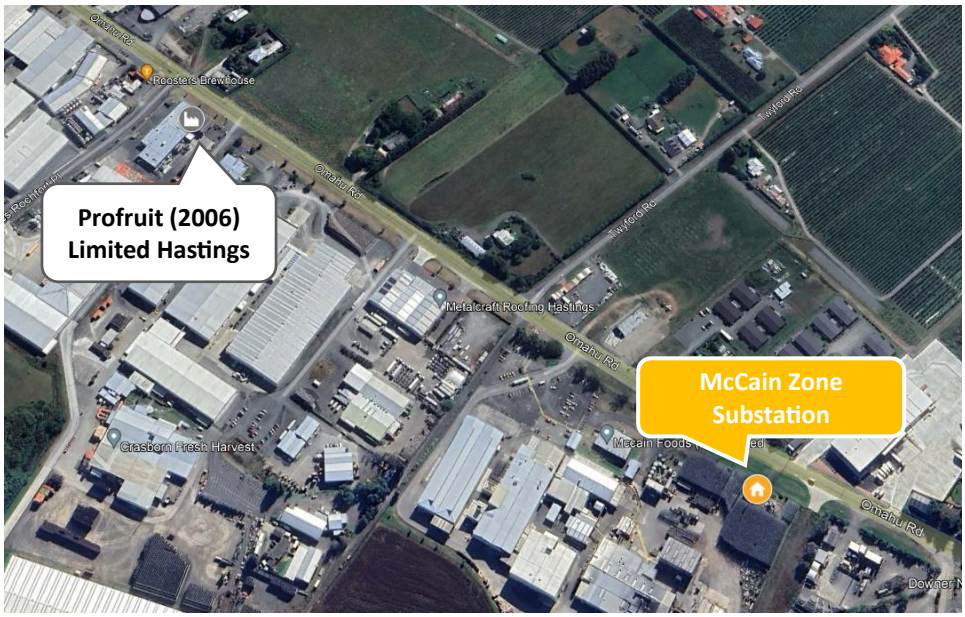


Figure 29. Profruit (2006) Limited Hastings geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both McCain ZS and Fernhill GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity.

To accommodate an (N) capacity condition at Fernhill 33 kV GXP, a special protection scheme would be required for the GXP transformers to avoid overloading the remaining transformer in the event of a single transformer outage.

For Fernhill 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded/replaced to accommodate the additional load.

For McCain ZS to achieve the required spare (N-1) capacity, an additional supply transformer would be required, which will also require installation of associated circuit breakers and a new 33 kV feeder from the GXP.

The feeder presently supplying Profuit is loaded at approximately 3.88 MVA. It is expected that upgrades of some sections of underground cable and overhead line on this existing feeder would be required to accommodate the additional Profruit load. This would require the reconductoring of 0.65 km of overhead line and replacement of 0.05 km of underground cable.

Capital Cost Estimate

Table 15. Profruit (2006) Limited Hastings: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	Reconductor 11kV line (larger)	0.65	$0.13
Distribution	Single underground 11kV cable	0.05	$0.03
		TOTAL	**$0.66**

Table 16: Profruit (2006) Limited Hastings: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Medium supply transformer (ZS)	1.00	$1.90
Subtransmission	33kV circuit breaker (ZS)	2.00	$0.60
Subtransmission	Single underground 33kV cable	2.80	$2.52
Distribution	Reconductor 11kV line (larger)	0.65	$0.13
Distribution	Single underground 11kV cable	0.05	$0.03
		TOTAL	**$14.18**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

PROFRUIT (2006) LIMITED HASTINGS
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.3.7 Hawke's Bay Regional Prison

		HAWKE'S BAY REGIONAL PRISON
Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.140	Fernhill

Existing Electrical Supply to the Plant

Hawke's Bay Regional Prison is presently supplied by Unison Networks' Irongate substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Irongate is in turn supplied from Fernhill GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 545 A (31 MVA) each.

This site is located approximately 4.5 km from Irongate ZS. In turn, Irongate ZS is approximately 6.5 km from Fernhill GXP.

There is currently a maximum loading of 10 MVA on Irongate zone substation, with 20 MVA of spare (N) capacity and 10 MVA of spare (N-1) capacity. Fernhill GXP presently has ~60 MVA of spare (N) capacity and no spare (N-1) capacity.

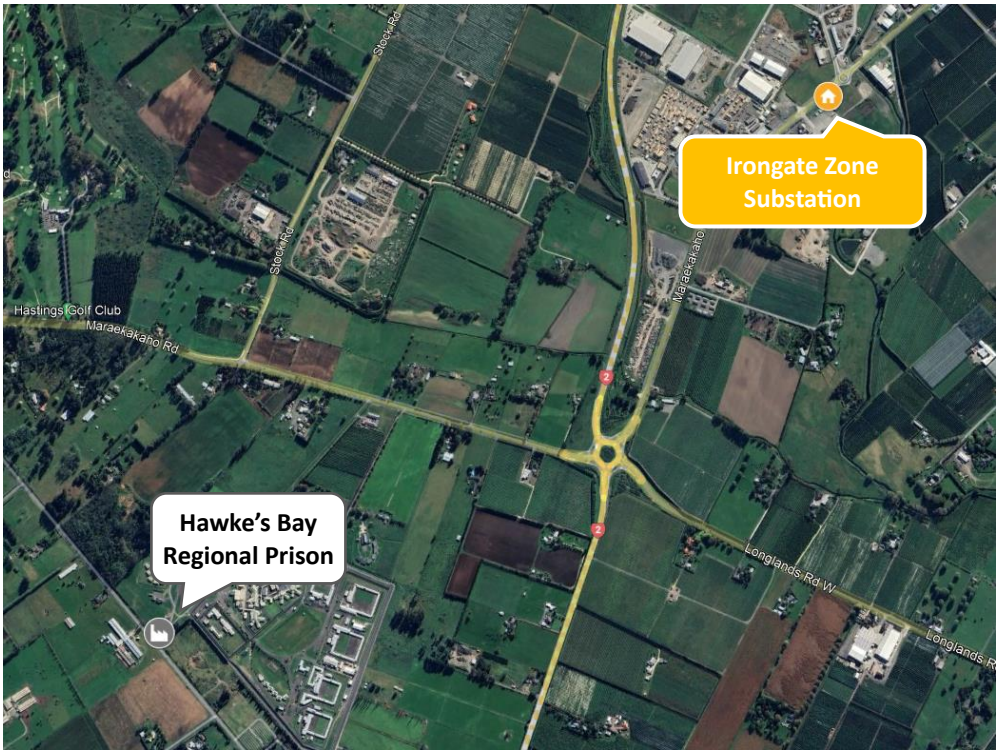


Figure 30. Hawke's Bay Regional Prison geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Irongate ZS has adequate (N) and (N-1) spare capacity, but Fernhill GXP is lacking in spare (N-1) capacity.

HAWKE'S BAY REGIONAL PRISON

To accommodate an (N) capacity condition at Fernhill 33 kV GXP, a special protection scheme would be required for the GXP transformers to avoid overloading the remaining transformer in the event of a single transformer outage.

For Fernhill 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded / replaced to accommodate the additional load.

The feeder presently supplying Profuit is loaded at approximately 4.69 MVA. Due to the size of the load, a line and cable upgrade would be required to accommodate the additional load. This would require the reconductoring of 1.4 km of overhead line and 0.18 km of underground cable to accommodate the increased load to the site.

Capital Cost Estimate

Table 17. Hawke's Bay Regional Prison: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	Reconductor 11kV line (larger)	1.40	$0.28
Distribution	Single underground 11kV cable	0.18	$0.11
		TOTAL	**$0.89**

Table 18: Hawke's Bay Regional Prison: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	Reconductor 11kV line (larger)	1.40	$0.28
Distribution	Single underground 11kV cable	0.18	$0.11
		TOTAL	**$9.39**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.8 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 RMUs and appropriately sized distribution transformers to supply the site.

Table 19. 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)
Tumu Timbers Limited	Irongate	10	20	6.63	0.727	200
Humes Hastings	Fernhill	N/A	3	2.30	0.455	130
Progressive Meats Limited Hastings	Camberley	-3	6	Unknown	0.191	80
Havelock North Village Pool	Havelock North	5	25	3.73	0.070	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.

8.3.9 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs in this section are additional to those stated in the preceding sections assessing individual loads.

8.3.9.1 Havelock North

Two of the Load Sites on Fernhill GXP are expected to connect to Havelock North zone substation. The loads are Webster's Hydrated Lime Company Havelock North and Havelock North Village Pool. The sum of peaks of these loads is 5.22 MW, which the zone substation doesn't have (N-1) capacity for. However, the upgrades considered in the individual load analysis are considered adequate for the two connecting loads.

8.3.9.2 McCain

Three of the Load Site on Fernhill GXP are expected to connect to McCain zone substation. The loads are Profruit (2006) Limited Hastings, Russell Asphalt, and McCain Foods Hastings. The sum of peaks of these loads is 11.45 MW, which the zone substation doesn't have (N) capacity for. However, the upgrades considered in the individual load analysis are considered adequate for the three connecting loads, assuming that the new transformer and lines installed consider the requirements of the three Load Sites. This would also present an opportunity for the three connecting Load Sites to share the costs of upgrades.

Unison is intending to upgrade McCain ZS in the future, however due to the scale of the upgrade it is not expected to be completed in the near future. It is expected that the connection of the three proposed loads would bring forward the planned upgrades – this may present an opportunity for better cost sharing between Unison and the loads.

8.3.9.3 Irongate

Two of the loads on Fernhill GXP are expected to connect to Irongate zone substation. The loads are Tumu Timbers Limited, and Hawke's Bay Regional Prison. The sum of peaks of these loads is 1.87 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades at Irongate are considered.

8.3.10 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Fernhill GXP gives a combined load of 1.51 MW. When the load shapes are combined, they result in the following load shape (Figure 31), with a maximum load of 1.21 MW, with a diversity factor of 0.80.

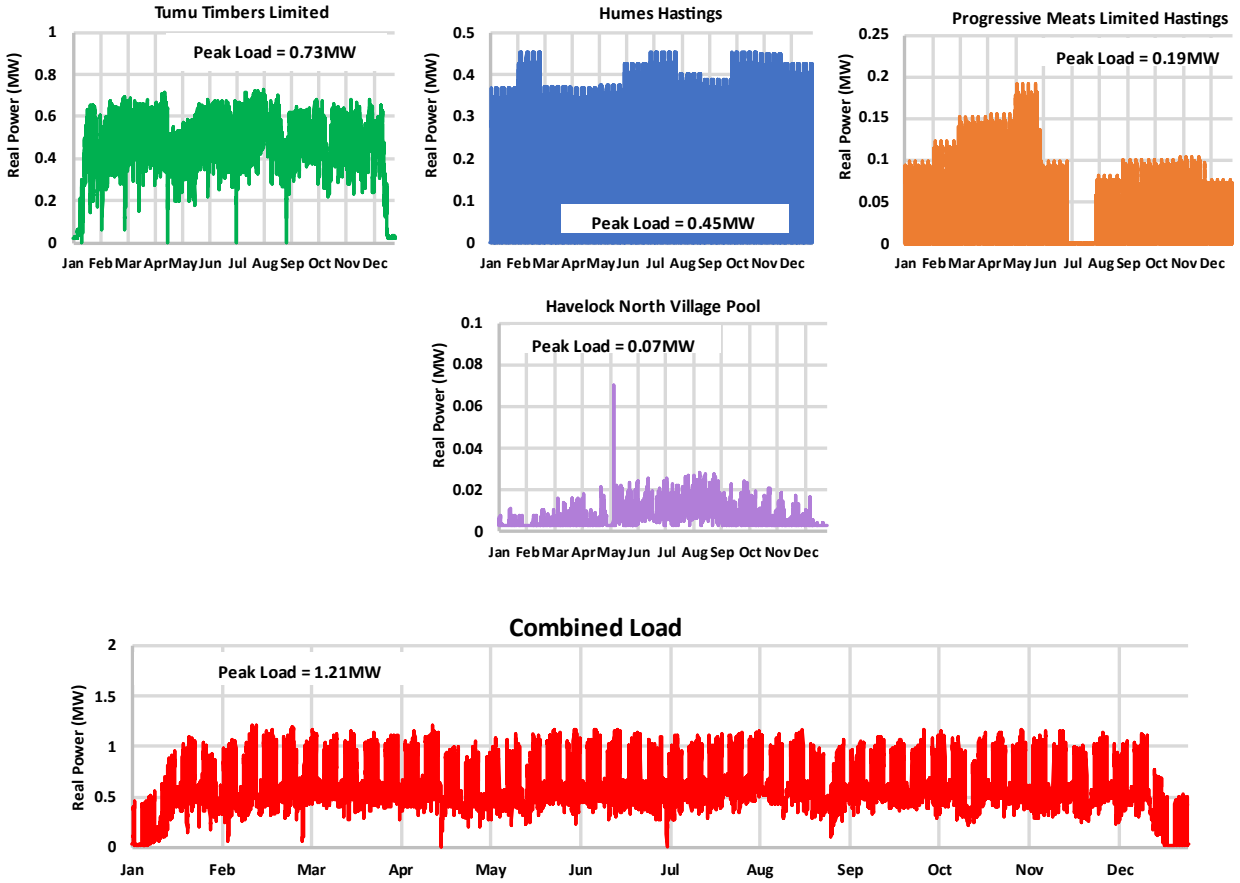


Figure 31. Loading Profiles: Fernhill GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.3.11 Effect of all Load Sites Connecting to Fernhill GXP

The following Figure 32 illustrates the Fernhill GXP load profile together with the load profiles of all the Load Sites within the Fernhill GXP region. Also shown in Figure 32 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Fernhill GXP would increase to 76.93 MW, an increase of 7.41 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 91.93 MW there is a diversity factor of 0.84 between the loads.
- Based on Ergo's analysis, the Fernhill GXP's (N-1) limit is expected to be exceeded. Ergo has discussed mitigation for this in Section 8.3.1.

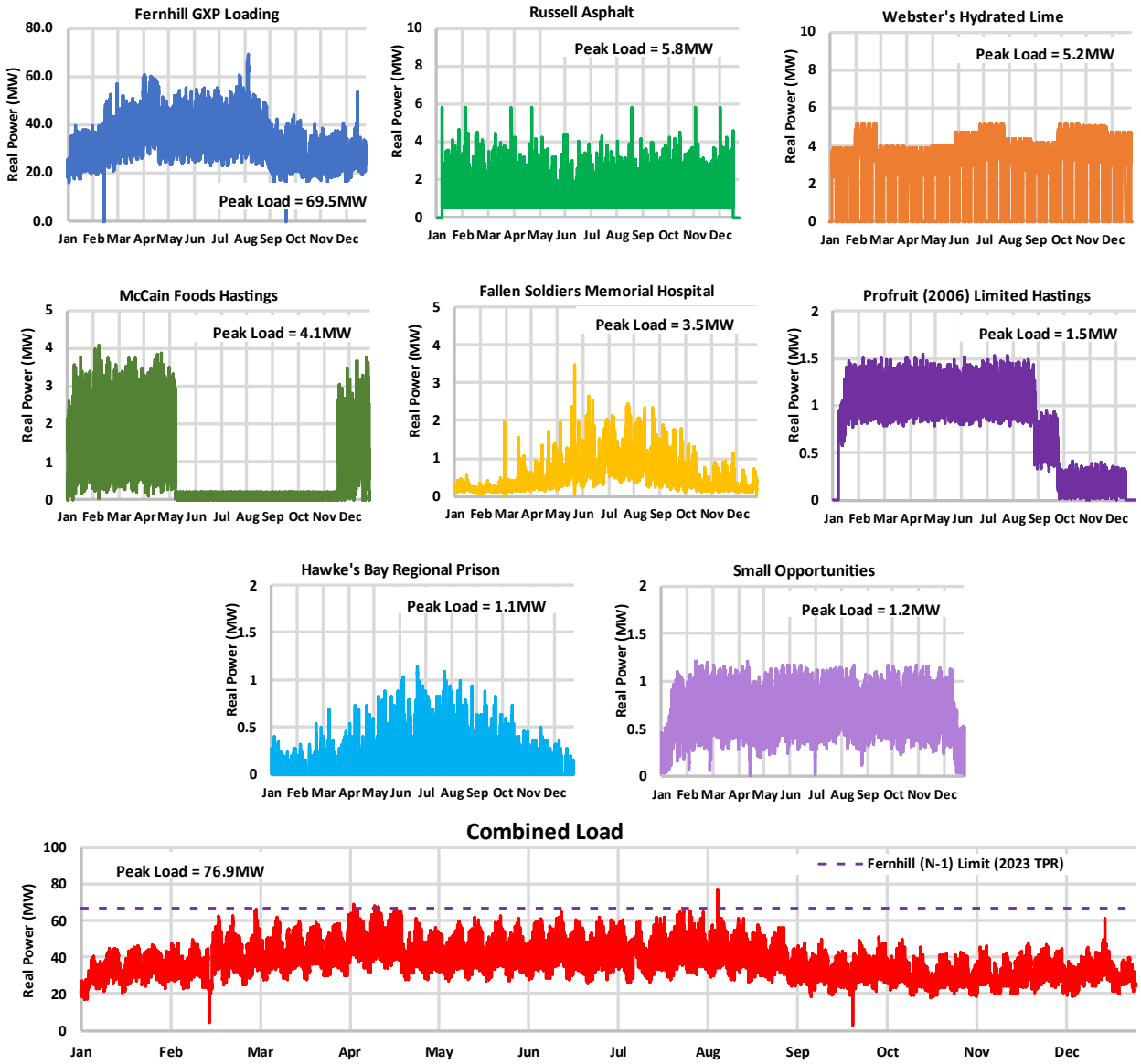


Figure 32. Loading Profiles: Fernhill GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.4 Redclyffe GXP

The "Large" EECA Load Sites connecting to the Redclyffe GXP include:

- Hawke's Bay Protein (3.89 MW)
- WoolWorks Awatoto (3.24 MW)

The "Small" Load Sites connecting to the Redclyffe GXP include (refer to sections 8.4.4 and 8.4.6):

- Higgins Napier (0.90 MW)
- Bremworth Napier (0.89 MW)
- Fresh Meats NZ Limited Napier (0.63 MW)
- Eastern Institute of Technology Hawke's Bay Campus (0.39 MW)
- AFFCO Napier (0.28 MW)
- Napier Health Centre (0.26 MW)
- ZIWI Limited Napier (0.25 MW)
- Oceania Healthcare Atawhai (0.10 MW)

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

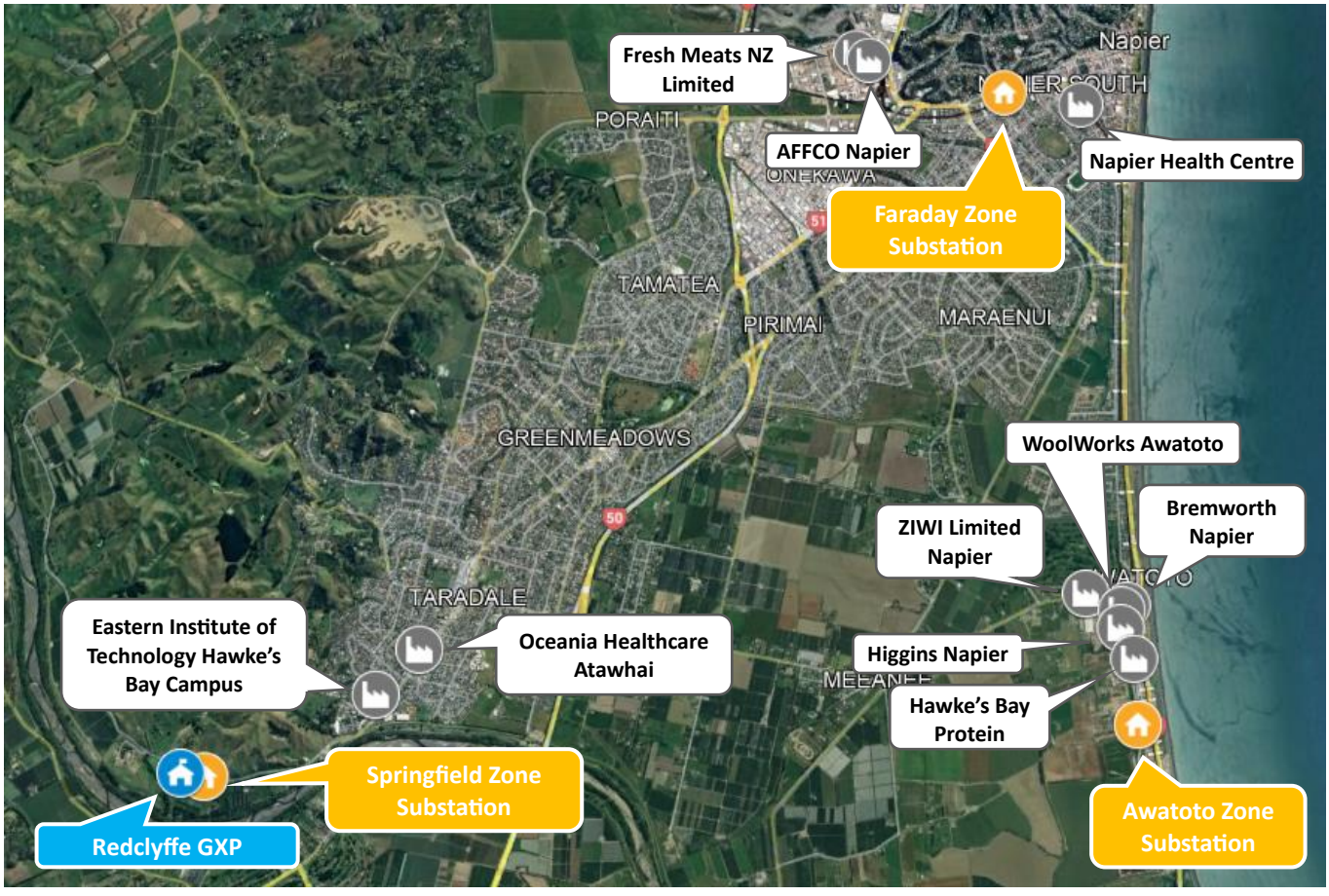


Figure 33. Redclyffe GXP: EECA Load Sites vs local substations

8.4.1 Redclyffe GXP Upgrade

The Redclyffe GXP presently has 57 MVA of spare (N-1) capacity and 167 MVA of spare (N) capacity, based on the transformer ratings.

Analysis in Section 8.4.7 indicates that the spare (N-1) capacity of the Redclyffe GXP is not expected to be exceeded if all the load sites connect. Therefore, upgrades of the Redclyffe GXP are not considered.

8.4.2 Hawke's Bay Protein

		HAWKE'S BAY PROTEIN
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	3.889	Redclyffe
Existing Electrical Supply to the Plant		

Hawke's Bay Protein is presently supplied by Unison Networks' Awatoto substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Awatoto is in turn supplied from Redclyffe GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 281 A (16 MVA) each.

This site is located approximately 0.6 km from Awatoto ZS. In turn, Awatoto ZS is approximately 8.5 km from Redclyffe GXP.

There is currently a maximum loading of 8 MVA on Awatoto zone substation, with 12 MVA of spare (N) capacity and 2 MVA of spare (N-1) capacity. Redclyffe GXP presently has 167 MVA of spare (N) capacity and 57 MVA of spare (N-1) capacity.

Figure 34. Hawke's Bay Protein geographic location in relation to the surrounding zone substations

HAWKE'S BAY PROTEIN

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity for this load, but Awatoto ZS does not have spare (N-1) capacity. To provide (N-1) capacity to the site, an upgrade to the supply transformers at Awatoto ZS is expected.

Ergo notes that design work is presently underway for upgrades at the Awatoto substation, which may present a cost sharing/saving opportunity for the connecting load/s.

Due to the size of the load, it is expected that 1 x new 11 kV feeder from Awatoto substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~0.6 km long.

Capital Cost Estimate

Table 20. Hawke's Bay Protein: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.60	$0.36
		TOTAL	**$0.46**

Table 21: Hawke's Bay Protein: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.60	$0.36
		TOTAL	**$4.26**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

HAWKE'S BAY PROTEIN
Any land acquisition and consenting, if required, is excluded.

8.4.3 WoolWorks Awatoto

		WOOLWORKS AWATOTO
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	3.224	Redclyffe
Existing Electrical Supply to the Plant		
WoolWorks Awatoto is presently supplied by Unison Networks' Awatoto substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Awatoto is in turn supplied from Redclyffe GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 281 A (16 MVA) each. This site is located approximately 1.1 km from Awatoto ZS. In turn, Awatoto ZS is approximately 8.5 km from Redclyffe GXP. There is currently a maximum loading of 8 MVA on Awatoto zone substation, with 12 MVA of spare (N) capacity and 2 MVA of spare (N-1) capacity. Redclyffe GXP presently has 167 MVA of spare (N) capacity and 57 MVA of spare (N-1) capacity.		
Supply Option(s) for New Load		
Both the zone substation and the GXP have adequate spare (N) capacity for this load, but Awatoto ZS does not have spare (N-1) capacity. To provide (N-1) capacity to the site, an upgrade to the supply transformers at Awatoto ZS is expected. Ergo notes that design work is presently underway for upgrades at the Awatoto substation, which may present a cost sharing/saving opportunity for the connecting load/s.		

Figure 35. Woolworks Awatoto geographic location in relation to the surrounding zone substations

Due to the size of the load, it is expected that 1 x new 11 kV feeder from Awatoto substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~0.95 km long.

Capital Cost Estimate

Table 22. Woolworks Awatoto: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.90	$0.57
		TOTAL	**$0.67**

Table 23: Woolworks Awatoto: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.90	$0.57
		TOTAL	**$4.47**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.4.4 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 RMUs and appropriately sized distribution transformers 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)
Higgins Napier	Awatoto	2	12	2.57	0.904	260
Bremworth Napier	Awatoto	2	12	2.57	0.885	260
Fresh Meats NZ Limited Napier	Tamatea	9	29	2.99	0.633	200
Eastern Institute of Technology Hawke's Bay Campus	Springfield	0	7	3.43	0.391	130
AFFCO Napier	Faraday Street	9	29	2.42	0.281	130
Napier Health Centre	Faraday Street	9	29	1.84	0.263	130
ZIWI Limited Napier	Awatoto	2	12	Unknown	0.247	130
Oceania Healthcare Atawhai	Springfield	0	7	3.43	0.095	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.

8.4.5 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs in this section are additional to those stated in the preceding sections assessing individual loads.

8.4.5.1 Awatoto

Five of the Load Sites on Redclyffe GXP are expected to connect to Awatoto zone substation. The loads are WoolWorks Awamoto, Bremworth Napier, Hawke's Bay Protein, Higgins Napier, and ZIWI Limited Napier. The sum of peaks of these loads is 9.15 MW, which the zone substation doesn't have (N-1) capacity for. However, the upgrades considered in the individual load analysis are considered adequate for the five connecting loads. This would present an opportunity for the five connecting Load Sites to share the costs of upgrades.

8.4.5.2 Faraday Street

Two of the Load Sites on Redclyffe GXP are expected to connect to Faraday Street zone substation. The loads are Napier Health Centre and AFFCO Napier. The sum of peaks of these loads is 0.54 MW, which the zone substation has (N-1) capacity for. Therefore, no further upgrades at Tamatea are considered.

8.4.5.3 Springfield

Two of the loads on Redclyffe GXP are expected to connect to Springfield zone substation. The loads are Eastern Institute of Technology Hawke's Bay Campus, and Oceania Healthcare Atawhai. The sum of peaks of these loads is 0.49 MW, which the zone substation doesn't have (N-1) capacity for. However, as the total load increase is low, further upgrades of the substation are not considered.

8.4.6 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Redclyffe GXP gives a combined load of 3.70 MW. When the load shapes are combined, they result in the following load shape (Figure 36), with a maximum load of 2.26 MW, with a diversity factor of 0.61.

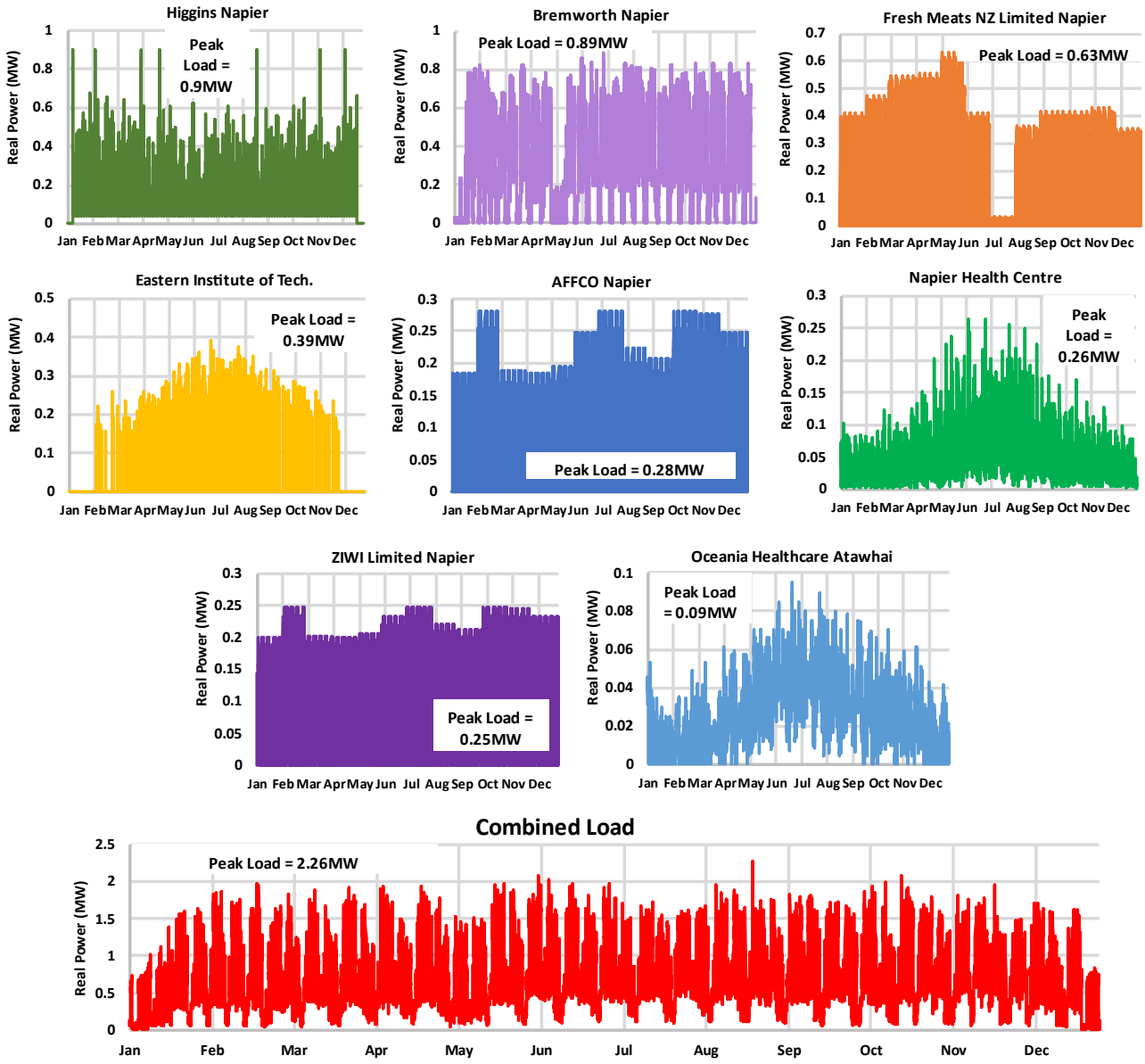


Figure 36. Loading Profiles: Redclyffe GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.4.7 Effect of all Load Sites Connecting to Redclyffe GXP

The following Figure 37 illustrates the Redclyffe GXP load profile together with the load profiles of all the Load Sites within the Redclyffe GXP region. Also shown in Figure 37 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Redclyffe GXP would increase to 77.01 MW, an increase of 3.90 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 82.51 MW there is a diversity factor of 0.93 between the loads.
- Based on Ergo's analysis, the Redclyffe GXP's (N-1) limit is not expected to be exceeded.

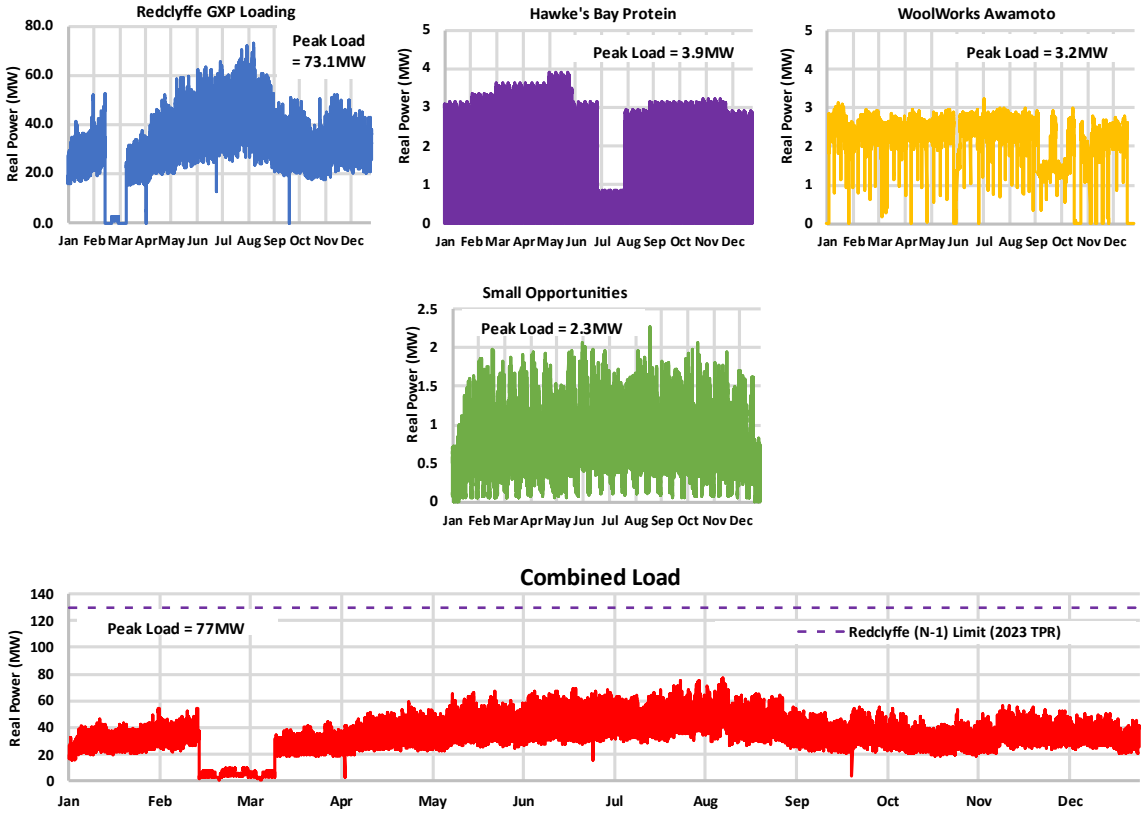


Figure 37. Loading Profiles: Redclyffe GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.5 Tuai GXP

One "small" Load Site is connecting to the Tuai GXP (refer to Section 8.5.2):

- Wairoa Hospital (0.66 MW)

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

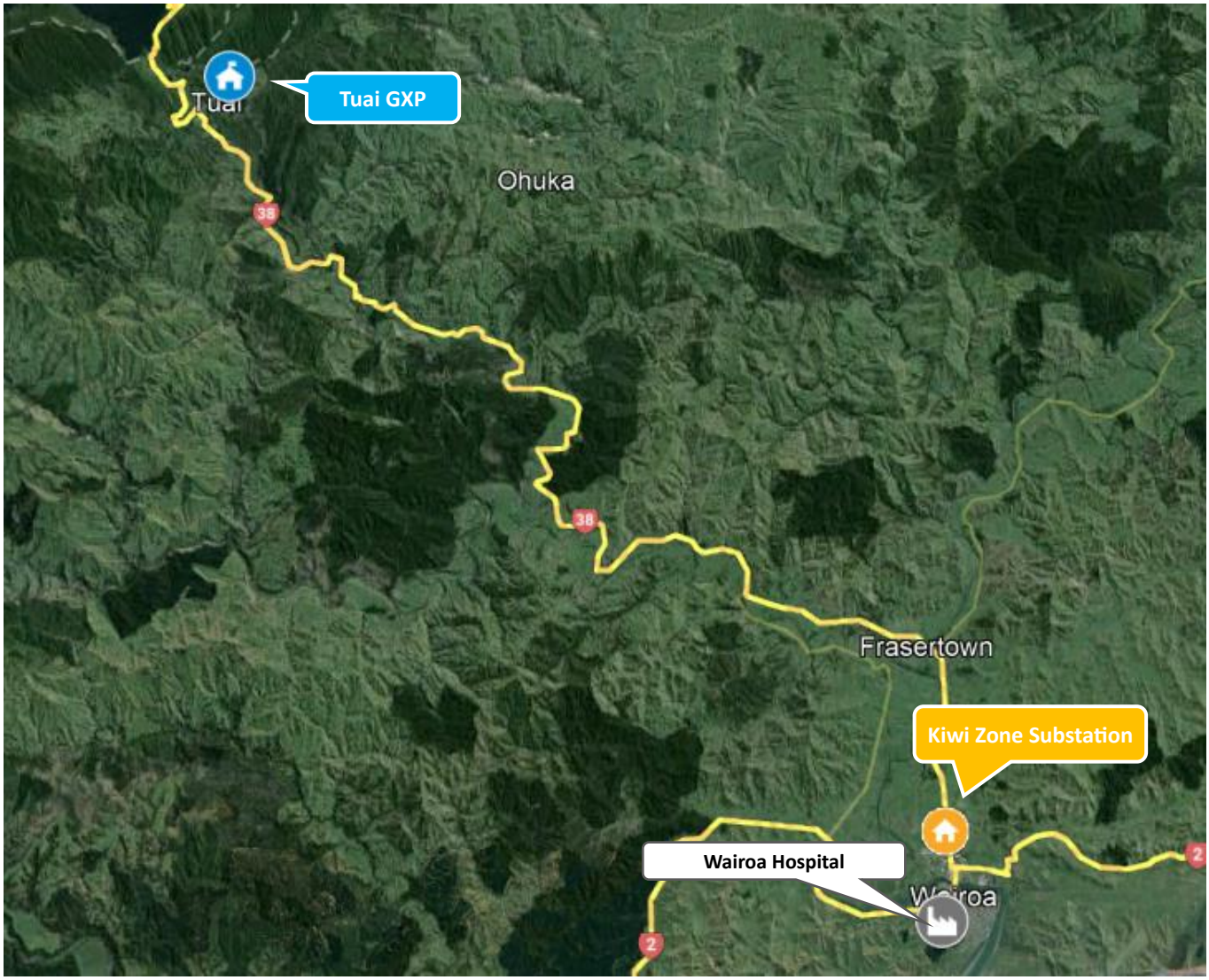


Figure 38. Tuai GXP: EECA Load Sites vs local substations

8.5.1 Tuai GXP Upgrade

As only one small load site is proposed to connect to the Tuai GXP, upgrades of the GXP are not considered.

8.5.2 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 RMUs and appropriately sized distribution transformers to supply the site.

Table 25. 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)
Wairoa Hospital	Kiwi	N/A	2	Unknown	0.66	200

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.

8.5.3 Effect of all Load Sites Connecting to Tuai GXP

The following Figure 39 illustrates the Tuai GXP load profile together with the load profiles of all the Load Sites within the Tuai GXP region. Also shown in Figure 39 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Tuai GXP would increase to 65.0 MW, an increase of 0.01 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 65.6 MVA there is a diversity factor of 0.99 between the loads.
- The single small load is not expected to have a material effect on the GXP loading.

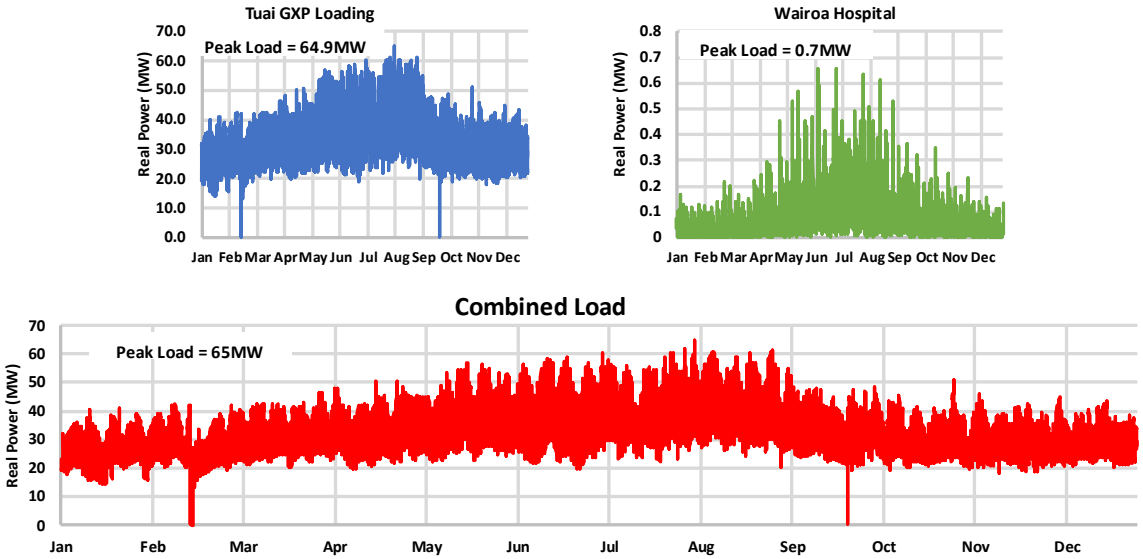


Figure 39. Loading Profiles: Tuai GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.6 Waipawa GXP

The "Large" EECA Load Sites connecting to the Waipawa GXP include:

- Silver Fern Farms Takapau (2.56 MW)
- Ovation & Pasture Petfoods (7.00 MW)

The "Small" Load Sites connecting to the Waipawa GXP include (refer to Sections 8.6.4 and 8.6.6):

- Pukeora Estate Limited Waipukurau (0.38 MW)
- Central Hawke's Bay College (0.20 MW)

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

Figure 40. Waipawa GXP: EECA Load Sites vs local substations

8.6.1 Waipawa GXP Upgrade

The Waipawa GXP presently has no spare (N-1) capacity and 26 MVA of spare (N) capacity, based on the transformer ratings.

With two large load sites, Ovation & Pasture Petfoods (~7.0 MVA) and Silver Fern Farms Takapau (~2.6 MVA), the GXP upgrades suggested for the connection of the two loads (replacements of the GXP transformers) are considered adequate for connection of all of the connecting loads (considering the small loads, in total, represent an increase of 0.6 MVA per Section 8.6.6).

8.6.2 Silver Fern Farms Takapau

		SILVER FERN FARMS TAKAPAU
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	2.564	Waipawa

Existing Electrical Supply to the Plant

Silver Fern Farms Takapau is presently supplied by Centralines' Takapau substation. It is unknown how the site is supplied but it is assumed to be via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Takapau is in turn supplied from Waipawa GXP by one 33 kV subtransmission circuit. The subtransmission circuit current ratings are unknown but assumed to be sufficient to supply the full capacity of one of the substation transformers.

This site is located approximately 0.4 km from Takapau ZS. In turn, Takapau ZS is approximately 12.2 km from Waipawa GXP.

There is currently a maximum loading of 5.8 MVA on Takapau zone substation, with 9.2 MVA of spare (N) capacity and 1.7 MVA of spare (N-1) capacity. Waipawa GXP presently has 26 MVA of spare (N) capacity and no spare (N-1) capacity.

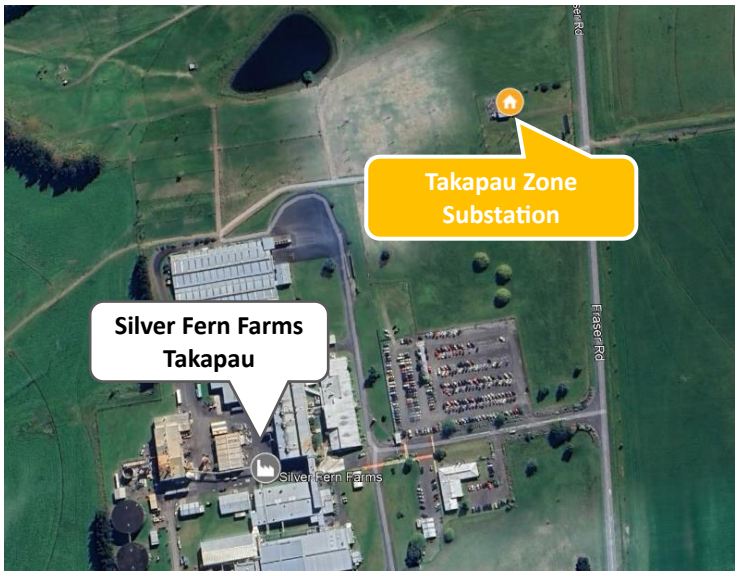


Figure 41. Silver Fern Farms Takapau geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, they're both lacking in spare (N-1) capacity.

For Takapau ZS to achieve the required spare (N-1) capacity, the transformers at Takapau ZS would need be replaced. Additionally, a second 33 kV line from the GXP and accompanying circuit breakers would be required.

To accommodate an (N) capacity condition, it is expected that a special protection scheme would be required for the transformers at Waipawa 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage.

For Waipawa 33 kV GXP to reach the required spare (N-1) capacity, the existing supply transformers would need to be upgraded/replaced.

Existing 11kV feeder loading is not known. However, due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the rural topography of the area, this would likely be an overhead line, at a length of 0.4 km.

Capital Cost Estimate

Table 26. Silver Fern Farms Takapau: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single overhead 11kV line	0.40	$0.10
		TOTAL	**$0.70**

Table 27. Silver Fern Farms Takapau: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Medium supply transformer (GXP)	2.00	$7.00
Subtransmission	33kV circuit breaker bay	2.00	$0.50
Subtransmission	Single overhead 33kV line	16.20	$5.67
Subtransmission	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single overhead 11kV line	0.40	$0.10
		TOTAL	**$17.17**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

SILVER FERN FARMS TAKAPAU
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.6.3 Ovation & Pasture Petfoods

OVATION & PASTURE PETFOODS		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and/or high temperature heat pumps	7.000	Waipawa

Existing Electrical Supply to the Plant

Ovation & Pasture Petfoods is presently supplied by Centralines' Waipukurau substation. It is unknown how the site is supplied but it is assumed to be via an 11 kV feeder which consists of a mixture of underground cable and overhead line.

Waipukurau is in turn supplied from Waipawa GXP by two direct 33 kV subtransmission circuits, and another circuit via Waipawa substation. The subtransmission circuit current ratings are unknown but assumed to be sufficient to supply the full capacity of one of the substation transformers.

This site is located approximately 0.6 km from Waipukurau ZS. In turn, Waipukurau ZS is approximately 12.0 km from Waipawa GXP.

There is currently a maximum loading of 8.5 MVA on Waipukurau zone substation, with 1.5 MVA of spare (N) capacity and 6.5 MVA of spare (N-1) capacity. Waipawa GXP presently has 26 MVA of spare (N) capacity and no spare (N-1) capacity.

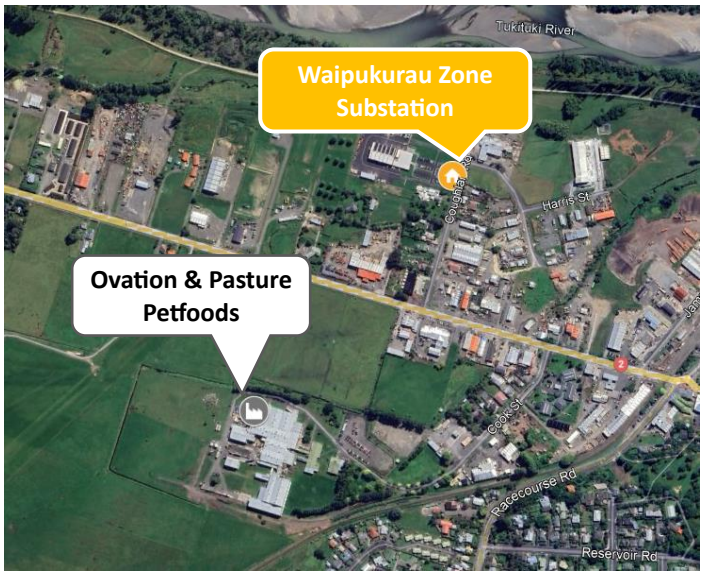


Figure 42. Waipukurau geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

The GXP has adequate spare (N) capacity for this load, but not adequate (N-1) capacity. The zone substation does not have adequate (N) or (N-1) spare capacity for this load.

OVATION & PASTURE PETFOODS

Stage 1: 5.5 MW

Ergo understands that the existing supply to the site has already been upgraded to supply up to 3 MW. The site has recently increased its load by 1.54 MW, with plans to utilise the remaining capacity up to 3 MW by the end of 2024.

A transformer has been installed at the site to provide an additional 2.5 MW supply to the site. However, this is limited to 1.3 MW in the short-term, while Centralines works to increase zone substation capacity.

To accommodate an (N) capacity condition, it is expected that a special protection scheme would be required for the transformers at Waipawa 33 kV GXP, to avoid overloading the remaining transformer in the event of a single transformer outage. For an (N-1) supply, upgrades of the Waipawa GXP transformers (including installing on-load tap changers) would be required.

It is expected that to accommodate the total Stage 1 load of 5.5 MW, no additional upgrades would be required for an (N) supply, while for an (N-1) supply, Centralines has advised that larger transformers at Waipukurau substation would be required. Ergo notes that for an (N) or (N-1) supply for this stage, some network switching may be required to offload some load from the existing feeders from Waipukurau to the nearby Waipawa zone substation.

Stage 2: 7.0 MW

The second stage of expansion at this site, presently planned for ~2027-2028, adds an additional 1.5 MW onto the Stage 1 load, for a total load of 7 MW.

To accommodate an (N) capacity condition, it is expected that voltage support may be required at Waipawa GXP, e.g. a 33 kV capacitor bank.

For an (N-1) supply condition, it is expected that the transformer replacements carried out in Stage 1 at both the GXP and the zone substation would provide enough capacity for the additional load. No additional transformer upgrades are expected.

For both an (N) and an (N-1) supply option, it is expected that a new feeder from the zone substation to the site would be required.

Capital Cost Estimate

Table 28. Ovation & Pasture Petfoods: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 1).

Transmission => (N)	Subtransmission => (N)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**
Transmission	Special protection system (GXP)	1.00 $0.50
	TOTAL	**$0.50**

OVATION & PASTURE PETFOODS

Table 29. Ovation & Pasture Petfoods: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 1).

Transmission =>	(N-1)	Subtransmission =>	(N-1)	Distribution =>	(N)
Network Asset		**Equipment**		**Number and Capital Cost ($M)**	
Transmission		Medium supply transformer (GXP)	2.00	$7.00	
Subtransmission		Medium supply transformer (ZS)	2.00	$3.80	
			TOTAL	**$10.80**	

Table 30. Ovation & Pasture Petfoods: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 2).

Transmission =>	(N)	Subtransmission =>	(N)	Distribution =>	(N)
Network Asset		**Equipment**		**Number and Capital Cost ($M)**	
Transmission		33kV Capacitor Bank	1.00	$0.40	
Distribution		11kV circuit breaker (ZS)	1.00	$0.10	
Distribution		Single underground 11kV cable	1.50	$0.90	
			TOTAL	**$1.40**	

Table 31. Ovation & Pasture Petfoods: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 2).

Transmission =>	(N-1)	Subtransmission =>	(N-1)	Distribution =>	(N)
Network Asset		**Equipment**		**Number and Capital Cost ($M)**	
Distribution		11kV circuit breaker (ZS)	1.00	$0.10	
Distribution		Single underground 11kV cable	1.50	$0.90	
			TOTAL	**$1.00**	

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-18 months
- Stage 2 – 24-36 months

OVATION & PASTURE PETFOODS
For the (N-1) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage: • Stage 1 – 36-48 months • Stage 2 – 12-18 months Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.6.4 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 RMUs and appropriately sized distribution transformers to supply the site.

Table 32. 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)
Pukeora Estate Limited Waipukurau	Waipukurau	1.5	6.5	Unknown	0.375	130
Central Hawke's Bay College	Waipukurau	1.5	6.5	Unknown	0.202	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.

8.6.5 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs in this section are additional to those stated in the preceding sections assessing individual loads.

8.6.5.1 Waipukurau

Three of the loads on Waipawa GXP are expected to connect to Waipukurau zone substation. The loads are Ovation & Pasture Petfoods, Central Hawke's Bay College, and Pukeora Estate Limited Waipukurau. The sum of peaks of these loads is 7.58 MW, which the zone substation does not have (N-1) capacity for. However, the upgrades specified for Ovation & Pasture Petfoods are expected to be adequate for all of the loads connecting. Ergo notes that should the other two loads connect earlier, the transformer upgrades required for the Ovation & Pasture Petfoods supplies may be brought forward.

8.6.6 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Waipawa GXP gives a combed load of 0.58 MW. When the load shapes are combined, they result in the following load shape (Figure 43), with a maximum load of 0.56 MW, with a diversity factor of 0.97.

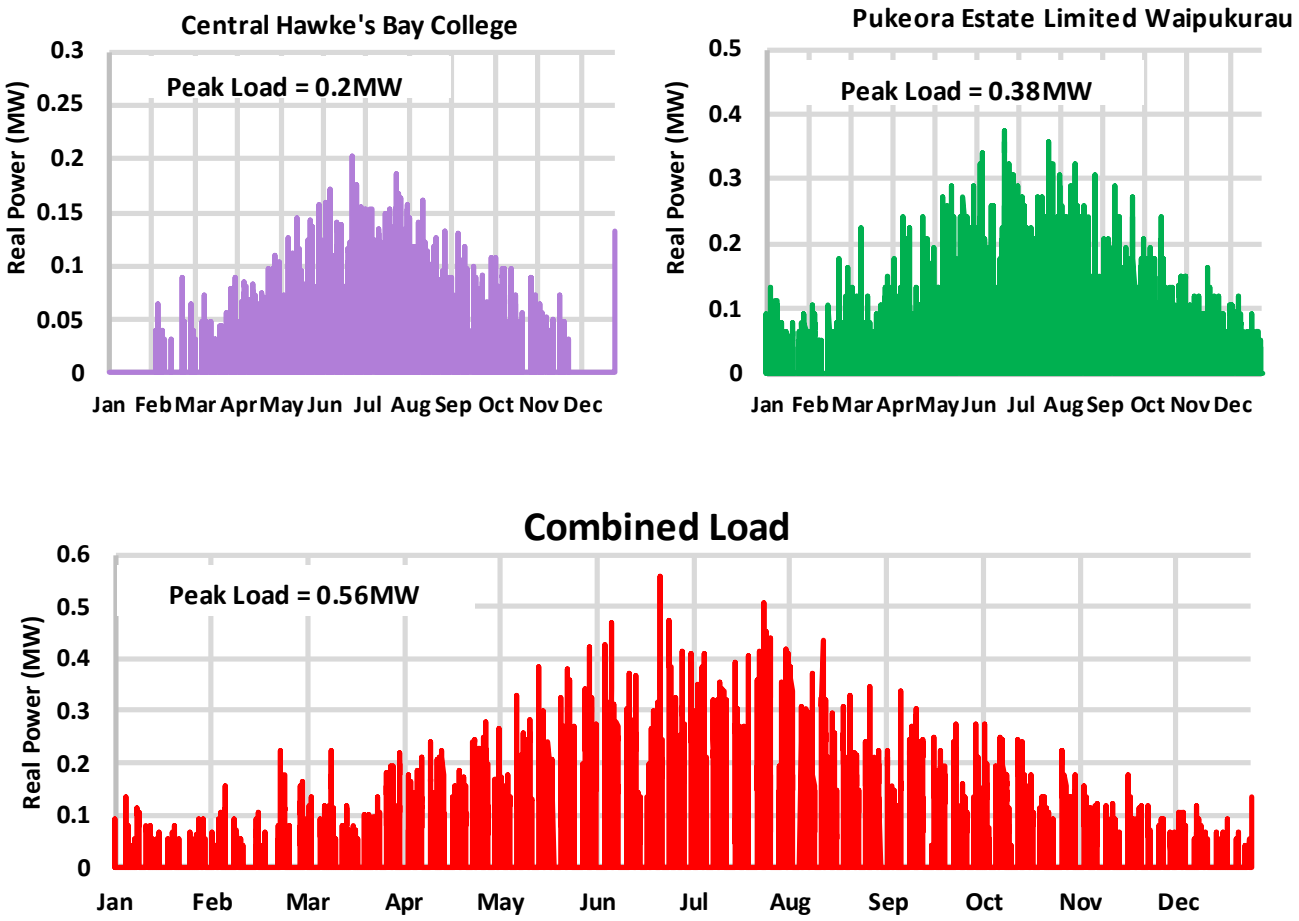


Figure 43. Loading Profiles: Waipawa GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.6.7 Effect of all Load Sites Connecting to Waipawa GXP

The following Figure 44 illustrates the Waipawa GXP load profile together with the load profiles of all the Load Sites within the Waipawa GXP region. Also shown in Figure 44 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Waipawa GXP would increase to 31.6 MW, an increase of 8.2 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 33.53 MW there is a diversity factor of 0.94 between the loads.
- Based on Ergo's analysis, the Waipawa GXP's (N-1) limit is expected to be exceeded. Ergo has discussed mitigation for this in Section 8.6.1.

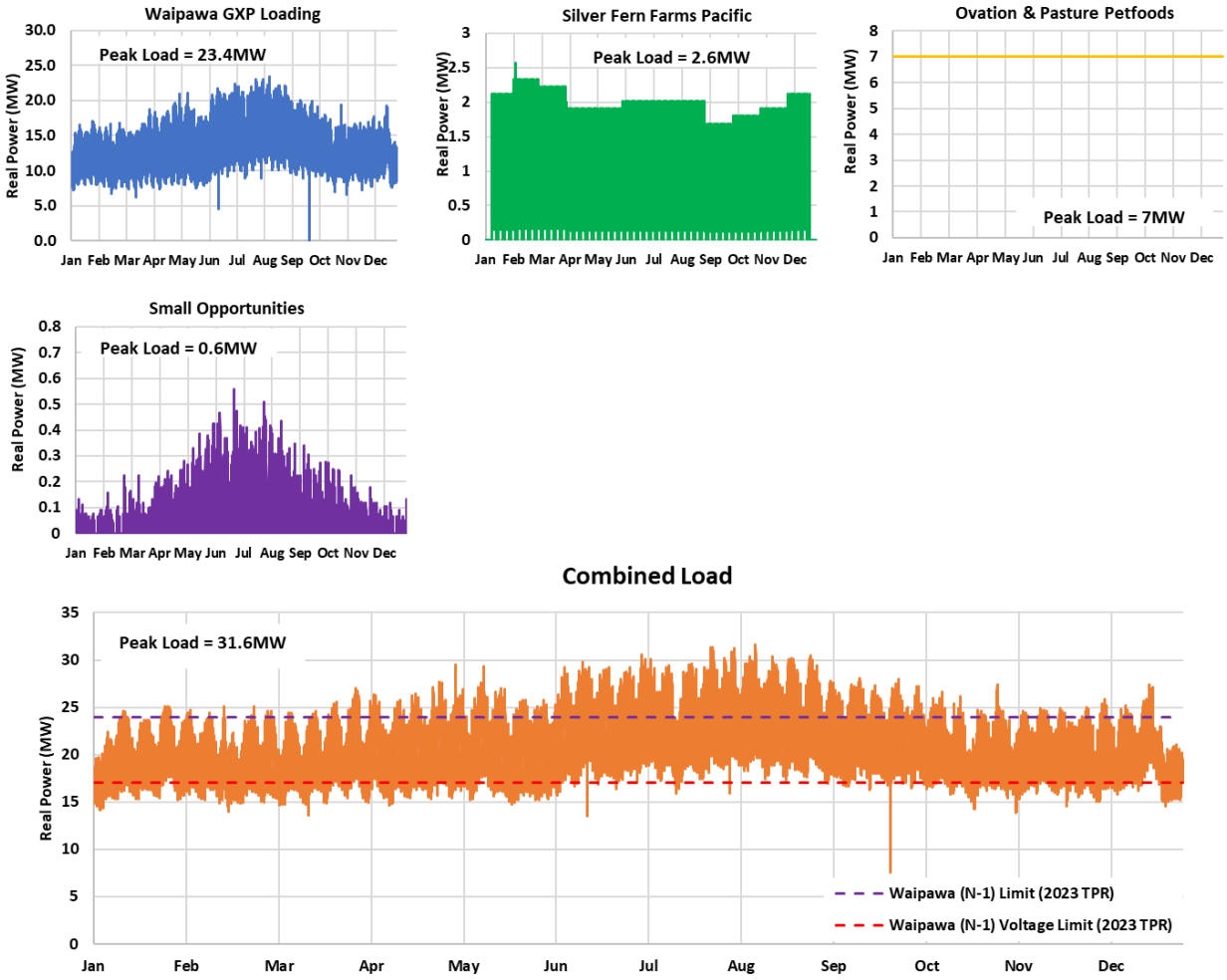


Figure 44. Loading Profiles: Waipawa GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.7 Whakatu GXP

The "Large" EECA Load Sites connecting to the Whakatu GXP include:

- Heinz Watties Ltd King Street (24.17 MW)
- Cedenco Foods Fresh Fields (10.00 MW)
- Heinz Watties Ltd Tomoana (5.64 MW)
- Diamond Apparelmaster (4.09 MW)
- Higgins Port of Napier (4.02 MW)
- Lowe Corporation Hastings Tannery (3.73 MW)
- Hawk Group (3.63 MW)
- Silver Fern Farms Pacific (1.70 MW)
- WoolWorks Clive (2.46 MW)
- Progressive Leathers Limited (2.20 MW)

The "Small" Load Sites connecting to the Whakatu GXP include (refer to Sections 8.7.12 and 8.7.14):

- Liqueo Bulk Storage Port of Napier (0.28 MW)
- William Colenso College (0.22 MW)
- Splash Planet (0.14 MW)
- Oceania Healthcare Gracelands (0.13 MW)
- MTG Hawke's Bay (0.11 MW)
- Oceania Healthcare Eversley (0.07 MW)
- Scenic Hotel Te Pania (0.07 MW)
- Clive War Memorial Pool (0.02 MW)

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

Figure 45. Whakatu GXP: EECA Load Sites vs local substations (note some of the loads and substations shown above connect to Redclyffe GXP rather than Whakatu)

8.7.1 Whakatu GXP Upgrade

The Whakatu GXP presently has no spare (N-1) capacity and 88 MVA of spare (N) capacity, based on the transformer ratings.

Analysis in Section 8.7.15 indicates that the spare (N-1) capacity of the Whakatu GXP is expected to be exceeded if all the load sites connect, with a total increase in GXP load of 31.80 MW. To accommodate the increased load, it is expected that transformer replacements would be required at Whakatu, at a cost of approximately $9M. Ergo notes that these transformer upgrades are already included in the analysis for each of the larger loads for an (N-1) option. If more loads connect, it is possible that the costs of these transformer upgrades may be spread between more of the Load Sites.

8.7.2 Heinz Watties Ltd King Street

		HEINZ WATTIES LTD KING STREET
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	24.173	Whakatu
Existing Electrical Supply to the Plant		
Heinz Watties Ltd King Street is presently supplied by Unison Networks' Mahora substation via two dedicated underground 11 kV feeders (Watties A and B), with a backfeed option from a third 11 kV Mahora feeder (Cornwall). Mahora is in turn supplied from Whakatu GXP by two 33 kV subtransmission circuits, one of which is via Tomoana substation, with the second circuit (not via Tomoana) which is able to be switched onto Fernhill GXP if required. The subtransmission circuits are rated to approximately 625 A (35.7 MVA) and 537 A (30.7 MVA), respectively. This site is located approximately 1.2 km from Mahora ZS. In turn, Mahora ZS is approximately 3.2 km from Whakatu GXP. There is currently a maximum loading of 10 MVA on Mahora zone substation, with 20 MVA of spare (N) capacity and 0 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity. There is a current maximum loading of 7 MVA on Tomoana ZS, meaning that the lines supplying Tomoana and Mahora are presently loaded to a maximum of ~17 MVA, with ~13 MVA of spare (N-1) capacity. The lines supplying the nearby Windsor and Hastings substations have minimal (N-1) capacity, and so these substations are not considered as an alternate option to supply the load.		

HEINZ WATTIES LTD KING STREET

Figure 46. Heinz Watties Ltd King Street geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Due to the size of this load, analysis considers two stages of installation – the first being 11 MVA, and the second being the remaining 13.173 MVA.

Stage 1 – 11 MVA

The Whakatu GXP and Mahora zone substation both have adequate spare (N) but not (N-1) capacity for the proposed load.

To supply the 11 MVA load with (N) security, it is expected that two new 11 kV feeders from the zone substation to the site would be required, which would be underground cabled due to the urban/industrial topography, and would be ~1.8 km long. It has been assumed that these feeders would be rated to 33 kV, to accommodate the Stage 2 upgrades.

To supply the 11 MVA load with (N-1) security, additional to the 2x new 11 kV feeders, upgrades/replacements of the Mahora zone substation transformers would be required. Upgrades/replacements of the existing Whakatu GXP transformers would also be required.

Ergo notes that the Mahora zone substation is planned for renewal in the near future, which may present a cost sharing opportunity for the load with Unison.

Stage 2 – 13.173 MVA

The second stage for this load brings the total connecting additional load to 24.173 MVA (including Stage 1's 11 MVA).

Due to the size of the load, it is expected that at this stage a new zone substation would be required at the site. For both an (N) or an (N-1) supply, the two feeders from Mahora substation would be upgraded to/reconnected at 33 kV.

To supply the ~24 MVA load with (N) security, it is expected that a new 33/11 kV transformer and accompanying switchboard/s would be required at the site. A special protection scheme would also be required on the GXP, to prevent overload of one transformer should the other trip.

To supply the ~24 MVA load with (N-1) security, it is expected that two new 33/11 kV transformers and accompanying switchboard/s would be required at the site. Additionally, a third 33 kV circuit would be required between Mahora zone substation and the Whakatu GXP – this 33 kV circuit is assumed to be via underground cables.

Capital Cost Estimate

Table 33. Heinz Watties Ltd King Street: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 1).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Double underground 33kV cable	1.80	$2.52
		TOTAL	$2.72

Table 34. Heinz Watties Ltd King Street: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 1).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Large supply transformer (ZS)	2.00	$4.60
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Double underground 33kV cable	1.80	$2.52
		TOTAL	$16.32

Table 35. Heinz Watties Ltd King Street: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 2).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	

Transmission	Special protection system (GXP)	1.00	$0.50
Subtransmission	33kV circuit breaker (ZS)	5.00	$1.50
Subtransmission	Large supply transformer (ZS)	1.00	$2.30
Distribution	Medium switchroom (ZS)	1.00	$3.00
		TOTAL	**$7.30**

Table 36. Heinz Watties Ltd King Street: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 2).

Transmission =>	**(N-1)**	**Subtransmission =>**	**(N-1)**	**Distribution =>**
Network Asset	**Equipment**			**Number and Capital Cost**
Transmission	33kV circuit breaker bay		1.00	$0.25
Subtransmission	Single underground 33kV cable		1.00	$0.90
Subtransmission	33kV circuit breaker (ZS)		7.00	$2.10
Subtransmission	Large supply transformer (ZS)		2.00	$4.60
Distribution	Large switchroom (ZS)		1.00	$4.00
			TOTAL	**$11.85**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-18 months
- Stage 2 – 36-48 months

For the (N-1) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 24-36 months
- Stage 2 – 36-48 months

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.3 Cedenco Foods Fresh Fields

		CEDENCO FOODS FRESH FIELDS
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	10.000	Whakatu
Existing Electrical Supply to the Plant		

Cedenco Foods Fresh Fields is presently supplied by Unison Networks' Tomoana substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Tomoana is in turn supplied from Whakatu GXP by two 33 kV subtransmission circuits, one of which is via Mahora substation. The subtransmission circuits are rated to approximately 537 A (30.7 MVA) and 625 A (35.7 MVA), respectively.

This site is located approximately 0.5 km from Tomoana ZS. In turn, Tomoana ZS is approximately 2.6 km from Whakatu GXP.

There is currently a maximum loading of 7 MVA on Tomoana zone substation, with 8 MVA of spare (N) capacity and 1 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity. There is currently a maximum loading of 10 MVA on the nearby Mahora zone substation, with 20 MVA of spare (N) capacity and 0 MVA of spare (N-1) capacity.

Tomoana shares the lines supplying it with Mahora zone substation. Given the loadings above, the lines supplying Tomoana and Mahora are presently loaded to a maximum of ~17 MVA, with ~13 MVA of spare (N-1) capacity.

Figure 47. Cedenco Foods Fresh Fields geographic location in relation to the surrounding zone substations

CEDENCO FOODS FRESH FIELDS

Supply Option(s) for New Load

Whakatu GXP has adequate spare (N) but not (N-1) capacity for this site, and Tomoana ZS does not have sufficient spare (N-1) or (N) capacity for the new load.

For an (N) security supply, rather than taking supply from Tomoana, the site may be supplied from Mahora substation, which does have (N) capacity for the load. This would require installation of 2x 11 kV feeders, which would be ~0.3 km long.

For an (N-1) subtransmission security supply, it is expected that transformer upgrades would be required at Tomoana substation and at Whakatu GXP. Ergo notes that Unison is presently planning an upgrade of the Tomoana substation transformers for 2023-2024, so potentially, the substation will have already been upgraded, however, costs for this are included below to be conservative. Additionally, 2x new 11 kV feeders to the site would be required, which would be underground due to the urban/industrial topography. The feeders would each be ~0.5 km long.

Capital Cost Estimate

Table 37. Cedenco Foods Fresh Fields: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)		Subtransmission => (N)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.20
Distribution	Double underground 11kV cable	0.30	$0.24
		TOTAL	**$0.44**

Table 38. Cedenco Foods Fresh Fields: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)		Subtransmission => (N-1)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Double underground 11kV cable	0.50	$0.40
		TOTAL	**$13.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

CEDENCO FOODS FRESH FIELDS
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.7.4 Heinz Watties Ltd Tomoana

		HEINZ WATTIES LTD TOMOANA
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.639	Whakatu

Existing Electrical Supply to the Plant

Heinz Watties Limited Tomoana is presently supplied by Unison Networks' Tomoana substation via an 11 kV feeder which consists of an underground cable. Tomoana is in turn supplied from Whakatu GXP by two 33 kV subtransmission circuits, one of which is via Mahora substation. The subtransmission circuits are rated to approximately 537 A (30.7 MVA) and 625 A (35.7 MVA), respectively.

This site is located approximately 0.1 km from Tomoana ZS. In turn, Tomoana ZS is approximately 2.6 km from Whakatu GXP.

There is currently a maximum loading of 7 MVA on Tomoana zone substation, with 8 MVA of spare (N) capacity and 1 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

Tomoana shares the lines supplying it with Mahora zone substation. Mahora zone substation is presently loaded to a maximum of 10 MVA, meaning the lines supplying Tomoana and Mahora are presently loaded to a maximum of ~17 MVA, with ~13 MVA of spare (N-1) capacity.

Figure 48. Heinz Watties Ltd Tomoana geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate spare (N) but not (N-1) capacity for this site, and Tomoana ZS does not have sufficient spare (N-1) or (N) capacity for the new load.

For an (N-1) security supply, it is expected that transformer upgrades would be required at Tomoana substation and at Whakatu GXP. Ergo notes that Unison is presently planning an upgrade of the

HEINZ WATTIES LTD TOMOANA

Tomoana substation transformers for 2023-2024, so potentially, the substation will have already been upgraded, however, costs for this are included below to be conservative.

The existing Heinz site is supplied via 2x 11kV feeders (Nelsons A & Nelsons B) each loaded to 3.25MVA. Due to the size of the load, for both an (N) or an (N-1) supply, it is expected that 1 x new 11 kV feeder from Tomoana ZS would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~0.1 km long.

Capital Cost Estimate

Table 39. Heinz Watties Ltd Tomoana: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11 kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.10	$0.06
		TOTAL	**$0.16**

Table 40. Heinz Watties Ltd Tomoana: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.10	$0.06
		TOTAL	**$12.96**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.5 Diamond Apparelmaster

		DIAMOND APPARELMASTER
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	4.086	Whakatu

Existing Electrical Supply to the Plant

Diamond Apparelmaster is presently supplied by Unison Networks' Rangitane substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Rangitane is in turn supplied from Whakatu GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 450 A (25 MVA) each.

This site is located approximately 0.9 km from Rangitane ZS. In turn, Rangitane ZS is approximately 0.6 km from Whakatu GXP.

There is currently a maximum loading of 19 MVA on Rangitane zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

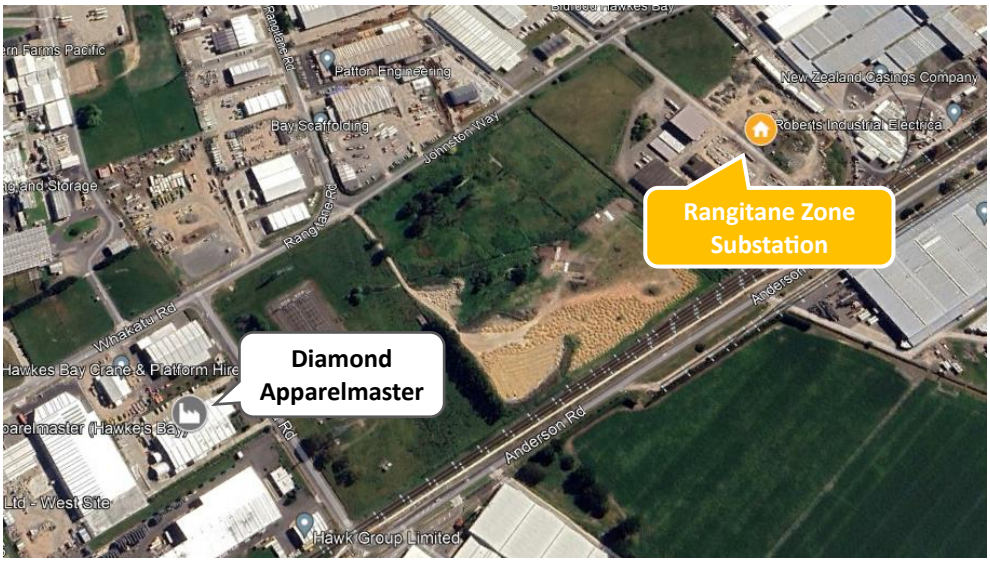


Figure 49. Diamond Apparelmaster geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate spare (N) but not (N-1) capacity for this site, and the substation has adequate spare (N-1) and (N) capacity for this load.

Due to the size of the load, it is expected that 1 x new 11 kV feeder from Rangitane substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~0.9 km long.

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

DIAMOND APPARELMASTER

Capital Cost Estimate

Table 41. Diamond Apparelmaster: Capital cost estimate to supply the Load Site with (N) supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11 kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.90	$0.54
		TOTAL	$0.64

Table 42. Diamond Apparelmaster: Capital cost estimate to supply the Load Site with (N-1) supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.90	$0.54
		TOTAL	**$9.64**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.6 Higgins Port of Napier

		HIGGINS PORT OF NAPIER
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	4.024	Whakatu
Existing Electrical Supply to the Plant		

Higgins Port of Napier is presently supplied by Bluff Hill substation via two 11 kV feeders which consists of a mixture of underground cable and overhead line. Bluff Hill is in turn supplied from Whakatu GXP by 1x 33 kV subtransmission circuit. The subtransmission circuit is rated to approximately 700 A (40 MVA).

This site is located approximately 1.6 km from Bluff Hill ZS. In turn, Bluff Hill ZS is approximately 13.7 km from Whakatu GXP.

There is currently a maximum loading of 9 MVA on Bluff Hill zone substation, with 21 MVA of spare (N) capacity and no (N-1) capacity (the substation operates on (N) security at all times at present). Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

The nearby Faraday zone substation is presently loaded to a maximum of 11 MVA, with 9 MVA of spare (N-1) capacity and 29 MVA of spare (N) capacity.

Figure 50. Higgins Port of Napier geographic location in relation to the surrounding zone substations

HIGGINS PORT OF NAPIER

Supply Option(s) for New Load

Whakatu GXP and Bluff Hill zone substation both have adequate spare (N) but not (N-1) capacity for this site.

Given the spatial constraints at Bluff Hill Substation, it is unlikely that a second transformer can be installed to provide (N-1) capacity for this load. Therefore, it is expected for an (N-1) security supply, the load would instead be supplied from Faraday ZS, which does have (N-1) capacity for the load.

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Due to the size of the load, it is expected that 1x new 11 kV feeder would be required for this project. Due to the urban topography, it is expected that this feeder would be underground. If from Bluff Hill ZS, it would be ~1.9 km long. If from Faraday ZS, it would be ~3.2 km long.

Capital Cost Estimate

Table 43: Higgins Port of Napier: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission =>	(N)	Subtransmission =>	(N)	Distribution =>	(N-1)
Network Asset	Equipment		Number and Capital Cost ($M)		
Distribution	11kV circuit breaker (ZS)		1.00	$0.10	
Distribution	Single underground 11kV cable		1.90	$1.14	
			TOTAL	$1.24	

Table 44: Higgins Port of Napier: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission =>	(N-1)	Subtransmission =>	(N-1)	Distribution =>	(N)
Network Asset	Equipment		Number and Capital Cost ($M)		
Transmission	Large supply transformer (GXP)		2.00	$9.00	
Distribution	11kV circuit breaker (ZS)		1.00	$0.10	
Distribution	Single underground 11kV cable		3.20	$1.92	
			TOTAL	$11.02	

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

HIGGINS PORT OF NAPIER
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.7.7 Lowe Corporation Hastings Tannery

LOWE CORPORATION HASTINGS TANNERY		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers	3.727	Whakatu
Existing Electrical Supply to the Plant		

Lowe Corporation Hastings Tannery is presently supplied by Unison Networks' Tomoana substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Tomoana is in turn supplied from Whakatu GXP by two 33 kV subtransmission circuits, one of which is via Mahora substation. The subtransmission circuits are rated to approximately 537 A (30.7 MVA) and 625 A (35.7 MVA), respectively.

This site is located approximately 0.6 km from Tomoana ZS. In turn, Tomoana ZS is approximately 2.6 km from Whakatu GXP.

There is currently a maximum loading of 7 MVA on Tomoana zone substation, with 8 MVA of spare (N) capacity and 1 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

Tomoana shares the circuits supplying it with Mahora zone substation. Mahora zone substation is presently loaded to a maximum of 10 MVA, meaning the circuits supplying Tomoana and Mahora are presently loaded to a maximum of ~17 MVA, with ~13 MVA of spare (N-1) capacity.

Figure 51. Lowe Corporation Hastings Tannery geographic location in relation to the surrounding zone substations

LOWE CORPORATION HASTINGS TANNERY

Supply Option(s) for New Load

Whakatu GXP has adequate spare (N) but not (N-1) capacity for this site, and Tomoana ZS does not have sufficient spare (N-1) or (N) capacity for the new load.

For an (N-1) security supply, it is expected that transformer upgrades would be required at Tomoana substation. Ergo notes that Unison is presently planning an upgrade of the Tomoana substation transformers for 2023-2024, so potentially, the substation will have already been upgraded, however, costs for this are included below to be conservative.

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Due to the size of the load, it is expected that 1 x new 11 kV feeder from Tomoana ZS would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~0.6 km long.

Capital Cost Estimate

Table 45. Lowe Corporation Hastings Tannery: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.60	$0.36
		TOTAL	**$0.46**

Table 46. Lowe Corporation Hastings Tannery: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	Medium supply transformer (ZS)	2.00	$3.80
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.60	$0.36
		TOTAL	**$13.26**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

LOWE CORPORATION HASTINGS TANNERY
It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.7.8 Hawk Group

HAWK GROUP		
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	3.636	Whakatu
Existing Electrical Supply to the Plant		

Hawk Group is presently supplied by Unison Networks' Rangitane substation via an underground 11 kV feeder. Rangitane is in turn supplied by two 33 kV subtransmission circuits from Whakatu GXP. These subtransmission circuits are rated to approximately 437 A (25 MVA) and 610 A (34 MVA).

This site is located approximately 0.8 km from Rangitane ZS. In turn, Rangitane ZS is approximately 0.6 km from Whakatu GXP.

There is currently a maximum loading of 19 MVA on Rangitane zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

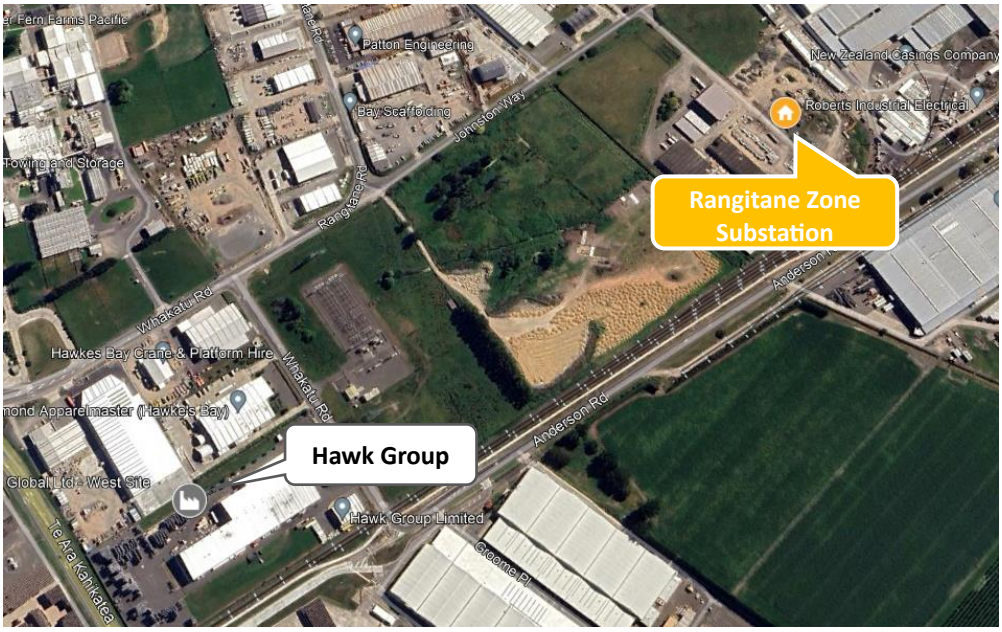


Figure 52. Hawk Group geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate (N) capacity but not (N-1) capacity for this load. The zone substation has adequate spare (N) and (N-1) capacity for this load.

Hawk Group is currently supplied via a single underground 11kV feeder (Treeo) which is loaded to 3.07 MVA. Due to the size of the load, it is expected that 1 x new 11 kV feeder from Rangitane substation would be required for this project. Due to the urban/industrial topography, it is expected that this feeder would be underground, and would be ~1.2 km long.

HAWK GROUP

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Capital Cost Estimate

Table 47. Hawk Group: Capital cost estimate to supply the Load Site with (N) supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.20	$0.72
		TOTAL	**$0.82**

Table 48. Hawk Group: Capital cost estimate to supply the Load Site with (N-1) supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.20	$0.72
		TOTAL	**$9.82**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.9 Silver Fern Farms Pacific

SILVER FERN FARMS PACIFIC		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	1.7	Whakatu

Existing Electrical Supply to the Plant

Silver Fern Farms Pacific is presently supplied by Unison Networks' Rangitane substation via two underground 11 kV feeders. Rangitane is in turn supplied by two 33 kV subtransmission circuits from Whakatu GXP. These subtransmission circuits are rated to approximately 437 A (25 MVA) and 610 A (34 MVA).

This site is located approximately 1.0 km from Rangitane ZS. In turn, Rangitane ZS is approximately 0.6 km from Whakatu GXP.

There is currently a maximum loading of 19 MVA on Rangitane zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

Figure 53. Silver Fern Farms Pacific geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate (N) capacity but not (N-1) capacity for this load. The zone substation has adequate spare (N) and (N-1) capacity for this load.

Silver Fern Farms Pacific is currently supplied via two undergound 11kV feeders (Pakowhai and Pacific) which are loaded to 4.1 MVA and 2.5 MVA, respectively. It is expected that the existing feeders to the site would be able to accommodate the proposed 1.7 MVA increase in load.

Any costs expected for this load for an (N) security supply would be those associated with new distribution transformers/RMUs located on the plant site.

SILVER FERN FARMS PACIFIC

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Capital Cost Estimate

Table 49. Silver Fern Farms Pacific: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

(N/A)

Table 50. Silver Fern Farms Pacific: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.30	$0.78
		TOTAL	**$9.88**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 3-6 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.10 WoolWorks Clive

WOOLWORKS CLIVE		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	2.456	Whakatu

Existing Electrical Supply to the Plant

WoolWorks Clive is presently supplied by Unison Networks' Rangitane substation via an underground 11 kV feeder. Rangitane is in turn supplied by two 33 kV subtransmission circuits from Whakatu GXP. These subtransmission circuits are rated to approximately 437 A (25 MVA) and 610 A (34 MVA).

This site is located approximately 1.6 km from Rangitane ZS. In turn, Rangitane ZS is approximately 0.6 km from Whakatu GXP.

There is currently a maximum loading of 19 MVA on Rangitane zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

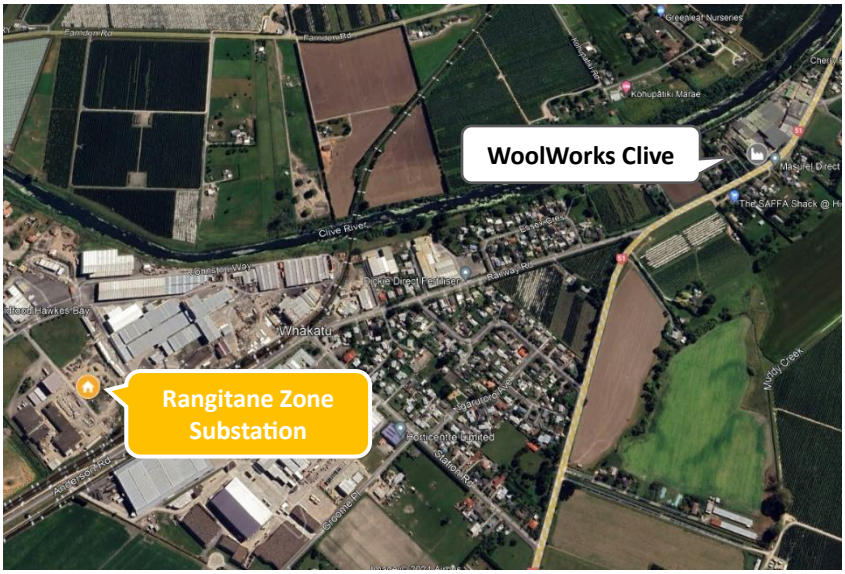


Figure 54. WoolWorks Clive geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate (N) capacity but not (N-1) capacity for this load. The zone substation has adequate spare (N) and (N-1) capacity for this load.

WoolWorks Clive is currently supplied via a single undergound 11kV feeder (Clive) which is loaded to 3.0 MVA. Due to the size of the load, it is expected that 1x new 11 kV feeder from Rangitane substation would be required for this project. Due to the urban/industrial topography, it is expected that this feeder would be underground, and would be ~1.9 km long.

WOOLWORKS CLIVE

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Capital Cost Estimate

Table 51. Woolworks Clive: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.90	$1.14
		TOTAL	**$1.24**

Table 52. Woolworks Clive: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.90	$1.14
		TOTAL	**$10.24**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.11 Progressive Leathers Limited

PROGRESSIVE LEATHERS LIMITED		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and/or high temperature heat pumps	2.200	Whakatu

Existing Electrical Supply to the Plant

Progressive Leathers Limited is presently supplied by Unison Networks' Rangitane substation via the underground Works A and B feeders (as part of the Whakatu industrial park supply). The two 11 kV feeders terminate at a switchboard within the industrial park before being distributed within the industrial park. Rangitane is in turn supplied by two 33 kV subtransmission circuits from Whakatu GXP. These subtransmission circuits are rated to approximately 437 A (25 MVA) and 610 A (34 MVA).

This site is located approximately 1.6 km from Rangitane ZS. In turn, Rangitane ZS is approximately 0.6 km from Whakatu GXP.

There is currently a maximum loading of 19 MVA on Rangitane zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Whakatu GXP presently has 88 MVA of spare (N) capacity and no spare (N-1) capacity.

Figure 55. Progressive Leathers Limited geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Whakatu GXP has adequate (N) capacity but not (N-1) capacity for this load. The zone substation has adequate spare (N) and (N-1) capacity for this load.

The existing Works A and B feeders are both rated to approximately 6.3 MVA each, with present loadings of 2.3 MVA and 1.6 MVA on the two feeders. It is expected that the two existing feeders to the industrial park could be utilised for this additional load, though a new feeder from the industrial park

switchboard may be required for this project. Due to the urban/industrial topography, it is expected that this feeder would be underground, and would be ~0.3 km long.

To establish an (N-1) security supply, the transformers at Whakatu GXP would require upgrades/replacements.

Capital Cost Estimate

Table 53. Progressive Leathers Limited: Capital cost estimate to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.30	$0.18
		TOTAL	**$0.28**

Table 54. Progressive Leathers Limited: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.30	$0.18
		TOTAL	**$9.28**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months for an (N) security supply or 36-48 months for an (N-1) security supply to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.12 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 RMUs and appropriately sized distribution transformers to supply the site.

Table 55. 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)
Liqueo Bulk Storage Port of Napier	Bluff Hill	N/A	21	3.01	0.281	130
William Colenso College	Marewa	8	28	2.47	0.224	130
Splash Planet	Windsor	13	33	1.92	0.141	80
Oceania Healthcare Gracelands	Mahora	0	20	3.83	0.133	80
MTG Hawke's Bay	Bluff Hill	N/A	21	2.29	0.112	80
Oceania Healthcare Eversley	Mahora	0	20	3.81	0.070	50
Scenic Hotel Te Pania	Bluff Hill	N/A	21	2.29	0.068	50
Clive War Memorial Pool	Rangitane	5	29	4.10	0.023	40

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.

8.7.13 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs in this section are additional to those stated in the preceding sections assessing individual loads.

8.7.13.1 Rangitane

Six of the loads on Whakatu GXP are expected to connect to Rangitane zone substation. The loads are WoolWorks Clive, Hawk Group, Silver Fern Farms Pacific, Clive War Memorial Pool, Progressive Leathers Limited, and Diamond Apparelmaster. The sum of peaks of these loads is 15.59 MW. However, the zone substation doesn't have (N-1) capacity for this.

If all of the loads proposed for Rangitane substation were to connect, in order to maintain (N-1) security, it is expected that the transformers at the substation would need be replaced. Upgrades of one of the 33 kV lines supplying the substation would also be required. An approximate cost for these upgrades is $4.7M.

Ergo notes that Rangitane is presently subject to a number of other decarbonisation projects combined with significant growth in the Whakatu industrial park. Unison is currently progressing with designs to upgrade the supply at Rangitane for this reason.

8.7.13.2 Bluff Hill

Four of the loads on Whakatu GXP are expected to connect to Bluff Hill zone substation. The loads are Scenic Hotel Te Pania, MTG Hawke's Bay, Liqueo Bulk Storage Port of Napier, and Higgins Port of Napier. The sum of peaks of these loads is 4.49 MW. Bluff Hill substation has sufficient spare (N) capacity for these loads, however Bluff Hill is an (N) security site, so an (N-1) supply is not available. Due to space constraints around the substation, it is taken as unlikely that the substation would be able to be upgraded to provide an (N-1) security supply. This has been discussed in particular for the one large load connecting to Bluff Hill, which may connect to the nearby Faraday zone substation instead if an (N-1) supply is required for that load.

8.7.13.3 Tomoana

Three of the loads on Whakatu GXP are expected to connect to Tomoana zone substation. The loads are Cedenco Foods Fresh Fields, Heinz Watties Limited Tomoana, and Lowe Corporation Hastings Tannery. The sum of peaks of these loads is 19.37 MW, which the zone substation doesn't have spare (N) or (N-1) capacity for.

It is expected that if all of the proposed loads were to connect, a new zone substation would be required in the area, at an approximate cost of $10M. This substation is assumed to connect to the same 33 kV ring that supplies Tomoana and Mahora at present. As the Tomoana substation shares its subtransmission lines with Mahora, the subtransmission lines are discussed separately below.

8.7.13.4 Mahora

Three of the loads on Whakatu GXP are expected to connect to Mahora zone substation. The loads are Heinz Watties Ltd King Street, Oceania Healthcare Gracelands, and Oceania Healthcare Eversley. The sum of peaks of these loads is 24.38 MW, which the zone substation doesn't have (N-1) capacity for.

However, for connection of the Heinz Watties Ltd King Street load, as in the individual Load Site analysis above, it is recommended that a new substation is established at the Heinz site. This means that further upgrades to Mahora substation are not expected.

8.7.13.5 Tomoana and Mahora Subtransmission Lines

As above, the sum of peaks of loads proposed to connect to Tomoana and Mahora zone substations is 19.37+24.38 = 43.75 MW. The 33 kV circuits supplying the two substations do not have capacity for this load. It is expected that, to supply this load, another 33 kV (underground) circuit would be required in parallel to each of the existing circuits making up the 33 kV ring (i.e. a new Whakatu-Mahora line, a new Whakatu-Tomoana line, and a new Tomoana-Mahora line). An indicative cost for this is $8.10M.

8.7.14 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Whakatu GXP gives a combined load of 1.05 MW. When the load shapes are combined, they result in the following load shape (Figure 56), with a maximum load of 0.61 MW, with a diversity factor of 0.58.

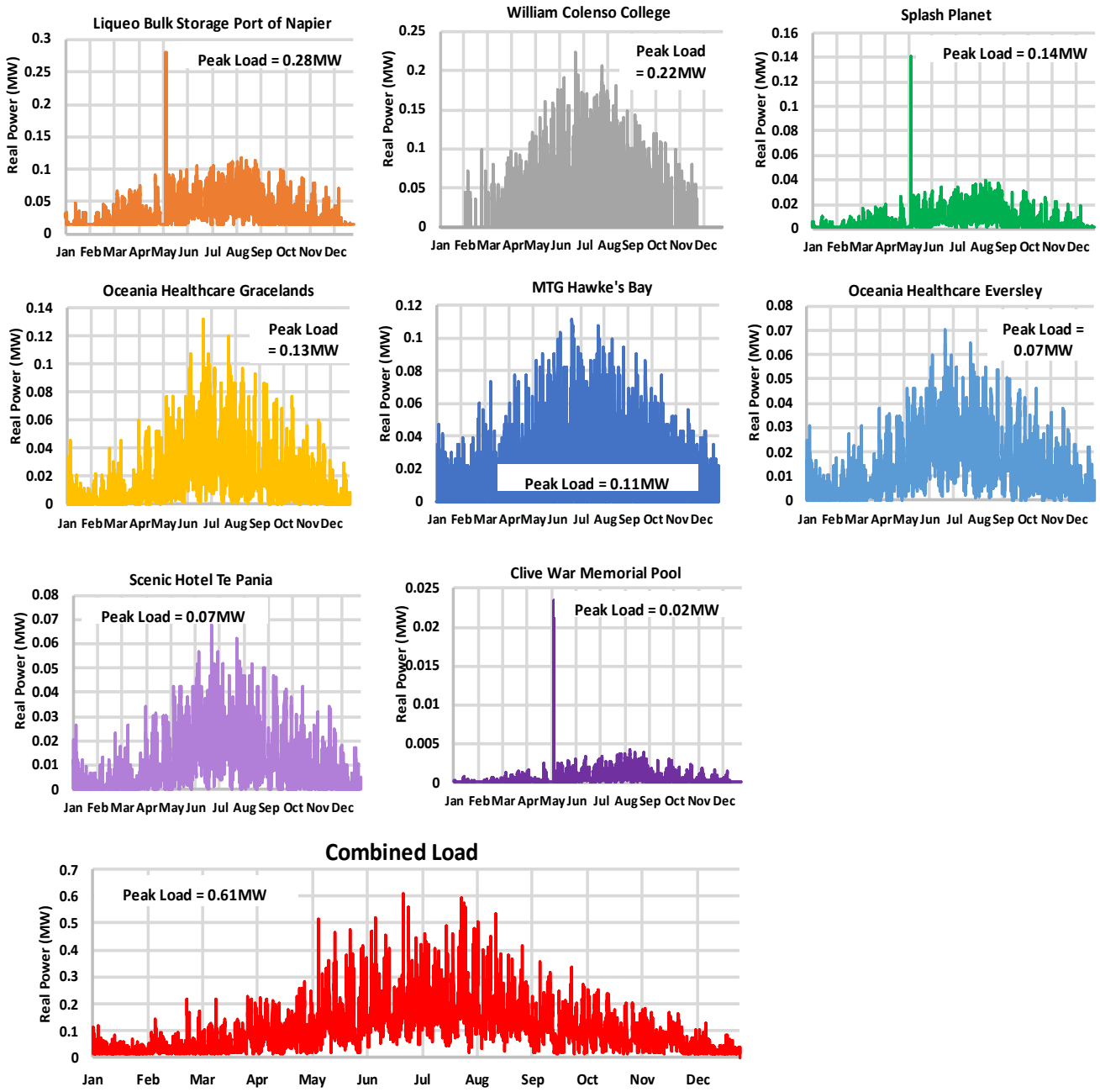


Figure 56. Loading Profiles: Whakatu GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.7.15 Effect of all Load Sites Connecting to Whakatu GXP

The following Figure 57 illustrates the Whakatu GXP load profile together with the load profiles of all the Load Sites within the Whakatu GXP region. Also shown in Figure 57 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Whakatu GXP would increase to 120.29 MW, an increase of 33.05 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 150.74 MW there is a diversity factor of 0.81 between the loads.
- Based on Ergo's analysis, the Whakatu GXP's (N-1) limit is expected to be exceeded. Ergo has discussed mitigation for this in Section 8.7.1.

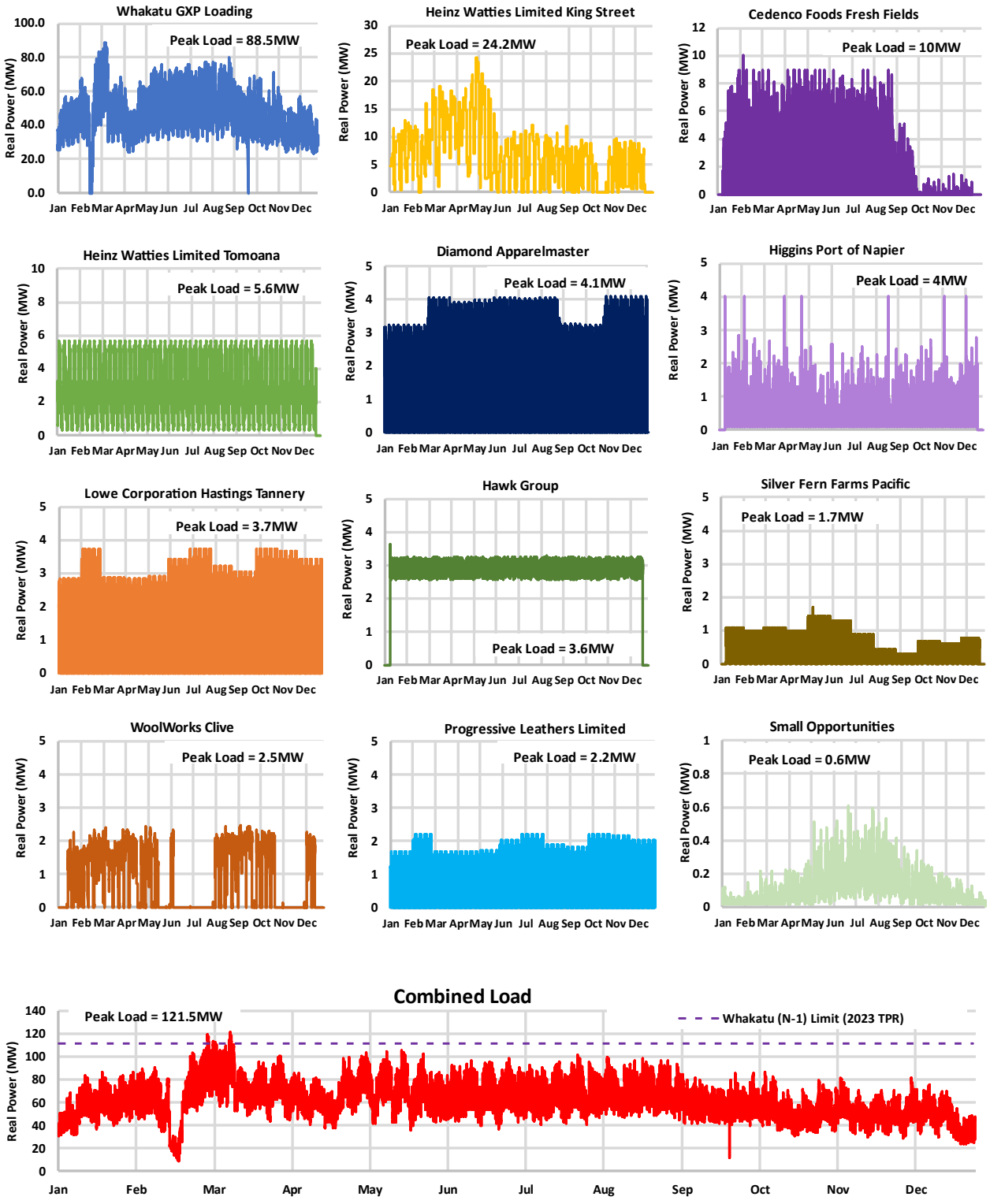


Figure 57. Loading Profiles: Whakatu GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

9. Conclusions

9.1 Network Spare Capacity

The following Figure 58 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Hawke's Bay region.

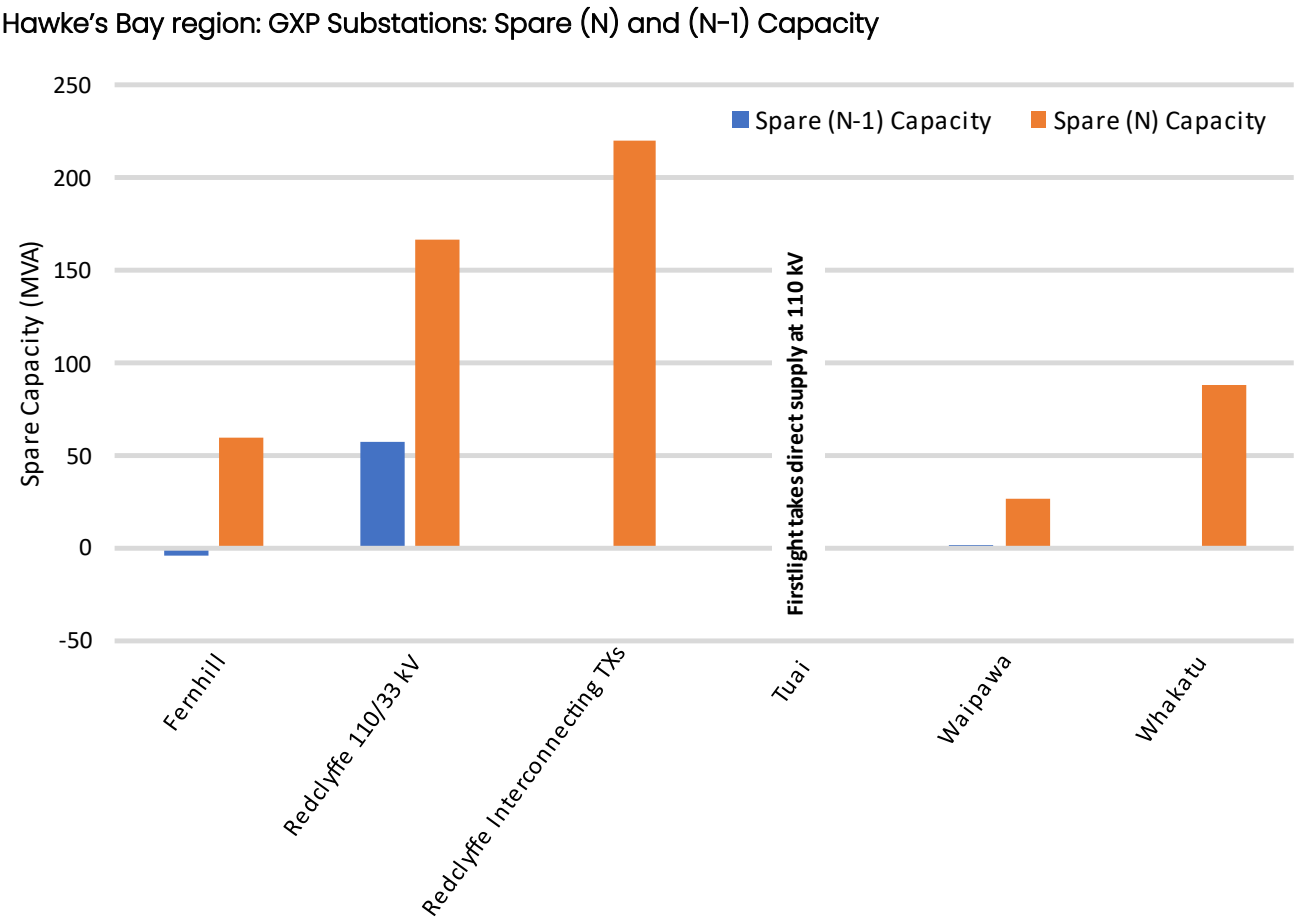


Figure 58. Summary: Approximate (N) and (N-1) spare capacity at GXP substations.

The following figures illustrate the (N) and (N-1) spare capacity at the EDB zone substations in the Hawke's Bay region. These figures are based on the maximum loadings and the EDB 2023 disclosures.

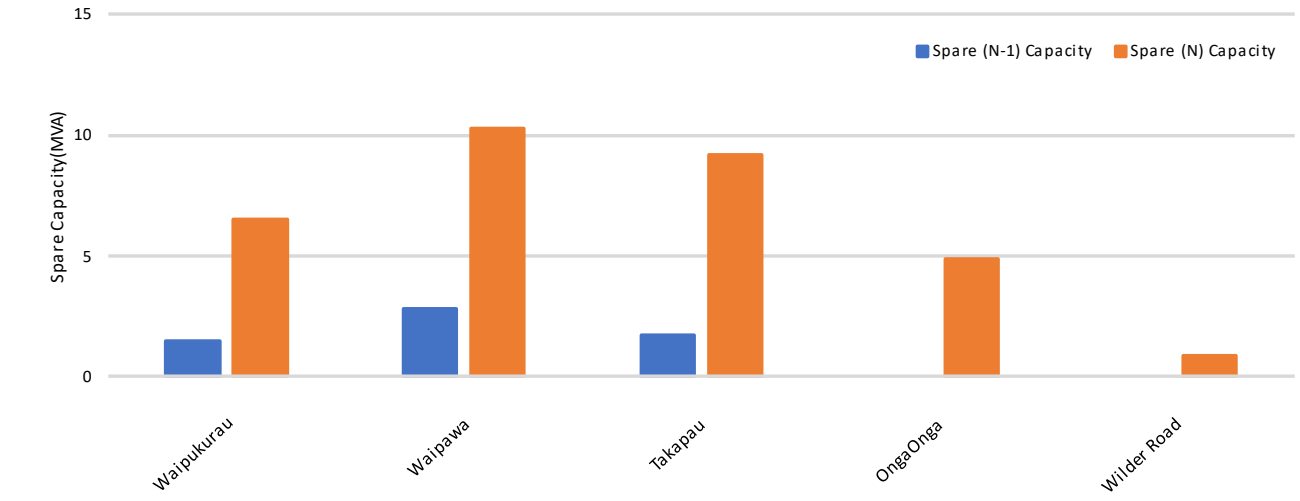


Figure 59. Summary: Approximate (N) and (N-1) spare capacity at Centralines' zone substations

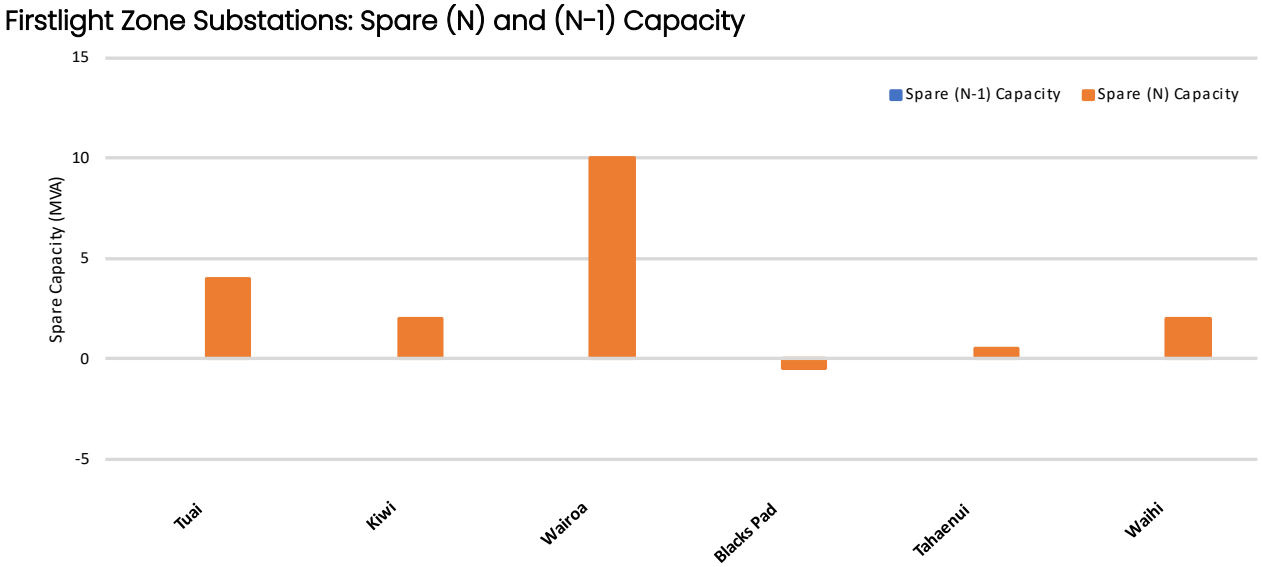


Figure 60. Summary: Approximate (N) and (N-1) spare capacity at Firstlight's zone substations.

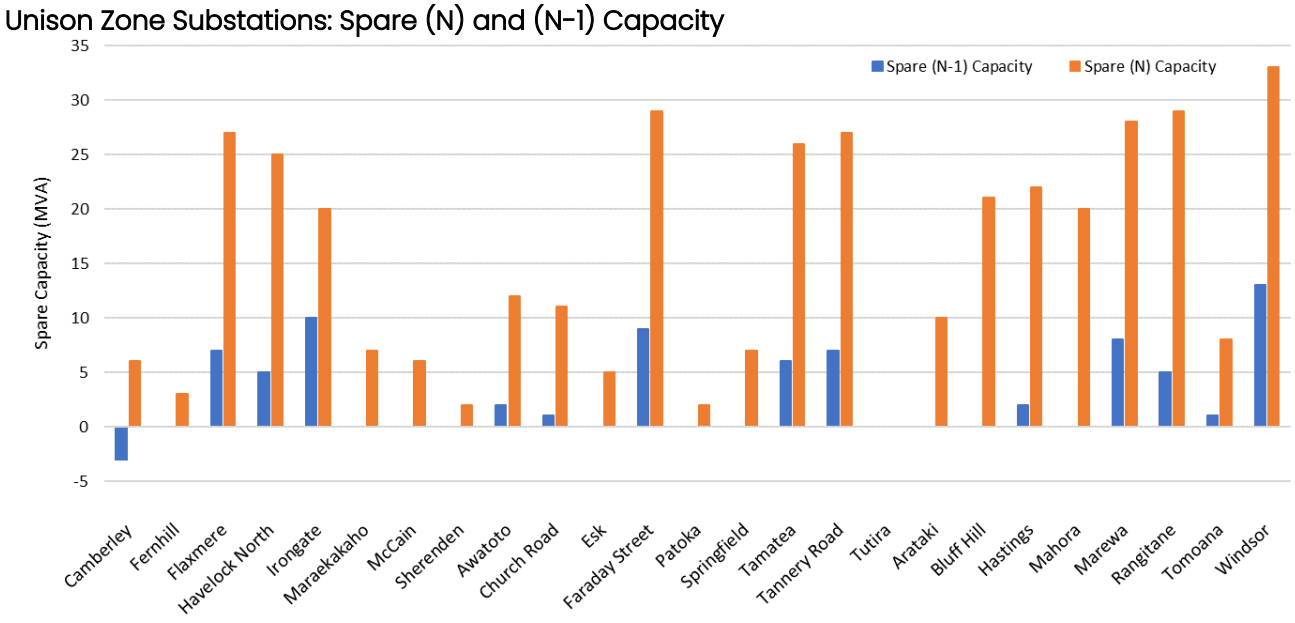


Figure 61. Summary: Approximate (N) and (N-1) spare capacity at Unison's zone substations.

9.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 23163-RPT-004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Fernhill GXP* – Supplies Hastings, and the surrounding agricultural areas, resulting in the dominant load being residential with some commercial, industrial, and agricultural loads. Load peaks in late summer/early Spring due to high irrigation and cold storage demand. Daily load has typical morning and evening peaks in winter, and is more flat during summer, which is again likely due to irrigation loads.
- *Redclyffe GXP* – Load is dominated by that of Napier, resulting in a mix of residential, commercial, and industrial loads, with some agricultural. The GXP is winter peaking with typical daily morning and evening peaks (though again with a flatter daily profile over summer). The winter peak is offset slightly by increased generation at the nearby Esk hydro scheme.
- *Tuai GXP* – Supplies Gisborne and Wairoa as well as a number of small townships and low density rural areas, resulting in a mix of residential, commercial, agricultural, and industrial loads. Load peaks during winter, though the net load is influenced greatly by the nearby Tuai hydro generation.
- *Waipawa GXP* – Supplies a number of small townships and the surrounding agricultural region, being a mix of agricultural, industrial, residential, and commercial. Summer peaking, which is driven by irrigation loads. Daily load has typical morning and evening peaks.
- *Whakatu GXP* – Supplies Hastings, resulting in the dominant load being residential with some commercial, industrial, and agricultural loads. Winter peaking. Daily load is reasonably flat in summer however has typical morning and evening peaks in winter.

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[27], which is only suitable for concept screening. (Refer to the assumptions outlined in Section 8.2 for more details)

[27] 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 56 Summary of Load Sites and estimated capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
HB23	Russell Asphalt	5.82	Fernhill	$9.00	McCain	$5.60	$14.60	$2.51	Major	1, 2
HB6	Webster's Hydrated Lime Company Havelock North	5.15	Fernhill	$9.00	Havelock North	$12.46	$21.46	$4.16	Major	1, 2
HB24	McCain Foods Hastings	4.09	Fernhill	$9.00	McCain	$0.82	$9.82	$2.40	Major	1, 2
HB10	Hawke's Bay Fallen Soldiers Memorial Hospital	3.47	Fernhill	$9.00	Camberley	$0.28	$9.28	$2.68	Major	1, 2
HB21	Profruit (2006) Limited Hastings	1.54	Fernhill	$9.00	McCain	$5.18	$14.18	$9.21	Major	1, 2
HB33	Hawke's Bay Regional Prison	1.14	Fernhill	$9.00	Irongate	$0.39	$9.39	$8.24	Major	1, 2
HB28	Tumu Timbers Limited	0.73	Fernhill	$0.00	Irongate	$0.00	$0.00	$0.00	Minor	1
HB34	Humes Hastings	0.45	Fernhill	$0.00	Fernhill	$0.00	$0.00	$0.00	Minor	1
HB35	Progressive Meats Limited Hastings	0.19	Fernhill	$0.00	Camberley	$0.00	$0.00	$0.00	Minor	1
HB14	Havelock North Village Pool	0.07	Fernhill	$0.00	Havelock North	$0.00	$0.00	$0.00	Minor	1
HB19	Hawke's Bay Protein	3.89	Redclyffe	$0.00	Awatoto	$4.26	$4.26	$1.10	Moderate	1, 2
HB1	WoolWorks Awatoto	3.24	Redclyffe	$0.00	Awatoto	$4.47	$4.47	$1.38	Moderate	1, 2
HB30	Higgins Napier	0.90	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB4	Bremworth Napier	0.89	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB29	Fresh Meats NZ Limited Napier	0.63	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB37	Eastern Institute of Technology Hawke's Bay Campus	0.39	Redclyffe	$0.00	Springfield	$0.00	$0.00	$0.00	Minor	1
HB25	AFFCO Napier	0.28	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB11	Napier Health Centre	0.26	Redclyffe	$0.00	Faraday Street	$0.00	$0.00	$0.00	Minor	1
HB42	ZIWI Limited Napier	0.25	Redclyffe	$0.00	Awatoto	$0.00	$0.00	$0.00	Minor	1
HB40	Oceania Healthcare Atawhai	0.09	Redclyffe	$0.00	Springfield	$0.00	$0.00	$0.00	Minor	1
HB12	Wairoa Hospital	0.66	Tuai	$0.00	Kiwi	$0.00	$0.00	$0.00	Minor	1
HB8	Silver Fern Farms Takapau	2.56	Waipawa	$7.00	Takapau	$10.17	$17.17	$6.70	Major	1, 2
HB45	Ovation & Pasture Petfoods - Stage 1	5.50	Waipawa	$7.00	Waipukurau	$3.80	$10.80	$1.96	Major	1, 2
	Ovation & Pasture Petfoods - Stage 2	1.50	Waipawa	$0.00	Waipukurau	$1.00	$1.00	$0.67	Minor	1, 2
HB41	Pukeora Estate Limited Waipukurau	0.38	Waipawa	$0.00	Waipukurau	$0.00	$0.00	$0.00	Minor	1
HB36	Central Hawke's Bay College	0.20	Waipawa	$0.00	Waipukurau	$0.00	$0.00	$0.00	Minor	1
HB16	Heinz Watties Limited King St (N) Stage 1	11.00	Whakatu	$0.00	Mahora	$2.72	$2.72	$0.25	Minor	1, 3
	Heinz Watties Limited King St (N) Stage 2	13.17	Whakatu	$0.50	Mahora	$6.80	$7.30	$0.55	Moderate	1, 3
	Heinz Watties Limited King St (N-1) Stage 1	11.00	Whakatu	$9.00	Mahora	$7.32	$16.32	$1.48	Major	1, 3
	Heinz Watties Limited King St (N-1) Stage 2	13.17	Whakatu	$0.25	Mahora	$11.60	$11.85	$0.90	Major	1, 3
HB9	Cedenco Foods Fresh Fields	10.00	Whakatu	$9.00	Tomoana	$4.40	$13.40	$1.34	Major	1, 2
HB18	Heinz Watties Limited Tomoana	5.64	Whakatu	$9.00	Tomoana	$3.96	$12.96	$2.30	Major	1, 2
HB44	Diamond Apparelmaster	4.09	Whakatu	$9.00	Rangitane	$0.64	$9.64	$2.36	Major	1, 2
HB31	Higgins Port of Napier	4.02	Whakatu	$9.00	Bluff Hill	$2.02	$11.02	$2.74	Major	1, 2
HB22	Lowe Corporation Hastings Tannery	3.73	Whakatu	$9.00	Tomoana	$4.26	$13.26	$3.56	Major	1, 2
HB5	Hawk Group	3.64	Whakatu	$9.00	Rangitane	$0.82	$9.82	$2.70	Major	1, 2
HB7	Silver Fern Farms Pacific	1.70	Whakatu	$9.00	Rangitane	$0.88	$9.88	$5.81	Major	1, 2
HB2	WoolWorks Clive	2.46	Whakatu	$9.00	Rangitane	$1.24	$10.24	$4.17	Major	1, 2
HB46	Progressive Leathers Limited	2.20	Whakatu	$9.00	Rangitane	$0.28	$9.28	$4.22	Major	1, 2
HB27	Liqueo Bulk Storage Port of Napier	0.28	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB32	William Colenso College	0.22	Whakatu	$0.00	Marewa	$0.00	$0.00	$0.00	Minor	1
HB13	Splash Planet	0.14	Whakatu	$0.00	Windsor	$0.00	$0.00	$0.00	Minor	1
HB38	Oceania Healthcare Gracelands	0.13	Whakatu	$0.00	Mahora	$0.00	$0.00	$0.00	Minor	1
HB26	MTG Hawke's Bay	0.11	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB39	Oceania Healthcare Eversley	0.07	Whakatu	$0.00	Mahora	$0.00	$0.00	$0.00	Minor	1
HB3	Scenic Hotel Te Pania	0.07	Whakatu	$0.00	Bluff Hill	$0.00	$0.00	$0.00	Minor	1
HB15	Clive War Memorial Pool	0.02	Whakatu	$0.00	Rangitane	$0.00	$0.00	$0.00	Minor	1
	TOTAL =>	131.14	TOTAL =>	$158.75	TOTAL =>	$95.36	$254.11			

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 (N-1) scenario cost shown

3 (N-1) scenario cost included in totals only

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. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate.

Appendix 1 Glossary

CT	Current transformer
DG	Distributed generator
EDB	Electrical Distribution Business
EIPC	Electricity Industry Participation Code
ENA	Electricity Network Association
ESA	Electricity Supply Authority
GIP	Grid injection point
GXP	Grid exit point substation
kV	Kilovolts
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
FHL	Fernhill GXP
RDF	Redclyffe GXP
SPS	Special protection system
TUI	Tuai GXP
TOPS	Transformer overload protection scheme
WPW	Waipawa GXP
WTU	Whakatu GXP
ZS	Zone substation

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 57 Cost estimate classification matrix[28]

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.

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