

Powerco CPP – Portfolio Overview Document

Portfolio Name	Moturoa Security of Supply Project
Expenditure Class	Capex
Expenditure Category	Growth & Security
As at Date	12 June 2017

Expenditure Forecast ^{1,2}	Pre CPP	FY19	FY20	FY21	FY22	FY23	Post CPP	CPP Period Total	Project Total
Pre-Internal Cost Capitalisation and Efficiency Adjustments ³ (2016 Constant NZ\$(M))	\$3.2	\$4.9	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$4.9	\$8.1
Post-Internal Cost Capitalisation and Efficiency Adjustments (2016 Constant NZ\$(M))	\$3.5	\$5.2	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$5.2	\$8.8

Description

Project need overview

Powerco’s Moturoa zone substation is the only substation supplied by Transpower’s New Plymouth GXP. Transpower is intending to disestablish its New Plymouth GXP and as a result, Powerco is investigating alternative supply options to the Moturoa zone substation.

Proposed solution

Project solution overview

Powerco is proposing to install 2 x 33kV, ≈7km, underground cables from the existing Transpower owned Carrington Street GXP to the existing Moturoa 33/11kV zone substation.

Need Identification

Underlying Drivers and Investment Triggers

New Plymouth city is supplied from two 110kV Transpower GXPs; namely, Carrington Street and New Plymouth (refer to Figure 1 and

¹ Forecast expenditure is based on Powerco’s financial year (i.e. FY18 is for the period April 2017 through March 2018). Expenditures do not consider general price level changes over time (i.e. are in real or constant terms).

² Only includes Growth & Security Expenditure. Some projects discuss and rely on the replacement of assets that are at “end of life”. However, the replacement cost for these assets is accounted for in the Replacement Expenditure category.

³ All other forecast expenditure / cost estimates in this POD are pre-internal cost capitalisation and efficiency adjustments, consistent with this forecast.

Figure 4).

The Carrington Street GXP supplies the Brooklands, City, Katere and Oakura 33/11kV substations.

The New Plymouth GXP is located adjacent to the decommissioned New Plymouth Power Station and only supplies the Moturoa 33/11kV substation. The GXP is located on the land that belongs to the Port of Taranaki (The Port) and the switchgear is in a building owned by The Port.

Under the Electricity Act 1992 Transpower has the right to occupy the land at the New Plymouth Power Station. However, The Port has indicated to Transpower that they want to make use of the land/area and as such have requested that Transpower consider future options/locations for the New Plymouth GXP. Transpower published a New Plymouth Site Strategy Document⁴ in February 2013 and since that time Transpower has had further discussions with The Port of Taranaki and have submitted an application for a project to address the North Taranaki Transmission Capacity⁵. This project rationalises the 220kV / 110kV interconnection capacity in North Taranaki, locating both transformers at Stratford substation, which facilitates the complete disestablishment of the New Plymouth substation if alternate supply to Moturoa can be provided. Given this fact, as prudent network operator, Powerco has investigated alternative supply options for the Moturoa zone substation.

The “*Moturoa Security of Supply Project*” looks to address an alternative means of supply to the Moturoa zone substation and is a “security of supply” driven project.

The following additional constraints/issues are relevant to the project:

1. There are presently two 220/110kV interconnecting transformers located at Transpower’s Stratford (T10), and New Plymouth (T8) substations. The transformers operate in parallel to supply the Taranaki 110kV regional load and have nameplate ratings of 100MVA and 200MVA respectively. The nominal installed capacity is 295MVA, and the n-1 capacity is 135/143 MVA (summer/winter). Presently, an outage of the New Plymouth interconnecting transformer may cause⁶ the Stratford interconnecting transformer to exceed its n-1 capacity (depending on the 110kV Taranaki generation). These constraints will get worse as the regional load increases.
2. The 2 x 400mm² AL, PILC, underground cables that run from the New Plymouth GXP to the Moturoa substation each have a rating of 20.7MVA during contingencies. The 2017 forecast peak demand on the Moturoa substation is 22MVA. The existing supply network to Moturoa does not meet the requirements of Powerco’s Security-of-Supply Standard, which recommends a (N-1), no break supply network, security class AAA⁷ for the substation.
3. The two 33/11kV transformers at the Moturoa substation have a continuous, summer/winter rating of 18.6MVA/19.7MVA. The existing substation capacity does not meet the requirements of Powerco’s Security-of-Supply Standard, which recommends a (N-1), no break supply network, security class AAA⁷ for the substation.
4. The equipment at the Moturoa substation is exposed to a highly corrosive coastal environment and is subject to a costly

⁴ Transpower Site Development Strategy – New Plymouth Substation. Document TP.TS 80.24 dated 19/02/2013

⁵ Transpower RCP2 Project Application: North Taranaki Transmission Capacity Project Overview Document. June 2014

⁶ Transpower Annual Planning Report, 2014

⁷ AAA – Supply is uninterrupted in the event of the outage of one major element of the sub-transmission network. Load can be transferred to other substations without interruption by switching on the network if necessary to avoid exceeding ratings (Powerco - Standard 310S001 – Security of Supply Classification – Zone Substations).



	<p>maintenance regime. Some of the equipment on the site is located in buildings that are in poor condition⁴.</p>
<p><i>Timing of the need</i></p>	<p>Present indications are that the project (i.e. an alternative supply point to Moturoa) is desired by 2019. The exact timing will depend on discussions between the relevant parties (Transpower, Powerco, Port of Taranaki), which includes establishing who will fund the alternative supply to Moturoa. This project is posited on the basis (yet to be finally confirmed) that Powerco would fund two 33kV cables from Carrington St. with Transpower providing feeder connections at Carrington St.</p>



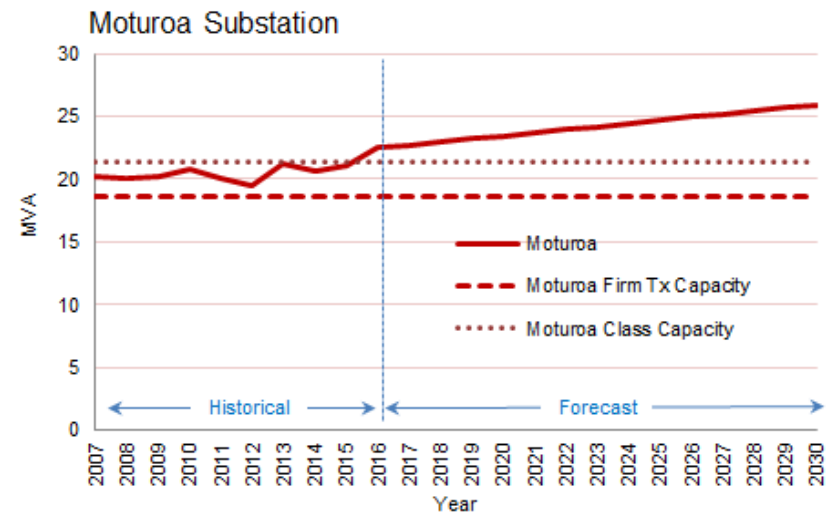
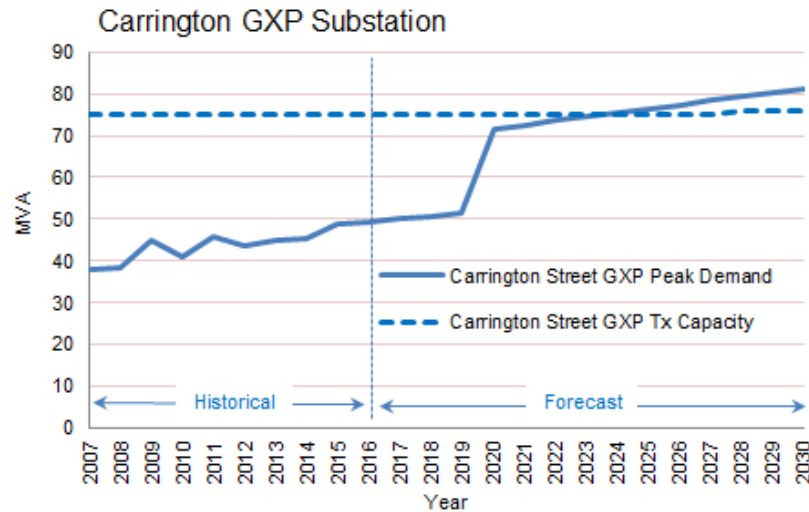
Demand Forecast | Carrington & New Plymouth GXPs

CARRINGTON & NEW PLYMOUTH GXP SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	CLASS CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Bell Block	22.9	2.2%	18.4	18.8	19.2	19.6	20.0	22.0	24.0
Brooklands	27.0	0.8%	15.3	15.4	15.6	15.7	15.8	16.5	17.1
City	20.1	0.6%	19.1	19.2	19.3	19.4	19.5	20.0	20.6
Katere	24.3	2.6%	13.5	13.8	14.2	14.5	14.9	16.7	18.4
Moturoa	21.4	1.1%	22.5	22.7	23.0	23.2	23.5	24.7	25.9
Oakura	4.2	1.4%	3.5	3.5	3.6	3.6	3.7	3.9	4.1

CARRINGTON & NEW PLYMOUTH AREA GXPS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	FIRM TX CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Carrington GXP	75.0	1.4%	49.3	50.0	50.6	51.3	71.6	76.4	81.2
New Plymouth GXP	30.0	1.2%	22.4	22.6	22.9	23.2	0.0	0.0	0.0

Notes:

1. Class capacity is similar to Firm Capacity and represents the capacity that can be delivered following the first outage of any major equipment. Unlike Firm Capacity it considers the long term deliverable capacity in the context of switching and network reconfiguration (11kV & 33kV) post-fault conditions.
2. All maximum demand values are in MVA.
3. Purple shaded cells indicate that the substation's Class Capacity has been exceeded and network enhancements should be considered.
4. The forecast loads on the Carrington GXP do not include the anticipated transfer of Bell Block to the Huirangi GXP and the Moturoa onto the Carrington GXP.



Options Analysis | Long List of Project Options | High Level Assessment

<p>Assessment Process</p>	<p>A wide range of potential options are available for the resolution of electrical network constraints. However, depending on local conditions many of the options can have fatal flaws. On this basis a two tier Options Analysis is followed. In the first instance all potential options are considered against a set of high level criteria. Those options that are identified as having significant challenges and not favourable are not considered further.</p> <p>A significant issue that Powerco often faces is the reality of trying to secure landowner easements and or public support for projects that the local community or landowners are opposed to. For this reason the costs associated with easements/consents are often difficult to estimate and the consenting/land-acquisition stage of a project can take a significant period. Given this fact Powerco assesses the risk / likelihood of securing development rights for individual projects (within a realistic timeframe) during the high level assessment stage.</p>
<p>Long List of Options</p>	<p>The following table contains a list of the high level project options that are potentially available to resolve the needs associated with the Moturoa substation. The four non-network options (Options 2, 3, 4 & 5) are not shortlisted on the following basis:</p> <ul style="list-style-type: none"> • Fossil fuelled generation (i.e. diesel generation) is technically viable but not shortlisted due to the cost and environmental/consenting challenges⁸ associated with supplying the ≈21MW Moturoa substation load on permanent basis. The capital cost of a 21MW diesel generation plant to permanently supply the demand is estimated to be \$42M^{9,10}. Additional diesel generators would need to be installed to provide security/redundancy and to cope with the increasing demand for electricity. • Powerco has not identified any viable renewable generation options that would provide the required security of supply¹¹. • Fuel switching and demand side response (DSR) are not viable options. • Energy storage is not a viable option. <p>Five potential network options have been identified (6, 7, 8, 9 & 10). Three of the options involve a new 33kV supply to the existing Moturoa substation as follows:</p> <ul style="list-style-type: none"> • Option 6 – 2 x 33kV Cables from Carrington to Moturoa • Option 7 – 1 x 33kV Cable Ring from Carrington St to Moturoa to City • Option 8 – New Omata 110/33kV GXP plus Omata 33/11kV Substation <p>And for completeness two options are included that consider the replacement of the existing Moturoa substation equipment (to address the equipment condition issues identified in Item 4 on page 4) as follows:</p> <ul style="list-style-type: none"> • Option 9 – Same as Option 6 plus Replace Moturoa Substation • Option 10 – 2 x 33kV Cables from Carrington to Spotswood – New Spotswood Substation

⁸ "by 2025 90 percent of electricity will be generated from renewable sources", New Zealand Energy Strategy 2011-2011, Ministry of Economic Development, www.med.govt.nz.

⁹ Excludes the ongoing maintenance and operational costs.

¹⁰ Diesel generation plant is estimated to range from \$1,500/kW to \$2,000/kW, depending on whether it is high, medium or low speed plant.

¹¹ Typical plant might involve wind turbines or photovoltaic arrays. Both of these generators have an intermittent output which cannot be relied upon unless there was significant penetration and diversity.



Network Options 7 and 8 were not shortlisted due to their significantly higher capital expenditure costs and the fact that Option 7 has significant challenges due to the lack of land/space at the City substation.

Option 6 was shortlisted due to its lower capital cost. Options 9 and Options 10 were both shortlisted in order to confirm the most cost effective solution that also addresses the condition of the existing Moturoa substation equipment. Option 9 is an extended version of Option 6.

Long List of Options High Level Assessment										
Moturoa Security of Supply Project		Long list of projects and high level assessment				Assessment Criteria				
PROJECT FOCUS	No.	PROJECT	Safety	Fit	Feasible	Practical	GEIP	Security	Cost	Short-list
Do Nothing	1	Allow the electrical demand & risk of consumer non-supply to increase	✓	✗	✗	✗	✗	✗	✓	✗
	2	Distributed Generation (DG) including peak lopping generation	✓	✗	✓	✓	✓	✓	✗	✗
Non-network	3	Fuel switching to reduce electrical demand	✓	✓	✗	✗	✓	✓	✗	✗
	4	Demand Side Response (DSR)	✓	✓	✗	✗	✓	✓	✗	✗
	5	Energy storage	✓	✓	✓	✓	✗	✓	✗	✗
Network Reinforcement	6	2 x 33kV Cables from Carrington to Moturoa	✓	✓	✓	✓	✓	✓	✓	✓
	7	1 x 33kV Cable Ring from Carrington St to Moturoa to City Substation	✓	✗	✓	✗	✓	✓	✗	✗
	8	New Omata 110/33kV GXP and Omata 33/11kV Substation	✓	✓	✓	✓	✓	✓	✗	✗
	9	Same as Option 6 plus Upgrade Moturoa Substation	✓	✓	✓	✓	✓	✓	✓	✓
	10	2 x 33kV Cables from Carrington to Spotswood - New Spotswood Substation	✓	✓	✓	✓	✓	✓	✗	✓

Key:

- Safety Health and Safety: Any significant implications in terms of Safety or Health - new products or compounds or practices, or requires difficult live line access etc.
- Fit Fit for Purpose: Does the option address the need appropriately and does it fit with other developments in the vicinity.
- Feasible Technically Feasible: Consider the complexity, future adaptability, and whether it aligns with company standards, strategies and policies.
- Practicality Practical to Implement: Are there potential environmental or property issues which may be insurmountable. Can it be achieved in the required time frame.
- GEIP Good Electricity Industry Practice (GEIP): Good practice (technically and environmentally) and in terms of AM practice (capacity, age, technological, safety)
- Security Security and Reliability: Does the option provide adequate levels of security and appropriate reliability considering the demand, load type and future growth.
- Cost Some options will intuitively be known to be far more expensive than other options, and this may preclude them.

Options Analysis Short List of Options		
Option	Capital Cost ¹²	Description
<p>Option 6 <i>(2 x 33kV Cables from Carrington to Moturoa)</i></p>	\$8.1M	<p>This option involves the following network enhancements (refer to Figure 2 and Figure 5):</p> <ul style="list-style-type: none"> • ≈7km, 2 x 33kV, 630mm² AL cables from the Carrington Street GXP to the Moturoa substation. The cables would be installed via a combination of cable trench and directional drilling through the urban and inner commercial streets of New Plymouth. • ≈7km of fibre cables (one for protection/SCADA and a second for thermal monitoring) • Unit protection across the 33kV cables. • 2 x additional 33kV circuit breakers at the Carrington Street GXP. This equipment would be supplied/installed by Transpower and the costs for this work are not included here. • 2 x Directional/zone 33kV protection • 2 x additional 11kV switchgear/feeders at Moturoa (including protection/SCADA equipment)
<p>Option 9 <i>(Same as Option 6 plus Upgrade Moturoa)</i></p>	\$13.8M	<p>This option is identical to Option 6 (refer to Figure 2 and Figure 5) but also includes the upgrade/replacement of the existing equipment at the Moturoa substation as follows:</p> <ul style="list-style-type: none"> • New switch room building, site works and earth grid. • New 33kV indoor switchboard. • New 11kV switchboard (2 incomer, 1 bus section and 10 feeder circuit breakers). • 2 x new 33/11kV, 30MVA, On-Load-Tap-Changer Transformers • New DC, SCADA etc. panels.
<p>Option 10 <i>(2 x 33kV Cables from Carrington to Spotswood - New Spotswood Substation)</i></p>	\$15.5M	<p>The major sub-transmission enhancement projects required for this option are (refer to Figure 3 and Figure 6):</p> <ul style="list-style-type: none"> • Purchase/designate new substation site in Spotswood. • ≈6km, 2 x 33kV, 630mm² AL cables from the Carrington Street GXP to a new substation site in Spotswood. The cables would be installed via a combination of cable trench and directional drilling through the urban and inner commercial streets of New Plymouth. • New switch room building, site works and earth grid. • New 33kV indoor switchboard. • New 11kV switchboard (2 incomer, 1 bus section and 10 feeder circuit breakers). • 2 x new 33/11kV, 30MVA, On-Load-Tap-Changer Transformers • Integration of the 11kV feeders into the existing 11kV network • New DC, SCADA etc. panels. • Decommission the existing Moturoa substation site and sell the land.

¹² The total capital cost of each project. The costs do not consider the time value of money and do not include the economic value of other factors (i.e. network losses and consumer outage costs).

Option Analysis | Advantages vs Disadvantages

The following sections summarise the advantages/disadvantages associated with the short listed options. The intention being to also capture project risks and inter-dependencies.

Option	Advantages	Disadvantages
<p>Option 6 <i>(2 x 33kV Cables from Carrington to Moturoa)</i></p>	<ul style="list-style-type: none"> • Delivers the required security class of AAA⁷ to the Moturoa substation. • Involves the lowest capital expenditure cost (in comparison to other options). Mainly due to the lack of land/designation costs and the fact that the 11kV feeders at the Moturoa substation are already integrated into the surrounding 11kV network. • Substation is located in existing industrial location with limited public opposition/complaints. 	<ul style="list-style-type: none"> • Long run of underground 33kV cable through residential/commercial streets of New Plymouth. If significant rock excavation or thermal backfill is required the project costs would escalate.
<p>Option 9 <i>(Same as Option 6 plus Upgrade Moturoa)</i></p>	<ul style="list-style-type: none"> • Same advantages as Option 6 • No additional easements/land required. • Project can be staged. For example, the 33kV cables could initially be installed with the additional 11kV feeder breakers and/or the entire substation being replaced/refurbished when required (i.e. end-of-life). 	<ul style="list-style-type: none"> • Upgrade of an existing substation site, which would involve consumer outage risks during construction & commissioning.
<p>Option 10 <i>(2 x 33kV Cables from Carrington to Spotswood - New Spotswood Substation)</i></p>	<ul style="list-style-type: none"> • Delivers a new substation with a security class of AAA⁷. • Relatively high capital cost due to need to purchase/designate a new substation site and integrate the substation into the existing 11kV distribution network. • Relatively small consumer outage risk due the fact that Spotswood substation would be constructed/commissioned prior to Moturoa being removed from service. 	<ul style="list-style-type: none"> • Involves a significant amount of 11kV distribution feeder reconfiguration. • Both cables and substation need to be installed at once (no staging possible). • The usual land/consent/public-opposition risks in relation to securing a new substation site. • Early retirement of an existing substation.



Preferred Option	
Preferred Option	Option 6 - 2 x 33kV Cables from Carrington to Moturoa
Reasons for choosing Option	Option 6 involves the least capital cost, is flexible (can be staged) and establishes a platform from which to addresses all the issues/constraints outlined on page 2. In the long run Powerco expects to implement Option 9 and the costs associated with replacing the existing substation equipment are accounted for in the Replacement Expenditure category ¹³ .

Option 6 | Detailed Costs¹⁴

Item	Description	Actual Cost	Projected Cost
A	Property & Consent Costs		
A.1	None expected	\$0	\$0
B	Investigation and Reporting Costs		
B.1	Concept Design Report (CDR)	\$0	\$20,000
C	Substation Costs		
C.1	None required (Cable protection included in D.1 below)	\$0	\$0
D	Line and Cable Costs		
D.1	Carrington St GXP to Moturoa substation 33kV underground cable	\$0	\$8,082,000
E	Committed/Historical Costs (A+B+C+D)	\$0	
F	Future Projected Costs (A+B+C+D)		\$8,102,000
G	Anticipated Final Cost (E+F)		\$8,102,000

¹³ This Growth and Security option analysis, which considers only standard failure rates (inferring average asset health), concluded that an upgrade to the transformers (option 9) was not justified. Fleet lifecycle analysis, focusing on asset health, necessitated urgent refurbishment of the substation, particularly replacement of the transformers due to their poor condition. The incremental cost of additional capacity during replacement is very small. Hence, Option 9 will effectively be the outcome, but the transformer replacement (and synergistic upgrade) is driven by asset health, not capacity and security. This investment is therefore included in our zone substation renewal portfolio.

¹⁴ Excludes Powerco's internal/overhead costs.

Option 6 Implementation Plan				
Project or Action	Start Year ¹	End Year ¹	NZ \$'000 ¹	Details / Comments
Project costs to date	-	FY18	\$0	Costs that have already occurred.
Concept Design Report (CDR)	FY18	FY18	\$20	Report outlining a concept design for tender documents
Carrington St GXP to Moturoa substation 33kV underground cable	FY18	FY19	\$8,082	The detailed design, construction and commissioning of a new ≈7km, 630mm ² AL, 33kV cable between Carrington Street and Moturoa.
Total Project Costs	FY18	FY19	\$8,102	Includes Only Growth & Security Expenditure.

Supporting Documents and Models	
<p>Planning documents Standards Policies Reviews and Consultant reports Concept Designs Estimates</p>	<ol style="list-style-type: none"> 1. NPL GXP Proposal V3, Internal Powerco planning document. 2. Economic Evaluation of Moturoa Supply for New Plymouth GXP Disestablishment. 3. "Moturoa 33kV Cable Installation – Concept Cost Estimate", Jacobs Report VH00012-RPT-EEE-016, dated May 2015. 4. Powerco's Demand Forecast. 5. Powerco's 2016 Asset Management Plan (AMP). 6. Powerco Network Development Plan (NDP) 7. "310S001 Security-of-Supply Classifications – Zone Substations", Powerco Standard. 8. "393S041 Zone Substation Transformer Ratings", Powerco Standard. 9. "393S035 Electrical network Conductor Rating Standard", Powerco Standard.

Notes/Assumptions	
<p>Generic Assumptions in relation to Options Costs</p>	<ul style="list-style-type: none"> • Costs are expressed in 2016 (real) dollars. • The costs quoted are to construct the network and do not include economic factors (i.e. costs of non-supply) • The capital costs fall within the Growth and Security expenditure categories only. • The capital costs only include Powerco's capital expenditure (not Transpower or other parties). • The costs include all costs associated with the proposed projects (or alternate options) regardless of whether those costs fall within the CPP period or not, although they do not include any sunk costs (committed already).



Specific Assumptions in Relation to Options Costs

- Cost estimation for the options has initially been achieved via a desktop study using Powerco’s standard building block unit costs. They costs have then been refined by further investigations.
- Property and consenting costs are usually a high risk area involving considerable uncertainty. Due to the urban/lifestyle-block nature of area underground cable is used and where possible installed in road reserve.

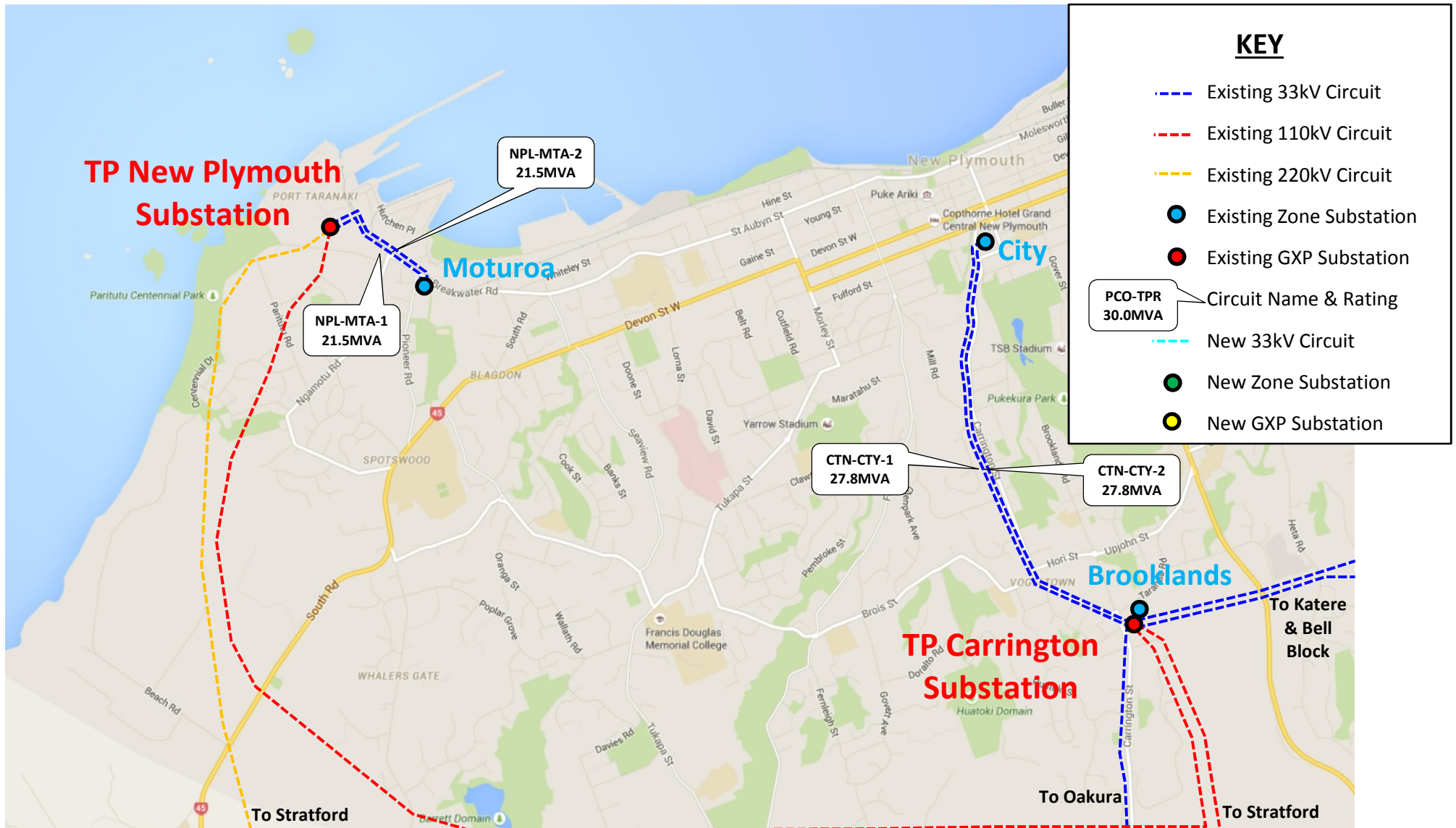


Figure 1: Existing New Plymouth & Carrington GXP Sub-transmission Networks: Geographic Diagram

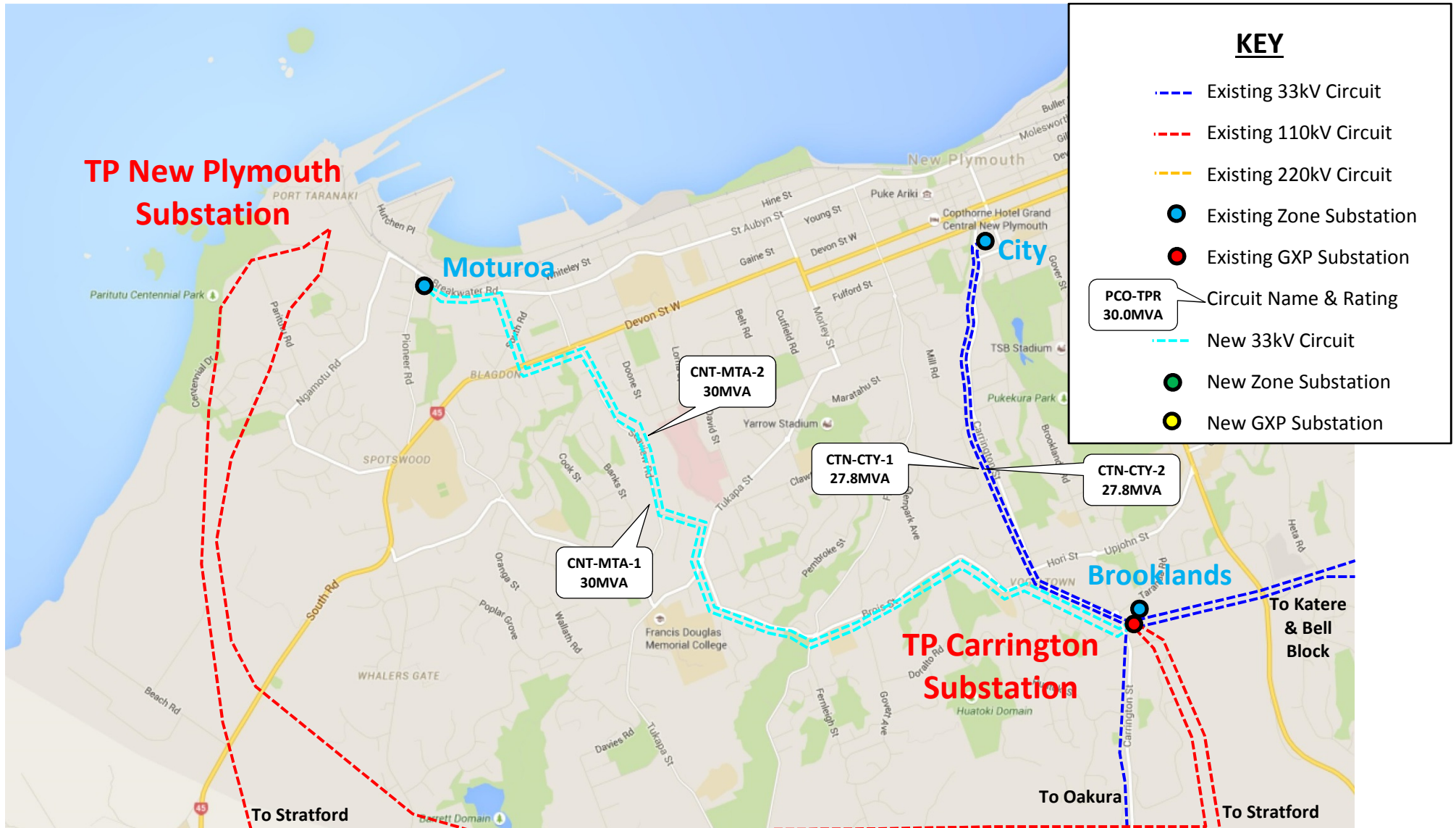


Figure 2: Option 6 – 2 x 33kV Cables From Carrington to Moturoa : Geographic Diagram

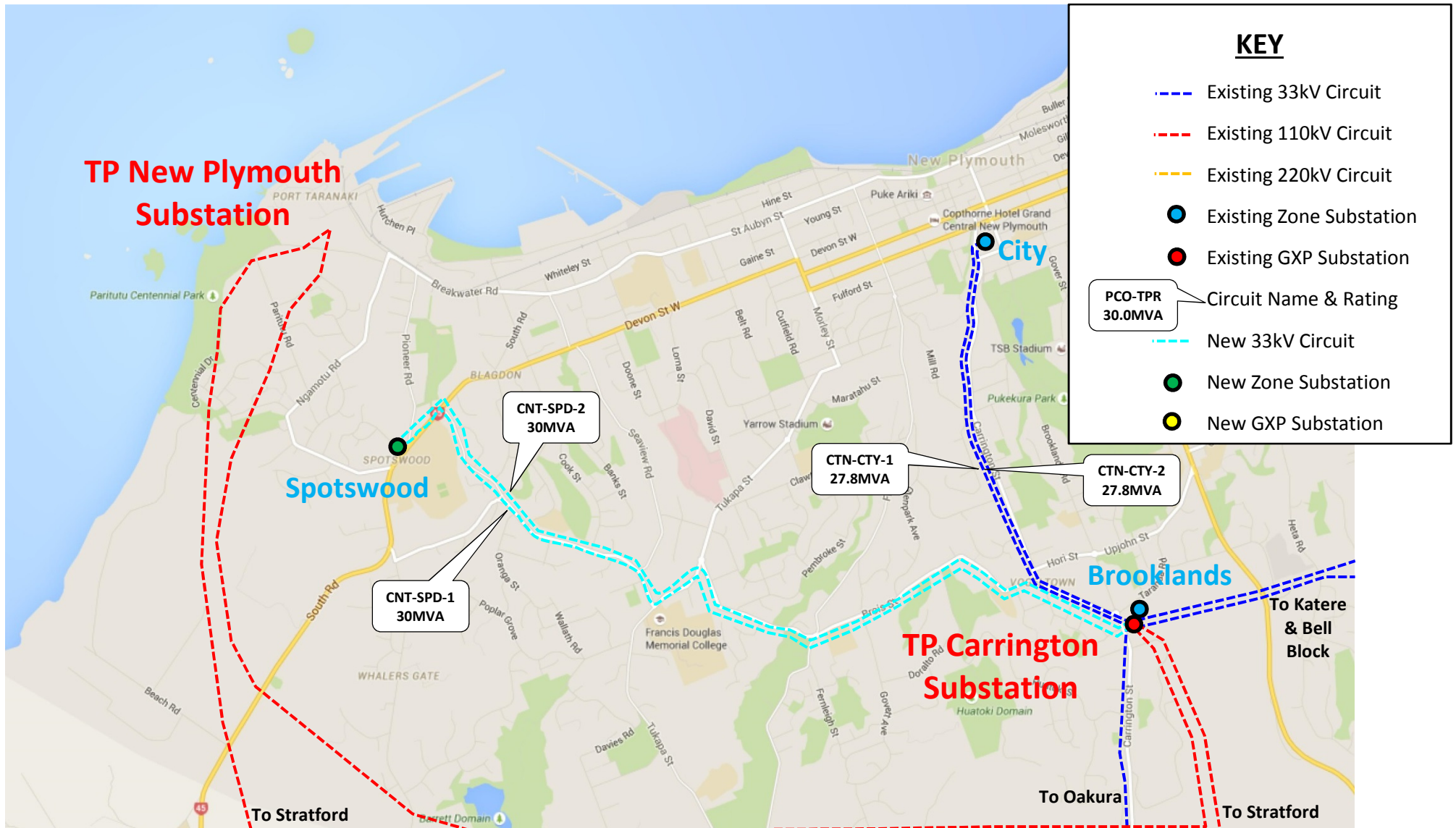
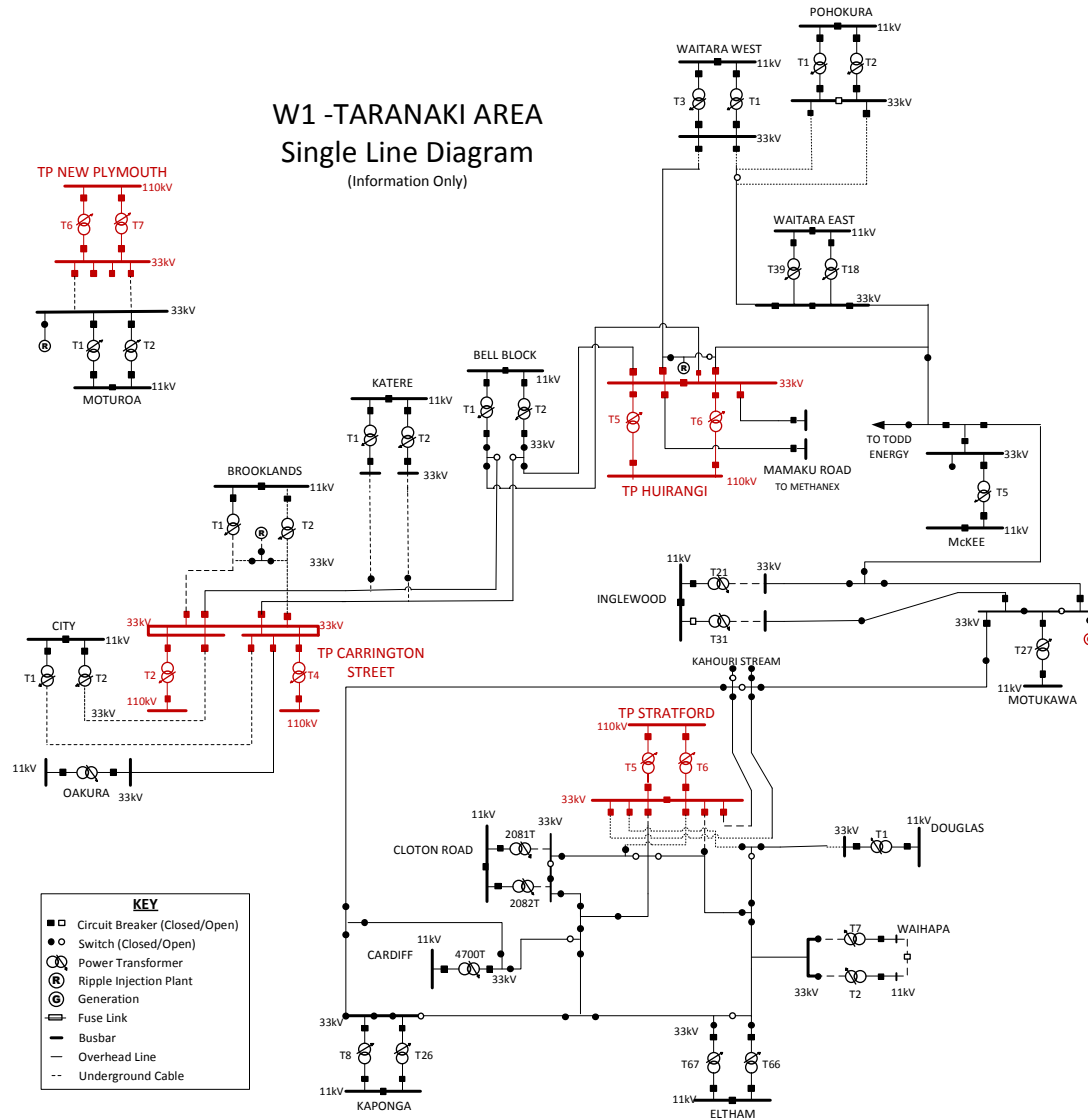


Figure 3: Option 10 – 2 x 33kV Cables From Carrington to Spotswood – New Spotswood Substation : Geographic Diagram

W1 - TARANAKI AREA
Single Line Diagram
(Information Only)



KEY	
□	Circuit Breaker (Closed/Open)
○	Switch (Closed/Open)
⊗	Power Transformer
⊕	Ripple Injection Plant
⊙	Generation
— —	Fuse Link
—	Busbar
—	Overhead Line
- - -	Underground Cable

Figure 4: Existing New Plymouth & Carrington GXP Sub-transmission Networks: Single-line Diagram

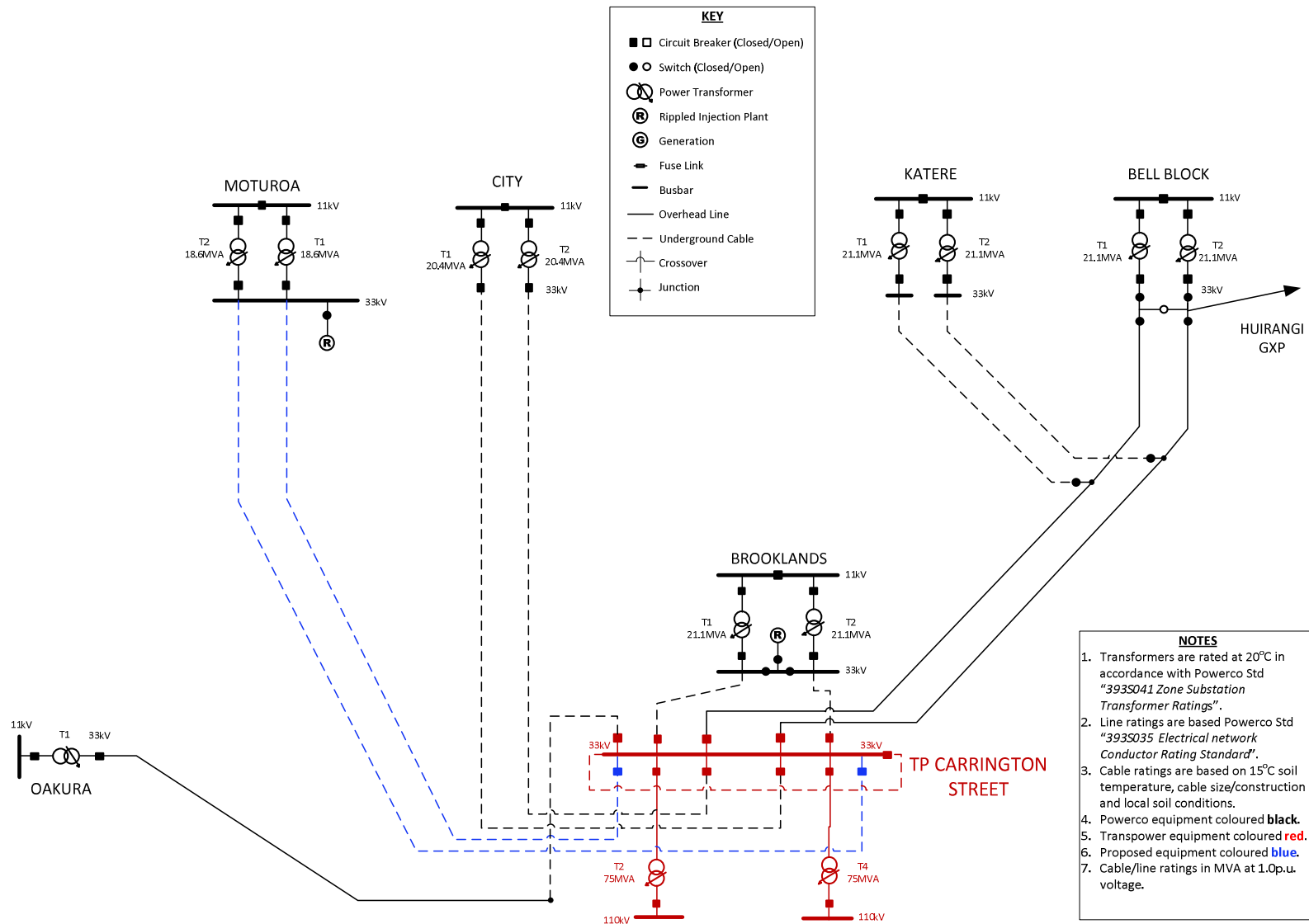


Figure 5: Option 6 – 2 x 33kV Cables From Carrington to Moturoa : One-line Diagram

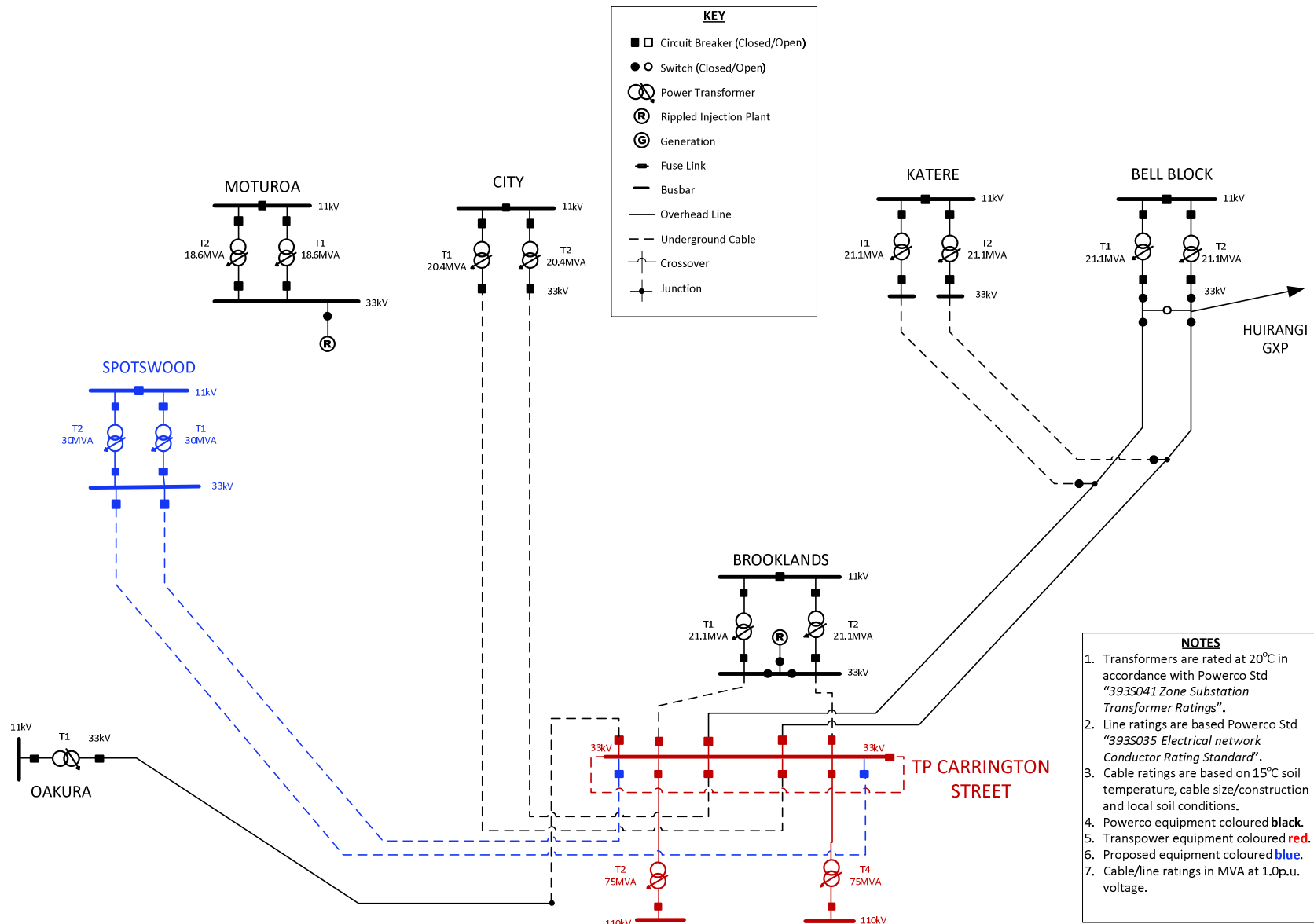


Figure 6: Option 10 – 2 x 33kV Cables From Carrington to Spotswood – New Spotswood Substation : One-line Diagram