Marsden Park Industrial Capacity Limitation PR674
Network Investment Options Report

Final Report

December 2013

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1 Executive Summary

This paper has been prepared in order to comply with Clause 5.6.2 of the National Electricity Rules (the NER), which includes the application of the Regulatory Test. It will provide a basis for Endeavour Energy to consult with Rules Participants and interested parties to examine options for the supply of electricity to the Marsden Park Industrial Precinct.

There are interdependent projects in this area and these have been identified as two separate, but linked, activities. The projects are:

1. PR596 Establishment of Marsden Park Residential 132/11kV Zone Substation Stage 1 (Board approved in June 2013)
2. PR674 Marsden Park Industrial Capacity Limitations (this proposal)

This document describes in detail Item 2 above, Marsden Park Industrial Capacity Limitations. The outcomes that are sought from this project are to:

- Meet customer requirements for supply capacity in the short, medium and long term.
- Provide flexibility to enable long-term secure supply at a time dictated by the rate of development.
- Provide for staged development to minimise the risk of underutilised assets.
- Minimise the Present Value of Costs of the staged development.

Four options were considered to achieve these outcomes, namely;

Option 1: Establish a permanent South Marsden Park Zone Substation (from the outset).

Option 2a: Establish a substation in two stages: Stage 1 involving the provision of a single transformer and permanent 11kV switchroom with one radial 132kV transmission Feeder 21J followed by the establishment of a full 132/11kV substation and the remaining transmission feeder to be installed at a later date that would be dictated by the pace of development.

Option 2b: As per option 2a without 132kV feeder circuit breaker and busbar.

Option 3: Establish a substation in two stages: Stage 1 involving the provision of a mobile 132/11kV zone substation followed by the establishment of the permanent 132/11kV zone substation at a later date that would be dictated by the pace of development.

Option 4: Establish a substation in two stages: Stage 1 involving the provision of a mobile 33/11kV zone substation followed by the establishment of the permanent 132/11kV zone substation at a later date that would be dictated by the pace of development.

Option 3 is the preferred option as it best achieves the required project outcomes and particularly minimises the Present Value of Costs.

- **The total funding approval required for the preferred option for Stage 1 is estimated to be $22.6m**
- **The Present Value of Costs (Option 3 combined Stage 1 and Stage 2) over the asset life is estimated to be $41.8m**

- **The Net Present Value (NPV) of the project (Option 3 combined Stage 1 and Stage 2) is estimated at $16.7m**

The system requirement date for the works is summer 2016. The works are required to be completed by this date to enable the initial and future industrial lot releases to be connected.

This project is an integral part of the implementation of the network strategy to supply power to the Marsden Park, Marsden Park Industrial, Marsden Park North and Schofields West Precincts within the North West Growth Centre.

Endeavour Energy will assess each of the build options in accordance with the Environmental Planning and Assessment Act 1979. The final option will be determined after consideration of responses to the Consultation Paper and the outcomes of the environmental assessment and associated community consultation.

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2 Introduction

The 551 hectare Marsden Park Industrial Precinct known as Sydney Business Park in the North West Growth Centre was released under the Department of Planning and Infrastructure's Precinct Acceleration Protocol (PAP) following application from Marsden Park Developments Pty Ltd, the majority landowner, in November 2008. The precinct was rezoned in November 2010.

Correspondence between Sydney Business Park developer and Endeavour Energy has occurred on a regular basis. This documentation outlines the need for the proposed works and details some of the background on the type of development expected in this area.

Options canvassed in this document are considered to be "new large distribution assets" as defined by the National Electricity Rules.

This document comprises the following:

- A discussion of the regulatory context in which this project will be carried out;
- A description of existing supply limitations in the area under consideration;
- Discussion of the Planning or Supply Security Standards that are applicable to a network of the scale under consideration;
- An assessment of the ultimate electrical load that can be expected to be realised when the area has become fully developed and is mature;
- A description of options considered to be appropriate to meet the long term forecast demand profile of the area;
- A discussion of the technical and environmental considerations taken into account when assessing the available options;
- An economic cost effectiveness analysis of each option, in accordance with Section 5.6.2(g) of the National Electricity Rules, to "identify options that satisfy the regulatory test".

3 Context

In proposing the installation of new large distribution assets, there is a backdrop of relevant regulatory considerations that need to be satisfied. These include the following:

3.1 National Electricity Rules Requirements

In October 2012 the AEMC made a final rule in response to the Distribution Network Planning and Expansion Framework rule change proposed by the Ministerial Council on Energy. Obligations imposed on DNSPs included the requirement to carry out the new Regulatory Investment Test – Distribution (RIT-D). Endeavour Energy is required to apply the RIT-D to investment projects that meet certain criteria that are submitted for approval after 1 January 2014.

The AER published the "Regulatory investment test for distribution – Application Guidelines" on 23 August 2013. Transition arrangements are explained in these guidelines under Section 1.2.2 Commencement of the RIT-D:

After 1 January 2014, projects will be assessed under the RIT-D instead of the Regulatory Test, unless by 31 December 2013:

- a NSP has commenced assessing the projects under the Regulatory Test; and
- the NSP has submitted a list of those projects to the AER

Under cl. 11.50.5(e) of the NER, we may determine that project/s have not commenced assessment under the Regulatory Test. We consider that an NSP has commenced assessing a project under the Regulatory Test if, before 1 January 2014, it has:

- Published a project evaluation under the former regulations; or
- Identified the project in a published Distribution Annual Planning Report (DAPR); or
- Released a Request for Information; or
- Commenced an option analysis for the project under the Regulatory Test.

Based on these conditions, this project is considered to be a transition project. Hence this options paper will comply with pre 1 January 2014 obligations in the National Electricity Rules described below.

Endeavour Energy is registered with AEMO as a "Distribution Network Service Provider" (DNSP) under the National Electricity Rules (NER) and consequently all of its assets are deemed to be distribution assets. As a result, Endeavour Energy's operations are governed by the NER and Section 5.6.2, Network Development, is particularly relevant.

Where a network constraint has been identified, paragraph 5.6.2 (e) requires that the Distribution Network Service Provider must "….notify any affected Registered Participants and AEMO of these limitations and advise those Registered participants and AEMO of the expected time for undertaking the proposed corrective action ……",

Paragraph (f) further requires that, except for new small distribution assets, the DNSP ",,,, must consult with affected Registered Participants, AEMO and interested parties on the possible options….to address the projected limitations of the relevant distribution system….", prior to the making the report in paragraph 5.6.2(h) of the rules.

This NIO report will form the basis of a Consultation Paper that is intended to satisfy the requirements of paragraphs 5.6.2 (e) and (f).

Paragraph (h) of the NER states that "…. The relevant Distribution Network Service Provider… must prepare a report that is to be made available to affected Registered Participants, AEMO and interested parties which:

(1) includes an assessment of all identified options…

(2) includes details of the preferred proposal including:

(i) its economic cost effectiveness…

(ii) the consultations conducted ……

(3) summarises the submissions from the consultations and

(4) recommends the actions to be taken

Paragraph (g) of the NER requires that the DNSP carry out economic cost effectiveness analysis of possible options to identify options that satisfy the regulatory test.

The Australian Energy Regulator published its final decision on the Regulatory Test (version 3) together with Application Guidelines in November 2007. The test is to be applied in relation to new network investments estimated to require a total capitalised expenditure in excess of $1 million, and does not apply to the replacement of assets. Public consultations are required for total capitalised expenditure in excess of $10 million.

According to the Regulatory Test, an augmentation satisfies this test if it meets either the regulatory or the market benefits limb –

Regulatory limb - in the event the option is necessitated principally to meet the service standards linked to the technical requirements of schedule 5.1 of the rules or in applicable regulatory instruments – the option minimises the present value of the costs of meeting those requirements compared with alternative option(s) in a majority of reasonable scenarios;

or

Market benefits limb - in all other cases – the augmentation maximises the expected net economic benefit to all those who produce, consume and transport electricity in the national electricity market compared to the likely alternative option(s) in a majority of reasonable scenarios. Net economic benefit equals the present value of the market benefit less the present value of costs.

The costs include the capital, operating and maintenance costs for the new asset(s). The calculation of the net present value of cost has been performed with appropriate sensitivity analysis as per the following requirements of the Regulatory Test:

Reasonable scenarios under this test must encompass sensitivity testing on key input variables.

3.2 Design, Reliability and Performance Licence Conditions

The mandated design, reliability and performance licence conditions, which came into effect on 1 August 2005 and amended on 1 December 2007, require an N-1 security standard for zone substations with a maximum forecast demand of greater than 10MVA.

This means that the network is designed such that the loss of any one element at times of peak demand will not result in loss of load for greater than one minute. In the case of zone substation transformers, should this security standard be predicted to be exceeded (by forecast data), then any network augmentation is planned to occur prior to the situation where the load on any transformer will exceed its cyclic rating for more than 1% of the year. The application of these standards is intended to ensure an appropriate level of security for urban networks. The amount of demand exceeding the stated "N-1" standard is generally termed "Load at Risk". The amount of "N-1" capacity is often referred to as "Firm Capacity".

Schedule 1 in the Licence Conditions has been repealed by the Minister for Energy and the changes will take effect on 1 July 2014. The preferred option in this business case is to establish an initial "N" supply to the industrial park and is as such not affected by N-1 supply security standards. The timing of N-1 requirements for NPV analysis has been based on the 10MVA currently stated in the licence conditions for option comparison purposes.

3.3 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (the Act) defines two approval processes depending on whether a proposal, or components of it, is considered an "activity" (addressed under Part 5 of the Act) or a "development" (Part 4 of the Act).

In December 2007 the NSW Government gazetted under the Environmental Planning and Assessment Act, 1979, the State Environmental Planning Policy (Infrastructure) 2007. The aim of this Policy is to facilitate the effective delivery of infrastructure across the State.

*Under **"Section 41 Development permitted without consent"***

(1) *"Development for the purpose of an electricity transmission or distribution network may be carried out by or on behalf of an electricity supply authority or public authority without consent on any land…"*

The Policy's definition of an "electricity transmission or distribution network" includes the following components:

(a) *above or below ground electricity transmission or distribution lines (and related bridges, cables, conductors, conduits, poles, towers, trenches, tunnels, ventilation and access structures)*

(b) *above or below ground electricity kiosks or electricity substations, feeder pillars or transformer housing, substation yards or substation buildings…*

Since Endeavour Energy is an "Electricity Supply Authority" as defined in this Policy, Endeavour Energy will not need to seek Local Council approval for components of projects (i.e buildings) formerly requiring approval under Part 4 of the Act. All works are therefore considered to be an 'activity' for the purposes of the Act and are required to be assessed in accordance with the provisions of Part 5. Endeavour Energy is the determining authority under Part 5 of the Act.

The Act requires a determining authority to consider whether a proposal is likely to result in a "significant" impact on the environment having particular regard to the requirements of Clause 228(2) of the Environmental Planning and Assessment Regulation 2000. If the impact is considered to be "significant" and Endeavour is the determining authority (and the proponent), Part 3A of the Planning Act applies and an Environmental Assessment must be prepared as the primary means of identifying and assessing the environmental impacts of the proposal. The Director General of the Department of Planning issues requirements relating to the form and content of the Environmental Assessment. The Department assesses the Environmental Assessment and the Minister makes a determination regarding the approval of the project. There are a series of requirements relating to stakeholder consultation and exhibition of the Environmental Assessment.

If the impacts of a proposal are not considered to be "significant", a determining authority must still consider the environmental effects of a proposal.

3.4 Electromagnetic Fields

At present, the regulations of 50/60Hz electromagnetic fields are assigned to the Australian Radiation Protection and Nuclear Safety Authority (ARPANSA). The Statutory Rules, passed in 1999, recommend a maximum of 1000mG (100μT) for residential exposure in Australia, which is based on the latest general international public guidelines that have been set by the World Health Organisation. These guidelines state that, for a full day occupational exposure, the electric field should be no greater than 10kV/m and the magnetic field 500μT, and similarly, a general public exposure limit has been set at 5kV/m and 100μT.

Endeavour Energy Planning policy 9.2.5 states that:

"all assets shall be designed to achieve compliance with the National Health and Medical Research Council (NHMRC) Interim Guidelines on Limits of Exposure to 50/60Hz Electric and Magnetic Fields … all electrical network assets should be designed to minimise Electric and Magnetic Fields (EMF) exposure to the public and employees as far as is practicable at reasonable cost…"

Similarly, the NHMRC states that:

"members of the general public should not be exposed on a continuous basis to unperturbed rms magnetic flux densities exceeding 0.1 mT. This restriction applies to areas in which members of the general public might reasonably be expected to spend a substantial part of the day. Exposures to magnetic flux densities between 0.1 and 1.0 mT (rms) should be limited to a few hours per day. When necessary, exposures to magnetic flux densities in excess of 1 mT should be limited to a few minutes per day.

Hence, it can be concluded that the extended public exposure on premises other than roadways, such as easements and other reserves should not exceed 100μT. Shielding of magnetic fields may be required where these levels may be exceeded.

4 Background

4.1 General

Marsden Park Industrial Precinct is located within the North West Growth Centre (Figure 1) and is zoned for industrial / commercial use (Figure 2).

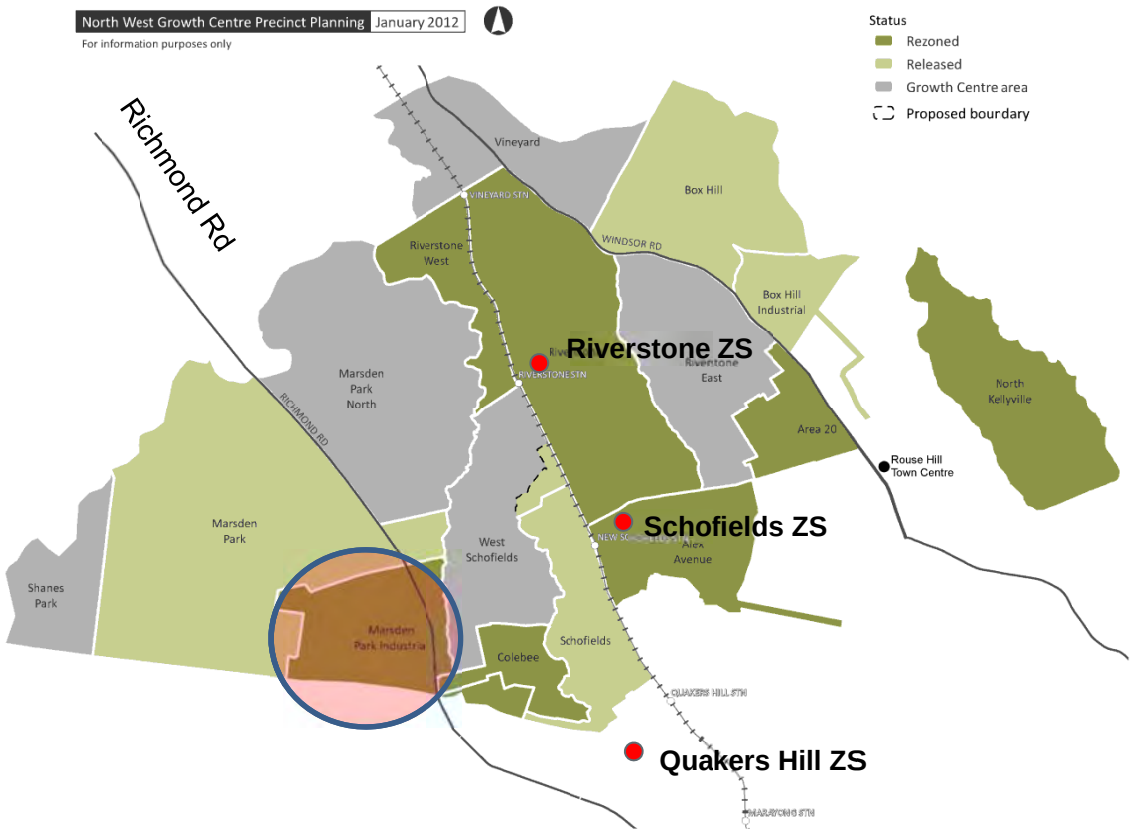


Figure 1 – Marsden Park Industrial Precinct and the North West Growth Areas

The North West Growth Centre is a defined area in Sydney's North West. It is approximately 10,000 hectares in area and includes 16 precincts that will ultimately contain about 66,000 new homes. Marsden Park Industrial Precinct is the first to be released under the Government's Precinct Acceleration Protocol, which allows planning and development to proceed earlier than that initially proposed by the Growth Centres Commission. The precinct was released by Planning NSW in June 2008. The draft Precinct Plan was exhibited for public comment in November 2008 and the precinct was rezoned in April 2010.

Once developed, Marsden Park Industrial Precinct will comprise of 70 hectares of commercial land, 40 hectares of bulky goods retailing, 206 hectares of industrial land, 63 hectares of conservation land and open space. There will also be a mix of residential housing close to the planned Marsden Park town centre just to the north of the precinct to accommodate up to 3500 people.

The area under consideration currently has no electrical infrastructure except along Richmond Rd. The Marsden Park area is currently supplied by Riverstone and Schofields Zone Substations with 11kV distribution cross zone links with Rooty Hill and South Windsor Zone Substations. The existing network has been designed for predominantly rural and low density customers. Therefore, any new development in the area will require major network upgrades, including a new zone substation and sub transmission infrastructure.

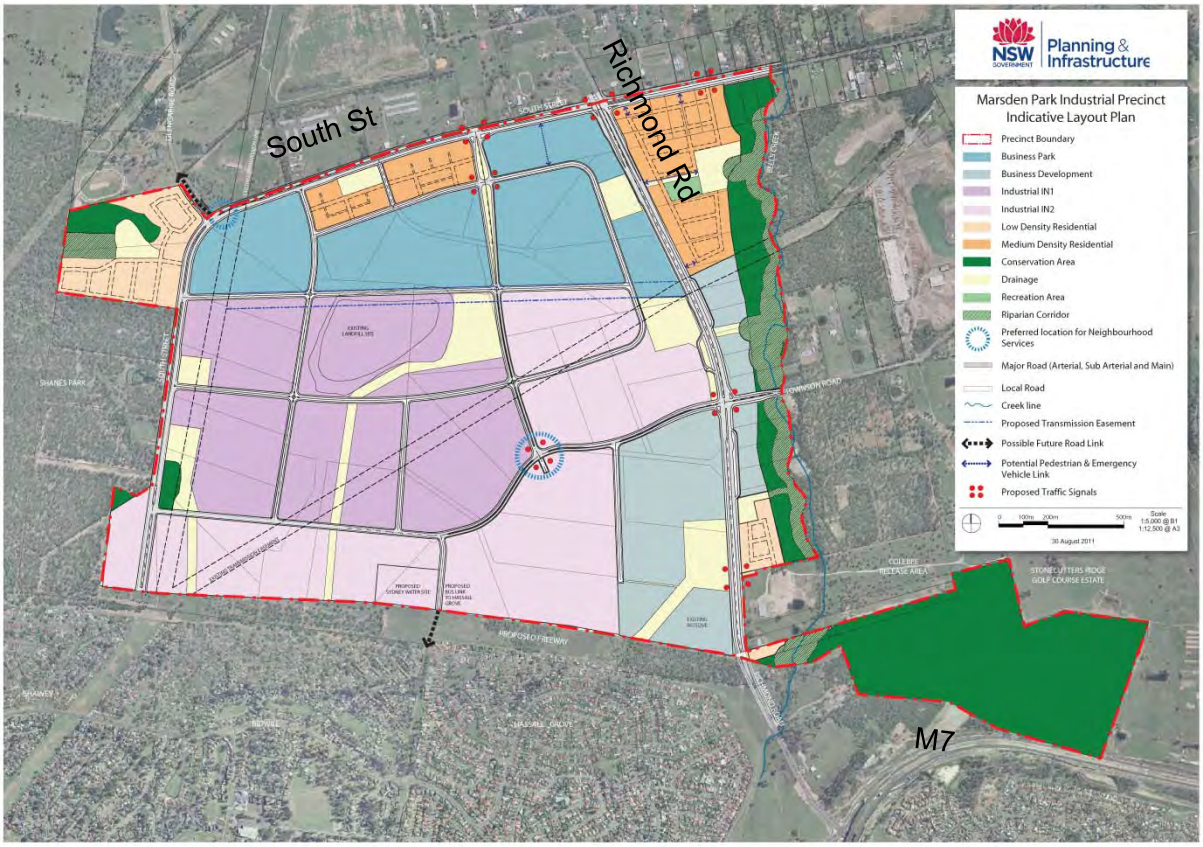


Figure 2 – Marsden Park Industrial Precinct

Endeavour Energy has developed a strategic area plan for electricity supply in the North West Sector that involves establishing a 132kV sub-transmission network and associated zone substation throughout the sector. Establishing a new zone substation in the Marsden Park Industrial Precinct is in accordance with the strategic area plan. South Marsden Park ZS will supply power not only to the precinct but also provide network support to the surrounding areas.

The existing transmission supply arrangement is shown in Figure 3.

A Statement of Network Need (SNN) has been developed for this project and is included as Appendix 1.

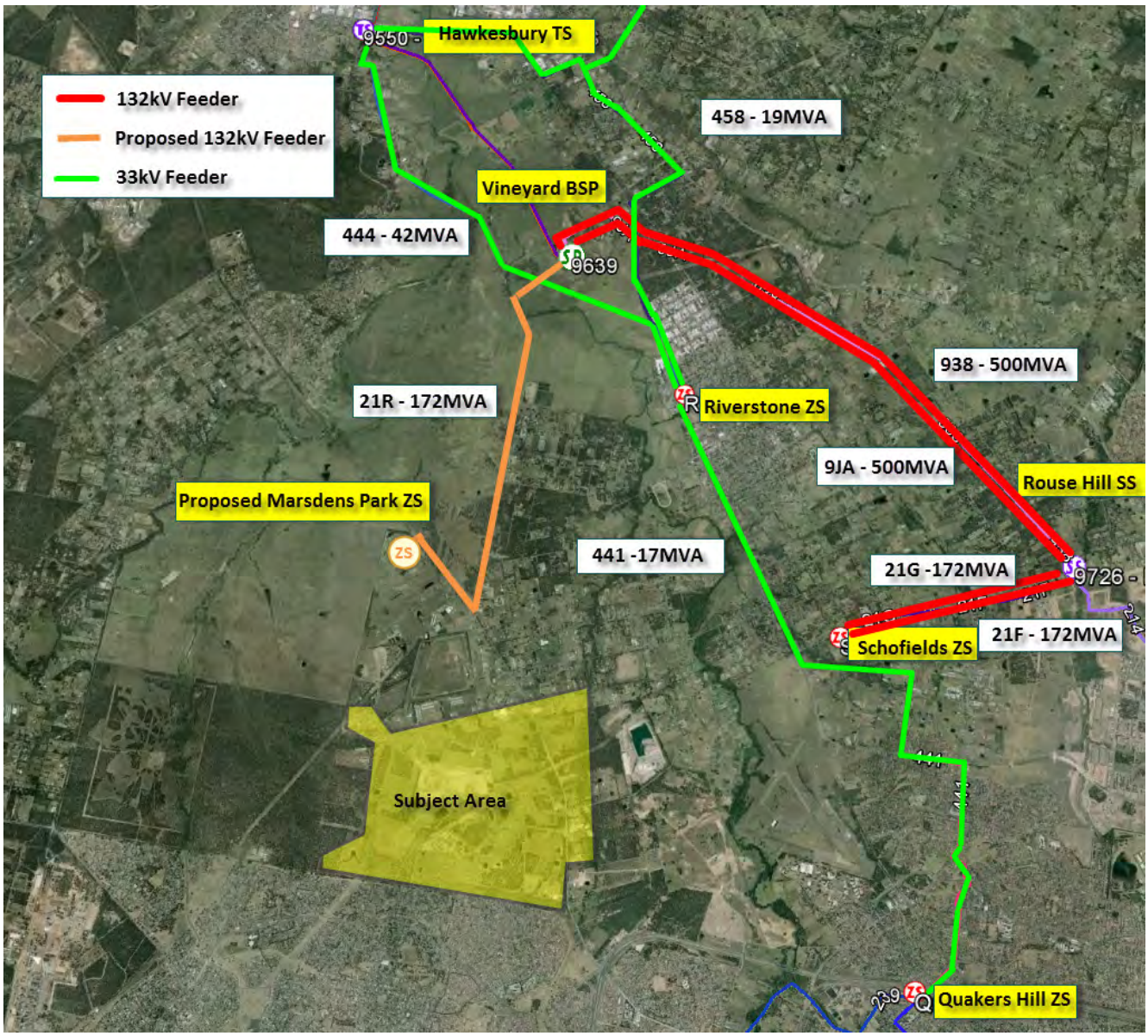


Figure 3 – Existing Transmission Supply Arrangement

4.2 Network Constraints

The principal network constraint is that the site is a greenfield site with essentially no existing electrical infrastructure, transmission or distribution, adequate to service the power requirements of the proposed Sydney Business Park development. The Marsden Park Industrial area is currently supplied by Riverstone and Schofields Zone Substations with a cross zone tie to Rooty Hill Zone Substation. Notwithstanding this, two developer funded contestable 11kV feeders and an existing 11kV feeder from Schofields Zone Substation will supply up to 6MVA of capacity into the Marsden Park Industrial Precinct. A further 2MVA of capacity will be available from an existing feeder from Rooty Hill Zone Substation once the developer funded contestable distribution feeders are commissioned.

Schofields Zone Substation has sufficient capacity to service the development in the short to medium term. Due to the geographic remoteness from Marsden Park (approximately 7km by road) and at a cost of approximately $5M for each 4.5MVA feeder, the cost of installing sufficient distribution feeder capacity for anything more than the short term requirements is considered prohibitive.

The establishment of Marsden Park Zone Substation to the north of the development area will supply further capacity into the area. However, this will not be established in time to meet the short term requirements of the development.

The Load at Risk in summer for 11kV feeders with respect to a design rating of 240A is shown below in Table 1. The table shows only 11kV feeders adjacent to the Marsden Park Industrial Precinct. Summer load is considered as it presents the greatest load at risk on these feeders. Table 1 highlights the limited distribution capacity from the adjacent 11kV feeders.

Zone Substation	Feeder	Summer Load (2012/13) (Amps)	Load at Risk (MVA)	Voltage Regulation (%)	Exceeds Planning Standards >240A or >3.5%[1]
Riverstone	A052	150	Nil	5.3	**YES**
Schofields	SC1238	200	Nil	6.1	**YES**
Rooty Hill	T884	203	Nil	4.3	**YES**
Non Compliances / Load at Risk		0 Feeders > 240A	Nil	3 Feeders >3.5%	3 Non Compliances

Table 1 – Summer Load at Risk for Distribution Feeders

Note:

1. Endeavour Energy Standard SDI501 recommended normal urban voltage limit for the 11kV and 22kV urban networks

The transmission network performance load summary for the adjacent 33kV network is shown in Table 2. The existing 33kV transmission feeder 458 to Riverstone Zone Substation is overloaded under an outage of feeder 444. To reduce the feeder load on feeder 458, the 33kV busbar at Riverstone is split and one section of 33kV busbar is supplied from feeder 441 supplied by Quakers Hill. Table 2 highlights the available transmission capacity from the adjacent 33kV feeders under these fault conditions.

Fault	Nil	444[1]	458	Rating	Year of Result
441[1]	S/B	16.5[1]		**17**	2022/23
444	23	X	32.3	**42**	2022/23
458 Tee to Riverstone[1]	9.2	16.5	0.1	**19**	2022/23

Table 2 – 33kV Transmission Loads and Rating Summary

Note:

1. The 33kV busbar is split at Riverstone ZS during outage of Feeder 444.

4.3 Potential for Growth

The Marsden Park Industrial Precinct is located within the North West Growth Centre and was rezoned in April 2010 for industrial / commercial use. The precinct has direct access to the M7 Motorway and access to Richmond railway stations via Garfield Rd. The NSW Government has announced the intersection of South St and Richmond Rd as a potential public transport corridor into Marsden Park for the northwest rail link. Marsden Park Developments Pty Ltd owns over 200 hectares of land at the centre of the precinct where it has begun the establishment of the Sydney Business Park. The precinct area has been accelerated by the State Government's Precinct Acceleration Protocol (PAP) and Employment Lands Development Program (ELDP).

Endeavour Energy has received load applications within the Marsden Park Industrial Precinct as listed in Table 3 and shown in Figure 4. The existing load applications total is 16.6MVA. When fully developed the precinct is expected to have a maximum demand of 45MVA to 50MVA.

Application No.	Load	Developer	Comments
UIS0640 & UIL4010	0.55MVA	Sydney Business Park	Under Construction - Bunnings
ENL1768	1.3MVA	Winten	Future - 250 Residential lots
ENL1897	2.3MVA	Pace	Future -Industrial enquiry corner of Richmond Rd and South St
ENL1929, UIS0666, UIS0668	1.45MVA	Sydney Business Park	Under Construction - McDonalds, Shell, Masters and Costco
UIS0667, UCL5863 & UIL4219	2MVA	Sydney Business Park	Under Construction - IKEA New 11kV distribution feeder from Schofields ZS
ENL2061	9MVA	Sydney Business Park	Future - two major distribution centres (7MVA) and (2MVA)
Total	**16.6MVA**		

Table 3 – Existing Load applications for the Marsden Park Industrial Precinct

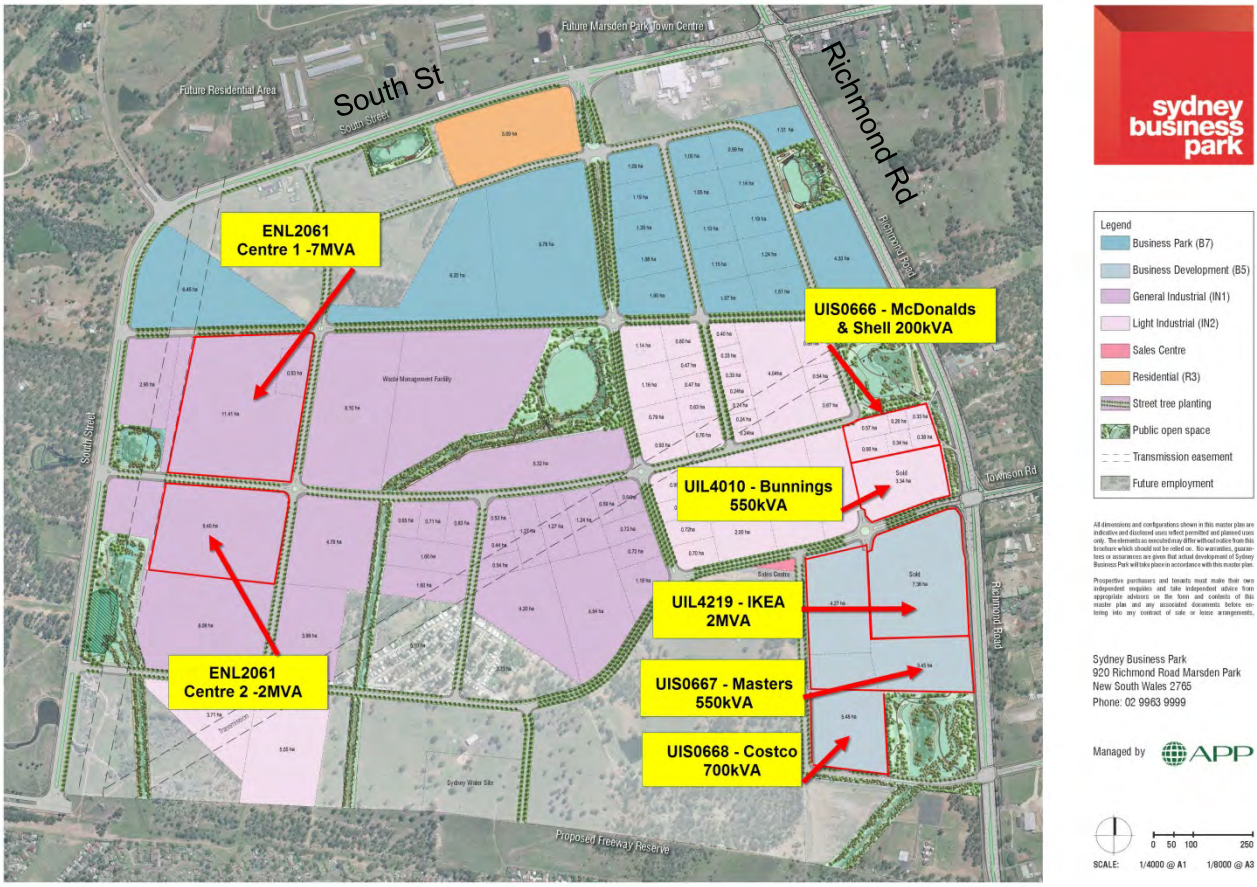


Figure 4 – Existing Load applications for the Marsden Park Industrial Precinct

A sales lot forecast has been provided by Sydney Business Park as shown in Table 4. It is expected that the land use will be a mix of manufacturing, warehouses, general industrial and low to medium residential use.

The load forecast has been developed based on load density of 40VA/m^2 for floor space area which experience shows is typical of this type of development. Sydney Business Park has indicated the forecast target land sales will be 15ha per year.

A preliminary load forecast based on current available information is shown in Table 4.

Business	Land Area	Floor Space	Opening	MVA	Cumulative MVA
Bunnings (UIL4010)	33,450	13,678	Jan-14	0.55	0.5
IKEA (UIL4219)	76,060	26,000	Jul-14	1.04	1.6
McDonalds (UIS0666)	3,000	520	Jul-14	0.02	1.6
Shell (UIS0666)	3,000	500	Jul-14	0.02	1.6
Masters (IUIS066)	34,920	13,221	Aug-14	0.53	2.2
Known Plumbing	4,100	1,000	Sep-14	0.04	2.2
Known Storage	22,000	11,000	Sep-14	0.44	2.6
Committed Recycling	32,000	10,000	Dec-14	0.40	3.0
Known Supermarket	6,000	2,000	Dec-14	0.08	3.1
Known Industrial	64,000	28,000	Mar-15	1.12	4.2
Committed Industrial	7,000	3,000	Aug-15	0.12	4.4
Distribution Centre 1 (ENL2061)			Jan-16	2.0	6.4
Distribution Centre 2 (ENL2061)			Jan-16	7.0	13.4
Costco (UIS0668)	59,830	18,109	Jun-16	0.72	14.1
Known Bulky Goods	39,120	20,000	Jun-16	0.80	14.9
Forecast Industrial 1	30,000	14,000	Jul-16	0.56	15.4
Forecast Industrial 2	30,000	14,000	Oct-16	0.56	16.0
Forecast Industrial 3	120,000	56,000	2017	2.24	18.2
Future Forecast Industrial[2]	150,000		2018	2.25	20.5
Future Forecast Industrial	150,000		2019	2.25	22.7
Future Forecast Industrial	150,000		2020	2.25	25.0
Future Forecast Industrial	150,000		2021	2.25	27.2
Future Forecast Industrial	150,000		2022	2.25	29.5
Future Forecast Industrial	150,000		2023	2.25	31.7
Future Forecast Industrial	150,000		2024	2.25	34.0
Future Forecast Industrial	150,000		2025	2.25	36.2
Future Forecast Industrial	150,000		2026	2.25	38.5
Future Forecast Industrial	150,000		2027	2.25	40.7
Future Forecast Industrial	150,000		2028	2.25	43.0
Future Forecast Industrial	150,000		2029	2.25	45.2
Future Forecast Industrial	150,000		2030	2.25	47.5

Notes: 1 – Committed customer's sales up to 2016
2 – Future land sales beyond 2018 are based on the developers project forecast land sales of 15ha per year.

Table 4 – High Growth Sydney Business Park Forecast

It is expected that the load will ultimately reach up to 45MVA. Depending on the exact land use and the market conditions, the load could change quickly. Endeavour Energy has received a spot load application of 7MVA for a robotic distribution centre. There is also potential for large load applications such as cold storage or data centre facilities within the business park.

The network investment preferred option should be flexible enough to modify the network solution if the Sydney Business Park forecast either achieves or does not realise its full sales potential. As such, a low growth load forecast based on the land sales rate of approximately 7.5ha per year is presented and shown in Table 5. Both the high growth and low growth forecasts are used to analyse the network investment options.

Business	Land Area	Floor Space	Opening	MVA	Cumulative MVA
Bunnings (UIL4010)	33,450	13,678	Jan-14	0.41	0.4
IKEA (UIL4219)	76,060	26,000	Jul-14	0.78	1.2
McDonalds (UIS0666)	3,000	520	Jul-14	0.02	1.2
Shell (UIS0666)	3,000	500	Jul-14	0.02	1.2
Masters (IUIS066)	34,920	13,221	Aug-14	0.40	1.6
Known Plumbing	4,100	1,000	Sep-14	0.03	1.6
Known Storage	22,000	11,000	Sep-14	0.33	2.0
Committed Recycling	32,000	10,000	Dec-14	0.30	2.3
Known Supermarket	6,000	2,000	Dec-14	0.06	2.3
Known Industrial	64,000	28,000	Mar-15	0.84	3.2
Committed Industrial	7,000	3,000	Aug-15	0.09	3.3
Distribution Centre 1 (ENL2061)			Jan-16	2.00	5.3
Distribution Centre 2 (ENL2061)			Jan-16	7.00	12.3
Costco (UIS0668)	59,830	18,109	Jun-16	0.54	12.8
Known Bulky Goods	39,120	20,000	Jun-16	0.60	13.4
Forecast Industrial 1	30,000	14,000	Jul-16	0.42	13.8
Forecast Industrial 2	30,000	14,000	Oct-16	0.42	14.3
Forecast Industrial 3	120,000	56,000	2017	1.68	15.9
Future Forecast Industrial[2]	75,000		2018	1.05	17.0
Future Forecast Industrial	75,000		2019	1.05	18.0
Future Forecast Industrial	75,000		2020	1.05	19.1
Future Forecast Industrial	75,000		2021	1.05	20.1
Future Forecast Industrial	75,000		2022	1.05	21.2
Future Forecast Industrial	75,000		2023	1.05	22.2
Future Forecast Industrial	75,000		2024	1.05	23.3
Future Forecast Industrial	75,000		2025	1.05	24.3
Future Forecast Industrial	75,000		2026	1.05	25.4
Future Forecast Industrial	75,000		2027	1.05	26.4
Future Forecast Industrial	75,000		2028	1.05	27.5
Future Forecast Industrial	75,000		2029	1.05	28.5
Future Forecast Industrial	75,000		2030	1.05	29.6

Notes: 1 – Committed customers and forecast industrial sales up to 2016
2 – Future land sales beyond 2018 are based on the developers project forecast land sales of 7.5ha per year.

Table 5 –Low Growth Sydney Business Park Forecast

It has been estimated that future developments in the Marsden Park area will generate up to 110-134MVA of demand as shown in Table 6 below.

Stage 1 of Marsden Park Zone Substation was subject to a separate business case and was Board approved in June 2013. Due for commissioning in 2015, it expected to supply up to 2400 lots within the Marsden Park Residential Precinct. Stage 2 of the Marsden Park Zone Substation development will be initiated when development has reached a level at which the risk of loss of supply becomes unacceptable.

Release Area	Number of Residential Dwellings	Land Use	Potential Load (MVA)
Marsden Park Industrial (551Ha)	1200	Significant industrial land Mixed use employment	45- 50
Marsden Park North	4,000	Predominantly residential	10-20
Marsden Park Residential	10,000	Residential scheduled lands	45- 50
Schofields West	2000	Residential scheduled lands	10-14
Total			**110-134**

Table 6 – Overall Load Estimate of Study Area

4.4 Long Term Network Strategy

Endeavour Energy has developed a long-term supply strategy for the North West Sector as previously indicated and this is contained in Special Report S073, "North West Sector Area Study". The establishment of Marsden Park and South Marsden Park 132/11kV Zone Substations are in line with the supply strategy outlined in that report. The report also outlined the possibility of establishing a 33kV transmission network in the North West sector. Adding an additional 33kV network to the North West sector creates an additional sub transmission layer and would require additional 132/33kV transmission substations in strategic locations. Zone substations costs are marginally more for 132/11kV 45MVA as against a 33/11kV 50MVA. The 33kV network will also require additional real estate to house a 132/33kV transmission substation. The report concluded the establishment of a 33kV network throughout the northwest sector was not a cost effective solution and the preferred transmission supply is 132kV transmission.

Neighbouring precincts of Riverstone and Schofields are expected to grow significantly as further lots are released. These include the rezoned areas of Riverstone, Riverstone West, Alex Avenue, Schofields, Marsden Park North and West Schofields. Marsden Park North and West Schofields precincts have been marked as future growth centre areas (Figure 1) and are part of the Marsden Park and South Marsden Park Zone Substation supply catchment areas.

Due to recent load applications (ENL2061) within the Marsden Park Industrial Precinct, the forecast demand growth in the short to medium term is higher than the original Sydney Business Park projection. As such, the medium term supply strategy for the greater Marsden Park area is currently being reviewed. If any significant industrial load is connected to Stage 1 Marsden Park Zone Substation there will be an unacceptable load at risk on a single transformer. The Board-approved Stage 1 Marsden Park Zone Substation will require augmentation to provide N-1 security. Marsden Park Stage 2 would require an earlier than expected commissioning in 2016 and up to four (4) or five (5) distribution feeders of approximately 4-5kms in length to supply the Marsden Park Industrial load in the medium term. The feeders can only exist in the Richmond Rd corridor and will have associated technical and timing issues to meet the industrial precinct medium term load demands. More than four feeders in the one corridor will have excessive derating factors that will compound once more feeders are installed to overcome the derating. When South Marsden Park Zone Substation is fully commissioned, these distribution feeders will become obsolete. The extra non recoverable costs of these feeders make this option non-viable. The alternative network investment option is to establish

South Marsden Park ZS Stage 1 in the industrial precinct and delay the construction of Stage 2 Marsden Park ZS until the pace of residential development dictates. This would allow large load customers to connect without significant contestable 11kV distribution feeder investment.

4.5 Environmental Issues

Environmental issues that are likely to impact on supply to the Marsden Park Industrial Precinct and surrounds include:

- The management of additional transformer noise.
- Visual impacts associated with the establishment of additional electricity assets.
- The increased public exposure to electromagnetic fields (EMF) due mainly to the installation of additional subtransmission capacity into the area and management of the public perception of the issues associated with this.

The project will be managed to comply with all aspects of the Environmental Planning and Assessment Act 1979.

Relevant stakeholders will be identified and managed in accordance with corporate stakeholder management and communications policies.

5 Project Design Requirements

Based on the previously identified network constraints and the context within which the project is to be carried out, the following factors have been identified as key to meeting the project purpose. All of these factors need to be addressed for each identified option, and the ideal project outcome is intended to satisfy all of these requirements:

- Meet customer requirements for supply capacity in the short, medium and long term.
- Reliability – ensuring customers receive appropriate levels of reliability in alignment with customer expectations and reliability standards outlined in the Licence Conditions.
- Minimise the Present Value of Costs of the staged development.
- Provide flexibility to enable long term secure supply at a time dictated by the ratio of development.
- Long Term Network Strategy – the solution must support and be supported by the long-term plan for network development in the area.
- Environmental Feasibility – ensuring that the project does not result in a worse environmental impact than currently exists. Where this is not possible, the project must aim to minimise the additional environmental impact.
- Technical Suitability – all relevant design standards must be met.
- Network Utilisation – Provide for staged development to minimise the risk of underutilised assets.
- Network Safety – the proposed solution does not present any future safety issues for operations and maintenance personnel or members of the public. It addresses any identified current safety concerns.

6 Options

6.1 Do Nothing

The Do Nothing option is not considered viable for this development as this is a “greenfield” industrial development.

The “Do Nothing” option does not change the risk profile at the existing surrounding zone substations. and does not provide a viable connection point to allow further precinct growth The expected ultimate load demand will be in excess of the firm substation capacity and consequently will not meet Endeavour Energy supply planning and voltage regulation standards. This option will not therefore be considered further.

6.2 Demand Management Strategy to Reduce Load

Endeavour Energy investigates non-network option options for all major projects in accordance with the National Electricity Rules (NER) Chapter 5. The NER states that all major distribution network capital investment projects must have non-network (demand management) options investigated for all projects above $5million and that pass the screening test for non-network options.

The investigation found that there is insufficient scope for demand reduction to overcome the 11kV system constraint in order to defer the construction of the new South Marsden Park Zone Substation.

Details of the investigation are included in Appendix 2.

6.3 Utilising the existing network

There is no opportunity to off-load the majority of this capacity to adjacent parts of the network due to geographical separation and capacity constraints at the closest alternative sources. The closest alternative sources are the 11kV networks emanating from Riverstone, Schofields and Rooty Hill Zone Substations located 9km, 6.8km and 7km by road respectively. It has been calculated that approximately 8MVA of capacity will be initially supplied from the surrounding zone substations through developer funded 11kV distribution feeder works from Schofields Zone Substation. However, to service the development beyond the initial stages a new zone substation and sub transmission infrastructure is required. Development of 11kV distribution feeders from Schofields ZS beyond the initial lot release would create underutilised distribution feeders once the zone substation is required and established.

Riverstone and Rooty Hill Zone Substations are considered too remote to effectively supply the anticipated demand at 11kV as the site is located more than 6 km from the existing substations. Utilising the existing 11kV network from Rooty Hill is limited to approximately 2MVA and is not a viable option due to physical feeder length and associated voltage regulation issues. This strategy is considered non-viable in the medium to long term and will not be considered further.

Stage 1 Marsden Park Zone Substation to be established under project PR596 is located 4.5km from the Marsden Park Industrial Precinct. Developing distribution feeders from Marsden Park Zone Substation would result in the advancement of Stage 2. As outlined in previous Network Investment Options paper PR596, Stage 2 involves the second transformer and additional 132kV and 11kV switchgear and a second 132kV transmission feeder from Schofields to Marsden Park Zone Substation at an approximate cost of $18.4 million. This cost does not include the four (4) or five (5) distribution feeders required to service industrial loads until 2020. These contestable 11kV distribution

feeders would cost approximately $3 - $4 million each. The total cost of this strategy would be $33m - $39m. Development of 11kV distribution feeders from Marsden Park Zone Substation for the medium term supply into Marsden Park Industrial Precinct would create very long and underutilised distribution feeders once the South Marsden Park Zone Substation is required and established. As such, it is not a viable option in the medium to long term and will not be considered further.

6.4 Build Options

The area under consideration is a “greenfield” development. Based on the growth potential outlined in section 4.3, five main build options are considered to address the medium and long term capacity limitations. Four of the five build options utilise a staged approach. The staging of the project will create an N network security arrangement in the medium term. This network supply risk will be alleviated when Stage 2 of the project is commissioned. It is anticipated that Stage 2 will be required by 2019/20 however, this will be kept under review in light of actual load growth.

Each of the build options has some common components. A comparison of the cost of each option sharing the components is shown in Table 7.

6.4.1 Transmission Lines

As previously outlined in Section 4.4 Long Term Network Strategy the established option for transmission supply to the North West Sector study area is 132kV. All options outlined below share the common requirement of a 132kV transmission line from Schofields Zone Substation to South Marsden Park Zone Substation site.

A number of potential 132kV transmission feeder routes from Schofields to South Marsden Park ZS have been identified and investigated. Some routes involving portions of Richmond and Schofields Rd were not suitable or considered a contingency option due to the proposed concurrent road works by Roads and Maritime Services (RMS). The timing needs to provide sub transmission lines into Sydney Business Park do not match the RMS road widening works proposed along Schofields Rd and South St.

To minimise the project risk associated with gaining easements for the proposed sub transmission lines, it is proposed to run parallel to and overlap with Transgrid easements where possible.

The preferred transmission feeder configuration has been determined by considering easement costs and relative costs of overhead and underground feeders, recognising that easement costs are reduced with an underground configuration.

The operation of this 132kV feeder at 11kV initially has been considered, however depending on load growth, it is likely that the capacity provided by this option would be exhausted by the time the feeder could be established. The overall network solution should deliver a long term staging plan for the Marsden Park Industrial Precinct. As such operating the 132kV transmission at 11kV in the medium term does not provide a flexible or scalable solution to provide capacity for future connections.

6.4.2 Option 1 Establishment of a Permanent South Marsden Park 132/11kV Zone Substation

This option involves the construction of an outdoor style 132/11kV 45MVA firm capacity substation on a site supplied by the proponent (Figure 5).

- Establishment of a 132kV feeder 21J from Schofields Zone Substation to South Marsden Park Zone Substation via underground tails with overhead construction.

- Establishment of a second 132kV feeder 21L from Marsden Park Zone Substation to South Marsden Park Zone Substation.
- Establishment of a new 132/11kV outdoor zone substation with 2 x 45MVA transformers, and provision for a future third transformer.

This option allows for the medium and long term needs of the Marsden Park Industrial Precinct.

The total capital nominal outlay for this option is $44.4million.

Details of this option are included as Appendix 3.

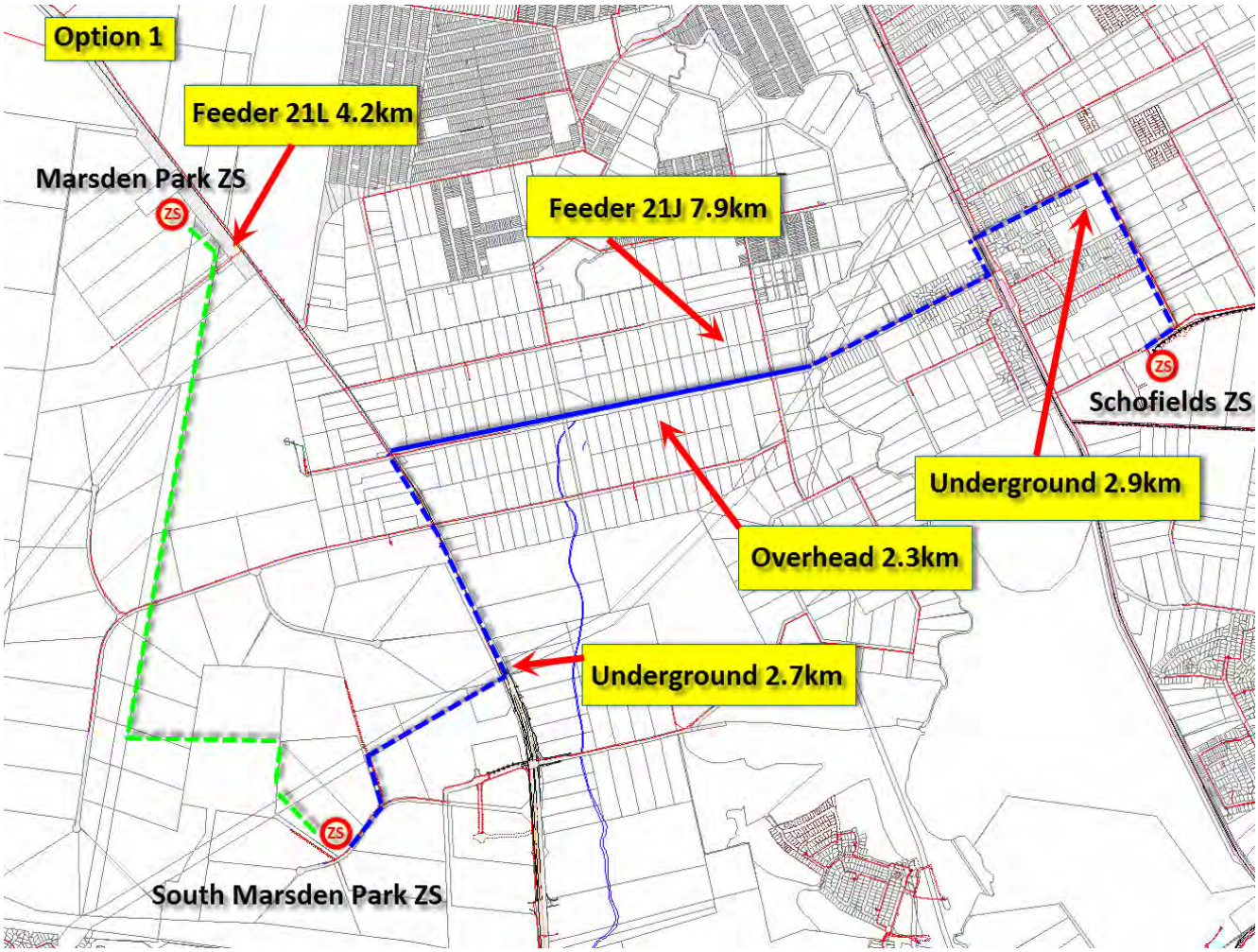


Figure 5 Option 1 proposed 132kV Transmission feeder arrangement

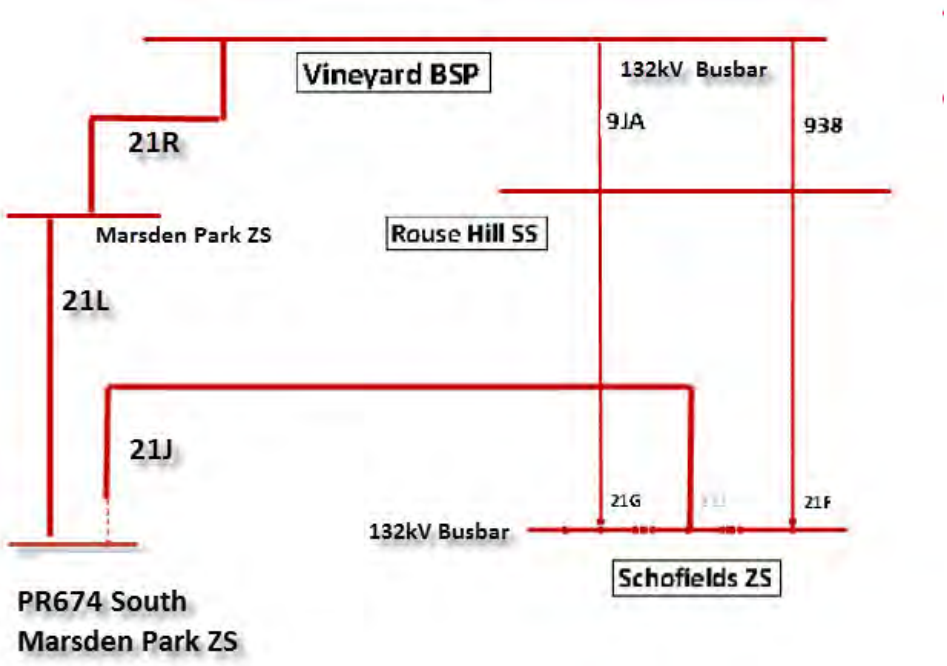


Figure 6 Option 1 proposed Single Line Diagram 132kV Transmission feeder arrangement

6.4.3 Option 2a (Stage1 and 2) Establish South Marsden Park Stage 1 – 132/11kV Zone Substation followed by Establishment of South Marsden Park Stage 2 132/11kV Zone Substation

This option involves the construction of an outdoor style 132/11kV 45MVA capacity substation in two stages on a site agreed with the development proponent.

Option 2a Stage 1 includes:

- Establishment of a new 132/11kV outdoor zone substation with 1 x 45MVA transformer and busbar with provision for a future second and third transformer.
- Establishment of a radial 132kV feeder 21J from Schofields Zone Substation to South Marsden Park Zone Substation.
- Construction of a permanent control building that will accommodate one section of 11kV switchboard and auxiliary equipment.

This option provides an N security for the sub transmission and zone substation elements. Limited backup can be provided at the distribution level subject to feeder loading at the time of an unplanned contingency.

Implementation of the second stage of this option will be required when load growth is such that the risk of non-supply becomes unacceptable.

Option 2a Stage 2 includes:

- Establish the second 132kV feeder 21L from Marsden Park Zone Substation to South Marsden Park Zone Substation.
- Augment the existing Stage 1 132/11kV outdoor zone substation with second 45MVA transformer.
- Augmentation of the control building, which will accommodate the complete 11kV switchboard and auxiliary equipment with provision for up to twenty 11kV distribution circuit breakers.

The total capital nominal outlay for Stage 1 is $28.6 million.

The total capital nominal outlay for Stage 2 is $18.3 million.

Details of this option are included as Appendix 4.

6.4.4 Option 2b (Stage 1 and Stage 2)

This option is as per option 2a Stage 1 with the following modifications:

Option 2b Stage 1 includes:

- Establishment of a new 132/11kV outdoor zone substation with 1 x 45MVA tail ended transformer with no 132kV feeder CB and Busbar.

This option provides an N security for the sub transmission and zone substation elements. Limited backup can be provided at the distribution level subject to feeder loading at the time of an unplanned contingency.

Option 2b Stage 2 includes:

- Establish the second 132kV feeder 21L from Marsden Park Zone Substation to South Marsden Park Zone Substation.
- Augment the existing Stage 1 132/11kV outdoor zone substation with second 45MVA transformer.
- Augmentation of the control building, which will accommodate the complete 11kV switchboard and auxiliary equipment with provision for up to twenty 11kV distribution circuit breakers.

The total capital nominal outlay for Stage 1 is $27.5 million.

The total capital nominal outlay for Stage 2 is $19.6 million

Details of this option are included as Appendix 5.

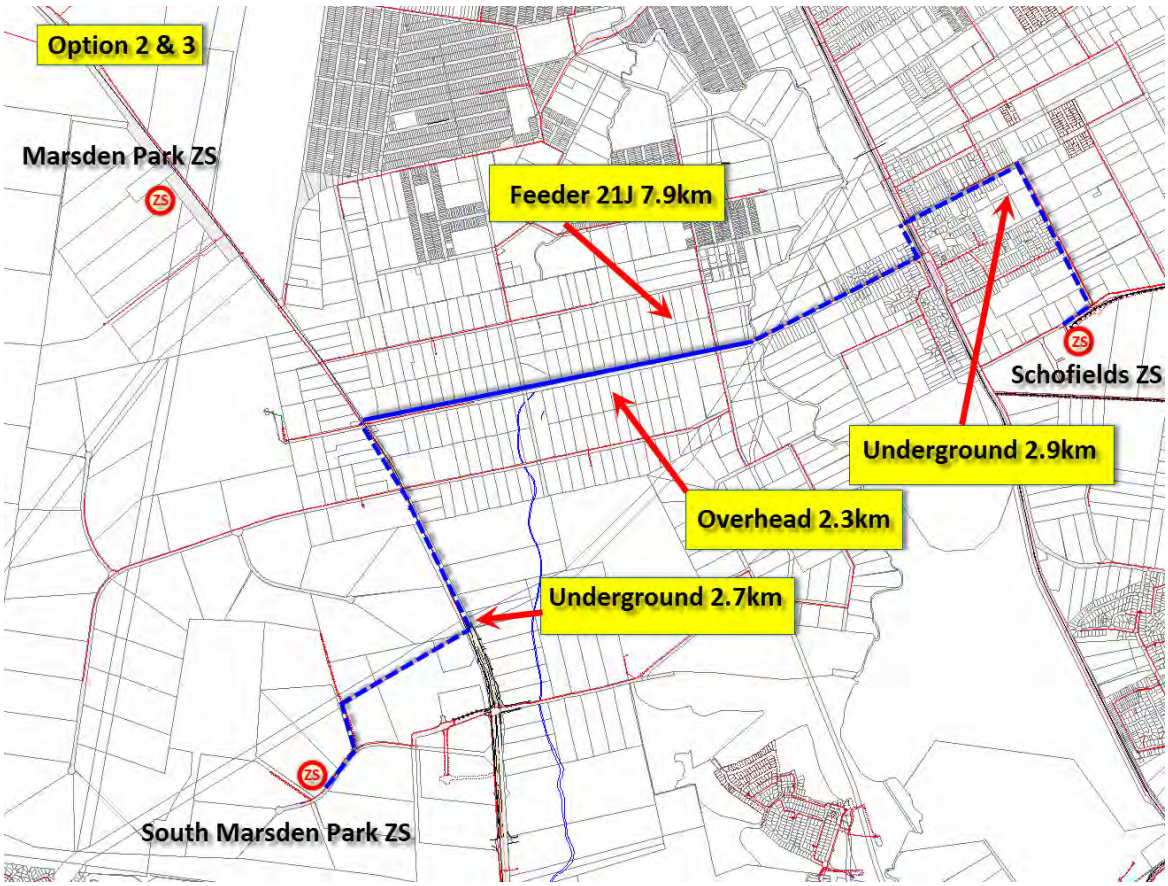


Figure 7 Option 2 & 3 proposed 132kV Transmission feeder arrangement

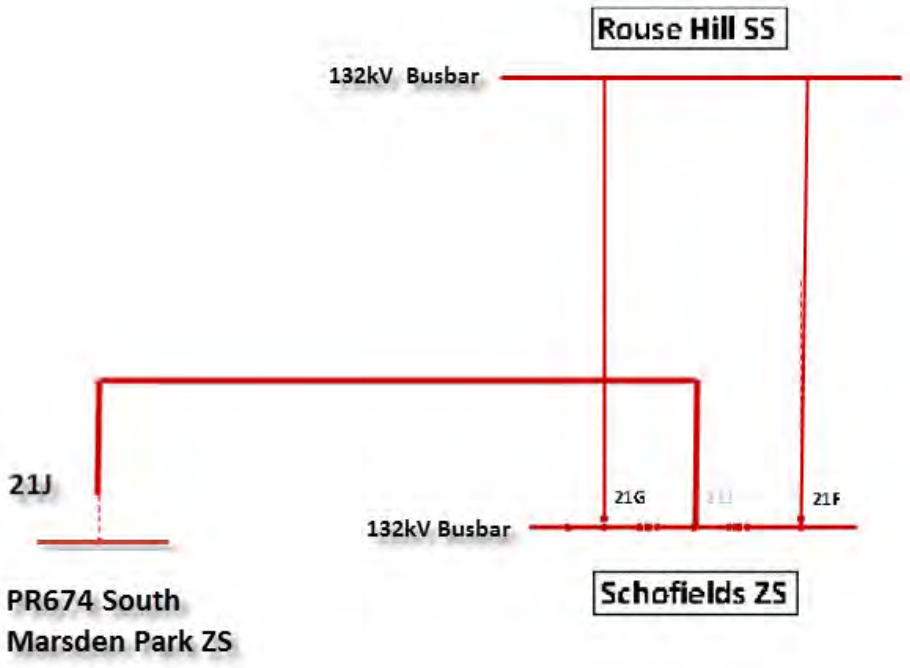


Figure 8 Option 2 & 3 proposed Single Line Diagram 132kV Transmission feeder arrangement

6.4.5 Option 3 (Stage 1 and Stage 2) Establish South Marsden Park 132/11kV Mobile Zone Substation followed by Establishment of Permanent South Marsden Park 132/11kV Zone Substation

Option 3 involves the establishment of a mobile 132/11kV zone substation followed by the permanent zone substation. Due to the pace of development it is proposed a 132/11kV mobile zone substation initially be installed on the site supplied by the proponent while the permanent zone substation is constructed when required. The site supplied by the proponent is adequate to house the mobile zone substation while the permanent zone substation is constructed.

The existing 132/11kV mobile substation is currently in service in Oran Park and will be available early 2017. Procurement of a second 132/11kV mobile will be required to meet forecast time frame.

Option 3 Stage 1 includes:

- Establishment of a radial 132kV feeder 21J from Schofields Zone Substation to South Marsden Park Zone Substation
- Establishment of a new mobile 132/11kV outdoor zone substation with 1 x 15MVA transformer

This option provides an N security for the sub transmission and zone substation elements. Limited backup can be provided at the distribution level subject to feeder loading at the time of an unplanned contingency.

The mobile substation will comprise of an incoming 132kV transformer breaker, a 132/11kV 15MVA transformer with provision for up to four 11kV distribution feeders.

The mobile substation is to be located outside of the permanent substation build area and would have a separate safety enclosure thus not impeding future construction of the permanent substation. This will be subject to environmental assessment

One new 11kV feeder will be established as part of South Marsden Park Mobile Zone Substation to allow a limited 11kV backup under contingency. The additional three 11kV feeders would be established as required by development over the ensuing 4 to 6 years.

Option 3 Stage 2 includes:

- Establish the second 132kV feeder 21L from Marsden Park Zone Substation to South Marsden Park Zone Substation.
- Establishment of a new 132/11kV outdoor zone substation with 2 x 45MVA transformers, and provision for a future third transformer.

The total capital nominal outlay for Stage 1 is $22.6 million

The total capital nominal outlay for Stage 2 is $30.8 million

Details of this option are included as Appendix 6.

The permanent South Marsden Park will be commissioned using a second sub transmission feeder 21L. Once the 11kV feeders are transferred from the mobile substation to the permanent substation the first feeder 21J can be disconnected from the mobile substation and connected to the permanent substation.

Mobile Zone Substation

Utilising a mobile zone substation at Marsden Park Industrial Precinct allows the flexibility of not providing a permanent zone substation if the Sydney Business Park does not realise the majority of the load as outline in the forecast in Section 4.3. The Transmission line built under this project would be used in Stage 2 of the Marsden Park Zone Substation establishment.

Endeavour Energy has deployed a 132kV mobile substation at Oran Park which will become available in 2017. The use of this mobile substation does not enable supply to the initial stages of the development. The purchase of a second mobile substation, under this project, will establish a fleet of two 132kV mobile substations which will provide additional flexibility to defer the establishment of a permanent 132/11kV zone substation in the North West and South West sectors.

Both the North West and South West growth centres are largely serviced by 132kV feeders and the current long term strategy is to establish multiple new zone substations at 132kV in these growth areas. There is an opportunity to minimise future capital expenditure to service these greenfield areas by utilising 132kV mobile zone substations.

A review of the 10 year SAMP and other future release areas indicate that for a fleet of two mobile substations there are 6 candidate locations in the next 10 years and 9 candidate locations in the 10-20 year timeframe. The exact timing and need of these will depend on developer activity.

The financial benefit of these future deferrals has not been included in the financial evaluation of this option.

6.4.6 Option 4 (Stage 1 and Stage 2) Establish South Marsden Park 33/11kV Mobile Zone Substation followed by Establishment of Permanent South Marsden Park 132/11kV Zone Substation

Option 4 proposes the establishment of Endeavour Energy's existing 33/11kV mobile substation initially followed by the establishment of a permanent 132/11kV zone substation when required by load growth. The mobile substation is currently in service at Jordan Springs and is supplied from a tee connection to 33kV feeder 441 from Quakers Hill (Figure 9).

The section of 33kV feeder 458 from Riverstone Zone Substation to Tee is overloaded under an outage of feeder 444 Riverstone Zone Substation to Hawkesbury. If there is a fault on feeder 444, both Riverstone 33kV and 11kVbusbar will be split and transformer No. 2 within Riverstone ZS can be supplied from Quakers Hill Feeder 441. Refer to Section 4.2. The extra load supplying the Marsden Park Industrial Precinct via Feeder 441 will cause an overload on Feeder 441 under an outage of Feeder 444. A requirement of the proposed Option 4 is to augment feeder 458 Riverstone to Tee. This will allow feeder 458 to supply both Riverstone transformers under an outage of 444 and negating the need to split the busbar and supply Riverstone via Quakers Hill Feeder 441. Refer to Section 4.2 Table 2 for Transmission network load summary.

Option 4 Stage 1 includes:

- Establishment of a radial 132kV feeder 21J from Schofields Zone Substation (Connect to 33kV feeder 441 via tee – Figure 9 & 10) to South Marsden Park Zone Substation
- Installation of the existing 33/11kV 22MVA Mobile No.1
- Augment 33kV Feeder 458 (5.6km Riverstone to Tee) to 42MVA (Figure 11)

- Construction of a temporary 33kV tee extension from feeder 444 along Schofields Rd to Schofields Zone Substation and connect to new established feeder 21J

This option provides an N security for the sub transmission and zone substation elements. Limited backup can be provided at the distribution level subject to feeder loading at the time of an unplanned contingency.

Option 4 Stage 2 includes:

- Establish the second 132kV feeder 21L from Marsden Park Zone Substation to South Marsden Park Zone Substation.
- Establishment of a new 132/11kV outdoor zone substation with 2 x 45MVA transformers, and provision for a future third transformer.

In line with the North West supply strategy the conversion of the existing two 33kV feeder corridors to 132kV transmission for the potential future rebuild of Riverstone Zone when required.

Option 4 proposes to augment existing feeder 458 within this 33kV corridor. This option contains a risk of stranded assets if the 33kV feeder corridors are augmented and then converted to 132kV within the next 5 to 10 years.

The total capital nominal outlay for Stage 1 is $20.4 million

The total capital nominal outlay for Stage 2 is $31.0 million.

Details of this option are included as Appendix 7.

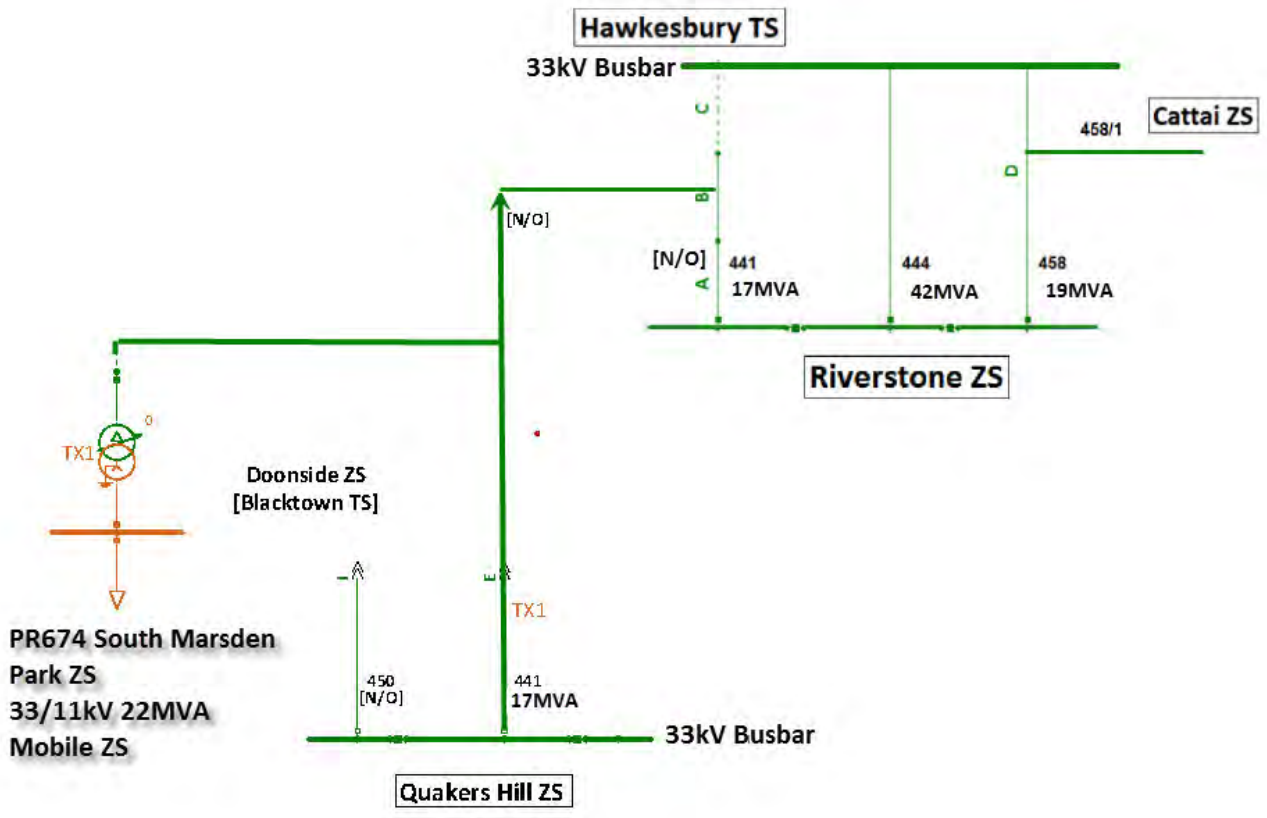


Figure 9 Option 4 proposed Single Line Diagram 33kV Transmission feeder arrangement

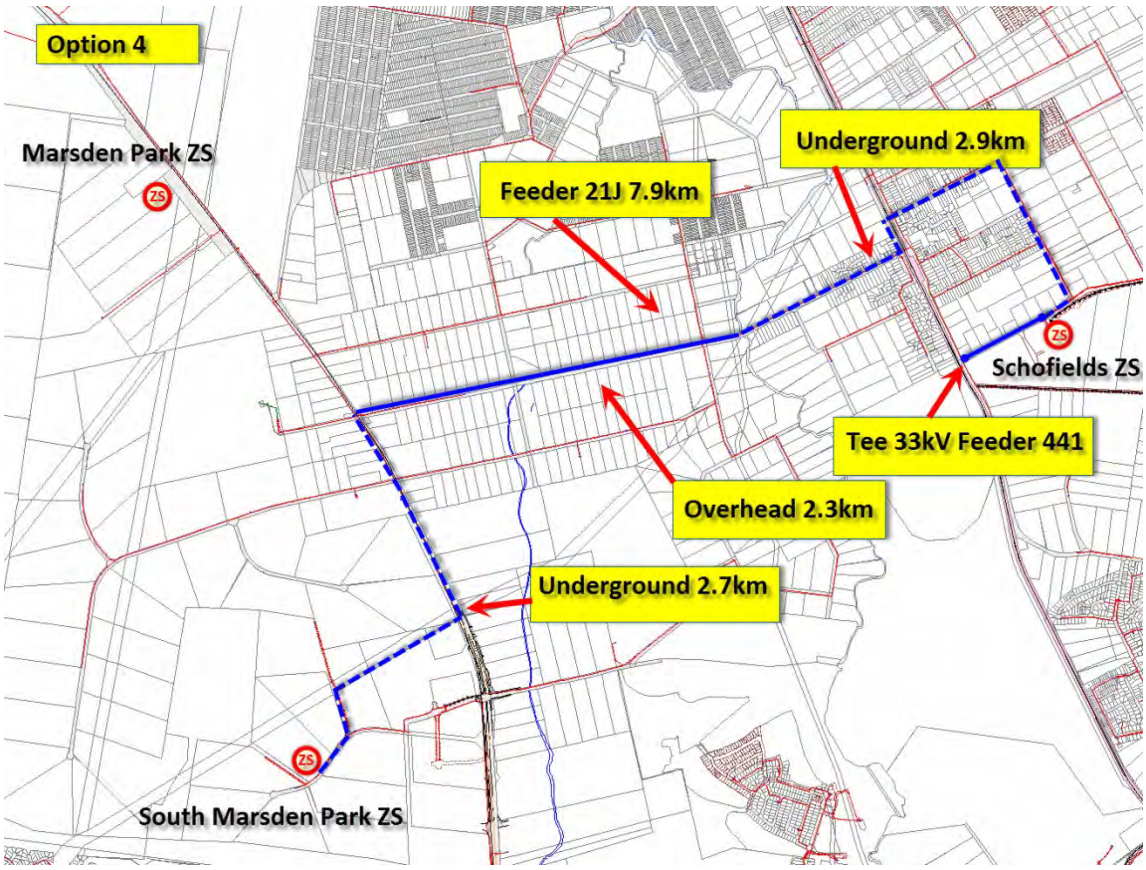


Figure 10 Option 4 proposed 132kV Transmission feeder arrangement constructed and operated at 33kV

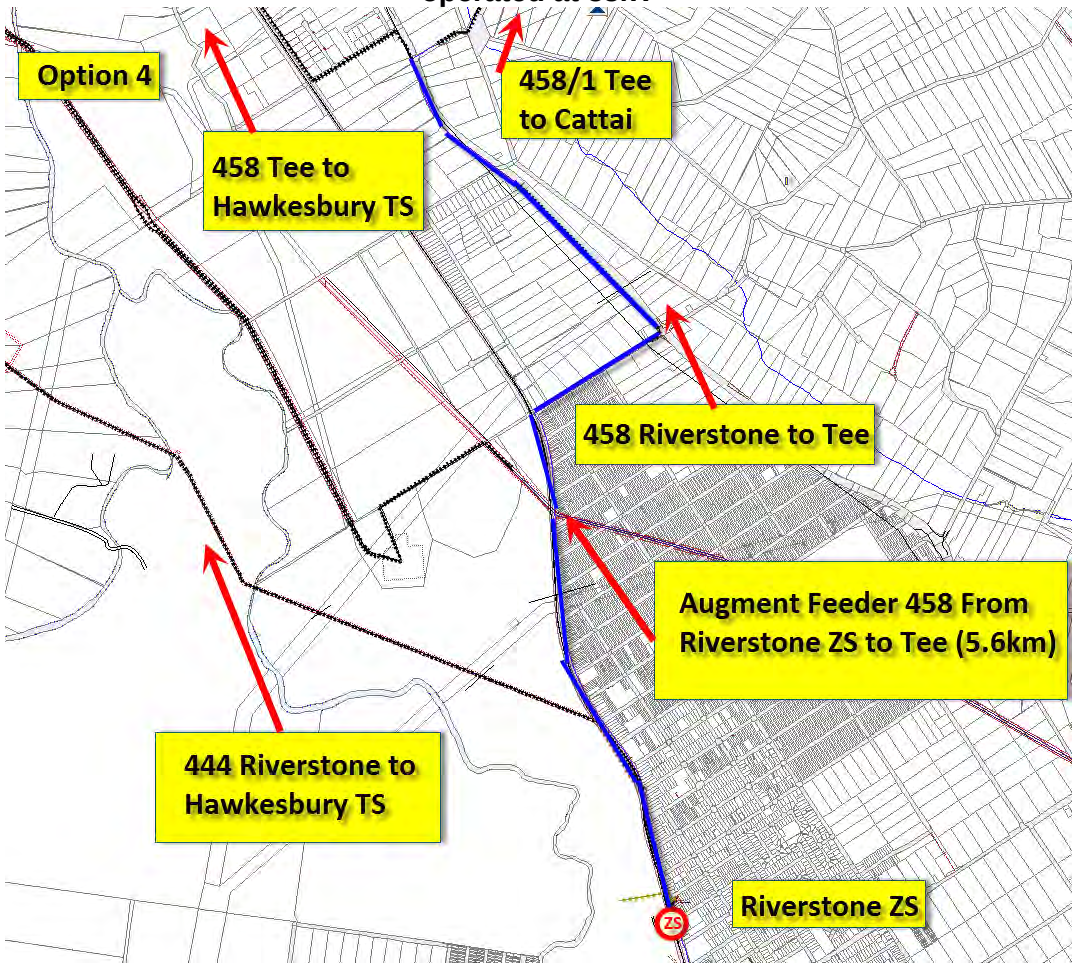


Figure 11 Option 4 Augment existing 33kV feeder 458 from Riverstone to Tee

Summary of Build Option Costs

A summary of the build options 1 to 4 components cost in real 2013/14 dollars is shown in Table 7 below.

Costs (real 13/14 dollars)	Option 1	Option 2a Stage 1	Option 2b Stage 1	Option 3 Stage 1	Option 4 Stage 1
Zone Substation	$16,613,021	$11,211,646	$10,211,646	$5,511,646	$473,914
132kV Feeder 21J	$14,893,354	$14,893,354	$14,893,354	$14,893,354	$14,893,354
132kV Feeder 21L	$8,598,625	-	-	-	-
33kV Augment Feeder 458	-	-	-	-	$3,007,732
Distribution Costs	$995,000	$995,000	$995,000	$995,000	$995,000
Total (real 13/14 dollars)	$41,100,000	$27,100,000	$26,100,000	$21,400,000	$19,370,000
Total nominal dollars (includes CPI)	$44,400,000	$28,600,000	$27,500,000	$22,580,000	$20,350,000

Table 7 – Summary of the Build Options components cost in real 2013/14 dollars

7 Option Comparison

The options proposed will provide sufficient capacity in the Marsden Park Industrial Precinct and assist in implementation of the medium and long term supply strategy for the North West Sector.

The build options were assessed against the objectively measurable service standards discussed in Section 5.

The proposed establishment of South Marsden Park Zone Substation was investigated and assessed based on technical suitability and ability to meet the medium and long term network and customer requirements as well as total project costs. The comparative nominal costs of the five options considered are as follows:

Option 1	Establishment of Permanent Substation in 2017	$44.4 million
Option 2a (Stage 1)	Establishment of Staged 1 Permanent Substation in 2016	$28.6 million
Option 2a (Stage 2)	Establishment of Stage 2 Permanent Substation in 2020	$18.3 million
Option 2b (Stage 1)	Establishment of Mobile Substation in 2016	$27.5 million
Option 2b (Stage 2)	Establishment of Permanent Substation in 2020	$19.6 million
Option 3 (Stage 1)	Establishment of Mobile Substation in 2016	$22.6 million
Option 3 (Stage 2)	Establishment of Permanent Substation in 2020	$30.8 million
Option 4 (Stage 1)	Establishment of Mobile Substation in 2016	$20.4 million
Option 4 (Stage 2)	Establishment of Permanent Substation in 2020	$31.0 million

Option details are included in Appendices 2 to 13. All of the considered options meet the project requirements; however, the staging of the construction offers a number of advantages, including:

(i) The opportunity to defer capital expenditure

(ii) The ability to respond more quickly to the proposed development timetable if required.

(iii) The mobile portions will be portable and relocatable and can be reused at other South West or North West Sector substation locations as development progresses throughout various parts of the growth area.

It is expected that the mobile will be used in various locations throughout the North West and South West growth centres after the commissioning of Stage 2. Potential 132kV Mobile locations in the next 10 year period include Box Hill, Catherine Field, Riverstone West, Leppington North, Austral and Oakdale (Near Horsley Park). In making a financial comparison of the options, this has been accounted for by recognising a recovery of the depreciated value of the mobile substation following the completion of Stage 2. This does include the financial benefit from deferring CAPEX on future zone substations that a second mobile substation allows.

7.1 Technical Considerations

The ultimate South Marsden Park ZS will have a firm capacity of 45 MVA when fully commissioned.

A number of technical factors were considered for each of the build options.

Fault Levels

Fault levels on the 132kV & 11kV busbars have been calculated and are within the maximum fault levels recommended in SDI501 Network Configuration. The calculated fault levels are shown in Appendix 8.

Reliability

The Australian Energy Regulator (AER) will introduce the Service Target Performance Incentive Scheme (STPIS) for NSW electricity distributors from 2014/15. The scheme will encourage continuous improvement by offering financial incentives or penalties based on improvements or deterioration in performance from target levels set at the start of the regulatory period. Ongoing analysis will be conducted to assess the reliability impact of the preferred option. STPIS will be dependent on customer number based metrics and as such the industrial precinct will not attract large penalties.

Options 2, 3 and 4 propose an "N" security configuration for the sub transmission and zone substation in the medium term. Any unplanned outages will incur a customer interruption time of "Best practice repair time". The following table outlines the potential risk to reliability under these options.

Network Element	Probability of failure	Consequence
132kV transmission	1 in 50 years	2-3 day repair time
Transformer	1 in 100 years	4 week repair time

Note: Limited distribution capacity 2-3MVA available to backup in the event of an emergency

Table 8 – "N" Security Potential Risk to Reliability

Step and Touch Potential

Concrete poles are considered to be electrically conductive. Where concrete poles are required on the line to obtain top loading strength, any hazardous step and touch potentials that may exist on the poles under fault conditions can be managed to safe levels (Refer AS7000) by adequately earthing affected poles.

All Options will require the use of a number of concrete poles.

7.2 Environmental Consideration

An environmental assessment of the build options will be carried out in accordance with statutory requirements outlined in Section 3.3 of this report.

A Preliminary Environmental Assessment has been prepared for the proposed substation site. The study did not identify any major constraints that would prohibit the construction of a permanent or mobile substation on the land. Based on preliminary inspection of the site and studies already undertaken the establishment of South Marsden Park ZS is considered feasible from an environmental perspective

The results of a preliminary environmental assessment are included in Appendix 11.

7.2.1 Electromagnetic Fields

The 132kV transmission feeders will contain sections of line that will be either overhead or underground circuits. The overhead transmission will be of a 132kV delta line post construction. The electromagnetic field strength was calculated on the maximum rating of the feeder 145MVA with a minimum clearance of 10.1m from ground level and conductor spacing of 1.25m between phases. The resultant EMF graph in Figure 12 shows that under the minimum clearance scenario the EMF value will be less than the maximum allowable of 100mG.

The underground cables will be a single circuit feeder configuration. The calculation is based on the standard buried depth, cables in trefoil configuration and a minimum setback of 5 metres from the property line. The load modelled is 145MVA, which is the maximum feeder rating. The resultant EMF graphs for single circuits are shown in Figure13. The graphs show that EMF value will be less than the maximum allowable of 100mG.

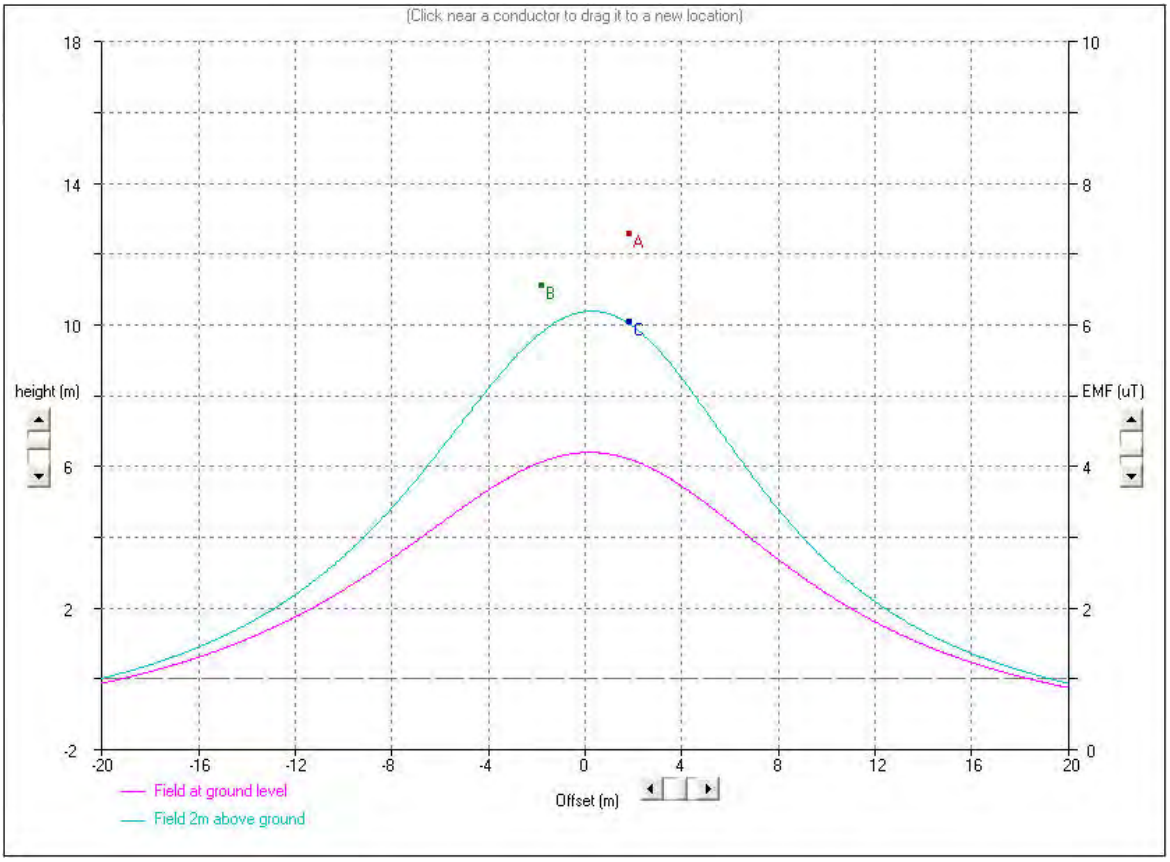


Figure 12 – Maximum EMF Calculation for overhead 132kV delta line post construction

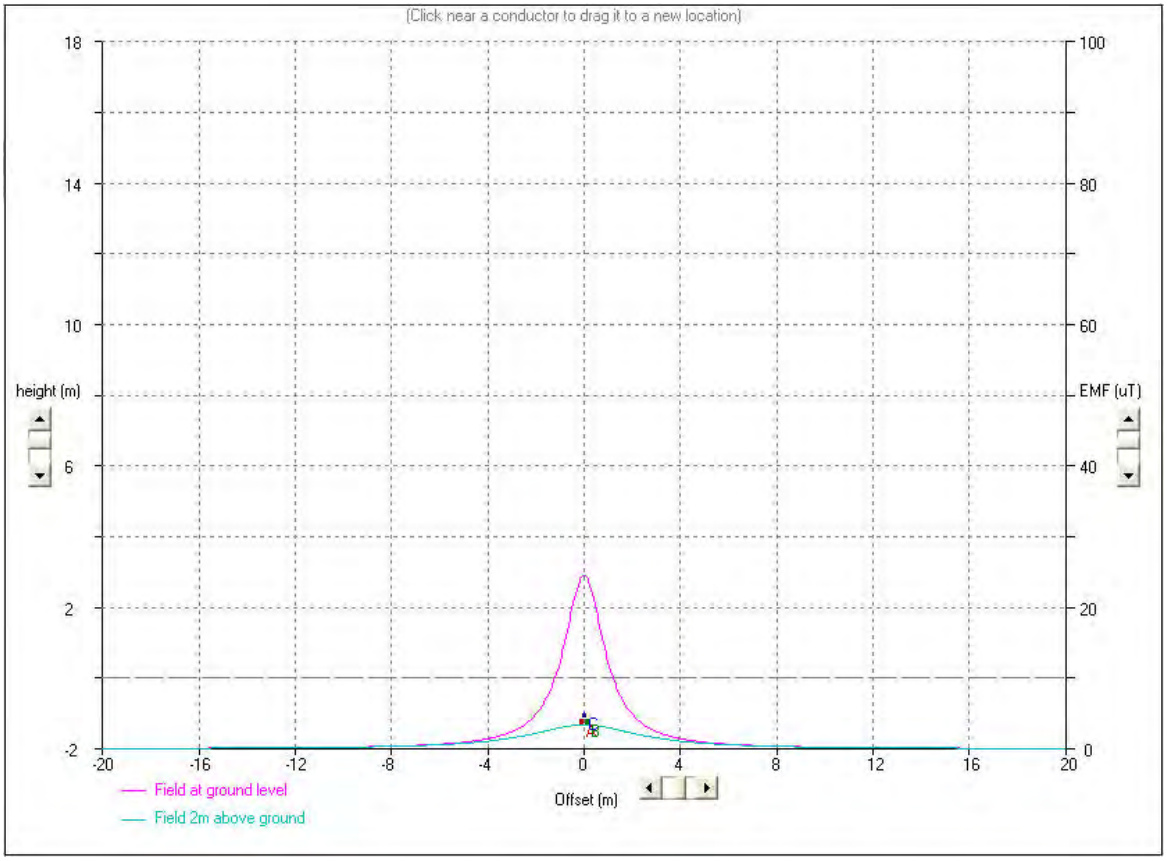


Figure 13 – Maximum EMF Calculation for underground 132kV single circuit construction

7.2.2 Stakeholder Management

There are a number of stakeholders that may be affected by this project. Their needs and issues need to be managed such that the project will not be adversely affected. A preliminary stakeholder management plan has been prepared and is included in Appendix 12. The plan recommends that detailed consultation takes place with residents in the immediate vicinity of the proposed substation as well as those on streets where transmission establishment will take place.

With the approach recommended in the plan, it is suggests that the technically feasible options can be achieved.

7.3 Financial Evaluation and Regulatory Test

A financial evaluation was carried out for each option. Details of the evaluation include calculations of the following parameters:

Net Present Value (NPV) ($)

Present Value of Costs ($)

Internal Rate of Return (IRR) (%)

Discounted Payback Period (years)

Capital Expenditure (Not including land) ($)

A summary of the results for each option are shown in Appendix 10. Cost estimates for all options for this project are shown in Appendix 9.

Clause 5.6.2 (g) of the National Electricity Rules states that:

> *"Each Distribution Network Service Provider must carry out an economic cost effectiveness analysis of possible options to identify options that satisfy the regulatory test, while meeting the technical requirements of schedule 5.1 … "*

As such the regulatory test is applicable to the build options outlined in section 6.4.

The Net Present Value and the Present Value of Costs were calculated for all South Marsden Park build options outlined in section 6. Refer to Table 10 below for results of the calculations, which include sensitivity analysis as required by the Regulatory Test.

A financial analysis has been performed based on the Sydney Business Park forecasts shown in Section 4 Tables 4 and 5. Both the high and low growth scenarios have been analysed. It is considered that he low growth scenario is the most probable. However, the solution will require a degree of flexibility to allow future growth if the high growth scenario dictates. Based on a low growth scenario, Option 3 minimises the present value of costs. This option allows the flexibility to implement Stage 2 as the pace of development dictates. The analysis assumes that the procured cost of the mobile substation will be recovered at the end of Stage 1. The mobile will then become available for use in an alternate growth area listed in section 6.4.4.

The timing of the second Stage 2 is outlined in Table 9 below.

Stage 2 Commissioning	**Option 1**	**Option 2a**	**Option 2b**	**Option 3**	**Option 4**
High Growth	N/A	2017	2017	2017	2017
Low Growth	N/A	2020	2020	2020	2020

Table 9: Stage 2 timing for each build option

			Option 1	Option 2a Stage 1 & 2	Option 2b Stage 1 & 2	Option 3 Stage 1 & 2	Option 4 Stage 1 & 2
Total Capital Outlay (Nominal $m)			44.4	46.9	47.1	53.4	51.4
Net Present Value ($m)		Low Growth	13.9	15.6	15.9	16.7	15.8
		High Growth	32.6	32.6	32.7	33.0	31.6
Average Annual O&M * ($m)			1.27	1.06	1.06	1.07	1.13
Variability of capital outlay (+/- percent)			10%	10%	10%	10%	10%
Present Value of Costs ($ million)							
Base Case		Low Growth	43.8	42.8	42.6	41.8	42.7
		High Growth	44.4	44.5	44.4	44.0	45.5
High Capital	110%	Low Growth	47.6	46.4	46.1	45.2	46.2
		High Growth	48.1	48.2	48.1	47.7	49.3
Low Capital	90%	Low Growth	40.1	39.2	39.0	38.3	39.1
		High Growth	40.6	40.7	40.6	40.3	41.7
High O&M[1]	120%	Low Growth	43.8	42.8	42.6	41.8	42.7
		High Growth	44.4	44.5	44.4	44.0	45.5
Low O&M[1]	80%	Low Growth	43.8	42.8	42.6	41.8	42.7
		High Growth	44.4	44.5	44.4	44.0	45.5
High Discount Rate	10%	Low Growth	41.0	39.3	39.0	38.0	38.5
		High Growth	41.4	41.2	41.1	40.6	41.7
Low Discount Rate	6%	Low Growth	48.2	48.0	47.9	47.4	48.8
		High Growth	49.0	49.4	49.3	49.2	51.1

[1] O&M refers to Operating and Maintenance Costs and includes an allowance for Fault and Emergency.

Financial Analysis based on real 2013/14 dollars

Table 10: Results of Present Value of Costs Calculations

7.3.1 Regulatory Test Outcome

Option 3 “Establish South Marsden Park 132/11kV Stage 1 Mobile Zone Substation followed by Stage 2 establishment of the permanent South Marsden Park 132/11kV Zone Substation”, which includes the cost of establishing the mobile substation and the future expenditure to establish the permanent substation minimises the Present Value of Costs under both the low and high growth scenarios. This strategy meets the requirements of the Regulatory Test. Note that the calculation of Present Value of Costs allows for the completion of Stage 2 to occur in 2019/20, which is dependent on the developer meeting all anticipated lot release milestones and subsequent selling and occupation of the developed lots

7.4 Option Comparison Table

An assessment of the build option was considered against the project requirements and is shown in Table 11.

Requirement	Option 1	Option 2a Stage 1 & 2	Option 2b Stage 1 & 2	Option 3 Stage 1 & 2	Option 4 Stage 1 & 2
Provides short term N-1 Supply Security	Yes	No	No	No	No
Provides long term N-1 Supply Security	Yes	Yes	Yes	Yes	Yes
Licence Condition Compliance	Yes	Yes	Yes	Yes	Yes
Capital Cost (Stage 1 Only Nominal $m)	$44.4m	$28.6m	$27.5m	$22.6m	$20.4m
Satisfies the Regulatory Test	No	No	No	Yes	No
NPV (Stage 1 & Stage 2 Low Growth)	$13.9m	$15.6m	$15.9m	$16.7m	$15.8
Meets Demand Growth Long Term Network Strategy	Yes	Yes	Yes	Yes	No
Environmental Feasibility	Feasible	Feasible	Feasible	Feasible	Feasible
Addresses Identified Asset Condition Needs	Yes	Yes	Yes	Yes	Yes
Eliminates load at risk and voltage regulation problems of HVD feeders	Yes	Yes	Yes	Yes	Yes
Safety	No Issues	No Issues	No Issues	No Issues	No Issues

Table 11 – Comparison of Options

7.5 Preferred Option

It is considered that Option 3 provides the best overall solution for both the low and high growth scenarios and minimises present value of costs to achieve identified design requirements and is the preferred option.

A business case to implement Stage 2 of Option 3, to establish the permanent substation, will be developed at a later date, estimated to be in 2019/20 as the pace of industrial development dictates. A separate approval for Stage 2 will be sought at that time.

The final option will be determined after the consultation process.

All works associated with the preferred option will generally be in accordance with Endeavour Energy Standard SDI 501 “Network Configuration”. A technical specification of this option is found in Appendix 13.

8 Conclusion

Significant medium to long term network constraints have been identified for South Marsden Park as a result of greenfield growth. Five build options to address this network constraint have been investigated. Load transfers, Demand Management and Local Generation cannot address the constraints identified due to the magnitude of load, and the timing requirements imposed by the development. A financial evaluation of the cost of build options has identified that Option 3 Establishment South Marsden Park 132/11kV Mobile Zone Substation followed by the Establishment of the permanent South Marsden Park 132/11kV Zone Substation satisfies the Regulatory Test.

The final option will be determined based upon responses to a Consultation Paper on this project and the outcomes of the environmental assessment conducted. A Final Report will be prepared on this option following the consultation paper.

9 Appendices

Appendix 1 Statement of Network Need

Appendix 2 Demand Management Feasibility Investigation

Appendix 3 Build Option 1 Proposal

Appendix 4 Build Option 2a Proposal

Appendix 5 Build Option 2b Proposal

Appendix 6 Build Option 3 Proposal

Appendix 7 Build Option 4 Proposal

Appendix 8 Fault Level Calculations

Appendix 9 Cost Estimates

Appendix 10 Financial Evaluation Summary

Appendix 11 Preliminary Environmental Assessment

Appendix 12 Preliminary Stakeholder Management Plan

Appendix 13 Detailed Technical Specification (including Distribution Development Items)

Appendix 1 Statement Of Network Need

Internal Memo

To	Strategic Network Planning Manager	**File no**	Marsden Park Industrial
From	Andrew Worboys - Network Planner	**Date**	13 August 2013
Subject	**Marsden Park Industrial Precinct** Statement of Network Need No 674		
Copies	Manager Asset and Network Planning, File		

Background

The establishment of the "North West Sector", as an urban growth area, by the Department of Planning and Infrastructure (DoPI) has led Endeavour Energy to develop a strategy to establish a 132kV subtransmission network to meet the associated demand in the area (Attachment 1). Marsden Park Industrial, Marsden Park Residential and Marsden Park North precincts form part of the North West Sector growth sector and will have an ultimate potential load of 100-130MVA over the next 20-30 years. The long term strategy for the Marsden Park area ultimately requires two zone substations to service these loads and three 132kV subtransmission feeders. The first part of this strategy is a two staged approach to establish the Marsden Park Zone Substation (PR596) and radial feeder from Vineyard BSP. Stage 1 of this major project has been approved by the Board in June 2013.

The Sydney Business Park within the Marsden Park Industrial precinct (Attachment 2) has recently submitted load applications that are higher than the original forecast projection (Table 1). As such, the supply strategy for the greater Marsden Park area is currently being reviewed to maintain suitable flexibility within the network to insure a secure supply to the Marsden Park Industrial precinct and surrounding customers.

Network Need

There is currently no spare capacity available in the existing distribution network that services the Marsden Park Industrial area for any large scale customer needs. The Sydney Business Park developer will fund two extra 11kVdistribution feeders from Schofields Zone Substation that will service approximately 6MVA of loads. An extra 2MVA can be provided by Rooty Hill 11kV distribution network.

The current status of existing 11kV feeders that service Marsden Park area is as follows;

Feeder	Name	Zone Sub	Load	Comment
A052	Richmond Rd	Riverstone	150A	Limited 11kV backup. Will supply first 400 lots within Marsden Park precinct.
SC1238	Carnarvon Rd	Schofields	200A	Limited 11kV capacity.
T884	P.G.H	Rooty Hill	203A	

Sydney Business Park load application ENL2061 proposes to connect a large load of 7MVA.

The existing network has limited capacity; the closet zone substations are the existing Riverstone and Schofields which are 5.8km northeast and 4.7km east of Marsden Park Industrial precinct respectively.

The Sydney Business Park forecast and supply at risk is shown in Table 1. The forecast was originally provided by the developer in 2012 and now includes the most recent large load enquiry ENL2061.

Table 1: Sydney Business Park forecast and Supply at Risk

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sydney Business Park	0.5	3.1	4.4	16	18.2	20.5	22.7	25	27.2	29.5	36.2
Available Capacity[1]	0.5	8	8	8	8	8	8	8	8	8	8
Supply at Risk	0	0	0	**8**	**10.2**	**12.5**	**14.7**	**17**	**19.2**	**21.5**	**28.2**

Note[1]: Includes the existing capacity within the network as well as the capacity made available by the developer funded 11kV distribution feeders from Schofields ZS.

The combined load forecast for Sydney Business Park and Marsden Park Residential precinct is shown in Table 2.

Table 2: Combined Marsden Park forecast (Sydney Business Park & Marsden Park Residential) and Supply at Risk

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Marsden Park Area	0.5	5.2	8.5	22.2	26.6	30.9	35.2	39.6	43.9	48.2	52.5
Available Capacity[2]	0.5	8	18	18	18	18	18	18	18	18	18
Supply at Risk	0	0	0	**4.2**	**8.6**	**12.9**	**17.2**	**21.6**	**25.9**	**30.2**	**34.5**

Note[2]: Includes the capacity made available by the developer funded 11kV distribution feeders from Schofields ZS and the commissioning of Stage 1 Marsden park ZS.

Other Issues

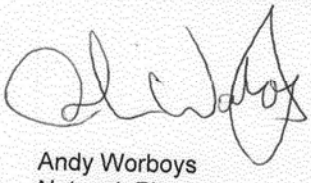
A site for South Marsden Park ZS is currently being acquired by Endeavour Energy in negotiations with the stakeholder and developer of the subject land. The site will be suitably located for the substation to service the release area and is free from flooding or other restrictions.

Recommendation

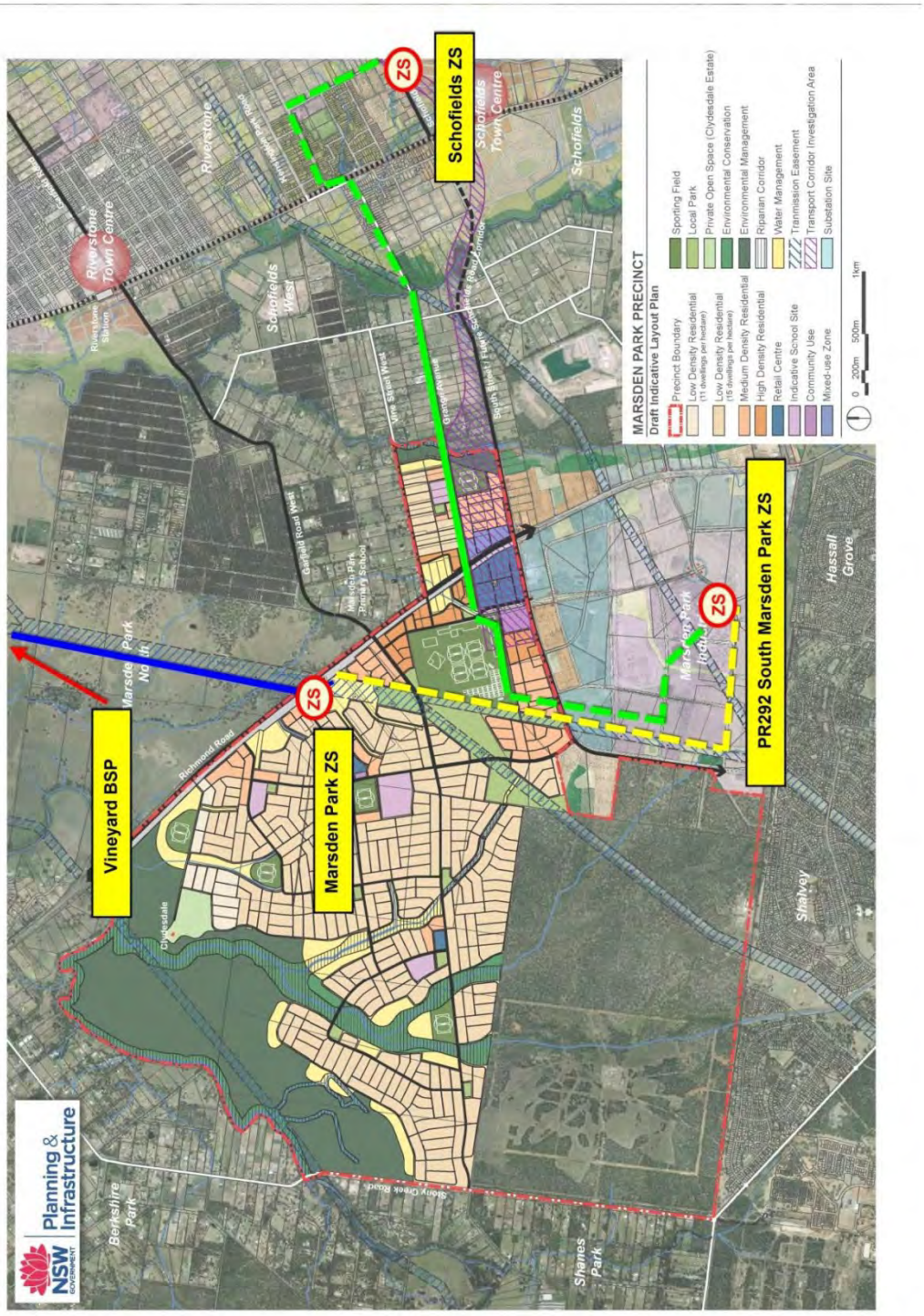
It is recommended that a NIO team be established to investigate options to address the network constraints caused by forecast load growth in the Marsden Park Industrial release area and provide capacity for new connections of load.

Based on the expected demand growth from the Marsden Park Industrial release area, the network requirement date for a solution is the second half of 2015 in readiness for customer connection.

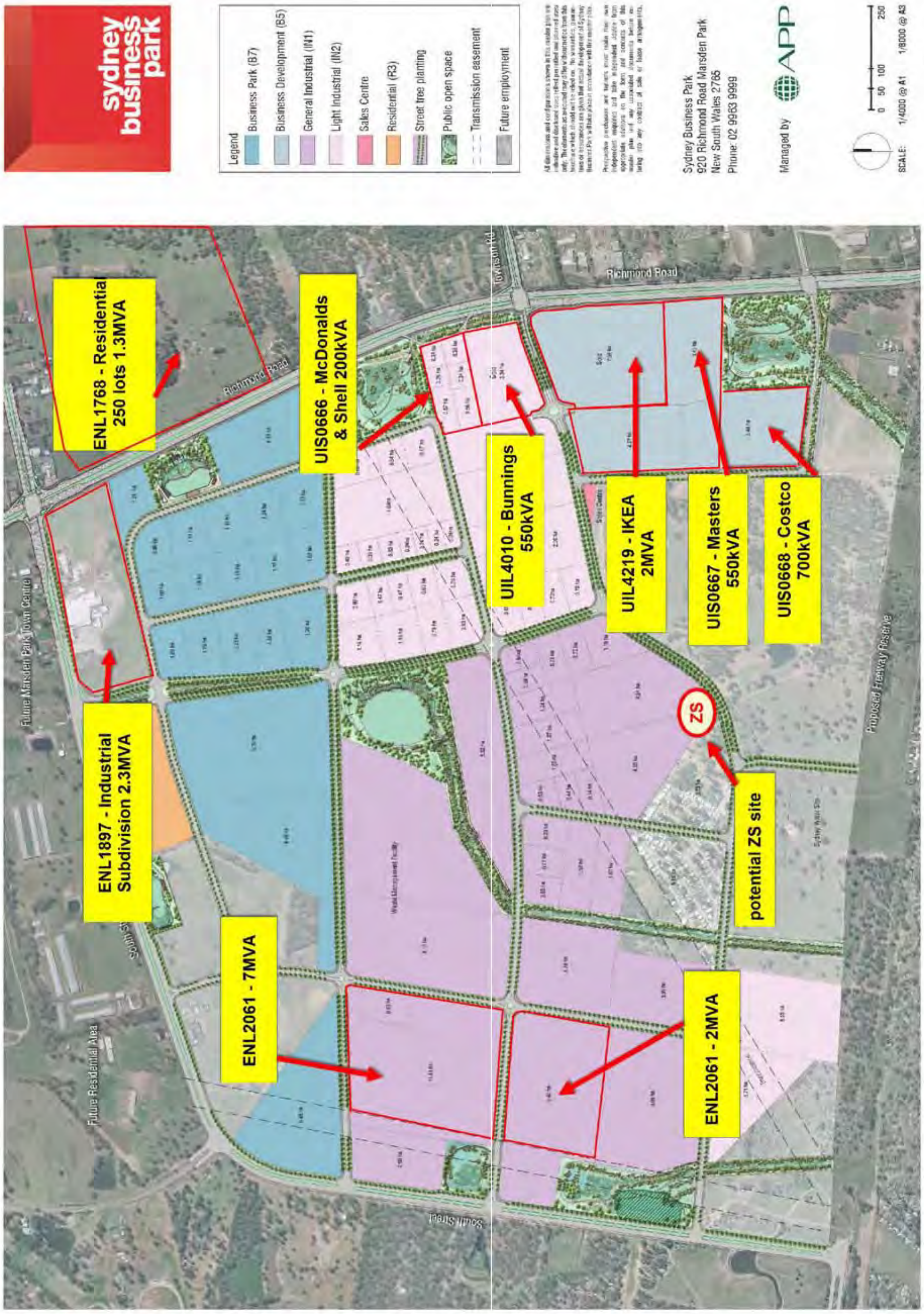
Your agreement or otherwise is sought in regard to the recommendation.



Andy Worboys
Network Planner
Asset and Network Planning



Attachment 1 – Ultimate 132kV transmission line route arrangement from Vineyard BSP to Marsden Park ZS to South Marsden Park ZS to Schofields ZS (Indicative Only)



Attachment 2 –Sydney Business Park with Existing Load applications

Demand Management Investigation
Screening for Non Network Options
Report No: S694

Marsden Park Industrial Area

Prepared by:

.....
Frank Bucca
Demand Management & Utilisation Manager

Endorsed by:

.....
Rick Wallace
Manager Asset and Network Planning

October 2013

Table of Contents

1.0 Introduction:

A review was conducted into the feasibility of implementing a demand management (DM) program to reduce the peak summer demands and defer the establishment of network infrastructure in the newly released Marsden Park industrial precinct currently supplied from Riverstone and Schofields zone substations (ZS), as part of the AEMC Rules 5.17.4 'Screening for non-network Options'. The new industrial area is managed by Sydney Business Park Developers and is seeing multiple load applications.

There is also a new residential development area to the north of the Marsden Park industrial area. This area will be supplied by the approved Marsden Park ZS which will be built with one transformer initially and is not capable of supplying the industrial area due to geographical constraints. The nearby Schofield ZS will have two new 11kV feeders developed funded by the Sydney Business Park Developer to supply 6 MVA of load. Rooty Hill ZS also has transfer capacity to supply 2 MVA of load.

The objective of a demand management program is to defer the construction of the proposed South Marden Park ZS situated in the industrial area. The increase in demand is created by load applications in the newly released industrial area at Marsden Park.

The investigation includes the timing and level of the network load at risk and other network limitations. Also investigated is the potential to remove the load at risk/network limitation by implementing a non-network solution and the available budget to implement a successful DM program.

2.0 Network Issues:

This section details the constraint faced by the network in terms of the available network capacity to supply the load applications in the industrial area and the preferred network option to increase network capacity. The existing surrounding substations of Riverstone, Schofield and Rooty Hill were investigated for their ability to offload the Marsden Park industrial area but were found to have only 8MVA of transfer capacity via the 11kV network. This includes the development of two new 11kV feeders from Schofield ZS.

The area was previously zoned rural and currently contains minimal network assets, being three 11kV feeders. The feeders traverse some distance to reach the new industrial area and are subject to voltage regulation issues when supplying large spot loads.

2.1 Forecast

Table 1 shows the demand forecast for the Marsden Park industrial area and the associated load at risk in terms of firm capacity of the 11kV network supplying the area. The demand forecast contains the known load applications. Being a newly released area there is a strong probability that further load applications will be submitted. The load growth for this area will not follow normal organic patterns as the land owners intend on releasing 15 Hectares of industrial land per annum for the next 20 Years. This will result in a consistent strong growth in electricity consumption.

The 11kV capacity includes the current available capacity in the network plus the additional capacity created by the two new 11kV feeders from Schofields ZS.

Table 1 – Marsden Park Industrial Area Forecast and Load at Risk

Summer	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Demand Forecast	0.5	3.1	4.4	16	18.2	20.5	22.7	25	27.2	29.5
11kV Capacity	0.5	8	8	8	8	8	8	8	8	8
Load at Risk	**0**	**0**	**0**	**8**	**10.2**	**12.5**	**14.7**	**17**	**19.2**	**21.5**

2.2 Planning Limitations

The distribution network is designed, constructed and augmented in accordance with company policies 9.2.1 Network Planning and 9.2.5 Network Design. These policies detail the conditions that drive network augmentation and construction. The main requirements that drive the augmentation of the network are:

- The 'Load at Risk' is to exist for more than 1% of the calendar year,
- The peak demand is greater than 120% of equipment thermal rating, and/or
- 11kV feeder voltage regulation must not exceed 3.5% in residential, industrial and commercial areas.

The 11 kV feeder loads and limitations are shown in Table 2. It should be noted that the new development areas are in excess of 7km away from the zone substation's and reach their voltage regulation limit before reaching their capacity limit. New 11kV feeders from these zone substation's will experience the same problem.

Table 2 – 11kV Feeders Supplying Marsden Park Industrial Area

Zone Substation	Feeder	Summer Load (Amps)	Load at Risk (MVA)	Voltage Regulation (%)	Exceeds Planning Standards >240A or >3.5%[1]
Riverstone	A052	150	Nil	5.3	**YES**
Schofields	SC1238[2]	200	Nil	6.1	**YES**
Rooty Hill	T884	203	Nil	4.3	**YES**
Non Compliances / Load at Risk		0 Feeders > 240A	Nil	3 Feeders >3.5%	3 Non Compliances

The network limitation in this case is insufficient 11kV capacity and inadequate voltage regulation to supply the load increase in the newly released Marsden Park industrial area. Distribution feeders from both substations would be greater than 7km in length to supply the extremities of the new release areas. The 11kV capacity listed in Table 1 includes the two new feeders developed from Schofields ZS.

2.3 Network Options

The preferred network option is the construction of a single transformer mobile zone substation at South Marsden Park to initially supply the proposed load applications in the industrial area. It will be augmented to a two transformer substation as load growth dictates. The cost of these works is estimated at $21.5m and is detailed in table 5.

3.0 Demand Management Program Development:

3.1 Customer Review

The Riverstone, Schofields and Rooty Hill zone substation's currently supply the Marsden Park development area. A review was conducted to determine the current load that is connected to the 11kV feeders that supply the Marsden Park area. This is to estimate the potential demand reduction available via a demand management program. If sufficient demand reduction is available then demand management may be feasible to defer the proposed new substations.

There are 134 business customers and 1,215 residential customers supplied by the 11kV feeders in the Marsden Park supply area. The total demand on the individual feeders is listed below.

- A052 Riverstone ZS 2.9 MVA
- SC1238 Schofields ZS 3.8 MVA
- T884 Rooty Hill ZS 3.9 MVA
- Total Demand 10.6 MVA

These 11kV feeders need to be targeted to reduce sufficient demand to defer the construction of Marsden Park South ZS.

3.2 Demand Management Objective

The objective of a demand management program would be to reduce sufficient demand to allow sufficient capacity to supply part of the new release areas in order to defer the construction of the proposed South Marsden Park ZS. This means that demand reduction must be targeted primarily on 11kV feeder A052, Riverstone ZS SC1238, Schofields ZS and T884, Rooty Hill ZS.

To be successful a demand reduction of 8,000 kVA needs to be obtained by summer 2015/16 (refer Table 1) on the 11kV system supplying the new release areas to ensure an adequate voltage level to supply the industrial release area. This will enable a one year deferral of the new South Marsden Park ZS.

3.3 Load Reduction Potential

Previous demand management programs have delivered demand reductions from industrial/commercial customers that have received an energy audit from between 10% to 20%. About 20% of the demand listed above is industrial/commercial. Using an average figure of 15% potential demand reduction this means that a demand reduction of about 320 kVA is achievable from the industrial/commercial customer sector.

The residential sector contains 1,800 customers on 11kV system that supplies the development area. Statistics from the *Peak*Saver and *Cool*Saver programs from the Rooty Hill DM Program indicate that a take-up rate of 4% can be expected with an average reduction level of 1.7 kVA per customer. Table 4 below shows the expected demand reduction on the 11kV system supplying the new release areas.

Table 4 – Potential Demand Reduction

Area	Take-up Rate / Conversion Rate	Demand Reduction on 11kV System (kVA)
Residential	4% @ 1.7 kVA	120
Industrial / Commercial	15%	320
Total		440

There exists a potential of 440 kVA demand reduction on the 11kV system supplying the Marsden Park release area.

4.0 Financial Evaluation:

The process for screening for non-network options involves three distinct evaluation phases:

- Technical Feasibility: To determine if the demand reduction required to defer the network option for at least one year is achievable within the load type being supplied.
- Financial Feasibility: To determine if the savings obtained by deferring the network project (Avoided Distribution Cost) is sufficient to incentivise the customer base to participate in demand reducing initiatives that is, the non-network option can be implemented at a lower cost that the network option.
- Timeliness: The non-network option can be implemented in sufficient time

As the screening identified that a demand management option is not technically feasible the financial evaluation for the program was not conducted.

5.0 Conclusion:

The investigation into the demand reduction potential found that a 440 kVA demand reduction is possible on the 11kV network supplying the Marsden Park release area. This falls far short of the required 8 MVA reduction to achieve a one year deferral.

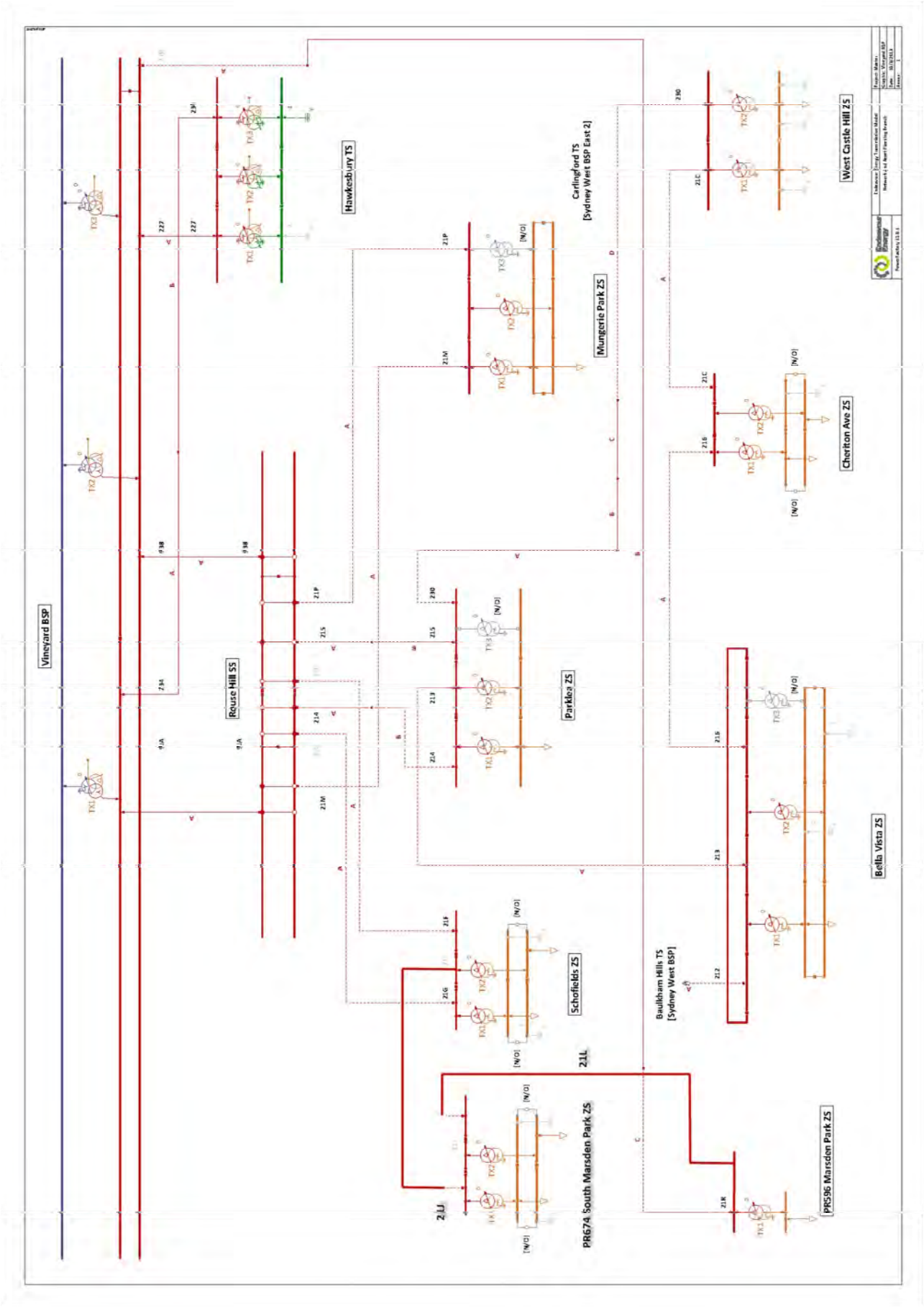
A demand management program is not technically feasible as there is insufficient opportunity in the existing customer base to achieve the required level of demand reduction. The load increase is driven by new development in a newly release industrial area.

6.0 Recommendation:

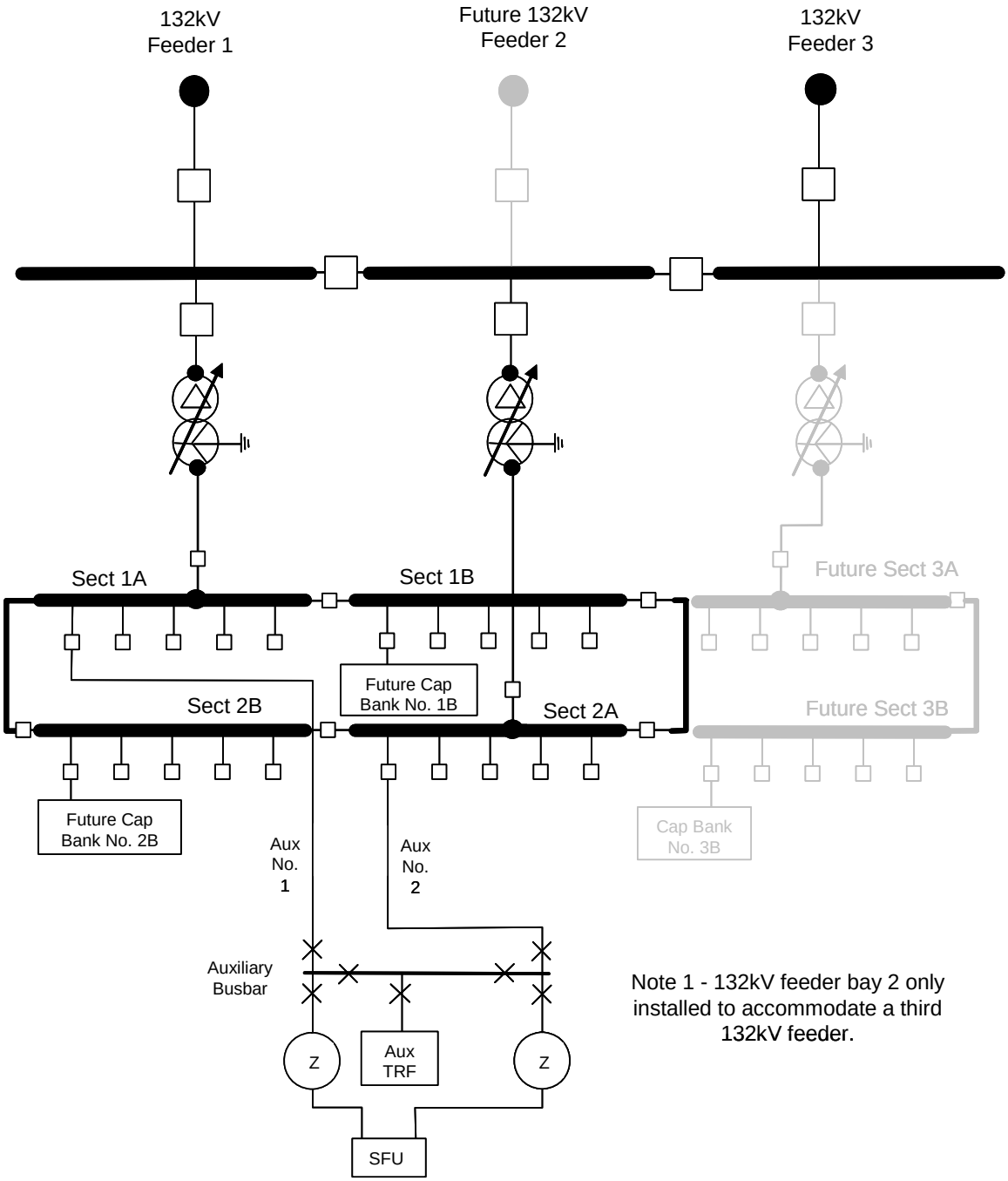
It is recommended not to proceed with further investigations into a demand management program to overcome the 11kV constraint as there is insufficient available demand reduction to economically defer the construction of Marsden Park South ZS.

Appendix 3 Build Option 1 Proposal

A3.1 132/11kV ZS Option 1 132kV transmission Single Line Diagram



A3.1 Option 1 - 132/11kV ZS Single Line Diagram

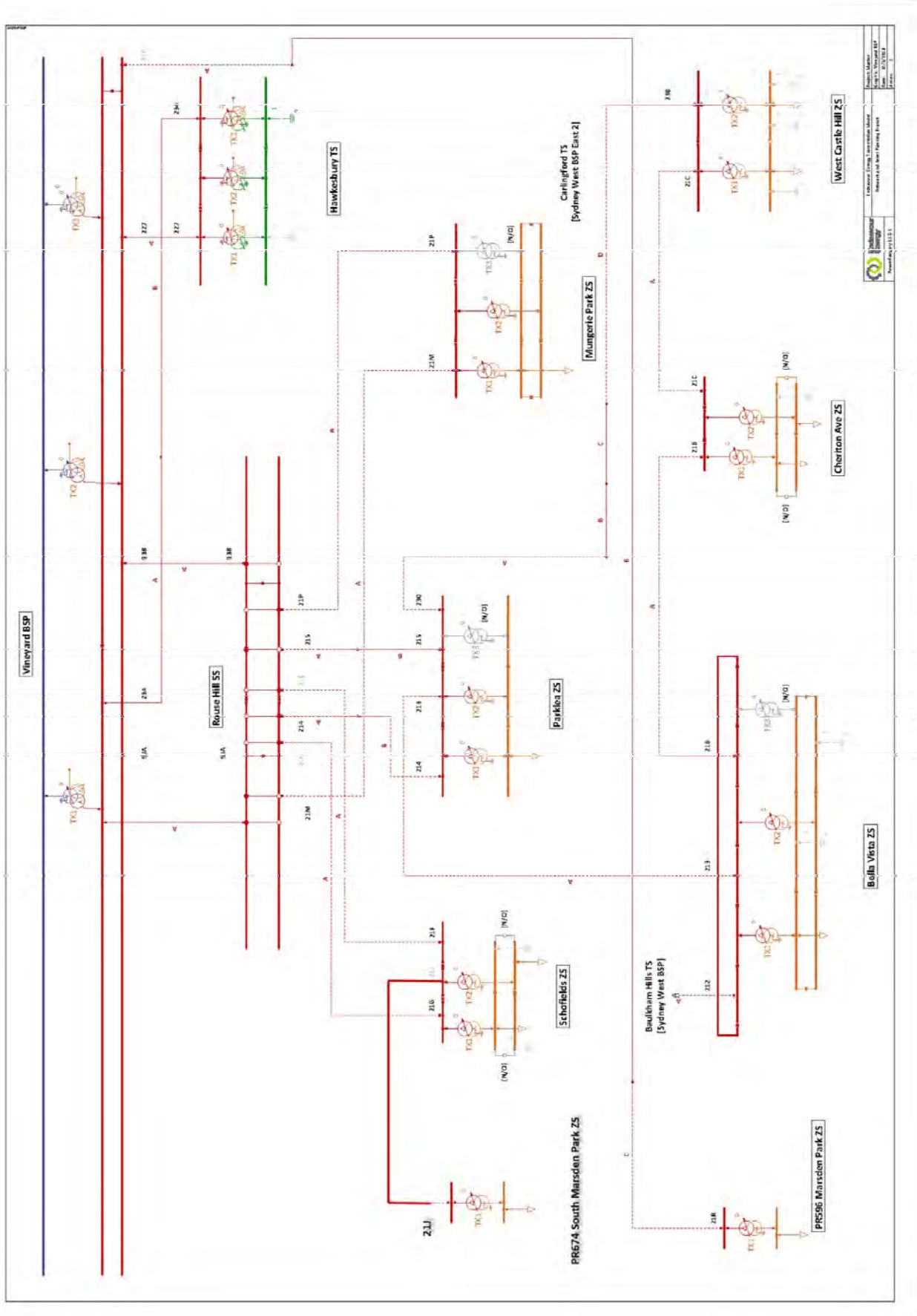


Note 1 - 132kV feeder bay 2 only installed to accommodate a third 132kV feeder.

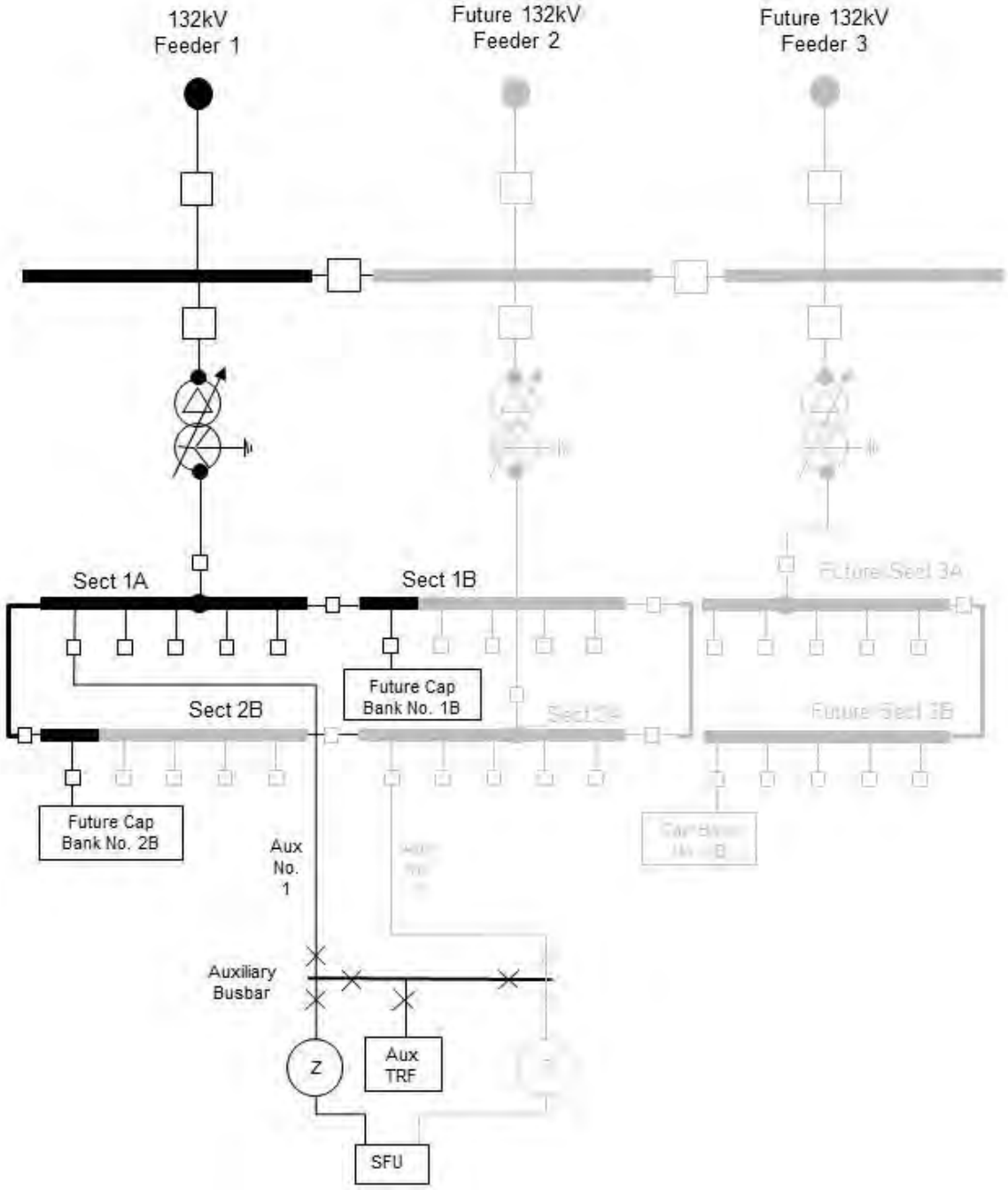
A3.2 Option 1- 132/11kV ZS Zone Substation Proposed Layout

Appendix 4 Build Option 2a Proposal

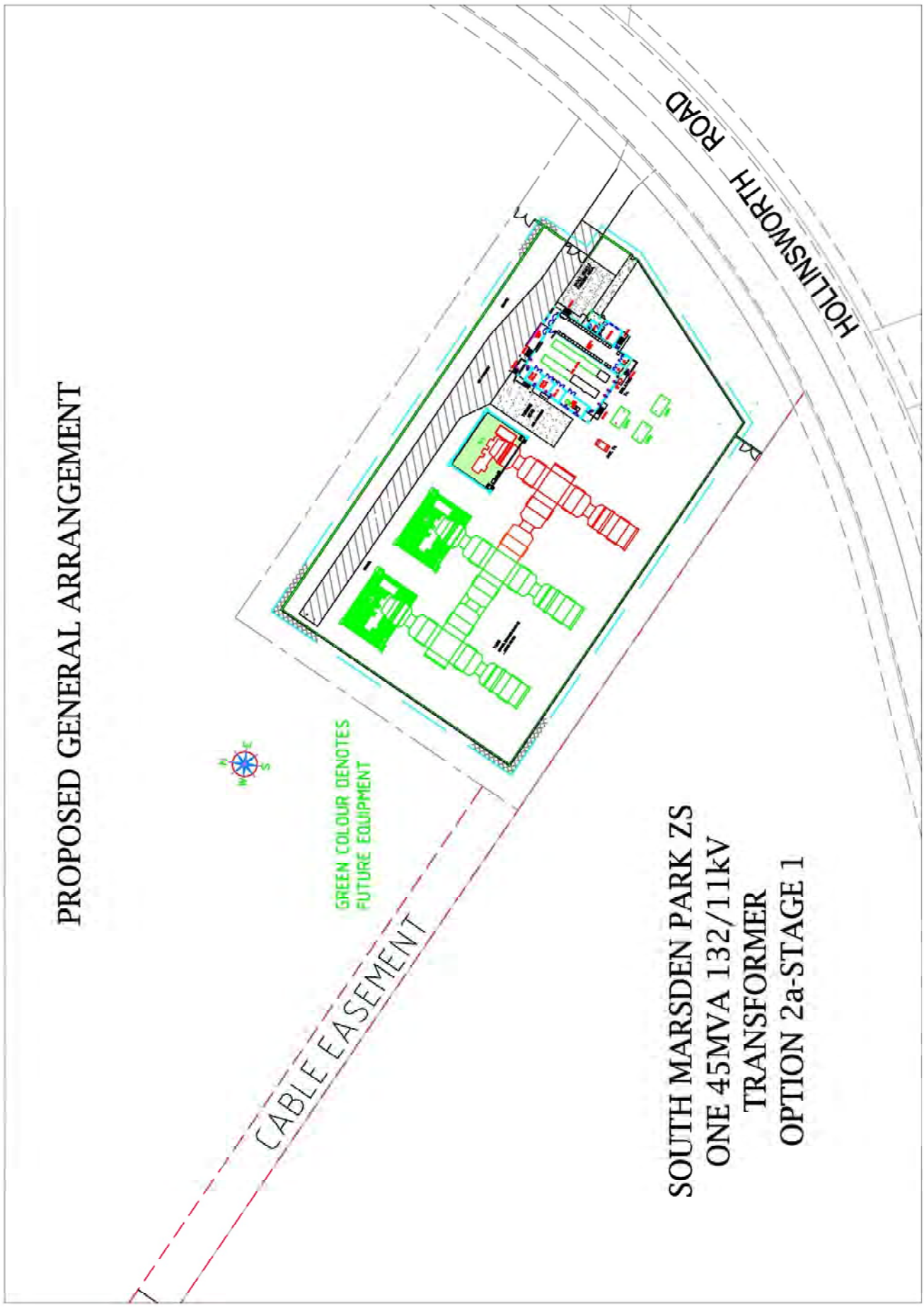
A4.1 132/11kV ZS Option 2a Stage 1 132kV transmission Single Line Diagram



A4.2 Option 2a- 132/11kV ZS Single Line Diagram

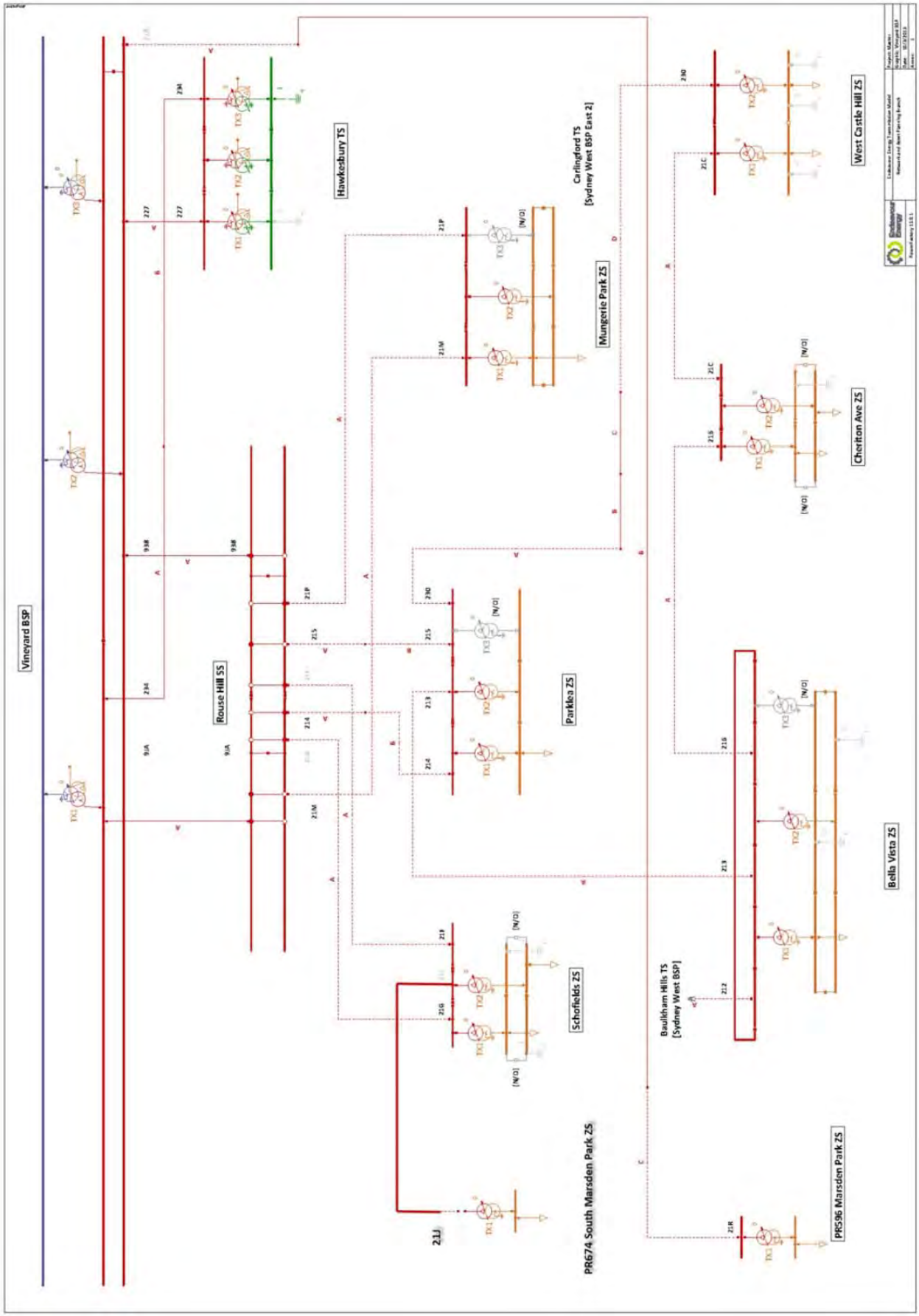


A4.3 Option 2a- 132/11kV ZS Zone Substation Proposed Layout

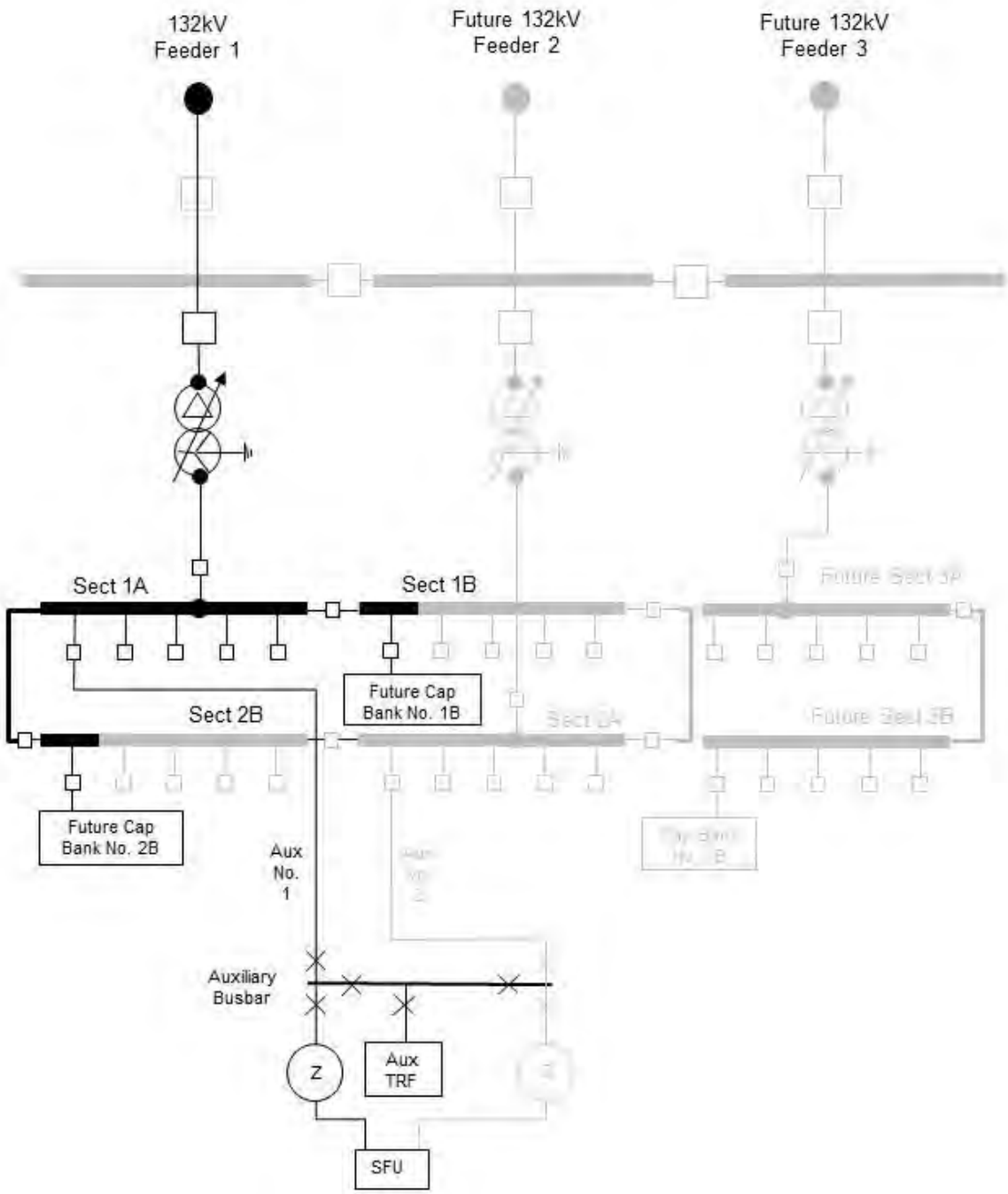


Appendix 5 Build Option 2b Proposal

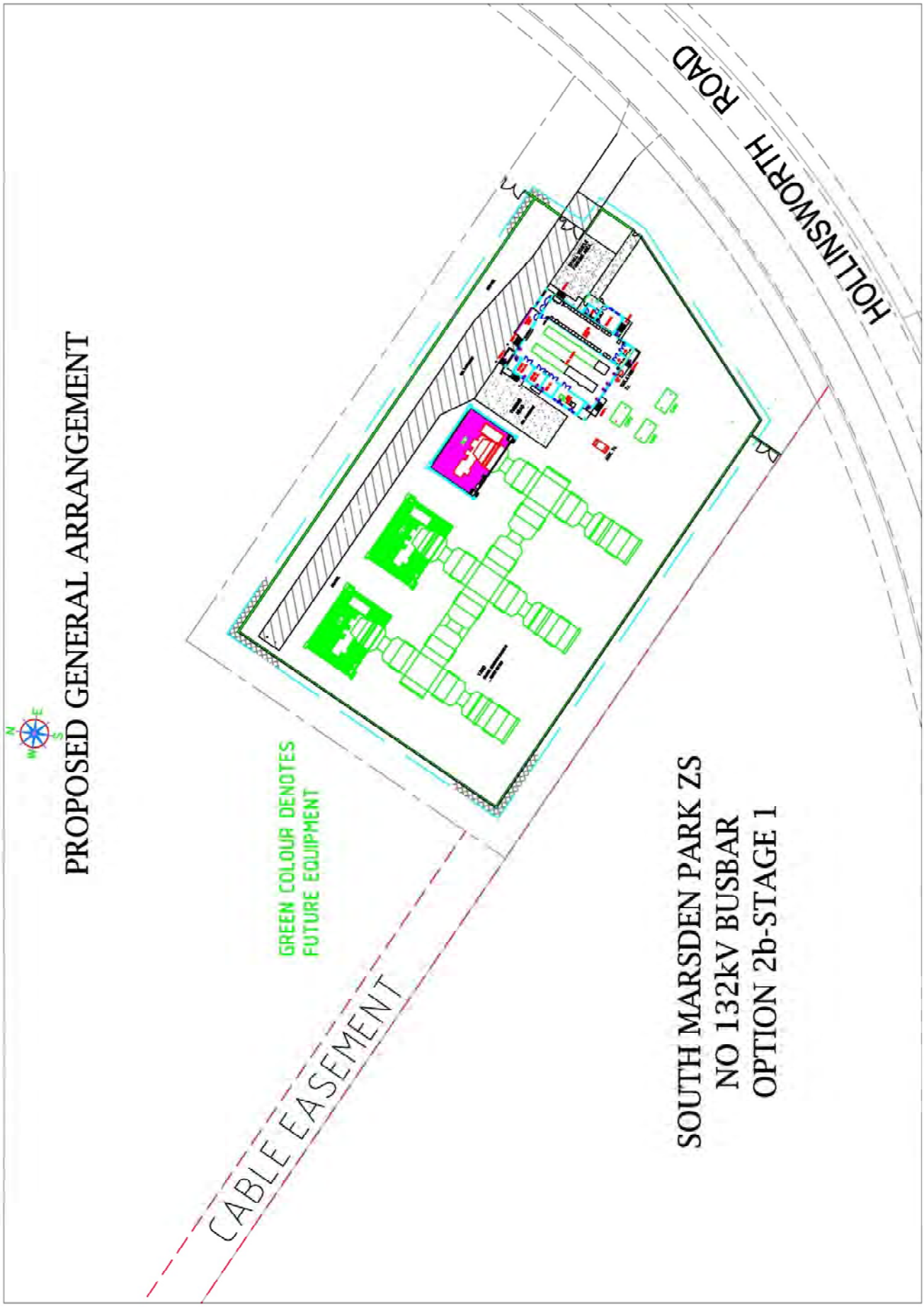
A5.1 132/11kV ZS Option 2b Stage 1 132kV transmission Single Line Diagram



A5.2 Option 2b- Stage 1 132/11kV ZS Single Line Diagram

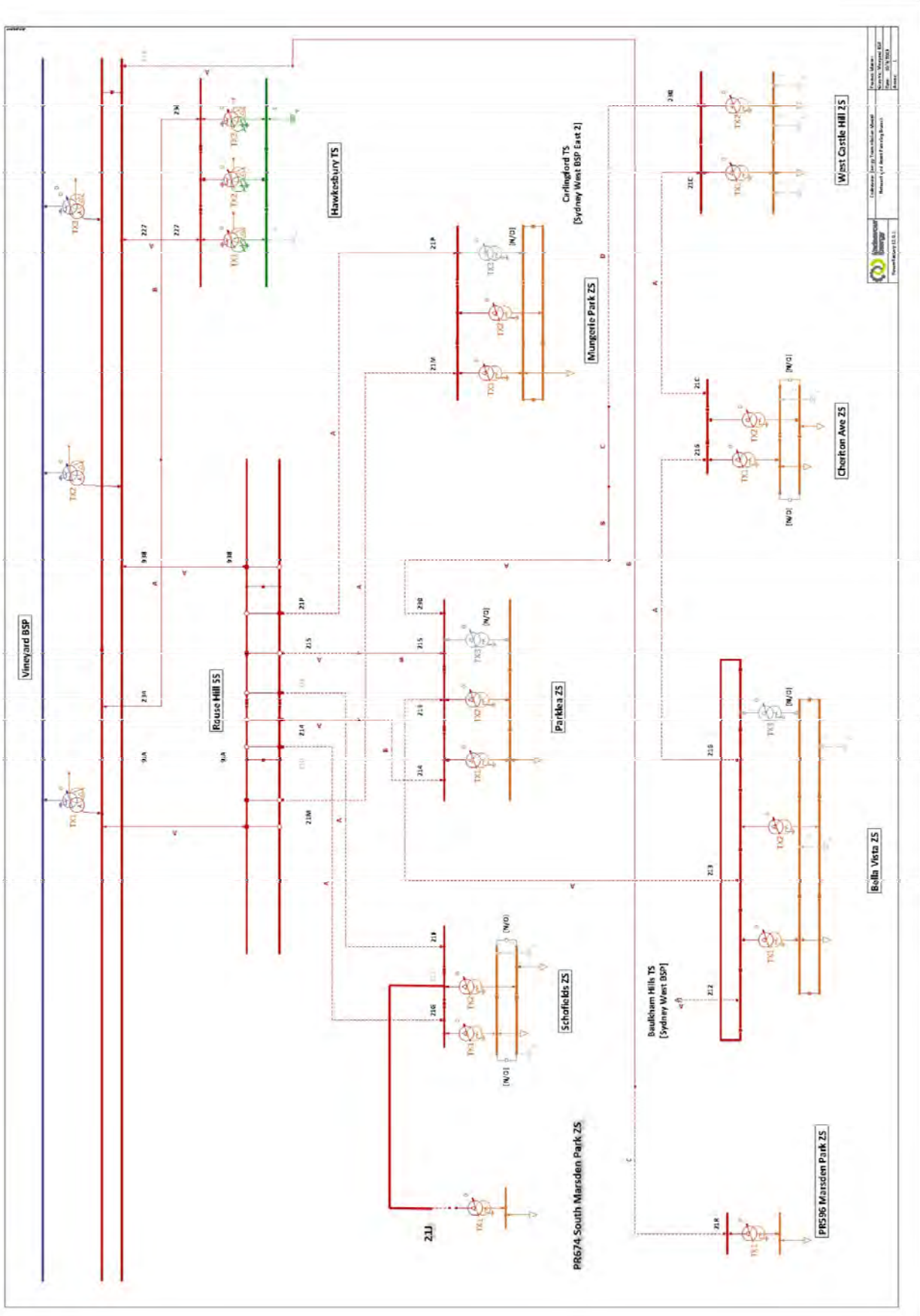


A5.3 Option 2b- 132/11kV ZS Zone Substation Proposed Layout

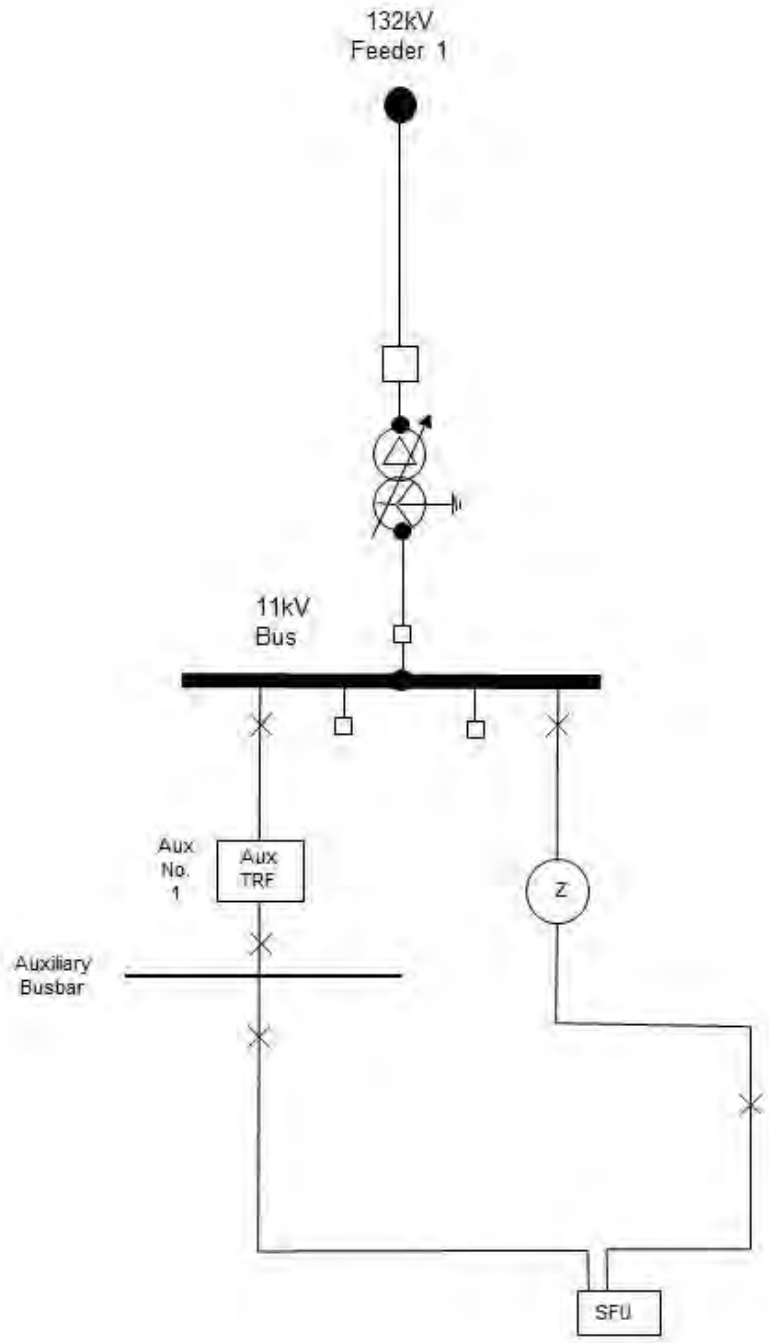


Appendix 6 Build Option 1 Proposal

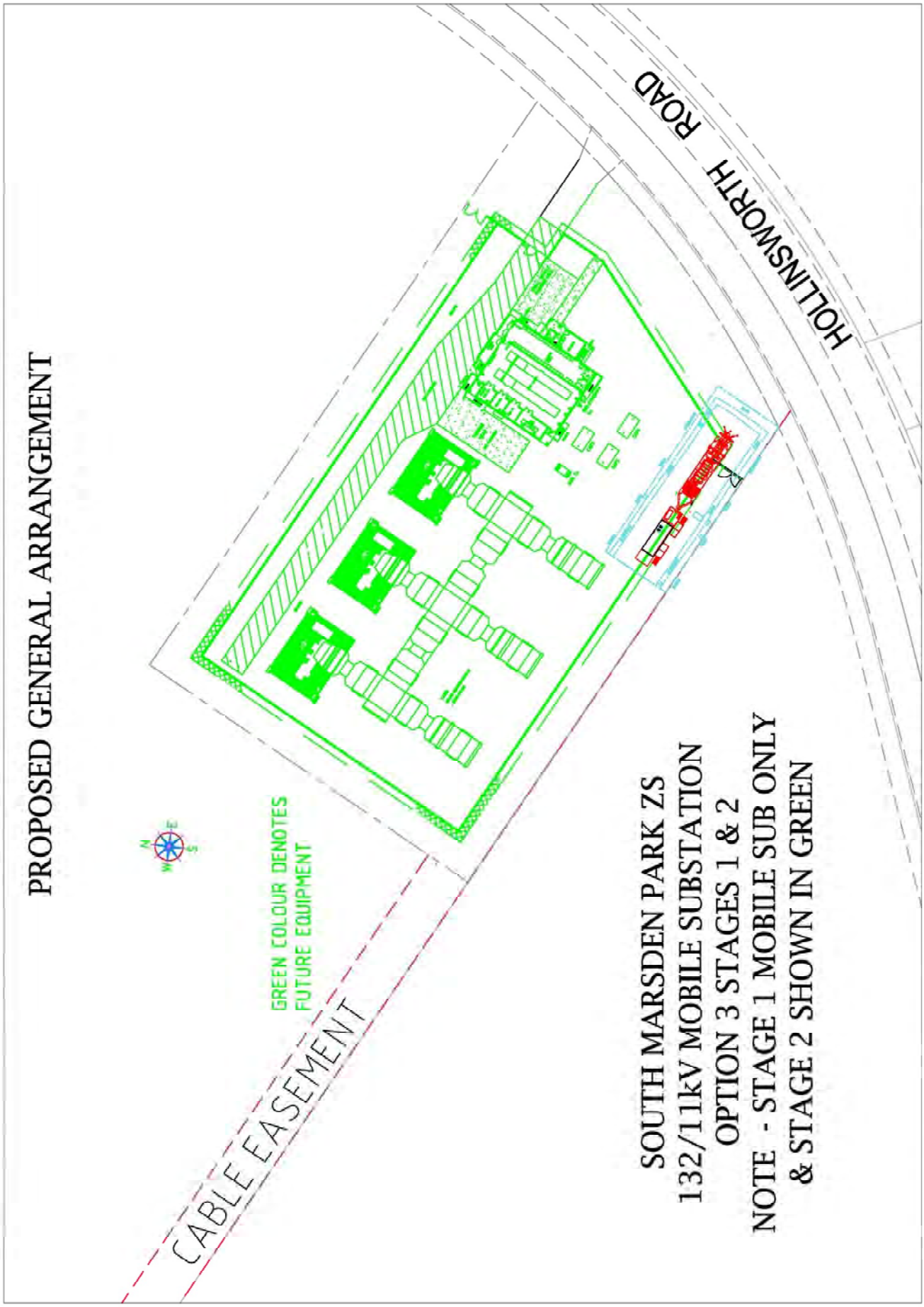
A6.1 Option 3- Stage 1 132kV transmission Single Line Diagram



A6.2 Option 3- Stage 1 132kV Mobile ZS Single Line Diagram

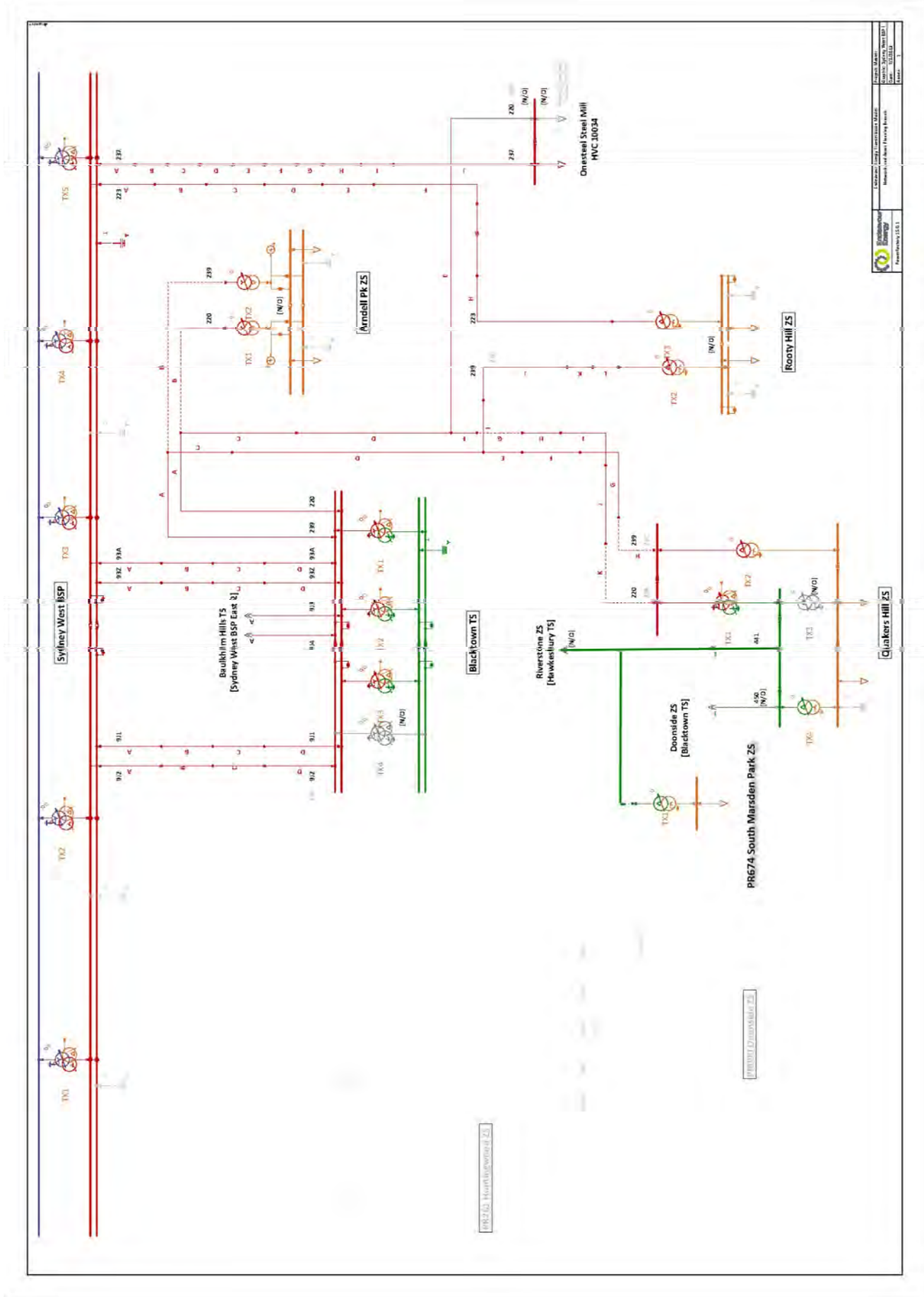


A6.3 Option 3- Stage 1 132/11kV Mobile ZS Zone Substation Proposed Layout

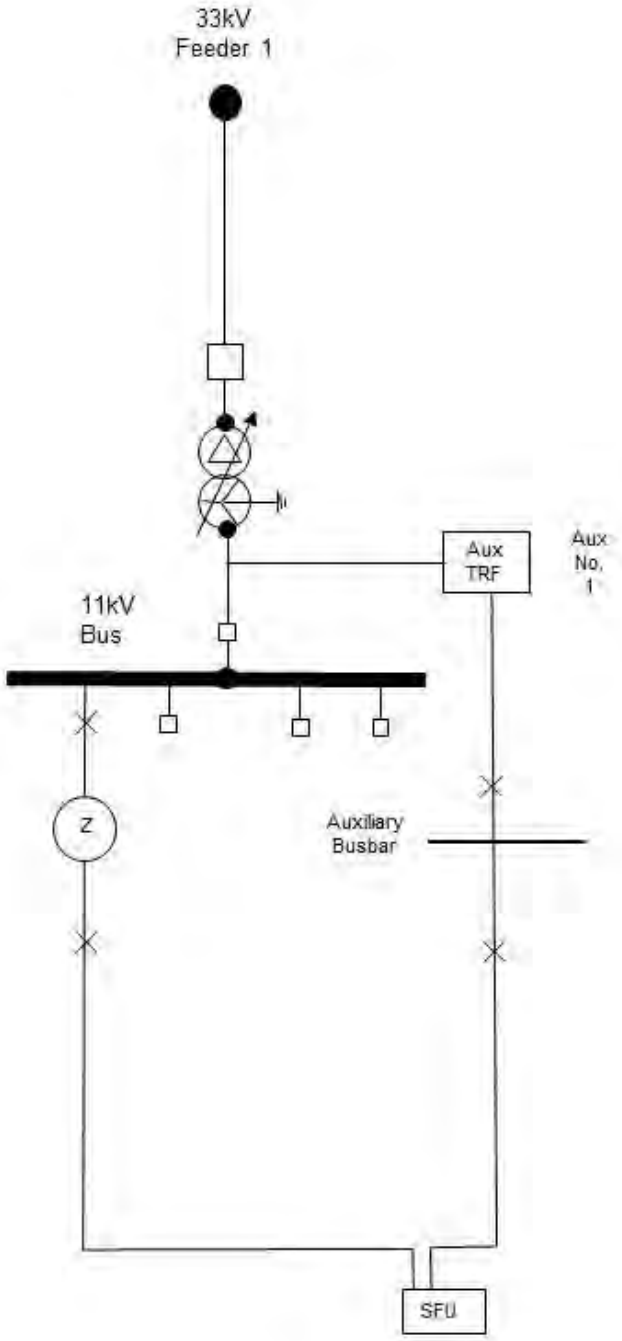


Appendix 7 Build Option 1 Proposal

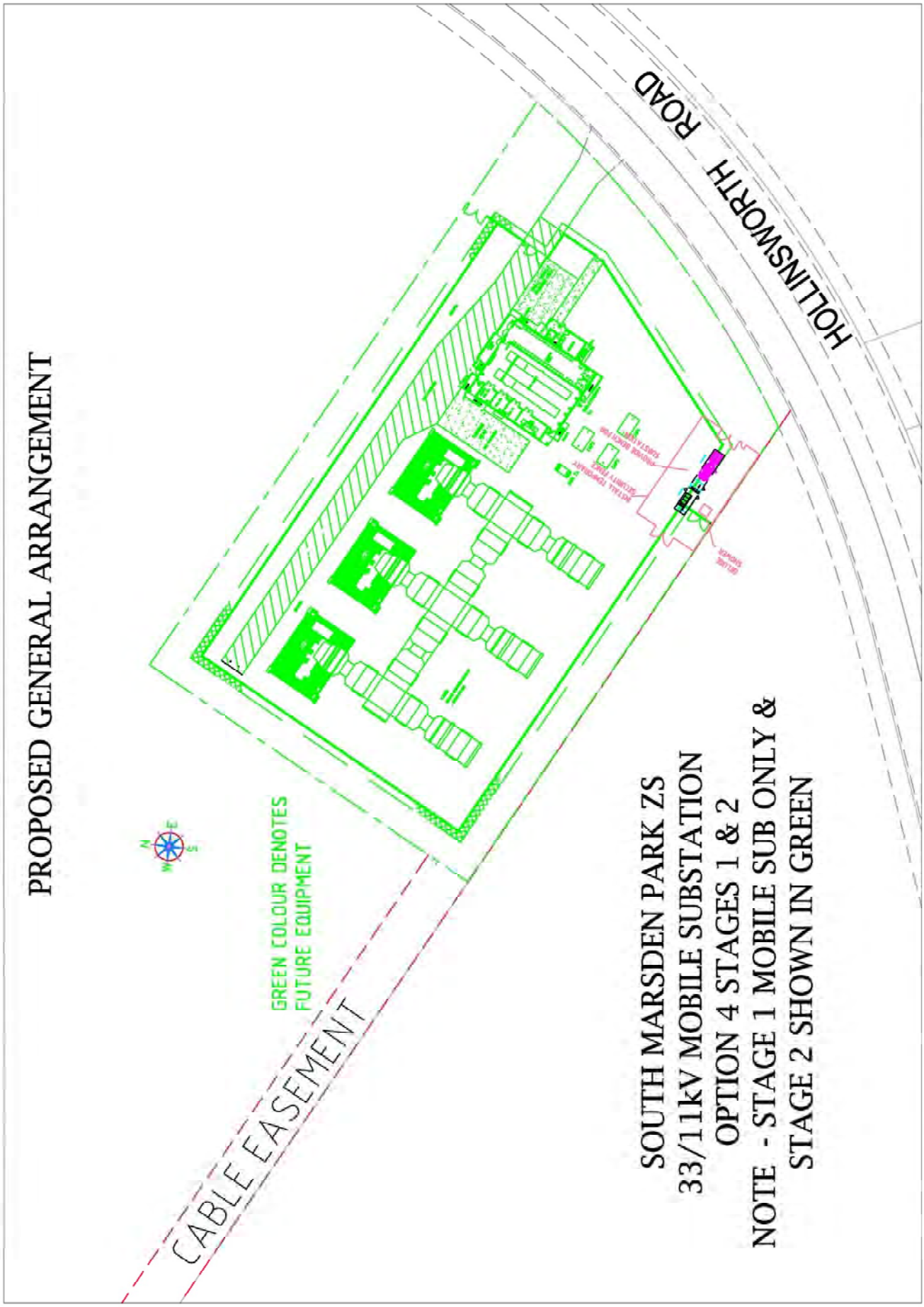
A7.1 33/11kV ZS Option 4 Stage 1 33kV transmission Single Line Diagram



A7.2 Option 4- 33/11kV ZS Stage 1 Single Line Diagram



A7.3 Option 3- Stage 1 33/11kV Mobile ZS Zone Substation Proposed Layout



Appendix 8 Fault Level Calculations

Fault levels on the South Marsden Park Zone Substation 132kV & 11kV busbar have been calculated and are as shown in Table A8-1 & A8-2 as follows:

PR 674 Option 1 Two 45MVA Tx in parallel	3 Phase-Earth Fault Level		1 Phase-Earth Fault Level	
	kA	MVA	kA	MVA
Note: Normal Operation all Feeders are solid	**South Marsden Park ZS 132kV Busbar**			
Feeder 21J & Feeder 2L in service (Normal Operation)	12.4	2913	13.0	2980
Feeder 21R & Feeder 21L in Service (Feeder 21J out)	11.3	2586	11.0	2524
Feeder 21R & Feeder 21J in Service (Feeder 21L out)	9.1	2079	8.4	1929
	South Marsden Park ZS 11kV Busbar			
Feeder 21J & Feeder 2L in service (Normal Operation)	12.4	236	12.7	243
Feeder 21R & Feeder 21L in Service (Feeder 21J out)	12.2	233	12.7	241
Feeder 21R & Feeder 21J in Service (Feeder 21L out)	12.0	228	12.5	238

Table A8-1 : PR 674 Sub Transmission Option 1 Details of System Fault Levels

PR 674 Option 2 One 45MVA Tx	3 Phase-Earth Fault Level		1 Phase-Earth Fault Level	
	kA	MVA	kA	MVA
	Marsden Park Industrial ZS 132kV Busbar			
Feeder 2J in service (Normal Operation)	9.1	2079	8.4	1929
	Marsden Park Industrial ZS 11kV Busbar			
Feeder 2J in service (Normal Operation)	6.3	121	6.5	123

Table A8-2 : PR 674 Sub Transmission Option 2 Details of System Fault Levels

PR 674 Option 3 One 15MVA Tx	3 Phase-Earth Fault Level		1 Phase-Earth Fault Level	
	kA	MVA	kA	MVA
	Marsden Park Industrial ZS 132kV			
Feeder 2J in service (Normal Operation)	12.7	2899	13.0	2962
	Marsden Park Industrial ZS 11kV Busbar			
Feeder 2J in service (Normal Operation)	5.6	106	5.7	108

Table A8-3: PR 674 Sub Transmission Option 3 Details of System Fault Levels

The fault levels on the 132kV and 11kV busbars are within the maximum fault levels recommended in SDI 501 Network Configuration.

Appendix 9 Cost Estimates

Option 1 – Cost estimate shows a total project cost to establish permanent outdoor 132/11kV 45MVA Zone Substation of $44.4 million.

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PROJECT: Project Description:

TOTALS	Work Packet	Labour Cost	Inc CPI	Actual	Store Costs	Inc CPI	Actual	Plant Costs	Inc CPI	Actual	Direct Charge	Inc CPI	Actual	Total Costs (inc CPI)	Total Actual	Contingency		Reason For Contingency
Planning & Development	1	$ 115,000	$ 123,843	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 123,843	$ -	$ -	0%	
NIOs & PDs	1.1	$ 30,000	$ 32,307	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 32,307	$ -	$ -		
Environmental Requirements	1.2	$ 85,000	$ 91,536	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 91,536	$ -	$ -		
Substation Design	2	$ 165,877	$ 178,631	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 590,000	$ 635,366	$ -	$ 813,997	$ -	$ 65,176	9%	
Electrical, Mechanical & Civil	2.1	$ 165,877	$ 178,631	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 178,631	$ -	$ 4,976		3 % for design modifications
Architect	2.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ 269,223	$ -	$ 269,223	$ -	$ 50,000		20% for design modifications
Earthing Design	2.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 340,000	$ 366,143	$ -	$ 366,143	$ -	$ 10,200		3 % for design modifications
Project Management	3	$ 390,000	$ 419,987	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 419,987	$ -	$ -	0%	
Substation Procurement/ Subcontract	4	$ 220,452	$ 237,402	$ -	$ 268,785	$ 289,453	$ -	$ 93,297	$ 100,471	$ -	$ 6,519,793	$ 7,021,105	$ -	$ 7,648,431	$ -	$ 861,700	12%	
Major Equipment	4.1	$ -	$ -	$ -	$ -	$ -	$ -	$ 22,784	$ 24,536	$ -	$ 5,137,210	$ 5,532,213	$ -	$ 5,556,749	$ -	$ 773,999		Allow 5% per year for copper & foreign exchange
Minor Equipment	4.2	$ -	$ -	$ -	$ 209,034	$ 225,107	$ -	$ 47,722	$ 51,392	$ -	$ 170,000	$ 183,071	$ -	$ 459,570	$ -	$ 64,013		Allow 5% per year for copper & foreign exchange
Steelwork & Busbars/Fittings	4.3	$ -	$ -	$ -	$ 44,671	$ 48,106	$ -	$ 8,517	$ 9,172	$ -	$ 104,730	$ 112,783	$ -	$ 170,061	$ -	$ 23,688		Allow 5% per year for steel prices
Major Equipment Storage	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 159,216	$ 171,459	$ -	$ 171,459	$ -	$ -		
On Site Security	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 161,534	$ -	$ 161,534	$ -	$ -		
Landscaping	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Control Panels	4.7	$ 211,176	$ 227,413	$ -	$ 15,080	$ 16,240	$ -	$ 4,019	$ 4,328	$ -	$ 94,500	$ 101,766	$ -	$ 349,747	$ -	$ -		
SCADA Hardware	4.8	$ 3,004	$ 3,235	$ -	$ -	$ -	$ -	$ 2,516	$ 2,710	$ -	$ 226,423	$ 243,833	$ -	$ 249,778	$ -	$ -		
Protection Relays	4.9	$ 6,272	$ 6,754	$ -	$ -	$ -	$ -	$ 7,738	$ 8,333	$ -	$ 477,714	$ 514,446	$ -	$ 529,533	$ -	$ -		
Trans Subs Construction	5	$ 2,215,773	$ 2,386,145	$ -	$ 20,707	$ 22,299	$ -	$ 120,924	$ 130,222	$ -	$ 40,000	$ 43,076	$ -	$ 2,581,742	$ -	$ -	0%	
Electrical Works	5.1	$ 1,650,366	$ 1,777,263	$ -	$ 14,651	$ 15,778	$ -	$ 104,007	$ 112,004	$ -	$ 40,000	$ 43,076	$ -	$ 1,948,121	$ -	$ -		
Protection & Control	5.2	$ 475,892	$ 512,484	$ -	$ -	$ -	$ -	$ 12,632	$ 13,604	$ -	$ -	$ -	$ -	$ 526,088	$ -	$ -		
HV Test	5.3	$ 85,625	$ 92,209	$ -	$ -	$ -	$ -	$ 3,890	$ 4,189	$ -	$ -	$ -	$ -	$ 96,398	$ -	$ -		
Metering	5.4	$ 3,890	$ 4,189	$ -	$ 6,055	$ 6,521	$ -	$ 395	$ 425	$ -	$ -	$ -	$ -	$ 11,135	$ -	$ -		
Trans Mains Construction	6	$ 3,798,315	$ 4,090,370	$ -	$ 731,036	$ 787,246	$ -	$ 341,554	$ 367,816	$ -	$ 19,057,972	$ 20,523,351	$ -	$ 25,768,783	$ -	$ 2,392,855	10%	
Project Management & Design	6.1	$ 1,203,551	$ 1,296,093	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,296,093	$ -	$ -		
Survey	6.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,062,500	$ 4,374,868	$ -	$ 4,374,868	$ -	$ -		
Civil Works	6.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,461,000	$ 8,034,681	$ -	$ 8,034,681	$ -	$ -		
Material Procurement	6.4	$ -	$ -	$ -	$ 731,036	$ 787,246	$ -	$ -	$ -	$ -	$ 6,709,672	$ 7,225,583	$ -	$ 8,012,829	$ -	$ -		
Construction	6.5	$ 2,594,764	$ 2,794,277	$ -	$ -	$ -	$ -	$ 341,554	$ 367,816	$ -	$ -	$ -	$ -	$ 3,162,093	$ -	$ 2,392,855		
Restorations	6.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 824,800	$ 888,219	$ -	$ 888,219	$ -	$ -		
Distribution Construction	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 995,000	$ 1,071,506	$ -	$ 1,071,506	$ -	$ -	0%	
Civil & Building Works	8	$ 52,786	$ 56,845	$ -	$ 16,437	$ 17,701	$ -	$ 90	$ 97	$ -	$ 5,489,579	$ 5,911,676	$ -	$ 5,986,319	$ -	$ 555,889	10%	Allow 10% for contaminated soil or rock
Additional Costs:	9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ 32,307	$ -	$ 32,307	$ -	$ -	0%	
Changeover	9.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Protection Upgrade Schofields ZS	9.2	$ -	$ -		$ -	$ -		$ -	$ -		$ 30,000	$ 32,307		$ 32,307				
	9.3	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.4	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.5	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.6	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.7	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.8	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.9	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Totals		$ 6,958,204	$ 7,493,223	$ -	$ 1,036,966	$ 1,116,699	$ -	$ 555,865	$ 598,606	$ -	$ 32,722,344	$ 35,238,387	$ -	$ 44,446,915	$ -	$ 3,875,621	9%	

TOTAL (CPI inc.): $ 44,400,000 Contingency: $ 3,900,000

TOTAL (inc. contigency): (Based On Project Finishing Within 3 years and CPI = 2.5%) $ 48,300,000

Option 2a Stage 1 – Cost estimate shows a total project cost to establish Stage 1 outdoor 132/11kV 45MVA Zone Substation of $28.6 million.

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PROJECT: | Project Description:

TOTALS	Work Packet	Labour Cost	Inc CPI	Actual	Store Costs	Inc CPI	Actual	Plant Costs	Inc CPI	Actual	Direct Charge	Inc CPI	Actual	Total Costs (inc CPI)	Total Actual	Contingency		Reason For Contingency
Planning & Development	1	$ 115,000	$ 120,822	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,822	$ -	$ -	0%	
NIOs & PDs	1.1	$ 30,000	$ 31,519	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 31,519	$ -	$ -		
Environmental Requirements	1.2	$ 85,000	$ 89,303	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 89,303	$ -	$ -		
Substation Design	2	$ 83,547	$ 87,776	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 590,000	$ 619,869	$ -	$ 707,645	$ -	$ 62,706	9%	
Electrical, Mechanical & Civil	2.1	$ 83,547	$ 87,776	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 87,776	$ -	$ 2,506		3 % for design modifications
Architect	2.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ 262,656	$ -	$ 262,656	$ -	$ 50,000		20% for design modifications
Earthing Design	2.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 340,000	$ 357,213	$ -	$ 357,213	$ -	$ 10,200		3 % for design modifications
Project Management	3	$ 390,000	$ 409,744	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 409,744	$ -	$ -	0%	
Substation Procurement/ Subcontract	4	$ 92,514	$ 97,198	$ -	$ 114,396	$ 120,188	$ -	$ 39,184	$ 41,167	$ -	$ 3,166,289	$ 3,326,582	$ -	$ 3,585,135	$ -	$ 267,468	8%	
Major Equipment	4.1	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,042	$ 9,500	$ -	$ 2,320,360	$ 2,437,828	$ -	$ 2,447,328	$ -	$ 232,940		Allow 5% per year for copper & foreign exchange
Minor Equipment	4.2	$ -	$ -	$ -	$ 87,975	$ 92,429	$ -	$ 20,713	$ 21,762	$ -	$ 170,000	$ 178,606	$ -	$ 292,797	$ -	$ 27,869		Allow 5% per year for copper & foreign exchange
Steelwork & Busbars/Fittings	4.3	$ -	$ -	$ -	$ 20,621	$ 21,665	$ -	$ 3,669	$ 3,854	$ -	$ 42,296	$ 44,437	$ -	$ 69,956	$ -	$ 6,659		Allow 5% per year for steel prices
Major Equipment Storage	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 49,807	$ 52,329	$ -	$ 52,329	$ -	$ -		
On Site Security	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 157,594	$ -	$ -		
Landscaping	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Control Panels	4.7	$ 85,982	$ 90,335	$ -	$ 5,800	$ 6,094	$ -	$ 1,546	$ 1,624	$ -	$ 38,500	$ 40,449	$ -	$ 138,502	$ -	$ -		
SCADA Hardware	4.8	$ 3,004	$ 3,156	$ -	$ -	$ -	$ -	$ 1,030	$ 1,082	$ -	$ 190,615	$ 200,265	$ -	$ 204,503	$ -	$ -		
Protection Relays	4.9	$ 3,528	$ 3,707	$ -	$ -	$ -	$ -	$ 3,184	$ 3,345	$ -	$ 204,711	$ 215,074	$ -	$ 222,126	$ -	$ -		
Trans Subs Construction	5	$ 918,322	$ 964,813	$ -	$ 9,017	$ 9,474	$ -	$ 50,044	$ 52,577	$ -	$ 40,000	$ 42,025	$ -	$ 1,068,889	$ -	$ -	0%	
Electrical Works	5.1	$ 689,046	$ 723,929	$ -	$ 5,990	$ 6,293	$ -	$ 43,235	$ 45,424	$ -	$ 40,000	$ 42,025	$ -	$ 817,671	$ -	$ -		
Protection & Control	5.2	$ 192,701	$ 202,457	$ -	$ -	$ -	$ -	$ 5,038	$ 5,293	$ -	$ -	$ -	$ -	$ 207,750	$ -	$ -		
HV Test	5.3	$ 34,631	$ 36,384	$ -	$ -	$ -	$ -	$ 1,573	$ 1,653	$ -	$ -	$ -	$ -	$ 38,037	$ -	$ -		
Metering	5.4	$ 1,945	$ 2,043	$ -	$ 3,028	$ 3,181	$ -	$ 197	$ 207	$ -	$ -	$ -	$ -	$ 5,431	$ -	$ -		
Trans Mains Construction	6	$ 2,652,831	$ 2,787,131	$ -	$ 508,568	$ 534,314	$ -	$ 241,947	$ 254,196	$ -	$ 11,708,287	$ 12,301,020	$ -	$ 15,876,661	$ -	$ 1,511,164	10%	
Project Management & Design	6.1	$ 766,928	$ 805,754	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 805,754	$ -	$ -		
Survey	6.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,941,500	$ 2,039,788	$ -	$ 2,039,788	$ -	$ -		
Civil Works	6.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,956,000	$ 5,206,898	$ -	$ 5,206,898	$ -	$ -		
Material Procurement	6.4	$ -	$ -	$ -	$ 508,568	$ 534,314	$ -	$ -	$ -	$ -	$ 4,233,987	$ 4,448,333	$ -	$ 4,982,647	$ -	$ -		
Construction	6.5	$ 1,885,903	$ 1,981,377	$ -	$ -	$ -	$ -	$ 241,947	$ 254,196	$ -	$ -	$ -	$ -	$ 2,235,573	$ -	$ 1,511,164		
Restorations	6.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 576,800	$ 606,001	$ -	$ 606,001	$ -	$ -		
Distribution Construction	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 995,000	$ 1,045,372	$ -	$ 1,045,372	$ -	$ -	0%	
Civil & Building Works	8	$ 20,581	$ 21,623	$ -	$ 6,682	$ 7,020	$ -	$ 45	$ 47	$ -	$ 5,414,104	$ 5,688,193	$ -	$ 5,716,883	$ -	$ 544,141	10%	Allow 10% for contaminated soil or rock
Additional Costs:	9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ 31,519	$ -	$ 31,519	$ -	$ -	0%	
Changeover	9.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Protection Upgrade Schofields ZS	9.2	$ -	$ -		$ -	$ -		$ -	$ -		$ 30,000	$ 31,519		$ 31,519				
	9.3	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.4	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.5	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.6	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.7	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.8	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.9	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Totals		$ 4,272,795	$ 4,489,107	$ -	$ 638,663	$ 670,996	$ -	$ 331,219	$ 347,987	$ -	$ 21,943,680	$ 23,054,580	$ -	$ 28,562,670	$ -	$ 2,385,479	9%	

TOTAL (CPI inc.): $ 28,600,000 | Contingency: $ 2,400,000

TOTAL (inc. contigency): (Based On Project Finishing Within 2 years and CPI = 2.5%) $ 31,000,000

Option 2b Stage 1 – Cost estimate shows a total project cost to establish Stage 1 outdoor 132/11kV 45MVA Zone Substation of $27.5 million.

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PROJECT: | Project Description:

TOTALS	Work Packet	Labour Cost	Inc CPI	Actual	Store Costs	Inc CPI	Actual	Plant Costs	Inc CPI	Actual	Direct Charge	Inc CPI	Actual	Total Costs (Inc CPI)	Total Actual	Contingency		Reason For Contingency
Planning & Development	1	$ 115,000	$ 120,822	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,822	$ -	$ -	0%	
NIOs & PDs	1.1	$ 30,000	$ 31,519	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 31,519	$ -	$ -		
Environmental Requirements	1.2	$ 85,000	$ 89,303	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 89,303	$ -	$ -		
Substation Design	2	$ 68,576	$ 72,048	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 590,000	$ 619,869	$ -	$ 691,917	$ -	$ 62,257	9%	
Electrical, Mechanical & Civil	2.1	$ 68,576	$ 72,048	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 72,048	$ -	$ 2,057		3 % for design modifications
Architect	2.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ 262,656	$ -	$ 262,656	$ -	$ 50,000		20% for design modifications
Earthing Design	2.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 340,000	$ 357,213	$ -	$ 357,213	$ -	$ 10,200		3 % for design modifications
Project Management	3	$ 390,000	$ 409,744	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 409,744	$ -	$ -	0%	
Substation Procurement/ Subcontract	4	$ 69,129	$ 72,629	$ -	$ 20,810	$ 21,864	$ -	$ 20,690	$ 21,737	$ -	$ 2,661,072	$ 2,795,789	$ -	$ 2,912,019	$ -	$ 213,812	8%	
Major Equipment	4.1	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,452	$ 5,728	$ -	$ 1,935,500	$ 2,033,485	$ -	$ 2,039,213	$ -	$ 194,095		Allow 5% per year for copper & foreign exchange
Minor Equipment	4.2	$ -	$ -	$ -	$ 16,170	$ 16,989	$ -	$ 11,002	$ 11,559	$ -	$ 170,000	$ 178,606	$ -	$ 207,154	$ -	$ 19,717		Allow 5% per year for copper & foreign exchange
Steelwork & Busbars/Fittings	4.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Major Equipment Storage	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 42,110	$ 44,242	$ -	$ 44,242	$ -	$ -		
On Site Security	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 157,594	$ -	$ -		
Landscaping	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Control Panels	4.7	$ 62,597	$ 65,786	$ -	$ 4,640	$ 4,875	$ -	$ 1,237	$ 1,299	$ -	$ 28,000	$ 29,418	$ -	$ 101,358	$ -	$ -		
SCADA Hardware	4.8	$ 3,004	$ 3,156	$ -	$ -	$ -	$ -	$ 917	$ 964	$ -	$ 188,097	$ 197,619	$ -	$ 201,739	$ -	$ -		
Protection Relays	4.9	$ 3,528	$ 3,707	$ -	$ -	$ -	$ -	$ 2,082	$ 2,187	$ -	$ 147,365	$ 154,825	$ -	$ 160,719	$ -	$ -		
Trans Subs Construction	5	$ 599,956	$ 630,329	$ -	$ 6,968	$ 7,321	$ -	$ 38,310	$ 40,248	$ -	$ 40,000	$ 42,025	$ -	$ 719,923	$ -	$ -	0%	
Electrical Works	5.1	$ 417,276	$ 438,401	$ -	$ 3,941	$ 4,140	$ -	$ 32,802	$ 34,463	$ -	$ 40,000	$ 42,025	$ -	$ 519,029	$ -	$ -		
Protection & Control	5.2	$ 154,096	$ 161,897	$ -	$ -	$ -	$ -	$ 4,100	$ 4,307	$ -	$ -	$ -	$ -	$ 166,204	$ -	$ -		
HV Test	5.3	$ 26,639	$ 27,988	$ -	$ -	$ -	$ -	$ 1,210	$ 1,271	$ -	$ -	$ -	$ -	$ 29,259	$ -	$ -		
Metering	5.4	$ 1,945	$ 2,043	$ -	$ 3,028	$ 3,181	$ -	$ 197	$ 207	$ -	$ -	$ -	$ -	$ 5,431	$ -	$ -		
Trans Mains Construction	6	$ 2,652,831	$ 2,787,131	$ -	$ 508,568	$ 534,314	$ -	$ 241,947	$ 254,196	$ -	$ 11,708,287	$ 12,301,020	$ -	$ 15,876,661	$ -	$ 1,511,164	10%	
Project Management & Design	6.1	$ 766,928	$ 805,754	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 805,754	$ -	$ -		
Survey	6.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,941,500	$ 2,039,788	$ -	$ 2,039,788	$ -	$ -		
Civil Works	6.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,956,000	$ 5,206,898	$ -	$ 5,206,898	$ -	$ -		
Material Procurement	6.4	$ -	$ -	$ -	$ 508,568	$ 534,314	$ -	$ -	$ -	$ -	$ 4,233,987	$ 4,448,333	$ -	$ 4,982,647	$ -	$ -		
Construction	6.5	$ 1,885,903	$ 1,981,377	$ -	$ -	$ -	$ -	$ 241,947	$ 254,196	$ -	$ -	$ -	$ -	$ 2,235,573	$ -	$ 1,511,164		
Restorations	6.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 576,800	$ 606,001	$ -	$ 606,001	$ -	$ -		
Distribution Construction	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 995,000	$ 1,045,372	$ -	$ 1,045,372	$ -	$ -	0%	
Civil & Building Works	8	$ 16,954	$ 17,812	$ -	$ 5,739	$ 6,030	$ -	$ 45	$ 47	$ -	$ 5,385,050	$ 5,657,668	$ -	$ 5,681,557	$ -	$ 540,779	10%	Allow 10% for contaminated soil or rock
Additional Costs:	9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ 31,519	$ -	$ 31,519	$ -	$ -	0%	
Changeover	9.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Protection Upgrade Schofields ZS	9.2	$ -	$ -		$ -	$ -		$ -	$ -		$ 30,000	$ 31,519		$ 31,519				
	9.3	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.4	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.5	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.6	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.7	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.8	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.9	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Totals		$ 3,912,446	$ 4,110,515	$ -	$ 542,086	$ 569,529	$ -	$ 300,991	$ 316,228	$ -	$ 21,409,409	$ 22,493,262	$ -	$ 27,489,534	$ -	$ 2,328,013	9%	

TOTAL (CPI Inc.): $ 27,500,000 | Contingency: $ 2,300,000

TOTAL (inc. contigency): (Based On Project Finishing Within 2 years and CPI = 2.5%) $ 29,800,000

Option 3 Stage 1 – Cost estimate shows a total project cost to establish Stage 1 mobile 132/11kV 15MVA Zone Substation of $22.6 million.

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PROJECT: PR674 Project Description:

TOTALS	Work Packet	Labour Cost	Inc CPI	Actual	Store Costs	Inc CPI	Actual	Plant Costs	Inc CPI	Actual	Direct Charge	Inc CPI	Actual	Total Costs (inc CPI)	Total Actual	Contingency		Reason For Contingency
Planning & Development	1	$ 25,000	$ 26,266	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 26,266	$ -	$ -	0%	
NIOs & PDs	1.1	$ 20,000	$ 21,013	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 21,013	$ -	$ -		
Environmental Requirements	1.2	$ 5,000	$ 5,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,253	$ -	$ -		
Substation Design	2	$ 26,787	$ 28,143	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 185,737	$ -	$ 5,304	3%	
Electrical, Mechanical & Civil	2.1	$ 26,787	$ 28,143	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 28,143	$ -	$ 804		3 % for design modifications
Architect	2.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Earthing Design	2.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 157,594	$ -	$ 4,500		3 % for design modifications
Project Management	3	$ 50,000	$ 52,531	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 52,531	$ -	$ -	0%	
Substation Procurement/ Subcontract	4	$ 7,736	$ 8,128	$ -	$ 580	$ 609	$ -	$ 161	$ 170	$ -	$ 4,693,150	$ 4,930,741	$ -	$ 4,939,648	$ -	$ 460,000	10%	
Major Equipment	4.1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,600,000	$ 4,832,875	$ -	$ 4,832,875	$ -	$ 460,000		
Minor Equipment	4.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Steelwork & Busbars/Fittings	4.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Major Equipment Storage	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 92,000	$ 96,658	$ -	$ 96,658	$ -	$ -		
On Site Security	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Landscaping	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Control Panels	4.7	$ 7,736	$ 8,128	$ -	$ 580	$ 609	$ -	$ 146	$ 154	$ -	$ -	$ -	$ -	$ 8,891	$ -	$ -		
SCADA Hardware	4.8	$ -	$ -	$ -	$ -	$ -	$ -	$ 15	$ 16	$ -	$ 1,150	$ 1,208	$ -	$ 1,224	$ -	$ -		
Protection Relays	4.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Trans Subs Construction	5	$ 80,621	$ 84,703	$ -	$ 373	$ 392	$ -	$ 2,293	$ 2,410	$ -	$ -	$ -	$ -	$ 87,505	$ -	$ 17,501	21%	
Electrical Works	5.1	$ 30,697	$ 32,251	$ -	$ 373	$ 392	$ -	$ 823	$ 865	$ -	$ -	$ -	$ -	$ 33,508	$ -	$ 6,702		Design changes
Protection & Control	5.2	$ 36,605	$ 38,458	$ -	$ -	$ -	$ -	$ 865	$ 909	$ -	$ -	$ -	$ -	$ 39,367	$ -	$ 7,873		Design changes
HV Test	5.3	$ 13,320	$ 13,994	$ -	$ -	$ -	$ -	$ 605	$ 636	$ -	$ -	$ -	$ -	$ 14,630	$ -	$ 2,926		Design changes
Metering	5.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Trans Mains Construction	6	$ 2,545,332	$ 2,674,190	$ -	$ 502,750	$ 528,202	$ -	$ 227,895	$ 239,432	$ -	$ 11,617,377	$ 12,205,507	$ -	$ 15,647,331	$ -	$ 1,489,336	10%	
Project Management & Design	6.1	$ 698,465	$ 733,825	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 733,825	$ -	$ -		
Survey	6.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,941,500	$ 2,039,788	$ -	$ 2,039,788	$ -	$ -		
Civil Works	6.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,956,000	$ 5,206,898	$ -	$ 5,206,898	$ -	$ -		
Material Procurement	6.4	$ -	$ -	$ -	$ 502,750	$ 528,202	$ -	$ -	$ -	$ -	$ 4,143,077	$ 4,352,820	$ -	$ 4,881,022	$ -	$ -		
Construction	6.5	$ 1,846,867	$ 1,940,365	$ -	$ -	$ -	$ -	$ 227,895	$ 239,432	$ -	$ -	$ -	$ -	$ 2,179,797	$ -	$ 1,489,336		
Restorations	6.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 576,800	$ 606,001	$ -	$ 606,001	$ -	$ -		
Distribution Construction	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 995,000	$ 1,045,372	$ -	$ 1,045,372	$ -	$ -	0%	
Civil & Building Works	8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 517,500	$ 543,698	$ -	$ 543,698	$ -	$ 103,500	20%	Allow 20% for contaminated soil or rock
Additional Costs:	9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000	$ 52,532	$ -	$ 52,532	$ -	$ 5,000	10%	
Changeover	9.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Transport costs	9.2	$ -	$ -		$ -	$ -		$ -	$ -		$ 20,000	$ 21,013		$ 21,013		$ 5,000		Increase costs due to route
Protection Upgrade Schofields ZS	9.3	$ -	$ -		$ -	$ -		$ -	$ -		$ 30,000	$ 31,519		$ 31,519				
	9.4	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.5	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.6	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.7	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.8	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.9	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Totals		$ 2,735,477	$ 2,873,961	$ -	$ 503,703	$ 529,203	$ -	$ 230,350	$ 242,012	$ -	$ 18,023,027	$ 18,935,444	$ -	$ 22,580,620	$ -	$ 2,080,641	10%	

TOTAL (CPI inc.): $ 22,580,000 Contingency: $ 2,080,000

TOTAL (inc. contigency): (Based On Project Finishing Within 2 years and CPI = 2.5%) $ 24,660,000

Option 4 Stage 1 – Cost estimate shows a total project cost to establish Stage 1 outdoor 132/11kV 45MVA Zone Substation of $20.4 million.

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PROJECT: | Project Description:

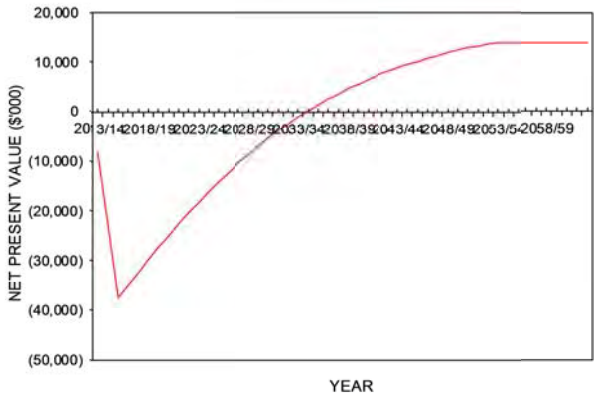
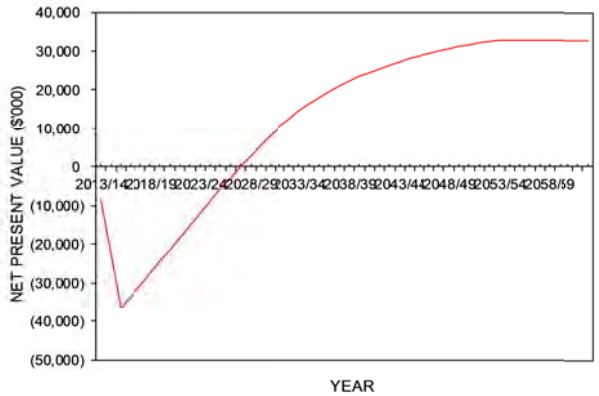
TOTALS	Work Packet	Labour Cost	Inc CPI	Actual	Store Costs	Inc CPI	Actual	Plant Costs	Inc CPI	Actual	Direct Charge	Inc CPI	Actual	Total Costs (inc CPI)	Total Actual	Contingency		Reason For Contingency
Planning & Development	1	$ 25,000	$ 26,266	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 26,266	$ -	$ -	0%	
NIOs & PDs	1.1	$ 20,000	$ 21,013	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 21,013	$ -	$ -		
Environmental Requirements	1.2	$ 5,000	$ 5,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,253	$ -	$ -		
Substation Design	2	$ 26,787	$ 28,143	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 185,737	$ -	$ 5,304	3%	
Electrical, Mechanical & Civil	2.1	$ 26,787	$ 28,143	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 28,143	$ -	$ 804		3 % for design modifications
Architect	2.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Earthing Design	2.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 157,594	$ -	$ 157,594	$ -	$ 4,500		3 % for design modifications
Project Management	3	$ 50,000	$ 52,531	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 52,531	$ -	$ -	0%	
Substation Procurement/ Subcontract	4	$ 7,736	$ 8,128	$ -	$ 580	$ 609	$ -	$ 161	$ 170	$ -	$ 1,150	$ 1,208	$ -	$ 10,115	$ -	$ -	0%	
Major Equipment	4.1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Minor Equipment	4.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Steelwork & Busbars/Fittings	4.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Major Equipment Storage	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
On Site Security	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Landscaping	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Control Panels	4.7	$ 7,736	$ 8,128	$ -	$ 580	$ 609	$ -	$ 146	$ 154	$ -	$ -	$ -	$ -	$ 8,891	$ -	$ -		
SCADA Hardware	4.8	$ -	$ -	$ -	$ -	$ -	$ -	$ 15	$ 16	$ -	$ 1,150	$ 1,208	$ -	$ 1,224	$ -	$ -		
Protection Relays	4.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Trans Subs Construction	5	$ 80,621	$ 84,703	$ -	$ 373	$ 392	$ -	$ 2,293	$ 2,410	$ -	$ -	$ -	$ -	$ 87,505	$ -	$ 17,501	21%	
Electrical Works	5.1	$ 30,697	$ 32,251	$ -	$ 373	$ 392	$ -	$ 823	$ 865	$ -	$ -	$ -	$ -	$ 33,508	$ -	$ 6,702		Design changes
Protection & Control	5.2	$ 36,605	$ 38,458	$ -	$ -	$ -	$ -	$ 865	$ 909	$ -	$ -	$ -	$ -	$ 39,367	$ -	$ 7,873		Design changes
HV Test	5.3	$ 13,320	$ 13,994	$ -	$ -	$ -	$ -	$ 605	$ 636	$ -	$ -	$ -	$ -	$ 14,630	$ -	$ 2,926		Design changes
Metering	5.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Trans Mains Construction	6	$ 3,799,254	$ 3,991,592	$ -	$ 989,542	$ 1,039,638	$ -	$ 428,593	$ 450,291	$ -	$ 12,683,697	$ 13,325,810	$ -	$ 18,807,331	$ -	$ 1,790,109	10%	
Project Management & Design	6.1	$ 1,158,215	$ 1,216,850	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,216,850	$ -	$ -		
Survey	6.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,991,500	$ 2,092,320	$ -	$ 2,092,320	$ -	$ -		
Civil Works	6.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,956,000	$ 5,206,898	$ -	$ 5,206,898	$ -	$ -		
Material Procurement	6.4	$ -	$ -	$ -	$ 989,542	$ 1,039,638	$ -	$ -	$ -	$ -	$ 5,159,397	$ 5,420,591	$ -	$ 6,460,229	$ -	$ -		
Construction	6.5	$ 2,641,039	$ 2,774,742	$ -	$ -	$ -	$ -	$ 428,593	$ 450,291	$ -	$ -	$ -	$ -	$ 3,225,033	$ -	$ 1,790,109		
Restorations	6.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 576,800	$ 606,001	$ -	$ 606,001	$ -	$ -		
Distribution Construction	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 995,000	$ 1,045,372	$ -	$ 1,045,372	$ -	$ -	0%	
Civil & Building Works	8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 47,500	$ 49,905	$ -	$ 49,905	$ -	$ 9,500	20%	Allow 20% for contaminated soil or rock
Additional Costs:	9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 80,000	$ 84,051	$ -	$ 84,051	$ -	$ 5,000	6%	
Changeover	9.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Transport costs	9.2	$ -	$ -		$ -	$ -		$ -	$ -		$ 20,000	$ 21,013		$ 21,013		$ 5,000		Increase costs due to route
33kV FDR Protection Upgrade	9.3	$ -	$ -		$ -	$ -		$ -	$ -		$ 60,000	$ 63,038		$ 63,038				
	9.4	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.5	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.6	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.7	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.8	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
	9.9	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -		$ -				
Totals		$ 3,989,399	$ 4,191,363	$ -	$ 990,495	$ 1,040,639	$ -	$ 431,048	$ 452,871	$ -	$ 13,957,347	$ 14,663,940	$ -	$ 20,348,813	$ -	$ 1,827,414	9%	

TOTAL (CPI inc.): $ 20,350,000 | Contingency: $ 1,830,000

TOTAL (inc. contigency): (Based On Project Finishing Within 2 years and CPI = 2.5%) $ 22,180,000

Appendix 10 Financial Evaluation Summary

Capital evaluation summary based on 2013/14 real dollars to establish **Option 1** 132kV 45MVA Outdoor Zone Substation.

Low Growth	High Growth
NETWORK PLANNING ***CAPITAL EVALUATION SUMMARY*** PROJECT NAME **PR674 Marsden Park Inductrial capacity** **Full permanent ZS**	*NETWORK PLANNING* ***CAPITAL EVALUATION SUMMARY*** PROJECT NAME **PR674 Marsden Park Industrial** **Full permanent ZS**
INITIAL CAPITAL EXPENDITURE **$41,100,000** **FUTURE CAPITAL EXPENDITURE** **$0** **TOTAL CAPITAL EXPENDITURE** **$41,100,000** **PRESENT VALUE OF COSTS** **$43,811,077** **NET PRESENT VALUE OF PROJECT** **$13,910,544** **INTERNAL RATE OF RETURN** **10.71%** **DISCOUNTED PAYBACK** **21 Years**	**INITIAL CAPITAL EXPENDITURE** **$41,100,000** **FUTURE CAPITAL EXPENDITURE** **$0** **TOTAL CAPITAL EXPENDITURE** **$41,100,000** **PRESENT VALUE OF COSTS** **$44,380,380** **NET PRESENT VALUE OF PROJECT** **$32,612,365** **INTERNAL RATE OF RETURN** **13.83%** **DISCOUNTED PAYBACK** **15 Years**
CUMULATIVE DCF  ASSESSMENT DATE 14-Nov-13	CUMULATIVE DCF  ASSESSMENT DATE 14-Nov-13

Capital evaluation summary based on 2013/14 real dollars to establish **Option 2a Stage 1 and Stage 2** 132kV 45MVA outdoor Zone Substation.

Low Growth	High Growth

NETWORK PLANNING

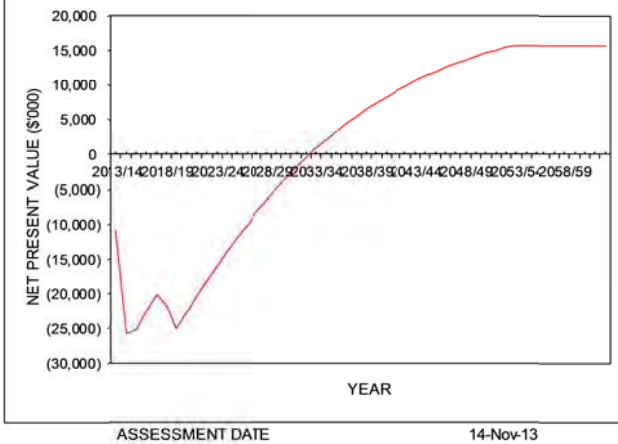
CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 2a 132kV ZS Stage 1 & 2

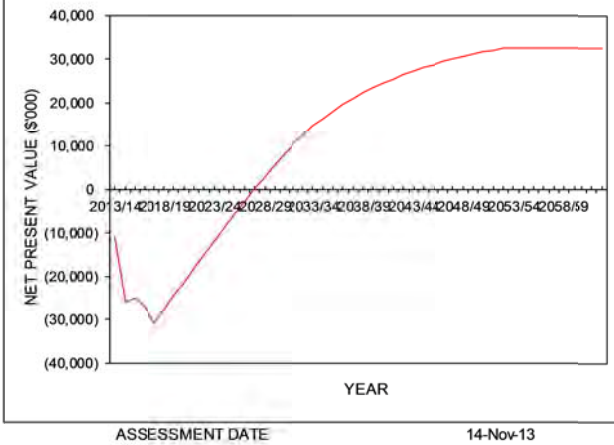
	Low Growth	High Growth
INITIAL CAPITAL EXPENDITURE	$27,100,000	$27,100,000
FUTURE CAPITAL EXPENDITURE	$15,200,000	$15,200,000
TOTAL CAPITAL EXPENDITURE	$42,300,000	$42,300,000
PRESENT VALUE OF COSTS	$42,788,748	$44,452,738
NET PRESENT VALUE OF PROJECT	$15,627,075	$32,566,718
INTERNAL RATE OF RETURN	11.38%	14.02%
DISCOUNTED PAYBACK	20 Years	14 Years

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

Capital evaluation summary based on 2013/14 real dollars to establish **Option 2b Stage 1 and Stage 2** 132kV 45MVA outdoor Zone Substation.

Low Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 2b 132kV ZS Stage 1 & 2

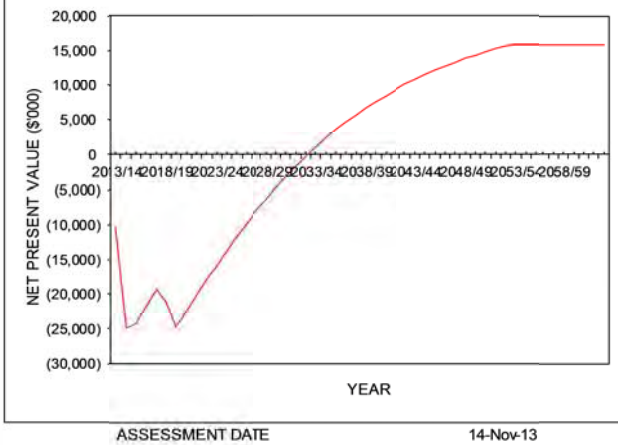
INITIAL CAPITAL EXPENDITURE
$26,100,000
FUTURE CAPITAL EXPENDITURE
$16,300,000
TOTAL CAPITAL EXPENDITURE
$42,400,000
PRESENT VALUE OF COSTS
$42,560,609

NET PRESENT VALUE OF PROJECT
$15,857,440

INTERNAL RATE OF RETURN
11.48%

DISCOUNTED PAYBACK
20 Years

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

High Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 2b 132kV ZS Stage 1 & 2

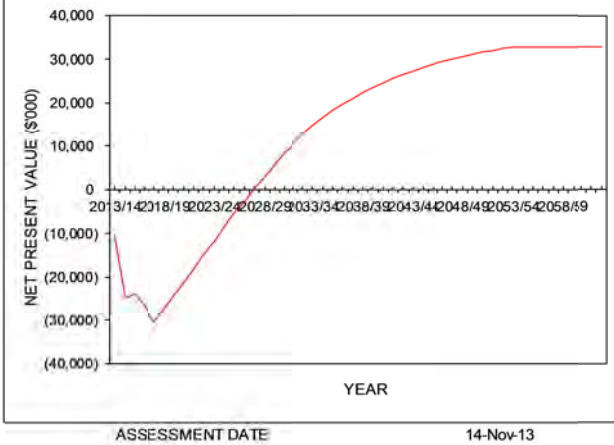
INITIAL CAPITAL EXPENDITURE
$26,100,000
FUTURE CAPITAL EXPENDITURE
$16,300,000
TOTAL CAPITAL EXPENDITURE
$42,400,000
PRESENT VALUE OF COSTS
$44,345,019

NET PRESENT VALUE OF PROJECT
$32,676,663

INTERNAL RATE OF RETURN
14.10%

DISCOUNTED PAYBACK
14 Years

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

Capital evaluation summary based on 2013/14 real dollars to establish **Option 3 Combined Stage 1 132/11kV Mobile and Stage 2** outdoor Zone Substation.

Low Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 3 132kV Mobile ZS Stage 1 & 2

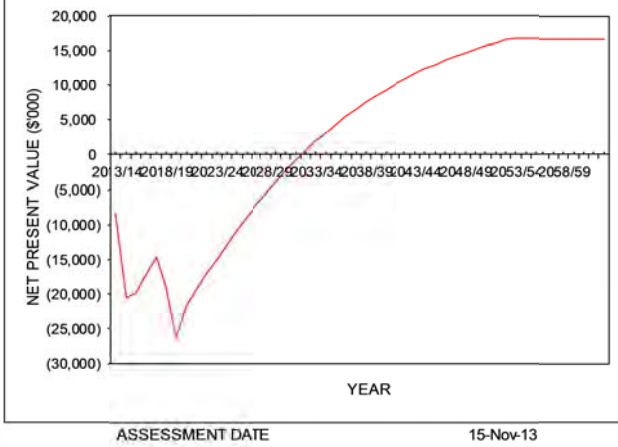
INITIAL CAPITAL EXPENDITURE
$21,400,000
FUTURE CAPITAL EXPENDITURE
$21,500,000
TOTAL CAPITAL EXPENDITURE
$42,900,000
PRESENT VALUE OF COSTS
$41,782,624

NET PRESENT VALUE OF PROJECT
$16,646,554

INTERNAL RATE OF RETURN
11.88%

DISCOUNTED PAYBACK
19 Years

CUMULATIVE DCF



ASSESSMENT DATE 15-Nov-13

High Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 3 132kV Mobile ZS Stage 1 & 2

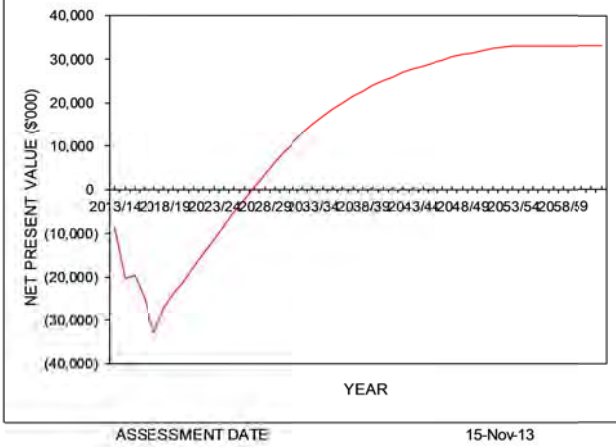
INITIAL CAPITAL EXPENDITURE
$21,400,000
FUTURE CAPITAL EXPENDITURE
$21,300,000
TOTAL CAPITAL EXPENDITURE
$42,700,000
PRESENT VALUE OF COSTS
$44,013,306

NET PRESENT VALUE OF PROJECT
$33,015,054

INTERNAL RATE OF RETURN
14.36%

DISCOUNTED PAYBACK
14 Years

CUMULATIVE DCF



ASSESSMENT DATE 15-Nov-13

Note: Option 3 total capital outlay includes only the depreciated value of the mobile cost. Mobile procurement cost will be absorbed by future major projects. The depreciated value of the mobile cost is lower under the high growth scenario.

Capital evaluation summary based on 2013/14 real dollars to establish **Option 4 Combined Stage 1 33/11kV Mobile and Stage 2** 132/11kV outdoor Zone Substation.

Low Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 4 33kV Mobile ZS Stage 1 & 2

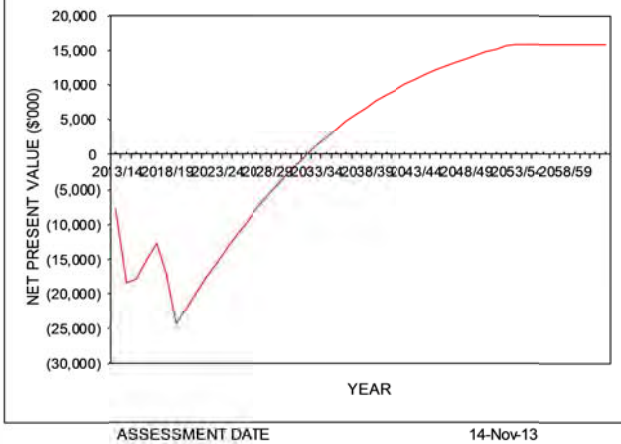
INITIAL CAPITAL EXPENDITURE
$19,370,000
FUTURE CAPITAL EXPENDITURE
$25,700,000
TOTAL CAPITAL EXPENDITURE
$45,070,000
PRESENT VALUE OF COSTS
$42,649,372

NET PRESENT VALUE OF PROJECT
$15,828,110

INTERNAL RATE OF RETURN
11.80%

DISCOUNTED PAYBACK
20 Years

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

High Growth

NETWORK PLANNING

CAPITAL EVALUATION SUMMARY

PROJECT NAME

PR674 Marsden Park Industrial
Option 4 33kV Mobile ZS Stage 1 & 2

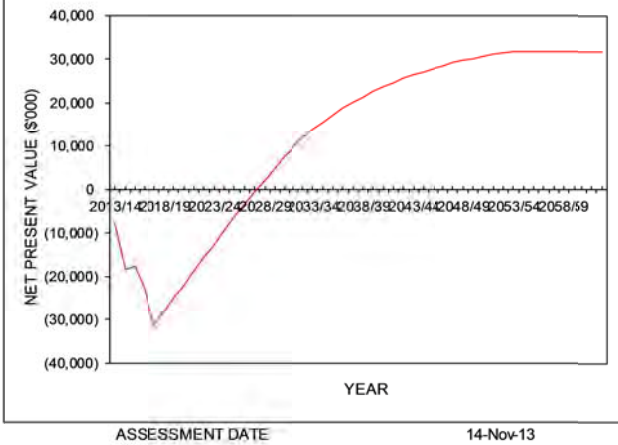
INITIAL CAPITAL EXPENDITURE
$19,370,000
FUTURE CAPITAL EXPENDITURE
$25,700,000
TOTAL CAPITAL EXPENDITURE
$45,070,000
PRESENT VALUE OF COSTS
$45,462,828

NET PRESENT VALUE OF PROJECT
$31,618,286

INTERNAL RATE OF RETURN
14.17%

DISCOUNTED PAYBACK
15 Years

CUMULATIVE DCF



ASSESSMENT DATE 14-Nov-13

A11.1 Preliminary Environmental Assessment

Endeavour Energy

Memorandum

To	Danny Asvestas, Transmission Project Development	**File no**	
From	Liz Mathieson, Environmental Specialist	**Date**	12 September 2013
Subject	Preliminary Environmental Assessment – South Marsden Park Zone Substation and 132kV Feeder Routes		
Copies	Andy Worboys		

1.0 BACKGROUND

Endeavour Energy has recently received load applications for the Sydney Business Park within the Marsden Park Industrial Precinct. These load applications are higher than the original forecast applications and there is currently no spare capacity within the existing electricity network to meet these load demands. Based on forecast loads, if no action is taken there will be load at risk by 2016.

A number of options are currently being investigated by the NIO team to identify an appropriate method of supply to the Marsden Park Industrial Precinct. These options are discussed in Section 2 and 3.

2.0 OPTIONS

The NIO team identified a number of options to meet the short and medium term needs of the Marsden Park Industrial Precinct. These options are described in Table 1 below.

Option	Stage 1 (2015)	Stage 2 (2019/20)
1	Construct 132kV line from Schofields ZS	
	Construct 132kV line from Marsden Park ZS	
	Establish full 132/11kV South Marsden Park ZS (n-1)	
2a	Construct 132kV line from Schofields ZS	Establish full South Marsden Park ZS
	Establish 132/11kV South Marsden Park ZS with: • Permanent control building • 1 x 132/11kV transformer • 1 x section 132kV busbar • 1 x section of 11kV busbar	Construct 132kV line from Marsden Park ZS
2b	Construct 132kV line from Schofields ZS	Establish full South Marsden Park ZS
	Establish 132/11kV South Marsden Park ZS with: • Permanent control building • 1 x 132/11kV transformer	Construct 132kV line from Marsden Park ZS

3a	Construct 132kV line from Schofields ZS	Establish full South Marsden Park ZS
	Install 132/11kV mobile sub (existing)	Construct 132kV line from Marsden Park ZS
3b	Construct 132kV line from Schofields ZS	Establish full South Marsden Park ZS
	Procure and install new 132/11kV mobile sub	Construct 132kV line from Marsden Park ZS
4	Construct 132kV line from Schofields ZS	Establish full South Marsden Park ZS
	Install existing 33/11kV mobile sub	Construct 132kV line from Marsden Park ZS
	Augment 33kV Feeder 458 (5.6km)	

Table 1: Description of Options

3.0 Options Assessment

While the options vary in their approach and staging, all options result in the same ultimate outcome, being the construction of the new South Marsden Park ZS on a parcel of land within the Marsden Park Industrial Precinct and the establishment of 132kV transmission feeders to both Schofields ZS and Marsden Park ZS by 2019/20.

For this reason, this report is generally limited to a discussion on the potential or likely environmental impacts associated with the ultimate scenario, being use of the subject site for the South Marsden Park ZS (Section 3.1) and the associated 132kV transmission feeders (Section 3.2 and 3.3). Discussion on the feasibility of Option 4, in particular the augmentation of an existing 33kV feeder, is also provided in Section 3.4

3.1 SOUTH MARSDEN PARK ZONE SUBSTATION

The proposed South Marsden Park ZS site is located on Part Lots 32 and 33 in DP 362886 (proposed Lot 24) on Hollinsworth Dr, Marsden Park.

With the exception of Option 1, all options involve the use of a mobile substation or partial construction of a permanent substation on this land. The differences between these options from an environmental perspective are considered minimal, with the preferred option likely to be determined by factors such as technical and operational suitability and cost rather than environmental reasons. This report therefore focuses on the construction and operation of the ultimate 132/11kV substation.

The final substation will be an outdoor type construction with a brick / masonry control building and outdoor electrical switchgear within a secured compound. Given its location within a future industrial precinct, the visual impact of the substation is not considered to be significant.

There is however an existing caravan park located on the western boundary of the substation site (see Figure 1). Whilst the caravan park land has been rezoned for Industrial uses, the developer of the Marsden Park Industrial precinct does not have ownership of this land. It is therefore possible that the land could remain in use as a caravan park for the foreseeable future and the impact of the substation on residents of this park, particularly noise, visual and EMF, will need to be taken into consideration.

As indicated in Figure 1, the residential complexes within the caravan park are located towards the rear of the property, well away from the proposed substation site which will be constructed on the front portion of the adjoining land. This is likely to assist in ameliorating impacts arising from the construction and operation of the substation on the residents of the adjoining caravan park.

Figure 1: Approximate location of the proposed Marsden Park South ZS in relation to the existing caravan park residents.

Nevertheless, a Noise Impact Assessment should be carried out as part of the environmental assessment process to determine impacts on the caravan park, and future industrial uses, and recommendations for noise controls as necessary. Similarly, consideration should also be given to providing some visual screen, in the form of a solid wall or landscaping, along the western boundary of the substation, to ameliorate the visual impact of the substation to the caravan park.

The subject site is currently heavily vegetated however the land is mapped as 'certified' under the North West Growth Centre Biodiversity Conservation Order. This means that the vegetation can be removed without the need for any additional threatened species assessments. Depending on the staging of surrounding development, temporary asset protection zones (APZ's) may need

to be established around the substation site (including any interim substations). A Bushfire Impact Assessment will be necessary to determine the extent of any APZ's.

Based on the previous Aboriginal Heritage Assessment prepared by Kelleher Nightingale Consulting Pty Ltd in May 2009 for the Marsden Park Industrial precinct, there are no previously identified Aboriginal sites located within or around the proposed substation site. A potential archaeological deposit (PAD2) was identified on the southern side of Hollinsworth Rd, opposite the ZS site, which has been classified as having 'moderate' significance, requiring archaeological test / salvage excavation under S87(1) permit and ongoing consultation with Aboriginal stakeholders. This requirement does not however extend to the substation site.

The Non-Indigenous Heritage Assessment prepared by Godden Mackay Logan for the Precinct Plan did not identify any actual or potential heritage items within the vicinity of the substation site.

Due Diligence studies, including flora and fauna assessment, Aboriginal Heritage Impact Assessment and Bushfire Protection Assessment reports are currently being carried out by APP on behalf of Endeavour Energy to assist in determining the suitability of this site for a substation. Based on the previous precinct studies carried out and discussed above however, there appear to be no major environmental obstacles which would prevent development of the site for the purposes of a substation[1].

3.2 132kV TRANSMISSION FEEDERS

Two new 132kV transmission feeders will be required by 2019/2020 to service the full Marsden Park ZS.

All options involve the establishment of a new 132kV feeder from Schofields ZS to the new South Marsden Park ZS as part of the first stage of the construction works. A second feeder, between South Marsden Park ZS and the new Marsden Park ZS will be required for all options by 2019/20.

Potential routes for the transmission lines were investigated as part of the original Marsden Park NIO team in 2012. As a result of these investigations, the NIO team agreed that the following principals should apply:

- Avoid roads that are designated for future upgrading by the Roads and Maritime Services wherever possible;
- Feeder should be undergrounded where passing within close proximity to schools and existing urban residential areas.

A discussion on the transmission feeders is provided below.

3.2.1 Feeder 21J - Schofields ZS to South Marsden Park ZS

This route option follows Junction Rd from Schofields ZS past the Schofields Primary School to St Albans Rd. It then continues along St Albans Rd, crosses the railway line to Bridge St and then on to Grange Ave. From the end of Grange Ave, the route then crosses through private land to the existing 330kV Transgrid easement and follows this easement to the Marsden Park South ZS.

[1] Note Geotechnical and Contamination Studies may not support the use of this site for the purposes of a substation.

Section 1: Schofields ZS to Blacktown – Richmond Rail Line

Between Schofields ZS and the Blacktown – Richmond railway line the surrounding land use is predominantly low density residential (RU2), containing the existing Schofields residential area and Schofields Primary School (corner of St Albans Rd and Junction Rd). The existing rural land along the eastern side of Junction Rd and Schofields Rd has been identified for future medium and low density residential development (likely within the next 2 to 5 years) in accordance with the Riverstone Precinct plan.

No heritage listed properties or previously recorded Aboriginal items have been identified in this part of the route. Similarly, there are no threatened species or ecological communities identified within this area.

It is possible that concerns may be raised by local residents / community in regard to this proposal, particularly as it passes by the Schofields Primary School. It will be necessary to undertake EMF studies to determine the impact of the feeder on EMF levels within and around the Schofields Primary School and surrounding residential areas. Extensive consultation with the local community, particularly the school, will be necessary as part of the REF process and during construction.

Given the nature of the surrounding area, it is proposed that this section of the feeder be undergrounded. It is considered that this portion of the proposed route will have minimal environmental and community impacts provided the necessary studies and community consultation are undertaken.

A more direct route across the Railway line from Schofields Rd was also considered for this section of the feeder. The RMS is however in the planning stage of widening and deviating Schofields Rd and acquiring land on the western side of the railway line for a future link road. The timing of the RMS work does not however coincide with Endeavour Energy's requirements and as such, this route was not considered feasible at this point in time.

Section 2: Richmond Rail Line to Richmond Rd (via Grange Ave)

On the western side of the railway line, existing low density residential extends along Grange Ave to Argowan Rd, just east of Eastern Creek. From Argowan Rd, the land use changes to rural (RU4 Rural Small Holdings). Much of this area falls within the Schofields Precinct which is likely to be developed within the next 5 years. An existing Transgrid easement crosses Grange Ave at Eastern Creek. The feeder will continue underground from the rail line past the 330kV crossing in Grange Ave (near Canarvon Rd).

From Carnarvon Rd the surrounding land use is RU4 (Small Rural Holdings) consisting of rural residential properties on cleared lands. The section between Eastern Creek and Bells Creek forms part of the future West Schofields precinct which has not yet been released. West of Bells Creek, the land forms part of the Marsden Park precinct which is currently in the process of being rezoned. The area around Grange Ave is however part of Stage 5 development plans and is not expected to be developed in the immediate future.

Small patches of roadside vegetation, namely Shale Plains Woodland and Alluvial Woodland, both of which are threatened ecological communities, occur along the southern side of Grange Ave between Argowan Ave and Carnarvon Rd and along the riparian corridor around Eastern creek. Patches of roadside vegetation are also located further along Grange Ave, particularly on the southern side of the road although smaller patches do exist on the northern side. One threatened species *Pultanaea parviflora* is recorded as occurring along the southern side of Grange Ave between Bells Creek and Richmond Rd. The majority of the land along this route is mapped as 'certified', with the exception of the vegetation along Eastern Creek, meaning that the vegetation can be removed without the need for additional threatened species assessment. A flora and fauna study may however be required for those sections where the route passes through 'non-certified' land.

One heritage item is located on the corner of Grange Ave and Richmond Rd. Given that the feeder would only pass by this property, it is unlikely to have a significant impact to the heritage significance of this property. No previous aboriginal items have been identified however a Due Diligence Assessment may be required as part of the REF.

Given the rural nature of the surrounding area, and the lack of immediate plans to redevelop the area, an overhead option is considered suitable along Grange Ave between Carnarvon Rd and Richmond Rd.

An alternative route along South St was also considered however due to future RMS plans for road widening this route was not considered feasible at this stage.

Section 3: Richmond Rd to South Marsden Park ZS

From the end of Grange Ave, two alternative routes have been considered:

- Via Grange Ave and Waste Services Site to South Marsden Park ZS
- Via Richmond Rd to South Marsden Park ZS

The first option avoids the issues associated with the widening of Richmond Rd by RMS by following Grange Ave to the disused Waste Services site at the western end of Grange Ave. From here, this route passes through the disused waste services site to the Transgrid 330kV easement and follows this easement and future precinct roads to the South Marsden Park ZS.

A new overhead easement (25m wide) or permanent underground easement (9m wide) would be required through the disused waste services site which is proposed to be developed for future playing fields and open space, to the existing 330kV Transgrid easement. Transgrid has indicated that they 'agree in principal' to a new 132kV underground feeder being laid wholly with the existing Transgrid 330kV easement.

The Transgrid easement passes through privately owned rural lands and a new easement would be required over these lands. This easement is generally cleared of vegetation and structures however an Aboriginal Impact Assessment may be necessary to ensure the works do not impact on any Aboriginal heritage items.

The route within the industrial precinct will be dependent upon discussions with the developer and the timing and layout of the new road network. Where possible, the feeder will follow the existing road pattern as much as possible to the South Marsden Park ZS. The Aboriginal Heritage Assessment prepared for the Marsden Park Industrial Precinct has identified a number of aboriginal relics and PAD sites within the precinct area of varying significance. An Aboriginal Heritage Impact Assessment is likely to be required to ascertain whether the works may have the potential to impact upon any Aboriginal heritage items.

This option is considered feasible however will be dependent upon the results of further studies and the acquisition of necessary easements.

The second option, utilising Richmond Rd, is dependent upon the timing of the Richmond Rd widening. At this stage, Endeavour Energy has requested ducts to be laid within this section of Richmond Rd to enable future undergrounding however the timing of these works is not yet known. Further discussions would also be required with the developer of the Marsden Park Industrial Precinct to identify routes within the precinct to the substation site. This may follow future internal roads as either an overhead or underground line. Similar to above, an Aboriginal Heritage Impact Assessment may be necessary for works within this area.

This option is considered preferable as it removes the need to acquire additional easements and minimises impacts on privately owned land. This option is however dependent on the timing of the RMS road widening of Richmond Rd and may not be feasible from a network supply perspective.

3.2.2 Feeder 21L - Marsden Park ZS to South Marsden Park ZS

This option proposes to establish one new underground 132kV cable wholly within the existing Transgrid 330kV / 500kV easement between Marsden Park ZS and Marsden Park South ZS. A 6m wide easement will be required along the entire route for this 132kV feeder.

This route traverses through existing private property. The surrounding land use is currently zoned as RU4 (Rural Small Holdings) however it falls within the Marsden Park Precinct and Marsden Park Industrial Precinct, both of which will be developed (in stages) over the next 2 to 20 years.

An overhead option was not considered feasible as it would necessitate obtaining a 14m wide easement on one side of the Transgrid easement. This would effectively sterilise a large section of land designated for future development. In addition, existing buildings located adjacent to the Transgrid easement would need to be demolished to enable construction and operation of overhead feeder/s.

The existing Transgrid easement is currently cleared of vegetation and no threatened species have been identified along or within the vicinity of the easement. Some small patches of Shale Plains Woodland adjoin sections of the easement. The majority of the land has been mapped as 'certified' as part of the Growth Centres Biodiversity Conservation Order and as such the land can be cleared with no further threatened species assessments required.

A number of farm dams and small tributaries are located along the proposed feeder route. Consideration will need to be given to construction methods, such as under boring, to minimise impacts on these water bodies.

No heritage items have been identified along the feeder route. The Aboriginal Heritage Assessment prepared for the Marsden Park Industrial Precinct has identified a number of aboriginal relics and PAD sites within the precinct area of varying significance. A route through the precinct to the ZS site is yet to be determined and will be dependent upon discussions with the developer and the timing and layout of future road networks. An Aboriginal Heritage Impact Assessment is likely to be required to ascertain whether the works may have the potential to impact upon any Aboriginal heritage items.

Based on these preliminary findings, this route is considered to have minimal impacts on any matter affecting the environment. The incorporation of the underground 132kV feeders within the existing Transgrid 330kV / 500kV corridor limits the impacts on adjoining, developable lands.

3.3 33kV Feeder 458 - Option 4

Option 4 involves the augmentation of a portion of existing 33kV Feeder 458 between Riverstone ZS and a tee on Windsor Rd. The feeder follows Riverstone Pde, Bandon Rd and Windsor Rd for a distance of approximately 5.8km.

This route passes by areas of Shale / Gravel Transition Forests and patches of Shale Plains Woodland and Alluvial Woodland communities which form part of the threatened Cumberland Plain Woodland community. As an existing transmission line, the augmentation of this feeder is unlikely to further impact on these vegetation communities.

Some threatened species, namely the Cumberland Plain Land Snail and *Dillwynia tenuifolia* have been previously recorded within close proximity to this feeder however, given that the feeder is located within the existing road reserves, the works are unlikely to impact on any such individuals. There are no known heritage items or aboriginal items located along this feeder route.

The augmentation of this feeder is not expected to result in any significant environmental issues and is considered feasible from an environmental perspective.

4.0 Conclusions

Based on the discussions above the following conclusions are made:

- The proposed substation site is considered suitable for the purposes of a future zone substation, subject to the results of due diligence studies and inclusion of appropriate noise controls, screening and other recommendations arising from further studies.
- The proposed 132kV transmission line routes are considered appropriate subject to further studies, acquisition of necessary easements and community consultation.

- The augmentation of 33kV Feeder 458 is considered unlikely to have any significant environmental impacts.

Prepared By:	Reviewed By	Approved By
17/9/13	17/09/2013	17.9.13
Liz Mathieson Environmental Specialist	Pat Woodbury Network Environmental Assessment Manager	Danny Asvestas Manager Project Development

Memorandum

To	Kate McCue	File no	
From	Lisa Mullins	Date	9 October 2013
Subject	Update community engagement approach for Marsden Park project		
Copies	Andy Worboys and Liz Mathieson		

BACKGROUND

The Marsden Park and Marsden Park Industrial precincts are within the NSW Government's North-West Growth Sector – an area of 10,000 hectares, containing about 70,000 new dwellings which will be home to around 200,000 people.

Both Marsden Park and Marsden Park Industrial precincts have been rezoned under the NSW Government's Precinct Acceleration Protocol. This means they can be developed earlier than originally timetabled providing there is no extra cost to taxpayers.

On 5 October 2013 the Minister for Planning announced the fast-tracking of Marsden Park Precinct which will be home to around 30,000 people in more than 10,300 dwellings.

The expected electricity load for Marsden Park and Marsden Park Industrial precincts is estimated at 50MVA and 45-50MVA respectively. To cater for the future growth of these areas Endeavour Energy needs to construct the South Marsden Park Zone Substation (ZS) to supply the Marsden Park Industrial precinct (PR292), the Marsden Park ZS (previously approved) to supply the Marsden Park Precinct and associated transmission infrastructure to connect the new substations into the electricity network (PR674).

The Marsden Park Industrial precinct has the potential to provide land for around 10,000 jobs and 1,200 homes in Sydney's growing northwest. Once developed, it will feature:

- 70 hectares of commercial land
- 40 hectares of bulky goods retailing
- 206 hectares of industrial land
- a mix of residential housing close to the planned Marsden Park town centre just to the north of the precinct to accommodate 3500 people; and
- 63 hectares of conservation land and open space

SOUTH MARSDEN PARK ZS

An assessment of the site originally proposed for the future South Marsden Park ZS on South Street, Marsden Park, found it to be unsuitable.

In conjunction with the developer, a second site – which will become known as Lot 24 – has been identified in Hollinsworth Dr, Marsden Park.

This updated community engagement proposal takes into account this new substation location and is prepared after the route options for the new lines have changed.

The type of substation to be developed has yet to be decided.

The new ZS site is near a caravan park called Town and Country Estate. It comprises van sites, cabins which sleep up to six, barbecues for communal use, a playground, swimming pool, an amenities block and grassed area for recreation.

The caravan park is west of the ZS site and while it has been rezoned industrial, there are no plans yet to change its usage. Therefore, our communication plans must focus on this park. The impact of the substation on residents of this park, particularly noise, visual and EMF, will need to be taken into consideration.

Approximate location of the proposed Marsden Park South ZS in relation to the existing caravan park.

As shown above, the caravan park's accommodation lies at the far end of the property. The ZS will be built towards to front of the earmarked site, thereby leaving a reasonable gap between the ZS and the first row of caravan park accommodation. This will help ease any negative impact from the construction and ongoing operation of the new ZS.

The inclusion of a Noise Impact Assessment in the environmental assessment process will also help manage the relationship with the caravan park owner/operator and its guests/residents.

While the park may not be there forever, it will be important to afford it the same courtesy and consideration given to other, permanent neighbours in this situation.

The proposal to consider a visual screen, in the form of a solid wall or landscaping, along the western boundary of the substation where it joins the caravan park site would enhance the relationship with this neighbour.

MARSDEN PARK TRANSMISSION INFRASTRUCTURE

To supply the new zone substations, two new transmission lines need to be established, with a third required to connect Marsden Park ZS and South Marsden Park ZS.

Four route options have been identified – three traverse 7.9 km; the other 12.1 km - and will now be subjected to further rigorous examination. Each option traverses a mix of urban and semi-rural residential developments, and the final community engagement strategy will take these differing population densities into account.

Community consultation needs to be undertaken in parallel with the environmental assessment. The community will therefore be involved in the assessment process and can provide feedback and have their concerns considered well in advance of the works' commencement.

When the routes are decided, a community engagement plan can be finalised.

The plan will likely recommend:

- Appropriate fencing and landscaping be established around South Marsden Park ZS to help screen the site.
- The management of construction hours, noise, dust and traffic be carefully considered as part of any works program especially for the construction of the transmission lines. This is important given the extent of construction activities that are occurring in the precincts, and the issues that arose during the construction of the transmission line between Rouse Hill Switching Station and Schofields ZS.
- Construction activities take into consideration peak traffic periods, especially near Schofields Primary School.
- Meeting with the principal at Schofields Public School to discuss construction activities well in advance. This will also enable Endeavour Energy to provide appropriate notifications to parents and care givers to factor road work activities into their school drop off times.
- Meeting with any other stakeholders who serve large numbers eg nursing homes or shopping centres to ensure they know what is happening and any potential impact
- Strict compliance with mitigation measures detailed in the Review of Environmental Factors for each project.
- The issuing of a media release to local newspapers. Advertising may also be required to ensure the message gets through.

SUGGESTED APPROACH

Local community

It is recommended that Endeavour Energy consult local residents in the following ways:

- Seek feedback during the environmental assessment stage via a letter or newsletter.
- Notification of works before and during construction via letter.
- Information and updates on the project available on Endeavour Energy's website.
- Public notices in the local paper regarding construction activities.
- Community notices for Schofields Public School
- Media release at the same time the community is advised of the project

KEY EXTERNAL STAKEHOLDERS

There will be a number of key stakeholders who will need to be consulted regarding the proposed works including (but not limited to):

- Landowners and residents along the route
- Schofields Public School
- TransGrid
- Roads and Maritime Services
- Railcorp
- Office of Environment and Heritage (regarding potential environmental impacts addressed in the Review of Environmental Factors)
- Member for Riverstone
- Blacktown City Council
- Precinct developers
- Waste services
- Local road users, who may be impacted by traffic movements.

COMMUNITY ENGAGEMENT

Once the project is approved, a comprehensive stakeholder assessment will be undertaken and a community engagement plan drafted. This plan will be updated appropriately throughout the life of the project and includes a number of key communication materials that will be required to support the planned works. They include:

- Key messages about the project
- A communication timetable to key stakeholders
- Media release/s
- Information and Q&As for the website

The plan will also detail Endeavour Energy's community engagement protocols to assist Endeavour Energy staff who will be involved in the project.

Recommended:

Lisa Mullins

Acting Community Relationships Manager

Date: 9/10/13

Endorsed:

Kate McCue

Manager, Corporate and Government Affairs

Date: 10/10/13

5

A13.1 Transmission Lines

Transmission line work required in this project includes:

- Establishment of feeder 21J 132kV supply to South Marsden Park Zone Substation from Schofields ZS via underground 7tails from Schofields ZS and South Marsden Park ZS. Overhead construction shall be of a delta line post configuration. (Figure A13.1)
- The proposed transmission feeder shall have a minimum continuous rating of 145MVA with an emergency rating of 245MVA.
- The proposed feeder route has been assessed by Endeavour Energy as being a feasible proposal. Key Stakeholders will be consulted as per the Stakeholder Management Plan

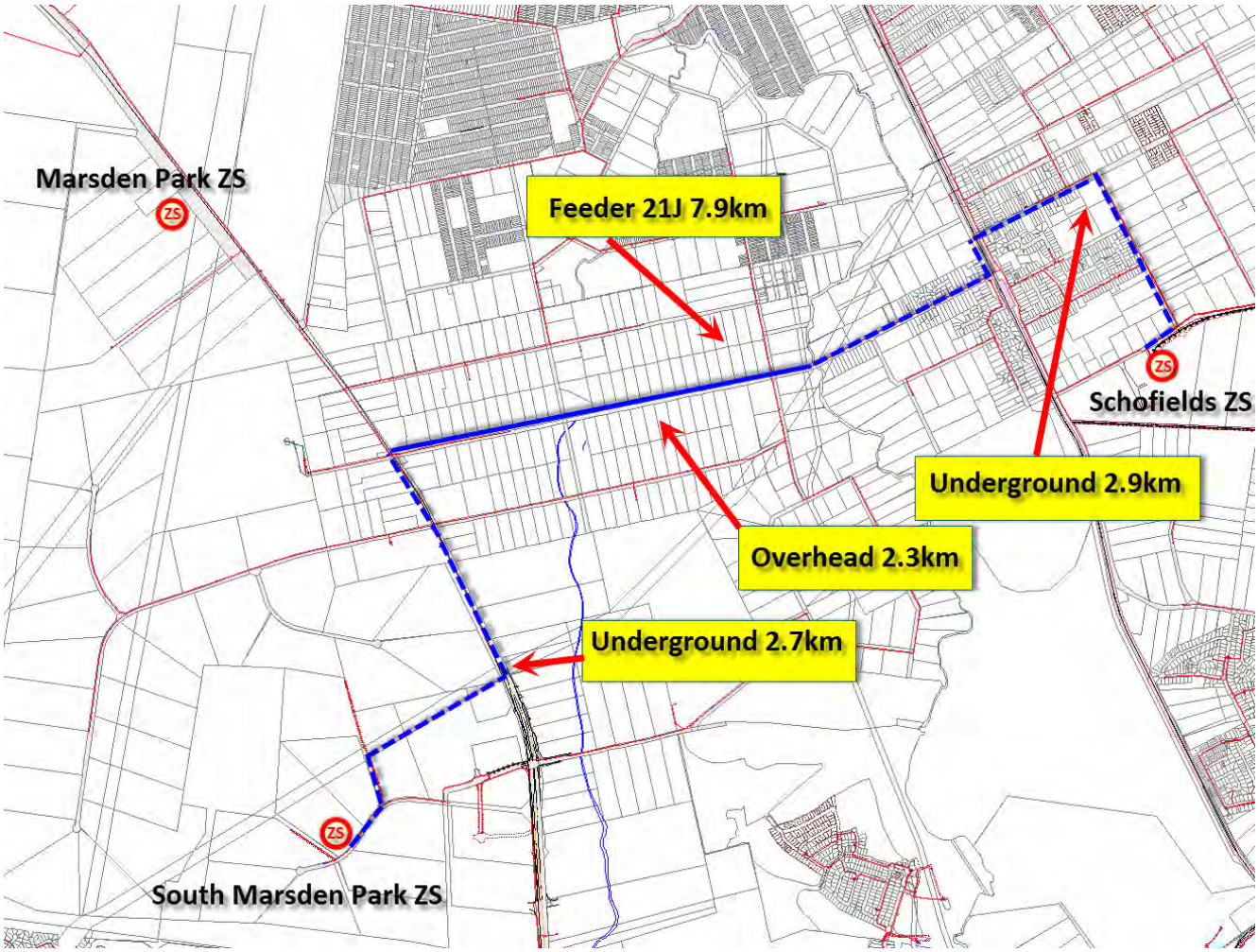


Figure A13.1 Stage 1 proposed 132kV Transmission feeder arrangement

The second stage of this project will establish the second feeder 21L 132kV supply to South Marsden Park Zone Substation from Marsden Park ZS via underground cable (Figure A9.2).

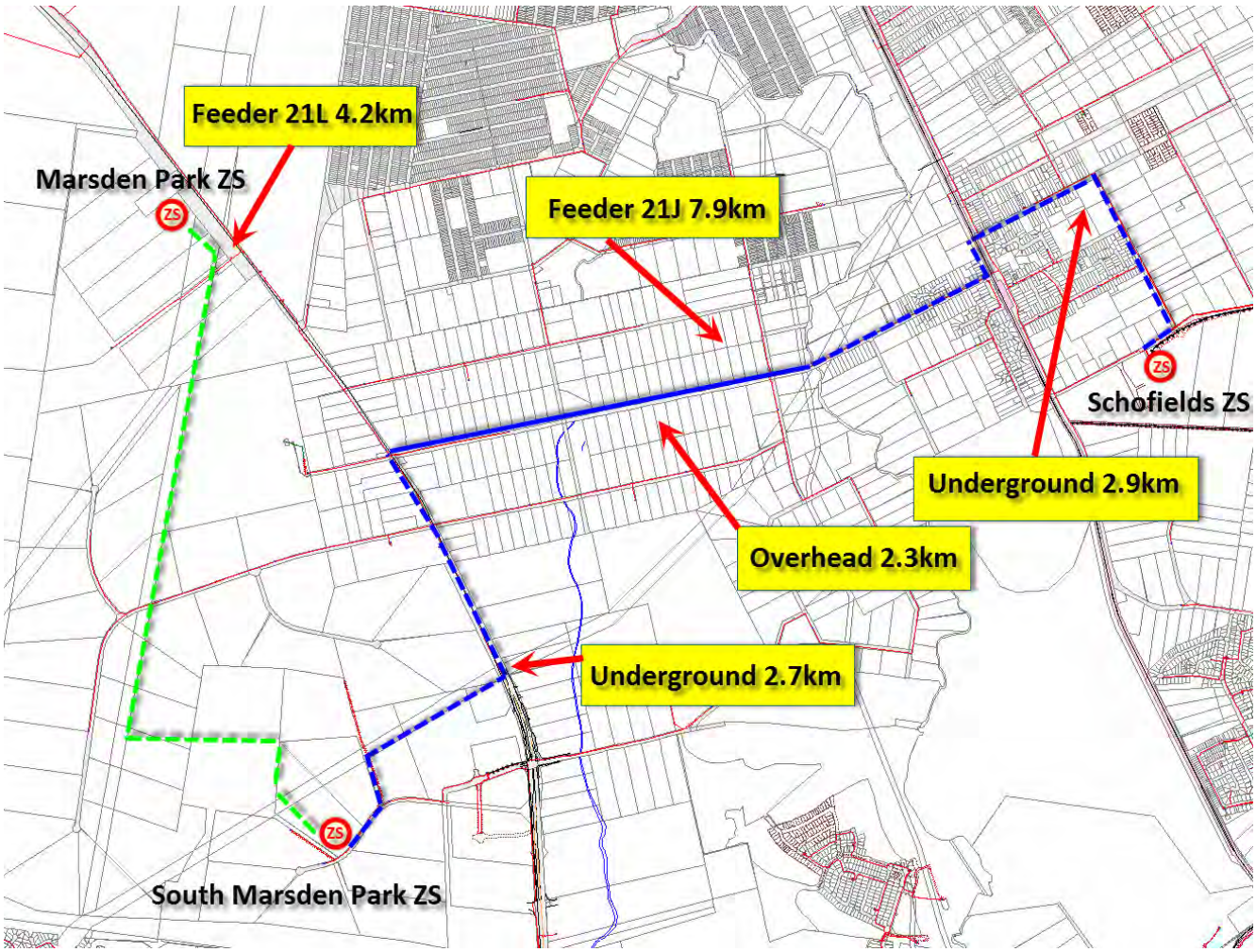


Figure A13.2 Stage 2 proposed 132kV Transmission feeder arrangement

A13.2 Substation Works

Establish a mobile 15MVA transformer substation as detailed in the following Table A and Table B.

The temporary assets are to be located outside of the future permanent substation footprint so not to interfere with future construction of the ultimate substation control building and transformer bays.

Table A 132/11kV 15MVA South Marsden Park Mobile Zone Substation Plant Requirements	
Standard Zone Substation Single Line Diagram	**Custom Special** by Transmission Substation Development. Refer to Single Line Diagram
Required Installed Capacity - Initial	15MVA -1 x 15MVA Transformer
Required Firm Rating	N/A
Transformer Details	As per Table B – Transformer Details
Minimum Fault Rating of 33kV Elements	40.0kA & curve 1 CB's
Minimum Rating of 132kV Feeder CB, Busbar and Bus-section CB	1250A
Required number of 132kV Feeder CB's	1
Required number of 132kV Bus-section CB's	N/A
Ultimate number of 132kV Bus-sections	N/A
Minimum 132kV Transformer CB Rating	1250A (Standard asset so can be redeployed to other location)
Ulimate number of 132kV Transformer CB's	N/A
Minimum Fault Rating of 11kV Elements	20.0kA & curve 1 CB's
Minimum 11kV Transformer Bus-duct or Cable Rating	2500A
Minimum 11kV Transformer CB, Busbar and Bus-section CB Rating	2500A
Required 11kV Transformer CB Number	1
Required 11kV Bus-section CB Number	N/A
Required 11kV Bus-sections	1
Minimum 11kV Feeder CB Rating	630A
Required number of 11kV Feeder CBs	2 (each capable of accepting two 1kV feeders in parallel)
Minimum Number of 11kV CB's per Bus-section and required Bus-section arrangement	2 x CB's to each section (each capable of accepting two 1kV feeders in parallel)
Required Capacitor Bank Capacity	Not Required
Minimum SFU Rating	49.5MVA (45MVA x 110%)
Required number of Auto Frequency Injection Cells & Rating	1 x cell each with a minimum rating of 49.5MVA (45MVA x 110%)
Auxiliary Busbar	1 x bus-section and 1 x bus section switch

Table B 132/11kV 45MVA Transformer Details	
Minimum Continuous Rating at any Voltage Tap	15MVA
Minimum Over-excitation Capability	30%
Voltage Ratio on Nominal Tap	132/11kV
Standard Tapping Range	132kV + (3 x 1.5%) – (17 x 1.5%)/11kV
Minimum pu Impedance on 100MVA base at any Voltage Tap	0.78pu
Standard Vector Group	Dyn1 (Star point of secondary winding earthed)

Float voltage

The float voltage at South Marsden Park Zone Substation will be set to 10.9kV to match Riverstone, Schofields and Rooty Hill networks

Line Drop Compensation

The Line Drop Compensation at South Marsden Park 132/11kV Zone Substation will be set to 0%

Under Frequency Load Shedding

System Operations Branch shall determine UFLS priorities between 11kV feeders.

Capacitor banks

There are no capacitor banks that are required to be installed under this project. Provision is to be made for the installation of capacitors at a later date.

Protection

The overall protection schemes shall be determined by the Protection Branch. Protection shall be applied in such a way as to conform to the National Electricity Rules taking into account Endeavour Energy protection practices and standards. This includes duplicate protection for all 132kV equipment in particular duplicate communications paths for 132kV feeder protection.

11kV Duct Requirements

Ducts will be required to exit the northern western and southern side of the Zone Substation. Provisions are to be made within the control building to accommodate 11kV cable exit points.

A13.3 Distribution Works

- **New distribution feeders** – Establish one (1) new 11kV feeder from the Zone Substation and connect them into the existing network as shown in the following Distribution Works Program (DWP) project items. The expected load and voltage drops are shown in Table 13.1.
- **Augment existing network** – Augment existing overhead conductor that will become fault level exceeded by the establishment of South Marsden Park ZS as shown in the following DWP project items.

Marsden Park Industrial precinct will require a significant number of dedicated feeders. These feeders will be deemed as contestable work and will be funded by the developer. The feeders will be designed and installed by the appropriate level of Accredited Service Provider. A small number of feeders will supply into the shared network and provision has been made in the project costs to allow for this to occur.

Item No.	Feeder Name/Item Description	Predicted Initial Load (Amps)	Predicted Initial Load (MVA)	Predicted Voltage Regulation (%)	Cost
MHN02663	Establish Feeder 'Hollinsworth Rd'	55	1	1	$115,000
MHN02665	Fault Exceed Conductor/X Zone tie				$400,000
MHN02677	HV Duct Installation				$480,000
Total					$995,000

Table13.1 – Proposed 11kV Feeder Loads and Voltage Regulation

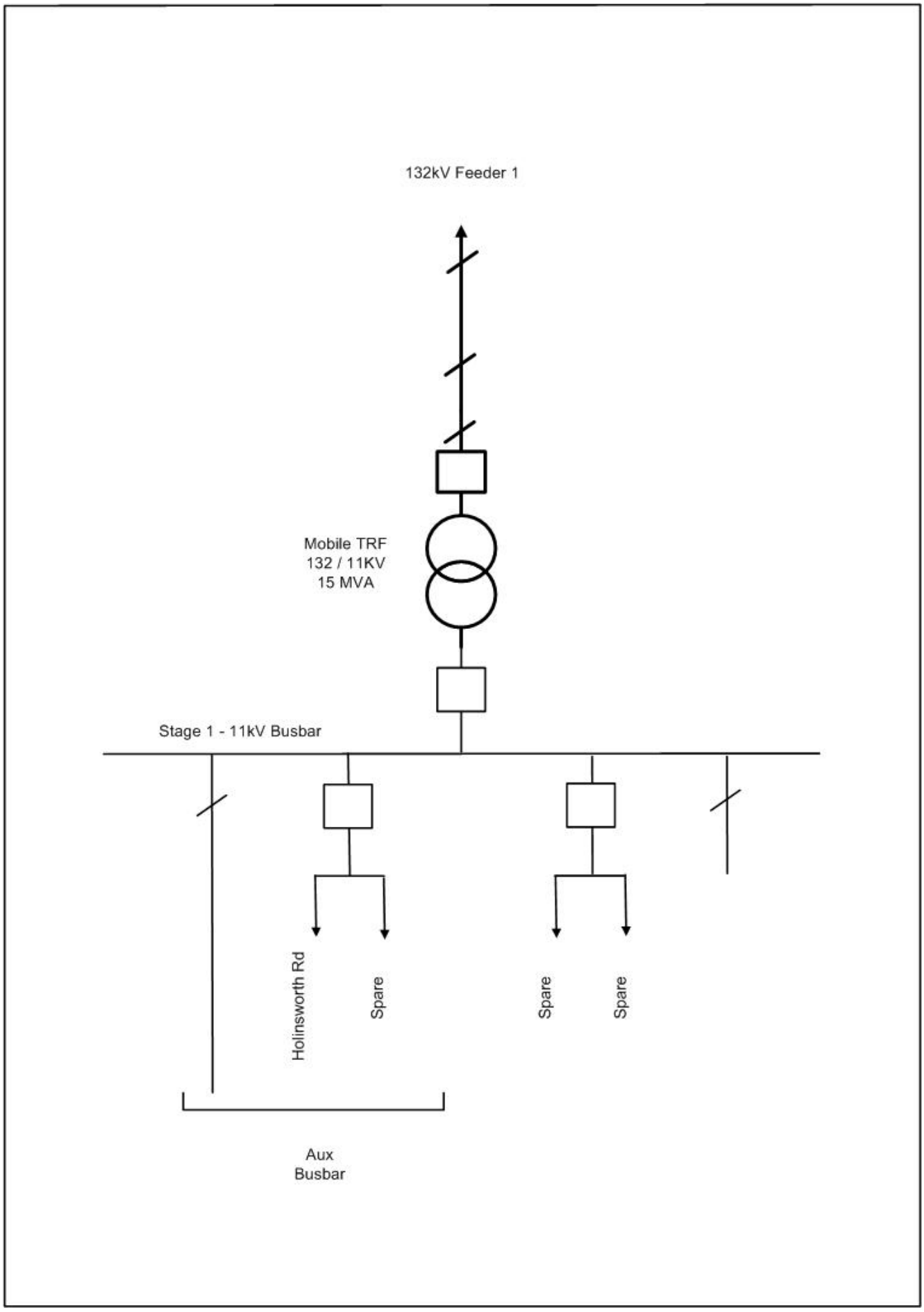


Figure A13.1 Option 3 Proposed feeder arrangement at South Marsden Park 132/11kV Zone Substation

A13.3.1 Distribution Works in DWP Format

Distribution Works Program 2014/15

Zone Substation: **South Marsden Park**	**0002**	LG Area: **BCC**	Item No:	**MHN02663**	
Feeder Name: **Hollinsworth Road**		CB No.: **SMars2**	UBD Ref:	**126 L8**	Amend No.: **0**
Location: **Hollinsworth Rd**	**Marsden Park**		Prepared By:	**Andy Worboys**	

Reason for Works

This project is for the development of a new feeder from South Marsden Park ZS. The existing "PGH" feeder T884 from Rooty Hill ZS is to be reconfigured to establish the new "Hollinsworth Rd" CB XXXX feeder from South Marsden Park.

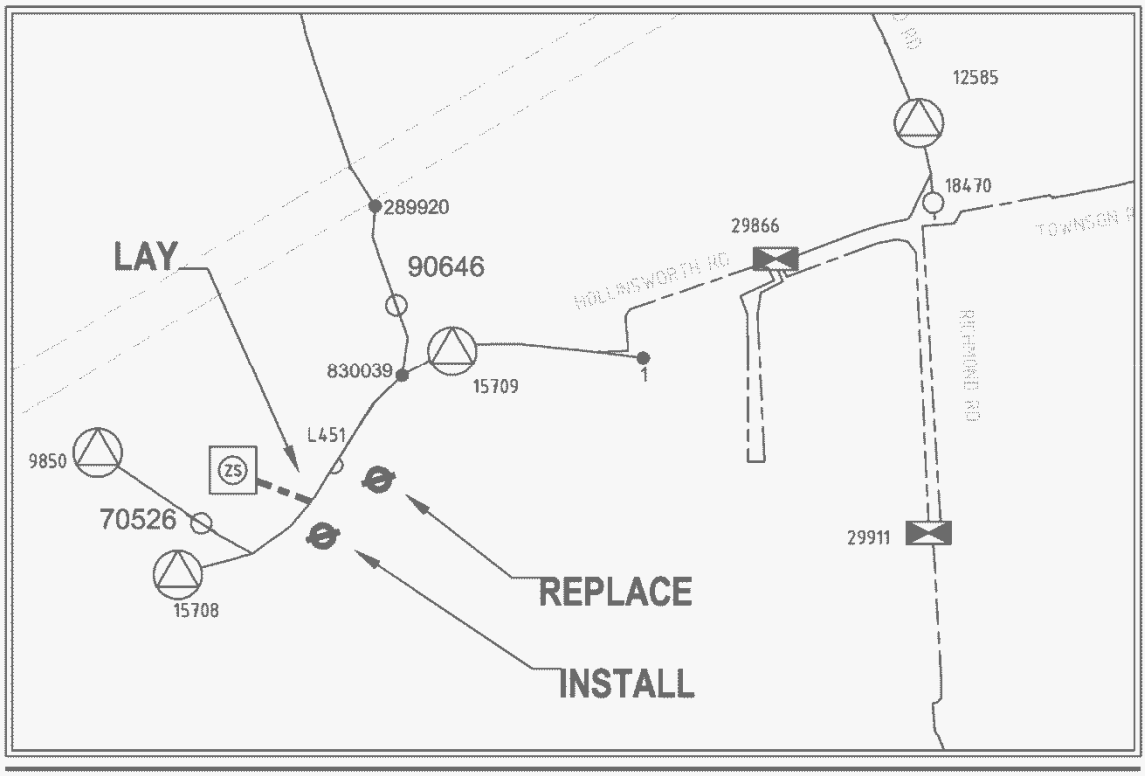
Description Of Works	Length (km)
Lay 240mm2 Cu XLPE cable from Zone Substation CB XXXX to new UGOH along Hollinsworth Rd	0.05
Install an ABS in a suitable location along Hollinsworth Rd as indicated	
Replace existing USL L451 with an ABS as indicated	

Note: At the time of project development no roads had been formed within Marsden Park Industrial precinct. Designer to consult Network Planner prior to design

Estimated Total Project Cost: **$115,000**

Remarks

This item is part of Major Project PR674. Refer to project MHN02677 for HV duct installation. Contact Asset and Network Planning for CB No. and switching details.



Strategic Asset Management

Distribution Works Program 2013/14

Zone Substation: **South Marsden Park**	0002	LG Area: BCC	Item No: **MHN02665**	
Feeder Name: **Hollinsworth Road**		CB No.: **SMars2**	UBD Ref: **147 F8**	Amend No.: **0**
Location: **Meadow Rd**		**Marsden Park**	Prepared By: **Andy Worboys**	

Reason for Works

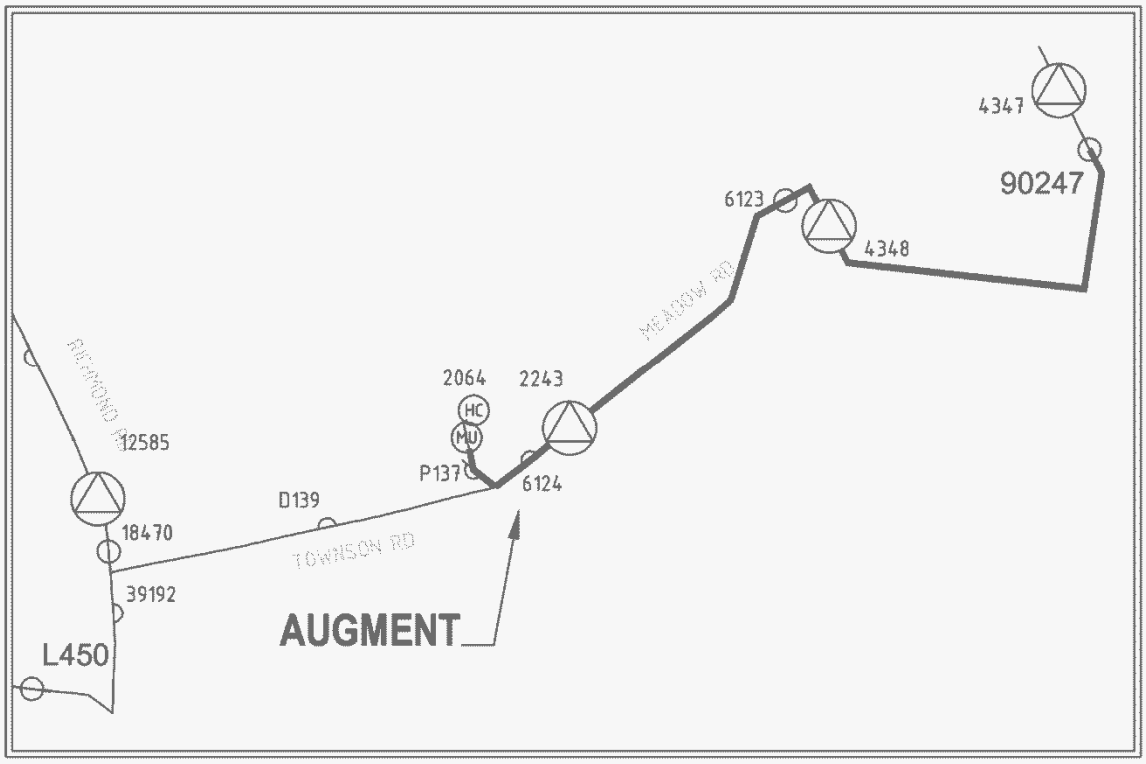
Protection group has confirmed that this section of fault exceeded conductor will not be protected. The prospective 3 phase fault level from South Marsden Park ZS is 5.6kA on this section of 7/2.00 HDCU conductor in South St. The 3 phase fault rating of the existing 7/2.00 HDCU conductor is 2.7kA for 1.5sec. Under the newly configured network, this section of conductor will became the backbone of the feeder and requires augment to meet

Description Of Works	Length (km)
Augment existing 7/2.00 HDCU HV conductor to 7/4.5AAC (or Equivalent) along Meadow Rd from HVC2064 to ABS6123	1.0
Augment existing 7/3.00 AAC HV conductor to 7/4.5AAC (or Equivalent) along Meadow Rd from ABS6123 to ABS90247	1.0

Estimated Total Project Cost: **$400,000**

Remarks

This item is part of Major Project PR674. Under the newly configured network, this section of conductor will became the feeder backbone and cross zone tie.



Strategic Asset Management

Distribution Works Program 2013/14

Zone Substation: **South Marsden Park**	**0002**	LG Area: **BCC**	Item No:	**MHN02677**
Feeder Name: **Hollinsworth Road**		CB No.: **SMars2**	UBD Ref:	Amend No.: **0**
Location: **Hollinsworth Rd**	**, Marsden Park**		Prepared By:	**Andy Worboys**

Reason for Works

This project is for the installation of a new ducts around South Marsden Park ZS. New ducts are required to allow 11kV feeder cables to be developed to various points within the employment area.

Description Of Works	Length (km)
Lay 2 x type "26" ducts along easement from the back of the ZS to a location at the end of the proposed easement	0.4
Underbore suitable No. of type "28 ducts" from ZS across Hollinsworth Rd as indicated.	0.03

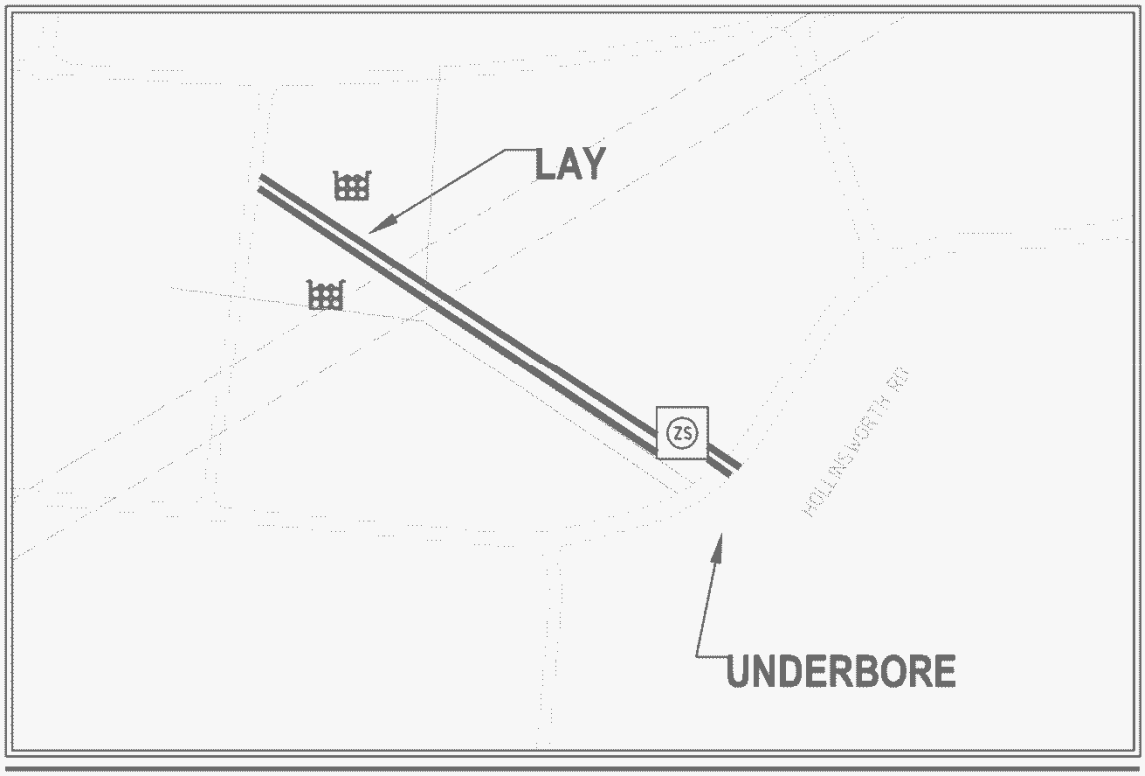
Note: Distribution ducts within easement should be adequately spaced to minimise derating and allow for installation of transmission ducts

HV ducts installed along Hollinsworth Rd will depend on the pace of development within the industrial subdivision and will be installed under the Network Connection Urban Industrial Subdivision (UIS) process.

Estimated Total Project Cost: **$480,000**

Remarks

This item is part of Major Project PR674.
Note: At time of project development no roads had been formed within Marsden Park Industrial precinct. Designer to consult Network Planner prior to design.



Strategic Asset Management