Establishment of Marsden Park Zone Substation PR 596
Network Consultation Paper

January 2014

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1 Executive Summary

The National Electricity Rules (NER) were amended on 1 January 2013 to implement the Distribution Network Planning and Expansion Framework. This included requirements to comply with the Regulatory Investment Test – Distribution (RIT-D) from 1 January 2014. Endeavour Energy is seeking exemption from the AER to not apply the RIT-D process for this project as part of transitional provisions in the AER RIT-D Application Guidelines. As such, this consultation paper has been prepared in order to comply with the now deleted Clause 5.6.2 of 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 establishment of Marsden Park Zone Substation.

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 132/11kV Zone Substation (this proposal)
2. Establishment of South Marsden Park 132/11kV Zone Substation

Demand Management and local generation cannot address the constraints identified due to the magnitude of the greenfield development.

This document describes in detail Item 1 above, the Establishment of Marsden Park 132/11kV Zone Substation. Two options were considered for this, namely:

Option 1: Establish the substation in two stages, which involves the provision of an interim solution with a single transformer and permanent 11kV switchroom with one radial 132kV transmission Feeder 21R followed by the establishment of the full substation and the remaining transmission feeder to be installed at a later date that would be dictated by the pace of development.

Option 2: Establish the full permanent zone substation (from the outset).

Option 1 is the preferred option as it minimises the Present Value of Costs.

- **The total cost of the Option 1stage 1 project recommended is $19.9 million, required in 2015. Stage 2 of the Option 1 strategy will cost $18.4million, estimated timing in 2020. The total capital outlay of both stages is $38.3million. Stage 2 will be subject to options analysis and consultation in compliance with the NER when the network need is more certain in the future.**
- **The Present Value of Costs of the project over the asset life is estimated to be $33.1 million**

This is compared with Option 2 Present Value of Costs.

- **The total cost of the Option 2 project recommended is $36.3 million**
- **The Present Value of Costs of the project over the asset life is estimated to be $35.1 million**

The system requirement date for the Option 1 Stage 1 zone substation works is early 2015. The works are required to be completed by this date to supply the initial 2000 lots up to 10MVA capacity. This will minimise capital investment and allow development in the area to progress at a pace in line with prevailing economic conditions. The establishment of the zone substation will allow planned greenfield development to proceed. Stage 2 zone substation works will align to the pace of

development in the area and be subject to a future business case approval. Based on lot sales forecast provided by the developer, Stage 2 could be required by 2020.

Establishment of South Marsden Park 132kV Zone Substation (Item 2 above) will be described in a separate document. The line works proposed under Stage 1 and Stage 2 in this document will be required to allow the commissioning of the South Marsden Park zone substation proposed under a separate future project. The system requirement date for project Establishment of South Marsden Park Zone Substation is presently being reviewed and will depend on the pace of development. Initial lot release can be supplied from capacity from Schofields Zone Substation with suitable feeder development work.

These projects are an integral part of the implementation of the strategy to supply power to 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 this Consultation Paper and the outcomes of the environmental assessment and associated community consultation.

2 Introduction

The main driver for the proposed capital works is the recently released development of the 1800 hectares within the Marsden Park precinct in the North West Growth Centre. The Marsden Park precinct was released for planning as one of two precincts advanced under the NSW Government's Precinct Acceleration Protocol (PAP) in July 2011.

The establishment of the "North West Sector" as an urban growth area by the Department of Planning and Infrastructure (DPI) led Endeavour Energy to develop a strategy to establish a 132kV subtransmission network to meet the associated future demand in the area. A key part of the overall strategy is the establishment of a 132/11kV zone substation (ZS) at Marsden Park. This report investigates the options available to implement this proposal.

The National Electricity Rules (NER) were amended on 1 January 2013 to implement the Distribution Network Planning and Expansion Framework. This included requirements to comply with the Regulatory Investment Test – Distribution (RIT-D) from 1 January 2014. Endeavour Energy is seeking exemption from the AER to not apply the RIT-D process for this project as part of transitional provisions in the AER RIT-D Application Guidelines. As such, this consultation paper has been prepared in order to comply with the now deleted Clause 5.6.2 of the NER which includes the application of the Regulatory Test.

Options canvassed in this document are considered to be "new large distribution assets" as previously 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 the now deleted Section 5.6.2(g) of the National Electricity Rules, to "identify options that satisfy the regulatory test".

3 Background

3.1 General

The proposed Marsden Park precinct land release area is located within the North West Growth Centre in the Blacktown Local Government Area (Figure 1) and is zoned for residential use. The Marsden Park study area is shown in Figure 2.

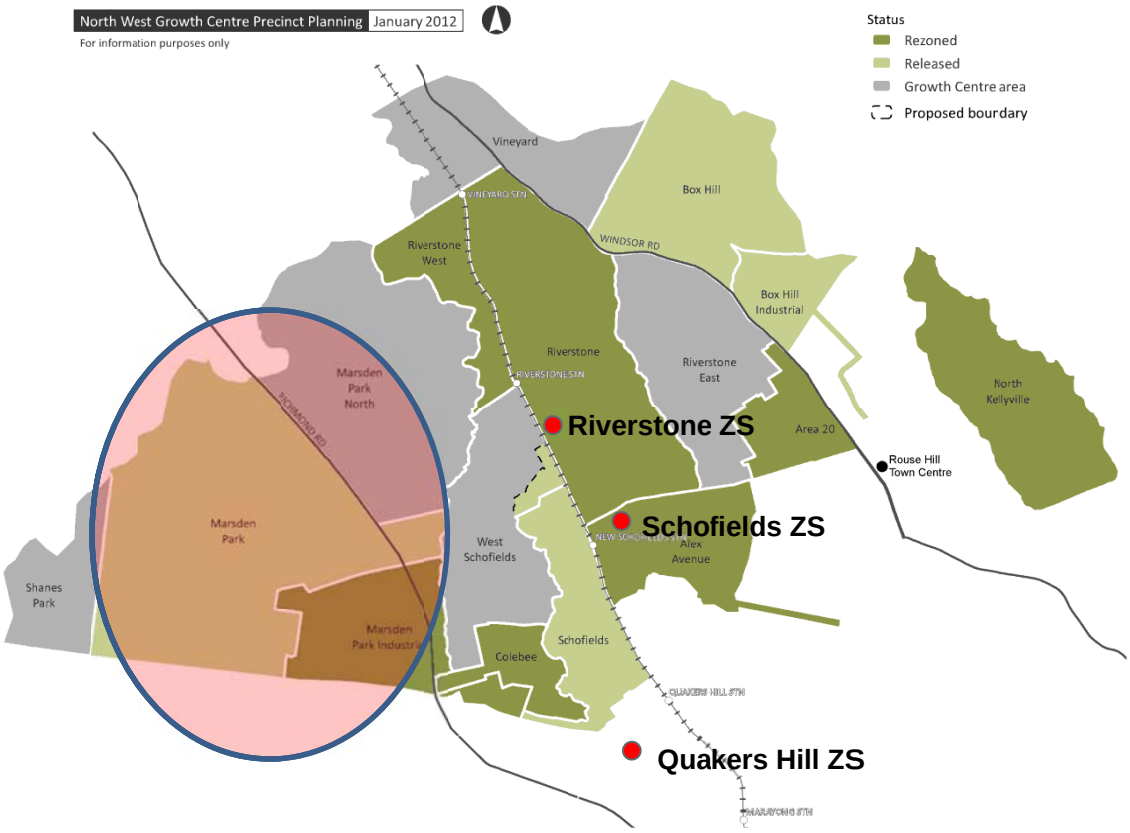

Figure 1 – Marsden Park Precinct and the North West Growth Areas

The precinct is bounded by South Creek to the North, Richmond Road to the East, the proposed Marsden Park Industrial Precinct (MPIP) to the South and Stony Creek Road to the West. The current main land use of the precinct is for agriculture with a variety of mixed businesses located along Richmond Road. The total area of the precinct is approximately 1,800 hectares and is expected to accommodate up to 10,000 dwellings. The precinct also includes approximately 600 hectares of the Air Services Australia Site in the south, which is intended to be set aside for conservation and open space.

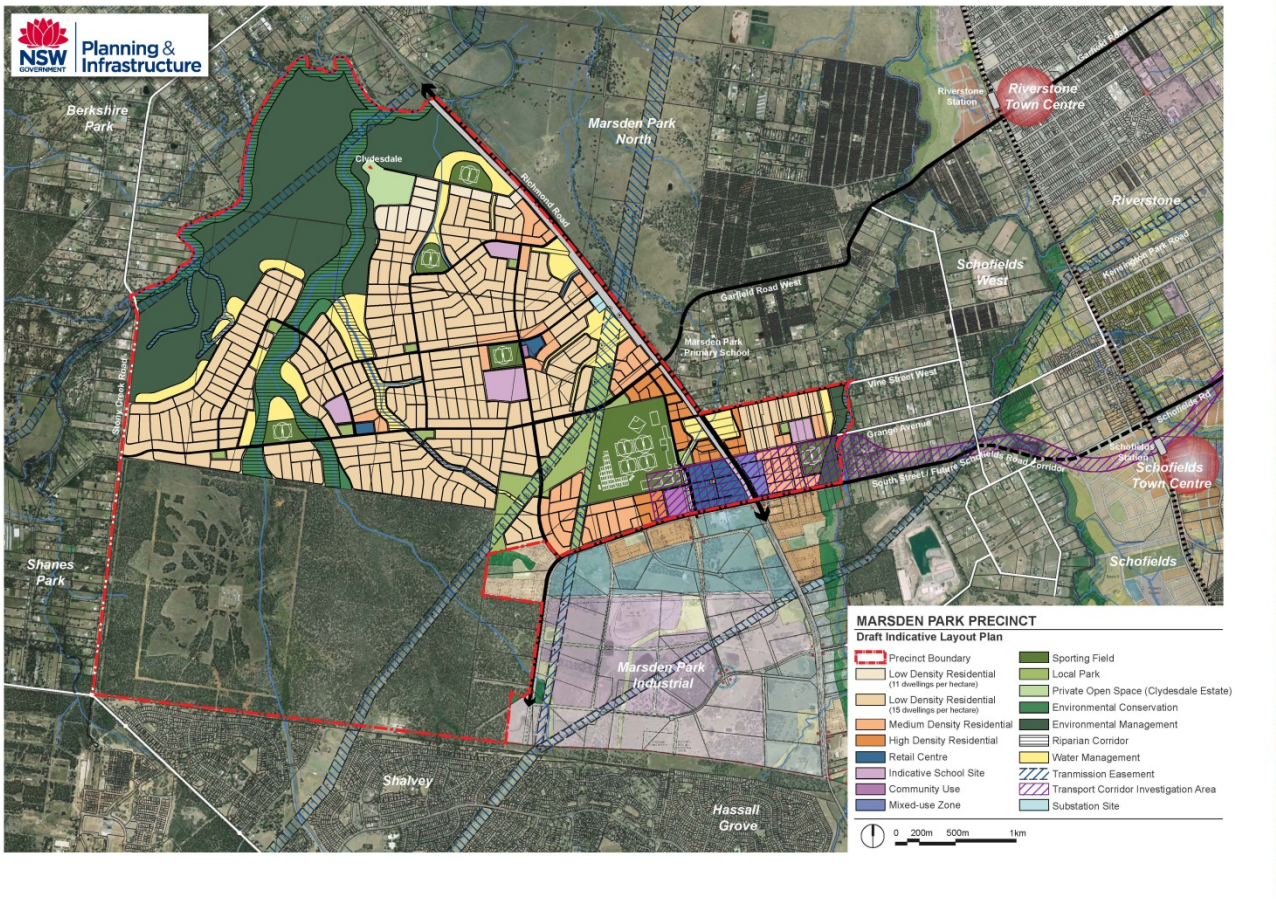

Figure 2: Marsden Park Precinct Study Area

Once developed, the Marsden Park precinct will comprise of 596 hectares of residential, 15 hectares of town/village centres and 811 hectares of conservation land and open space. There will be a mix of low and medium density residential housing to accommodate up to 10,000 lots.

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

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 Precinct is in accordance with the strategic area plan. Marsden Park ZS will supply power not only to the precinct but also to the surrounding areas.

The existing sub transmission supply arrangement is shown in Figure 3.

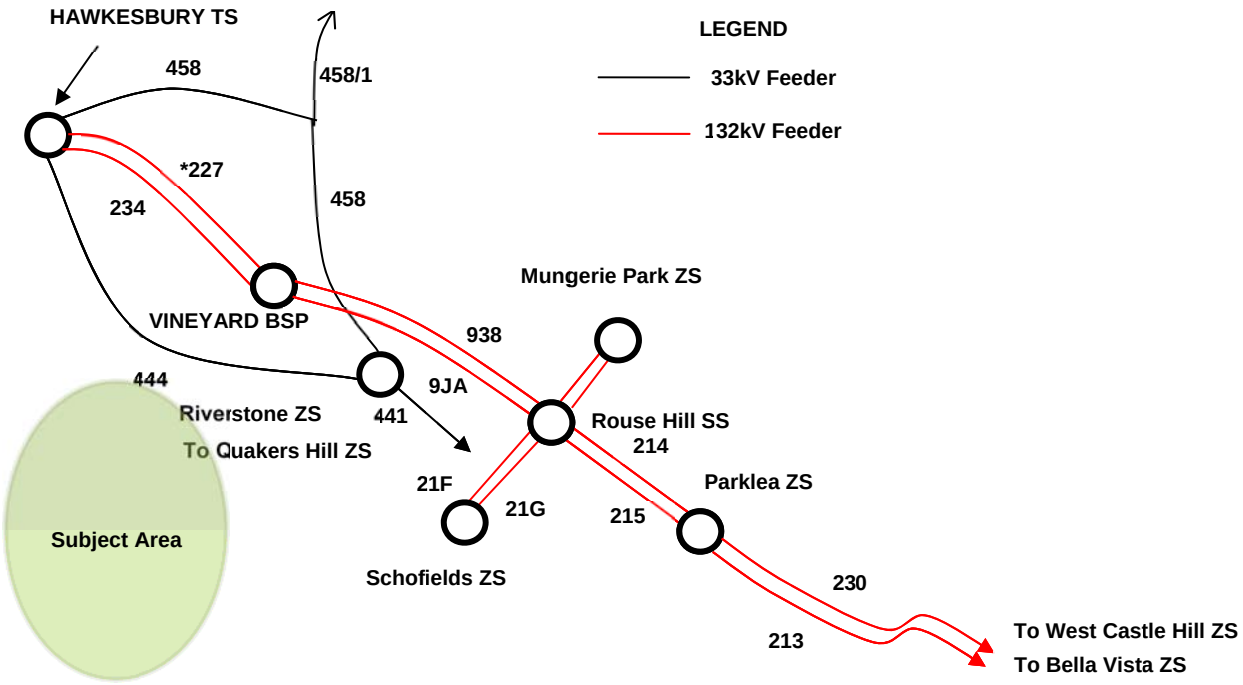

Figure 3: Existing supply arrangement

3.2 Network Constraints

The principal network constraint is that the site is a greenfield site with essentially no electrical infrastructure adequate to service the power requirements of the proposed Marsden Park precinct development. As previously stated, the area is currently supplied by Riverstone ZS with cross zone ties to Schofields ZS, Rooty Hill ZS and South Windsor ZS. Riverstone ZS is the closest zone substation with one overhead 11kV distribution feeder adjacent to the development along Richmond Rd. Schofields ZS has been commissioned 5km to the east of the proposed greenfield site and, due to its remoteness from the proposed development, can only offer limited supply to the Marsden Park residential area.

Emerging constraints have been identified at Riverstone ZS as a result of sustained growth in the area.

Riverstone ZS has a current firm capacity of 25MVA as it contains two 33/11kV 25 MVA transformers. Riverstone ZS is forecast to exceed its firm rating in 2020 due to current load applications within the North West Sector, and will continue to experience future growth based on the proposed Riverstone and Riverstone West growth precincts. Rooty Hill ZS contains two 132/11kV 45MVA transformers and is normally supplied from Sydney West BSP via 132kV feeders 220 and 239 (via Blacktown TS). Demand on Rooty Hill ZS is constant and within zone substation capacity.

A forecast for Riverstone and Schofields ZSs has been produced and is shown in Table 1 and 2 below along with the associated load at risk.

The Load at Risk in summer for Riverstone ZS is shown in the following table.

	Actual			Forecast									
Year[1,2]	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Firm Capacity (MVA)	25	25	25	25	25	25	25	25	25	25	25	25	25
Load Forecast (MVA)	27	25.7	19	19.7	21	22.3	22.8	23.4	24.1	24.9	25.8	26.9	28
Load at Risk (MVA)	**2.0**	**0.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.8**	**1.9**	**3.0**

Table 1: Summer Demand Forecast and Load at Risk for 2010-2022 Riverstone ZS

Note:

1. Year 2010 refers to summer 2009/10.
2. Years 2010, 2011 and 2012 are actual recorded (Network Load History) load data.
3. Forecast includes up to the scheduled 400 lot release from Marsden Park Residential supplied from Riverstone ZS
4. Riverstone ZS was offload by the establishment of Schofields ZS in 2012

The Load at Risk in summer for Schofields ZS is shown in the following table

	Actual			Forecast									
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Firm Capacity (MVA)				45	45	45	45	45	45	45	45	45	45
Load Forecast (MVA)				20.1	22.3	24.9	28.4	32.0	34.7	36.5	37.9	39.5	41.3
Load at Risk (MVA)				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 2: Summer Demand Forecast and Load at Risk for 2010-2022 Schofields ZS

Note: Forecast includes an additional 400 lots at Marsden Park Residential supplied from Schofields ZS

The Load at Risk in summer for 11kV feeders with respect to a design rating of 240A is shown below in Table 3. The table shows only 11kV feeders adjacent to the Marsden Park Residential precinct. Summer load is considered as it presents the greatest load at risk on these feeders.

Zone Substation	Feeder	Summer Load (Amps)	Load at Risk (MVA)	Voltage Regulation (%)	Exceeds Planning Standards >240A or >3.5%[1]
Riverstone	A052	180	Nil	5.3	**YES**
	A052[2,3]	95	Nil	2.7	NO
Schofields	SC1238[2]	219	Nil	4.2	**YES**
Rooty Hill	T884	198	Nil	4.3	**YES**
	T884	198	Nil	4.3	**YES**
South Windsor	T851	275	0.67	8.5%	**YES**
Non Compliances / Load at Risk		1 Feeder > 240A	0.67MVA	5 Feeders >3.5%	5 Non Compliances

Table 3: Summer Load at Risk for adjacent Distribution 11kV Feeders

Note:

1. Endeavour Energy Standard SDI501 recommended normal urban voltage limit for the 11kV and 22kV networks
2. Load after the commissioning of Schofields ZS as modelled by Dinis load flow program.
3. It is anticipated Riverstone Feeder A052 will supply the initial 1-400 lot release within Marsden Park. Load not included in model.

3.3 Potential for Growth

The need for more capacity in the Marsden Park precinct area is driven by the State Government's Precinct Acceleration Protocol (PAP). The Marsden Park precinct is one of the first to be released in the North West Sector under this programme. The proponent for Stage 1 of the Marsden Park precinct development is Stockland Developments Pty Ltd and the remaining 2 - 5 stages are under separate control.

The precinct has direct access to the M7 Motorway via Richmond Rd and access to Richmond railway stations via Garfield Rd, making it an attractive residential location.

An indicative programme and staging plan has been developed and prepared for the Marsden Park Precinct with the concurrence of the Department of Planning and Infrastructure. The concept staging plan is shown in Figure 4.

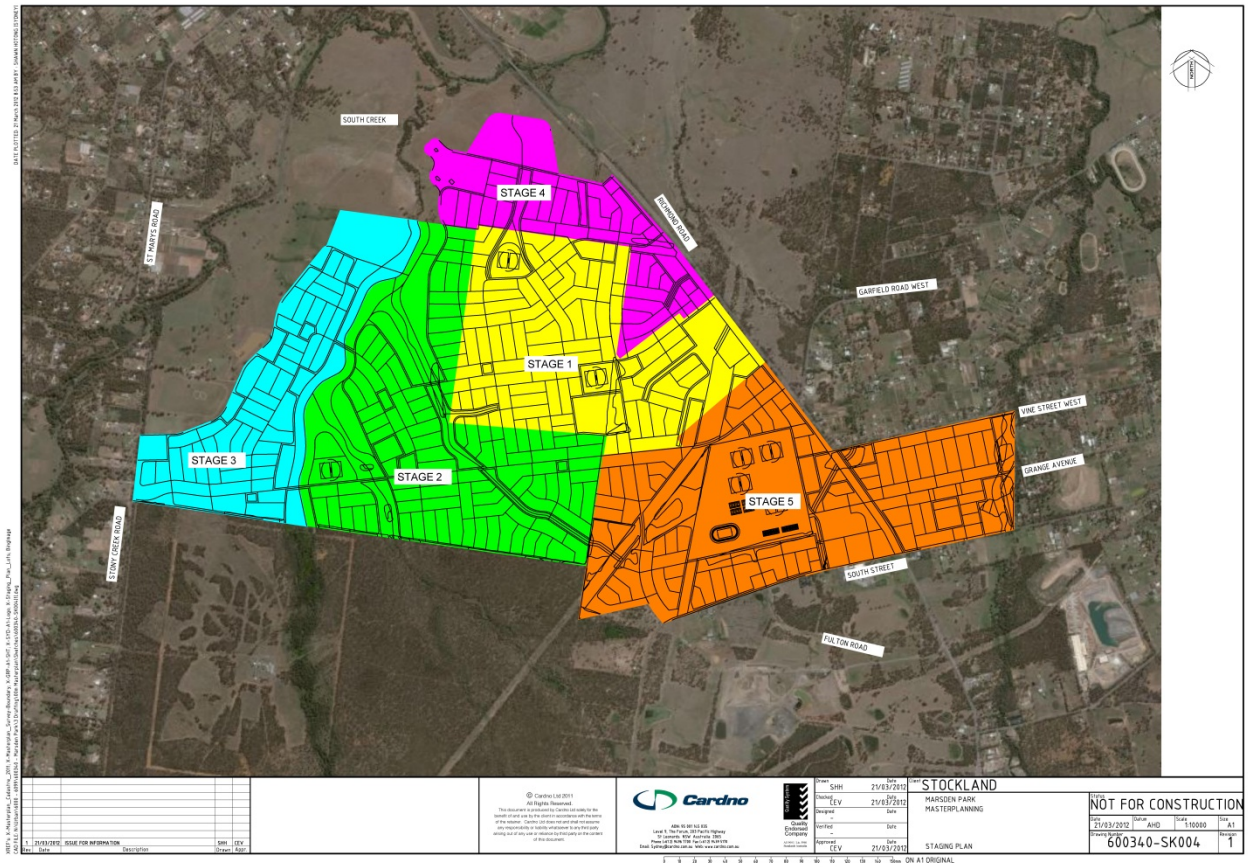

Figure 4: Concept Staging Plan

Indications from the prospective developer are that Marsden Park precinct stages 1, 2 and 3 could yield 400 lots per year from 2014. Stage 4 is estimated to yield 550 lots per year and stage 5 is estimated to yield 600 lots. However, the yield generation is likely to vary. Yield generation is most likely to eventuate at an average rate of 280 completed and occupied new dwellings per year commencing in 2014/15. This is based on Endeavour Energy's past assessment of developers' ability to deliver occupied dwellings.

Table 4 details the concept development lot delivery programme.

Marsden Park Residential Area Marsden Park Indicative Delivery Programme																							
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Cumulative lots	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6550	7100	7200	7800	8400	9000	9600	10200
Lots delivered																							
Stage 1	400	400	400	400	400	400																	
Stage 2							400	400	400	400	400	400											
Stage 3													400	400	400								
Stage 4																550	550	100					
Stage 5																			600	600	600	600	600
Load (MVA)	2.1	4.2	6.2	8.3	10.4	12.5	14.6	16.6	18.7	20.8	22.9	25.0	27.0	29.1	31.2	34.1	36.9	37.4	40.6	43.7	46.8	49.9	53.0

Table 4: Concept Development Lot Delivery Programme

The adjacent Marsden Park Industrial precinct area contains 551 hectares of employment lands. When fully developed the precinct is expected to yield between 45MVA and 50MVA. It is difficult to determine accurately at this stage the expected maximum demand within the industrial precinct without knowing the exact end customer load usage.

The Marsden Park North Precinct, to the north west of Marsden Park, can accommodate around 4000 dwellings. It is not part of the first release precincts and has not been released for precinct planning to date. It is bounded by Richmond Rd to the West and South Wianamatta Creek to the North. It has been estimated that future developments within the Marsden Park general area will generate up to 100-120MVA of demand as shown in Table 5 below. Additional zone substation capacity is required in this area as the existing Riverstone and Schofields ZSs are not capable of meeting the supply requirements.

Ultimately a second zone substation in the Marsden Park Industrial area will be required and is the subject of a separate business case. It is expected that this proposed substation (South Marsden Park ZS) will have the capacity to supply the surrounding Marsden Park Industrial area for the foreseeable future.

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
Total			**100-120**

Table 5 – Overall Load Estimate of Study Area

3.4 Long Term Network Strategy

Endeavour Energy has developed a long-term supply strategy for the North West Growth Sector. The establishment of Marsden Park and South Marsden Park ZSs are in line with this supply strategy. A number of new zone substations including the South Marsden Park ZS will be required to service the ultimate demand in the North West Sector.

The supply strategy for the Marsden Park Residential Precinct is to establish the zone substation in two stages. The initial short term interim solution followed at a suitable time by the long term permanent solution. This is defined as follows;

STAGE 1: Establishment of Marsden Park Zone Substation

The short term interim strategy involves the establishment of a "N" rated capacity substation consisting of a single 45MVA transformer together with a radial 132kV line. This will initially deliver a "N" level of supply security, which will supply the initial release of residential land in Marsden Park and provide distribution capacity support in the surrounding areas. The substation will cater for up to 10MVA of development which is estimated to take approximately 5 years to eventuate at an average rate of 280 completed and occupied new dwellings per year commencing in 2014/15.

STAGE 2: Establishment of Marsden Park Permanent Zone Substation

This involves the establishment of the final stage of the 132/11kV zone substation within the Marsden Park Residential Precinct to cater for the ultimate development of the precinct. A firm "N-1" capacity of 45MVA is proposed for Marsden Park ZS. The rate of development will dictate the timing of the permanent long term solution which will be monitored by Endeavour Energy but is envisaged to be required after 5 years of development in 2019/20. Stage 2 will increase the substation firm "N-1" rating to 45MVA and complete the 132kV transmission loop to Schofields ZS.

Stage 2 zone substation works will be subject to a future business case study when needs dictate.

The supply strategy for the Marsden Park Industrial Precinct is reliant on the establishment of the associated 132kV transmission feeders outlined in this report. The rate of development will dictate when to establish the South Marsden Park ZS. The 132kV transmission feeder requirements for Stage 2 could be modified to allow the commissioning of the 132kV feeders under the South Marsden Park ZS project if the necessity arises.

3.5 Environmental Issues

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

- The management of transformer noise.
- Visual impacts associated with the establishment of additional electricity assets.
- The impact of electromagnetic fields (EMF) due mainly to the installation of additional transmission 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.

4 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:

- Supply Security – ensuring that customers receive the supply security level detailed in Endeavour Energy planning standards.
- Licence Condition Compliance – ensuring that the DNSP licence conditions related to design planning criteria are complied with.
- The timely development of a solution to allow accelerated housing development in line with NSW Government's Precinct Acceleration Program (PAP).
- Financial / Economic Feasibility – ensuring that the requirements of the Regulatory Test are met.
- Demand Growth – ensuring that the preferred solution continues to be appropriate into the future, given forecast levels of demand growth.
- 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 – the solution proposed makes the best use of the existing capacity of the network.
- 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.

5 Options

5.1 Do Nothing

The Do Nothing option is not appropriate for this project as the proposal is for a new, greenfield residential development that requires new electrical infrastructure.

This option will not therefore be considered further.

5.2 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 Marsden Park Zone Substation.

5.3 Utilising the existing network

There is no opportunity to off-load the majority of the greenfield forecast load 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 zone substations at Riverstone, Schofields, Rooty Hill and South Windsor. Only Riverstone and Schofields ZSs are capable of providing interim short term supply to a limited number of lots in both the Marsden Park and Marsden Park Industrial precincts. A further 400 lots could be supplied from Schofields ZS. However, once the zone substation is established this feeder would be underutilised.

South Windsor and Rooty Hill zone substations are considered too remote to effectively supply the anticipated demand at 11kV as the site is located more than 5km from these existing substations.

Utilising the existing Riverstone network is only considered a viable option to supply up to 400 lots in the short term, but is not considered a viable long term option.

5.4 Build Options

The establishment of a zone substation in the Marsden Park area will provide the additional distribution capacity required for the release of up to 10,000 residential dwellings. The proposed Marsden Park ZS will provide capacity into the long term and will enable cross zone support on the distribution network to Riverstone, Schofields.

The residential development will be staged over a number of years at a developer forecast lot production rate of 400 lot dwellings per annum. A suitable servicing strategy for this is considered to be a staged approach, with the establishment of an interim substation on the final site to service the initial development with the subsequent establishment of the permanent substation some 5-6 years later. This 'two stage' approach was examined and deemed to provide the necessary capacity to service the initial short-term requirements and then later the ultimate long-term requirements of both the network and the growing customer base in the Marsden Park area. The second build option considered is to establish the permanent zone substation immediately, without any staging alternatives. The two build options are detailed below.

5.4.1 Option 1 (Stages 1 and 2) - Establish Marsden Park 132/11kV Interim Zone Substation followed by Establishment of the Final Marsden Park 132/11kV Zone Substation

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

Option 1 Stage 1 (Figure 5) includes:

- Establishment of a new 132/11kV outdoor zone substation with 1 x 45MVA transformer, and provision for a future second and third transformer.
- Construction of a permanent control building that will accommodate a temporary 11kV switchboard and Auxiliary equipment with provision for four 11kV circuit breakers.
- Establishment of a radial 132kV feeder 21R to Marsden Park Zone Substation from Vineyard BSP via underground tails from Vineyard BSP and Marsden Park ZS.

Stage 1 will provide up to 10MVA of capacity via a single transformer supply. The 10MVA limitation is directly related to network security of supply licence conditions for installations with a single transformer. Once the interim substation reaches this mandated capacity limit, the permanent substation will then be constructed. It is estimated to take at least 3-5 years to reach this target depending on the rate of take up of residential land and occupation of completed dwellings.

The total capital outlay for Stage 1 is $19.9million.

Option 1 Stage 2 (Figure 6) includes:

- Augment the existing interim 132/11kV outdoor zone substation with 2 x 45MVA transformers, and provision for a future third transformer.
- Augmentation of the final control building, which will accommodate the permanent 11kV switchboard and Auxiliary equipment with provision for up to twenty 11kV distribution circuit breakers.
- Establish the second 132kV feeder 21J to Marsden Park Zone Substation from Schofields ZS via underground cable tails with overhead delta line post construction.

The total additional capital outlay for Stage 2 is $18.4million (real $ 2013/14).

Stage 2 zone substation works is subject to the pace of development in the area and will be considered in a separate future business case study.

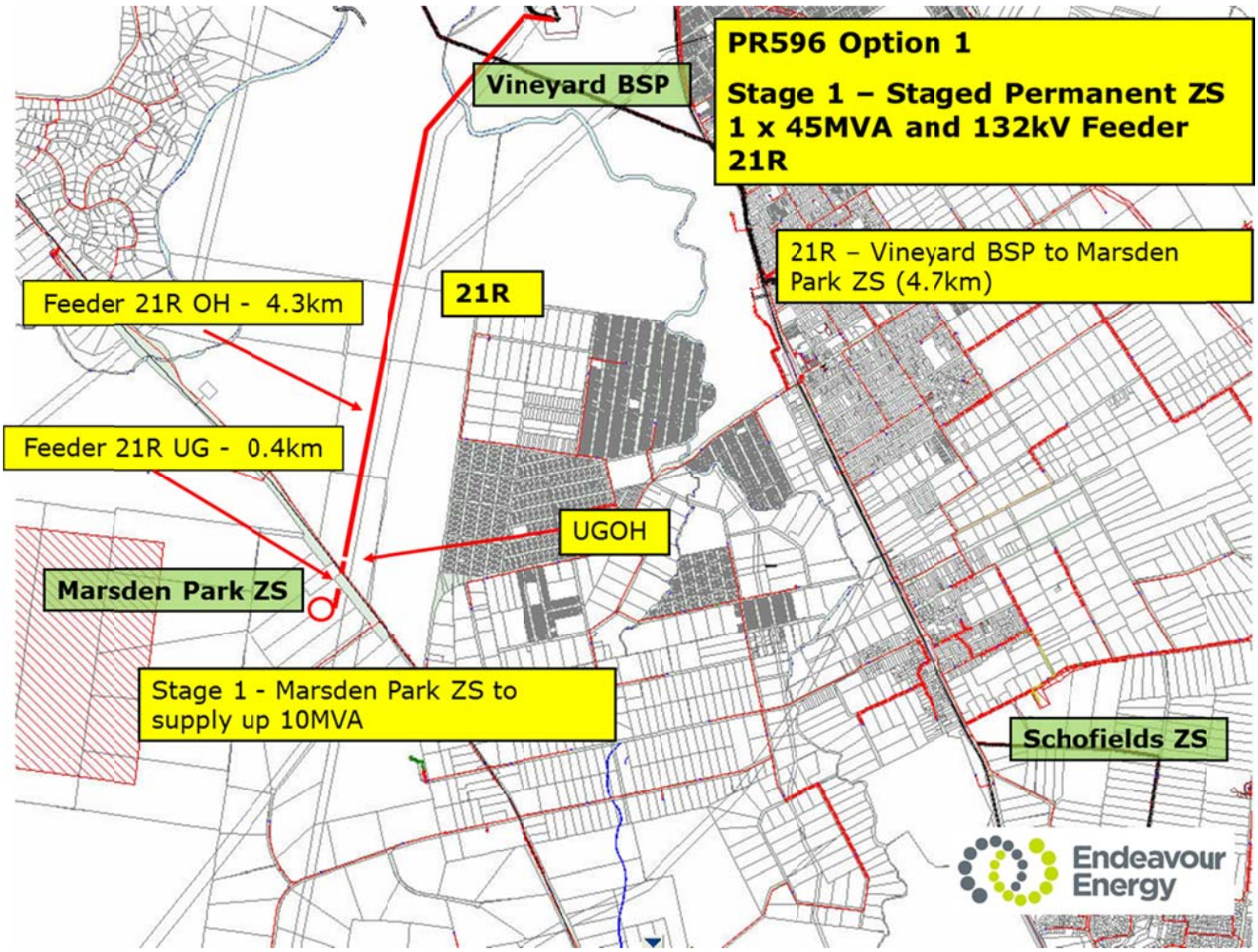

Figure 5 Stage 1 proposed 132kV Transmission feeder arrangement (Line routes depicted are indicative only and subject to REF and consultation with affected landowners)

5.4.2 Option 2 – Establishment of Permanent Marsden Park 132/11kV Zone Substation

This option involves the construction of an outdoor style 132kV/11kV 45MVA firm capacity substation on the site agreed with the proponent.

Option 2 (Figure 6) includes:

- Establishment of a new 132/11kV outdoor zone substation with 2 x 45MVA transformers, and provision for a future third transformer.
- Establishment of a 132kV feeder 21R to Marsden Park Zone Substation from Vineyard BSP via underground tails and Marsden Park ZS and the establishment of a second 132kV feeder 21J to Marsden Park Zone Substation from Schofields ZS via underground cable tails with overhead delta line post construction.

The total capital outlay for this option is $36.3million.

A fully indoor option was considered. However, following discussions with the developer, and taking into account the location of the site adjacent to a main road and transmission easements and towers,

it was agreed that an approach where a focus on a combination of landscape screening and suitable security fencing/walls would permit an acceptable outcome from a visual perspective and thus avoid the significant additional costs associated with 132kV indoor equipment.

A number of potential 132kV transmission feeder routes from Rouse Hill and Schofields to Marsden Park ZS have been identified and investigated. The estimated costs of the alternate supply routes were approximately $8 -13 million dollars more than the preferred transmission route outlined in this report. The larger capital expenditure places a level of risk to the financial viability of the project. These transmission route options will not therefore be considered further.

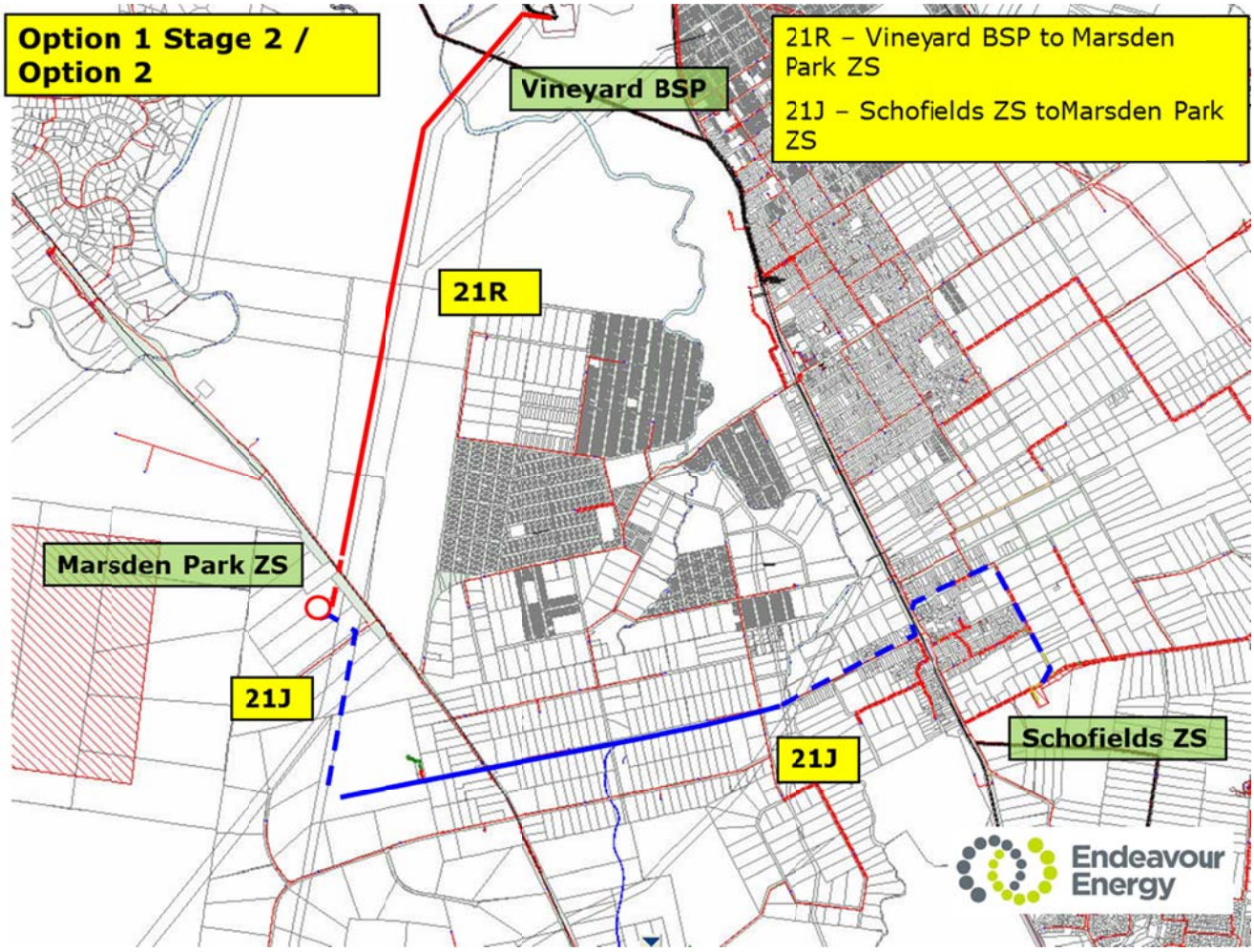

Figure 6 Option 1 - Stage 2/ Option 2 proposed 132kV Transmission feeder arrangement (Line routes depicted are indicative only and subject to REF and consultation with affected landowners)

6 Option Comparison

Each of the build options for the Marsden Park ZS was assessed against the objectively measurable service standards discussed in section 4.

The comparative costs of the two options considered are as follows:

Option 1 (Stage 1)	Establishment of Interim Substation in 2014/15	$19.9 million
Option 1 (Stage 2)	Establishment of Permanent Substation in 2019/20	$18.4 million
Option 2	Establishment of Permanent Substation in 2015/16	$36.3 million

Both 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

(iii) The permanent portion constructed in Stage 1 allows the Stage 2 augment to proceed with minimal impact on the existing network.

The total capital outlay for Option 1 – Stage 1 is $19.9M with a future capital outlay of $18.4M for Stage 2, resulting in a total option cost of $38.3M and a combined Stage 1 and 2 Present Value of Cost of $33.1M.

Note that the 132kV transmission infrastructure and transformer to be used in the initial stages will be constructed in its final position and remain at that location for use in the permanent arrangement.

6.1 Technical Considerations

A number of technical factors were considered for each build option.

Fault Levels

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

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 ENA C(b)1-2006 Section 11) by adequately earthing affected poles.

Option 1 and Option 2 will require the use of a number of concrete poles.

Easements

Easement acquisitions will be essential to the establishment of the 132kV sub transmission infrastructure. Much of the land required for easement is currently zoned rural and flood affected as advised by Blacktown City Council. It is proposed to overlap our easements with Transgrid easements to the extent possible. The use of the proposed Transgrid line easement will require written approval from Transgrid where necessary. Difficulties with the acquisition of easements may contribute a level of risk to the proposed route configuration.

Endeavour Energy has developed a strategic direction for the South West Sector in relation to line route acquisitions. A similar acquisition strategy is proposed for this project. Based on this recommendation the preferred Option 1 includes the funding for the strategic early acquisition of all required easements for Stage 2.

Reliability

The area under consideration is currently supplied by Riverstone ZS at 11kV. The Richmond Rd feeder (A052) was a non-compliant feeder in September 2012 and contributed 0.71 minutes to organisational SAIDI. It is classified as a short rural feeder and is moderately vegetated. The establishment of Marsden Park ZS will improve the reliability performance of the distribution Richmond Rd feeder A052 by up to 45%. Marsden Park ZS will also provide additional backup capacity and cater for future load growth in the residential precinct and surrounding areas.

6.2 Environmental Considerations

Each of the above options to establish Marsden Park ZS will have a different impact on the local environment. An environmental assessment of each of the above options is being carried out in accordance with statutory requirements. The assessment will encompass the range of technologies being considered under each option. Endeavour Energy will consult with affected community and other stakeholders on environmental issues.

The assessment shows that, with adequate screening around the substation site, either option is considered to be achievable from an environmental perspective.

6.2.1 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 7 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 Figure 8. The graphs show that EMF value will be less than the maximum allowable of 100mG.

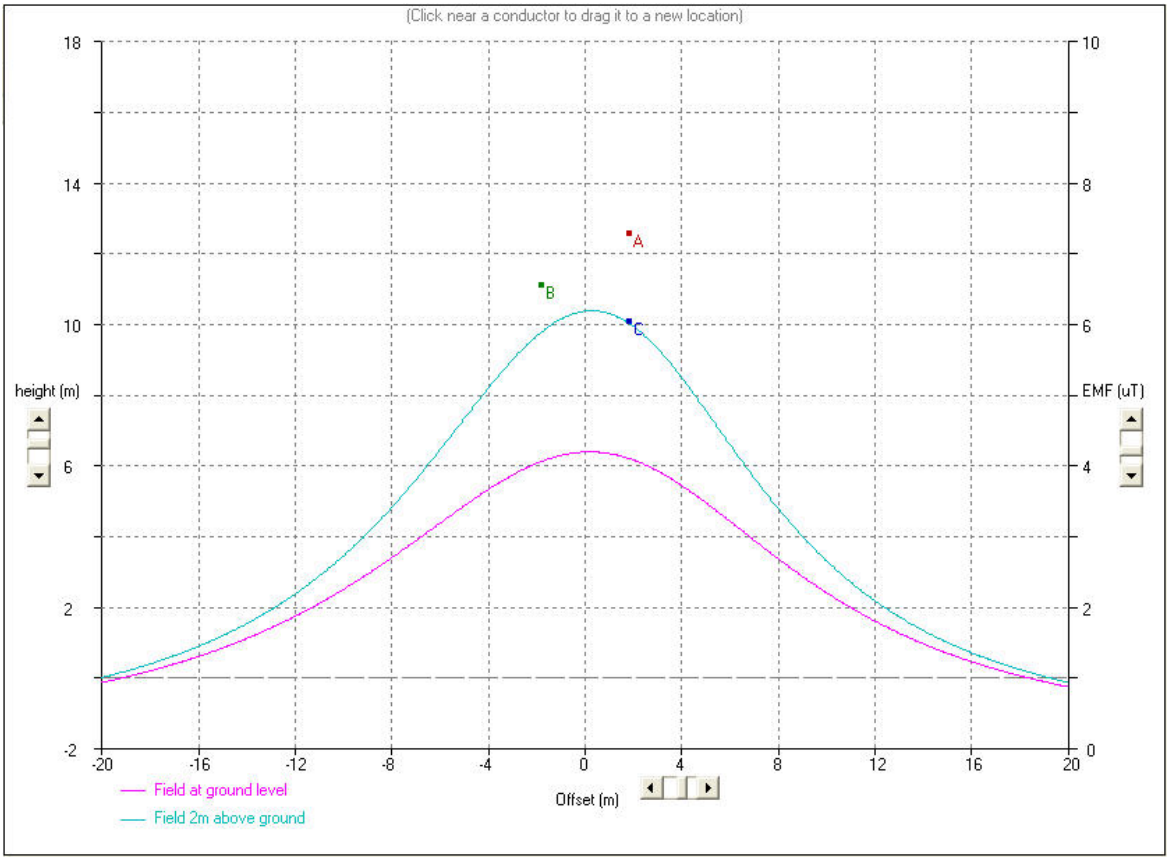

Figure 7 – Maximum EMF Calculation for overhead 132kV delta line post construction

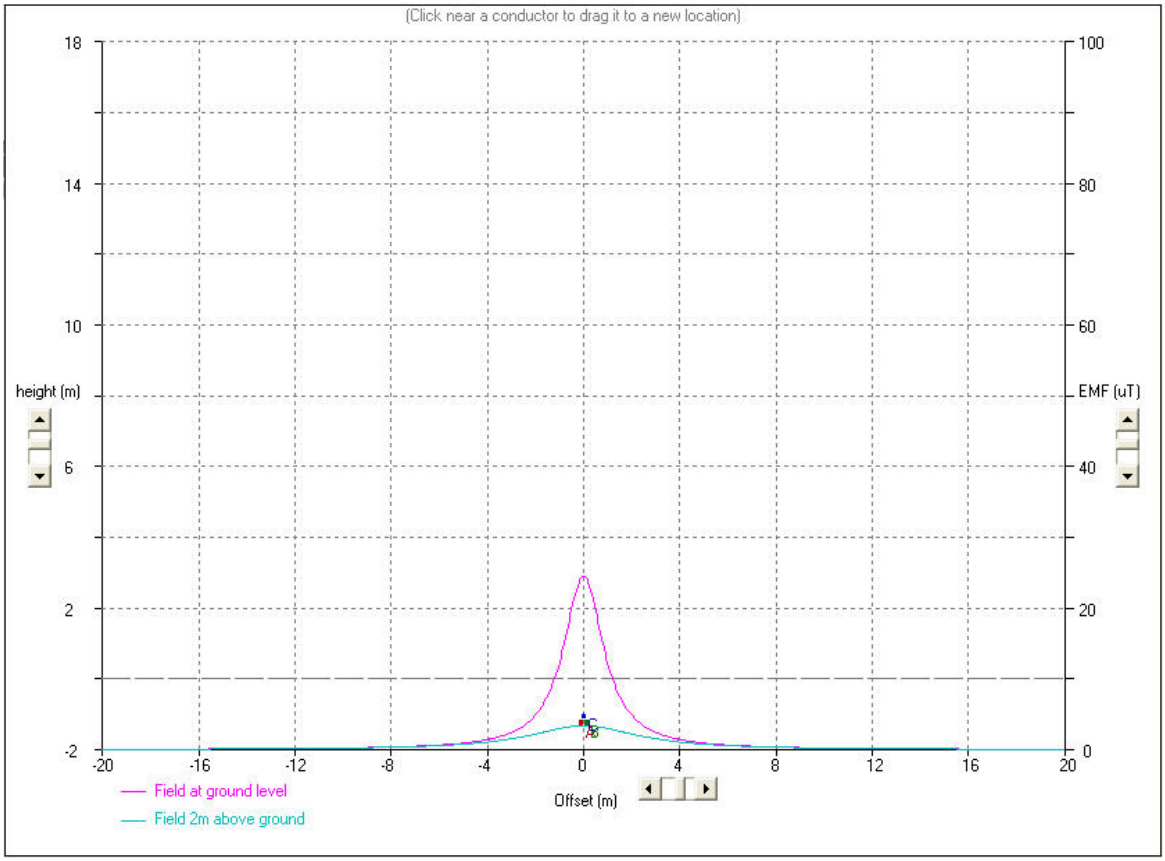

Figure 8 – Maximum EMF Calculation for underground 132kV single circuit construction

6.2.2 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. 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 either of the two technically feasible options can be achieved.

6.3 Financial Evaluation and Regulatory Test

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

Present Value of Costs ($)

Internal Rate of Return (IRR) (%)

Discounted Payback Period (years)

Capital Expenditure (Not including land) ($)

The now deleted Clause 5.6.2 (g) of the National Electricity Rules stated 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 5.4.

The Present Value of Costs were calculated for all Marsden Park build options outlined in section 6. Refer to Table 6 below for results of the calculations, which include sensitivity analysis as required by the Regulatory Test. In all scenarios Option 1 - Stage 1 followed by Stage 2 has the lowest present value of cost.

The total project cost for Option 1 - Stage 1 and Stage 2 is included in the present value of cost calculations in Table 6. This is to provide a reference point to compare costs with Option 2, a permanent zone substation establishment.

		OPTION 1		OPTION 2
		Stage 1	Combined Stage 1 & Stage 2	Permanent ZS
Total Capital Outlay ($m)		19.9	38.3	36.3
Average Annual O&M * ($m)		0.4	0.9	0.8
Variability of capital outlay (+/- percent)		10%	10%	10%
Scenario		**PV of Costs ($million)**		
		Option 1		**Option 2**
		Stage 1	**Combined Stage 1 & Stage 2**	
Base Case($m)		**19.73**	**33.11**	**35.1**
High Capital($m)	110%	21.4	35.8	38.1
Low Capital($m)	90%	18.1	30.1	32.1
High O&M($m)	120%	19.7	33.1	35.1
Low O&M($m)	80%	19.7	33.1	35.1
High Discount Rate($m)	10.2%	18.5	29.9	32.8
Low Discount Rate($m)	6.2%	21.7	37.9	38.7
Early commissioning($m)	2014	21.2	33.4	36.5
Late Commissioning($m)	2016	19.2	30.3	34.3

* O&M refers to Operating and Maintenance Costs and includes an allowance for Fault and Emergency

Table 6: Results of Present Value of Costs Calculations

6.3.1 Regulatory Test Outcome

Option 1 “Establish Marsden Park 132/11kV Interim Zone Substation followed by Establishment of the Final Marsden Park 132/11kV Zone Substation”, which includes the cost of establishing the substation and the future expenditure to establish the permanent substation minimises the Present Value of Costs and so far 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.

6.4 Option Comparison Table

An assessment of the various build options considered against the project requirements is shown in Table 7 below:

Requirement	Option 1 Stage 1 then Stage 2	Option 2
Provides short term N-1 Supply Security at Marsden Park ZS	**No**	**Yes**
Provides long term N-1 Supply Security at Marsden Park ZS	Yes	Yes
Eliminates load at risk and voltage regulation problems of HVD feeders	Yes	Yes
Capital Cost	$38.3m	$36.3m
PV of Costs	$33.1m	$35.1
Satisfies the Regulatory Test	Yes	No
Addresses Identified Asset Condition Needs	Yes	Yes
Technical Suitability – design standards met	Yes	Yes
Environmental Feasibility	Feasible	Feasible
Network Utilisation – best use of existing network capacity	Yes	Yes
Safety	No Issues	No Issues

Table 7: Comparison of Options

6.5 Preferred Option

It is considered that Option 1 provides the best overall solution and minimises present value of costs to the identified design requirements and is the preferred option. Due to time constraints for delivery of capacity to the Marsden Park area, and it can be implemented more quickly than the full permanent Option 2 and will provide the necessary capacity for the proposed development.

Stage 2 of Option 1, to establish the permanent substation, will be pursued at a later date, estimated to be in 2019/20 as housing development dictates. A separate consultation process for Stage 2 will be undertaken at that time.

All works associated with the preferred option will generally be in accordance with Endeavour Energy Standard SDI 501 Network Configuration".

7 Conclusion

Significant medium to long term network constraints have been identified for Marsden Park as a result of greenfield growth. Two 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**.** A financial evaluation of the cost of build options has identified that Option 1 Establish Marsden Park 132/11kV Interim Zone Substation followed by Establishment of the final Marsden Park 132/11kV Zone Substation has the potential to satisfy the Regulatory Test.

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