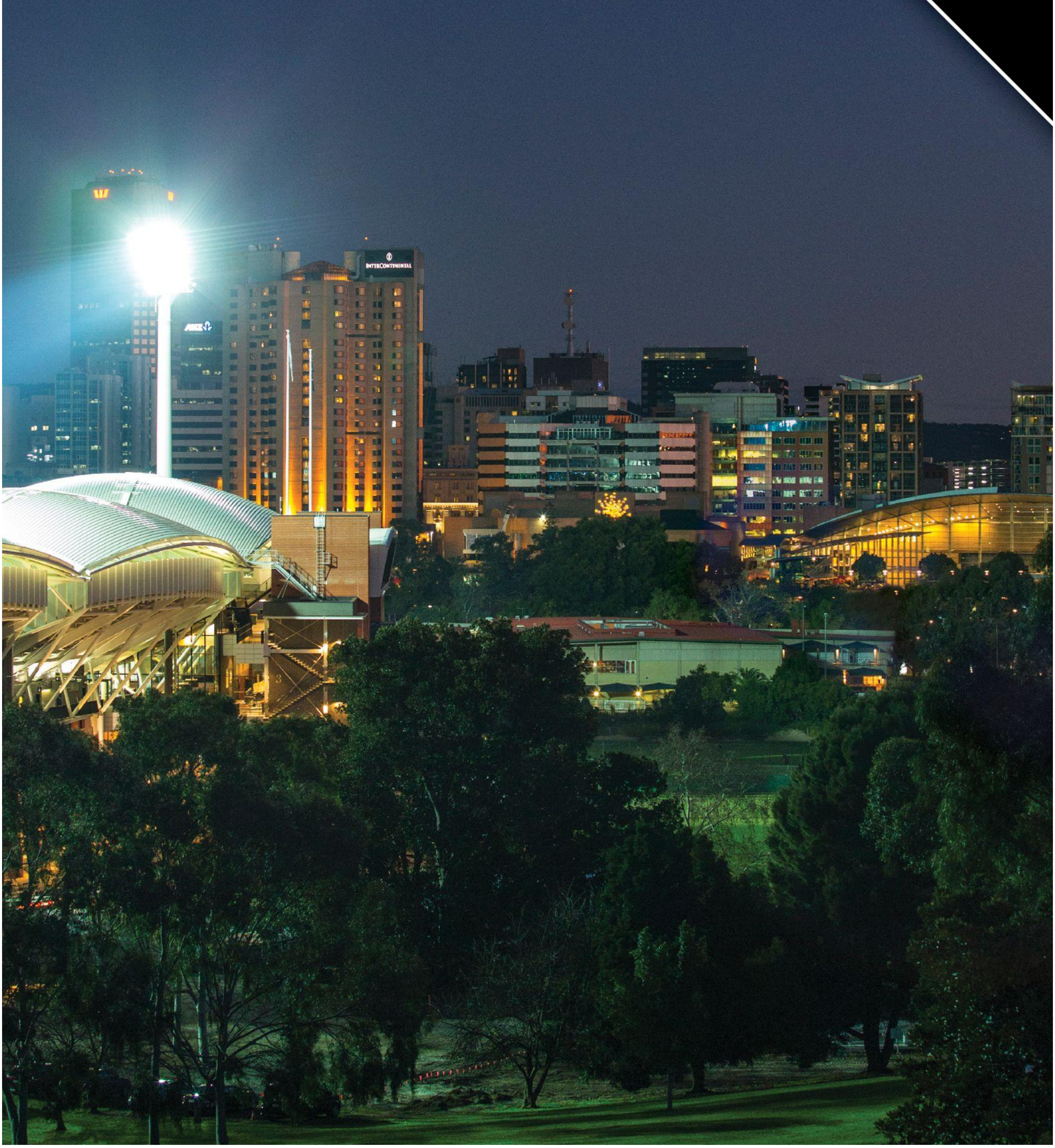
Attachment 20.45

SA Power Networks: Bushfire Mitigation Programs Business Case

October 2014



Business Case

Bushfire Mitigation Program

Project Ref Number :

Document Ref Number : Attachment 20.45

Version : 2.0

SA Power Networks

www.sapowernetworks.com.au

Table of Contents

1. Executive Summary

1.1 Requirement for the Project

South Australia has always faced significant risks from bushfires. The State often experiences hot, dry and windy weather conditions, creating high fire danger, particularly in fuel rich areas. The highest fire risk areas include those close to regional centres, in the Adelaide Hills and southern coastal areas.

On average SA Power Networks' assets are associated with 68 fires per annum, across South Australia. Recent major bushfires in NSW, Victoria and Tasmania have heightened the community focus on mitigating bushfire risks.

Community concern is appropriate, as the risk of ignition of bushfires by power infrastructure is both major and increasing.

SA Power Networks continually reviews its risk management programs to maintain the focus on reducing the risk of bushfires on extremely hot, dry and windy days. This includes reviewing strategies used interstate and customer preferences as they pertain to these risks.

This reflects SA Power Networks' duty to take reasonable steps to ensure that the distribution system is safe and safely operated (Section 60(1) of the *Electricity Act*) and to maintain and operate the distribution system in accordance with good electricity industry practice (NER Clause 5.2.1(a)). These duties require SA Power Networks to have regard to objectively determined standards of safety (ie what would a reasonable and prudent electricity distribution system operator faced with the same conditions and circumstances as apply to SA Power Networks do, to ensure that the distribution system is safe and safely operated and is maintained and operated in a manner that is consistent with the degree of skill, diligence, prudence and foresight expected from Australian electricity distribution system operators).

Given that these standards of safety are required to be objectively determined, they will by definition change over time as what constitutes reasonable steps and good electricity industry practice is influenced by industry developments and learnings. SA Power Networks continually monitors these industry developments and learnings to ensure that it is discharging these dynamic and evolving duties.

SA Power Networks proposes to implement a Bushfire Mitigation program of work that:

- reduces the likelihood of SA Power Networks' assets causing fire starts in High Bushfire Risk Areas (**HBFRAs**), through targeted investments over the 2015 – 20 Regulatory Control Period (**RCP**); and
- improves the security of supply to selected Country Fire Service (CFS) Bushfire Safer Places (**BSP's**), which are places of relative safety during catastrophic fire danger conditions.

The proposed Bushfire Mitigation program is in response to the recommendations of the Victorian Bushfire Royal Commission (**VBRC**) and the resulting Powerline Bushfire Safety Taskforce (**PBST**) which reviewed the outcomes of the VBRC. To comply with its legislative obligations, SA Power Networks must adopt good electricity industry practice in bushfire risk management.

In addition, throughout SA Power Networks' Customer Engagement Program, customers and stakeholders overwhelmingly reinforced that the community places very significant priority on bushfire risk management, as well as those relating to network inspections, maintenance and upgrades which impact bushfire safety outcomes.

For example, 90% of respondents to SA Power Networks' 2013 on-line survey supported increased inspection, maintenance and construction standards in bushfire risk areas in order to minimise the probability of fires starting from power lines, and 90% supported investment to ensure more reliable power supply to CFS Bushfire Safer Places.

SA Power Networks considers that it has developed a considered and cohesive program that uses a number of tools to both reduce the risk of a bushfire starting from electricity assets and mitigate the risk of community harm once bushfires occur, which clearly benefits the community.

The program includes a number of coordinated strategies to reduce bushfire start risk, in particular, using a prioritisation methodology, where areas are targeted to achieve the greatest incremental benefit in fire risk reduction.

High voltage power lines have been prioritised based on fire start risk (refer Attachment A). The following process will be used to develop tailored fire start reduction solutions for each feeder based on the following hierarchy of solution options:

- underground sections of power lines located in HBFRAs that supply BSPs;
- replace manual reclosers on bushfire risk area boundaries with SCADA controlled equipment;
- implement further undergrounding of sections of power lines that present high risk (eg highly vegetated areas), in HBFRAs; and
- replace obsolete Rod Air Gap (**RAG**) and Current Limiting Arcing Horn (**CLAH**) equipment with modern surge arrestors for the remaining overhead sections of power line.

Deploying reactive based solutions to reduce the likelihood of electrical assets starting fires is considered less efficient than applying a structured prioritisation methodology, based on risk management principles, to produce our approach of an effective and efficient feeder by feeder risk reduction program.

1.2 Business Options Considered

SA Power Networks considered a large range of fire start reduction initiatives recommended by the PBST, as canvassed in the Jacob's report[1], and narrowed the areas of focus to the following options that are addressed in this overarching business case (for a full list of the recommended programs, refer to section 2.8):

1. Replacing ageing mechanical 33kV, 19kV and 11kV pole mounted reclosers with modern fast operating equipment, complete with SCADA control to reduce the likelihood of fire starts;
2. Replacing out-dated lightning protection systems such as RAGs and CLAHs with modern surge arresters to reduce the likelihood of fire starts; and
3. Targeted undergrounding of high risk sections of overhead power lines in HBFRAs, to significantly reduce the likelihood of SA Power Networks' assets causing fire starts, and installing more secure electricity supplies to targeted BSPs.

1.3 Recommended Option

SA Power Networks must adopt good electrical industry practice in bushfire risk management practices. This will be achieved by implementing a prudent Bushfire Mitigation program of works as detailed in this business case, reducing the likelihood of SA Power Networks' assets causing fire starts in the highest risk areas, through targeted investments and improving the security of supply to targeted CFS BSPs, particularly.

[1] Recommended bushfire risk reduction strategies for SA Power Networks, Jacobs, October 2014.

2. Reasons

2.1 Objectives

SA Power Networks proposes to implement a Bushfire Mitigation program of works that:

- reduces the likelihood of SA Power Networks' assets causing fire starts in HBFRAs through targeted investments over the 2015 – 20 RCP; and
- improve the security of supply to targeted CFS BSPs, particularly during catastrophic conditions and when fires are in the locality.

After the catastrophic bushfires of Black Saturday in February 2009, the VBRC was established to conduct an extensive investigation into and report on the causes, operational response, preparation for and impact of the fires.

In its report the VBRC identified that electricity assets started fires and called for "major changes" to the operation and management of ageing electricity infrastructure. It determined that it was "time to start replacing the ageing infrastructure" and called on both the State of Victoria and the distribution businesses to invest in infrastructure improvements in order to "substantially remove one of the primary causes" of catastrophic fires in Victoria (2009 Victorian Bushfires Royal Commission, Final Report Summary July 2010).

A number of the VBRC's recommendations have been adopted through amendments to Victoria's electricity safety legislation and regulations, in effect mandating a new Victorian standard of practice. This is funded by reference to a new funding mechanism which provides Victorian Distribution Network Service Providers (**DNSPs**) with financial incentives for fire mitigation based investment.

The Victorian Government established the Powerline Bushfire Safety Taskforce (**PBST**) to review the outcomes of the VBRC, and advise it of the strategies that would maximise value from the implementation of the VBRC's recommendations. Specifically the PBST recommended the rebuild of power lines with a fire start safe construction as well as replacing manual reclosers with SCADA controlled reclosers. The PBST also made other recommendations to reduce the number of fires started from power lines. For example, moving to a maximum of a three yearly inspection cycle, which is addressed in SA Power Networks' Asset Inspection business case.

The PBST adopted a "precautionary-based approach" to determine what should be done to reduce bushfire risk from power lines. Under that approach "all reasonable practicable precautions" would be considered having regard to balancing the magnitude of the risk and the effort required to reduce the risk." Refer to the Regulatory Proposal Attachment 11.7, Powerline Bushfire Safety Taskforce, Final Report, September 2011.

SA Power Networks considers that the PBST's recommendations now constitute **good electricity industry practice** in Australia.

In 2012 SA Power Networks engaged independent consultants Sinclair Knight Merz, now Jacobs Engineering Group (**Jacobs**), to report on SA Power Networks' bushfire mitigation management practice vis-à-vis other DNSPs, and to advise what, if any, strategies it should adopt to maintain consistency with industry trends.

Jacobs reviewed and reported on:

- SA Power Networks' current practices and procedures for bushfire risk management;
- SA Power Networks' fire start history in order to establish root cause of bushfire starts;

- current DNSPs bushfire risk management practices in Australia; and
- the findings of VBRC and PBST investigations.

Jacobs recommended options which provide the greatest prospect of reduction in fire starts given a prudent economic investment, as a basis for ongoing consultation, project and proposal development by SA Power Networks. After allowing for differences between Victoria's and South Australia's electricity infrastructure (eg in terms of pole and cross-arm construction materials, and associated earthing systems), key recommendations of the PBST still apply to the distribution network in South Australia. Those recommendations have been carefully analysed by Jacobs who assessed which mitigation strategies should be selected for inclusion in SA Power Networks' program of bushfire mitigation strategies. Refer to Section 2.8 for a description of the full program.

The program of works addressed in this business case includes the following investments:
1. replacing ageing mechanical 33kV, 19kV and 11kV pole mounted reclosers with fast-operating equipment, complete with SCADA control;
2. replacing out-dated lightning protection systems (RAGs and CLAHs) with modern surge arresters; and
3. targeted undergrounding of high risk sections of overhead power lines in HBFRAs, to reduce the likelihood of SA Power Networks' assets causing fire starts, and installing more secure electricity supplies to selected CFS BSPs.

Details of these programs are explained in the following sections.

2.1.1 Recloser Replacement & SCADA Installation

SA Power Networks has many manual and aged 33kV, 19kV and 11kV reclosers in service that require replacement with modern, fast-operating SCADA controlled units, to reduce the fire start risk and improve safety for the community and power line workers.

Table 1: SA Power Networks Recloser Population

Bushfire Zone	Total Reclosers	Reclosers not on SCADA			
		Total	33kV	19kV	11/7.6kV
No Bushfire Zone	255				
Medium Bushfire Zone	726	481	27	367	87
High Bushfire Zone	315	206	13	69	124
Total	**1296**	**687**	**40**	**436**	**211**

Reclosers are self-contained pole mounted circuit breakers with inbuilt fault detection mechanisms and control systems. For transient faults, reclosers will interrupt supply allowing the fault to clear, and then automatically reclose to restore supply. For permanent faults, the recloser trips and remains open or "locks out" until the line is patrolled and confirmed as safe to restore supply. These units are constructed to be pole mounted, either on overhead line pole structures or inside substations.

The majority of reclosers present on SA Power Networks system are manufactured either by Reyrolle or McGraw Edison, and are around 40 to 50 Years old. Their operating mechanism is predominantly hydraulic for fault detection and operation. The limitations of these units compared with modern units includes slower fault clearing times, inflexible protection and control settings, and an inability to remotely monitor or control their operation. Additionally, parts of SA Power Networks' network are only protected by HV fuses which do not operate fast enough to materially reduce the risk of fire ignition following the detection of a fault.

Evidence submitted at the VBRC suggests that the probability of a fire starting from fallen conductor increases significantly if the line protection system (recloser or fuse) operates slowly and/or operates a number of times. Tests by Marxsen et al[2] confirms that for the "worst case fire conditions (see Table 2), by disabling the reclose function and setting the recloser to clear faults as quickly as possible (Non-auto in the SA Power Networks terminology), the probability of a fire starting from a line fault significantly reduces".

Table 2: Marxsen – Worst Case Fire Conditions

Parameter	Condition
Relative Humidity	less than 20%
Fuel	with up to 5% moisture
Mean wind (at 0.5m above ground)	10 km/h
Air temperature	45^{o}C

SCADA control of reclosers enables remote operation (including setting changes such as not permitting multiple reclose attempts prior to disconnecting electricity in response to detecting a fault), and facilitates fast reaction to changing weather conditions by removing the need for line crews to be deployed on days of extreme fire danger to manually change protection settings on reclosers.

SA Power Networks proposes to replace reclosers that have slow fault clearing times with SCADA-controlled high speed reclosers. The program discussed in this business case is intended to replace in the order of 151 High Voltage (**HV**) reclosers in HBFRAs over the 2015-20 RCP. Replacement of the remaining 55 HBFRA reclosers is being addressed across the same period under the "Backup Protection" project (for further details refer to the Protection and Control Asset Management Plan – AMP 3.2.14).

The scope of the recloser replacement program as recommended by the Jacobs report (refer section 2.8 for further details), consists of the replacement of 11kV, 19kV and 33kV line reclosers in HBFRAs, with modern SCADA controlled equipment with the following specifications:

- electronic protection relays that allow for very fast first fault clearance time (50-80ms);
- multi-shot re-close capability when required;
- flexible protection settings;
- paired with industry standard SCADA controllers; and
- fitted with remote communications (Fibre, Radio or NextG) to allow full SCADA monitoring and control capability, including the ability to remotely trip/disconnect, set the trip circuit to Non-auto, and alter protection settings.

2.1.2 Replacing Rod Air Gaps and Current Limiting Arcing Horns with Surge Arresters

Historically SA Power Networks has installed RAGs on 33kV and 19kV networks, and CLAHs on 11kV networks as an economic overvoltage protection method. They are widely deployed across SA Power Networks' network.

An assessment has been made of the lightning protection devices installed on SA Power Networks system, with the total quantity being detailed in Table 3.

[2] Marxsen – New research on Bushfire Ignition - 2012

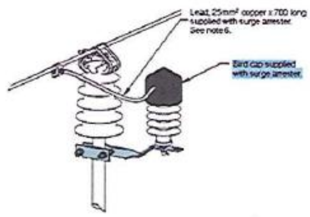
Table 3: Total Population of Lightning Protection Devices (Excluding 66kV)

SA Power Networks Feeder Data		Quantity of Devices			
Type	**QTY**	**RAG**	**CLAH**	**S/A**	**Total**
NBFRA feeders	524	12629	2223	4558	19409
MBFRA feeders	741	17858	3143	6445	27446
HBFRA feeders	426	10267	1807	3705	15779
Total feeders	**1691**	**40754**	**7172**	**14708**	**62634**

RAG
(Rod Air Gaps)
Pre 1990's

CLAH
(Current Limiting Arcing Horns)
1990 ~ 2002

Surge Arrester
From 2003 onwards



RAGs usually comprise three metal rods arranged to provide two air gaps between the high voltage connection and earth. CLAHs are a series combination of a rod gap and a non-linear current limiting zinc oxide resistor. Conduction to earth occurs during an overvoltage event of sufficient magnitude to break down the insulation of the two air gaps in the case of rod gaps and the one air gap in the case of the CLAH device.

Surge Arrestors are a more modern and technically superior product, but are a more expensive form of overvoltage protection. These are also used by SA Power Networks. Surge arrestors are constructed of an outer insulating cylinder of either ceramic or synthetic material with sheds to increase the surface area and effective conducting distance from conductor to earth. Inside this cylinder are stacked disks now made of metal oxide that form the active surge arrestor elements. Metal oxide has a characteristic such that at lower voltages conduction does not occur but as voltage increases, the resistance becomes lower and rapidly nonlinear causing high currents to flow through the Surge Arrestor.

While RAGs and CLAHs are low cost, they suffer from a number of deficiencies:

- The accuracy and repeatability of voltage breakdown varies because the breakdown characteristic is dependent on the initial and then ongoing accuracy of the rod gap settings, which vary with humidity and rain, and also with mis-alignment as a result of transport or handling. This increases the risk of insulation failure and conductor burning due to poor overvoltage protection from incorrectly set rod gaps;
- Because the rods are un-insulated, there is the potential for animals, birds and airborne vegetation to bridge the air gaps causing a flashover; and

- When the devices operate, there is a power frequency follow- through current that can cause sparks and molten metal to drop, creating a fire start risk.

There is evidence in SA Power Networks' fire start statistics that failures have occurred to overhead line equipment because CLAHs and RAGs have failed to arrest line surges, and this has resulted in power lines falling to the ground and starting fires.

Jacobs' analysis of 5 years of SA Power Networks' fire start records indicated that about 32 fire starts in HBFRAs and MBFRAs could have been prevented if RAGs had been replaced with surge arrestors. Ad-hoc replacements and some programmed replacements have previously been undertaken, however a structured program is now proposed. The benefits of the targeted program include the ability to optimise the replacement of these devices against other planned work such as undergrounding and the ability to better schedule work to make the best use of limited network access opportunities.

The implementation strategy will use the results of fire consequence modelling to identify locations of highest consequence taking into account other programs such as undergrounding. Power lines will then be prioritised on the basis of which line voltages lead to the most fire starts, which power lines have the highest numbers of CLAHs or RAGs to replace, and where there is a history of fires starting due to bird or animal interference with line hardware.

The estimated replacement costs vary with voltage level as follows:

- Estimated cost to replace 33kV RAGs or CLAHs with surge arrestors =about $4,670 per set of 3.
- Estimated cost to replace 19kV RAGs or CLAHs with surge arrestors =about $2,007 each.
- Estimated cost to replace 11kV RAGs or CLAHs with surge arrestors = about $3,755 per set of 3.

To replace all RAGs and CLAHs on power lines in HBFRAs would cost approximately $42M, in accordance with the data in Table 4 below. SA Power Networks is proposing to structure the total replacement program over the next 4 regulatory periods, commencing with approximately 30% of the program in the next 5 years, representing an investment of $12.2M. The remaining surge arresters would be addressed on a sliding scale of 25%/25%/20% over the following 3 regulatory periods, although the total time period may be reduced as some RAGs and CLAHs will be replaced through the asset replacement program.

This rate of replacement is prudent as:

- it allows the selection of devices to be replaced in any regulatory period to be optimised taking into account other programs of work such as undergrounding; and
- the annual volume of work and network access requirements can be accommodated without exceeding existing organisational capacity.

Table 4: Population of Lightning Protection Devices on HBFRA Power lines (Excluding 66kV)

HBFRA Power lines		RAG	CLAH	SUM RAG & CLAH	RAG or CLAH Replace Cost	Total Program Cost in HBFRA
HBFRA - 33kV	66	1591	280	1871	$4,670	$8,735,492
HBFRA - 19kV	89	2145	377	2522	$2,007	$5,062,487
HBFRA - 11kV	271	6531	1149	7681	$3,755	$28,840,698
	426	**10267**	**1807**	**12074**		**$42,638,677**

2.1.3 Undergrounding Power lines in HBRA's & Supplies to Bushfire Safer Places

Undergrounding of existing overhead 33kV and 11kV power lines significantly reduces bushfire start risk compared to bare overhead power lines which can be impacted by tree branches, animals and birds. Replacement of bare overhead conductors with overhead insulated conductors presents an improvement with respect to momentary contact from vegetation, animals and birds, but can still be subject to falling trees or branches, or impacts from foreign objects being blown by gale force winds, which can result in the conductor falling to the ground.

Many Australian Distribution Network Service Providers (**DNSPs**) are implementing schemes to underground overhead power lines, or installing insulated overhead conductors in high bushfire risk areas, to reduce fire start risk. Recommendation 27 of the VBRC related to the progressive replacement of distribution power lines with insulated overhead conductors, underground cable or other technology to reduce bushfire start risk. The Powerline Bushfire Safety Taskforce (**PBST**) recommended implementation of this recommendation by the targeted replacement of distribution power lines with underground cable or insulated overhead conductors.

Through a comprehensive Customer Engagement Program and subsequent Willingness to Pay analysis, SA Power Networks customers' advised that they are willing to contribute a small amount of funds through their annual electricity bills to improve bushfire safety through dedicated programs to place overhead power lines in HBFRAs underground in conjunction with vegetation management initiatives. Specifically, the Willingness to Pay analysis identified a willingness to fund an investment in 135 km of undergrounding over the next regulatory period.

Jacobs have determined that undergrounding for broad scale replacement of bare power lines is an unrealistic option due to the high cost. However targeted undergrounding of overhead power lines in HBFRAs to contribute to fire start reduction, and to provide a robust supply to BSPs is considered to be a prudent investment to both reduce the likelihood of fire starts from bare overhead power lines, as well as providing more secure supplies to BSPs, when implemented in accordance with strict prioritisation criteria.

The proposed program of work provides for targeted undergrounding of sections of high risk 33kV and 11kV overhead power lines in HBFRA's, as well as undergrounding of sections of power line to targeted BSP's. The underground option provides superior protection against supply interruption during catastrophic weather conditions compared with other network options particularly when there are fires in the area.

SA Power Networks is proposing to commence in 2015 a program to install approximately 135 km of targeted undergrounding on high risk sections of power lines. This equates to the undergrounding of approximately 1% of the highest risk sections of the network in HBFRAs. Running over 5 years, the program will deliver a secure supply to a selected set of BSPs and install additional targeted undergrounding in other high bush fire risk areas to reduce fire start risk. The total program cost across the 5 years is $128.6m.

2.1.4 Remote Generation option

A secure supply to BSPs could also be achieved through either the permanent installation of local generation, or deployment of microgrid technology in the BSP community. It is likely that installation of sufficient size local generation to cater for the maximum likely load in each BSP centre will prove to be a costly alternative to undergrounding, especially considering the cost and storage of the required diesel fuel, and the anticipated higher maintenance costs of such a system, as well as the consideration that the generation assets would be highly underutilised except for a small number of days per annum.

Microgrid technology is being trialled in other areas of SA Power Networks' system, and at this stage is not proven technically or commercially ready for widespread deployment, but in the future could prove to be a viable alternative to supply BSPs when the main power line is interrupted for any reason. Both of these alternative options may provide better security than bare power lines during bushfire events, however they do not contribute to hazard reduction to the same extent that undergrounding does.

In general terms, the cost of undergrounding varies with the cable route length, rather than the load to be supplied by the cable, due to the relatively high standard capacity of HV cables specified by SA Power Networks. However, for a local generation solution, the load to be supplied in a BSP will directly influence the cost of the isolated generation solution. Generation or microgrid solutions are likely be a more efficient supply alternative for remote townships where undergrounding lengthy sections of the 33kV network would be cost prohibitive.

2.2 Background

The risk of fire ignition from electricity assets is well known. Equally well known is that the total elimination of this risk would require expenditure which is cost prohibitive. SA Power Networks is committed to targeted investment to reduce the risk of fire start as far as practicable using a prudent allocation of funds, that is, *mitigate* the risk of bush fire, recognising that it is not financially prudent to *eliminate* this risk.

SA Power Networks has a comprehensive and mature Bushfire Risk Management System (**BRMS**) that is detailed in the Bushfire Risk Management Manual No 8[3]. The manual describes both longer term initiatives and annual bushfire management practices and processes. The present management system has been in place since the early 1980s after investigations into the impacts of the 1983 Ash Wednesday fires, and has been progressively improved since. The system was described in a recent report by Jacobs as "generally mature, logical, defendable", appropriately documented and well managed."

While historically bushfire risk management by SA Power Networks has been effective, an analysis of climatic trends by the Bureau of Meteorology (BoM) (refer to the Climate extremes analysis for SA Power Networks operations report, Regulatory Proposal Attachment 10.1) predicts that in South Australia, the conditions most conducive to intense and damaging fires are occurring on a more frequent basis. Given the outcomes of the Black Saturday bushfires of 2009, it is critically important that prudent bushfire mitigation efforts are undertaken having regard to this forecast increase in risk.

As explained previously, SA Power Networks engaged Jacobs, to identify prudent and targeted bushfire programs aimed at achieving the greatest level of reduction in fire risk, relative to the investment involved. The program is also designed to ensure SA Power Networks continues to operate in accordance with good electricity industry practice, having regard to comparative networks elsewhere in Australia.

The programs identified as a result of this analysis are set out below:

- progressive replacement of ageing recloser devices with modern SCADA controlled devices which can be operated remotely (detailed in this business case);

[3] SA Power Networks Bushfire Risk Management Manual No. 8 2014

- targeted replacement of bare 11kV and 33kV with underground cables to mitigate fire start risk in the highest risk areas, and to improve community safety by ensuring security of supply to targeted CFS Bushfire Safer Places (detailed in this business case);
- replacement of Rod Air Gaps (**RAGs**) and Current Limiting Arcing Horns (**CLAHs**) with surge arrestors (detailed in this business case);
- investigation of the potential future use of ground fault neutralising (**GFN**) technology (refer GFN Business Case Regulatory Proposal Attachment 20.70);
- scoping of the extent of metered mains installations in need of reconstruction and commencement of reconstruction works (refer Low Voltage Services AMP 3.1.08);
- improved backup protection on the rural network in accordance with the Protection and Control AMP 3.2.14;
- increased thermal inspection frequency (refer to Proposal supporting document 20.13); and
- increased cyclical asset inspection frequency (refer to Proposal supporting document 20.13).

SA Power Networks' Customer Engagement Program identified that customers place very significant priority on bushfire risk management and accordingly expect SA Power Networks to adopt appropriate bushfire risk management practices, commensurate with good electrical industry practice. This practice is now set through the VBRC and PBST outcomes and subsequent Victorian Government directions. Section 3.4 clearly outlines the extent of customer support through customers' Willingness to Pay for such work. Our Bushfire Risk Management program represents a prudent approach at a forecast cost of $221.7 million.

Relevant to the Bushfire Risk Management program are those objectives regarding maintaining the quality, reliability and security of SA Power Networks Standard Control Services (SCS) (sections 6.5.7(a)(3) and 6.5.6(a)(3) of the NER).

The Jacobs 'Bushfire risk reduction strategies' report outlines the program in further detail and the 'Bushfire Mitigation' summary report (Regulatory Proposal Attachment 20.50), demonstrates in greater detail that:

1. bushfire mitigation is critical to maintaining the quality, reliability and security of SA Power Networks' SCS;
2. the proposed bushfire mitigation strategies are a cost efficient way of achieving that objective;
3. a prudent operator in SA Power Networks' circumstances would implement the proposed strategies; and
4. the forecast capital and operating costs associated with the proposed strategies are realistic expectations of those costs.

The nature of power line faults

Power line faults can release sufficient energy that can very quickly lead to a bushfire under Total Fire Ban conditions, and particularly on Catastrophic Fire Danger days. On other days the moisture content of vegetation and other combustible material is high and has a lower likelihood of ignition.

Bushfires can be started when power lines:

- fall to the ground and the consequential electric arc ignites surrounding vegetation or other combustible material;
- clash thereby releasing hot molten metal particles which ignite dry materials on which they fall; and
- are subject to momentary contact by vegetation, animals, birds, or impacts from foreign objects being blown by strong winds, which can bring conductors to the ground, or cause ignition from the current that flows through the contacting foreign object.

SA Power Networks' bushfire mitigation strategies are directed towards the reduction of fire start risk from its power lines on extreme fire danger days.

As part of the implementation of the BRMS, SA Power Networks adopts well proven risk management principles to assess the likelihood and consequence of fire starts from the SA Power Networks system. The operational plans for bushfire preparedness include an annual Fire Danger Level Exercise, and a range of other strategies on asset management, operator management and customer management. These plans also cover risk mitigation down to the individual distribution feeder level, to optimise expenditure on fire start risk reduction initiatives.

To facilitate this risk management approach, many sources of data are assessed, and the key sources are described in the following sections.

2.3 Fire Start Data

Despite the well documented capability of the SA Power Networks BRMS, incidents beyond the control of SA Power Networks may still occur, and over the last 5 years, SA Power Networks has recorded data indicating 339 fire starts across SA that could be attributed to the SA Power Networks system, or around 68 per year on average, as detailed in Table 5.

Table 5: SA Power Networks Fire Start Statistics 2008 – 2012

SAPN No of Fire Starts 2008 - 2012	Voltage						
	LV	7.6 & 11 kV	33kV	19kV	66kV	TOTAL	Average per Year
Total No. of fire starts	68	172	58	38	3	339	**68**
% Contribution to total	20%	51%	17%	11%	1%		
Bushfire Risk Area							
HBFRA	31	75	22	5	2	135	**27**
% Contribution to total HBFRA	23%	56%	16%	4%	1%		
MBFRA	13	50	34	33	1	131	**26**
% Contribution to total MBFRA	10%	38%	26%	25%	1%		
NBFRA	24	47	2	0	0	73	**15**
% Contribution to total MBFRA	33%	64%	3%	0%	0%		

SAPN Fire starts per 1,000 kms	Voltage					
Bushfire Risk Area	LV	7.6 & 11 kV	33kV	19kV	66kV	TOTAL
HBFRA	9	11	24	2	8	53
% Contribution to total	17%	20%	45%	3%	16%	
MBFRA	4	8	13	1	1	28
% Contribution to total	14%	30%	47%	5%	5%	
NBFRA	2	10	5	0	0	16
% Contribution to total	11%	61%	28%	0%	0%	

The Electricity (Principles of Vegetation Clearance) Regulations 2010[4], specify the definitions of Bushfire Risk Areas (**BFRA**) and Non-Bushfire Risk Areas (**NBFRA**), and also include maps which delineate the relevant parts of the state that fall into each category. For the purposes of recording

[4] Electricity (Principles of Vegetation Clearance) Regulations 1996

fire start data, and implementing bushfire mitigation strategies, SA Power Networks has further defined the BFRA into High and Medium risk, and these are described below:

Medium Bushfire Risk Area (**MBFRA**)
The MBFRA is defined as an area where a fire could start and readily escape to an unrestricted area of flammable material causing Moderate Consequences. The relevant parts of the State are shown in the maps in Schedule 4 of the Electricity (Principles of Vegetation Clearance) Regulations 2011.

High Bushfire Risk Area (**HBFRA**)
The HBFRA is a subset of the MBFRA (as defined by SA Power Networks) and is an area where a fire could start and readily escape into an unrestricted area of flammable material causing Major to Catastrophic Consequences, broadly classified as areas which receive 600mm or more rainfall.

Non-Bushfire Risk Area (**NBFRA**)
The NBFRA is as defined in the Electricity (Principles of Vegetation Clearance) Regulations 1996 Schedule 3.

The number of fire starts in SA requires vigilance by SA Power Networks to continue working towards fire start reduction. As discussed by Jacobs, even a single fire start on an extreme fire risk day in a location with hilly terrain and large quantities of dry grass and/or forest fuels could result in another catastrophic bushfire in SA, something that SA Power Networks is very focused on avoiding.

SA Power Networks has over 11,000 kms of 11kV/19kV/33kV power lines in the HBFRA, and over 33,000 kms of high voltage power lines in the MBFRA. This is a large asset base and risk reduction programs will necessarily require many years to complete.

From the fire start data shown above in Table 5, a number of conclusions can be made:

- the highest proportion of total events are caused by the 11kV network, so measures that can be implemented economically on this part of the network would be prudent to investigate;
- the 33kV network contributes the highest proportion of fire start incidents in bushfire risk areas when measured on fire starts per 1,000km of route length, so measures that can be implemented economically on this part of the network would proportionately contribute greater benefits in fire start reductions; and
- the 66kV sub-transmission network does not contribute to many fire start events and hence current maintenance programs are effective in fire start risk reduction.

Jacobs highlights differences in SA Power Networks' construction standards from those interstate which assists with reducing bushfire starts:

(i) concrete and steel poles (Stobie poles) are used in SA, whereas wooden poles are generally used interstate. Stobie poles have consistent mechanical strength, are not combustible and are not prone to termite attack. This results in longer life and a lower likelihood of failure in high winds;

(ii) steel cross arms are used in SA for all voltages in bushfire risk areas compared to a wider use of timber interstate. Unlike wooden cross arms, steel cross arms are not combustible and do not catch fire during events such as flashover (caused by conductors on cross arms) or lightning surge; and

(iii) in many locations, SA Power Networks uses a common multiple earthed neutral (**CMEN**) arrangement that provides a low impedance path for fault current back to the source zone substation. CMEN, coupled with steel cross arms and steel poles, provides low impedance for earth fault currents resulting in generally fast protection operation and clearance.

2.4 Bushfire Loss (Consequence) Modelling

Recently, SA Power Networks commissioned Willis Risk Services (**Willis**) to undertake Bushfire consequence modelling for ten specific regions of SA covered by their distribution network. The reports produced by Willis[5] determined the current level of risk and exposure to bushfires by utilising their own Bushfire risk model, and clearly demonstrates the magnitude of financial loss that could reasonably be expected to occur if a bushfire was to occur in one of these regions.

Table 6: WILLIS Total Financial Loss Modelling July 2014

		$M				
Region	**Estimated number of addresses**	**Residential Property Damage**	**Fatalities & Injuries**	**Other Costs**	**Claims Handling**	**Total**
Adelaide Hills	847	263	17	183	46	509
Port Lincoln	821	228	16	158	40	442
Kangaroo Island	417	170	8	118	30	326
South East	594	134	12	93	24	264
Clare	448	109	9	76	19	213
Willunga	402	100	8	69	18	194
Bangor	359	65	7	45	12	129
West Coast	227	49	4	34	9	96
Riverland	287	44	6	30	8	88
Yorke Peninsula	161	28	3	20	5	56

The Willis analysis concluded that the area of highest potential cost is Adelaide Hills, and that this cost could be in the region of $509m per bushfire event. The loss calculation included Bushfire Attack Level analysis, property values, potential fatalities and land use. Through Willis' sensitivity analysis, the location of maximum loss was determined with high confidence.

SA Power Networks with Willis' input settled on a maximum two fire scenario in the Adelaide Hills, each fire causing a loss of $509M, and hence a Maximum Probable Loss of $1.018 billion, from a Catastrophic Fire Danger day.

2.5 Assessment of Weather Trends in the Context of Fire Starts

The Australian Government Bureau of Meteorology (**BoM**) recently produced a report for SA Power Networks[6] that assessed trends and variability of climate and weather parameters known to impact SA Power Networks' operations. This report demonstrates that in SA, the conditions most conducive to intense and damaging fires are occurring on a more frequent basis. It is important that prudent bushfire mitigation efforts are undertaken having regard to this forecast increase in risk.

5 Willis Risk Services – Bushfire Modelling, Dec 13 & April 2014
6 BoM - Climate Extremes Analysis for SA Power Networks Operations, July 2014

The BoM report concluded that:

> ***Higher temperatures***
> Analysis across the South Australian agricultural area as a whole, and at individual weather stations, clearly indicate a warming trend in the last few decades of about 1^0C in both average daytime and night-time temperatures, consistent with trends observed for Australia. Average Daily Temperatures (ADT = ½ (Max temp + Min temp)) greater than 32.5^0C are known to impact SA Power Networks operations, and the frequency of such events has generally doubled since 2000. Many southern areas which have had few, if any, such days prior to the year 2000, have been experiencing them regularly since then. With further temperature rises likely over the next 5 to 10 year timeframe, *this trend to greater numbers of days with extreme temperatures is likely to continue.*
>
> ***Increased fire risk***
> Along with increasing temperatures, the number of Severe, Extreme or Catastrophic Fire Danger Rating days in summer has increased by between 1.7 and 2.5 times since 2000, in the Mount Lofty Ranges and at Port Lincoln. *This increased fire risk is likely to remain or increase further with increased temperatures over the next 5 to 10 year timeframe.*
>
> ***Thunderstorm and lightning activity***
> Thunderstorm and lightning activity has varied significantly across South Australia, with low levels of activity prior to the mid-1970's, much increased activity from then until the late 1990's, and somewhat decreased levels since 2000. Correlations with the Inter-decadal Pacific Oscillation, a major mode of climate variability, suggest *increased thunderstorm and lightning activity may occur in the next 10 to 20 year timeframe.*
>
> ***Vegetation related damage***
> No increase in either sustained wind events or extreme wind gusts is seen in the available data. It is noted that extreme wind events in the Adelaide region cluster in the period June to December but more particularly August to October. A significant increase in the duration of heat events, which is likely to cause heat stress in trees, has been observed since the late 1990's. This suggests that *when wind events do occur, the increased heat stress may result in more material being blown around by winds.*

Since the 1970s there has been an increase in the incidence of extreme fire weather and a longer fire season across large parts of Australia, with the largest increases occurring in the south east and inland. Continued increases in extreme temperatures are likely, evidenced by the fact that over a period of about 55 years the number of record hot days across Australia has doubled.[7]

As explained in section 2.6, electricity-caused fires are more likely to occur on extreme fire danger days. This coupled with forecasts of more frequent and extreme high temperature days, means that not only are the number of electricity-caused fires likely to increase, but those fires are likely to be more intense and create more damage, if efforts to mitigate fire start risk are not escalated.

In summary, the BoM report suggests that the environment for the propagation of bushfires will continue to be unfavourable, and the long-term weather patterns and associated risks reinforce the importance of undertaking prudent investment to maintain the safety and operation of electricity assets to reduce the likelihood of starting fires.

---

[7] Climate Commission, *The Critical Decade: Extreme Weather*, April 2013, page 19.

2.6 Learnings from Victoria – Black Saturday Reflections

The investigations into the 2009 Black Saturday bushfires in Victoria, comprising the 2009 Victorian Bushfires Royal Commission (**VBRC**)[8], the Victorian Governments response to key findings of the Royal Commission[9], and the report from the Powerline Bushfire Safety Taskforce (**PBST**)[10] have been reviewed in detail and assessed for relevance to the SA Power Networks Bushfire Management system. Their recommendations are documented in a number of reports produced by Jacobs over the last 2 years. These are referenced throughout this discussion.

The findings from the VBRC observed "…on days of extreme fire danger, the percentage of fires linked to electrical assets rises dramatically…" and "…electricity-caused fires are most likely to occur when the risk of a fire getting out of control and having deadly consequences is greatest…" The VBRC further observed that "...with populations at the rural-urban interface growing and the impact of climate change, the risks associated with bushfire are likely to increase…"

Jacobs in their final report recommended that through the experiences derived from the Victorian bushfires, SA Power Networks should implement a prudent range of measures that have the potential to reduce the likelihood of SA Power Networks network assets contributing to fire starts in the future, and continue to allow SA Power Networks to operate in a manner consistent with "good industry practice".

2.7 SA Power Networks Feeder Prioritisation Model

SA Power Networks has developed a feeder (power line) model to rank power lines for bushfire risk mitigation work.

The prioritisation model takes into account risk elements including:

- the distance a crew needs to travel to manually apply Non-Auto operations on a feeder;
- the more difficult the terrain to traverse to get to a recloser or switch, the more problematic it is to send a line crew to effect Non-Auto operations;
- the longer the length of bare overhead line in a bushfire risk area, the more risk it presents; and
- the more customers supplied by the feeder, the bigger the impact.

The methodology involves a risk calculation of the probability of a feeder starting a fire, and the consequences of a fire starting from that feeder. The calculated risk is the product of these factors and the higher the risk, the greater the priority for action:

P(E) x C(E) = the Risk presented by an SA Power Networks line

where P(E) = The weighted average of the probability factors

and C(E) = Maximum probable loss moderated by other factors

The probability and consequence calculations shown above take into account a range of factors that are detailed in Appendix A – **Feeder Prioritisation Model**, and some factors of interest are:

[8] The 2009 Victorian Bushfires Royal Commission – Teague et al

[9] Victorian Government Response to The 2009 Victorian Bushfires Royal Commission Recommendations 27 and 32

[10] The Powerline Bushfire Safety Taskforce – Final Report, Sep 2011

- How often does the Fire Ban District (**FBD**) in which that feeder is located, experience Total Fire Ban (**TOBAN**) days ie high fire danger weather?
- How many fires have there been since 2008?
- How far from the depot is the recloser?
- With reference to the Willis report, what could the expected losses be?
- Does the feeder supply a Bushfire Safer Precinct (BSP) location?
- How many customers are supplied by this feeder?
- How many CFS Fire stations around that BSP?

2.8 Jacobs Recommended Strategies

The Jacobs' Recommended Bushfire Risk Reduction Strategies report made a number of recommendations regarding the highest priority areas for SA Power Networks to focus on to further reduce the likelihood of SA Power Networks' assets contributing to fire starts in bushfire risk areas. The eight strategies recommended are detailed in Table 7 below. The expenditure estimates were high level and included for the purposes of budgeting and program scale, and three specific programs 1, 2, and 5 are detailed in this business case.

Table 7: Jacobs Recommended Bushfire Mitigation Strategies ($ June 15)

Strategy No.	Strategy Description	2015/16	2016/17	2017/18	2018/19	2019/20	Total[11]
1	Replace 33kV, 19kV and 11kV reclosers with SCADA controlled modern units	$3.6m	$3.6m	$3.6m	$3.6m	$3.6m	$18.0m
2	Replace high risk power lines with modern construction[12] (BSP's)	$5.7m	$5.9m	$3.8m	$6.3m	$4.9m	$26.6m
3	Increase the frequency of asset inspections	$2.3m	$2.6m	$2.7m	$2.7m	$2.7m	$13.0m
4	Extend and increase the frequency of thermographic asset inspections	$0.5m	$0.5m	$0.5m	$0.5m	$0.5m	$2.5m
5	Replace rod air gaps and current limiting arcing horns with Surge Arrestors	$2.4m	$2.4m	$2.4m	$2.4m	$2.4m	$12.2m
6	Undertake field simulation, testing and trial installation of Ground Fault Neutralisation Technology	$0.0m	$1.0m	$4.0m	$5.0m	$2.0m	$12.0m
7	Reconstruct metered mains	$4.1m	$8.2m	$8.2m	$8.2m	$4.1m	$32.8m
8	Backup protection	$2.9m	$3.0m	$3.4m	$3.6m	$5.6m	$18.5m
	Totals	**$21.5m**	**$27.2m**	**$28.6m**	**$32.3m**	**$25.8m**	**$135.6m**

The three programs highlighted in Table 7 above, and investigated in detail in this business case, are entirely consistent with the priority target areas identified from the fire start data in Table 5. The remaining 5 programs recommended by Jacobs are also being investigated by SA Power Networks and are the subject of other investigations and business cases.

[11] Totals may not equate due to rounding.

[12] Jacobs recognised undergrounding as a potential solution to reduce fire start risk and in addition provide a robust all-weather supply to Bushfire Safer Precincts (BSP). The amount excludes additional Willingness to Pay undergrounding in HBFRAs.

2.9 Risk Management Framework

The SA Power Networks corporate Risk Management framework was used to undertake an inherent risk assessment for the purpose of this business case. The highlighted portions of the Risk Management framework are applicable for Electricity initiated fires.

2.9.1 Qualitative Measures of Probability (Likelihood)

Rating	Description	Description	Probability	Typical Frequency
5	Almost certain	Is expected to occur	96-100%	At least one event per year
4	Likely	Will probably occur	81-95%	One event per year on average
3	Possible	May occur	21-80%	One event per 2-10 years
2	Unlikely	Not likely to occur	6-20%	One event per 11-50 years
1	Rare	Most unlikely to occur	0-5%	One event per 51-100 years

2.9.2 Qualitative Measures of Consequence or Impact

Level	Minimal 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Financial	Less than $100 000	$100 000 or more, but less than $1 m	$1 m or more, but less than $10 m	$10 m or more, but less than $100 m	$100 m or more
Safety	• Incident but no injury.	• Medical treatment only.	• Lost time injury.	• Death or permanent disability.	• Multiple fatalities.
Environment	• Brief spill incident. • No environmental damage.	• Minor spill incident. • Pollution on site. • No environmental damage.	• Escape of pollutant causing environmental damage.	• Significant pollution on and off site <$0.5 m.	• Long term environmental damage.

2.9.3 Qualitative Risk Analysis Matrix (Level of Risk)

	Consequences				
Probability	Minimal 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
5 Almost Certain	Medium	High	High	Extreme	Extreme
4 Likely	Low	Medium	High	High	Extreme
3 Possible	Low	Low	Medium	High	High
2 Unlikely	Negligible	Low	Low	Medium	High
1 Rare	Negligible	Negligible	Low	Low	Medium

2.9.4 Risk Management - Response Level Required

Risk Level	Responsible Person	Action
Extreme	General Manager	Manage via a detailed control plan.
High	General Manager	Allocate responsibility to appropriate manager.
Medium	Manager	Manage by specific monitoring and response procedures.
Low	Manager	Manage by routine procedures.
Negligible	Manager	Monitor.

2.9.5 RISK TREATMENT – SA POWER NETWORKS EXAMPLES

ACTIONS TO REDUCE OR CONTROL "PROBABILITY"	PROCEDURES TO REDUCE OR CONTROL "CONSEQUENCES"
Audit and compliance programmes	Minimisation of exposure to risk
Formal review of requirements, specifications, design, engineering, maintenance and operations	Separation or relocation of an activity
Inspections and process controls	Disaster recovery plans
Project management	Contingency planning
	Education and or public relations programmes

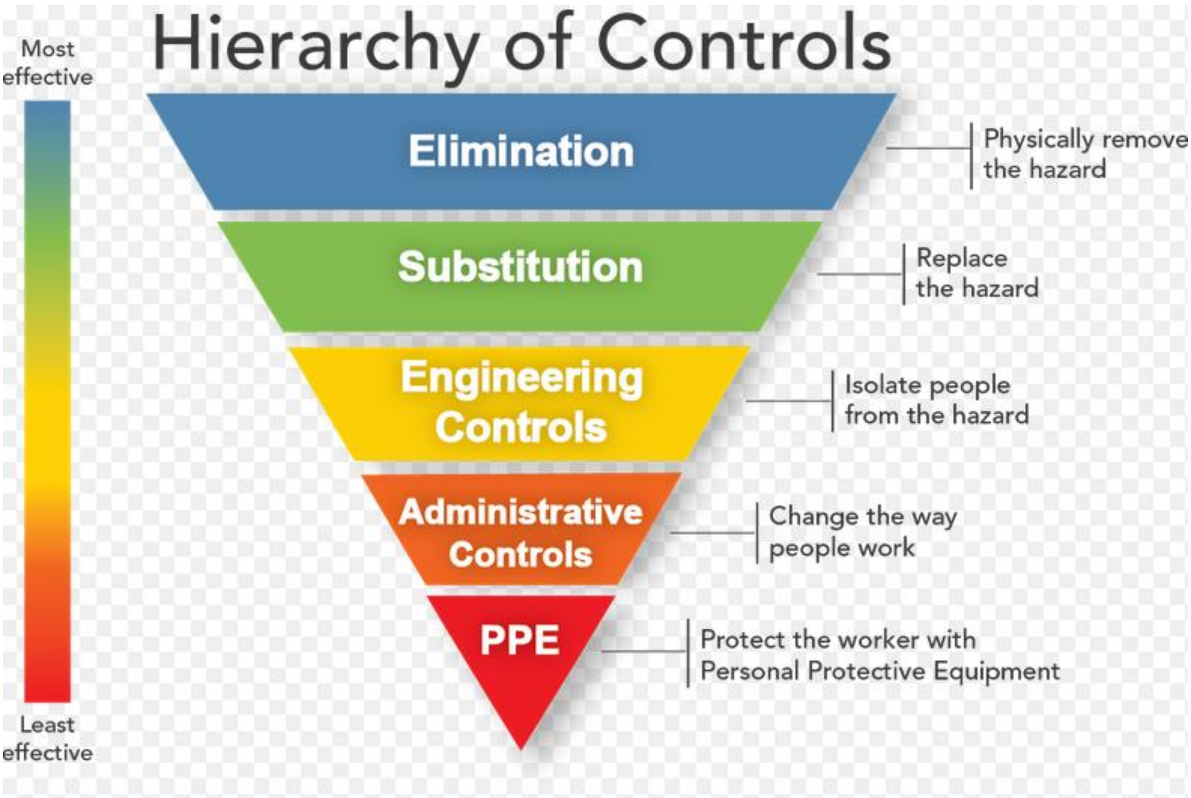
In accordance with the level of response required by the inherent bushfire start risk from SA Power Networks assets, Manager Emergency Management manages the Summer Preparations Plan Action Plan which is a detailed control plan to manage bushfire risk. Progress on this plan is reported to both executive management and the SA Power Networks Board.

Various actions are taken by SA Power Networks to reduce both likelihood and consequence of bushfire risk, and the programs discussed in this business case contribute to this risk reduction.

Despite these risk control measures, the residual risk is likely to remain in the High to Extreme range. This requires ongoing vigilance by SA Power Networks to reduce the future likelihood of fire starts, and manage the impact of fire starts on assets, staff and the public.

According to best practice thinking on risk management, the adoption of the hierarchy of controls is a good option for SA Power Networks to follow.

The hazard control hierarchy consist of a graded list of hazard controls ranking from most effective to least effective, and are often shown in illustrative form as a triangle – see below.



In order of decreasing effectiveness, they include Elimination, Substitution, Engineering, Administrative, and Personal Protective Equipment. This hazard control hierarchy is useful to guide SA Power Networks towards the most effective options to reduce the likelihood of SA Power Networks' assets causing fire starts in the future.

For instance, it is not possible for SA Power Networks to "eliminate" the fire start risk totally by removing its electrical network from HBFRAs, but it is realistic to "substitute" one type of network arrangement (eg overhead power lines) for another less hazardous (from a fire start perspective) type of network arrangement (eg underground cables). It is for this reason that the undergrounding of power lines in HBFRAs has taken some prominence in the bushfire mitigation program.

SA Power Networks has chosen this method of securing supplies to BSPs and for reducing fire start risk in HBFRAs as a more effective hazard reduction measure than replacing bare overhead HV power lines with spacer cables (Hendrix) or HV Aerial Bundled Conductor (HVABC) in the *highest risk* parts of our network. Both of these alternatives are inherently less likely than bare HV power lines to cause a fire start if damaged by intermittent contact by birds, animals or tree branches, but can still be damaged by large falling trees and branches, damaged by strong wind, lightning or ground fire, or by flying debris blown around by strong winds during storm events or hot, blustery winds driven by bushfires. Hendrix or HVABC conductor solutions may be considered for MBFRAs in the future.

Another useful example of the adoption of this control hierarchy methodology is in the choice of new surge arrester to replace the older style RAGs and CLAHs. SA Power Networks is not able to remove surge arrester devices from the electrical network, as they form an integral method of damage mitigation from lightning strikes and switching surges that are constantly present in overhead electrical networks. However, by substituting the older style RAGs and CLAHs with a sealed modern unit, that has no bare metallic components, the risk of animals and birds causing contact that leads to fault energy being expelled is vastly reduced, hence reducing the overall hazard in relation to possible fire start events.

2.10 Relationship to Business Strategies and Programs

The project contributes to achievement of strategic objectives as described below.

Table 8: Contribution to corporate strategic objectives

Corporate Strategic Objective	Contribution
Delivering on the needs of our shareholders, by achieving our target returns, maintaining the business' risk profile, and protecting the long term value of the business	The proposed program will help manage the business' key risk exposures..
Providing customers with safe, reliable, value for money electricity distribution services, and information that meets their needs	Customers have provided clear support for the proposed investment in undergrounding through feedback received via **Willingness to Pay** surveys. In combination the solutions deployed through the proposed project are consistent with recommendations arising from the VBRC regarding prudent actions to reduce fire start risks and will establish high security supplies to selected BSPs.
Maintaining our business standing in the community as an exemplary corporate citizen of South Australia.	The program supports the SA Government's policy to improve fire safety by establishing CFS BSPs and responds to the feedback received from customers regarding Willingness to Pay.

2.11 Relationship to National Electricity Rules Expenditure Objectives

Table 9: Contribution to the National Electricity Rules expenditure objectives

National Expenditure Objectives	Contribution
6.5.7(a)(3) maintaining the quality, reliability and security of SA Power Networks Standard Control Services	Reduce the likelihood of SA Power Networks' assets contributing to fire starts. Ensure the integrity of the SA Power Networks supply system as far as reasonably practical, during bushfire events.
6.5.7 (a) (4) Maintain the safety of the distribution system through the supply of Standard Control Services	Maintain a more secure supply to BSPs during catastrophic weather events and bushfires

2.12 Meeting the National Electricity Rules Expenditure Criteria

Table 10: Activities to Meet the National Electricity Rules expenditure objectives

National Expenditure Criteria	Activity
Efficient cost of achieving the objective(s)	Unit costs for the activities are benchmarked, averaged across a range of similar activities, and work packaging managed to enhance field efficiency.
Cost of a prudent operator	Each program has been prioritised using standard risk based processes, and with a focus on highest impact towards achieving objectives, and part of a long term strategy, with no sharp step-change expenditure.
Realistic expectation of forecast and cost impact	Each program is associated with a long term strategy to achieve stated benefits, with this business case focusing on the next phase of program delivery.

3. Scope

Reduce the likelihood of SA Power Networks assets causing fire starts and improve security of supply to selected BSPs, through targeted investments in:

1. replacing ageing mechanical 33kV, 19kV and 11kV pole mounted reclosers with modern equipment, complete with SCADA control to reduce the likelihood of fire starts;
2. replacing out-dated lightning protection systems such as RAG's and CLAH's with modern surge arresters to reduce the likelihood of fire starts; and
3. undergrounding electricity supplies to targeted CFS BSP's and place high risk sections of the network in HBFRAs, underground to achieve the volumetric target supported by customers.

3.1 Recloser Replacement & SCADA Installation

SA Power Networks has many ageing 33kV, 19kV and 11kV reclosers in service that require replacement with modern SCADA controlled units, to reduce the fire start risk and improve safety for the community and power line workers.

The Recloser population data is shown in Table 11 below:

Table 11: SA Power Networks Recloser Population

Bushfire Zone	Total Reclosers	Reclosers not on SCADA			
		Total	33kV	19kV	11/7.6kV
No Bushfire Zone	255				
Medium Bushfire Zone	726	481	27	367	87
High Bushfire Zone	315	206	13	69	124
Total	**1296**	**687**	**40**	**436**	**211**

The scope of the recloser replacement program for reclosers without SCADA in HBFRA includes:

- installation of 151 off 11kV, 19kV and 33kV line reclosers with new equipment;
- these new reclosers are made by Nulec/Schneider, Noja Power, and Coopers;
- they are fitted with electronic protection relays that allow for very fast first fault clearance (50-80ms), have multi-shot re-close capability when required, have the ability to set multiple protection groups, and can be paired with industry standard SCADA controllers;
- they will be fitted with remote communications (Fibre, Radio or NextG) to allow full SCADA capability of monitoring and control, including the ability to trip/disconnect remotely, set the trip circuit to non-auto, and to alter protection groups at the full discretion of the Network Operations Centre; and
- the unit rate adopted for the installation of each recloser includes allowance to upgrade the existing pole if deemed necessary, additional standard lightning protection, individual voltage transformer (**VT**) installation for local power supply, apply protection settings and review co-ordination with upstream and downstream devices such as sectionalisers, installation of appropriate communications bearer for each site, and back end ADMS functionality.

This program has taken into account related programs as follows to ensure programs are not doubled up, but does not specifically include any details of these programs:

- backup protection project – this project addresses 55 reclosers in HBFRAs; and
- SCADA roll-out in Zone Substations;

Priority will be given to 33kV and 11kV in HBFRA, followed by 19kV in HBFRA. Then consideration will be given to extending the programme for 33kV, 19kV and 11kV reclosers in MBFRA in future RCPs. The priority order is based on risk management principles and takes into account:

1. feeder reliability history;
2. fire start history;
3. length of line protected by the recloser;
4. number of Total Fire Ban (**TOBAN**) days;
5. feeder voltage; and
6. the potential losses from a bushfire taking into account population, terrain, fuel loads and fuel types.

The approximate cost of replacing an ageing recloser with a modern unit is about $120,000, which includes SCADA and the associated communications equipment. Refer to Table 12 for the forecast for the bushfire recloser program.

Table 12: Recloser replacement program in HBFRA

Recloser program	2015/16	2016/17	2017/18	2018/19	2019/20
Replace 30 per annum non-SCADA 33kV, 19kV, 7.6kV & 11kV reclosers with SCADA Controlled Reclosers	$3.6m	$3.6m	$3.6m	$3.6m	$3.6m

3.2 Replacing Rod Air Gaps and Current Limiting Arcing Horns with Surge Arresters

It is estimated that SA Power Networks has a population of over 70,000 lightning protection devices on its distribution network (7.6kV/11kV/19kV/33kV) as per the data in Table 13 below. Many of these are in high and medium bushfire risk areas, and as recommended by Jacobs, it is prudent to undertake a retrofit program.

Examination by Jacobs of SA Power Networks' fire start records indicated that over the 5 year period of analysis, about 32 fire starts in HBFRAs and MBFRAs could have been prevented if RAGs had been replaced with surge arrestors. It is prudent to commence a targeted replacement program to replace the lower performing devices over time.

SA Power Networks is proposing to replace the total population of RAGs and CLAHs in HBFRAs over the next 4 regulatory periods, commencing with approximately 30% of the population over the next 5 years, refer Table 13.

Table 13: RAGs and CLAHs replacement program in HBFRA

HBFRA Feeders	RAG's & CLAH's	1st 5 Yr program = 30% of total		RAG's & CLAH's	2nd 5 Yr program = 25% of total	
HBFRA - 33kV	1871	$4,670	$8,737,570	0	$4,670	$0
HBFRA - 19kV	345	$2,007	$691,438	797	$2,007	$1,598,950
HBFRA - 11kV	745	$3,755	$2,797,475	2493	$3,755	$9,361,215
	2961		**$12,226,483**	**3290**		**$10,960,165**

HBFRA Feeders	RAG's & CLAH's	3rd 5 Yr program = 25% of total		RAG's & CLAH's	4th 5 Yr program = 20% of total	
HBFRA - 33kV	0	$4,670	$0	0	$4,670	$0
HBFRA - 19kV	797	$2,007	$1,598,950	585	$2,007	$1,173,148
HBFRA - 11kV	2413	$3,755	$9,060,719	2030	$3,755	$7,621,386
	3210		**$10,659,669**	**2614**		**$8,794,534**

The implementation strategy will use the results of fire consequence modeling to identify locations of highest consequence. Power lines targeted for replacement will then be prioritised on the basis of:

- which line voltages lead to the most fire starts;
- which power lines have the highest numbers of CLAHs or RAGs to replace; and
- where there is a history of fires starting due to bird interference with line hardware.

The replacement of 33kV rod gaps or CLAHs with surge arrestors costs about $4,670 per set.
The replacement of 19kV rod gaps or CLAHs with surge arrestors costs about $2,007 each.
The replacement of 11kV rod gaps or CLAHs with surge arrestors costs about $3,755 per set.

The program discussed in this business case is intended to replace in the order of 2,960 RAGs and CLAHs over the next 5 year regulatory determination period. This rate of replacement is prudent as:

- it allows the selection of devices to be replaced in any regulatory period to be optimised taking into account other programs of work such as undergrounding; and
- the annual volume of work and network access requirements can be accommodated without exceeding existing organisational capability.

Refer to Table 14 for the forecast for the bushfire surge arrestor program.

Table 14: Surge Arrester Program

	2015/16	2016/17	2017/18	2018/19	2019/20
Replace targeted RAGs or CLAHs with Surge Arrestors in HBFRA	$2.4m	$2.4m	$2.4m	$2.4m	$2.4m

3.3 Undergrounding targeted sections of power lines

The current data on overhead conductors and underground cables for SA Power Networks is shown in Table 15 below.

Table 15: SA Power Networks Conductor Data

SAPN Asset Data (Km)									
Voltage	**High Bushfire risk area**	**% OH HBFRA**	**BushFire Risk area**	**% OH BFRA**	**Non Bushfire risk area**	**% OH NBFRA**	**% Conductor**	**Totals**	
66 kV **Over head**	241	1.62%	688	1.83%	490	2.46%	0.27	1419	
Underground	5		1		42			48	1467
33kV **Over head**	931	6.27%	2575	6.83%	429	2.15%	1.05	3935	
Underground	16		25		57			98	4033
19kV **Over head**	3082	20.74%	25171	66.78%	836	4.20%	3.48	29089	
Underground	13		41		5			59	29148
11/7.6 kV **Over head**	7097	47.76%	5902	15.66%	4710	23.65%	8.01	17709	
Underground	729		280		2794			3803	21512
LV **Overhead**	3509	23.61%	3356	8.90%	13452	67.54%	3.96	20317	
Underground	1095		1280		9739			12114	32431
Total Conductor									88591
Total OH	14860		37693		19917			72470	
Total UG	1858		1626		12637			16121	
UG percentage of total	11.11%		4.14%		38.82%			18.20%	

Undergrounding of overhead 33kV and 11kV power lines, or replacing with covered conductors, effectively eliminates the bushfire start risk when compared to bare overhead power lines that are impacted by external objects such as tree branches, animals, birds, and flying debris during storms.

Many Australian DNSPs are implementing schemes to underground network assets using strict investment criteria, or are installing insulated conductors in high bushfire risk areas to reduce fire start risk from conductors clashing in high winds, vegetation contact or contact with animals or birds.

Recommendation 27 of the VBRC is about the progressive replacement of distribution power lines with HVABC, underground cable or other technology that delivers greatly reduced bushfire risk. The PBST recommended implementation of this recommendation by the targeted replacement of distribution power lines with underground or insulated overhead cable.

Jacobs has determined that undergrounding of overhead HV power lines is a cost prohibitive option for broad scale replacement of bare power lines, however targeted undergrounding of the highest risk sections of power lines in the HBFRAs and the implementation of more secure supplies to CFS BSP's[13] , has been considered by SA Power Networks to be a prudent initial investment to both gradually reduce the likelihood of fire starts from bare overhead power lines, as well as providing secure supplies to BSP centres during catastrophic weather conditions.

SA Power Networks is proposing to commence a program in 2015to underground approximately 135 km of power lines (up to a maximum investment of $128.6m), including CFS BSPs. When fully implemented, this program would increase the length of underground power lines in HBFRAs from

13 http://www.cfs.sa.gov.au/site/prepare_for_bushfire/know_your_area/bushfire_safer_places.jsp

1858 km to 1993 km, and increase the percentage of total power lines in HBFRAs that are underground from 11.11% to 11.92%.

Whilst the program is only targeting 0.8% of the overhead power lines in HBFRA's, the program is very effective when combined with the recloser and surge arrestor program, as it is addressing the highest risk sections of the network in an efficient manner ie it is not broad scale undergrounding of an entire power line. For lower risk areas in future Regulatory Control Periods (**RCPs**), a targeted covered conductor program may be considered.

Running over 5 years, the program will deliver a more secure supply to a targeted set of BSPs identified in Table 16 and install additional undergrounding in other high bush fire risk areas to reduce fire start risk. The total program cost across the 5 years is $128.6m (refer to Table 17), of which the BSP portion of undergrounding is estimated at $26.6m (refer to Table 17). To assist with delivery, the undergrounding program has been profiled.

Table16: BSP High Priority sites

COUNCIL NAME	Township	Fire Ban District	Population	H or MBFRA	Historical fire Freq	Fire depots within 10km of BSP	Fire scar & proximity to BSP	Cost of selected BSPs
MOUNT BARKER	Mount Barker	Mount Lofty Ranges	11809	H	2	8	3	**$2.8**
MITCHAM	Blackwood	Mount Lofty Ranges	4053	H	1	0	1	**$2.9**
GAWLER	Gawler East	Mount Lofty Ranges	4740	H	2	4	1	**$4.0**
VICTOR HARBOR	Victor Harbor	Mount Lofty Ranges	4123	H	1	3	1	**$1.9**
ALEXANDRINA	Strathalbyn	Mount Lofty Ranges	3894	M	1	1	1	**$0.3**
ONKAPARINGA	Willunga	Mount Lofty Ranges	2416	H	1	5	1	**$1.3**
ONKAPARINGA	McLaren Flat	Mount Lofty Ranges	1310	H	2	6	1	**$2.2**
YANKALILLA	Normanville	Mount Lofty Ranges	1356	H	2	1	1	**$3.0**
ADELAIDE HILLS	Uraidla	Mount Lofty Ranges	461	H	3	3	3	**$0.7**
ALEXANDRINA	Goolwa	Mount Lofty Ranges	5882	H	0	3	1	**$2.6**
MOUNT GAMBIER	Mount Gambier	Lower South East	24905	H	1	5	1	**$4.0**
HAHNDORF	Hahndorf	Mount Lofty Ranges	2547	H	2	12	2	**$0.9**
							TOTAL	**$26.6**

Table 17: Proposed HBFRA undergrounding program

	2015/16	2016/17	2017/18	2018/19	2019/20
Undergrounding of 11kV and 33kV to BSPs	$5.7m	$5.9m	$3.8m	$6.3m	$4.9m
Undergrounding of high risk sections of power lines	$3.0m	$15.5m	$25.4m	$26.7m	$31.4m

3.4 Willingness to Pay (WTP) Survey for HBFRAs

Following customer research as part of the Customer Engagement Program and SA Power Networks' consideration of the resulting customer insights, two key areas - undergrounding power lines and managing vegetation clearance – were selected for further collaborative exploration with customers and subject matter experts.

SA Power Networks explored the topics further in two separate targeted strategic workshops (**TSW**) held in early October 2013. Customers and subject matter experts concluded that SA Power Networks should develop undergrounding and vegetation management strategies that place more emphasis on the long term whilst balancing the benefits with the costs. The initiatives proposed by the workgroups include:

- undergrounding high risk power lines and assets in high bushfire risk zones;

- undergrounding high risk power lines and assets for improved road safety;
- where practical place some priority on undergrounding power lines when replacing assets;
- further consultation and partnering with communities and groups;
- preserve community safety as a priority;
- minimise vegetation management (tree trimming) over the longer term;
- habitat creation programs in priority areas, including the removal and replacement of trees;
- more advanced tree trimming practices; and
- a differentiated range of tree trimming approaches to suit different regions and/or environments.

Subsequently, SA Power Networks formed an undergrounding internal working group who considered the requirements of the customer-designed principles and developed a range of costings for targeted programs of work.

SA Power Networks then tested customer price sensitivity to the various options developed by the working groups through Willingness to Pay (**WTP**) research.

In the WTP survey, respondents were given the opportunity to maintain the current network and service level, or they could choose to pay more for an improved level of service, framed around various scenarios. The service improvements tested in the WTP research comprised combinations of vegetation management activities (tree trimming cycles, tree removal and replacement) and undergrounding assets in HBFRAs, MBFRAs and NBFRAs.

The specific service improvements tested in HBFRAs and MBFRAs are tabled below.

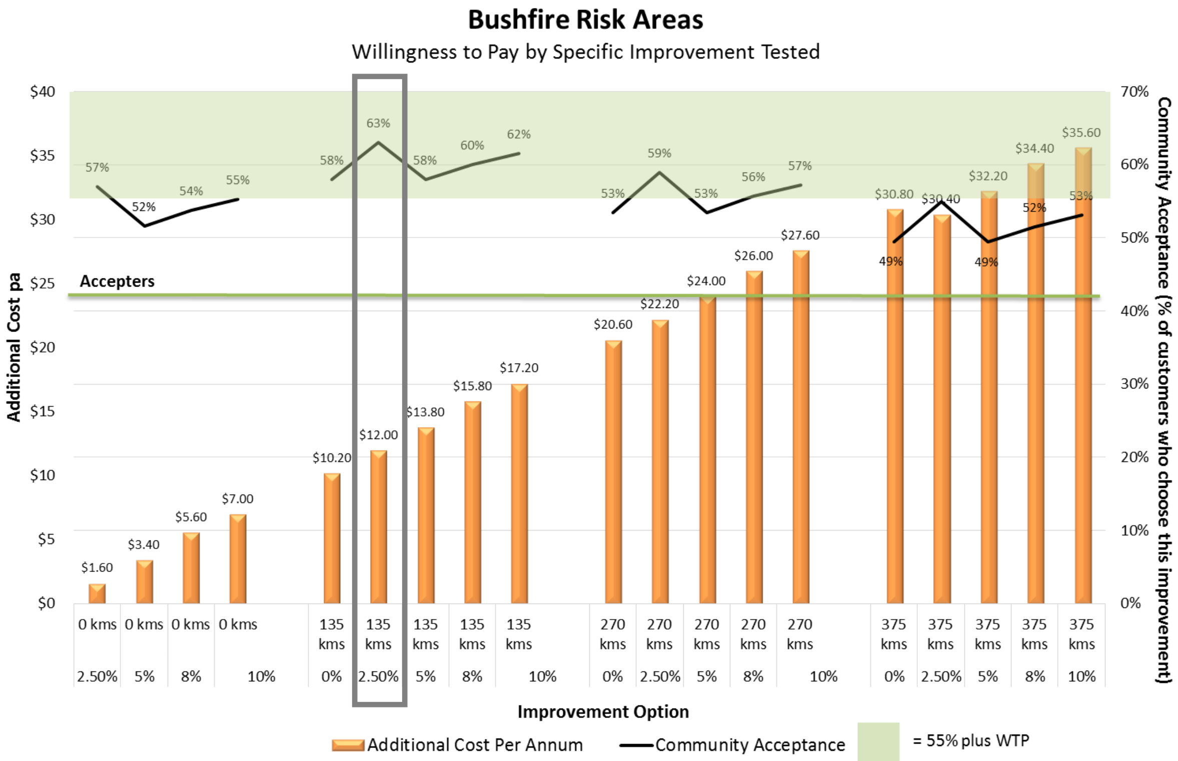
Table 18: Attributes and levels tested within high bushfire and bushfire risk areas

Attribute	Level
1. Removal and Replacement of Inappropriate Vegetation in targeted areas within **High Bushfire Risk Areas and Bushfire Areas.** This includes tree replacement activities.	2.5%, 5%, 8%, 10% approx. equivalent to 250km, 500km, 800km, 1000km of power lines respectively.
2. Undergrounding of Power lines in **High Bushfire Risk Areas.**	2.5%, 5%, 7% equivalent to 135km, 270km, 375km of power lines respectively.

The following chart, Figure 2 shows the level of willingness to pay (black line) for each improvement initiative tested. The orange bars represent the estimated incremental annual amount customers would be asked to pay. The chart is organised into four groups, corresponding with the four levels of undergrounding (0, 135, 270 and 375 kms) tested.

Within each of these groups there are four or five different vegetation management options (removal and replacement of inappropriate vegetation power lines in spans subject to inspection and clearance: 0%, 2.5%, 5%, 8% and 10%). The green ‘accepters’ line shows the percentage of respondents who accepted all improvement options presented to them relating to high bushfire and medium bushfire risk areas.

Figure 2: Willingness to Pay by Specific Improvement Tested – HBFRAs and BFRAs



SOURCE: The NTF Group, *SA Power Networks Targeted Willingness to Pay Research - Research Findings*, The NTF Group Pty Ltd, July 2013.

The chart above shows the WTP of the community for network and service improvements associated with **bushfire risk areas**. In terms of determining that constitutes robust support greater than 55%[14] represents majority consumer support, greater levels indicate more wide-spread support. Key features of the diagram and research outcomes demonstrate that:

- the grey box highlights the most preferred improvement option in high bushfire risk areas, encompassing a program of 135km of undergrounding combined with 2.5% removal and replacement of inappropriate vegetation for additional bush fire safety benefits;
- 63% of customers surveyed were willing to pay $12 annually if this was funded from an initial decrease in network charges; and
- for HBFRAs, overall undergrounding activities did not achieve the same level of acceptance as the more moderately priced vegetation management activities.

For customer segmentation information please refer to the Regulatory Proposal Attachment 6.8 titled “The NTF Group: SAPN Targeted Willingness to Pay Research - research findings” report.

[14] SA Power Networks has adopted a WTP hurdle for improvement proposals of 55% of the community or more being willing to fund the proposal. This hurdle was considered robust if the 55% threshold was achieved amongst all key community segments (ie mainstream, solar PV and hardship customers).

4. Business Options

4.1 Option 1 – Maintain the Existing Programs

The "Maintain" option for this business case represents a status-quo continuation of the existing SA Power Networks bushfire mitigation program.

The current program may haverepresented a reasonable approach to managing the risk of SA Power Networks assets starting bushfires in SA in the past, but the bushfire mitigation risk environment has changed since the catastrophic Victorian bushfires of 2009, and all hazardous bushfire areas must now be seen in a new light in terms of both assessing inherent risk of fire start from electricity assets, and the methods employed to reduce this risk to As Low As Reasonable Practicable (**ALARP**).

In addition, the BoM report warns that:

> "With further temperature rises likely over the next 5 to 10 year timeframe, this trend to greater numbers of days with extreme temperatures is likely to continue"; and
>
> "Along with increasing temperatures, the number of Severe, Extreme or Catastrophic Fire Danger Rating days in summer has increased by between 1.7 and 2.5 times since 2000, in the Mount Lofty Ranges and at Port Lincoln. This increased fire risk is likely to remain or increase further with increased temperatures over the next 5 to 10 year timeframe."

If SA Power Networks elects to make no change to its current bushfire mitigation approaches and protocols, then it could be seen as not taking reasonable actions to adopt what is considered good electricity industry practice, especially given extreme fire danger conditions are forecast to remain or potentially increase over the next 5 to 10 year period.

4.1.1 Option 1 Costs

Not applicable as option one presents no change to the existing program costs.

4.1.2 Option 1 Expected Benefits

The benefits of the "Maintain" option are that the current SA Power Networks bushfire mitigation program would continue unchanged and continue to deliver a well managed approach to bushfire risk reduction, albeit one that may not meet what is now considered good electricity industry practice.

4.1.3 Option 1 Expected Adverse Consequences

The adverse consequences of the "Maintain" option are that SA Power Networks may be perceived to not being responsive enough to the findings from the Victorian Bushfire Royal Commission by not adopting what is now considered to be good electricity industry practice. Reductions in the likelihood of SA Power Networks' assets contributing to fire starts may not be possible, and the undergrounding program for BSPs will not be implemented.

The option of maintaining SA Power Networks' bushfire management program in its current form does not align with customer preferences which supported improvement in community safety in HBFRAs. Additionally, customers would no doubt be concerned if SA Power Networks as not being seen to take into account the most recent knowledge in reducing bushfire risk.

4.1.4 Option 1 Major Business Risks

The risks of not proceeding with this project are outlined in the risk management section of this business case – Section 2.9.

4.2 Option 2 – Implement the Proposed Program

The Option 2 program includes the delivery of all 3 program components described in section 3, with the specific elements of work identified utilising the prioritisation model explained in section 2.7. This model will be used to maximise risk reduction and efficiency in program delivery. This option delivers the full benefits as described below, by reducing the risk of fire starts from electricity assets by adopting 'good electricity industry practices' and establishing a secure supply to selected BSPs.

4.2.1 Recloser Replacement & SCADA Installation

The scope of the recloser replacement program includes:

- Replacement of a total of 151 11kV, 19kV and 33kV manual reclosers with SCADA controlled reclosers;
- Fitting remote communications (Fibre, Radio or NextG) to allow full SCADA capability of monitoring and control, including the ability to trip/disconnect remotely, set the trip circuit to non-auto, and to alter protection groups at the full discretion of the Network Operations Centre; and
- The unit rate adopted for the installation of each recloser includes allowance to upgrade the existing pole if deemed necessary, additional standard lightning protection, individual voltage transformer (VT) installation for local power supply, apply protection settings and review co-ordination with upstream and downstream devices such as sectionalisers, installation of appropriate communications bearer for each site, and back end ADMS functionality.

Priority will be given to 33kV and 11kV in HBFRA, followed by 19kV in HBFRA. The priority order will be based on risk management principles, in accordance with the prioritisation model described earlier. See Appendix B for priority feeder list.

The approximate cost of replacing an aging recloser with a modern unit is about $120,000, which includes SCADA and the associated communications equipment.

Table 19: Recloser replacement program

	2015/16	2016/17	2017/18	2018/19	2019/20
Replace 30 per annum non-SCADA 33kV, 19kV, 7.6kV & 11kV reclosers with SCADA Controlled Reclosers	$3.6m	$3.6m	$3.6m	$3.6m	$3.6m

4.2.2 RAG & CLAH Replacement Program

The program to replace RAGs and CLAHs with modern surge arresters will be based on the feeder prioritization model to determine the highest priority feeders (power lines) to commence replacement, to achieve the highest benefit.

The replacement of 33kV rod gaps or CLAHs with surge arrestors costs about $4,670 per set.
The replacement of 19kV rod gaps or CLAHs with surge arrestors costs about $2,007 each.

The replacement of 11kV rod gaps or CLAHs with surge arrestors costs about $3,755 per set.

The preferred implementation program includes the use of the annual helicopter inspection teams, that conduct pre-summer feeder patrols, to log the location and type of existing lightning protection devices on all target power lines. These installations will be classified in the asset maintenance system as a type 4 defect which allows the maintenance work program team to package surge arrester replacement jobs together on target power lines, and achieve the highest work efficiency when allocation of work crews, and feeder switching is taken into account.

The program discussed in this business case is intended to replace in the order of 2960 RAGs and CLAHs on HV power lines over the next 5 year regulatory determination period.

Table 20: Surge Arrester Program

	2015/16	2016/17	2017/18	2018/19	2019/20
Replace targeted RAGs or CLAHs with Surge Arrestors in HBFRA	$2.4m	$2.4m	$2.4m	$2.4m	$2.4m

4.2.3 Undergrounding targeted sections of power lines

In 2015 SA Power Networks is proposing to commence a program to replace around 135km of overhead power lines (2.5% of power lines in HBFRA) with underground cable, over a 5 year period at a program cost of around $128.6m. The volume of undergrounding reflects the customer preference expressed through the Willingness to Pay survey.

Table 21: Undergrounding program

	2015/16	2016/17	2017/18	2018/19	2019/20
Undergrounding of 11kV and 33kV to BSP's	$5.7m	$5.9m	$3.8m	$6.3m	$4.9m
Undergrounding of high risk sections of power lines	$3.0m	$15.5m	$25.4m	$26.7m	$31.4m
TOTAL	**$8.7m**	**$21.4m**	**$29.2m**	**$33.0m**	**$36.3m**

This program of work will also deliver a high security supply to targeted CFS BSPs during catastrophic weather conditions, and will reduce fire start hazards from SA Power Networks' assets in HBFRAs. Undergrounding the supply to these CFS BSPs will make it very unlikely that a bushfire will interrupt that supply unless the source[15] supply is lost. This ensures that people who are directed by fire agencies to evacuate to a Bushfire Safer Place, can have a reasonable expectation of some level of amenity at the BSP.

[15] Source supply is via ElectraNet's transmission network and SA Power Networks' 66kV sub-transmission network.

4.2.4 Option 2 Delivery Costs

Table 22 summarises the bushfire mitigation project delivery costs[16].

Table 22: Delivery costs

Cost component	Cost type	Financial year $M					Total[17]
		15/16	16/17	17/18	18/19	19/20	
Replace 30 reclosers per annum	Capex	3.6	3.6	3.6	3.6	3.6	17.9
Replace RAGs & CLAHs	Capex	2.4	2.4	2.4	2.4	2.4	12.2
Undergrounding to BSPs	Capex	5.7	5.9	3.8	6.3	4.9	26.6
Undergrounding high risk sections of power lines	Capex	3.0	15.5	25.4	26.7	31.4	102.0
Total							**158.5**

4.2.5 Option 2 Expected Benefits

The primary reason for the implementation of the proposed bushfire mitigation measures is to ensure SA Power Networks is adopting good electricity industry practice in bushfire management, being the reasonable steps required to ensure that the distribution system is safe and safely operated (Section 60(1) of the Electricity Act) and to maintain and operate the distribution system in accordance with good electricity industry practice (NER Clause 5.2.1(a)). Additionally, improving the safety of communities in HBFRAs is strongly supported by SA Power Networks' consumers.

The financial benefits of implementing this program of work are difficult to express in monetary terms as it is difficult to quantify precisely the level of fire start risk reduction that will be achieved over the do nothing option.

An alternative approach to calculation of a financial benefit stream is to assess the qualitative benefits accruing from the implementation of this program.

The qualitative benefits include:

- It is expected that by implementing the recloser SCADA program, there are clear timeliness and safety benefits in enabling a central control room to remotely set a recloser into non-auto mode, rather than having to send a switching operator (field crew) to undertake the change manually. This facility enables a rapid response time to fast moving fire events, and removes switching operators from a potentially hazardous situation where a fire may have been initiated, and when extreme weather effects are being felt in the district of the recloser location;
- In line with the discussion in section 2.1.1 of this business case, there are likely benefits in fault energy reduction, as per the evidence submitted at the VBRC that suggests the probability of a fire starting from a fallen conductor increases significantly if the line protection system (recloser or fuse) operates slowly and operates a number of times. By implementing SCADA control of reclosers in HBFRAs, setting the reclosers to non-auto, and allowing it to clear faults as fast as possible, significant reduction in the probability of a fire starting from a line fault, will result.
- The replacement of a large number of old technology RAGs and CLAHs would deliver clear reductions in the number of arcing events when these devices are bridged by animals or birds and lightning strikes. By reducing the quantity of arcing events on the overhead network, the

[16] For the programs addressed in this business case.
[17] Totals may not equate due to rounding.

likelihood of bushfires being started by hot metal particles falling onto dry ground and igniting the local grasses and vegetation would be similarly reduced.

- By implementing the undergrounding program as proposed, the exposure of bare overhead power lines to known causes of fire starts, such as conductor clashing, bird, animal or tree momentary impact, and damage by flying debris during strong winds and storms, is reduced.
- Implementing the undergrounding program of work will also deliver a high security supply to targeted BSPs during catastrophic weather conditions, and will reduce fire start hazards from SA Power Networks' assets in HBFRAs. Undergrounding the feeder supplying these BSPs will make it very unlikely that a bushfire in the area will interrupt supply to these BSPs unless the source supply is lost. This ensures members of the public seeking refuge from a bushfire to have a reasonable expectation of some level of amenity at the BSP.

4.2.6 Option 2 Major Business Risks

The risks around the bushfire mitigation program are discussed at length in the risk management section of this business case – Section 2.11.

5. Recommendation

SA Power Networks should implement option 2 - the proposed program of bushfire mitigation works as follows:

- underground sections of power lines located in HBFRAs that supply CFS BSPs;
- replace reclosers on bushfire boundaries with SCADA controlled equipment;
- implement further undergrounding of sections of power lines that present high risk (eg highly, vegetated areas), in HBFRAs; and
- replace obsolete Rod Air Gaps (**RAGs**) and Current Limiting Arcing Horns (**CLAHs**) with modern surge arrestors for the remaining overhead sections of power line.

This being the reasonable steps required to ensure that the distribution system is safe and safely operated (Section 60(1) of the Electricity Act) and to maintain and operate the distribution system in accordance with good electricity industry practice (NER Clause 5.2.1(a)). These duties require SA Power Networks to have regard to objectively determined standards of safety (ie what would a reasonable and prudent electricity distribution system operator faced with the same conditions and circumstances as apply to SA Power Networks do, to ensure that the distribution system is safe and safely operated and is maintained and operated in a manner that is consistent with the degree of skill, diligence, prudence and foresight expected from Australian electricity distribution system operators).

6. References

The following documents were referenced in completion of this document:

Ref	Document Name	Date	Version	Author
1	Recommended Bushfire risk reduction strategies for SA Power Networks	July 2014	2.0	Jacobs
2	SA Power Networks Bushfire Risk Management Strategies	18/12/12	2.0	SKM
3	The SA Distribution Network – Directions & Priorities	2014	na	SA Power Networks
4	Memo - Background to Bushfire Risk Management for Reset 2015-2020	3/4/14	1	SA Power Networks
5	Climate extremes analysis for Power Networks operations	July 2014	1	BOM
6	SA Power Networks Risk Management Policy	29/3/10	1.4	SA Power Networks
7	SA Power Networks Risk Management Framework	July 2014		SA Power Networks
8	SA Power Networks Undergrounding Program	July 2014		SA Power Networks
9	SA Electricity (Principles of Vegetation Clearance) Regulations 2010			SA Government

A. Feeder Prioritisation Model

The attached model proposes a method for prioritisation of HV power lines in HBFRA's in order to focus programs for fire start reduction works.

[redacted]

[redacted]

[redacted]

Probability of a feeder starting a fire

Probability factor	Impacts	Weighting
How often does the Fire Ban District (FBD) in which that feeder is located, experience TOBAN days ie high fire danger weather?	The higher the no. of TOBANs, the more likely requirement for Non-Auto	
How reliable is the feeder? How many times has it tripped plus how many times have we had to switch on this feeder to effect an emergency repair?	High Risk (>5 events p.a.) Medium Risk (>3, ≤5) Low Risk (≤3)	
How many fires have there been since 2008?	The more fires, the more probability of repeats	
Is the feeder totally located in the NBFRA?	If yes, no need to consider further	
What's the length of the feeder? How much is bare and how much is insulated?	The longer the feeder in HBFRA (or MBFRA), the more risk it poses	
How far from the depot is the recloser?	The further from the depot, the more need to make it SCADA controlled	

Consequence factor	Scoring Table	FACTOR	Weighting
Is the feeder located in a HBFRA?	Score HBFRA = 7; MBFRA = 3	BFRA	0.3
How many BSPs supplied by this feeder?	No. of BSPs =	BSP	0.1
With reference to the Willis report, what could the expected losses be?	HBFRA = $400M MBFRA = $100M If feeder has x kms bare in HBFRA & y kms bare in MBFRA then evaluate as: x/(x + y) * $400M + y/(x+y) * $100M	MPL	
How many feeders supply that BSP?	Single feeder = 2 Multiple feeders = 1	NoBSP	0.1
Does the feeder go through a National Park?	National Park: Yes = 2; No = 0	NP	0.1
How many CFS Fire stations around that BSP?	No. fire stations = NoFS	NoFS	0.2
How many customers are supplied by this feeder?	No. of customers = CUST	CUST	0.2

Probability factor	Scoring table	FACTOR	Weighting
TOBAN	The Average no. of TOBANs per annum = TB	TB	0.1
How reliable is the feeder? How many times has it tripped plus how many times have we had to switch on this feeder to effect an emergency repair?	The Average no. of Forced outages + Unplanned outages per annum = OUT	OUT	0.3
How many fires have there been since 2008?	Average no. of fires per annum = Fi	Fi	0.3
Is the feeder totally located in the NBFRA?	If yes, no need to consider further If Y = 0, N=1	NBFRA	
What's the length of the feeder? How much is bare and how much is insulated?	Length of HV bare conductor in HBFRA = h Length of HV bare conductor in MBFRA = m Length factor = LEN = h + 0.3*m	LEN	0.1
How far from the depot is the recloser?	Distance = d	d	0.1
What voltage is the feeder?	3 = 33kV 2 = 11kV 1= 19kV	V	0.1

P(E) = NBFRA*(0.1TB + 0.3OUT + 0.3Fi + 0.1LEN + 0.1d + 0.1V)

Consequences of a fire on a feeder

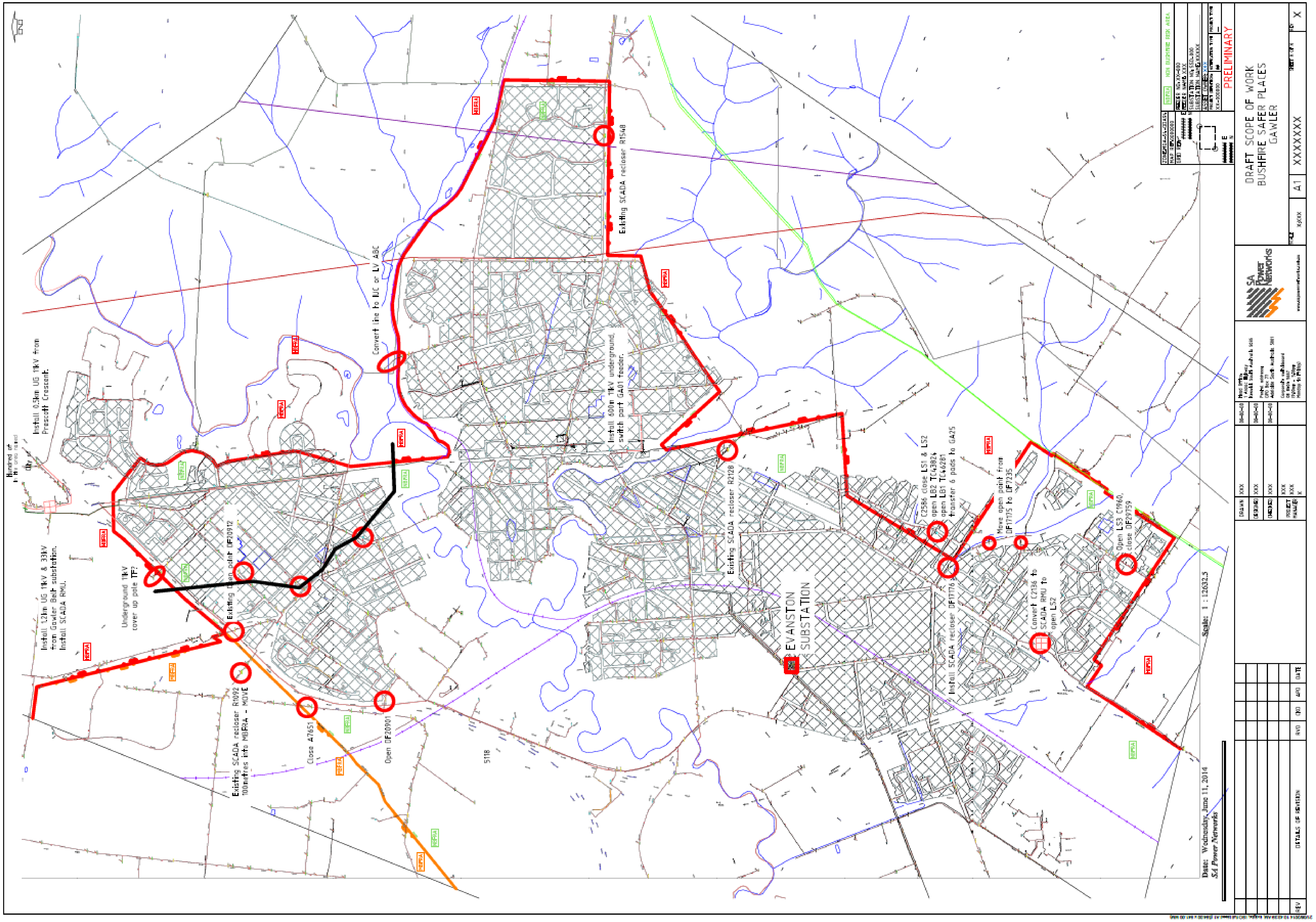
Consequence factor	Impacts	Weighting
Is the feeder located in a HBFRA?	Higher BF consequence	
Does the feeder supply a BSP?	People evacuate to BSP's and hence higher community impacts	
With reference to the Willis report, what could the expected losses be?	Higher losses, the higher the weighting	
How many BSPs in a FBD?	The more BSPs in that FBD, the more impacts on say FDL2/FDL3 for switching eg feeder to Non-auto may be interrupted while people have evacuated to that BSP	
How many feeders supply that BSP?`	The more feeders, the more diversity of supply, the lower the risk that the BSP will be off supply	
Does the feeder go through a National Park?	If it does then a fire start is likely to get away uncontrolled	
How many CFS Fire stations around that BSP?	Assuming fire stations are located where CFS is concerned about people safety, the more fire stations the more we should be concerned	
How many customers are supplied by this feeder?	The more customers supplied, the higher the score	

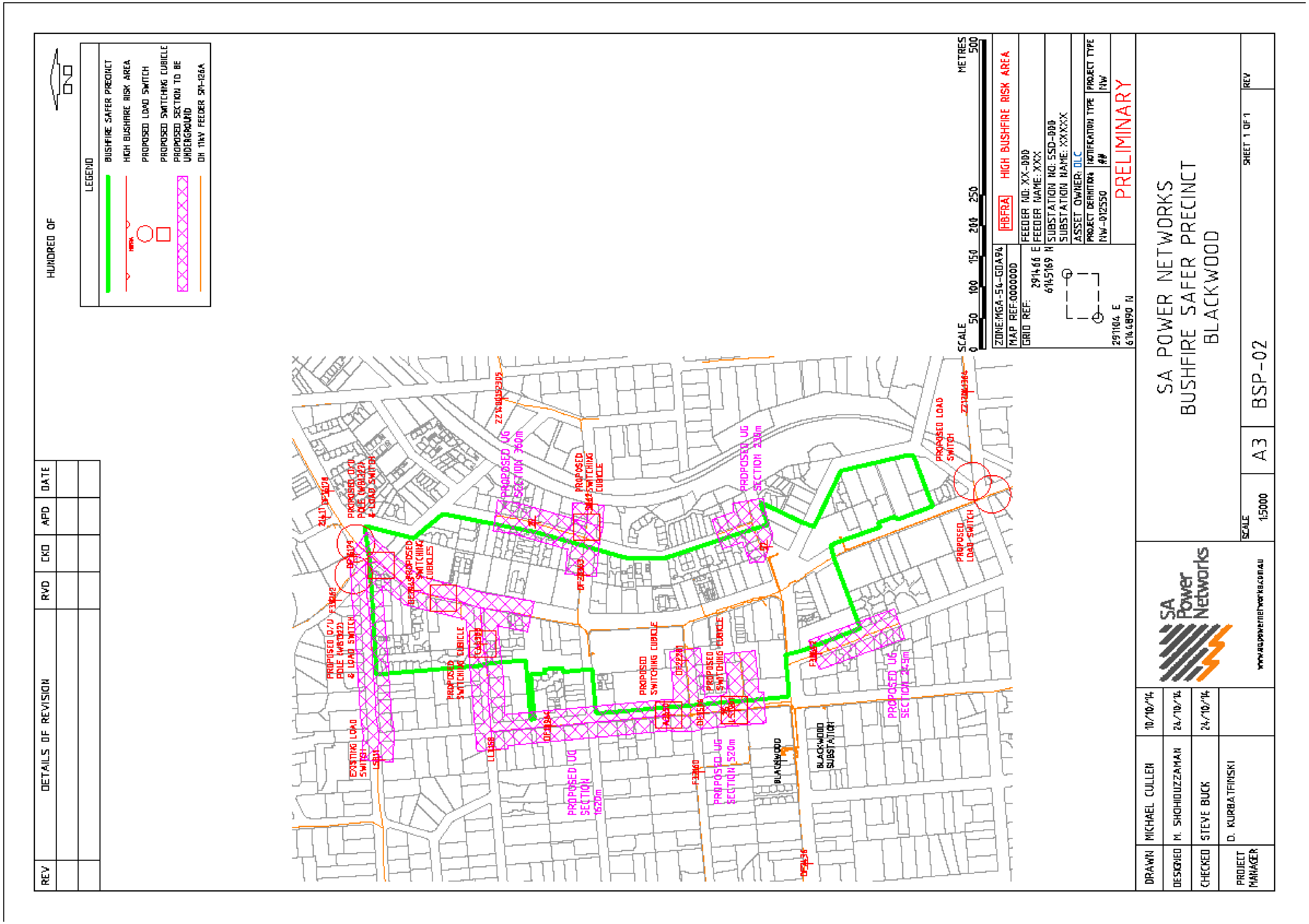
Consequence factor	Scoring Table	FACTOR	Weighting
Is the feeder located in a HBFRA?	Score HBFRA = 7; MBFRA = 3	BFRA	0.3
How many BSP's supplied by this feeder?	No. of BSP's =	BSP	0.1
With reference to the Willis report, what could the expected losses be?	HBFRA = $400M MBFRA = $100M If feeder has x kms bare in HBFRA & y kms bare in MBFRA then evaluate as: x/(x + y) * $400M + y/(x+y) * $100M	MPL	
How many feeders supply that BSP?	Single feeder = 2 Multiple feeders = 1	NoBSP	0.1
Does the feeder go through a National Park?	National Park: Yes = 2; No = 0	NP	0.1
How many CFS Fire stations around that BSP?	No. fire stations = NoFS	NoFS	0.2
How many customers are supplied by this feeder?	No. of customers = CUST	CUST	0.2

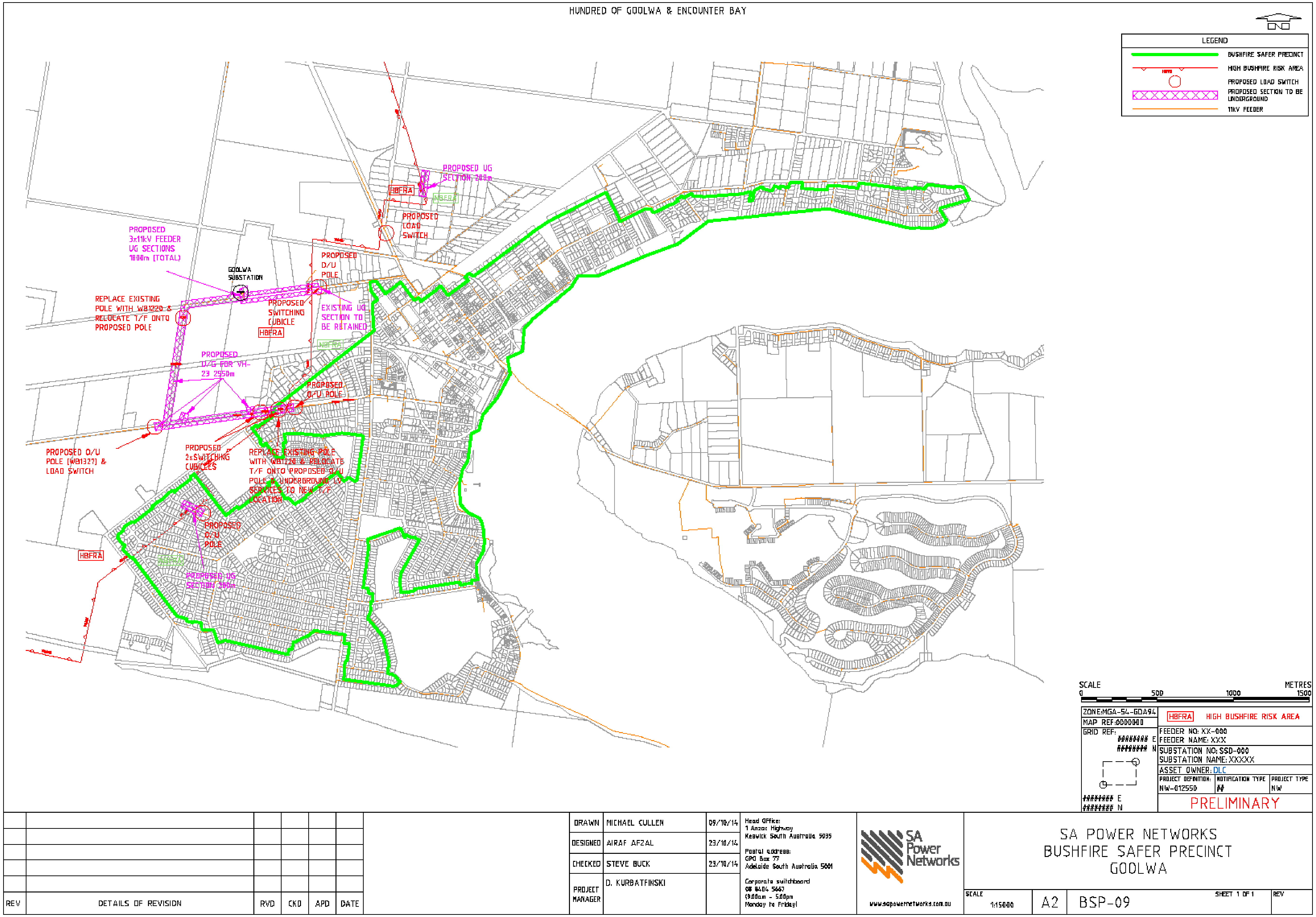
C(E) = MPL x (0.3BFRA + 0.1BSP + 0.1NoBSP + 0.1NP + 0.2NoFS + 0.2CUST)

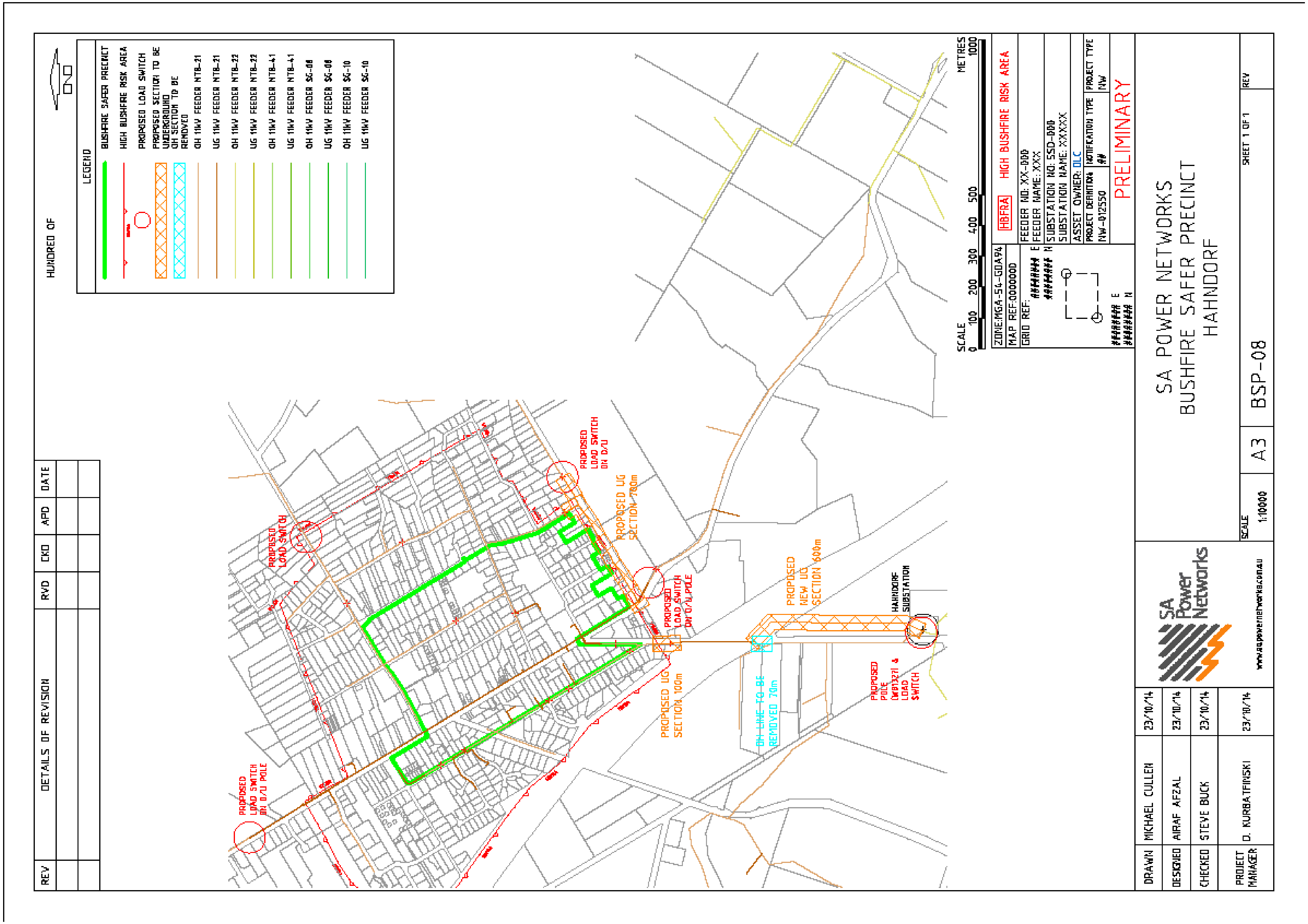
[redacted]

B. Bushfire Safer Places Concept Designs

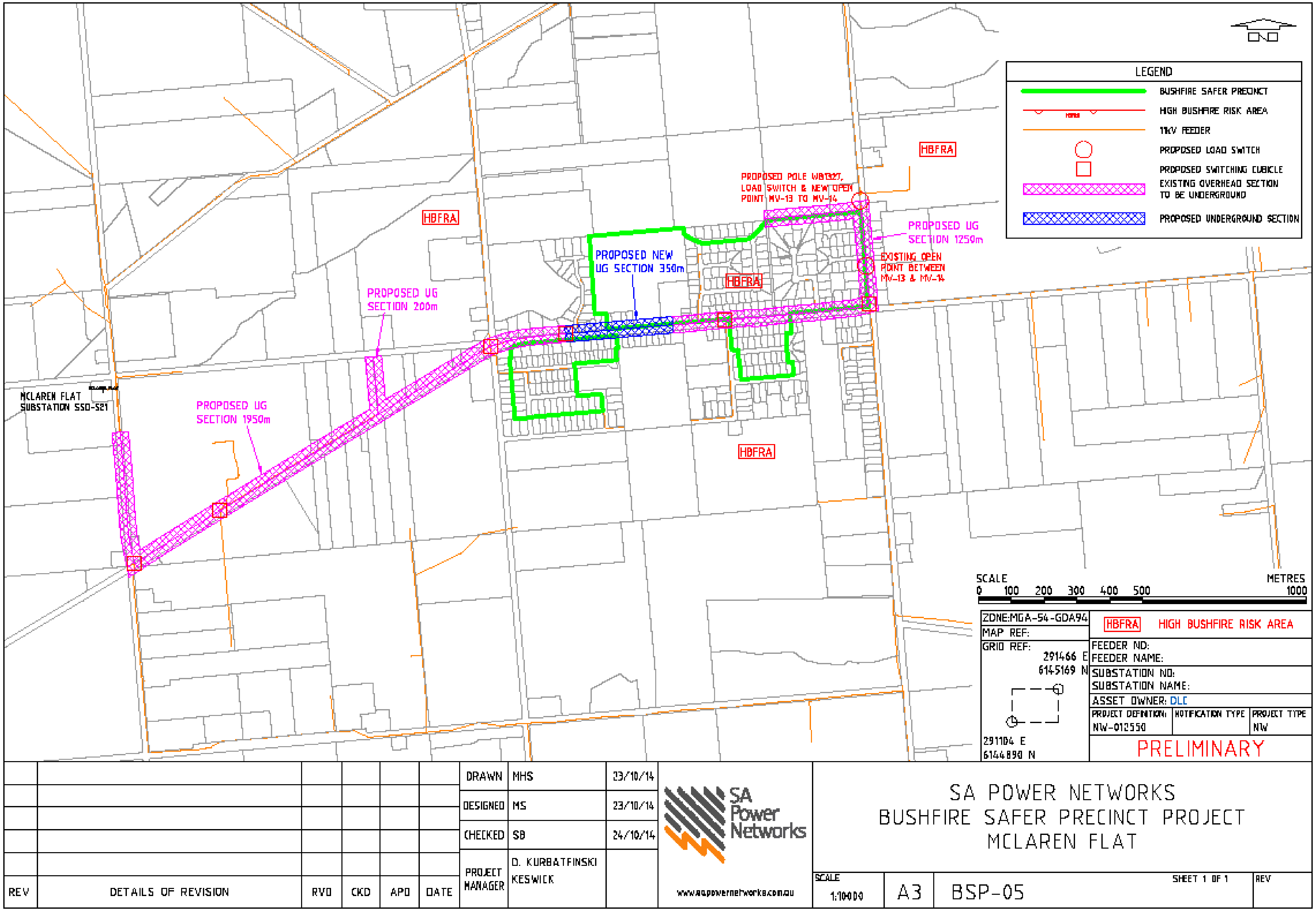

DRAFT SCOPE OF WORK
BUSHFIRE SAFER PLACES
GAWLER
PRELIMINARY
EVANSTON SUBSTATION
Existing SCADA recloser R1548
Convert line to UC or LV ABC
Install 600m 11kV underground, switch part GA01 feeder.
Install 0.5km UG 11kV from Prescott Crescent.
Install 1.2km UG 11kV & 33kV from Gawler Belt substation. Install SCADA RMU.
Underground 11kV cover up pole TF?
Existing open point DF20912
Existing SCADA recloser R1092 100metres into MBFRA - MOVE
Close A7651
Open DF20901
Existing SCADA recloser R2128
Install SCADA recloser DF7176
C2586 close LS1 & LS2 open LB2 TC43824 open LB1 TC46281 transfer 6 pads to GA25
Move open point from DF7175 to DF7235
Convert C2136 to SCADA RMU to open LS2
Open LS3 C1960, close DF29759
Scale: 1 : 12632.5
Date: Wednesday, June 11, 2014
SA Power Networks


SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
BLACKWOOD
PRELIMINARY
BSP-02
A3
SCALE 1:5000
SHEET 1 OF 1
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SWITCHING CUBICLE
PROPOSED SECTION TO BE UNDERGROUND
OH 11kV FEEDER SM-126A
HUNDRED OF
DETAILS OF REVISION
REV
RVD
CKD
APD
DATE
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION NW-012550
NOTIFICATION ##
PROJECT TYPE NW
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
291466 E
6145169 N
291104 E
6144890 N
SCALE
METRES
DRAWN MICHAEL CULLEN 10/10/'14
DESIGNED M. SHOHIDUZZAMAN 24/10/'14
CHECKED STEVE BUCK 24/10/'14
PROJECT MANAGER D. KURBATFINSKI
SA Power Networks
www.sapowernetworks.com.au
PROPOSED UG SECTION 360m
PROPOSED UG SECTION 230m
PROPOSED UG SECTION 1620m
PROPOSED UG SECTION 520m
PROPOSED UG SECTION 245m
PROPOSED SWITCHING CUBICLE
PROPOSED LOAD SWITCH
EXISTING LOAD SWITCH
BLACKWOOD SUBSTATION

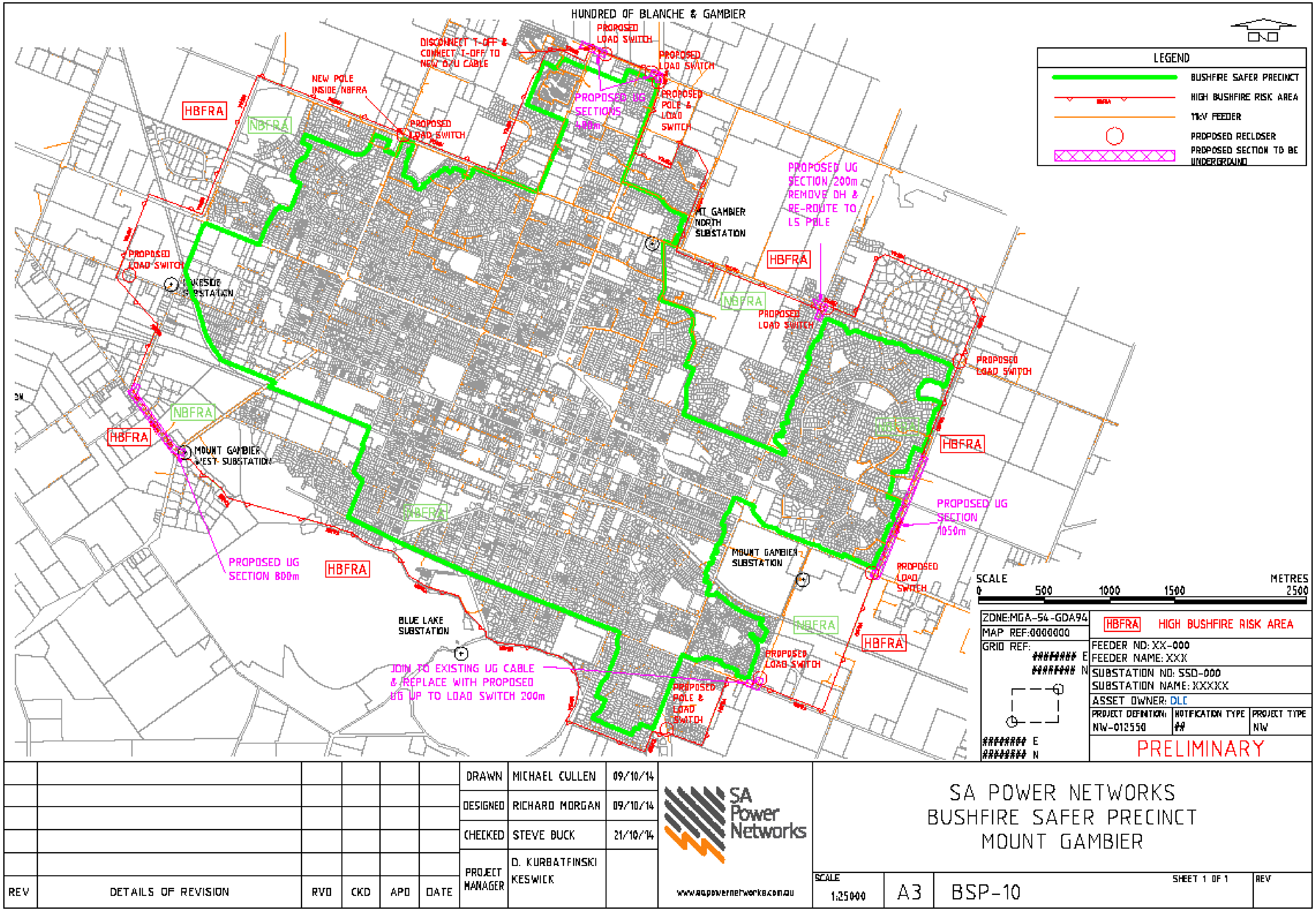

HUNDRED OF GOOLWA & ENCOUNTER BAY
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
11KV FEEDER
PROPOSED UG SECTION 280m
HBFRA
PROPOSED LOAD SWITCH
PROPOSED 3x11kV FEEDER UG SECTIONS 1800m (TOTAL)
GOOLWA SUBSTATION
PROPOSED O/U POLE
REPLACE EXISTING POLE WITH WB1220 & RELOCATE T/F ONTO PROPOSED POLE
PROPOSED SWITCHING CUBICLE
EXISTING UG SECTION TO BE RETAINED
PROPOSED U/G FOR VH-23 2550m
PROPOSED O/U POLE
PROPOSED O/U POLE (WB1327) & LOAD SWITCH
PROPOSED 2xSWITCHING CUBICLES
REPLACE EXISTING POLE WITH WB1220 & RELOCATE T/F ONTO PROPOSED O/U POLE & UNDERGROUND LV SERVICES TO NEW T/F LOCATION
PROPOSED O/U POLE
PROPOSED UG SECTION 280m
SCALE
0
500
1000
METRES
1500
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE
PROJECT TYPE NW
PRELIMINARY
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
DRAWN MICHAEL CULLEN 09/10/14
DESIGNED AIRAF AFZAL 23/10/14
CHECKED STEVE BUCK 23/10/14
PROJECT MANAGER D. KURBATFINSKI
Head Office: 1 Anzac Highway Keswick South Australia 5035
Postal address: GPO Box 77 Adelaide South Australia 5001
Corporate switchboard 08 8404 5667 (9.00am - 5.00pm Monday to Friday)
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
GOOLWA
SCALE 1:15000
A2
BSP-09
SHEET 1 OF 1
REV



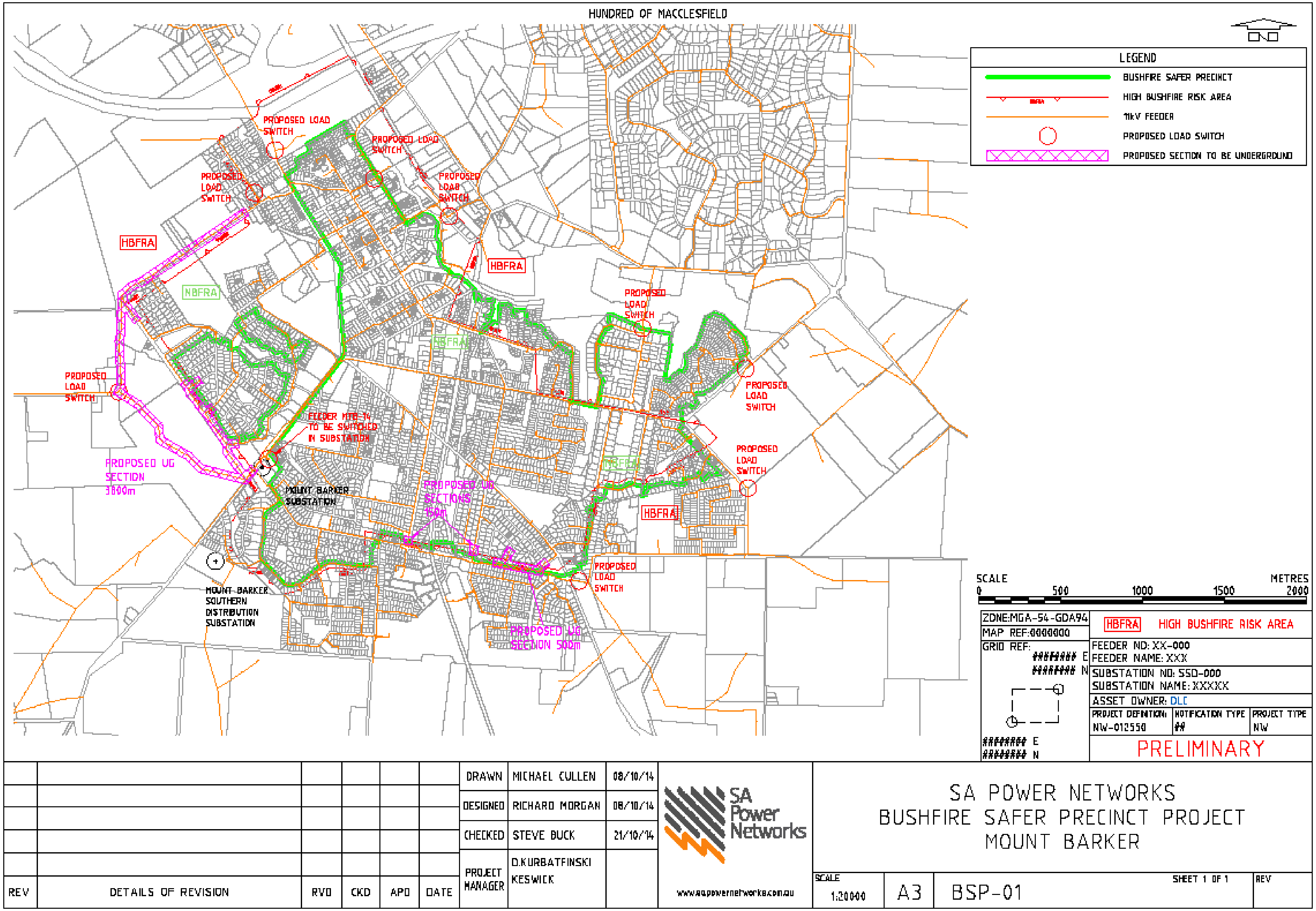
HUNDRED OF
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
OH SECTION TO BE REMOVED
OH 11KV FEEDER NTB-21
UG 11KV FEEDER NTB-21
OH 11KV FEEDER NTB-22
UG 11KV FEEDER NTB-22
OH 11KV FEEDER NTB-41
UG 11KV FEEDER NTB-41
OH 11KV FEEDER SG-08
UG 11KV FEEDER SG-08
OH 11KV FEEDER SG-10
UG 11KV FEEDER SG-10
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
PROPOSED LOAD SWITCH ON D/U POLE
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH ON D/U
PROPOSED UG SECTION 780m
PROPOSED LOAD SWITCH ON D/U POLE
PROPOSED UG SECTION 100m
OH LINE TO BE REMOVED 70m
PROPOSED NEW UG SECTION 500m
HAHNDORF SUBSTATION
PROPOSED POLE (WB1371 & LOAD SWITCH
SCALE
0 100 200 300 400 500 1000
METRES
ZONE:MGA-54-GDA94
MAP REF:000000D
GRID REF:
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-DDD
FEEDER NAME: XXX
SUBSTATION NO: SSD-DDD
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
HAHNDORF
SHEET 1 OF 1
REV
BSP-08
A3
SCALE 1:10000
SA Power Networks
www.sapowernetworks.com.au
DRAWN MICHAEL CULLEN 23/10/14
DESIGNED AIRAF AFZAL 23/10/14
CHECKED STEVE BUCK 23/10/14
PROJECT MANAGER D. KURBATFINSKI 23/10/14

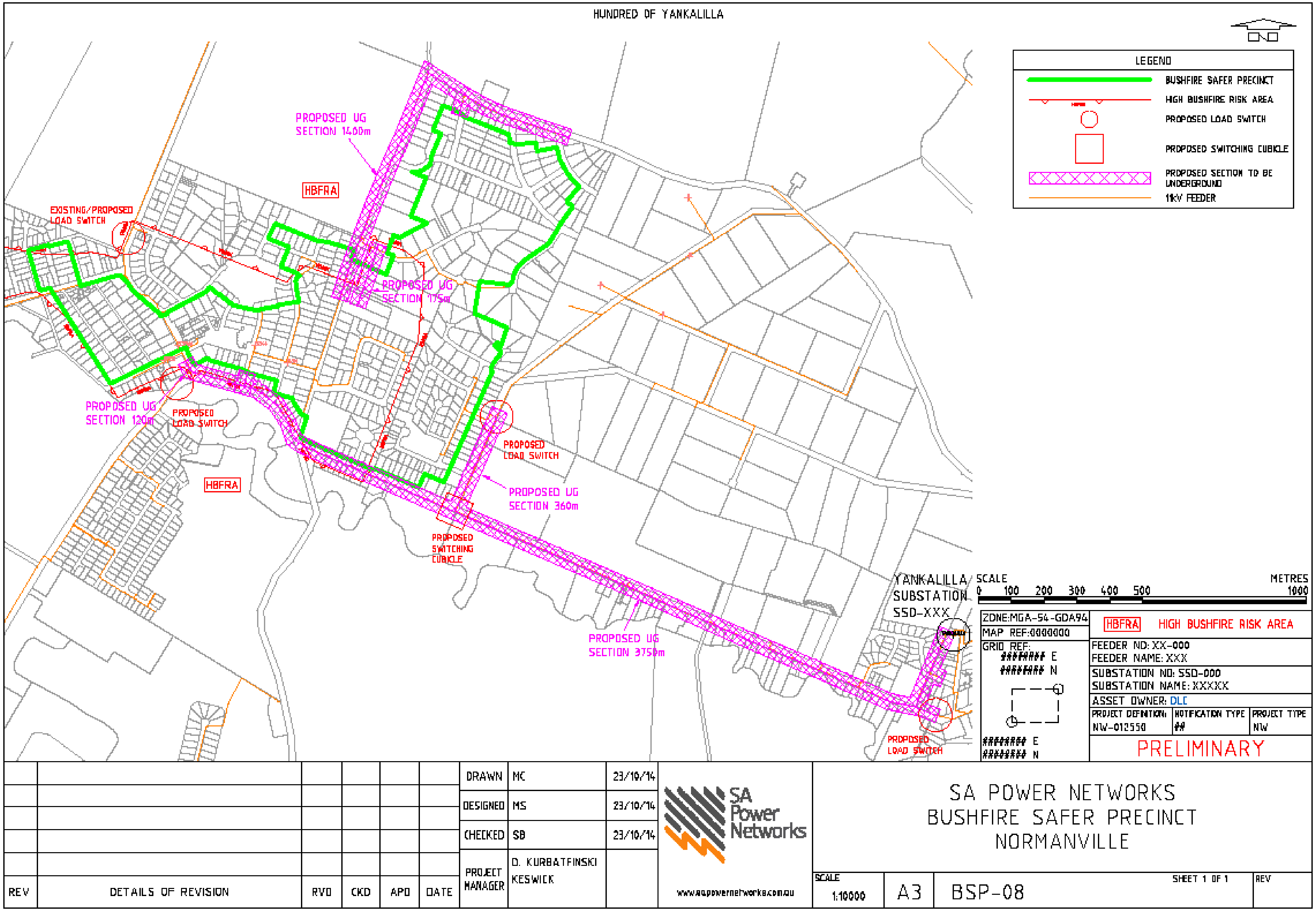


LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
11kV FEEDER
PROPOSED LOAD SWITCH
PROPOSED SWITCHING CUBICLE
EXISTING OVERHEAD SECTION TO BE UNDERGROUND
PROPOSED UNDERGROUND SECTION
HBFRA
PROPOSED POLE, LOAD SWITCH & NEW OPEN POINT MV-13 TO MV-14
PROPOSED UG SECTION 1250m
EXISTING OPEN POINT BETWEEN MV-13 & MV-14
PROPOSED NEW UG SECTION 350m
PROPOSED UG SECTION 200m
PROPOSED UG SECTION 1950m
MCLAREN FLAT SUBSTATION SSD-521
SCALE
0 100 200 300 400 500
METRES 1000
ZONE:MGA-54-GDA94
MAP REF:
GRID REF:
291466 E
6145169 N
291104 E
6144890 N
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO:
FEEDER NAME:
SUBSTATION NO:
SUBSTATION NAME:
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE
PROJECT TYPE NW
PRELIMINARY
DRAWN MHS 23/10/14
DESIGNED MS 23/10/14
CHECKED SB 24/10/14
PROJECT MANAGER D. KURBATFINSKI KESWICK
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT PROJECT
MCLAREN FLAT
SCALE 1:10000
A3
BSP-05
SHEET 1 OF 1
REV

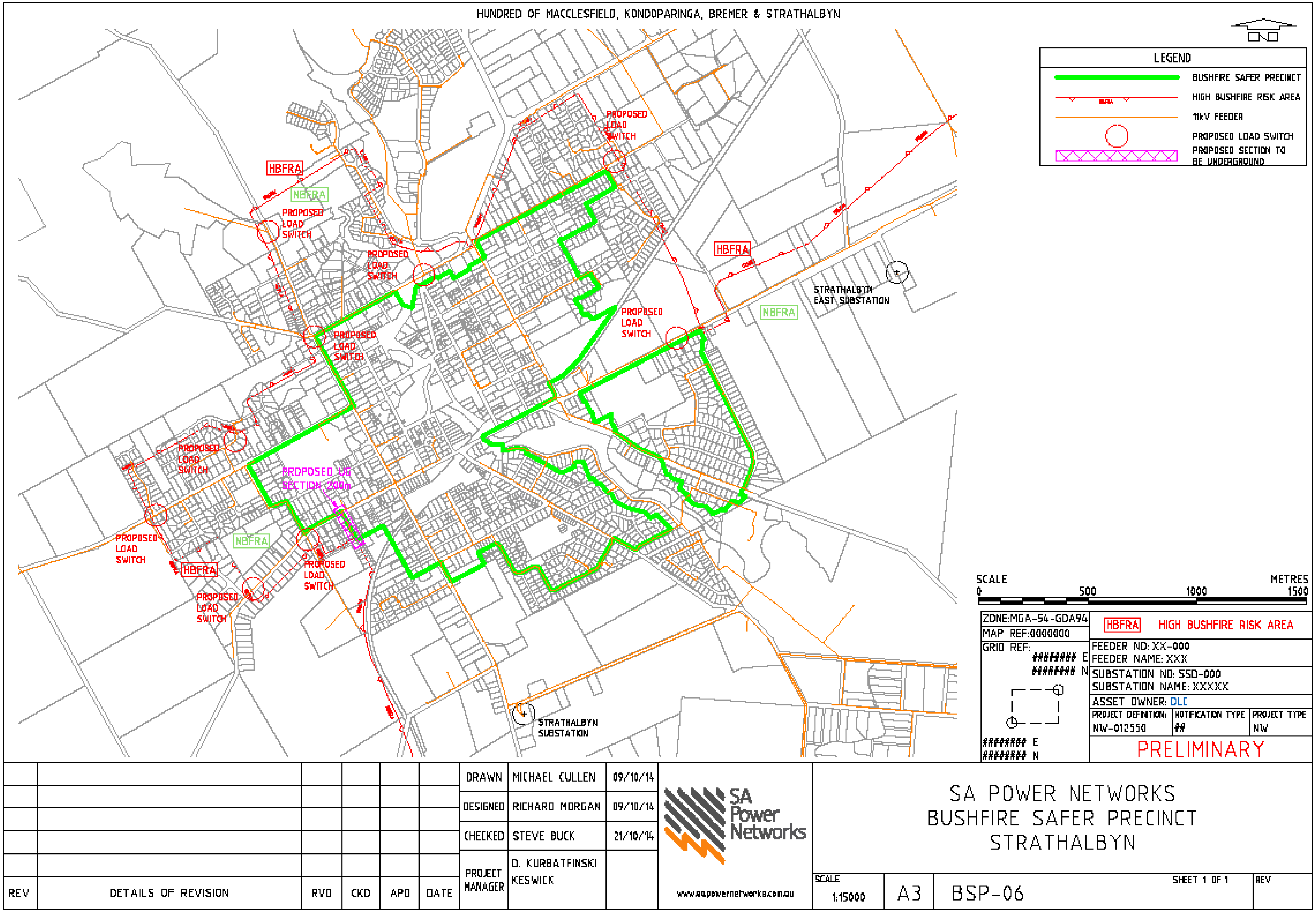


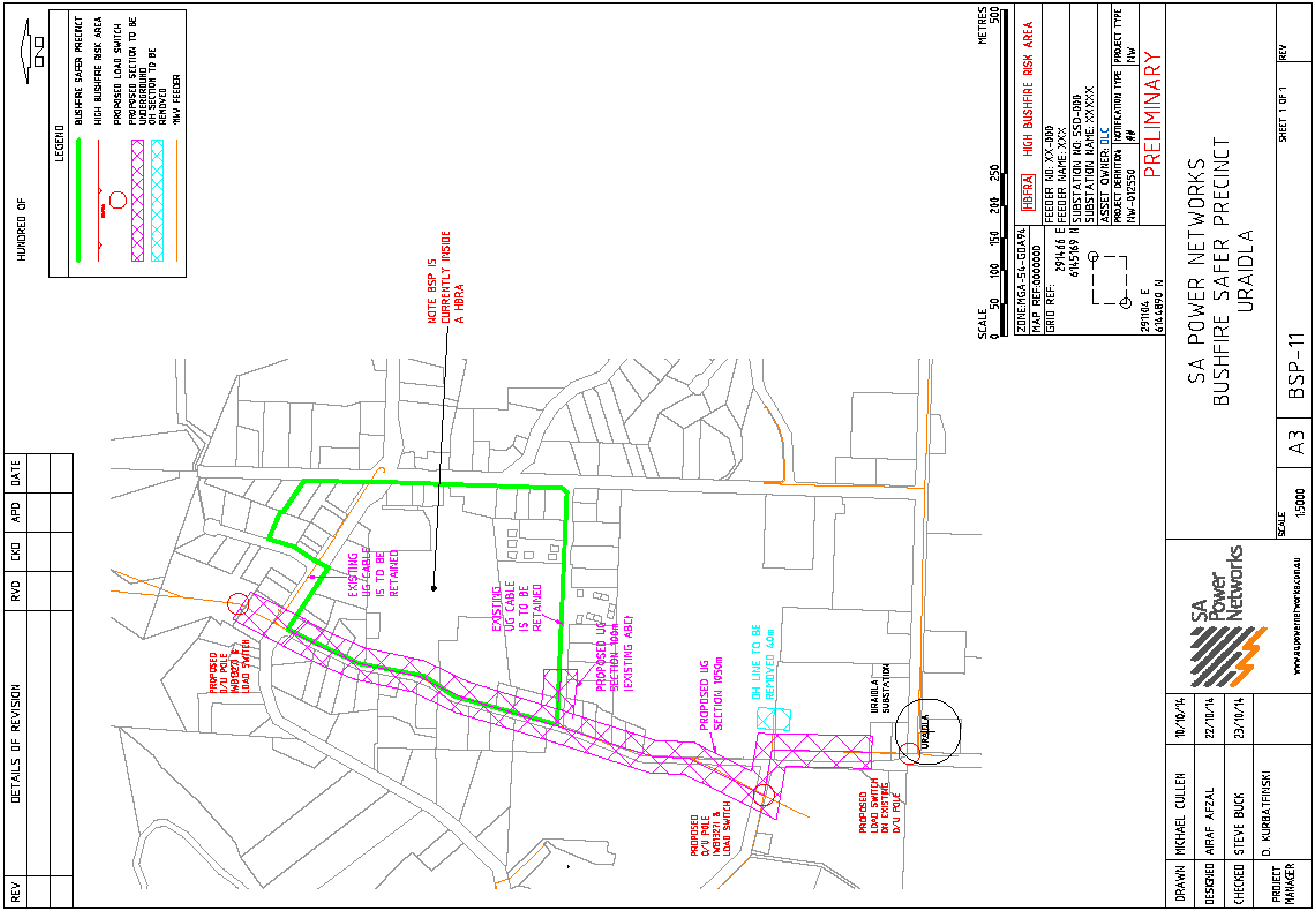
HUNDRED OF BLANCHE & GAMBIER
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
11kV FEEDER
PROPOSED RECLOSER
PROPOSED SECTION TO BE UNDERGROUND
PROPOSED LOAD SWITCH
DISCONNECT T-OFF & CONNECT T-OFF TO NEW O/U CABLE
NEW POLE INSIDE NBFRA
PROPOSED UG SECTIONS 300m
PROPOSED POLE & LOAD SWITCH
PROPOSED UG SECTION 200m REMOVE OH & RE-ROUTE TO LS POLE
MT GAMBIER NORTH SUBSTATION
LAKESIDE SUBSTATION
MOUNT GAMBIER WEST SUBSTATION
MOUNT GAMBIER SUBSTATION
BLUE LAKE SUBSTATION
PROPOSED UG SECTION 800m
PROPOSED UG SECTION 1050m
JOIN TO EXISTING UG CABLE & REPLACE WITH PROPOSED UG UP TO LOAD SWITCH 200m
HBFRA
NBFRA
SCALE
0 500 1000 1500 2500
METRES
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
DRAWN MICHAEL CULLEN 09/10/14
DESIGNED RICHARD MORGAN 09/10/14
CHECKED STEVE BUCK 21/10/14
PROJECT MANAGER D. KURBATFINSKI KESWICK
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
MOUNT GAMBIER
SCALE 1:25000
A3
BSP-10
SHEET 1 OF 1

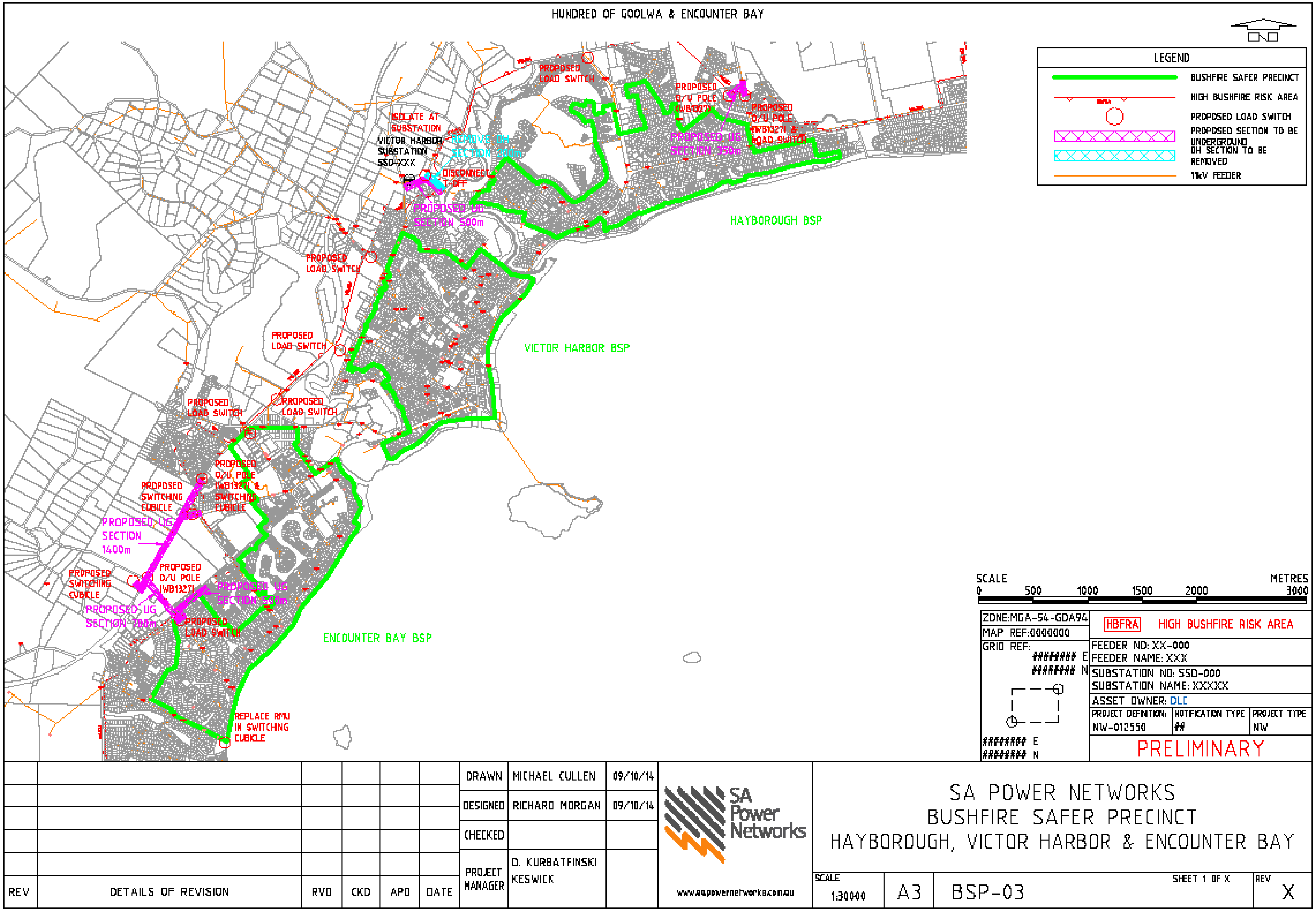

HUNDRED OF MACCLESFIELD
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
11kV FEEDER
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH
HBFRA
HBFRA
HBFRA
HBFRA
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH
PROPOSED LOAD SWITCH
FEEDER MTB-14 TO BE SWITCHED IN SUBSTATION
PROPOSED UG SECTION 3000m
MOUNT BARKER SUBSTATION
PROPOSED UG SECTIONS 150m
PROPOSED LOAD SWITCH
HBFRA
HBFRA
PROPOSED LOAD SWITCH
MOUNT BARKER SOUTHERN DISTRIBUTION SUBSTATION
PROPOSED UG SECTION 500m
SCALE
0 500 1000 1500 2000
METRES
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
######## E
######## N
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
DRAWN MICHAEL CULLEN 08/10/14
DESIGNED RICHARD MORGAN 08/10/14
CHECKED STEVE BUCK 21/10/14
PROJECT MANAGER D.KURBATFINSKI KESWICK
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT PROJECT
MOUNT BARKER
SCALE 1:20000
A3
BSP-01
SHEET 1 OF 1
REV



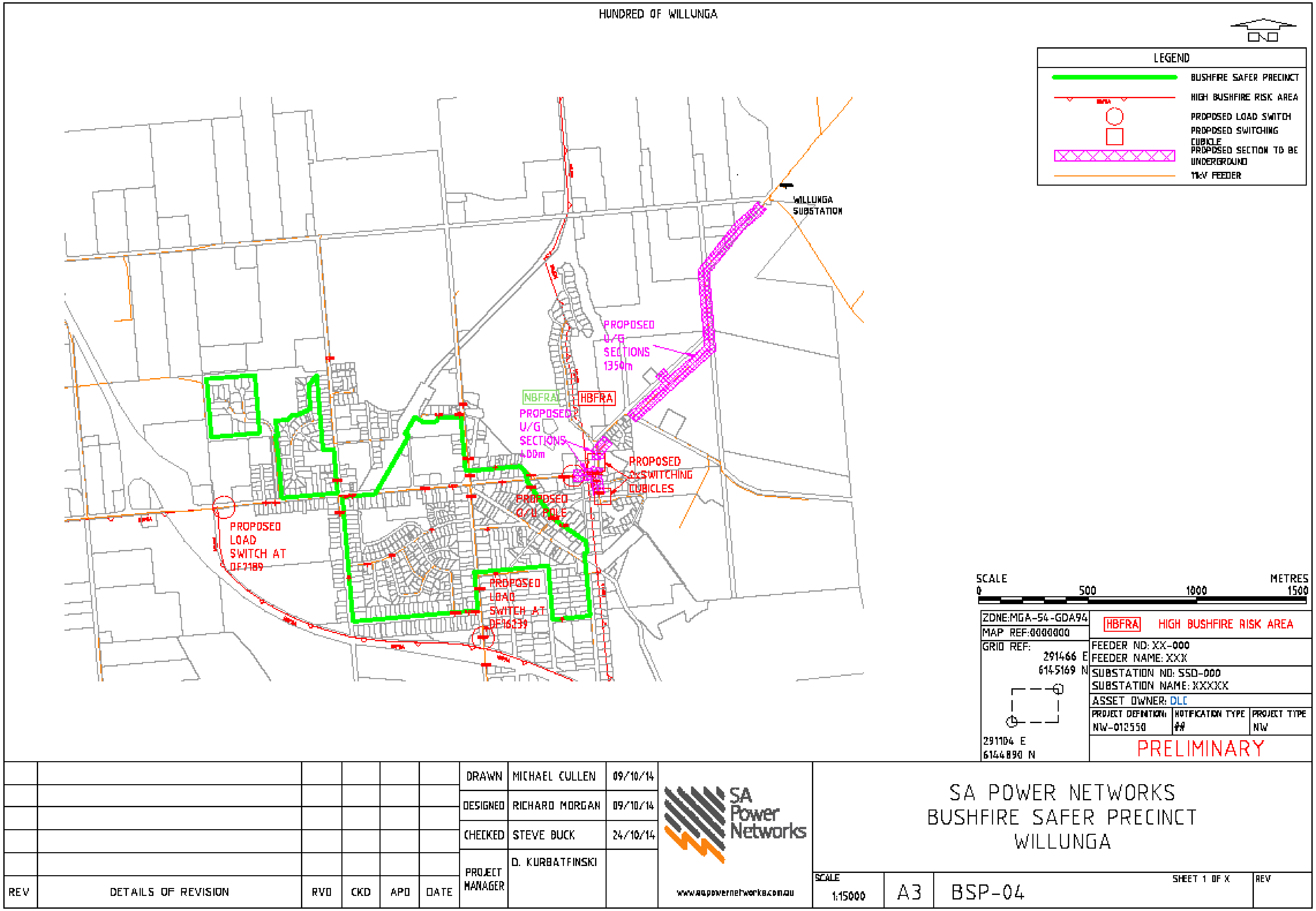
HUNDRED OF YANKALILLA
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SWITCHING CUBICLE
PROPOSED SECTION TO BE UNDERGROUND
11kV FEEDER
PROPOSED UG SECTION 1400m
HBFRA
EXISTING/PROPOSED LOAD SWITCH
PROPOSED UG SECTION 175m
PROPOSED UG SECTION 120m
PROPOSED LOAD SWITCH
HBFRA
PROPOSED LOAD SWITCH
PROPOSED UG SECTION 360m
PROPOSED SWITCHING CUBICLE
PROPOSED UG SECTION 3750m
YANKALILLA SUBSTATION SSD-XXX
PROPOSED LOAD SWITCH
SCALE
METRES
0 100 200 300 400 500 1000
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
######## E
######## N
######## E
######## N
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
DRAWN MC 23/10/14
DESIGNED MS 23/10/14
CHECKED SB 23/10/14
PROJECT MANAGER D. KURBATFINSKI KESWICK
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
NORMANVILLE
SCALE 1:10000
A3
BSP-08
SHEET 1 OF 1
REV


HUNDRED OF MACCLESFIELD, KONDOPARINGA, BREMER & STRATHALBYN
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
11kV FEEDER
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
HBFRA
NBFRA
PROPOSED LOAD SWITCH
PROPOSED UG SECTION 200m
STRATHALBYN EAST SUBSTATION
STRATHALBYN SUBSTATION
SCALE
METRES
0
500
1000
1500
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
DRAWN MICHAEL CULLEN 09/10/14
DESIGNED RICHARD MORGAN 09/10/14
CHECKED STEVE BUCK 21/10/14
PROJECT MANAGER D. KURBATFINSKI KESWICK
REV DETAILS OF REVISION RVD CKD APD DATE
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
STRATHALBYN
SCALE 1:15000
A3
BSP-06
SHEET 1 OF 1
REV


HUNDRED OF
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
OH SECTION TO BE REMOVED
MWV FEEDER
NOTE BSP IS CURRENTLY INSIDE A HBRA
EXISTING UG CABLE IS TO BE RETAINED
EXISTING UG CABLE IS TO BE RETAINED
PROPOSED UG SECTION 100m (EXISTING ABC)
PROPOSED UG SECTION 1050m
OH LINE TO BE REMOVED 40m
URAIDLA SUBSTATION
URAIDLA
PROPOSED LOAD SWITCH ON EXISTING O/H POLE
SCALE
METRES
0 50 100 150 200 250 500
ZONE:MGA-54-GDA94
MAP REF:000000D
GRID REF:
291466 E
6145169 N
291104 E
6144890 N
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION NW-012550
NOTIFICATION ##
PROJECT TYPE NW
PRELIMINARY
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
URAIDLA
SA Power Networks
www.sapowernetworks.com.au
DRAWN MICHAEL CULLEN 10/10/14
DESIGNED AIRAF AFZAL 22/10/14
CHECKED STEVE BUCK 23/10/14
PROJECT MANAGER D. KURBATFINSKI
SCALE 1:5000
A3
BSP-11
SHEET 1 OF 1
REV
REV DETAILS OF REVISION RVD CKD APD DATE



HUNDRED OF GOOLWA & ENCOUNTER BAY
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SECTION TO BE UNDERGROUND
OH SECTION TO BE REMOVED
11kV FEEDER
HAYBOROUGH BSP
VICTOR HARBOR BSP
ENCOUNTER BAY BSP
PROPOSED LOAD SWITCH
ISOLATE AT SUBSTATION
VICTOR HARBOR SUBSTATION
DISCONNECT T-OFF
PROPOSED UG SECTION 500m
PROPOSED UG SECTION 1400m
PROPOSED SWITCHING CUBICLE
REPLACE RMU IN SWITCHING CUBICLE
SCALE
METRES
0 500 1000 1500 2000 3000
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSD-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
PROJECT TYPE NW
PRELIMINARY
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
DRAWN MICHAEL CULLEN 09/10/14
DESIGNED RICHARD MORGAN 09/10/14
CHECKED
PROJECT MANAGER D. KURBATFINSKI KESWICK
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
HAYBOROUGH, VICTOR HARBOR & ENCOUNTER BAY
SCALE 1:30000
A3
BSP-03
SHEET 1 OF X
REV X


HUNDRED OF WILLUNGA
LEGEND
BUSHFIRE SAFER PRECINCT
HIGH BUSHFIRE RISK AREA
PROPOSED LOAD SWITCH
PROPOSED SWITCHING CUBICLE
PROPOSED SECTION TO BE UNDERGROUND
11kV FEEDER
WILLUNGA SUBSTATION
PROPOSED U/G SECTIONS 1350m
NBFRA
HBFRA
PROPOSED U/G SECTIONS 400m
PROPOSED 2xSWITCHING CUBICLES
PROPOSED O/H POLE
PROPOSED LOAD SWITCH AT DF7189
PROPOSED LOAD SWITCH AT DF96339
SCALE
METRES
0
500
1000
1500
ZONE:MGA-54-GDA94
MAP REF:0000000
GRID REF:
291466 E
6145169 N
291104 E
6144890 N
HBFRA HIGH BUSHFIRE RISK AREA
FEEDER NO: XX-000
FEEDER NAME: XXX
SUBSTATION NO: SSO-000
SUBSTATION NAME: XXXXX
ASSET OWNER: DLC
PROJECT DEFINITION: NW-012550
NOTIFICATION TYPE ##
PROJECT TYPE NW
PRELIMINARY
DRAWN MICHAEL CULLEN 09/10/14
DESIGNED RICHARD MORGAN 09/10/14
CHECKED STEVE BUCK 24/10/14
PROJECT MANAGER D. KURBATFINSKI
REV
DETAILS OF REVISION
RVD
CKD
APD
DATE
SA Power Networks
www.sapowernetworks.com.au
SA POWER NETWORKS
BUSHFIRE SAFER PRECINCT
WILLUNGA
SCALE 1:15000
A3
BSP-04
SHEET 1 OF X
REV