

Program Business Need Identification

Power and Water Corporation

CONTROLLED DOCUMENT

NMP5 (PRD33435)

Lake Bennet Feeder Conductor Clearance Rectification

Proposed:

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Date: 15/2/2018

Approved:

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Date: 23/2/2018

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Date: 15/2/2018

Refer to email
D2018/72353

Finance Review
Date: 06/02/2018

Refer to email
D2018/72527

PMO QA
Date: 15/02/2018



1 Program Summary

Program Name:	Lake Bennet Feeder Conductor Clearance Program		
Program No:	NMP5/PRD33435	SAP Ref:	
Financial Commencement:	Year	2019/20	
Business Unit:	Power Networks		
Program Owner (GM):	Djuna Pollard	Phone No:	08 8985 8431
Contact Officer:	Stuart Eassie	Phone No:	08 8924 5214
Date of Submission:	23/02/18	File Ref No:	D2017/376704
Submission Number:		Priority Score:	
Primary Driver:	Compliance	Secondary Driver:	Renewal / Replacement
Program Classification:	Program of Works		

2 Recommendation

2.1 MAJOR PROJECT >\$1M OR PROGRAM

It is recommended that the Chief Executive note the proposed Lake Bennett feeder conductor clearance rectification program for an estimated budget of [REDACTED] million, and approve the inclusion of this program into the SCI for this amount, with a corresponding completion date of June 2024.

The current forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI. This program will be included in the 2019-24 Regulatory Proposal to the Australian Energy Regulator (AER).

Note that individual projects within the program will be documented in Business Case Category C to be approved by the Executive General Manager Power Networks.

3 Description of Issues

3.1 Overview

The Lake Bennett feeder is in breach of statutory safety standards, in poor condition and difficult to maintain. The feeder was constructed in the mid-1970's and recent investigations



called to attention a range of defects including failure to meet safe ground clearance, burnt conductor damage, single and multiple broken strands, and conductor corrosion.

The deteriorated and unsafe condition of the feeder has prompted the need for investment in the refurbishment of the Lake Bennett feeder. The aim of the refurbishment is to maintain public and worker safety by bringing Lake Bennett feeder up to an acceptable standard. To achieve this it is proposed to install mid-span poles and perform conductor replacements along the entire feeder during the next regulatory period.

3.2 Safety Clearances

A conductor clearance investigation was completed in August 2017 involving 21.8km, or 48.0% of the feeder length. The investigation found that 66.7% of road crossing spans and 39.6% of other spans were in breach of the minimum ground clearances specified in the Electricity Reform (Safety and Technical) Regulations and AS7000:2016. A summary of the clearance issues are shown in the table below.

Lake Bennett - Ground clearance inspection results	Clearance over carriageway of roads (m)	Clearance over land other than carriageway of roads (m)
Ground clearance standard ¹	6.7	5.5
Volume of breaches	66.7%	39.6%
Largest breach	2.3	1.9
Smallest breach	1.7	0.05
Average breach	2.0	0.8

3.3 Conductor condition

There is a history of defects found on the Cockatoo conductor on the Lake Bennett feeder, including:

- Burnt conductor
- Broken strands
- Conductor corrosion

The widespread presence of these defects was confirmed during recent maintenance and repair works undertaken on the feeder. Figure 1 shows some photos taken during these works.

¹ Statutory clearances are shown. PWC internal standards for conductor clearance are 7.5m (Roads) and 6m (other areas)



Figure 1 – Cockatoo conductor photos showing broken strands, burning and corrosion

The Lake Bennett feeder is also affected by the “poly-pipe” corrosion issue. Widespread damage to overhead conductors has been identified where “poly-pipe” style bat protection has been used. This style of protection is used widely in the Katherine region and sporadically in Darwin’s rural area. The risk associated with this damage is conductor failure and wires dropping onto the ground. Anecdotal evidence suggests that the Cockatoo conductor type is not affected as badly as other conductor types but this has not been comprehensively tested.

Figure 2 shows an example of severely corroded conductor caused by the “poly-pipe” bat guards.



Figure 2 – Damaged conductor Due to “poly-pipe” bat guards

3.4 Maintainability

In comparison with works undertaken on typical overhead distribution networks, repairs and maintenance works undertaken on the Lake Bennett feeder are hindered by the unique feeder construction. The feeder design took advantage of high-tension conductor installations to achieve extreme span lengths – averaging around 200m and in some particular cases nearly 300m. By contrast, typical rural distribution span lengths are around 120 to 150m. A comparison of average span lengths is shown in Figure 3 below.

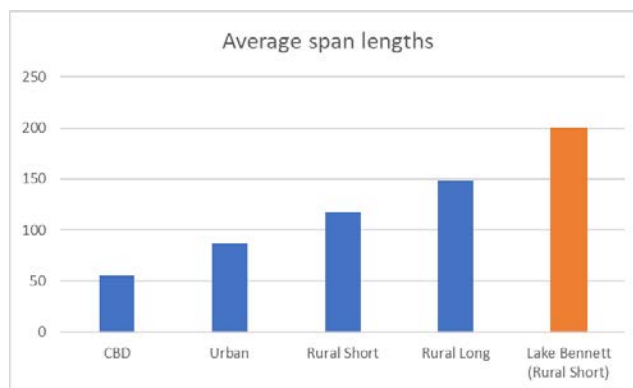


Figure 3 – Average span length comparison

The high-tension conductor requires specialised equipment and onerous work practices to allow safe and effective maintenance and repair. This results in higher maintenance costs and longer duration outages and higher safety risks to maintainers.



3.5 Project Drivers

3.5.1 Compliance

A fundamental business driver for PWC is compliance with statutory requirements encapsulated in the objective of providing safe and reliable power supply at a minimal cost as expressed through the Network Technical Code and Network Planning Criteria.

Targeted refurbishment of the Lake Bennett feeder will address non-compliances that exist, in a cost efficient manner.

3.5.2 Safety

The HV overhead network is managed in a manner that ensures PWC’s obligations to the safety of its employees, contractors and the public are met. Extreme insufficient ground clearances poses a safety risk to the public as well as PWC employees involved in undertaking works on and being in the proximity of the asset.

Refurbishment of the Lake Bennett feeder effectively addresses the public and worker safety risk.

3.5.3 Reliability (if not compliance obligation)

The Lake Bennett feeder contributes to the reliability performance of the power network. The poor condition of the overhead conductors, compounded by the particular design and construction arrangements of the feeder impacts on the ability to efficiently maintain network reliability.

Refurbishment of the Lake Bennett feeder will ensure continued maintenance of system reliability and achievement of PWC’s reliability performance objectives.

4 Potential Solution

Opportunities to maintain the safe and reliable operation of the network have been considered. These include:

Option 1 – Run to failure

Run to failure involves the reactive maintenance and repair of assets. It does not address the safety non-compliance and is characterised by increasing operations and maintenance costs, adverse system performance impacts, and unacceptable and potential spiralling of public and worker safety risk associated with the continued deterioration of the assets.

This approach is not aligned with PWC’s business objective for operating a safe and reliable network. The extensive insufficient safe ground clearances and poor condition of the



overhead conductors has urged the need for a focused investment to address the non-compliance and feeder condition issues.

Option 2 – Mid-span pole installation and re-conductoring (preferred option)

This option involves the installation of approximately 227 midspan poles across the length of the feeder, the replacement of 241 existing poletops, and the installation of around 40km (route length) of overhead conductor (noting that 5km has been previously replaced but without addressing the clearance issues).

Project execution would require special consideration to maintaining power supply and security of supply to customers in the Lake Bennett, Coomalie, Tortilla Flats, Adelaide River distribution areas. Given the unique climate and work environment it is reasonable to expect that the delivery timeframe would span up to 3 years.

The total cost for option 2 is \$ [REDACTED] and the cost estimate is detailed in Table 1.

Table 1 - Cost estimate for option 2

Task / Cost Item	Qty	Material	Internal Labour	Contractor	Total
Inter-pole Entire Route	227	[REDACTED]	[REDACTED]		[REDACTED]
Replace poletops	241	[REDACTED]			[REDACTED]
Re-conductor	40km	[REDACTED]	[REDACTED]		[REDACTED]
Clearing	45km			[REDACTED]	[REDACTED]
Network operation					
Generation		[REDACTED]		[REDACTED]	[REDACTED]
Conductor removal & disposal	180km			[REDACTED]	[REDACTED]
Total		[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Option 3 – Line rebuild

This option considers the complete rebuild of the Lake Bennett feeder parallel to the existing feeder. It involves the installation of approximately 379 poles, and around 45kms (route length) of overhead conductor. It also involves the decommissioning and disposal of approximately 227 poles and poletops, and 45kms (route length) of overhead line.

Given the unique climate and work environment it is reasonable to expect that the delivery timeframe would span up to 2 years for the construction of the new line, and a further 1 year for the removal and disposal of the existing line.

There is a potential that the existing easement may not accommodate construction works associated with the installation of a second parallel overhead line over the full length of the feeder. This may impact on the deliverability and execution schedule of this option and will be considered during the planning and design phase.

The total cost for option 3 is \$7.0M and the cost estimate is detailed in Table 2.



Table 2 – Cost estimate for option 3

Task / Cost Item	Qty	Material	Internal Labour	Contractor	Total
Re-build line	320	██████████	██████████	██████████	██████████
Conductor stringing	45km	██████████	██████████	██████████	██████████
Clearing	45km	██████████	██████████	██████████	██████████
Network operation		██████████	██████████	██████████	██████████
Generation		██████████	██████████	██████████	██████████
Pole & conductor removal & disposal	180km	██████████	██████████	██████████	██████████
Total		██████████	██████████	██████████	██████████

4.2 Preferred Option

Option 2 is the preferred option, since it is the lowest cost option which adequately addresses the compliance and safety drivers.

The program will re-conductor the Cockatoo portion of the Lake Bennett feeder install mid-span poles to ensure that ground safety clearance are met. The program will be undertaken during the next regulatory period, 2019/20 to 2023/24. It is expected to cost █████ million over the 5 year period, and the strategy will bring the Lake Bennett feeder up to acceptable standards within the regulatory period.

4.3 Non Network alternatives

No non-network alternatives were identified that would mitigate the need for the refurbishment of the Lake Bennett feeder.

4.4 Capex/Opex substitution

The proposed refurbishment investment addresses design and compliance issues that cannot be solved through operations and maintenance activities.

4.5 Contingent Project

The expenditure does not meet the criteria for a contingent project - National Electricity Rules, section 6.6A.1(b)(2).

5 Strategic Alignment

PWC’s objective is to operate a safe and reliable network. Investing in the refurbishment of the Lake Bennett feeder is aimed at achieving PWC’s objectives as set out in the Strategic Asset Management Plan (SAMP), and the Lake Bennett feeder Asset Management Plan (AMP).

6 Timing Constraints



It is essential that this project commence as proposed to manage the continued safe and reliable operation of the network.

7 Expected Benefits

Driver	Benefit	Measure
Asset Renewal	Removal of ageing and poor condition assets from the network	SAIDI/SAIFI performance Asset age profile
Service Improvement	Network Reliability	SAIDI/SAIFI performance
Safety	Mitigate increasing public and personnel risk	Safety Index
Compliance	Meet ground safety clearance requirements	Compliance to Electricity Reform (Safety and Technical) Regulations and AS7000:2016

8 Milestones

Investment Planning	Project Development	Project Commitment	Project Delivery	Review
01/2018	01/2018	07/2019	06/2024	09/2024

The program delivery is scheduled to run over 5 years from July 2019 to June 2024. A program review will be held at the end of the 5 year program as well as interim reviews at the end of each Financial Year.



9 Key Stakeholders

Stakeholder	Responsibility
Internal governance stakeholders	Executive General Manager Power Networks
	Group Manager Service Delivery
	Chief Engineer
Internal design stakeholders	Senior Manager Network Development and Planning
	Senior Manager Contracts and Projects
	Senior Manager Asset Management
	General Manager System Control
External – Unions and public	Local Residents
	ETU
	Ministers
External regulators	Utilities Commission
	Australian Energy Regulator

10 Resource Requirements

Resource requirements for this project are considered business as usual. Part of the annual planning process includes assessment of current feeder performance against requirements of the code and identification of targeted projects to address performance of those feeders.

11 Delivery Risk

- Site access for the removal and installation of poles and conductors may need to be negotiated on a site by site basis. These negotiations could impact on the timely and effective delivery of the project. Early stakeholder notification and consultation would assist in managing the delivery of the project scope.
- Consequential, site specific costs may result from works being undertaken on existing installations in existing built up environments. The expenditure estimates have been based on similar brown field works undertaken in recent years and includes for potential variances in costs.
- Availability of internal resources can affect the delivery of the program. Expenditure forecast has been based on recent similar investments and makes allowance for external resourcing.



12 Financial Impacts

12.1 Expenditure Forecasting Method

The expenditure forecast has been based on a programmed approach. The forecast volumes have been determined using a risk based prioritisation of assets focusing on the highest risk installations first.

Cost Estimates have been referenced from similar completed projects for the Re-conductoring of Howard Springs Feeder and the completion of new Darwin River Dam 22kv feeder.

The investment program is internally driven and no customer contributions are expected.

12.2 Historical and Forecast Expenditure

The annual forecast capital expenditure for the 2019/20 to 2023/24 regulatory period is provided in Section 12.4 below. No capital expenditure over the previous 5 years has been identified.

12.3 Validation

In the absence of expenditures recorded for recent similar upgrades on the Lake Bennett feeder, the expenditure estimate has been compared to typical pole and conductor replacement costs encountered by peer utilities nationally. With respect to conductors, shown in Figure 4, the unit cost is lower than the peer average, however this is somewhat expected for a rural line with very limited obstructions along its route.

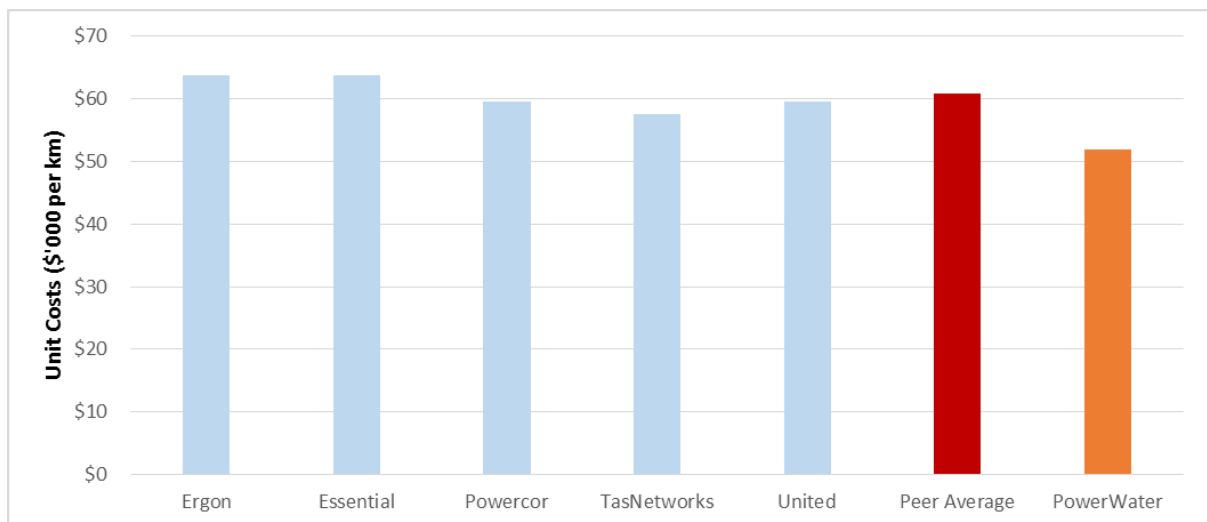


Figure 4 – Conductor replacement unit cost benchmarking

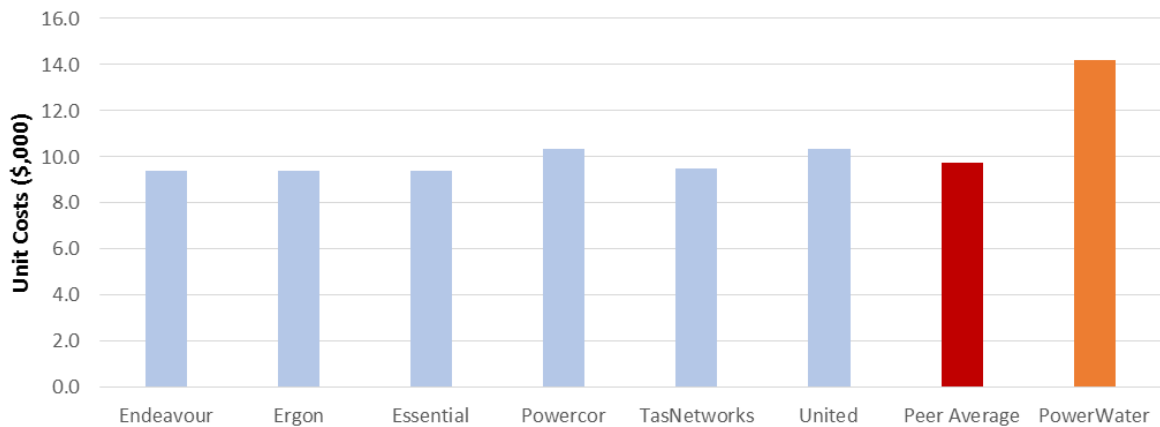


Figure 5 – Pole installation unit cost benchmarking

In comparison with peer utilities, PWC’s pole installation unit cost compares slightly above average but is reflective of a unique network construction due to operating environment factors, climate conditions, and work environment.

Works undertaken in the Northern Territory are characterised by higher costs than other areas in Australia. This can partly be attributed to the remoteness of the network attracting additional transport and logistic costs, as well as the harsh weather conditions set apart by extended wet periods that impedes the effective execution of works and a tropical climate that impacts on the productivity that can be achieved during normal work hours.

Activity associated with overhead line installation is considered to require a high metabolic work rate, and is therefore heavily affected by the weather conditions in Darwin. Based on analysis conducted by Thermal Hyperformance², workability for High metabolic activity reaches approximately 70% during only the coolest months of the year, June. Workability is not affected in any other major Australian population centre except for during the hottest 2-3 months of summer.

12.4 Capex Profile

The capex in the table below is in \$2017-18, and is excluding capitalised overheads and cost escalation.

Phase	2019-20 (\$'000)	2020-21 (\$'000)	2021-22 (\$'000)	2022-23 (\$'000)	2023-24 (\$'000)	Total (\$'000)
Investment Planning						
Project Development						
Project Commitment						

² Labour Efficiency and Work Management in Hot Humid Climates, Thermal Hyperformance.



Phase	2019-20 (\$'000)	2020-21 (\$'000)	2021-22 (\$'000)	2022-23 (\$'000)	2023-24 (\$'000)	Total (\$'000)
Project Delivery	██████	██████	██████	██████	██████	██████
Review						
Total	██████	██████	██████	██████	██████	██████

12.5 Opex Implications

No step change in operating cost is forecast for the next regulatory period as result of investing in the refurbishment of the Lake Bennett feeder.

12.6 Variance

The forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI.