PowerWater

Power and Water Corporation

Preliminary Business Case – Category B

PRD33006

Replace Port Feeder

Proposed:

Jim Mckay
A/Chief Engineer
Power Networks
Date: 6/2/2018

Approved:

Michael Thomson
Chief Executive & Chair
Investment Review Committee
Date: 23/02/2018

Endorsed:

Djuna Pollard
Executive General Manager
Power Networks
Date: 15/2/2018

Refer to email
D2018/72353

Finance Review
Date: 06/02/2018

Refer to email
D2018/63854

PMO QA
Date: 12/02/2018

1 RECOMMENDATION

It is recommended that the Chief Executive approve PRD33006 Replace Port Feeder (11BE18) at an estimated cost of [redacted] and a corresponding completion date of June 2021.

Approval is sought for expenditure of up to $0.2M of the total forecast expenditure to undertake the necessary work to proceed to the next approval gateway (Business Case Approval), including:

- Detailed design; and
- Detailed cost estimate, including by seeking a firm price offer from external contractors through a competitive tender.

Furthermore it should be noted that the project has a 95% likelihood of being delivered between [redacted].

The revised forecast expenditure is due to a reduction in project scope by targeting works to sections where the majority of the cable faults have occurred.

2 PROJECT SUMMARY

Project Title:	Replace Port Feeder		
Project No./Ref No:	PRD33006	**SAP Ref:**	
Anticipated Delivery Start Date:	Jul 2019	**Anticipated Delivery End Date:**	Jun 2021
Business Unit:	Power Networks		
Project Owner (GM):	Djuna Pollard	**Phone No:**	8985 8431
Contact Officer:	Peter Kwong	**Phone No:**	8924 5060
Date of Submission:	23/02/18	**File Ref No:**	D2017/394399
Submission Number:		**Priority Score:**	
Primary Driver:	Renewal/Replacement	**Secondary Driver:**	Service Improvement
Project Classification:	Capital Category B		

2.1 Prior Approvals

Document Type	Sub Number	Approved By	Date	Capex Value

3 INVESTMENT NEED

3.1 Background

The Port feeder (11BE18) is an 11kV feeder that originates from Berrimah Zone Substation and ends at the East Arm Port intake station, with a peak demand of 3.2MVA. It is a critical feeder servicing customers in the East Arm area and the [redacted]

3.2 Asset details

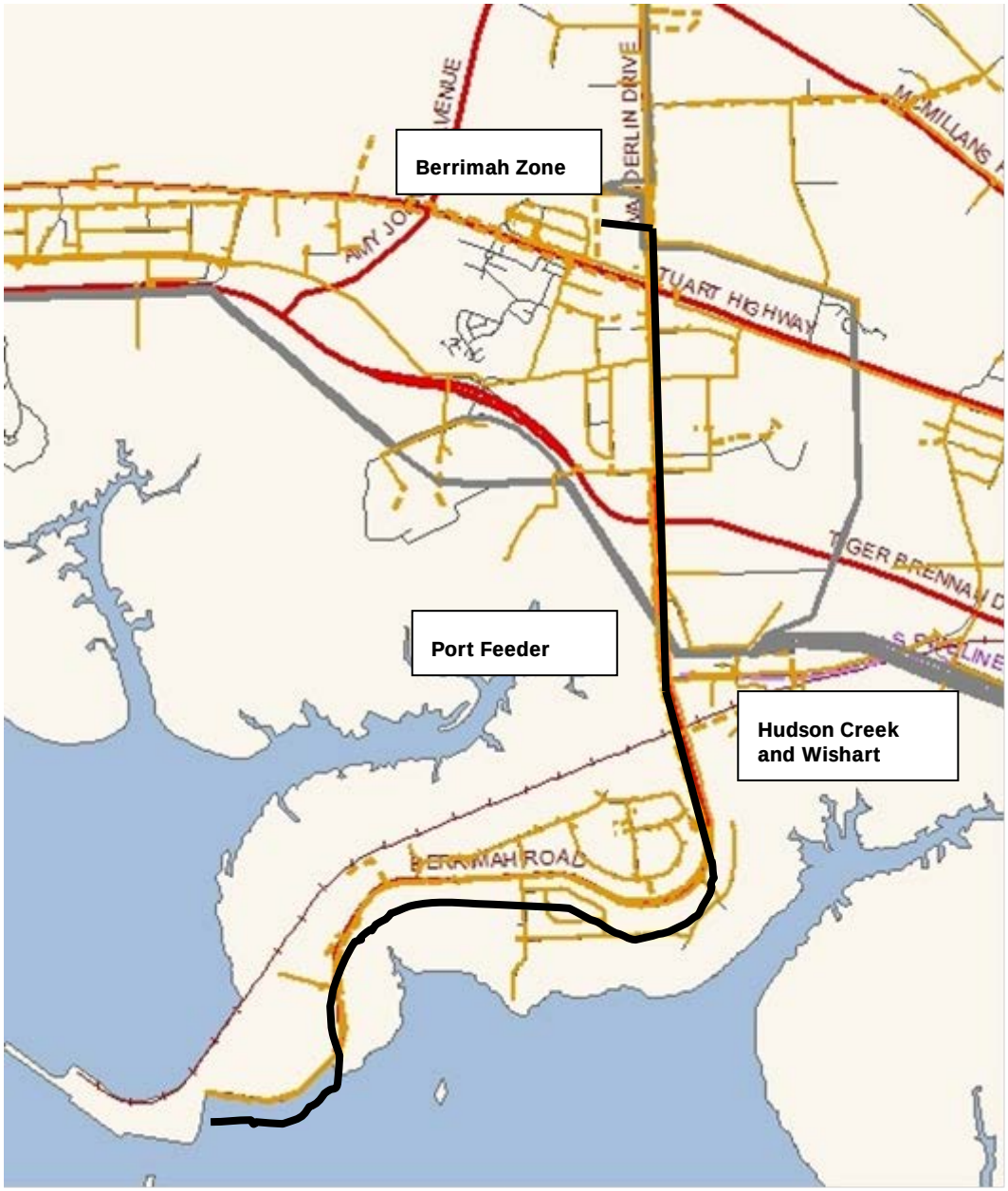
The Port feeder is supplied from Berrimah zone substation via a 11kV underground cable. The cable construction consists of a 3 core, 400mm2 aluminium conductor, with paper insulation and a lead sheath of approximately 8km in length. The cable was commissioned in 1997 and is over 20 years old.

Over the life of the cable, a number of in-line cable faults have occurred. It has been concluded that the root cause of these faults is due to compromised outer sheath resulted from poor installation methods. This is confirmed by recent electrical tests on the cable sheath and other tests also indicate that the overall internal insulation of the cable is below average.

By 2024, the cable will be 27 years old. Industry experience is that the typical cable operating life is 40 years, depending on the operational history and other factors.[1] As discussed below, since the installation of this cable, PWC has experienced numerous in-line failures which indicate that the integrity of the mechanical protection of the cable has been compromised, and as a result the typical design life will not be realised.

[1] Power and Water – Asset Management Plan Cables

Figure 1: Overview of feeder configuration to East Arm

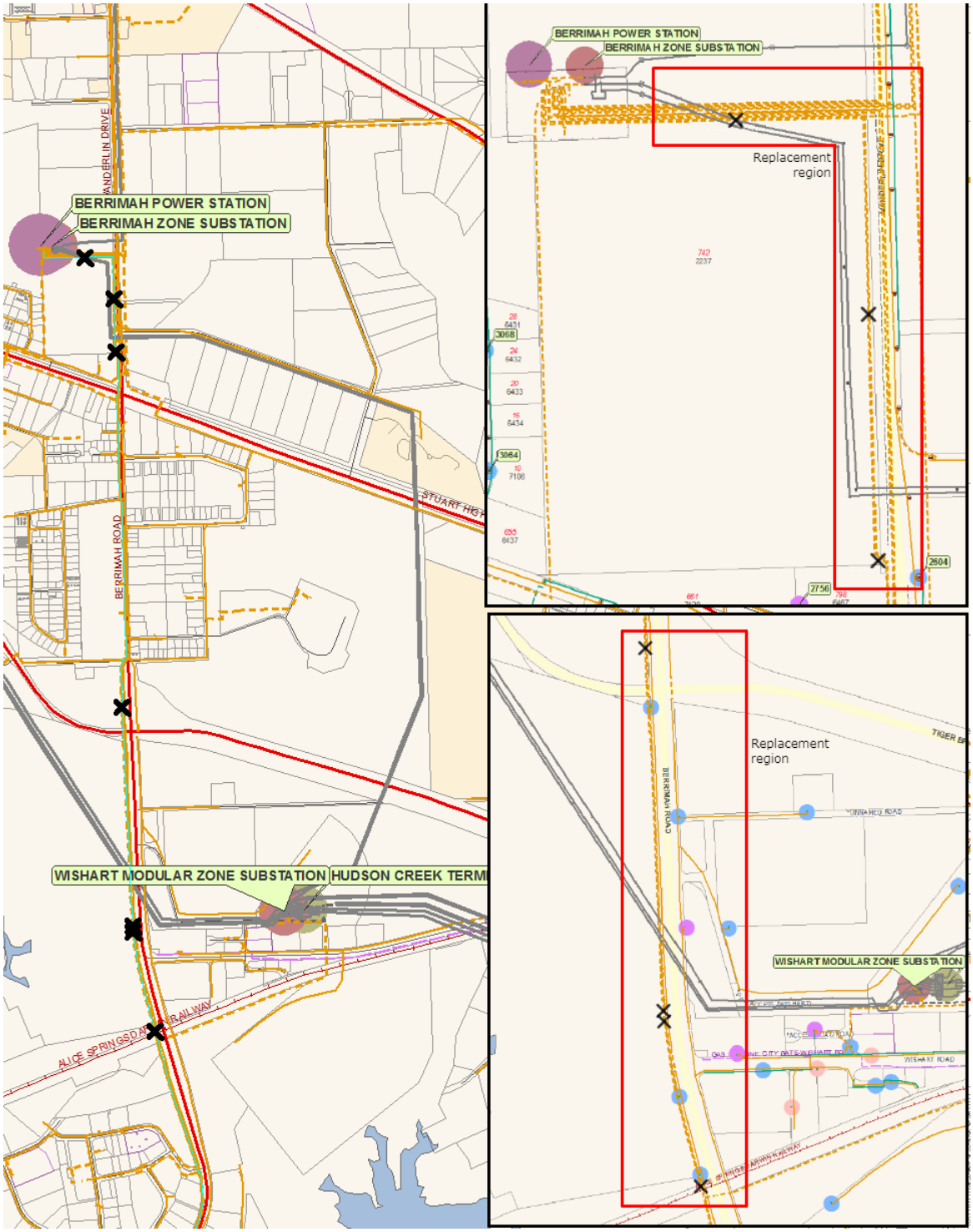


3.3 Management strategy & investigation outcomes

The primary failure mode of the cable is insulation breakdown. This is due to the damaged outer and lead sheath resulting moisture ingress into the paper insulation.

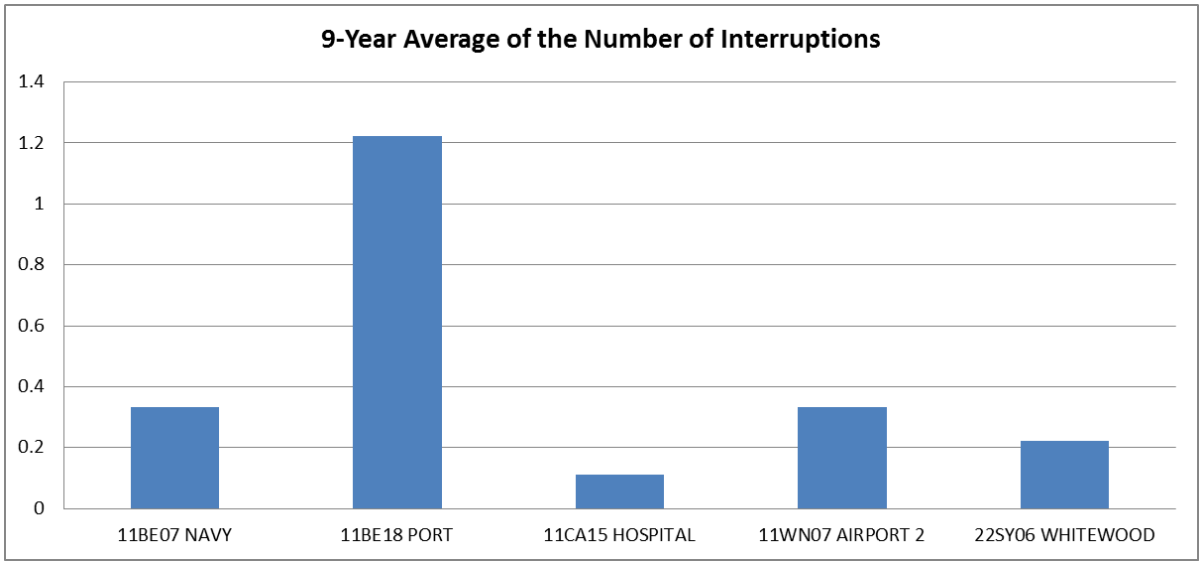
A number of in-line cable faults have occurred on this feeder cable as shown in Figure 2 below.

Figure 2. History of cable faults – 11BE03



As shown in Figure 2, the majority of the cable faults are located in two main sections, between Berrimah Zone Substation and the Stuart Highway crossing, and between Tiger Brennan Drive and Wishart Road.

Figure 3. Average number of Interruptions in comparison to similar feeders



On investigation, the primary root cause of the in-line cable faults is the compromised outer sheath. Many cable joints are now installed on this feeder cable and small sections of PILC cable have been replaced with XLPE.

PWC's cable strategy recommends a cable condition assessment after 2 – 3 in-line cable failures. A cable condition assessment[2] has been completed on the 11BE18 Port feeder cable and the recommendation from this assessment is that the section of the cable where the failures are located requires replacement.

The cables asset management plan has identified the Port feeder cable as a priority project for replacement in the next RCP.

3.4 Current and emerging issues

3.4.1 Compromised outer sheath

Anecdotal evidence by the cable jointers of poor cable installation practices are consistent with visual inspections revealing cracks in the outer jacket. Power and Water has concluded that maximum pulling tensions and bending radius have been exceeded during installation causing many of the cracks observed in the outer jacket.

The outer sheath protects the metallic screen and insulation from environmental damage such as punctures and corrosion to the lead sheath. The metallic screens in a cable are designed to provide an effective earth return path for fault currents and a uniform electric field distribution around the main insulation. If the metal screen is damaged at a point from excessive tension, bending or corrosion, the electrical field distribution is non-uniform. This leads to higher electrical stresses on the insulation of the cable and eventual in-line cable faults occur.

[2] 11BE18 Cable condition assessment report

3.4.2 Water ingress observed in cable

The outer sheath prevents moisture ingress. When cutting the Port feeder cable, water was observed pouring out from the centre. The cable is filled with oil to preserve the paper insulation; moisture will cause degradation of the screen and localised drying out of the paper insulation by displacing oil in that section of cable. These factors combined with poor cable quality and stress from exceeding the bending radius and pulling tensions during installation will lead to premature failure.

3.4.3 Poor insulation strength

Recent DC insulation resistance (IR) testing by specialist contractors RANS Electrical shows that the overall internal insulation of the PILC cable is below average. Electrical Integrity tests of the outer sheath have failed confirming the visual inspections[3]

3.4.4 Increased fault restoration time

In many areas it is installed in corrugated PVC conduit (Corflo), making fault finding an enormous task. In addition, the length of the cable increases the difficulty and complexities of fault finding as fault locating pulses are highly attenuated. A discontinuous metallic screen significantly increases the complexity of fault finding and condition testing of the cable. These problems add to the time required for fault restoration adding to cost.

3.4.5 High repair costs incurred

The in-line cable fault on 25th September 2012 cost PWC $362K over a period of more than one year in order to locate, repair, condition assess and return to service. During this time the cable was out of service placing significant stress on adjacent feeders during peak load periods.

3.4.6 Inadequate spare capacity / overloading

The TDZ (11BE03) and Port feeders are the main supplies into East Arm. There are two other feeders: Jail (11BE09) & Kormilda (11BE13); supplied from Berrimah that are available to provide backup supply in emergencies but their spare capacity is limited during peak loading due to the high demand in the Berrimah and Pinelands areas.

The large loads located at the end of East Arm peninsula causes excessive voltage drop and inhibits utilisation of the full capacity of 11BE03 TDZ and 11BE18 Port feeders under N-1.

In addition, loads at East Arm are increasing above the Darwin average of 2.7% p.a. 11BE18 Port feeder is increasing on average by 4.2% p.a. and for 11BE03 TDZ 4.4% p.a[4]. With a fault on 11BE18 modelling shows that a

[3] (TRIM D2014/202033).

[4] TRIM D2012/636415 NPR1303 East Arm Requirement for new Zone Substation – Appendix B Load Forecasts

number of feeders at Berrimah ZSS will exceed their full capacity rating during peak system demand[5].

3.5 Risk analysis

Figure 4 shows the current rating, inherent rating (in 2024, i.e. if no action is taken in the interim), and the residual (post-treatment) risk ratings associated with the Port feeder cable supplying the East Arm area.

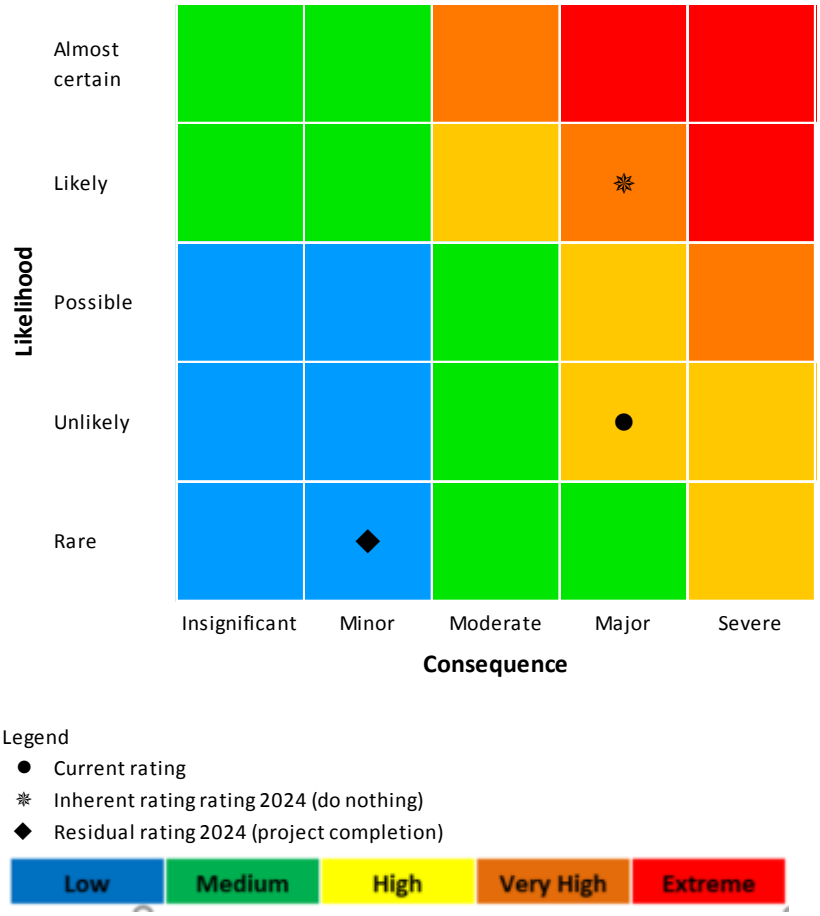
(i) *Current rating:* The Current rating (2017) is assessed to be 'High' because in the 'Unlikely' event there is a further cable failure, this failure will cause and extended supply interruption due to the extent of the repair that will likely be required and possible safety consequence. This consequence is classed as 'Major'.

(ii) *Inherent rating:* Due to the extent of the issues now identified on this feeder cable, the probability of a feeder cable failure by 2024 is likely, and that this failure will cause and extended supply interruption due to the extent of the repair that will likely be required and possible safety consequence. There is also likely to be media attention, given the history with this feeder cable. This consequence is classed as 'Major'. The overall risk rating is therefore 'Very high'.

(iii) *Residual rating:* The proposed project will address the probability and consequence of cable failure. A new feeder cable has a much higher level of availability, and therefore the likelihood of a failure event on a new cable is 'Rare'. If a failure event did occur, the impact of the event would be significantly lessened, to a level classified as 'Minor'. The overall risk rating is therefore 'Low'.

[5] TRIM D2012/636415 NPR1303 East Arm Requirement for new Zone Substation - Section 5.2 Stage 1 contingency

Figure 4: Port feeder cable risk assessment[6]



It is Power and Water's current practice to take action on risks that have an inherent rating of 'HIGH' or above. The PBC summarises the proposed response to this impending risk.

4 STRATEGIC ALIGNMENT

This project aligns with the Corporation's key result areas of operational performance and customer centricity, where the goals are to be an efficient provider of services and delivering on customers' expectations.

This project will allow PWC to provide safe, reliable power supply in line with our stakeholder expectations for the East Arm area.

5 TIMING CONSTRAINTS

It is required that the cable be replaced by 2021 to maintain the security of supply for the East Arm area. The likelihood of cable faults in the future is very high given the condition of the cable and the number of previous failures.

[6] Based on Power Network's Risk Assessment Guide

Condition assessment and electrical testing indicates that some sections of the cable have reached the end of its economic life.

6 EXPECTED BENEFITS

Driver/Objective	Benefit	Current State	Future State
Reliability	Increased reliability and reduced maintenance (inspection and repairs)	Risk of asset failure is very high and increasing maintenance costs	Risk of failure is low for new equipment and reduced maintenance costs
Safety	Reduced risk of injury from elevated risk of failure Reduced risk of injury from high level of corrective cable repairs	Elevated level of personnel safety risk due to poor condition of feeder cable	Risk of injury to personnel reduced to acceptable levels

7 REQUIREMENTS

The solution selected must resolve the need to allow PWC to supply power to the East Arm area during credible contingency events and support reliability targets during unplanned events and planned maintenance activity. It is also preferable to minimise impact on existing operational capabilities at both sites during construction (i.e. maintain system security requirements).

PWC will also require compliance with the following:

- Northern Territory Electricity Reform Act;
- Power and Water's Network Licence as issued by the Utilities Commission, and;
- Network Planning Criteria and Electricity Networks (Third Party Access) Code.

8 OPTIONS

8.1 Options Development

A number of options were analysed considering the main issues and proposed solutions. The results of the analysis are presented below:

8.1.1 Option 1 – Base case (replace on failure)

This option proposes to repair/replace feeder sections upon failure. The average operating cost of this feeder is $86,000 per annum, although the likelihood of failures will increase in the future as the cost of unplanned fault location and repairs are significantly more expensive compared to planned works. The scope of this option includes:

- Cable fault identification, excavation and repair of cable section
- Re-instatement works

The advantages of this option are:

(i) No capital investment required; and

(ii) Repairs are made using new XLPE cable.

The disadvantages of this option are:

(i) Given the age and assessed condition of the feeder cable, increasing numbers of failures are likely and will contribute to further supply interruptions to customers, financial losses to those customers and to PWC in the East Arm area;

(ii) It is unlikely that the quality and reliability of supply criteria will be able to be met in the East Arm area; and

(iii) It is likely that the elevated cable failures, and consequential corrective works and testing, will result in an elevated risk of a safety incident involving a member of the public or a PWC worker from these works and or related equipment failure.

8.1.2 Option 2 – Replace Port feeder from Berrimah substation

In this option, the existing 3c paper-lead cable will be replaced with a new XLPE cable from Berrimah ZSS of capacity 3.5MVA and total length of 11.2kms at an estimated cost of [redacted]. The scope of this option includes:

- Purchase and installation of 11.2 kms of 400mm2, aluminium, 11kV XLPE cable;
- Trenching, conduit and earthing installation;
- Cable jointing and termination at Berrimah ZSS, and RMU switch 4003 located at Darwin Port intake station; and
- Re-instatement works

The advantages of this option are:

(i) Improved reliability and reduced likelihood of cable faults;

(ii) Cable installed is to the latest technology and standards.

The disadvantages of this option are:

(i) High cost to replace the entire feeder;

(ii) Cable capacity limitations and voltage regulation issues will continue due to the length of the feeder.

8.1.3 Option 3 – Replace Port feeder from Wishart substation

In this option, the existing cable will be replaced with a new XLPE cable from Wishart ZSS of capacity 6MVA and total length 8.1kms at an estimated cost of [redacted]

Scope of this option includes:

- Purchase and installation of 5.1kms of 400mm2, aluminium, 11kV XLPE cable;
- Trenching, conduit and earthing installation;
- Cable jointing and termination at Wishart ZSS, and RMU switch 4003 located at the Darwin Port intake station; and
- Re-instatement works.

The advantages of this option are:

(i) Shorter cable route, and therefore lower voltage regulation on this feeder cable;

(ii) Higher effective cable capacity; and

(iii) Lower cost due to short cable route, and less road crossings including the Stuart Highway.

The disadvantages of this option are:

(i) Less security being connected to Wishart being a single transformer zone substation; and

(ii) Reduced distribution transfer capacity between Berrimah and Wishart.

8.1.4 Option 4 – Replace sections of the existing Port Feeder (Preferred option)

In this option, the two sections where the majority of the cable faults that have occurred will be replaced. These are the sections between Berrimah Zone Substation and the Stuart Highway crossing, and between Tiger Brennan Drive and Wishart Road. A total length of 2.9 km of cable will be replaced at an estimated base cost of [redacted].

Scope of this option includes:

- Purchase and installation of 2.9 km of 400mm2, aluminium 11kV XLPE cable;
- Trenching, conduit and earthing installation;
- Installation of two RMUs at Tiger Brennan Drive and Wishart Road and interconnection to adjacent feeders;
- Re-instatement works.

The advantages of this option are:

(i) The targeted replacement is lower cost compare to whole feeder replacements;

(ii) Ability to isolate and test shorter sections of cable for condition monitoring and accurate fault locating;

(iii) Ability to switch the East Arm load to other feeders for upstream faults to shorten restoration time.

The disadvantages of this option are:

(i) The majority of the cable will still be the original, paper lead cable;

(ii) There is still a risk of failure for the remaining sections with the original cable.

8.1.5 Option 5 – Demand Management

PWC confirm the ongoing need for this feeder cable to provide critical supply to loads in the East Arm area, with a long term demand forecast increasing to more than 3.5MVA.

Based on PWC's research, the most likely source of demand management is via curtailment contracts with large commercial and with industrial customers in the area. PWC does not have access to other forms of demand management such as through ripple control or smart meter activated control of customer loads (such as air conditioners).[7]

Given the stated condition of the feeder cable, deferral of this project using demand management is not considered to be prudent or technically feasible.

PWC does not currently have a register of available network support services available in the market, such as local generation, to be provided in proximity of Berrimah or Wishart ZSSs, and no such option is currently known to PWC.

The major advantage of Option 5 is that it could delay the need to commit to capital expenditure to maintain the reliability of supply in the event of further cable failures, in addition to drawing from available transfer capacity in the distribution network. However, the feeder cable into the East Arm area is considered a critical point of supply will continue to be required to meet the forecast demand growth. The option is unlikely to be viable in the medium to long term, as the condition of the feeder cable continues to deteriorate.

PWC will continue to explore the technical and commercial viability of this option by engaging with the market to identifier providers of network support services prior to submitting the Business Case for Approval.

In the interim, Option 5 is not considered to be viable.

8.2 Comparative cost analysis

PWC is currently developing a probabilistic risk-cost methodology which, when completed will be used to compare options and confirm the economically optimum time for investment.

Table 2 summarises the results of a comparative cost analysis, the details of which are included in Appendix A.

PWC has adopted a prudent approach to selecting a targeted replacement option, rather than full replacement.

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[7] It is unlikely that turning off air conditioner compressors, even for as little as 15 minutes at a time will be accepted as a demand management initiative in the Northern Territory due to the prevailing climatic conditions

Table 2: Summary of comparative capital cost analysis

Option	Capital Base Cost ($M)	Net Present Cost ($M)	Comments
1 – Do nothing (replace on failure only)	[redacted]	[redacted]	Does not achieve risk reduction to an acceptable level. Not considered technically feasible
2 – Replace feeder cable from Berrimah ZSS	[redacted]	[redacted]	
3 – Replace feeder cable from Wishart ZSS	[redacted]	[redacted]	
4 – Replace sections of existing feeder from Berrimah ZSS (Base Cost)	[redacted]	[redacted]	Preferred option
5 – Non-network solutions and demand management	[redacted]	[redacted]	Not considered technically feasible

8.3 Non-cost attributes

An analysis of the non-cost attributes for each option has been completed using the multi-criteria analysis method. The attributes are selected considering major risks and priorities to achieve Project Objectives. A weighting is allocated to each, totalling 100%. Each attribute is given a score out of 5 (from 1 – Fails to satisfy, to 5 – exceeds requirements); the score is then multiplied by the relevant weighting to give the weighted score that is summarised in the table below.

	Project Objectives			Technical & System Risk			Stakeholder Risk			Env. Risk		Commercial
Criteria	Reduced Risk Asset Failure	Maintain System Security	40 Year Design Life	Standard Assets	Constructability	Continuity of Supply	Safety	Community Impact	Approvals	Soil Containment	Land Clearing	NPV/C
Weighting (%)	10	10	10	5	5	10	10	5	5	5	5	20
Option 1	0.1	0.2	0.1	0.05	0.2	0.2	0.2	0.1	0.2	0.25	0.25	1.0
Option 2	0.4	0.4	0.4	0.2	0.1	0.3	0.4	0.2	0.15	0.15	0.15	0.4

Option 3	0.4	0.3	0.4	0.2	0.1	0.3	0.4	0.2	0.15	0.15	0.15	0.6
Option 4	0.3	0.4	0.3	0.15	0.15	0.4	0.3	0.2	0.15	0.2	0.2	0.8

8.3.1 Evaluation Summary

Table 1: Non-cost attributes analysis – weighted scores

Weighted Scores:

Option 1: Deferral	2.85
Option 2: Replace feeder from Berrimah ZSS	3.25
Option 3: Replace feeder from Wishart ZSS	3.35
Option 4: Replace section of existing cable	3.55

8.4 Preferred option

The preferred option (option 4) is to replace specific sections of the existing Port Feeder. This option best fulfils the project objectives of improving reliability of the feeder. It also minimises construction time and will allow the remaining sections to be monitored to obtain a more accurate picture of the condition of the remaining cable.

This is the preferred option for the following reasons:

(i) Of the technically feasible options, it has the lowest initial capital cost, and it has the lowest NPC over the study period;

(ii) It is based on PWC's standard design practice, which minimises design, maintenance and construction costs;

(iii) It has the highest weighted score from the assessment of non-cost attributes.

8.5 Other Considerations

It should be noted that Option 1 (deferral) does not include cost of loss load and the monetarisation of risks, including safety and corporate image. It is also likely the average operational cost will increase significantly in the future due to the increased frequency of failures.

9 PROJECT OUTLINE

9.1 Project Description

This project is to replace two sections of the existing Port Feeder that have been experiencing multiple faults. The first section starts from Berrimah Zone Substation and ends at the Stuart Highway intersection and it is 1.1kM in length. The second section starts at Tiger Brennan Drive intersection and ends at the Wishart Road intersection and is about 1.9km long.

9.1.1 Scope Inclusions

The scope of the project includes:

- Purchase and installation of 2.9 km of 400mm2, aluminium 11kV XLPE cable;
- Trenching, conduit and earthing installation;
- Cut and remove existing paper lead cable;
- Installation of two RMUs at Tiger Brennan Drive and Wishart Road and interconnection to adjacent feeders;
- Re-instatement works.

9.1.2 Scope Exclusions

- Works on the remaining sections of the original cable.

9.1.3 Assumptions

- It is assumed that the existing cable is installed at the correct alignment and no major changes are required.

9.1.4 Key Stakeholders

Name	Title / Business Unit
Internal – Governance Stakeholders	Chief Executive
	Investment Review Committee
	Executive General Manager Power Networks
	Chief Engineer
	Group Manager Service Delivery
Internal – Design Stakeholders	Senior Manager Networks Development and Planning
	Manager Major Projects
	Senior Manager Network Assets
	Manager Protection
External – Authorities	Environmental Protection Authority
	Aboriginal Areas Protection Authority
External - Other	Local Residents
	Ministers
	Utilities Commission
	Australian Energy Regulator

9.2 Capital Cost

A risk adjusted cost estimate (RACE) was conducted on the preferred option based on latest design, scope and cost information.

Based on the analysis, the project has a 90% likelihood of being delivered between [redacted]. The contingency attributable to risk is calculated as P95 – P50 = $0.29M.

[redacted]

9.2.1 Base Capital Cost

[redacted]

Table 1 – Base Capital Cost Estimate

9.2.2 Risk and Contingency

The current estimate has been developed largely based on PWC and consultant estimates considering previous experience with similar works. The contingency amount, calculated as the P95 value minus the expected P50 value, is currently $ 0.29M.

9.3 Estimated Operating Cost Impact

Forecast costs of the Port Feeder are related to operation and maintenance as detailed below. It is expected there will be a saving in operating cost from the current average cost of $86,267 due to the replacement of the less reliable sections of the cable.

Item	Annual Incremental Cost ($'000)
Planned Maintenance	3,136
Preventative Maintenance	3,136
Unplanned Maintenance	1,568
TOTAL	**7,840**

Table 2 – Estimated Operating Cost Impact

9.4 Project Milestones

Project Phase (end)	Investment Planning	Project Development	Commitment	Implementation	Review
Original Plan (BNI)	09/2017	06/2019	09/2019	06/2021	09/2021
Current Forecast	09/2017	06/2019	09/2019	06/2021	09/2021
Actual Completion	09/2017				

10 RISK MANAGEMENT AND COMPLIANCE

A preliminary risk register has been established to address project risk. This is included in Appendix B. This register will form the basis of the Project Risk Register into the project delivery phase. The register will be regularly reviewed and updated as required to ensure all identified risks are managed as the project progresses.

10.1 Legal Issues

There are no expected legal issues regarding this project.

10.2 Stakeholder and Approval Issues

There are no expected stakeholder and approval issues regarding this project.

10.3 Environment and Sustainability Issues

Soil management will need to be in place to limit the amount of soil entering the storm water system. This will be a significant issue for civil works during the wet season.

10.4 Technical and System Issues

There is an existing feeder (TDZ) installed next to the Port feeder for most of the route. This feeder will remain live and operational during most of the works.

11 PROJECT IMPLEMENTATION

11.1.1 Resourcing Requirements (to next gateway)

Resource Type/Role	How Many?	Internal/ External?	Anticipated Start Date	Duration Required	Allocation (% time or # hrs/days/ wks/mths)
Project Manager	1	Internal	Jul 2019	6 months	50%
Planning Engineer	1	Internal	Jul 2019	6 months	10%
Design Engineer	1	External	Jul 2019	6 months	50%

12 FINANCIAL IMPACT

12.1 Funding Arrangements

The capital expenditure for this project will need to be approved by the AER's 2019-24 Network Price Determination, which is recovered through standard control network tariffs.

Based on the most up to date information, the project cost estimate has been revised to [redacted] The revised cost is based on the estimated costs provided in the concept design and additional estimates for internal PWC expenditure.

12.2 Capital Expenditure

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

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			[redacted]	[redacted]		[redacted]

[redacted]

12.3 Incremental Operating Expenditure

An operating expenditure of approximately $7,840 per annum is expected for the maintenance of the new transformer and switchboard extension. Upon completion of the project, the operation cost of the new transformer will be included in the operational budget and forecasted in regulatory processes.

APPENDIX A

DETAILED FINANCIAL ANALYSIS

Introduction

The purpose of this Appendix is to provide details of the options analysis for the project to replace Port Feeder.

Table A1 below outlines the estimated capital expenditure for options 1, 2, 3 and 4.

Commercial analysis of Option 5 (Demand Management) was not undertaken as it is not considered to be a viable alternative due to the risk of outages that would affect large industrial customers and the limited demand management options available.

Table A1 – Estimated Capital & Operating Expenditure

Option	Capex – Base Costs ($M)	Opex – Base Costs ($000's)
1 – Do nothing (replace on failure)	[redacted]	$86 (from 2021/22)
2 – Replace feeder cable from Berrimah ZSS	[redacted]	$7.8 (from 2021/22)
3 – Replace feeder cable from Wishart ZSS	[redacted]	$7.8 (from 2021/22)
4 – Replace sections of existing feeder from Berrimah ZSS	[redacted]	$7.8 (from 2021/22)
5 – Non-network solutions and demand management	-	-

Assumptions

In modelling the options, technical, economic and cost parameters were included. The technical and cost data was provided by Power Networks and the economic data was sourced from Pricing and Economic Analysis (PEA). Base cost capital expenditure was based on the consultant's feasibility study.

In the assumptions, all costs exclude GST or other government charges.

The common variables employed in the Discounted Cash Flow (DCF) model are presented in Table A2 below. These variables are consistent with the 2019-24 Regulatory Proposal submitted to the AER and are considered appropriate for use in the detailed commercial analysis.

Table A2 – Common Variables

Variables	
Nominal Pre-Tax WACC	6.96%
CPI – 2017/18	2.42%
CPI after 2017/18	2.42%
Time Horizon of Project	40 years

Option 1 – Do Nothing (replace on failure)

The analysis for this option does not require any capital expenditure and it is expected the current average operational cost of $86,267 per annum will continue into the future.

Option 2 – Replace feeder from Berrimah Zone Substation

The analysis for this option includes capital expenditure of [redacted] is estimated to be the base cost with ongoing operational costs of $7,840 per annum.

Option 3 – Replace feeder from Wishart Zone Substation

The analysis for this option includes capital expenditure of [redacted] is estimated to be the base cost with ongoing operational costs of $7,840 per annum.

Option 4 – Replace sections of existing feeder from Berrimah Zone Substation

The analysis for this option includes capital expenditure of [redacted] is estimated to be the base cost with ongoing operational costs of $7,840 per annum.

Option *5 – Demand Management*

There is no CAPEX or OPEX expenditure associated with this option however it is not a viable option due to PWC's limited ability to impose demand management strategies on customers to manage load. This option may also not reduce the possibility of failures that are a result of equipment failure.

Least cost analysis

Based on the DCF analysis undertaken, the least cost option is Option 1 (Do Nothing). However, this is not considered to be a viable alternative due to the risk of outages affecting major industrial customers as a result of equipment failure. The next least cost option is Option 4. This is summarised in Table A3 below.

Table A3 – Net Present Cost of Options

Option	NPC ($M)
1 – Do nothing (replace on failure)	[redacted]
2 – Replace feeder cable from Berrimah ZSS	[redacted]
3 – Replace feeder cable from Wishart ZSS	[redacted]
4 – Replace sections of existing feeder from Berrimah ZSS	[redacted]
5 – Non-network solutions and demand management	[redacted]

Tariff cover

This project capex (2021/22 and 2022/23 expenditure) will be submitted as part of the 2019 Regulatory Proposal to the AER. The AER's Final Determination will provide the approved level of net capital expenditure for the 2019-24 period. In so far as the Regulated Networks annual capital expenditure program remains at this level (or lower), Networks will earn a guaranteed rate of return through standard control service charges until the commencement of the next regulatory control period in 2024-25.

APPENDIX B

DETAILED RISK REGISTER

Refer:

PRD33003 Risk Analysis Replace Port Feeder

PWC Ref: D2017/475927

APPENDIX C

SUMMARY PROJECT PROGRAM

Task	*Baseline*			*2019*				*2020*				*2021*			
	Plan Start	*Plan Duration*	*Percent Complete*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
Options Study	Jul 17	6 wks	100%												
Concept Design	Jul 17	6 wks	20%												
Planning and Permits	Jul 19	10 wks													
Detailed Design	Sep 19	10 wks													
Procurement	Jan 20	16 wks													
Civil Construction	Apr 20	16 wks													
Cable / RMU Installation	Jul 20	16 wks													
Cable termination	Sep 21	12 wks													
Commissioning and Energisation	Jan 21	12 wks													
Cutover Existing Services	Apr 21	2 wks													