PowerWater

Power and Water Corporation
Preliminary Business Case

PRA34420
Alice Springs Corroded Poles

Proposed:	Approved:	
Jim Mckay A/Chief Engineer Power Networks Date: 15/2/2018	Michael Thomson Chief Executive & Chair Investment Review Committee Date: 23/02/2018	

Endorsed:

Djuna Pollard	Refer to D2018/~~77307~~ 72353	Refer to D2018/~~77106~~ 77307
Djuna Pollard Executive General Manager Power Networks Date: 15/2/2018	Finance Review Date: 06/02/2018	PMO QA Date: 19/02/2018

1 RECOMMENDATION

It is recommended that the Chief Executive approve project PRA34420 – Alice Springs Corroded Poles, to inspect 2,175 (43%) of distribution steel poles and treat 936 poles in the Alice Springs area by June 2024, funding required to complete the project is $15.5M. Please note the total estimated capital cost is $17.4M of which $1.9M has already been committed.

The committed capital expenditure includes $1.4M of project development and pole replacement expenditure since BNI approval and a further $0.5M to complete engineering, construction and trials associated with the proposed works. The expenditure also includes $12.0M to be incurred in the next regulatory control period.

The estimated cost does not include expenditure for:

- Inspection and treatment of service poles
- Emergency / break-down repairs of steel poles.

2 PROJECT SUMMARY

Project Title:	Alice Springs Corroded Poles		
Project No./Ref No:	PRA34420	**SAP Ref:**	
Anticipated Delivery Start Date:	Jan 2017	**Anticipated Delivery End Date:**	June 2024
Business Unit:	Power Networks		
Project Owner (GM):	Djuna Pollard	**Phone No:**	8985 8431
Contact Officer:	Stuart Eassie	**Phone No:**	8924 5214
Date of Submission:	23 February 2018	**File Ref No:**	D2017/468434
Submission Number:		**Priority Score:**	
Primary Driver:	Service Improvement	**Secondary Driver:**	Compliance
Project Classification:	Capital Category A		

2.1 Prior Approvals

Document Type	Sub Number	Approved By	Date	Capex Value
BNI	10047	Michael Thomson	23/01/2017	$1.4M

2.2 Related submissions

Date	Document Type	Description
21/04/2015	Notes	Board meeting notes regarding Alice Springs pole failure and works
14/08/2015	Board submission	Board Meeting of 20 August 2015, Paper for Noting - Alice Springs Pole Failure Update
04/2016	Board submission	Board Meeting of 12 April 2016, Paper for Noting - Alice Springs Pole Replacement Project Update

3 INVESTMENT NEED

3.1 Background

The failure of a steel power pole due to corrosion of the pole footing in Alice Springs in January 2015 drew concern regarding the condition of pole assets in the Alice Springs area. The pole had been in service for approximately 40 years before it failed, which is considerably less than the expected service life for steel poles of 60 years and the average life in the NEM of 53 years. In the days up to and including the failure, the area had received 130mm of rain, double the average rainfall for January[1]. This incident triggered an investigation into the condition of pole footings for poles of similar design in the Alice Springs region and specifically in the High Salinity Area (HSA), as this was considered to be a significant contributing factor to the failure.

[1] Bureau of Meteorology – Past Weather data – Undoolya Station 2015 data

Figure 1 - Undoolya Rd Pole Failure 10/01/2015 Due to Footing Corrosion

3.2 Asset details

All distribution poles in the NT are steel due to the prevalence of termites and annual bushfires which affect much of the NT. Steel poles can be installed as either (i) direct buried, (ii) with a footing using a concrete collar around the pole at the ground level (top) and at the bottom of the hole (toe), or (iii) with the footing completely encased in concrete (full depth). Typically concrete was only used based on the required pole moment (tip load) and to prevent corrosion at the pole-ground interface of the footing.

At the time of writing there are 5,988 steel poles[2] in the Alice Springs area, as shown in Table 1.

Table 1 - Population of all steel polies in Alice Springs by function and zone

Function	Rural	Urban	Unclassified	Total
Service poles	212	691	55	958
Distribution	2,313	2,632	85	5,030
Total	2,525	3,323	140	5,988

The asset age profile for the 5,030 distribution poles is shown in Figure 1. The records indicate that the asset population has been steadily increasing over time, with a sharp increase in 1970's comprising over 25% of the population, in the 40-49 year age. The bulk of these installations are a result of the early development of Alice Springs Township, in particular the areas of Gillen, The Gap and Eastside. The

[2] Excluding transmission poles

population of Alice Springs grew rapidly in this period from approximately 7,800 in 1971 to 18,400 in 1981[3].

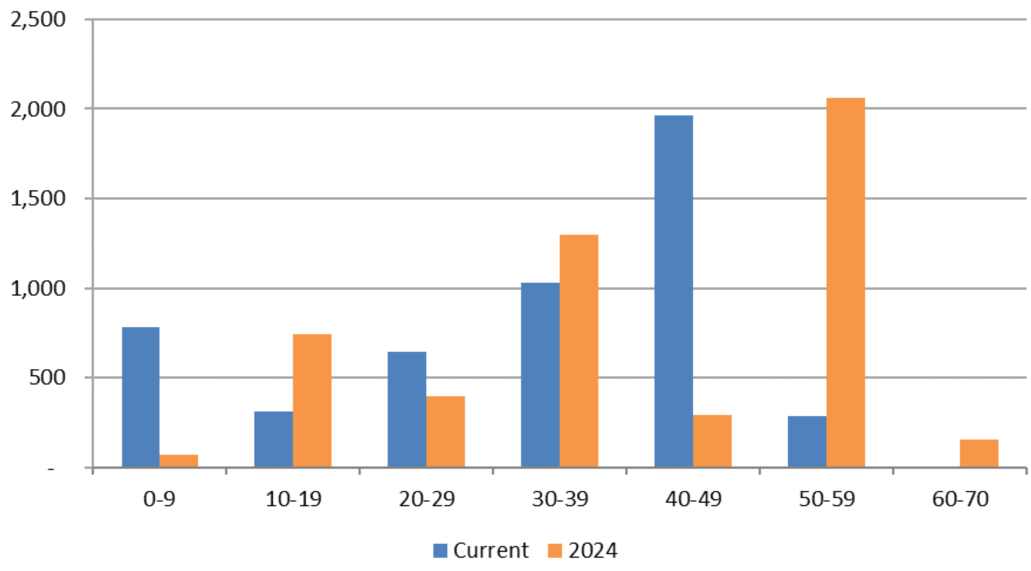


Figure 2 - Asset age profile (years) – ASP steel distribution poles

It can be seen from Figure 1, that at the end of the next RCP, a much larger proportion of poles (over 2,200) will be 50 years or older and approximately 160 exceeding their expected service life of 60 years.

Based on the average expected service life for steel poles of 53 years in NEM-based network businesses, an aged based replacement program would require full replacement of approximately 793 poles by the end of the next RCP.

3.3 Historical Management Strategy

Corrosion is the primary failure mode of steel poles, causing a loss of section over time depending on environmental conditions and corrosion protection. End-of-life is reached when the remaining section no longer meets safety criteria for the load applied i.e. conductor weight and tension, transformer weight, etc.

Typically advanced corrosion issues that have required intervention occur at or just below the pole-ground interface. This is due to the combination of ground moisture, exposure to air and any external factors such as regular watering that create an ideal environment for corrosion to occur. Intrusive inspection requiring breaking concrete and excavating around a pole base to partially expose the footing was previously the only method to confirm pole-ground interface corrosion. This is high-cost and slow, therefore knowledge of pole condition and risk across the pole population was poor. In 2014 a non-intrusive test method, Relative Loss Section (RLS) was introduced allowing the majority of the population to be surveyed over 3 years. RLS testing is only limited to detecting steel loss up to 200mm below ground level; however this was known to be the highest risk zone for pole corrosion at the time.

---

[3] http://population.city/australia/alice-springs/

Corrosion below ground level has been rare and limited to tidal areas in the Darwin region, most of which was replaced with underground infrastructure in the 2000’s.

3.4 Emergence of Alice Springs Pole Risk

Due to the low pole failure rate, including RLS based failures, and because there were few poles approaching end-of-life, PWC has little history of corrosion interventions in any region of the NT. Pole replacement was typically limited to circumstances where external forces such as third party impact/damage had triggered the need (i.e. Car versus pole). There was no detailed footing inspection practice or program for steel poles in any region, including Alice Springs. Consequently, a need for a planned replacement program had not been previously identified.

The investigation of the failed pole in 2015 identified that in addition to high soil salinity, the type of footing construction was a key factor. Typically poles are either direct buried or “top-and-toe”. Since the early 1990’s full concrete encasement for highly loaded poles became more common. The high soil salinity was deemed to have accelerated the corrosion of the unprotected steel below the ground between the “top-and-toe” which led to the pole failure.

The investigation of the pole failure highlighted the elevated risk level posed by steel poles in Alice Springs. In 2016, soil data was used to define an "at risk" areas (containing approximately 350 poles) and a below ground inspection program commenced.

In the early stages of the 2016 inspection program, PWC experienced two further unassisted pole failures, including one outside of the defined “at risk” area. This failure meant that a much larger proportion of poles in the region may be at risk, additional parameters needed to be considered in addition to the limited area of highest soil salinity. A partial failure also occurred during an inspection which highlighted the complexity and risk associated with both inspection and replacement practices.

It was also thought that pole footings with full depth concrete footings would be at least partially protected from the corrosion mechanism; however sample inspections have since confirmed that no protection was provided. While concrete can provide corrosion protection, this was not its purpose and installation procedures reflected this.

As the issue continued to develop, further anecdotal evidence emerged of additional historic unassisted pole failures as shown in Figure 2 below, highlighting an increasing trend of unassisted failures in the Alice Springs area. There have been no unassisted pole failures in any other part of PWC’s network.

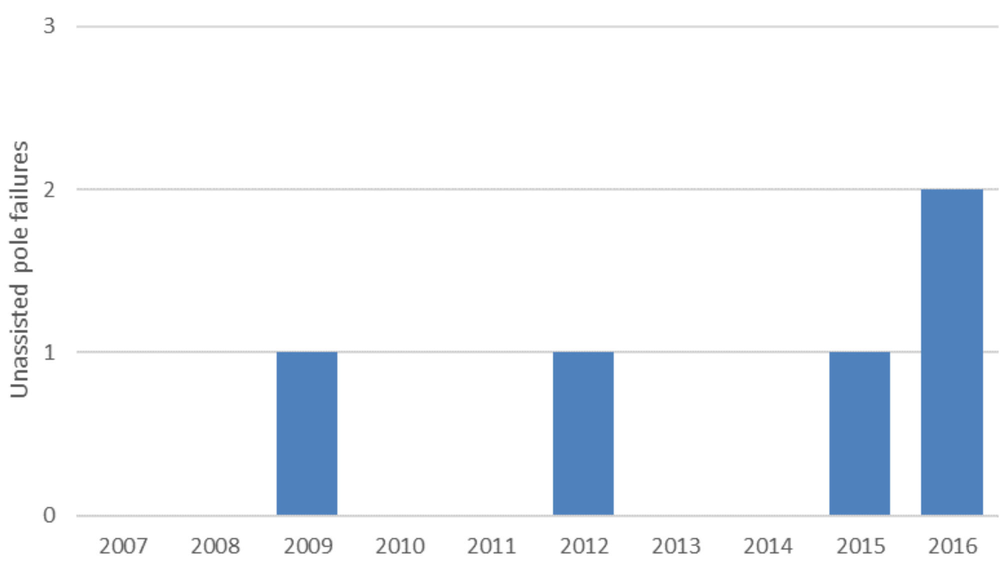


Figure 3 - Unassisted distribution steel pole failures in Alice Springs

When the number of unassisted distribution steel pole failures in Alice Springs is converted to a 3-year rolling average of unassisted pole failures per 10,000 poles as measured in other parts of Australia, this presents an increasing trend and above an industry target of 1 pole failure per year per 10,000 poles,[4] as shown in Figure 3.

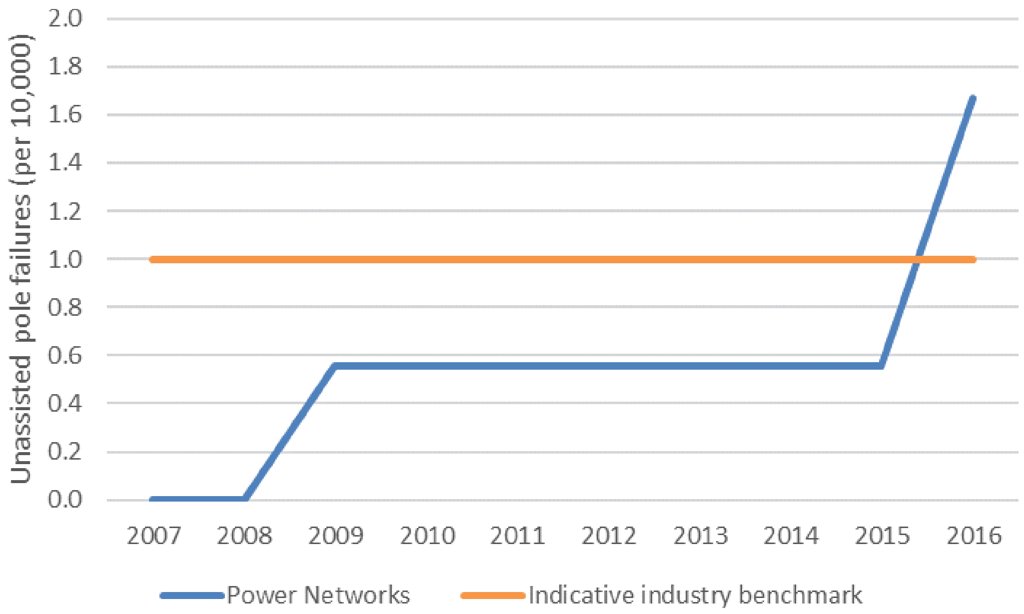


Figure 4 - 3-year rolling average unassisted distribution steel pole failure rate in Alice Springs

The industry benchmark is informative, as it is typically based on a population of poles across the entire network. The observed failures in the Alice Springs area are representative of a type-specific failure mode associated with the design and

[4] Department of Consumer and Employment Protection, EnergySafety, WESTERN POWER'S WOOD POLE MANAGEMENT SYSTEMS: REGULATORY COMPLIANCE AUDIT 2005, page 2 (Based upon Electricity Council of NSW guide EC 8 – 1994)

corrosive soil conditions present in the Alice Springs area. Similar conditions or failure characteristics in other parts of Australia have not been identified so as to provide a comparison to the PWC failure rates, and management practices.

3.5 Current and emerging issues

3.5.1 Results of initial inspection program

The results of the initial inspection program of 350 poles were used to prioritise the replacement of the identified poles that were considered at risk of failure due to complete loss of section below ground, examples of which are shown in Appendices E and F. This required replacement of approximately 120 poles[5] (comprising service poles and distribution poles), and indicated the extent of the risk present in the pole population.

A review of the initial inspection program identified:

- Its use was limited to a pass/fail indication of the need for pole replacement. Data captured from initial inspections was not complete or in a form that could be reliably used to develop a replacement program or predictive model. Tools and processes for inspections have been continually improved to ensure inspection outcomes are clearer;
- Updated geospatial data indicates the high saline area is more extensive than the original "at risk" area and poles outside of this area are at similar risk of corrosion;
- The inspection work practice associated with excavating around the pole was assessed as presenting an unacceptable level of risk to the inspectors, as the loading on the pole could not be reasonably supported during the practice. All planned inspection activity was suspended and continues to be suspended (at the time of preparing this PBC) until a modified work practice can be implemented;
- High costs associated with the initial brown field pole replacements, which required complex planning and outages for large areas of Alice Springs. Existing practices relied on adjacent poles being in good condition;
- Investigation and development of a re-butting solution to reduce the cost and risk associated with treating the below ground section of the pole was initiated. Structural inspections confirmed the above ground section of the poles was generally in a good condition; and
- Structural inspections of pole top condition of replaced poles identified 10% of crossarm welds were compromised. Based on these results, any solution that required the pole to be moved (especially live) was abandoned e.g. the traditional re-butt used with timber poles involves moving the pole around when cutting off the base. Weld cracking was difficult to identify visually.

3.5.2 Evidence of higher failure rate

Engineering assessments of failed poles, local assessment of the state of the assets and initial inspection samples indicate that unassisted failures are likely to increase.

---

[5] April 2016 Board submission, consisting of 40 distribution poles and 81 service poles

The risk is highest when the poles are exposed to increased loading levels (due to wind) at times of high rainfall where the below-ground footing sections are likely to fail due to the loss of strength associated with corrosion.

Whilst rapid escalation of unassisted failed poles have not yet been realised the inspections completed to date indicate a compromised asset condition (or conditional failure). Further below ground inspections are scheduled and are expected to identify similar rates of conditional failures in other urban areas. This failure rate is used in the modelling for estimating the number of poles that will require remediation as it reflects the best estimate of pole failure based on the available information and prudent response to managing the emerging risk.

3.5.3 H pole structures

Legacy dual pole overhead transformers (similar to H-pole in other utilities) are installed in 53 locations across Alice Springs. These H-poles are typically constructed using a standard fabricated pole and a shorter round steel pole. It is clear that the round steel service poles inspected to date have a far greater exposure to the corrosion risk due to having much thinner steel section and observed reaction between galvanising and soil which appears to have exacerbated corrosion on samples to date.

Service poles are typically lightly loaded and not at high risk of failure, however the loading on these poles when used in the H-pole configuration is significantly higher due to the mass of the transformer. These installations are planned for complete replacement, which will likely involve relocation of the transformer to an adjacent pole location. Allowance has been made to replace the transformers due to their age and likelihood of damage to degraded gaskets during removal and transport.

3.5.4 Pole Top Condition

During inspection of pole footings, it is likely that a reasonable proportion of poles requiring remediation will also have pole tops in poor condition. Structural inspections of 82 poles have identified 5% of crossarm welds were cracked and a further 5% had significant voids that compromised weld strength[6]. These issues are difficult to identify visually and are a key driver for a solution that allows remediation to be performed without moving the pole top. Visual inspections have also identified a reasonable number of poles that are leaning more than 5 degrees. These poles are considered uneconomical to straighten if remediation is required due to the risk associated with cracked welds and pole support limitations.

Other condition factors or existing defects such as insulator condition, conductor clearance and localised corrosion may be identified through the completion of the project and make a re-butt uneconomical due to the limited remaining life of the pole top. A conservative estimate of 0.5% has been used to forecast the likely volume of poles that would require complete replacement if found severely corroded.

[6] D2018/67286 Cross Arms Welds Analysis Report

3.6 Works currently underway

PWC is continuing to replace any poles identified as severely corroded using traditional practices i.e. complete brown-field pole replacement. To date 102 distribution poles and 137 service poles have been replaced. Due to being in built-up environments within shared alignments (water, sewer, and communications), the existing pole often needs to be removed prior to a new pole being installed, and generally significant outages are required. The complexity of planning associated with these works, as well as the management of hazards associated with working on and around the corroded poles themselves, is not considered efficient for reasons identified in previous sections.

In response to these issues an engineering solution to provide temporary support for the loads is under development. The solution will be designed to support the bending moment that is present on the pole to facilitate inspection, replacement and/or re-butting. The solution consists of a movable frame[7] that is anchored to the ground adjacent to the pole. It is also proposed to be used for supporting the very severely corroded poles if required post inspection, or poles that fail during inspection, until remediation can take place. A small volume of poles are constructed with pole tip loads that necessitate additional support using pole stays. While this is normal construction practice, this level of loading exceeds the parameters of the pole support solution. It was not economical to design a support solution to support the low volume of very highly loaded poles. These poles are also at very high risk of failure due to their loading condition, as well as similar corrosion risks for the pole stays. These poles are deemed not suitable for remediation using a re-butt process.

3.7 Next Steps

Following review of the work methods for erecting and treating poles, focussing on optimisation (cost, work efficiencies and risk exposure), the pole butt replacement has been selected as the preferred solution. Work methods and practices have been completed which include the check of pole hardware above ground. The pole re-butt solution is ready for implementation once the temporary support solution is engineered. This work will be subject to ongoing review to identify further opportunities for improvement.

The pole re-butt allows PWC to reduce the cost and time required when compared with a complete pole replacement. Furthermore, no outage will be required as the temporary pole support will keep the pole top section static. The proposed program includes the lower cost re-butt solution.

Additionally, investigations have been done to recognise other non-destructive technology to determine below ground corrosion. MRUT (Medium Range Ultrasonic Testing) is a device which has been trialled in 2017 and is able to detect full depth pole corrosion on our round steel service poles but requires further research and development for application to fabricated steel poles. Any efficiency realised from the ongoing testing and trial of this and similar solutions will be applied to this

[7] D2018/24265 Pole Support Fixture Concept Design

program. However there is insufficient confidence and understanding of its potential limitations for it to be included in forecasts at this time.

3.8 At risk pole population

Investigations to date have shown that simple visual inspections of the footing cannot provide a reliable assessment of footing condition. They can provide indication if corrosion is consistent in an area by identifying only the most severe corrosion, and only in circumstances where sections of pole have fallen away. Sections of pole that look in reasonable condition have also been found to deteriorate quickly in sections covered by concrete i.e. in top and toe footings. A combination of visual inspections and sample intrusive tests is proposed to assess each inspection area and determine treatment requirements.

In the absence of a reliable inspection and condition data, significant work has been undertaken to determine the quantum of the poles at risk of failure (that are unable to support the estimated actual pole loading), as an input to the development of a planned replacement program.

The risk based forecast model[8] applies the parameters and weighting factors indicated in Table 2. The risk score is the sum of the individual parameters multiplied by the weighting factors. This model will continue to be developed as inspections provide a higher level of granularity and other factors such as flooding can be assessed and modelled.

Parameter	Rating	Weighting	Risk range
Highest Salinity Area	0 = non-HSA 1 = HSA	1	0 to 1
HV or HV/LV	0 = LV 1 = HV	1	0 to 1
Known Corrosion area	0 = No known corrosion 1 = Known corrosion	2	0 to 2
Modelled Tip Load score	0 = <25% Design 1 = 25-50% Design 2 = 51-75% Design 3 = >75% Design	2	0 to 6
Age	-10 = 0-10 years -5 = 10-20 years	1	-10 to 5

[8] D2017/563003 Risk Based Forecast model – PRA34420 – Alice Springs Corroded Poles

	1 = 20-30 years 2 = 30-40 years 3 = 40-50 4 = 50-60 5 = 60+		
Flood Zone/ Ground Water	Under Development	-	-
Urban/Rural	-1 = Rural 1 = Urban	2	-2 to 2
Overall weighted risk score			0 to 15

Table 2 – At risk model parameters

The parameters are determined by:

- Highest Salinity Area – Initial area identified with highest levels of salinity.
- HV or HV/LV – HV poles are considered to have a higher consequence of failure, particularly as poles have typically fallen slowly and conductors may not clash or touch the ground, and the failure may not be detected by protection systems. While similar situations are likely with LV lines, the consequences are considered lower.
- Known Corrosion area – Where inspections and removals have identified a corroded pole in the area, the pole is considered to be exposed to conditions that promote corrosion.
- Modelled Tip Load score – The likelihood of a pole failing is primarily a function of the load applied, and therefore the moment at the poles base. Highly loaded poles are more dependent on their footing strength than lightly loaded poles. The scoring is based on each individual poles function and size (strength).
- Age – Extent of time exposed to corrosion. Scoring applied is non-linear as the risk of poles being severely corroded in early life is very low.
- Flood Zone/ Ground Water – a methodology to model the impact of flood zone or ground water is currently under development and has not been applied.
- Urban / Rural – The consequence of failure in the urban environment is considered to be substantially higher than rural in terms of both safety (exposure to the public in more populated areas) and reliability (more customers affected by a pole failure).

A composite risk level is then assigned to each pole, and rates according to the following limits:

- Very high risk – risk score of 10 or greater.
- High risk – risk score of between 6 and 9 inclusive.
- Medium risk – risk score of between 3 and 5 inclusive.
- Low risk – risk score of between 0 and 2 inclusive.

Where possible the pole-butt is replaced, as this is a lower cost solution when compared with full pole replacement and does not require outages or associated outage planning, switching and temporary generation for critical customers. In the absence of better information, the model has assumed that a re-butting solution can be applied to all failed poles.

Options have been explored that consider an inspection process and modelled a proportion of pole failures for treatment against options for treatment of poles only. As discussed earlier, the modelled failure rate has been developed based on engineering assessment of failed poles, local assessment of the state of the assets in the Alice Springs network and our initial inspection sample. We consider this reflects our best estimate based on the available information.

As asset and condition information is collected from our planned inspections we expect that the failure rate will have significant variation based on local environmental factors, with some areas requiring close to 100% pole treatment. Accordingly, we will adjust our planned pole treatment based on the actual assessed condition and safety risk of each pole to ensure the most cost efficient solution is applied.

From Figure 5, it can be seen that there are approximately 830 poles at highest risk (risk levels of 10 or above), rated as Very high. Without treatment the number of poles expected to present a High or Very high risk increases by 180 poles by 2024 to a total of 2238 poles from 2058 poles.

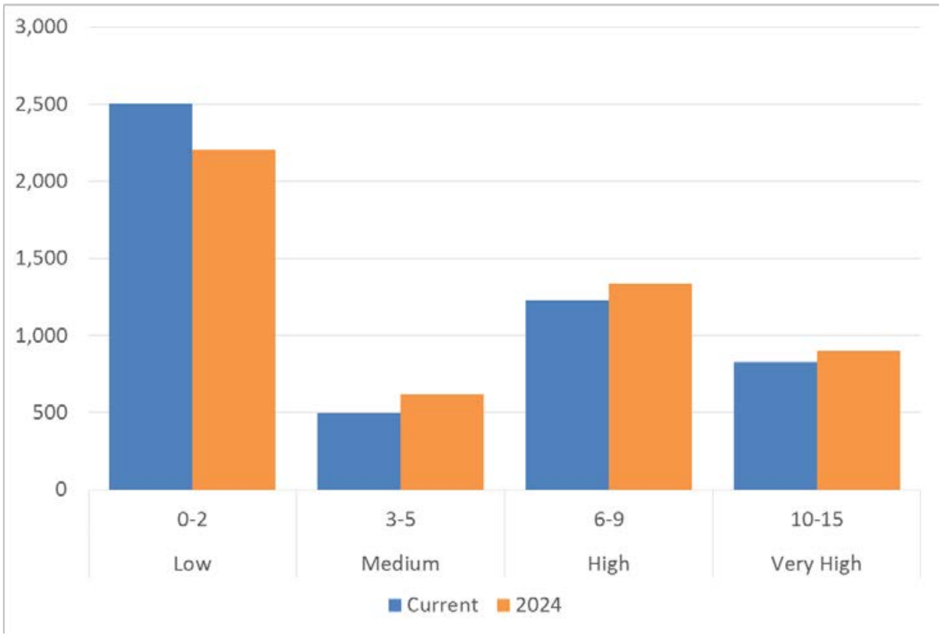


Figure 5 – Distribution steel pole risk level in Alice Springs

3.9 Risk analysis

Figure 6 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 steel poles in the Alice Springs Area.

(i) *Current rating:* The Current rating (2017) is assessed to be 'Very High' because in the 'Likely' event there is an unassisted pole failure, this failure will cause supply interruption and possible safety consequence. This consequence is classed as 'Major'.

The consequence of an unassisted pole failure has not been rated as catastrophic, due the safety factor inherent in the design of the distribution network. The overall risk rating is therefore 'Very high'.

(ii) *Inherent rating:* Due to the extent of the issues now identified on the network, the proposed works program focusses on the highest priority poles, and is not adequate to significantly influence the risk rating. The overall risk rating is therefore 'Very high'.

(iii) *Residual rating:* The proposed project will address the next highest risk poles. Whilst the consequence level of 'Major' will not change due to the potential impact to the safety of the public and to electricity supplies, the likelihood of the consequence occurring will reduce to 'Possible'. The overall risk rating is therefore 'High'.

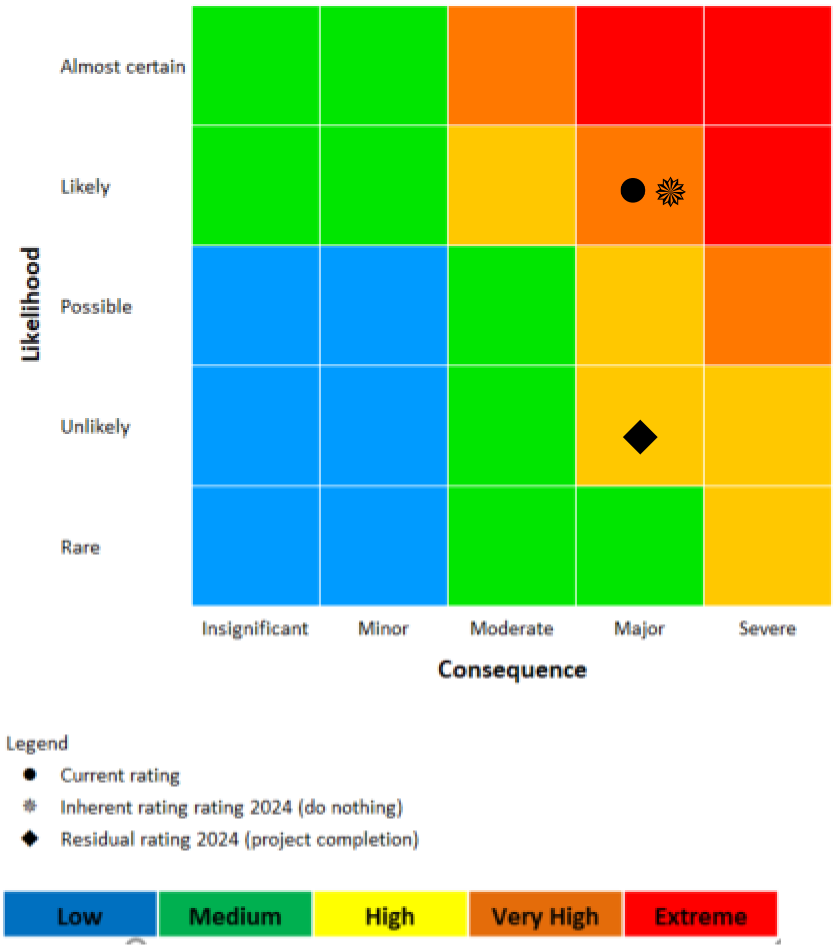


Figure 6 – Risk assessment[9]

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

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, recognising that this forms part of a longer term replacement strategy.

4 STRATEGIC ALIGNMENT

This project will allow PWC to safely and reliably operate the distribution system in Alice Springs. This 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.

The Poles and Towers Asset Class Management Plan provides additional detail on the asset objectives and measures of success for the effective management of this asset class in line with these and other key result areas. Measures include unassisted pole failures, unit costs for pole replacement, public interaction events, and a variety of others that ensure that the expected outcomes of this project are aligned with the Corporations goals.

5 TIMING CONSTRAINTS

The timing of this project is driven by the increased safety risk present by distribution steel poles in the Alice Springs area, for immediate commencement. A program has been prepared for the next 6 years, to progress the treatment of the highest risk poles, for completion by 2024.

It is recognised that the systems, processes and procedures to mitigate the risk of pole failure were not established within the organisation due to the lack of prior unassisted pole failure history within the network. The initial response including inspections and replacement methodologies were not considered to meet the organisations standards in terms of both safety and commercial efficiency and required significant development to ensure the failures could be mitigated without placing our own people at high risk of injury.

6 EXPECTED BENEFITS

Driver/Objective	Benefit	Current State	Future State
Health and Safety	Mitigate increasing public safety risk associaed with pole failure.	Very High risk. Unknown condition of pole footings. Evidence that poles are likely to continue to fail at an increasing rate.	Medium risk. Condition of poles at increased risk of failure known and poles risk of failure remediated.
Service Improvement	Improved levels of quality and reliability of service.	Likely to experience significant outages in urban area of Alice Springs due to pole failures.	Less outages will be experienced in urban area of Alice Springs due to pole failures.
Compliance	Operate safe and	Ongoing and significant safety risk associated with	Reduction in annual

	reliable network	pole failure	unassisted pole failures.
Social / Environmental	Mitigate significant increase in unplanned and planned outages	Significant outages required for pole replacement due to both space restrictions and risk assocaited with failure of adjacent poles.	Eliminate planned outages for re-butt solution and minimise or eliminate unplanned outages due to pole failure.

7 REQUIREMENTS

The solution selected must resolve the identified business need to reduce the identified network and safety risk to an acceptable level. This includes:

- Prioritise the remediation or replacement of poles with compromised footing strength beyond acceptable limits based on each poles function, soil risk factors and public accessibility.
- Effectively manage the hazards associated with working on, and around poles that are known to have compromised footing integrity.
- Effectively manage the hazards associated with working on, and around pole crossarm that are known to have compromised strength due to weld cracking and voids, and which are very difficult to identify through visual inspection.
- Efficient remediation process that minimises planning and design resources, particularly outage planning, customer negotiations and traffic control permits.
- Minimises the impact of outages to customers and businesses, both planned and unplanned.
- Minimises inconvenience to customers and businesses associated with civil works in urban and Alice Springs CBD environments.

PWC will also require compliance with the following:

- Northern Territory Electricity Reform Act
- Power and Water' Network Licence as issued by the Utilities Commission
- Network Technical Code and Network Planning Criteria.
- Work Health and Safety (National Uniform Legislation) Act, particularly with respect to pole support and remediation structural design.
- Local council and road owner regulations and permit systems for traffic control and road closure permits.

8 OPTIONS

The options considered to reduce the identified risk are described below, comprising expenditure over 6 years from 2018/19 – 2023/24, including the next RCP. This assumes that a level of risk is carried forward, and will require an ongoing replacement program to continue addressing the pole failure risk into the subsequent RCP as corrosion on poles will continue to reduce footing strength over time.

For all options, service poles in the Alice Springs area have been excluded as they are considered to pose a lower safety and reliability risk than distribution poles. Service poles have significantly lower physical loading levels on the poles and superior embedment characteristics. Accordingly, service poles have been rated as ‘Low to Medium risk’ however this risk will increase as corrosion continues to reduce footing strength.

At the time of preparing this PBC, the total number of distribution poles located in urban areas of Alice Springs (and form the basis of the scope for this business case) is 5,030.

In developing the included cost estimates, the following scope assumptions have been applied:

- all poles that are treated using re-butting are re-assessed as low risk
- poles that pass the inspection & condition assessment and are not treated are re-assessed as moderate risk
- all poles identified for treatment are completed within the program, and no backlog of pole treatment has been included
- full replacement poles have not been included, with the exception of the high-risk ‘H’ poles. Any requirement for full replacement will be managed within the cost estimate of the proposed program
- project supervision and contract management has been assumed at 6% of the project value
- design, engineering and support has been assumed at 4% of project value

The assumptions underpinning this program will continue to be reviewed and refined as more information becomes available following recommencement of the inspection and replacement program.

8.1 Options identification

8.1.1 Option 1 – Business as usual (replace on failure)

Due to the absence of reliable asset and condition information, PWC does not have a historical level of pole treatment or expenditure for this asset class in which to compare alternate options.

The current level of risk exceeds the acceptable level.

Given the age and assessed condition of the distribution poles in the Alice Springs area, without action the highest risk poles will not be treated within the next six years, exposing the business to an unacceptable level of risk. It is likely that the unassisted pole failure rate will continue to increase, with an elevated risk of a safety incident involving a member of the public or a PWC worker.

The resultant risk posed by the pole population in Alice Springs by 2024 will be similar to that presented in Figure 7. Whilst this chart has been adjusted for increasing age of the pole population only, it is likely that the condition characteristics will also continue to degrade and the number of failures (and consequences) will increase.

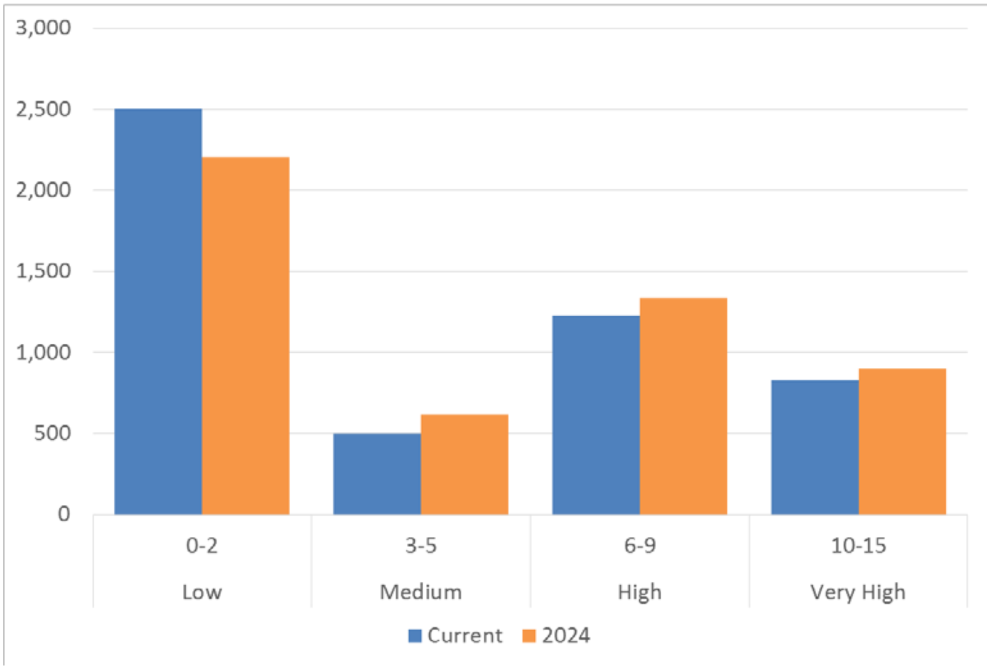


Figure 7 - Alice Springs steel distribution pole risk level – option 1

Adopting a business as usual approach is not considered to be technically feasible.

8.1.2 Option 2 – Inspect and treat only Very High risk poles

This option inspects all steel distribution poles rated as Very high risk of failure, and treat a proportion of poles that fail the condition assessment.

We have estimated a failure rate of 44% of the Very high poles that will require treatment using pole re-butting. The inspection program is also forecast to be completed prior to all remediation work being undertaken.

The estimated cost is $7.33M over 6 years.

The scope of work is summarised in Table 3 below:

Option 2	Number of Units	Unit cost ($)	Capital cost ($M)
Pole inspections	[redacted]	[redacted]	[redacted]
Pole butt replacement	[redacted]	[redacted]	[redacted]
Pole replacement – H-Pole/High Tip Load Structures	[redacted]	[redacted]	[redacted]
Expected Condition Failure of Pole Tops	[redacted]	[redacted]	[redacted]
Project management & engineering	[redacted]	[redacted]	[redacted]
Total	-	-	7.33

Table 3 - Summary of capital cost analysis – Option 2

The advantage of this option is that the volume of inspections is minimised as only the highest risk poles are inspected and treated by the end of the RCP.

The primary disadvantage of this option is that the program inspects less than half of the pole population, and exposes the business to elevated risks by relying solely on the modelled risk level of 17% of distribution poles. The number of poles planned to be treated are lower than that undertaken by a NEM-based business employing an age-based replacement strategy using a service life of 53 years. Given the premature failure of poles in Alice Springs, and the failure model of below ground corrosion, this option does not adequately address the risk.

The modelled risk at 2024 is presented in Figure 8, where all Very High poles are treated and adjusted to Low risk. Poles inspected but not treated have been adjusted to Medium as inspections do not reduce the failure risk factors and corrosion will continue to affect those poles.

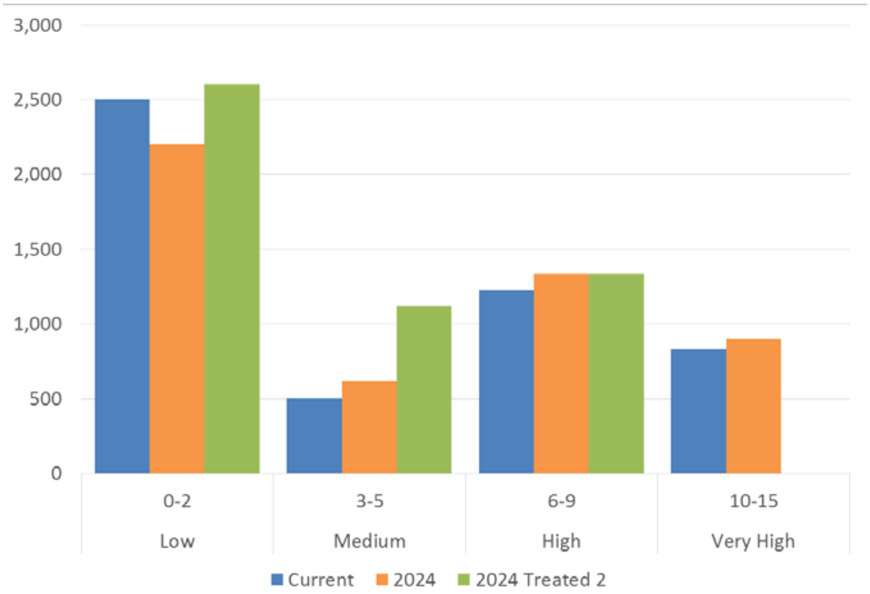


Figure 8 - Alice Springs steel distribution pole risk level – Option 2

8.1.3 Option 3 – Inspect and treat high and very high risk poles with the next RCP (Preferred Option)

This option inspects all steel distribution poles rated as Very high and High risk, and treat a proportion of poles that fail the condition assessment.

We have estimated a failure rate of 40% of the inspected poles that will require treatment using pole re-butting. The failure rate has been reduced from Option 2 due to the inclusion of both high and very high risk poles, and a small volume of rural poles due to their combined risk factors.

Similar to Option 2, the inspection program is also forecast to be completed prior to all remediation work being undertaken.

The estimated cost is $15.5M over 6 years.

The scope of work is summarised in Table 4 below:

Option 3	Number of Units	Unit cost ($)	Capital cost ($M)
Pole inspections	[redacted]	[redacted]	[redacted]
Pole butt replacement	[redacted]	[redacted]	[redacted]
Pole replacement – H-Pole/High Tip Load Structures	[redacted]	[redacted]	[redacted]
Expected Condition Failure of Pole Tops	[redacted]	[redacted]	[redacted]
Project management & engineering	[redacted]	[redacted]	[redacted]
Total	-	-	15.50

Table 4 - Summary of capital cost analysis – Option 3

The advantage of this option is that a larger proportion of poles are inspected ensuring greater risk reduction in areas that may be affected by more localised soil salinity or other corrosion accelerators. We consider that inspection of these assets represents a prudent investment to assess whether corrective treatment is required, prior to initiating the re-butting solution. The experience and information gathered by the inspection program will allow greater focus of the subsequent inspections and treatment program.

The primary disadvantage of this option is that a large proportion of poles are still not inspected. In particular, a significant proportion of lightly loaded intermediate poles assessed as medium risk of unassisted failure are likely to be severely corroded. This means they are highly susceptible to failure due to external forces such as minor impacts. As adjacent poles can also be significantly corroded, a cascading failure involving multiple poles would not be unexpected, similar to the January 2015 Undoolya road failure.

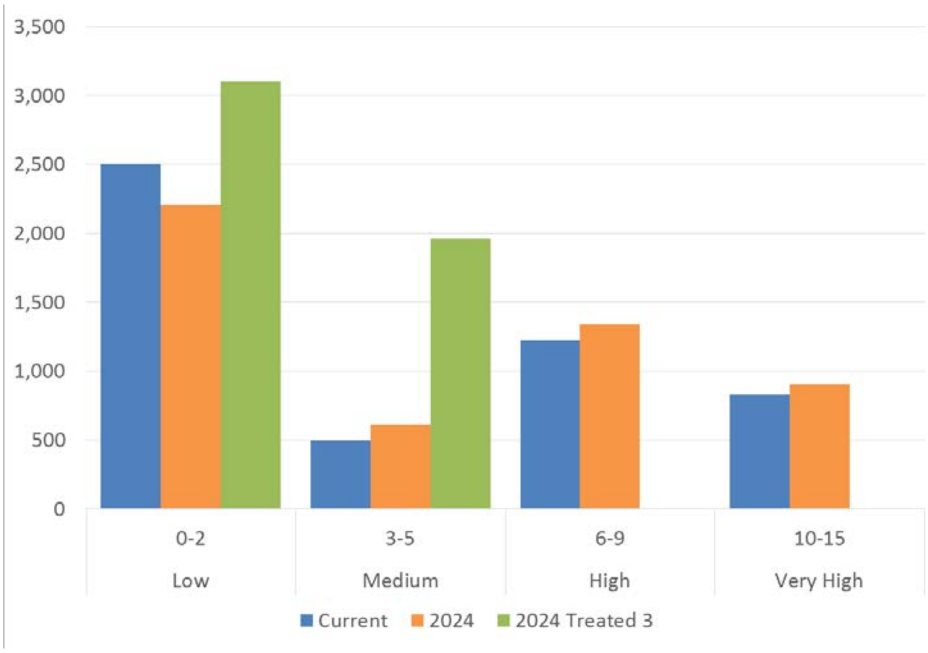


Figure 9 – Alice Springs steel distribution pole risk level – Option 3

8.1.4 *Option 4 – Direct Treatment of all Very High and High risk poles*

This option does not include any pole inspections, rather treats all modelled Very high risk and High risk distribution poles to maximise the risk reduction.

The scope of work is summarised in Table 5 below:

Option 4	Number of Units	Unit cost ($)	Capital cost ($M)
Pole inspections	[redacted]	[redacted]	[redacted]
Pole butt replacement	[redacted]	[redacted]	[redacted]
Pole replacement – H-Pole/High Tip Load Structures	[redacted]	[redacted]	[redacted]
Expected Condition Failure of Pole Tops	[redacted]	[redacted]	[redacted]
Project management & engineering	[redacted]	[redacted]	[redacted]
Total	-	-	28.00

Table 5 - Summary of cost analysis – Option 4

The advantages of this option are that the very high risk and high risk poles are treated within the next 6 years, as a priority.

The disadvantages of this option are:

(i) Given the age and assessed condition of the distribution poles in the Alice Springs area, this program relies solely on a desktop model without the benefit of condition data from an inspection program;

(ii) Without an inspection program or a proportion of the asset population, other assets expose the business to unacceptable level of risk; and

(iii) It is unlikely that other pole failures are experienced, with an elevated risk of a safety incident involving a member of the public or a worker.

The modelled risk by 2024 will be similar to that presented in Figure 10. Whilst this chart has been adjusted for increasing age of the pole population, it is likely that the condition characteristics continue to degrade and the number of failures increase.

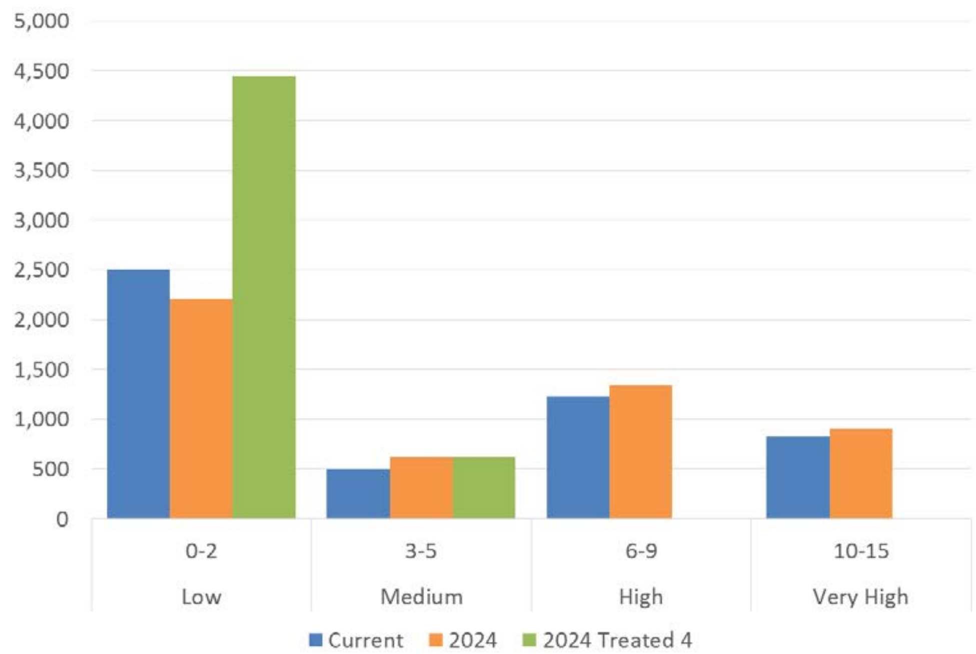


Figure 10 - Alice Springs steel distribution pole risk level – Option 4

8.1.5 Option 5 – Inspect all poles

This option inspects all steel distribution poles in Alice Springs and treats a proportion of poles that fail the condition assessment. This includes inspection of 5,035 distribution poles.

We have estimated a failure rate of 23% of the inspected poles that will require treatment using pole re-butting using the same methodology as Option 3.

The estimated cost is $21.84M over 6 years.

The scope of work is summarised in Table 6 below:

Option 5	Number of Units	Unit cost ($)	Capital cost ($M)
Pole inspections	[redacted]	[redacted]	[redacted]
Pole butt replacement	[redacted]	[redacted]	[redacted]
Pole replacement – H-Pole/High Tip Load Structures	[redacted]	[redacted]	[redacted]
Expected Condition Failure of Pole Tops	[redacted]	[redacted]	[redacted]
Project management & engineering	[redacted]	[redacted]	[redacted]
Total	-	-	$21.84

Table 6 - Summary of cost analysis – Option 5

The advantage of this option is that the condition of the entire population would be captured provided a significantly higher level of confidence in the condition of the network and the prioritisation of ongoing mitigation.

The primary disadvantages of this option are the cost and the significant customer inconvenience due to the scale of the inspection task and likely interaction with driveways and business frontage. There is also an inherently higher safety risk associated with the volume of inspections alone and associated manual handling tasks. While this risk is present in the Options 2-4, the level of exposure is significantly higher in Option 5.

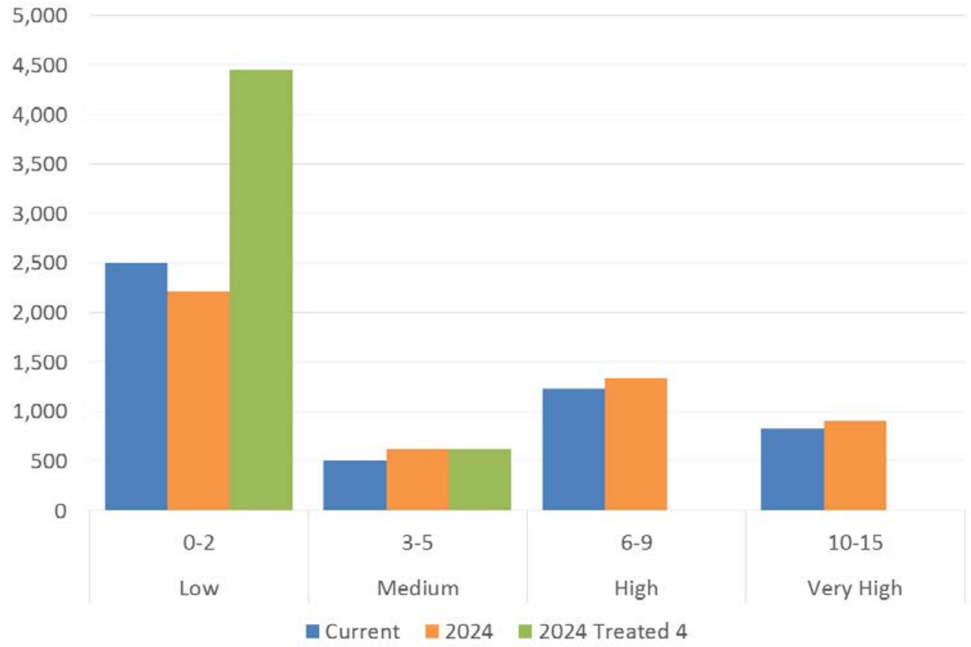


Figure 11 – Alice Springs steel distribution pole risk level – Option 5

8.1.6 Option 6 – Non-network solutions and demand management

PWC confirm the ongoing need for these assets to support the function of the distribution network and maintain supplied to connected customers. Given the stated condition of the steel pole assets, PWC has not identified any non-network or demand management options to meet the objective of this work.

Option 6 is not considered to be technically or commercially viable.

8.2 Comparative cost analysis (including sensitivity 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 D.

PWC has adopted a prudent approach to selecting a re-butt life extension option, rather than full replacement. PWC has not considered the full replacement or re-butt of all distribution poles in the Alice Springs area, or reduction of the risk level to 'Low' as these options were not considered to be commercially efficient.

Option	Capital cost ($M)	Net Present Cost ($M)	Comments
1 – Do nothing (replace on failure only)	n/a	n/a	Does not achieve risk reduction to an acceptable level. Not considered technically feasible
2 – Inspect and treat all Very High and High risk poles	7.3	6.4	Achieves risk reduction, and presents a deliverable program. Higher resultant risk than option 3 due to reduced inspection and treatment program. Not preferred
3 – Inspect and treat highest risk poles with the next RCP	15.5	13.6	Achieves risk reduction to an acceptable level, and presents a deliverable program. **Preferred option**
4 – Treat all Very high and High risk poles only	28.0	24.1	Achieves immediate risk reduction, however not considered deliverable. Higher cost, and does not include inspection program. Not preferred
5 – Inpect all poles	21.8	18.8	Achieves maximum risk reduction, however higher cost and not considered deliverable. Not preferred
6 – Non-network solutions	n/a	n/a	Not considered technically feasible

Table 7 - Summary of comparative capital cost analysis

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.

Criteria	Project Objectives			Technical & System Risk	Stakeholder Risk		Commercial
	Reduced Risk Pole Failure	Maintain Network Reliability	Mitigate Future Corrosion	Constructability	Safety	Community Impact	NPV/C
Weighting (%)	20%	10%	10%	10%	20%	10%	20%
Option 1	0.2	0.1	0.1	0.5	0.2	0.4	1
Option 2	0.6	0.3	0.2	0.4	0.6	0.4	0.8
Option 3	0.8	0.5	0.3	0.4	0.8	0.3	0.6
Option 4	0.8	0.5	0.4	0.3	0.8	0.3	0.2
Option 5	1	0.5	0.3	0.3	0.8	0.2	0.4

Table 8 Non-cost attributes analysis – weighted scores

Weighted Scores:

Option 1: Do nothing	2.5
Option 2: Inspect and treat all Very High and High risk poles	3.3
Option 3: Inspect and treat highest risk poles with the next RCP	3.7
Option 4: Treat all Very high and High risk poles only	3.3
Option 5: Inspect all poles	3.5

8.4 Preferred option

The preferred option (option 3) is to inspect and treat as required all the 'High' and 'Very High' risk poles within the next six years, comprising a total inspection of 2,146 poles and treatment of 945 poles, based on predicted failure rates derived from inspection and replacement work performed to date. This option assumes that the remaining poles, of 'Medium' and 'Low' risk, are treated over the subsequent RCPs in a managed program as there risk level increases with age, and ongoing corrosion depending on soil conditions.

This is the preferred option for the following reasons:

(i) Of the technically feasible options, it provides the highest risk reduction of the deliverable options;

(ii) Provides the maximum value to consumers;

(iii) It is based on PWC's standard design practice, reflecting efficiencies in pole treatment from historical approaches, which helps keep design, maintenance and construction costs to a practical minimum;

(iv) Adopts a prioritised approach to identifying and treating the highest risk poles first; and

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

Option 3 is a higher cost than option 2 due to the larger inspection and treatment program. This option is preferred due to the uncertainty surrounding the existing condition of the population and high safety risk presented by a pole failure. To reduce the scope further, would present an unacceptable level of risk posed by this asset class to the public and the business.

The options assessed provide a level of sensitivity related to risk reduction versus inspection and treatment volumes. A comparison of Option 2 and Option 3 demonstrates that based on the current pole failure risk model the cost to reduce pole failure risk from Very High to High is $7.33M and High to Medium is $15.5M. The additional cost to reach a medium risk of pole failure appears to be prudent given the potential public safety consequences of future pole failures.

8.5 Other Considerations

The network and assets in the Alice Springs area are considered to have an enduring need to maintain the electricity supply to customers in the Alice Springs area, as nominated in the Network Management Plan (NMP) as it is updated from time to time.

The poles and towers Asset Management Plan (AMP) identifies the issues with corrosion of steel poles in the Alice Springs area as a priority for treatment in the next RCP.

PWC will continue to investigate and trial solutions to mitigate the impact of the corrosive environment identified in the Alice Springs area, and apply this information to the management solutions for assets located in other parts of the PWC network.

The inclusion of additional information into the pole risk model will assist further refine the proposed program to achieve the maximum risk reduction.

9 PROJECT OUTLINE

9.1 Project Description

Replace or remediate poles in Alice Springs at high risk of failure due to corrosion caused by aggressive saline soil conditions.

9.1.1 Scope Inclusions

The scope of the project includes:

- Inspection of poles at highest risk of failure based on current failure risk model.
- Replacement and/or Re-butt of corroded poles.
- Design and engineering of pole support solution to facilitate inspections and re-butt.
- Design and engineering support for pole condition assessments, further development of risk and condition models and line design where full replacement of poles is required.
- Further investigation of the risk associated with Service Poles.
- Research and development of non-intrusive pole testing technology.
- Project management, contract management and supervision, planning and scheduling of outages to facilitate pole replacements.

9.1.2 Scope Exclusions

- Inspections of poles assessed as being 'Low' to 'Medium' risk of failure.
- Inspection and treatment of service poles, other than for the development of risk models, or otherwise triggered by new data which changes the current risk profile.

9.1.3 Assumptions

The cost estimate is considered to be within ±20% accuracy. It is based on the recently completed pole treatments and will continue to be updated as works are completed.

9.1.4 Dependencies

- None

9.1.5 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
	Senior Manager Major Projects
	Senior Manager Network Assets
External – Authorities	Alice Springs Town Council

	Department of Intrastructure, NT
	Aboriginal Areas Protection Authority
External - Other	Alice Springs Residents
	Ministers
	Utilities Commission / Australian Energy Regulator
	Telstra and other communications infrastructure owners affected

9.2 Capital Cost

A preliminary cost estimate for the proposed program has been developed using a model of pole risk and unit costs based on historical activities, adjusted where required to allow for additional risk control measures. The forecast cost of remediation and replacement works is a function of the predicted failure rates identified. Sensitivity analysis of predicted failure rates has not been completed, due the level of uncertainty associated with the current sample. It is considered equally likely the actual failure rate could be above or below the current prediction.

9.2.1 Base Capital Cost

Unit rates and volumes have been detailed in Section 8 16OPTIONS.

9.2.2 Risk and Contingency

Due to the uncertainty associated with the forecast pole inspection failure rate, a risk assessment of proposed costs has not been undertaken. The actual cost will be entirely dependent on the pole conditions found and forecasts will be updated regularly as the risk model input data improves.

9.3 Estimated Operating Cost Impact

The maintenance cost impact is not material. Direct costs associated with pole failures would be expected to increase if no action is taken to prevent further pole failures.

9.4 Project Milestones

Project Phase (end)	Investment Planning	Project Development	Commitment	Implementation	Review
Original Plan (BNI)	Nov 2016	Feb 2017	April 2017	Jul 2019	Sep 2019
Current Forecast	Complete	May 2018	Jul 2018	Jun 2024	Sep 2024
Actual Completion	Jan 2017				

Since the time of BNI approval, the following issues have developed which significantly affected the forecast:

- Discovery of severely corroded steel covered by concrete, even where exposed sections looked to be in reasonable condition.
- Non-intrusive inspection technology was expected to significantly reduce inspection program costs. Confidence has reduced significantly in the potential for this solution, although it looks promising for service poles of round steel construction.
- Progress on pole handling solution that required pole top movement abandoned due to compromised crossarm weld analysis.
- Detailed review and updates to inspection and re-butt procedures to ensure personnel safety and achieve engineering structural compliance.

10 RISK MANAGEMENT AND COMPLIANCE

A preliminary risk register has been established to address project risk. This is included in Appendix E. 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. The proposed re-butt solution is expected to be applied to the majority of corroded poles, minimising the requirement for negotiation of new easements, relocation of other services and requirements for traffic control and road closure permits.

Interaction with other underground and overhead services will require ongoing engagement with Water Services and other infrastructure owners such as Telstra.

10.3 Environment and Sustainability Issues

All replacement or upgrade work will take place on PWC owned assets and within utility corridors. The area surrounding the steel pole will be reinstated following excavation to a standard at least commensurate with the standard in which it was found.

Any use of private land in the preparation and completion of the required works will be minimised and customers informed of work activities in the area.

Decommissioned assets, such as pole butts, will be disposed of appropriately in accordance with good environmental practice.

10.4 Technical and System Issues

All required planned outages will be communicated with System Control as soon as possible for scheduling.

Construction work will likely be undertaken on energised plant, or adjacent to live cables and conductor. PWC has policies and procedures that must be adhered to such as the Access to Apparatus Rules. Additionally, all design and commissioning risks are to be identified in the project risk register and eliminated or mitigated to as low as reasonably possible.

11 PROJECT IMPLEMENTATION

This project is to be managed by the Power Networks' Project Management group. It is planned that the project will be delivered using a period contract methodology through an external contractor.

- This project will follow the requirements of the investment planning framework (gating process);
- This project will follow the requirements of the investment and delivery framework; and
- The project will comply with approved PWC designs.

11.1.1 Resourcing Requirements (to next gateway)

The estimated resource requirements to finalise the Business Case for final gate approval is shown in the table below.

Resource Type/Role	How Many?	Internal/ External?	Anticipated Start Date	Duration Required	Allocation (% time or # hrs/days/ wks/mths)
Senior Project Manager	1	Internal	March 2018	Jul 2018	20%
Engineering Manager	1	Internal	Started	Jul 2018	30%
Local Contract Supervisor	1	Internal	Started	Jul 2018	100%
Standards Engineer	1	Internal	Started	Jul 2018	20%

12 FINANCIAL IMPACT

12.1 Funding Arrangements

The current forecast for this program of work extends beyond the current SCI period. The 2018-19 proposed SCI is based on the forecast in Section 12.2 and is an increase from the 2017-18 SCI.

This program will be included in the 2019-24 Regulatory Proposal to the Australian Energy Regulator (AER).

12.2 Capital Expenditure

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

Year	16-17 ($'000)	17-18 ($'000)	18-19 ($'000)	19-20 ($'000)	20-21 ($'000)	21-22 ($'000)	22-23 ($'000)	23-24 ($'000)	Total ($'000)
Forecast	900	1,000	3,500	3,000	2,500	2,500	2,000	2,000	**17,400**
2017-18 SCI	1,400	3,100	3,500	-	-	-	-	-	**8,000**

12.2.1 Variance Coverage

The proposed forecast has been included in 2018/19 SCI and is included in the AER regulatory proposal for the 2019-24 period. The increase recognises the additional risk and cost factors identified associated with the proposed inspection, remediation and replacement methodologies.

Additional analysis of pole corrosion included the discovery of severe corrosion in full-depth concrete poles which has undermined previous assumptions. Proposed low-cost non-destructive test methods have not proven successful, and while they may yet be realised the revised forecast reflects the best available input assumptions and proven, albeit limited, inspection methodologies.

12.3 Incremental Operating Expenditure

No material increment in operating expenditure is forecast. Execution of the program as proposed will avoid increases in Opex associated with future pole failures and adhoc repairs.

APPENDIX A

Summary of Financial Analysis

Introduction

The purpose of this Appendix is to provide details of the options analysis for Alice Springs Corroded Poles.

Table A1 below outlines the estimated capital expenditure for Options 2, 3, 4 and 5. This is reflected in the operational cash flows below.

Commercial analysis for Option 1 (Deferral) was not undertaken as it is not considered to be a viable alternative due to the risk of major outages and public safety from pole failures.

Table A1 – Estimated Capital & Operating Expenditure

Option	Capex – Base Costs ($M)	Opex – Base Costs ($000's)
Option 2 – Inspect and treat all Very High and High risk poles	7.3	$0 (from 2018/19)
Option 3 – Inspect and treat highest risk poles with the next RCP	15.5	$0 (from 2018/19)
Option 4 – Treat all Very high and High risk poles only	28.0	$0 (from 2018/19)
Option 5 – Inpect all poles	21.8	$0 (from 2018/19)

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 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 - Deferral

Commercial analysis of Option 1 (deferral) was not undertaken as it is not considered to be a viable alternative due to the risk of major outages and public safety from pole failures.

Option 2 – Inspect and treat all Very High and High risk poles

The analysis for this option includes capital expenditure of $1.54 million in 2018/19, $1.35 million in 2019/20, $1.16 million in 2020/21, $1.16 million in 2021/22, $1.06 million in 2022/23, and $1.06 million in 2023/24. A total of $7.3 million is estimated to be the base CAPEX cost with annual net OPEX of $0.

Option 3 - Inspect and treat highest risk poles with the next RCP

The analysis for this option includes capital expenditure of $3.50 million in 2018/19, $3.00 million in 2019/20, $2.50 million in 2020/21, $2.50 million in 2021/22, $2.00 million in 2022/23, and $2.00 million in 2023/24. A total of $15.5 million is estimated to be the base CAPEX cost with annual net OPEX of $0.

Option 4 - Treat all Very high and High risk poles only

The analysis for this option includes capital expenditure of $4.67 million in 2018/19, $4.67 million in 2019/20, $4.67 million in 2020/21, $4.67 million in 2021/22, $4.67 million in 2022/23, and $4.67 million in 2023/24. A total of $28.0 million is estimated to be the base CAPEX cost with annual net OPEX of $0.

Option 5: Inspect all poles

The analysis for this option includes capital expenditure of $3.64 million in 2018/19, $3.64 million in 2019/20, $3.64 million in 2020/21, $3.64 million in 2021/22, $3.64 million in 2022/23, and $3.64 million in 2023/24. A total of $21.8 million is estimated to be the base CAPEX cost with annual net OPEX of $0.

Least cost analysis

Based on the DCF analysis undertaken, the least cost option is Option 2 (Inspect and treat all Very High and High risk poles). This is summarised in Table A3 below.

Table A3 – Net Present Cost of Options

Option	NPC ($M)
Option 2 – Inspect and treat all Very High and High risk poles	[redacted]
Option 3 – Inspect and treat highest risk poles with the next RCP	[redacted]
Option 4 – Treat all Very high and High risk poles only	[redacted]
Option 5 – Inpect all poles	[redacted]

Tariff cover

A portion of this project capex (2019/20 and 20120/21 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

PROJECT RISK ANALYSIS

Refer:

D2018/76137

APPENDIX C

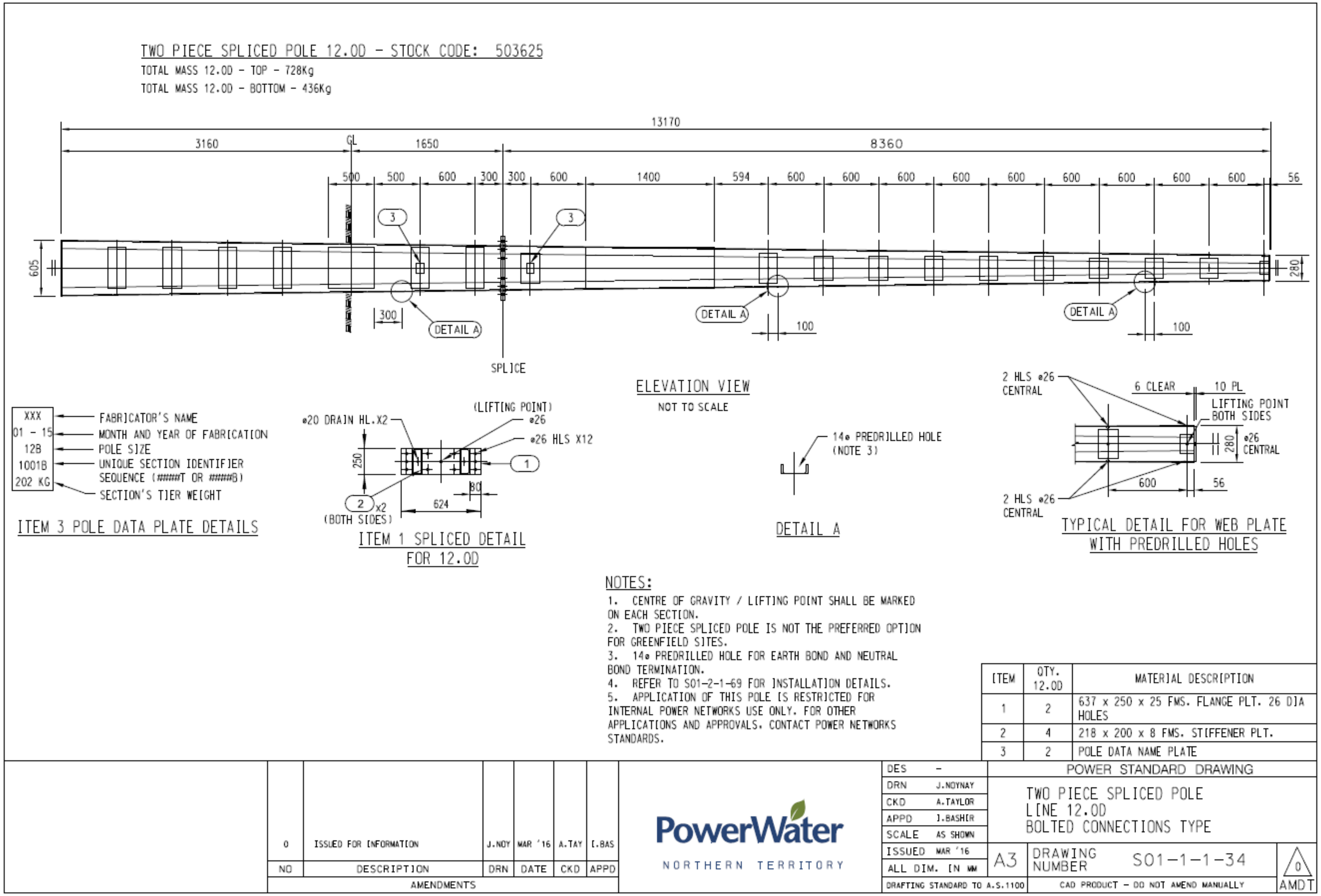
SUMMARY PROJECT PROGRAM

Task	*Baseline*			*2017*		*2018*				*2019*				*2020*	*2021*	*2022*	*2023*	*2024*
	Plan Start	*Plan Finish*	*Percent Complete*															
Pole Support Fixture Development	Jul 17	Mar 18	60%															
Pole Support Fixture Trials	Mar 18	May 18	0%															
Inspection Program Trials – Low Risk Poles	Mar 18	May 18	30%															
Works Delivery Contract Development, Tender and Award	Jan 18	Jul 18	10%															
Inspection and Remediation Program	Jul 18	Jun 24	0%															
High Tip Load and H- Pole Replacements	Sep 18	Dec 19	0%															

APPENDIX D

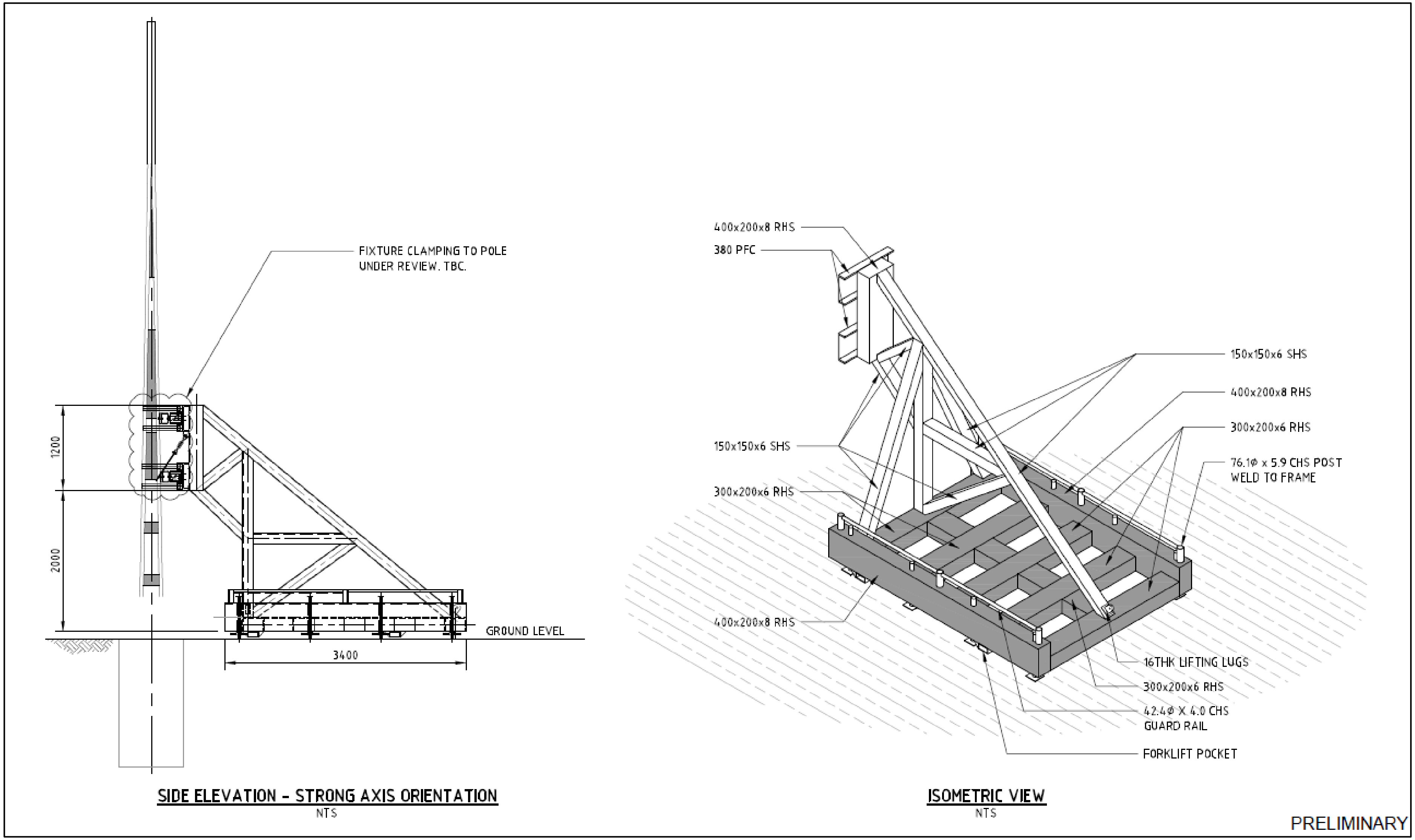
SPLICED POLE AND RE-BUTT SOLUTIONS

Developed Spliced Pole



Developed Re-butt Solution

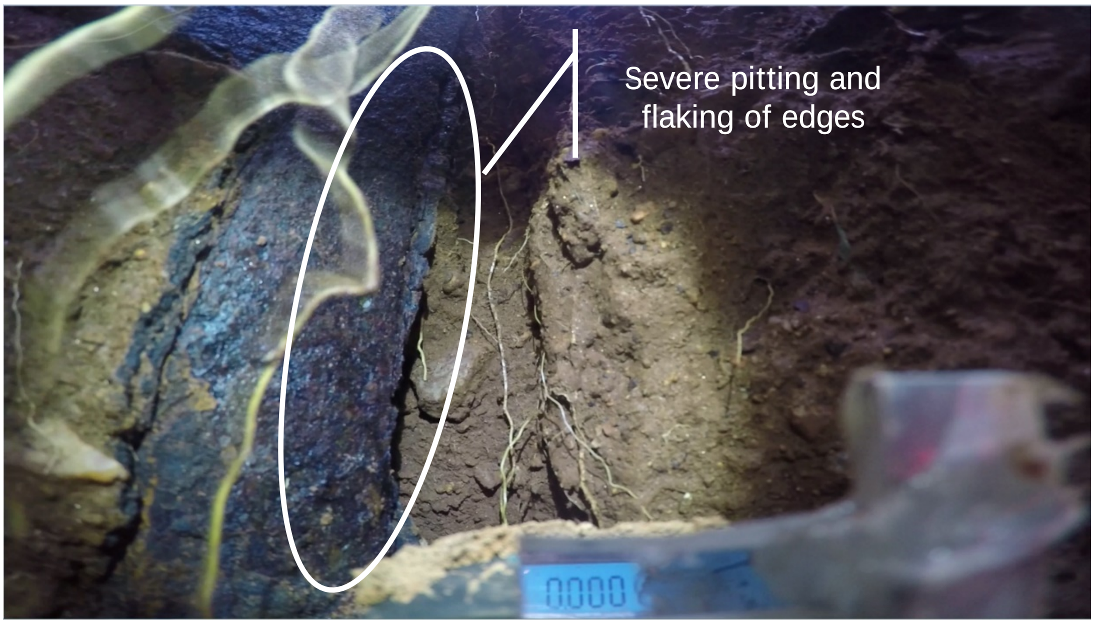
Pole Support Fixture Concept Design

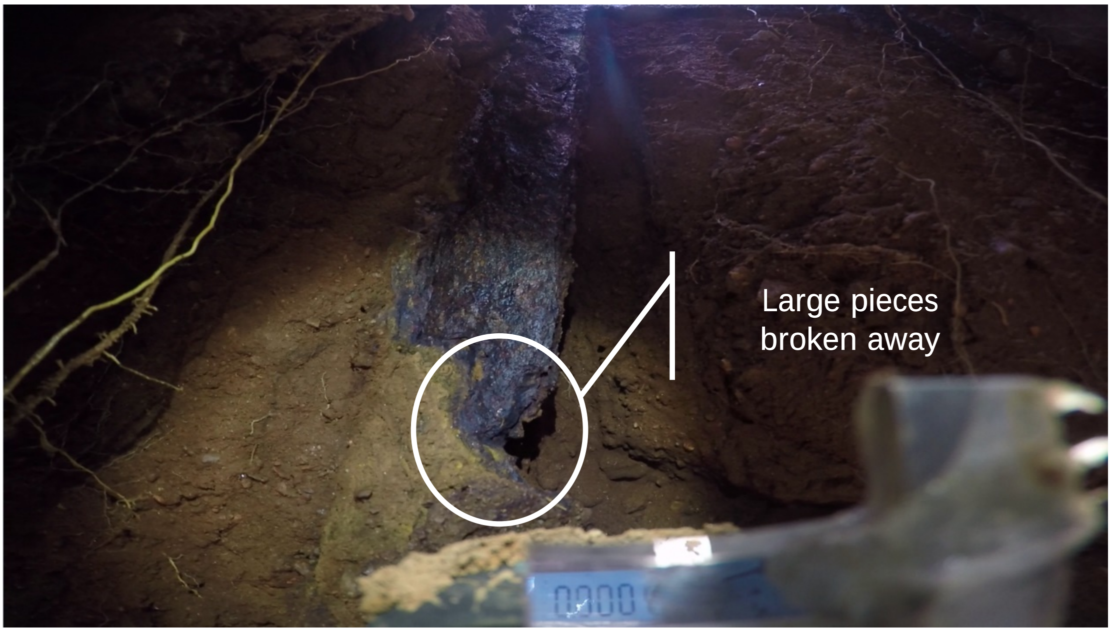


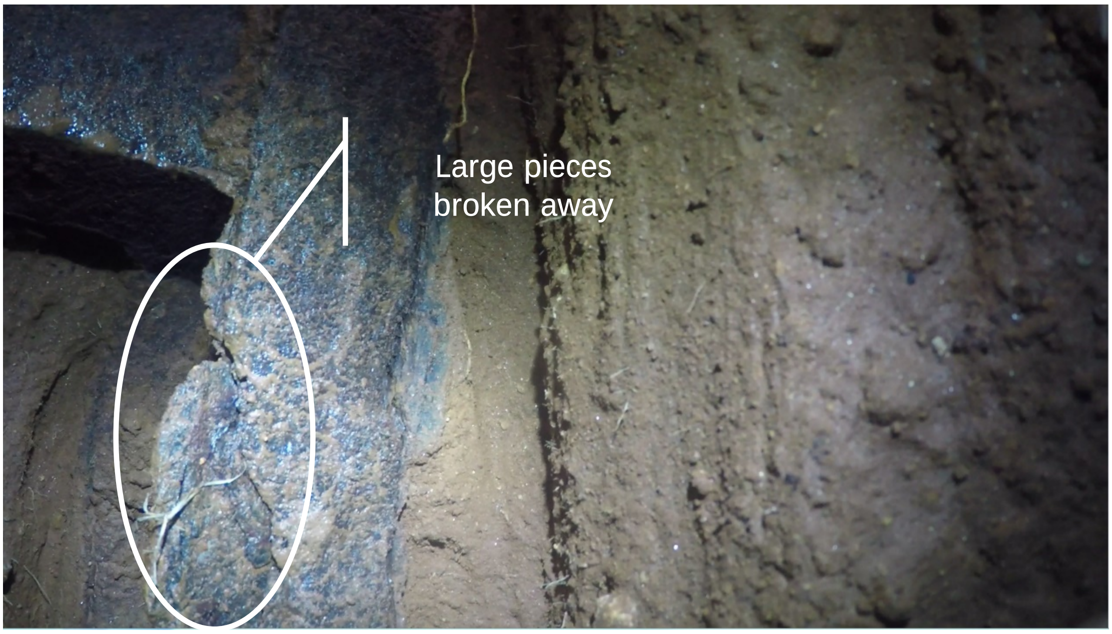
APPENDIX E

SAMPLE OF PHOTOS FROM INSPECTION VIDEOS


Complete loss of
section


Severe pitting and
flaking of edges
0000


Large pieces
broken away


Large pieces
broken away

APPENDIX F

SAMPLE OF PHOTOS OF CORROSION OF CONCRETED FOOTINGS