January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.03196 BS1009 Mudgeeraba to Terranora Refit

Project Status: Unapproved

Network Requirement

The Mudgeeraba to Terranora 110kV transmission line was first established in 1976 to augment electricity supply to the Tweed Valley in New South Wales from Queensland. It is a double circuit 110kV steel tower transmission line which consists of 58 structures, with the ownership of the asset split between Powerlink and Essential Energy. Powerlink maintains the feeders from Mudgeeraba substation up to and including structure 1731 along a 13.5km corridor, comprising of 18 tension and 14 suspension structures. The line operates in a coastal environment with elevated sections exposed to marine pollutants and is now nearly 50 years old. Earlier condition assessments identified isolated occurrences of G3 corrosion throughout the built section, although recent inspections have shown an increase in G3 and the emergence of G4 corrosion [1] [3].

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain supply to the Terranora substation. Removal of the Mudgeeraba to Terranora 110kV transmission line to address emerging condition risks would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and impact the power transfer capability between the Gold Coast and northern NSW via Directlink HVDC system. [2].

Consistent with the findings and recommendations of Powerlink's Asset Reinvestment Review Powerlink targets reinvestment in transmission line structures that will reach a health index (HI) of 8 or greater within the next five years. Powerlink must therefore take action to maintain existing electricity services and ensure an ongoing reliable, safe and cost-effective supply to customers in the Tweed Valley area and the ability for the Directlink HVDC Interconnector to support the networks in northern New South Wales and southern Gold Coast.

Recommended Option

As this project is currently 'Unapproved', project need and options will be subjected to the public RIT-T consultation process to identify the preferred option closer to the time of investment.

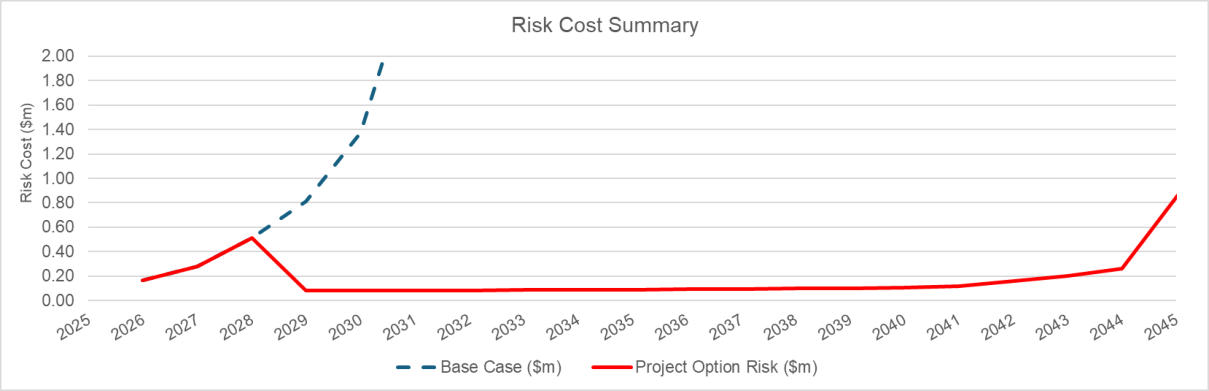
The current recommended option is to undertake a single stage of targeted refit works to extend the service life of the Mudgeeraba to Terranora 110kV transmission line for a further 15 years [3].

Options considered but not proposed include:

- Staged refit of selected structures on the Mudgeeraba to Terranora line with the first stage to be completed by 2028 and the second stage by 2033 – expected to be higher net present cost.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Mudgeeraba to Terranora transmission line from around $0.5 million per annum in 2028 to less than $0.1 million from 2029 [5].

Figure 1 Annual Risk Monetisation Profile ($ Real, 2025/26)



Cost and Timing

The estimated cost of the refit works on the Mudgeeraba to Terranora 110kV transmission line is $9.7 million ($2025/26) [4].

Target Commissioning Date: June 2028.

Documents in CP.03196 Project Pack

Public Documents

1. BS1009 Mudgeeraba to Terranora Condition Assessment Report
2. CP.03196 BS1009 Mudgeeraba to Terranora Refit – Planning Statement
3. CP.03196 BS1009 Mudgeeraba to Terranora Refit – Project Scope Report
4. CP.03196 BS1009 Mudgeeraba to Terranora Refit – Concept Estimate
5. CP.03196 BS1009 Mudgeeraba to Terranora Refit – Risk Cost Summary Report

BS1009 - MUDGEERABA – TERRANORA 110KV

Condition Assessment Report

MUDGEERABA – TERRANORA 110KV

BS 1009

Document Details	
Objective ID:	A2341883
Prepared By/Author:	[redacted] – Line Field Support Team Leader
Reviewed By:	[redacted] – Senior Asset Management Specialist [redacted] – Senior Lines Strategies Engineer
Approved By:	[redacted] – HV Asset Strategies Manager
Team	I&P – Asset Strategies Transmission Lines

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IMPORTANT: - This Condition Assessment Report provides an overview of the SAP built section meters outlined in the Report's Scope. As it is snapshot in time based upon available data and the accuracy of the prediction methodology, any estimates of remaining life are valid for 3 years only from the date of the report's approval.

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1.0 Executive Summary

1.1 General Comments

The Mudgeeraba – Terranora 110kV double circuit transmission line was commissioned in 1976 with Powerlink responsible for the section of line from Mudgeeraba (H004) to the Queensland – New South Wales border (structure 1009-STR-1731).

Climbing patrols of the line in 2014 identified widespread corrosion on the suspension and bridging insulator pins. All insulator strings that had grade 3 or 4 corrosion on the insulator pins were replaced by October 2014.

The overall condition of the built section is good for a 39year old transmission line built in proximity of the coastline. Many galvanised hardware components, tower members, nuts and bolts are beginning to exhibit evidence of Grade 2 corrosion, with Grade 3 corrosion in isolated instances. It is recommended that the line is monitored regularly to detect significant changes in condition for the remaining 11 years of design service life.

Cross arm, superstructure and body tower members are exhibiting some early evidence of Grade 2 corrosion, although none have yet suffered a total loss of their galvanised coatings. Approximately 10% of the superstructure and cross arm tip nuts and bolts are displaying early Grade 3, based for the most part on their sheltered location on the structure.

Testing of tower legs has shown that paint containing asbestos was applied during maintenance activities in the 1970's and 80's. The asbestos hazard increases the cost of maintenance work on the tower base area.

The anti-climb barriers are predominantly crown of thorns style barriers and some structures will need to be upgraded to barbed wire anti-climb barriers due to urbanisation changing tower proximity to residences and accessible to general public areas.

All warning and asset identification signs have also been progressively replaced over the past 4 years.

The line sits in a medium rainfall area with an average of 70% humidity. Exposed carbon steel in this environment (C3: including subtropical with low pollution) will corrode at between 25-50 micrometres per annum, which is 35-70 times faster than galvanised coatings. This could potentially result in the loss of 0.5mm of steel within 10-20 years.

The ACSR/GZ conductors are in sound condition and are considered to have at least another 25 years remaining life.

The overhead earthwires are Aluminium clad stranded steel conductors which have at least another 25 years remaining life.

Based upon the 2012-2014 photographic evidence, SAP Notifications and SAP Measuring Documents used in this report, the estimated remaining service life for BS 1009, **WITHOUT any refurbishment, life extension or increased maintenance** is a *minimum* of 10 years. As such, technical End of Life is estimated in 2025.

NOTE: This estimate is valid for a maximum of 3 years, after which new evidence will need to be collected and analysed.

1.2 Component Summary:

The table below summarises the average condition of each built section component for the Mudgeeraba – Qld/NSW Border 110 kV transmission line towers (Built Section 1009) originally commissioned in May 1976.

Average Observed Corrosion Grades are based upon existing Powerlink Visual Inspection Guides, as applied to 2013/14 field data and maintenance records.

Built Section Meter	Year of Commissioning	Comments/Corrosion Grade/ % Strs
Foundations	1976	G1++
Structure	1976	Overall 17% of the bolts exhibit G2 and 2% of members exhibit G2.
• Climbing Aids		G2 47% ^
• Anti-Climbing Barriers		G1 ~
• Tower Base		
○ Steel members		G1 ++
○ Nuts and Bolts		G1 ++
• Tower Body		
○ Steel members		G1
○ Nuts and Bolts		G1
• Superstructure		
○ Steel Members		G1
○ Nuts and Bolts		G2 24% **
• Conductor Attachment Plate		
○ Nuts and Bolts		G2 32% **

Built Section Meter	Year of Commissioning	Comments/Corrosion Grade/ % Strs

• Cross Arms
  ○ Steel members
  ○ Nuts and Bolts
• Earthwire Peak
  ○ Steel members
  ○ Nuts and Bolts
		G1
		G2 33% **
		
		G2 6% **
		G2 60% **

Earthing	1976	G3ˣ Damage to numerous earth straps which will require upgrade.
Conductor	1976	Greased ACSR/GZ conductor Meets electrical load. No visible deterioration
Conductor Hardware	1976	Aged
Conductor Mid-Span Joints	1976	No visible deterioration
Earthwire	1976	Twin 19/2.59mm SC/AC OHEW Meet current fault levels. G1
Earthwire Hardware	1976	G2 74%** No dampers fitted.
Suspension Insulators	1976 & 2014	G2 12%**
Bridging Insulators and Hardware • Insulators • Forged and Pressed Parts	2014	G1 G1
Suspension Insulator Hardware	1973 & 2014	G2 38%**
Tension Insulators	1976	G2 100%**

Built Section Meter	Year of Commissioning	Comments/Corrosion Grade/ % Strs
Tension Insulator Hardware	1976	G2 88%**
Signage	2013	G1

Notes:

++ The foundation tower leg interfaces on this line have been added to Powerlink's Asbestos Register as it is has been confirmed as being treated with an asbestos based paint.

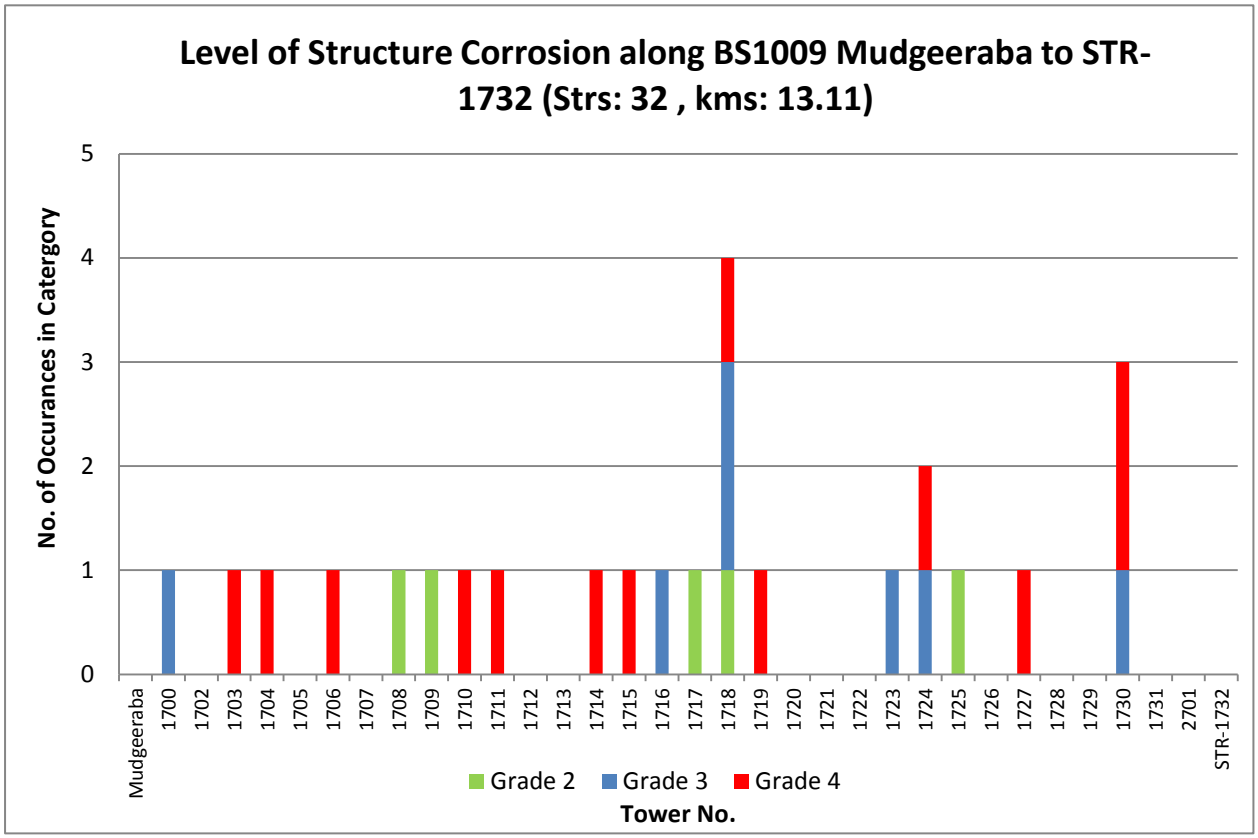
^ Step bolts no longer meet current Powerlink standards that require them to be used as an attachment point.

** Grade 2 Corrosion Observed. ***Monitor and Review***

ˣ Grade 3 Corrosion representing a total loss of galvanising and the onset of unprotected carbon steel corrosion has been observed on at least 5% of the component group. ***Estimated time until loss of 0.5mm of carbon steel in this environment is 10-20 years***

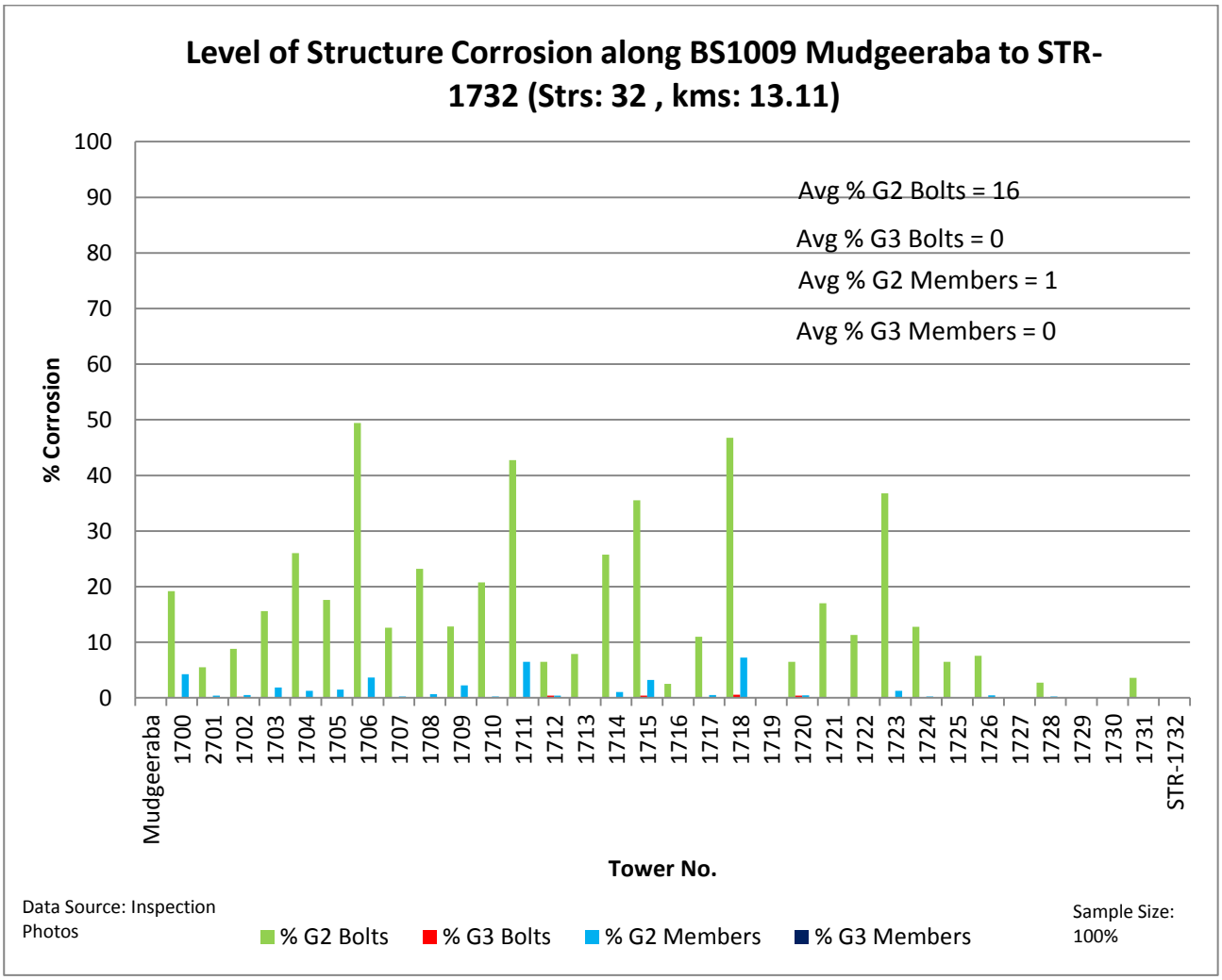
~ Anti-climb barriers in residential areas are predominantly of the barbed wire type although with the expansion of residential estates, some will require barbed wire type anti-climb barriers to be installed.

1.3 Notification Overview for Structures



The above graph shows the number of notifications relating to corrosion on each structure. It can be seen that a number of Grade 4 notifications have been raised and are being addressed through maintenance procedures. Many of the Grade 4 notifications were in relation to the condition of the suspension insulator pins, which have since been replaced.

1.4 Structure Corrosion along Built Section



2.0 Purpose

This report outlines the assessed condition of the Mudgeeraba – Qld/NSW transmission line towers and has been produced to assist in developing a future maintenance strategy for the line.

The report examines the condition of each major transmission line tower component group, using field data and maintenance records from 2012 to 2014, and assigns them a corrosion grade based upon existing Asset Management classifications.

3.0 Scope

SAP "Built Section Meters" have been used as the basis of categorising the transmission line components in this Condition Assessment Report.

Built Section Meters			
1	Foundations	**8**	Earthwire Hardware
2	Structure	**9**	Earthwire Mid-span Joints
3	Earthing	**10**	Suspension Insulators
4	Conductor	**11**	Suspension Insulator Hardware
5	Conductor Hardware	**12**	Tension Insulators
6	Conductor Mid-span Joints	**13**	Tension Insulator hardware
7	Earthwire	**14**	Signage

In addition to the built section meters the easement condition has also been assessed.

The Corrosion Grade assigned to each Built Section component is based on the corrosion/deterioration classifications used in Powerlink's existing Visual Guides, and has been assessed as :-

- A single value indicates **at least 5%** of the components exhibit the condition.
- A range of values indicates at **least 5% of the components exhibit the lower value and at least 5% exhibit the higher value.**
- A value of "no deterioration" indicates no deterioration, or minor deterioration impacting **less than 5% of components.**

4.0 Transmission Line Parameters

4.1 Overview

The Mudgeeraba – Qld/NSW Border transmission line is approximately 26.2km in length and consists of 18 Steel Lattice Tension Towers and 14 Steel Lattice Suspension Towers.

The line was commissioned in May 1976 and consists of Built Section 1009 constructed under contract number 73/22.

Figure 1: D1S2

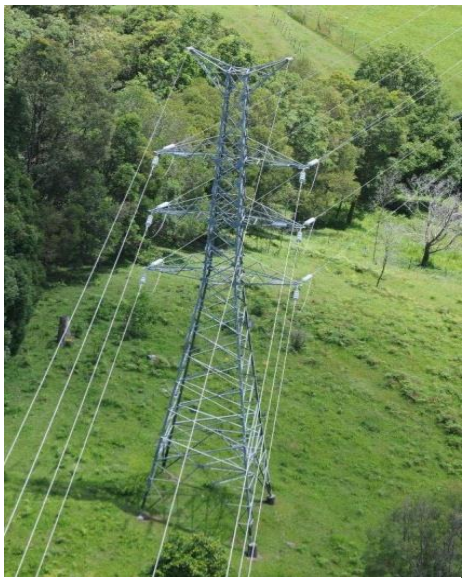


Figure 2: D1T20

4.2 Summary Table

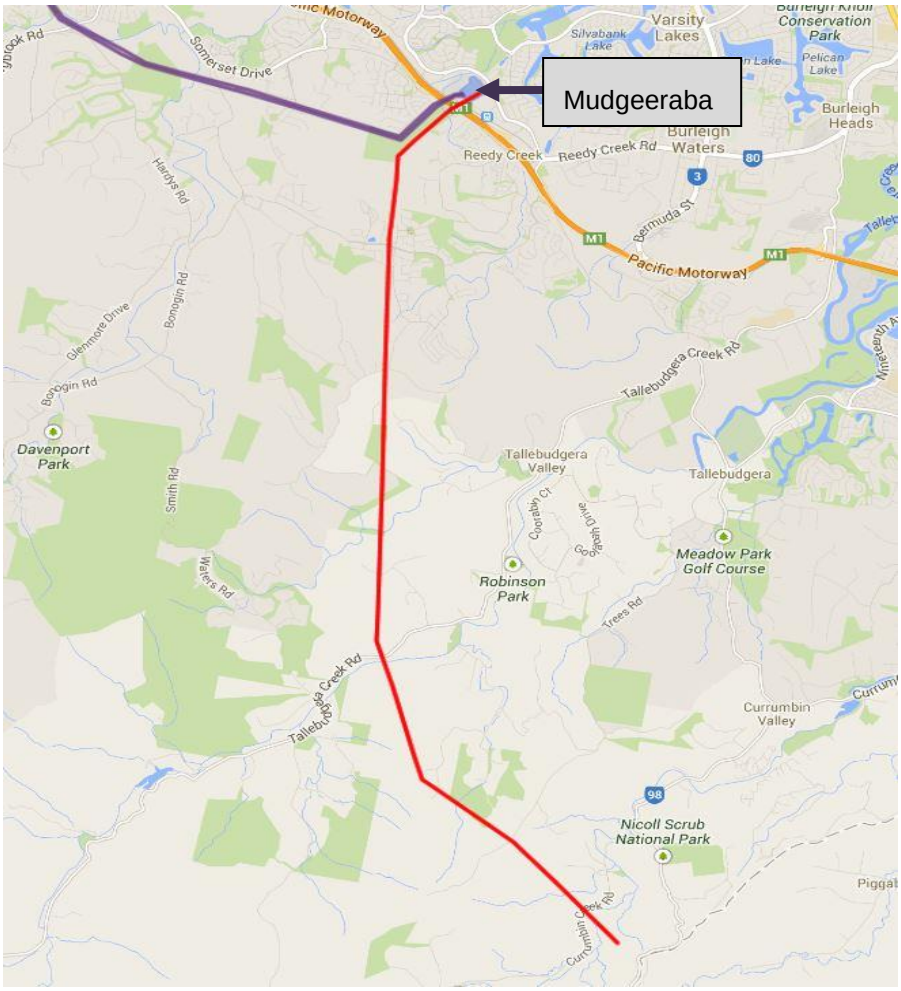
Item	Specification
The Line	The line was constructed under contract numbers 73/22 and consists of Built Section 1009
Commissioning Date	25.05.1976

Item	Specification
Voltage	110KV
No. of Circuits	2
Circuits	Feeder 757 Feeder 758
Length of Line	13.11km
No. of Towers	18x Steel Lattice Suspension Towers 14 x Steel Lattice Tension Towers
Foundations	Standard Reinforced Concrete
Conductor **Earthwire**	Bear ACSR/I 30/7/3.0 – Single Bundle A: SC/AC_RH 19/2.59 HITACHI B: SC/AC_RH 19/2.59 HITACHI
Line Clamps	Suspension - AGSU Tension – Galvanised steel compression fittings
Dampers	Conductor: Dog-Bone on all structures OHEW: Spiral on some structures
Avg Easement Width	70m between H004 and STR-1719 40m between STR-1719 and STR-1731
Insulators	
Suspension insulators	NGK Fog Disc 125kN Suspension, Porcelain, 9 Discs Installed 2014 NGK Fog Disc 125kN Suspension, Porcelain, 9 Discs Installed 1976
Bridging	NGK Fog Disc 125kN Suspension, Porcelain, 9 Discs Installed 2014
Tension insulators	NGK Fog Disc 125kN Tension, Porcelain, 10 Discs Installed 1976

5.0 Location and Environment

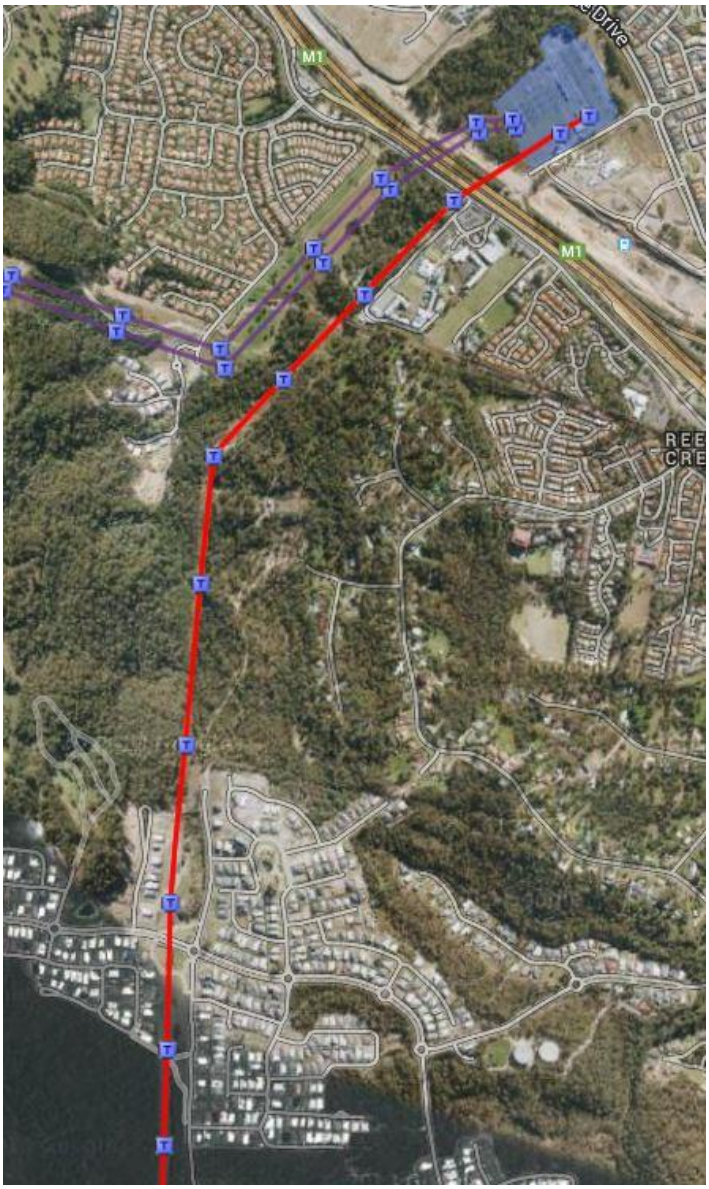
5.1 General Location

The transmission line is located between Powerlink's H004 Mudgeeraba Substation and the Qld/NSW Border, as marked in red. The primary road crossing is the Pacific Motorway between structures 1700 and 2701.



5.2 Land Use

The first 3.6 Km of Built Section 1009 is located adjacent to an established suburban precinct (Reedy Creek). The remainder of the line passes through larger allotments of private residences.



5.3 Atmospheric Corrosion

The Mudgeeraba – Qld/NSW 110kV transmission line is located between 10 and 20 kilometres from the coast and is reasonably well protected from any prevailing coastal winds. Notwithstanding this, its location in South East Qld leaves it exposed to a relatively high annual rainfall (1400mm) and average humidity (70%) which accelerates the corrosion process once the zinc galvanising layer has been lost.

The highest rates of galvanised steel corrosion normally occur on sheltered or partially sheltered steel members, nuts, bolts and joint interfaces. Reduced exposure to cleansing rains and drying winds creates a microenvironment where the accumulation of air-borne pollutants and trapped moisture accelerates the corrosion process.

The thickness of the original coating also determines the time to loss of zinc and the subsequent service life of the coating.

This increased potential for corrosion based upon microclimatic conditions and coating thickness is consistent with the observed condition of Powerlink's galvanised steel lattice towers, with spot rusting of major members accompanied by more advanced rusting of nuts, bolts and joint nodes.

Once the galvanised coating has been damaged or deteriorated to the point where visible corrosion is evident, the steel has effectively begun to break down (***AS/NZS 2312-2002 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings***) This point has been adopted as Level 2 corrosion in Powerlink's Visual Grading Guides and triggers corrective action to prevent deterioration of the underlying steel component

The Galvanizers' Association of Australia (refer Section 7) estimates the service life of nuts, bolts and members in this location as follows.

Component	Minimum thickness µm	Estimated life to First Service in Years *(First Appearance of Grade 2)*
Bolts & nuts (Centrifuged)	42	22+
Members ≤ 6mm	70	33+
Members > 6mm	85	40+

The end of Grade 3 Corrosion represents a total loss of galvanising and the onset of unprotected carbon steel corrosion. Rates of carbon steel corrosion can be between 10-300 times the rates of galvanised corrosion, depending upon the atmospheric conditions.

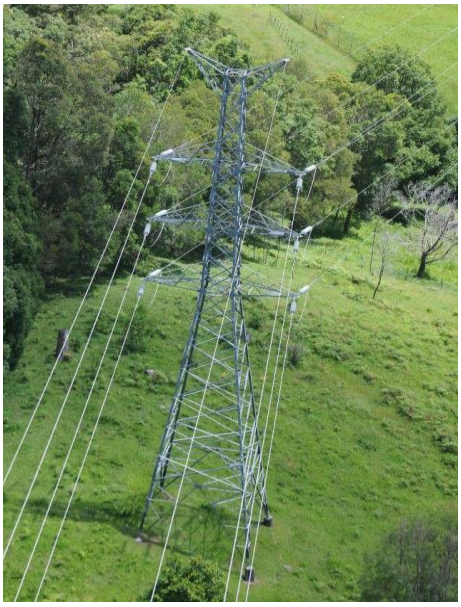
6.0 Condition Assessment

NOTE: Unless otherwise stated any Expected Remaining Life estimates are based upon the condition of the asset at the time the photographic evidence was collected in 2012 – 2014

6.1 Tower Structure – Overview

The following table outlines the type and numbers of towers that make up Built Section 1009. Body extensions vary between -20 and +50 feet (-6 and +15m).

Tower Types	Number	Body Extensions
D1S2	14	-20 – +40
D1T20	14	-20 – +50
D1T50	2	-20 – +50
D1T70	1	-20 – +50
D2T40	1	+3
TOTAL	**32**	



D1T20

D1S2

6.2 Foundations

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	Estimated Life
1976	AM-PR-0835 Visual Grading of Galvanised Members	G1	M&R

The towers foundations are either mass concrete or bored undercut/straight sided. While the majority show no signs of deterioration, there are isolated instances where a tower leg is showing signs of corrosion at the concrete/ tower leg interface and remedial action will be required. It is also noted that the K-braces on many structures are painted with an asbestos containing paint and before any work can be done, appropriate work methods are required.

6.3 Structure

6.3.1 Climbing Aids

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	Estimated Life
1976	AM-PR-0835 Visual Grading of Galvanised Members	G2 47%	M&R

Step bolts are the primary climbing aid used by linespersons to safely ascend and descend the towers. Step bolts are generally in sound condition, although none meet the current fall arrest standard which includes an attachment point for a fall arrest device.

6.3.2 Anti-Climbing Barriers

Year of	Condition Assessment Criteria	Corrosion	Estimated

Commissioning		Grade	Life
1976	AM-PR-0835 Visual Grading of Galvanised Members	G1	M&R

Towers were fitted with a combination of barbed wire and crown-of-thorn anti-climbing barriers at the time of construction, depending upon location.

The majority of the barriers remain in a serviceable condition. The traversing area contains expanding residential estates. Towers impacted by the urbanisation require upgrading to a barbed wire anti-climb barrier and a review of earthing for step and touch potential hazard.

Anti-Climb Barrier at 1009-STR-1706

6.3.3 Tower Base

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0836 Visual Grading of Galvanised Members	G1	M&R
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	G1	M&R

The tower base and legs are generally in good condition with minimal corrosion evident. There are some isolated cases of Grade 3 corrosion on some bolts, which will require replacement. The base of the tower legs has been painted with a silver paint, which has in many cases returned a positive result for the presence of asbestos. Due to the local urbanisation around some towers and probable impact from vehicles, some K-Brace members have been damaged and will require replacement once appropriate work methods for the asbestos containing paint have been developed.

6.3.4 Tower Body

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0836 Visual Grading of Galvanised Members	G1	M&R
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	G1	M&R

The tower body steel members are exhibiting minimal to no corrosion, with the aging of the structures consistent with 38 years of environmental exposure. Some fasteners (nuts and bolts) are showing signs of Grade 3 corrosion, but the majority remain in a fair condition.

6.3.5 Superstructure

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0836 Visual Grading of Galvanised Members	G1	M&R
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	G2 24%	10-15 years

Most superstructure members are exhibiting Grade 1-2 corrosion of the galvanised coating. The galvanised nuts and bolts are more susceptible to corrosion; however, on built section 1009, they are generally in a sound condition. There are isolated cases of fasteners on the structures at Grade 3, but these are not indicative of the general condition.

6.3.6 Conductor Attachment Plate

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1977	AM-PR-0835 Visual Grading of Galvanised Bolts	G2 32%	M&R

Most attachment plates are in a sound condition with Grade 2 corrosion evident on sections of the attachment plate, bolts and nuts. The figure below illustrates the typical condition of the attachment plate and bolts on built section 1009.

6.3.7 Cross-arms

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0836 Visual Grading of Galvanised Members	G1	M&R
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	G2 30%	10-15 years

The cross-arm members are exhibiting minimal to no indication of corrosion with only some grade 2 corrosion on the sheltered regions of some members. A larger percentage of bolts have grade 2 corrosion with a small percentage (<5%) with grade 3 level of corrosion. The bolts that are located on the underside of the members in more sheltered locations had consistently a higher degree of corrosion.

6.3.8 Earth Peak

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0836 Visual Grading of Galvanised Members	G2 6%	M&R
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	G2 60%	10 years

The earth peak members are beginning to exhibit Grade 2 corrosion, particularly on structures that have exposure to the coastline. Approximately 6% of all earth peak members have some Grade 2 corrosion, with the aging of the structures consistent with 38 years of environmental exposure.

The bolts on the earth peak are more susceptible to corrosion with 60% of the bolts showing Grade 2 corrosion and some isolated examples of Grade 3 corrosion have been observed.

6.4 Earthing

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade
1976	AM-POL-0174 Maintenance of Structure Earthing	No longer meets operational requirements

All towers are fitted with the original galvanised earth straps which are all showing signs of corrosion and in some cases the galvanised strap has been broken altogether. In 2004/2005, the footing resistances of all structures were measured and only two structures recorded footing resistances higher than 10Ω. The performance of the line during storm activity has been acceptable, although recent investigations after a lightning related outage had shown tower footing resistances of nearby towers to be considerably higher than 10Ω.

Given that many of the earth straps are coated with asbestos containing paint, the replacement of the earth straps will require appropriate work method instructions to be developed.

6.5 Conductor

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	Estimated Life
1976	AM-PR-0835 Visual Grading of Galvanised Bolts	No visible deterioration	M&R

The transmission line is strung with a single Panther ACSR/GZ conductor (30/7/3.00mm) on both sides with a maximum temperature of 120°C. The ACSR / GZ conductor contains a galvanised and greased central steel core and has an expected life of 80 years. The conductor meets current load requirements and has no history of over temperature operation.

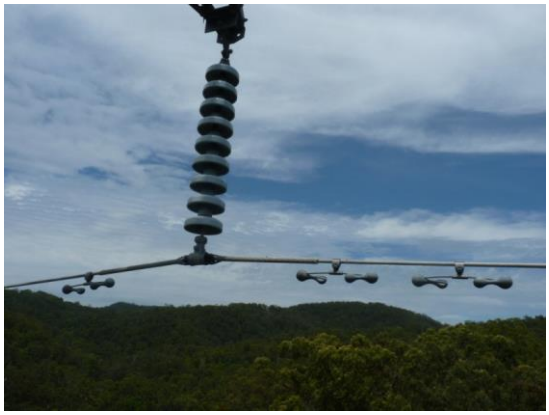
Experience on ACSR conductors overseas has shown that the grease can harden after 35 to 45 years, resulting in moisture ingress and accelerated core corrosion. Previous testing of conductors on other lines has identified a small amount of corrosion in conductors of this age. Powerlink's oldest ACSR/GZ conductor (installed in 1948 and removed in 2013) was installed in the Belmont area and was in a sound condition when inspected. Visual examination of the conductor has not indicated any major defects which could be attributable to aluminium or steel core corrosion or overloading.

The Panther ACSR/GZ conductor is terminated with a two part compression deadend and jumper bridge fitted by compression connectors. The two galvanised bolts on the dead-ends are exhibiting Level 2 corrosion.

6.6 Conductor Hardware

Year of Commissioning	Condition Assessment Criteria		Condition
1976	AM-PR-1070	Vibration Dampers – In Service Inspection	Aged

Dampers on the conductor are of a dog-bone construction and the earthwire dampers are spiral vibration dampers. The dampers were installed on the line during its construction and are in a fair condition.



6.7 Conductor Mid-Span Joints

Midspan splices visually appear to be sound but in 2014 the patrol identified corrosion on one midspan splice. It is expected that all overhead earthwire midspan joints will be replaced over the next 5years,

6.8 Earthwire

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET tp Loss of 0.5mm
1976	AM-PR-0924 Visual Grading of Galvanised Line Hardware	No visible deterioration	M&R

Both A & B earth-wires (19/2.59 SC/AC Hitachi) were installed in 1976. A limited number of spans were installed with spiral vibration dampers which require replacement during which all spans will have dampers retrofitted.

No visible deterioration of the earthwires have been observed

6.9 Earthwire Hardware

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	Estimated Life
1976	AM-PR-0924 Visual Grading of Galvanised Line Hardware	G2 74%	5 – 10 years

The line's OHEW suspension and tension hardware was installed in 1976 and is showing signs of Category 2 corrosion. The design of the OHEW termination allows fault current to pass through the preformed fitting which has been identified with strand damage on the thimble-preformed interface. Replacement of the deadend assemblies to a more robust design to prevent fault current damage is being assessed. There are isolated cases of grade 3 corrosion on the trunnion clamps and these will require replacement in the next 5 – 10 years.

6.10 Suspension Insulators

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976 & 2014	AM-PR-0499 Guide to Visual Inspection of Porcelain / Glass Insulation	G2 12%	M&R

The suspension insulators are NGK Fog discs that were manufactured in 1973 and installed in 1976. Inspections of the insulator discs revealed widespread pin corrosion on the insulator discs across a number of structures due to the proximity to the coastline and elevation of the line. Ten of the 14 suspension structures had the insulators replaced by October 2014 with the remaining structure considered to be in an acceptable condition.

The following suspension structures had insulators replaced in 2014:

STR-1703	STR-1706	STR-1710	STR-1711
STR-1714	STR-1715	STR-1718	STR-1725
STR-1727	STR-1730		

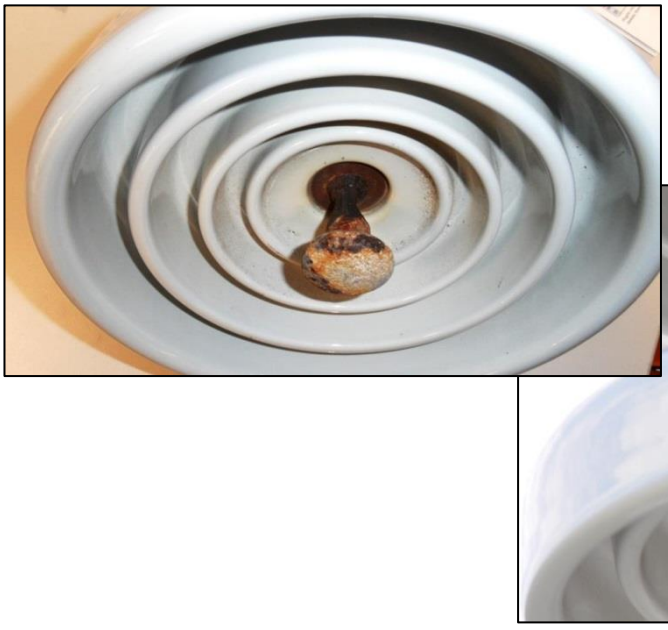


Figure 3: Condition of Removed suspension Insulators

6.10.1 Bridging Insulators and Hardware

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
2014	AM-PR-0499 Guide to Visual Inspection of Porcelain / Glass Insulation	1	M&R
2014	AM-PR-0924 Visual Grading of Galvanised Line Hardware	1	M&R

The bridging insulators and hardware were in a similar condition to the suspension insulators and hardware. There are only three structures which contain bridging insulators and these were replaced with NGK fog insulators. These replacements were completed in August 2014.

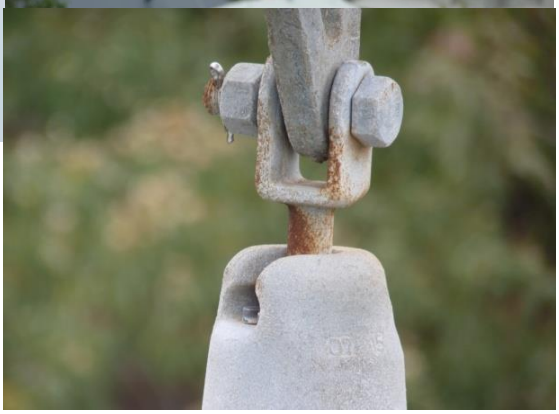
Figure 4: Condition of Removed Bridging Insulator

6.11 Suspension Insulator Hardware

Year of Commissioning	Year of Commissioning	Corrosion Grade
2014	AM-PR-0924 Visual Grading of Galvanised Line Hardware	G2 38%

The suspension assemblies on this line hang from a pivoting galvanised steel pin underneath the crossarm. Numerous examples of category 2 have been detected. While some category 2 corrosion is visible on the pivoting bracket, no major deterioration or wear has been detected. The steel locating pins, have begun to show signs of corrosion at the exposed ends of the pins, but are still in good condition within the pivoting bracket.

The other hardware at the cold end was replaced along with the insulators. The structures that were not replaced are in a good condition, generally category 2, with some instances where the galvanising on the hardware at the energised end has deteriorated. These can be periodically monitored and replaced under maintenance when required.



6.12 Tension Insulators

Year of Commissioning	Condition Assessment Criteria	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0499 Guide to Visual Inspection of Porcelain / Glass Insulation	G2 100%	M&R

The majority of the line's tension insulators are in good condition with minor corrosion present. The insulators are Fog type NGK insulators that were manufactured in 1973 and installed 1976. Structure 1009-STR-1718 is a transposition structure and the insulators were replaced in August 2014. On approximately half of the remaining tension structures, there are insulator strings that have accumulated mould that is growing on the underside of the insulator.

The presence of mould on the insulators should not adversely affect the performance of the insulators and it is recommended to monitor the insulators for any changes.

6.13 Tension Insulator Hardware

Year of Commissioning	Year of Commissioning	Corrosion Grade	ET to loss of 0.5mm
1976	AM-PR-0924 Visual Grading of Galvanised Line Hardware	G2 88%	M&R

The tension insulator hardware was installed in 1976 and like most components of the line remains in a good condition. In the majority of cases only minor corrosion is evident, but on several turnbuckles, the galvanising on the adjustable nut has deteriorated leaving the bare steel. At this stage there is very low risk to the network, but affected items will need to be replaced in the medium term under maintenance work orders.

6.14 Signage

A recent project installed identification and warning signage in 2012/13 to the current Powerlink standard. The patrol undertaken as part of this condition report has identified structure 1009-STR-1700 as not having the current standard and this will be rectified as part of a routine maintenance program.

6.15 Easement

The southern end of Feeders 757 / 758 are highly visible and accessible from several urban streets. The easement itself, however, provides unhindered access for all vehicle types, including EWPs.

The remainder of the lines easement poses a number of access issues due to its undulating nature, and in places, location in private residences or distance from roads. It also contains a number of heavily vegetated spans with a medium to high fire risk.

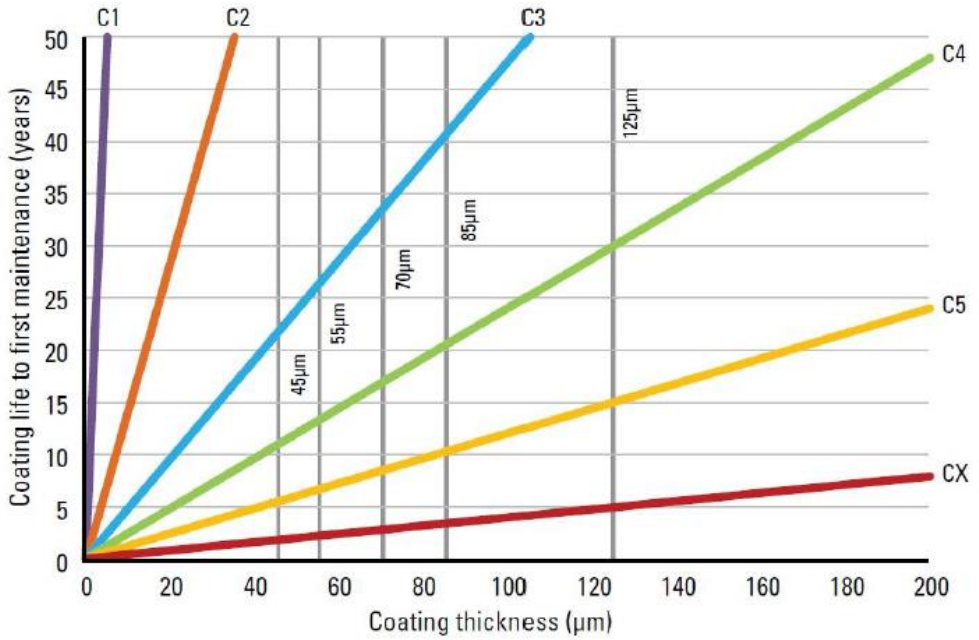
7.0 Appendices

7.0 Estimated Service Life of Galvanised Steel

Mudgeeraba - Terranora

Corrosivity Category	Corrosivity	Example
C3	Medium	Sub-tropical and tropical zones with low pollution

Chart 1: Life to First Maintenance of Hot Dip Galvanized Steel



The LFM range for a particular hot dip galvanizing coating thickness and each corrosivity zone can be read from the chart. For example, the LFM range for a hot dip galvanized article with an 85 µm thickness and located in the C4 (High) corrosivity zone is 20 to 40 years.

This chart is supported by case history evidence in Australia, where service life records of 50 years are common and up to 110 years are recorded.

The Life to First Maintenance chart is available as a standalone document directly from the Galvanizers Association of Australia.

Estimated Service Life of Carbon Steel

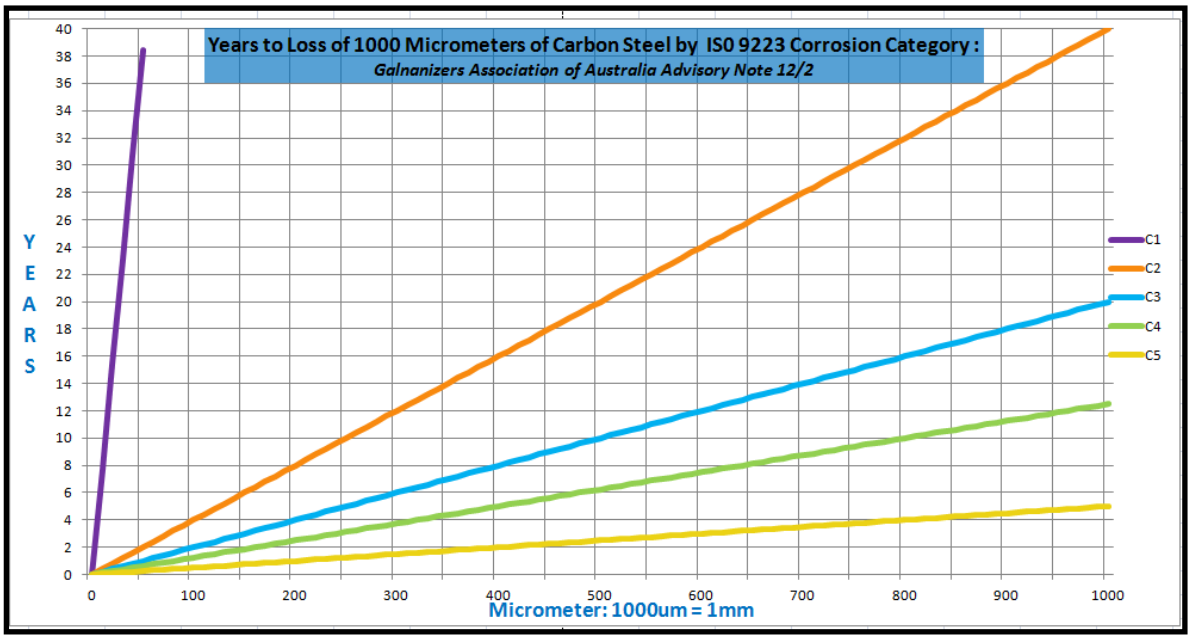


Figure 5: Source: Extrapolated from Table 2: Corrosion Rates for Steel and Zinc for the first year of exposure for different corrosion categories. Galvanisers Association of Australia – Advisory Note GEN12/2 April 2012

References

Inspection Guides and Corrosion Models

- AM-PR-0836 Visual Grading of Galvanised Members
- AM-PR-0835 Visual Grading of Galvanised Bolts
- AM-POL-0174 Maintenance of Structure Earthing
- AM-PR-0351 Maintenance of Conductors
- AM-PR-0924 Visual Grading of Galvanised Line Hardware
- AM-PR-0499 Guide to Visual Inspection of Porcelain / Glass Insulation
- AM-PR-1008 Vibration Dampers – In Service Inspection
- Galvanizers Association of Australia - Advisory Note GEN12/2 April 2012 *"Atmospheric Corrosion Resistance of Hot Dipped Galvanised Coatings"*

Built Section Configuration

- SAP Reports
    - B_SECT_DGN_Detail
    - SPAN_DOC_REF
    - EASEMENT DETAILS
    - SPAN_COND_DETAILS
    - SPAN_EWIRE_DTL
    - LINE_STR_DETAILS
    - LINE_STR_MAINT_DTL
    - STR_ACCESSORIES
    - LINE INSULATOR
    - FLOSS SHEETS

Condition Assessment Data

- Aeropower Transmission Pro
- SAP IK17 Measurement Documents

Planning Report	26/08/2025
Title	CP.03196 - BS1009 Mudgeeraba to Terranora 110kV Transmission Line Refit
Zone	Gold Coast
Need Driver	Emerging compliance risks due to deterioration of double circuit 110kV transmission line between Mudgeeraba and Terranora Substation.
Network Limitation	Mudgeeraba to Terranora double circuit 110kV transmission line is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standard and maintain power transfer capability between the Gold Coast and northern NSW via Directlink HVDC interconnector.
Pre-requisites	None

Executive Summary

Built section 1009 (Feeders 757 and 758) is a double circuit 110kV line commissioned in 1976. It connects Mudgeeraba to Terranora Substation. Asset ownership of his section is split between Powerlink and Essential Energy. Powerlink own up to structure 1731, along the 13.5km corridor.

The transmission line traverses a coast environment where exposure to marine pollutants is elevated. The condition assessment, refer to Reference [1] documents significant corrosion that needs to be addressed to ensure ongoing compliance with Powerlink's Electricity Act, Electrical Safety Act and Electricity Safety Regulation obligations.

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain supply to the Terranora substation. Removal of the Mudgeeraba to Terranora 110kV transmission line to address emerging condition risks would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and impact the power transfer capability between the Gold Coast and northern NSW via Directlink HVDC system.

The preferred network solution for Powerlink to continue to meet its statutory obligations is to refit the line to extend the life by 15 years.

1 Table of Contents

1. Introduction

Built section 1009 (Feeders 757 and 758) is a double circuit 110kV line that was commissioned in 1976.

The line consists of 58 structures, with the ownership of the asset split between Powerlink and Essential Energy. Powerlink maintains the feeders from Mudgeeraba substation up to and including structure 1731 along a 13.5km corridor. Therefore, Powerlink own 18 tension and 14 suspension structures.

These lines are essential to delivery power to Terranora and then to northern NSW via the HVDC Directlink Interconnector.

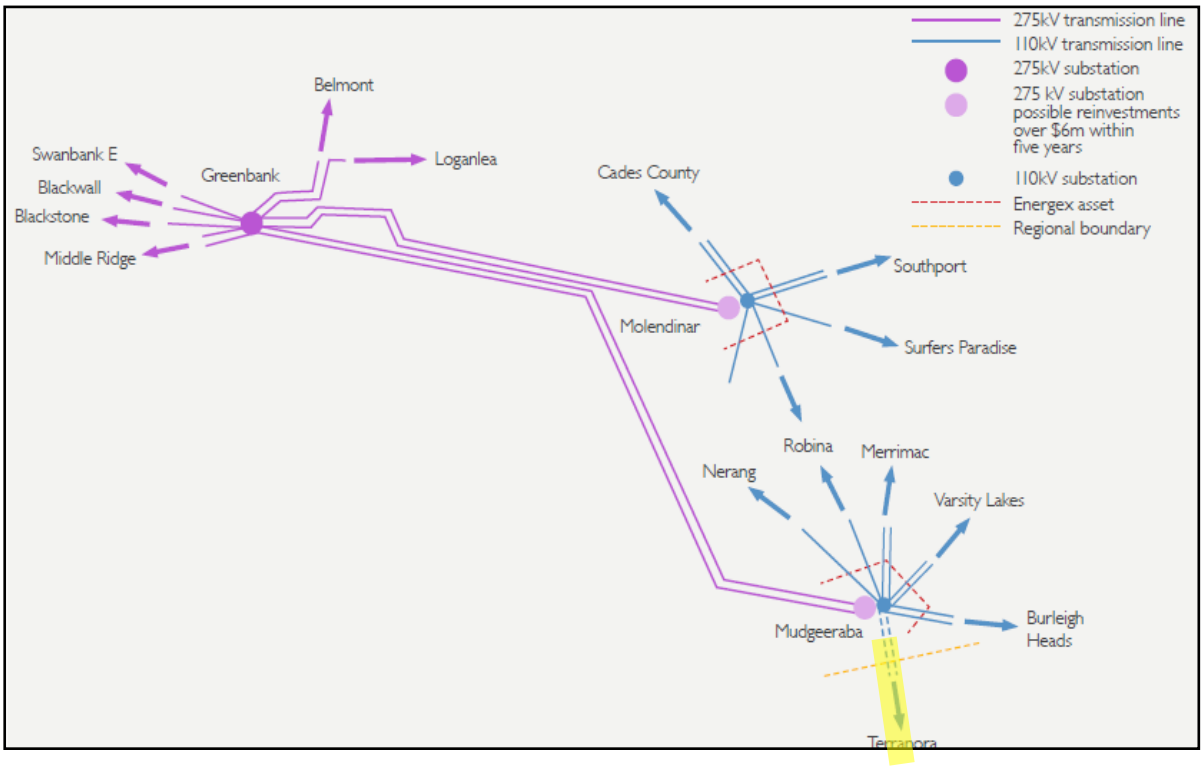


Figure 1. Mudgeeraba – Terranora 110kV Transmission Lines

The condition assessment [1] confirmed increased G3 and emergence of G4 corrosion on the built section. To ensure ongoing compliance with statutory safety obligations and reliability of supply standards, reinvestment in the line is required.

This report assesses the impact that removal of the at-risk lines would have on the performance of the network and Powerlink's statutory obligations. It also establishes the indicative requirements of any potential alternative solutions to the current services provided by the Mudgeeraba to Terranora feeders.

2. Terranora Demand Forecast

Terranora Substation, located in NSW, is connected to the QLD network via the double circuit 110kV line from Mudgeeraba Substation. Terranora then connects to Bungalora Substation where power between the two states are interconnected via the Directlink HVDC interconnector.

Figure 2 shows that the forecast maximum demand for the Central scenario is relatively flat, with a modest increase of approximately 10MW over the forecast period.

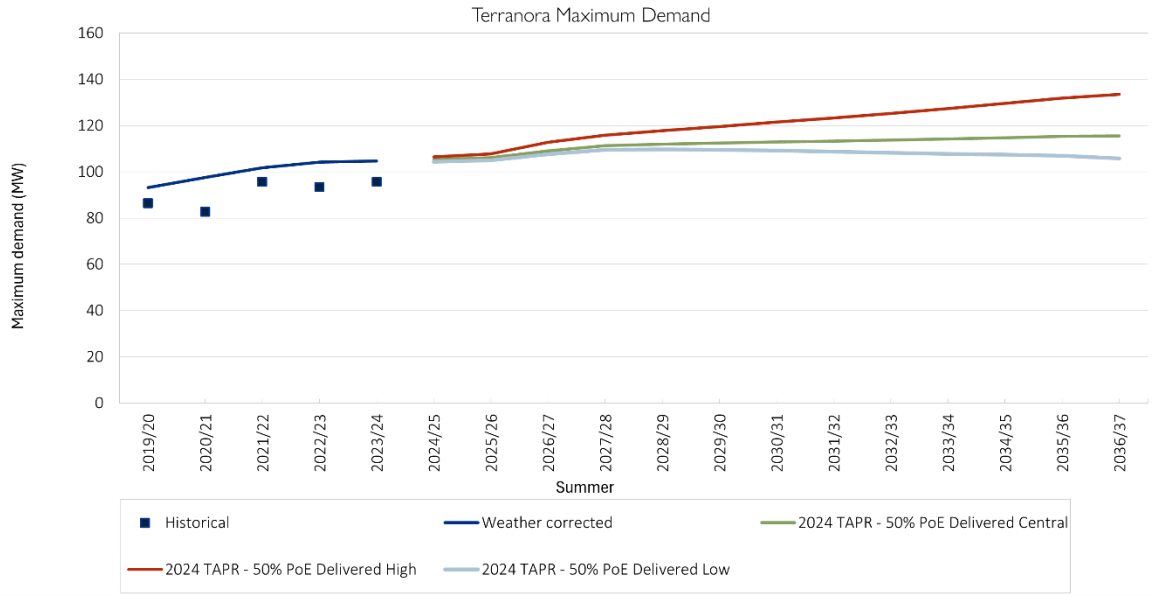


Figure 2. Terranora Maximum Demand

Figure 3 shows the historical flow duration curve for the aggregate power transfer on the 110kV feeders between Mudgeeraba and Terranora. This flow is net of the contribution from the Directlink HVDC interconnector and embedded generators (Condong 30MW biomass generator), as is evidenced by the negative transfers.

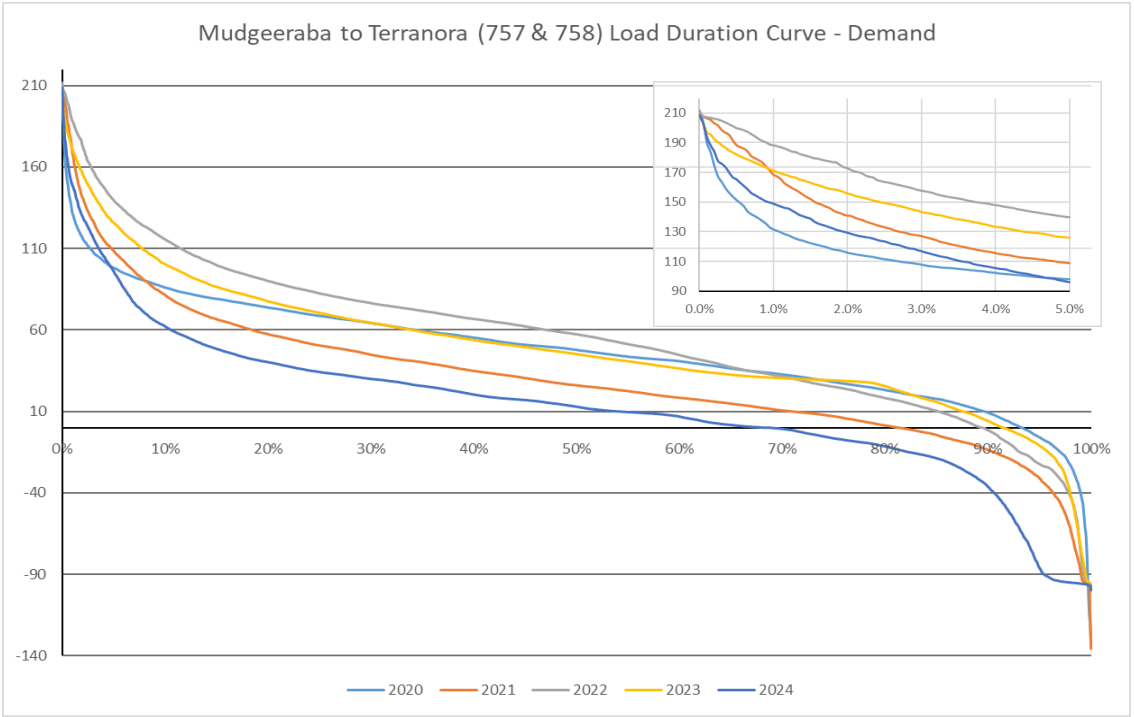


Figure 3. Mudgeeraba to Terranora (757 & 758) flow Duration Curve

The historical load duration curve for Terranora Substation in shown in Figure 4.

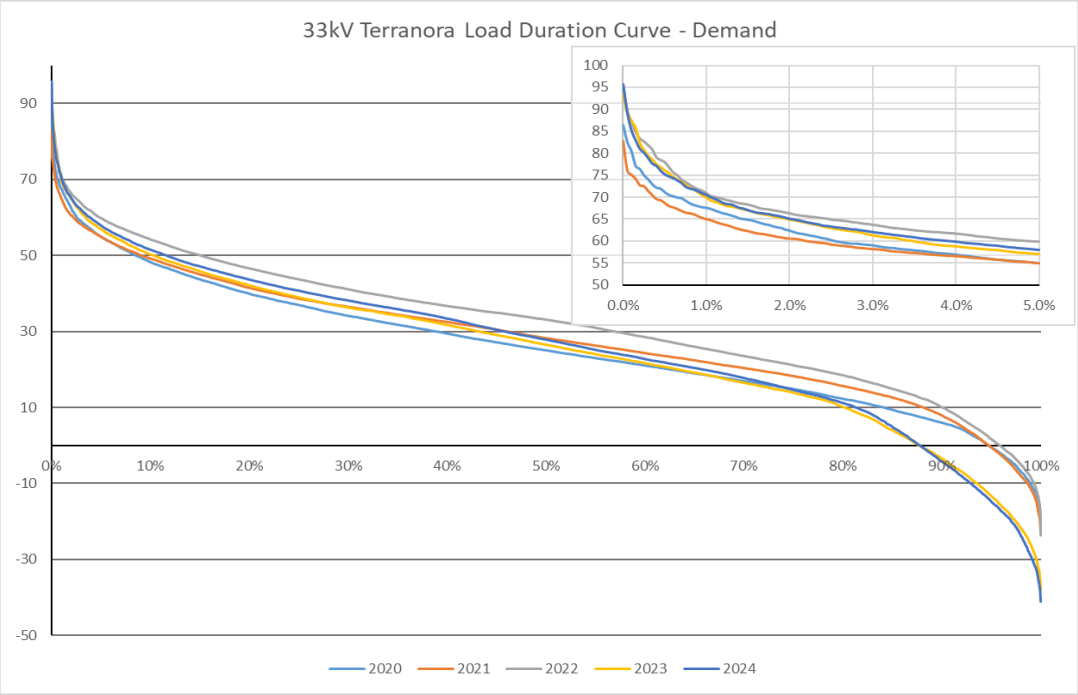


Figure 4. Terranora 33kV Load Duration Curve

3. Statement of Investment Need

Powerlink's 2024 Central scenario forecast confirms an enduring need to maintain electricity supply to Terranora Substation.

The removal of the Mudgeeraba to Terranora transmission lines to address emerging condition-based safety issues would have a major impact to the supply of the Terranora load and violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard.

Without these circuits, Queensland will no longer be able to support the loads of Terranora and northern NSW via the Directlink HVDC interconnector. Vice versa, Directlink will be unable to support the southern Gold Coast area.

Powerlink must therefore preserve the functionality of the Mudgeeraba to Terranora transmission lines to ensure ongoing compliance with its Transmission Authority reliability obligations. It also allows Powerlink to continue to leverage the interconnector as a source of support for the Gold Coast area or to allow for market benefits during export opportunities.

This strategy is aligned with Joint Planning discussions with Essential Energy.

4. Network Risk

The loss of a single Mudgeeraba to Terranora 110kV transmission line, Directlink will be constrained to ensure that the remaining feeder is within limits. If the remaining circuit is lost, the Directlink HVDC interconnector would also trip as the HVDC system requires AC supply at both ends to operate. There is little to no transfer capability to transfer load off Terranora (~1MVA).

Thus, it is assumed that scenarios causing the loss of supply from Mudgeeraba to Terranora that the load of Terranora will be shed.

Table 1 presents the load at risk, as well as the energy at risk for the local 33kV Terranora load.

Table 1. Terranora 33kV Load at Risk

At Risk	Contingency	Metric	2028
Terranora 33kV	Both Mudgeeraba to Terranora Feeders (758, 757)	Max (MW)	109
		Average (MW)	30
		24h Energy Unserved Max (MWh)	1489
		24h Energy Unserved Average (MWh)	719

5. Market Impact

The Directlink HVDC system connects Bungalora to Mullumbimby in Northern NSW (refer to Figure 5). Bungalora connects to Terranora at 110kV. The HVDC system requires an AC supply at both ends to operate. As a result, a double circuit outage between Mudgeeraba and Terranora results in the HVDC system being out of service. The outage of the HVDC reduces the overall power transfer capability between Queensland and NSW. To the extent that there is headroom on the AC interconnector (QNI), operationally this lost capacity can the picked up across QNI. However, this will not always be the case and as such there will be times when the market will be constrained.

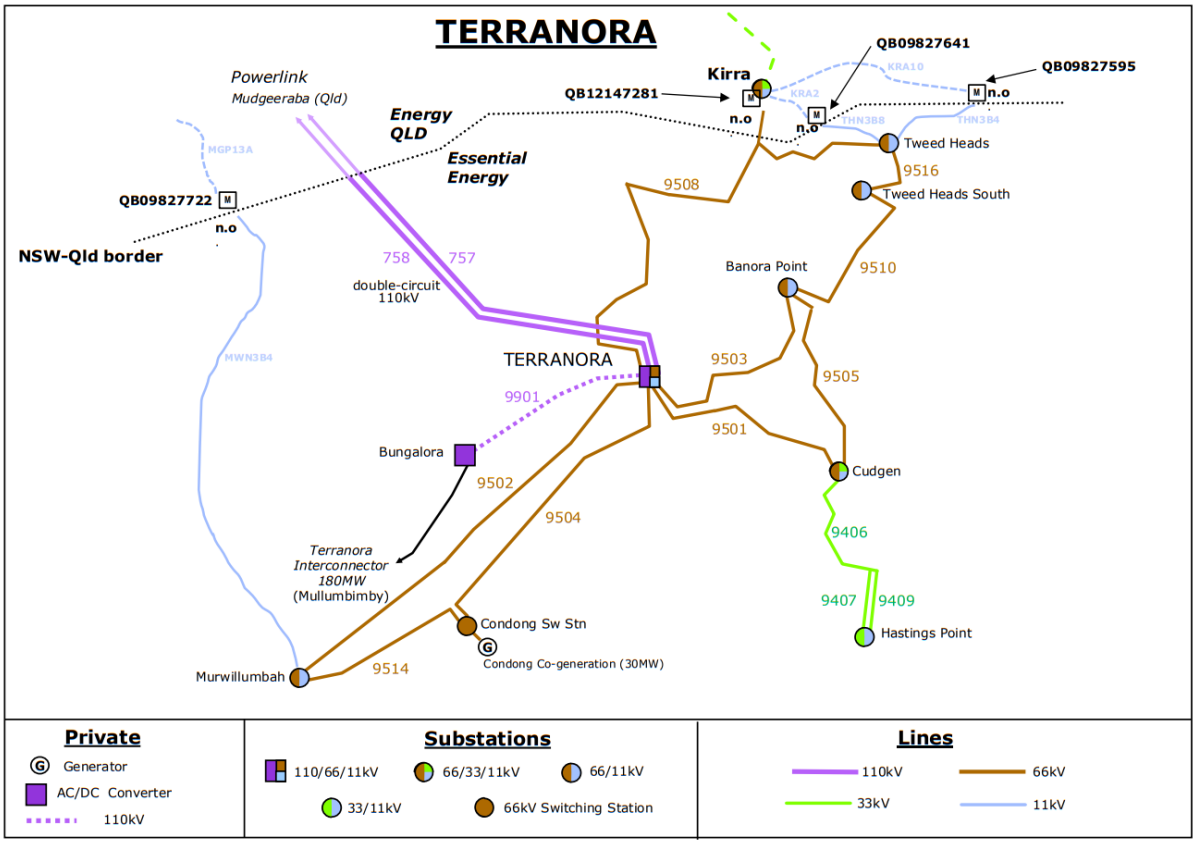


Figure 5. Northern NSW network

Table 2 defines the maximum and average difference in total system costs (including emission reduction benefits) per 24-hour period with the HVDC system removed from service. The analysis assumes that there is not impact on the generation investment pathway as a result of this outage.

The methodology used to assess these market impacts is outlined in Appendix A.

Table 1. Market impact of removing Barron Gorge Hydro Power Station from service

At Risk	Contingency	Metric	$M
Loss of Directlink HVDC system	110kV Feeders into Terranora (757 & 758)[1]	Max 24h incremental system cost ($m)	1.883
		Average 24h incremental system cost ($m)	0.173

6. Non-Network Options

Potential non-network solutions for the 110kV Transmission Lines would need to provide generation output up to a maximum of 109 MW and 1489 MWh of energy each day. Essentially, the non-network solution must be capable of supplying the local load at Terranora substation.

7. Network Options

1. Proposed Option to address the identified need

Details of the condition assessment for the Mudgeeraba to Terranora 110kV double circuit line Substation and recommended replacement timing can be found in Reference 1.

To address the emerging condition issues of the Mudgeeraba to Terranora 110kV line it is recommended that the required structures are refit.

This recommendation is aligned with Essential Energy's plan to refits their assets into Terranora. Combined, this ensures that Powerlink's Transmission Authority reliability standard is maintained as well as maintaining the power transfer capability into and out of the southern Gold Coast area via Directlink HVDC interconnector.

The proposed network solution will not have any material inter-network impact, and as such does not need to formally consult with other Market Participants.

8. Option Considered but Not Proposed

This section discusses alternative options that Powerlink has investigated but does not consider technically and/or economically feasible to address the above identified issues and thus are not considered credible options.

[1] For the outage of 110kV double circuit between Mudgeeraba and Terranora, the Directlink HVDC system would also trip as the HVDC system requires AC supply at both ends to operate. There is little to no transfer capability to transfer load off Terranora (~1MVA).

9. Do Nothing

“Do Nothing” would not be an acceptable option as the primary drivers (primary system condition) and associated safety, reliability and compliance risks would not be addressed.

Furthermore, the “Do Nothing” option would not be consistent with good industry practice and would result in Powerlink breaching their obligations with the requirements of the System Standards of the National Electricity Rules and its Transmission Authority.

10. Rebuild the 110kV line

The existing double circuit line occupies a double width easement for approximately 7.5 km south of Mudgeeraba. This area traverses areas of residential development. From here to the border (6km) is only a single width (40m) easement. Although development along this section of the corridor is more sparse, there are still areas where development has occurred up to the easement boundary.

At best a parallel double circuit 110kV line could be constructed for approximately 7.5km south of Mudgeeraba on the spare easement width, with an undertaking to the impacted community that the old line would be recovered. Even this is likely to receive opposition as the new line will be closer to more residential properties. A new easement (and/or easement widening) would then need to be acquired from tower (STR-1719) to the Queensland border. This traverses small acreage and lifestyle properties, through environmentally sensitive, rugged and valued land. Current access tracks are often remote from the towers being serviced, consistent with the challenging terrain. It is even questionable that these could support the required tonnage to construct a new line compliant with the current standards.

Therefore, rebuilding this line risks being forced underground for significant sections of this line.

Therefore, the strategy of refitting and extending the life of this line defers this very difficult project and is considered efficient and economic.

An alternate delivery strategy would be to dismantle the existing line and rebuild on the same alignment. Pre-requisites for this include funding the owners of Directlink to retrofit the capability for Directlink to supply into an islanded system (Terranora). The capability of Directlink is 180MW. However, the operation of Directlink has been impacted by reliability issues. This may impact the ability to supply the Terranora load under outage conditions. Notwithstanding the capability and reliability of Directlink, the northern NSW network (into Lismore and between Lismore and Mullumbimby) also has insufficient capacity to always supply the Terranora load.

These issues will be explored more fully with Essential Energy through joint planning at the time of the investment decision.

11. Recommendations

Powerlink has assessed the condition of the Mudgeeraba to Terranora 110kV line and concludes that reinvestment is required for Powerlink to continue to meet its reliability of supply obligations and maintain power transfer capability between the Gold Coast and northern NSW via Directlink HVDC interconnector.

It is recommended that the lines are refurbished.

12. References

1. CP.03196 BS1009 Mudgeeraba to Terranora Refit - Project Scope Report (Revenue Reset Purposes Only)
2. 2025 Transmission Annual Planning Report (A6049612)
3. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
4. Powerlink Queensland’s Transmission Authority T01/98

13. Appendix A – Market Impact Assessment

Market modelling was used to assess the operational market impact of network limitations that would result from an outage of the double circuit line between Mudgeeraba and Terranora substations.

The market modelling approach is consistent with the regulatory investment test for transmission requirements that a market benefit "must be a benefit to those who consume, produce and/or transport electricity in the market, that is, the change in producer plus consumer surplus." Critically, a market benefit must not "include the transfer of surplus between consumers and producers".[2]

As such, the market impact is assessed by comparing the changes in costs for market participants due to the differences in the operational and maintenance costs (including fuel costs), changes in involuntary load shedding (at the value of customer reliability [VCR] [3]), and changes in greenhouse gas emissions (at the value of emissions reduction [VER] [4])

The market modelling simulations considered committed and anticipated generators were commissioned on time, coal units closed according to their announced dates (as of December 2025), and modelled generation and storage projects consistent with the Queensland Energy Roadmap 2025.[5] The profiles of demand and energy available for variable energy resources followed the 2015 weather reference year as published by AEMO, as being a year found to result in 'median' outcomes.

A schedule of generator planned outages was modelled. However, generator forced outages were not considered. Instead, a reserve requirement is maintained via a reserve constraint equation, and therefore unserved energy may be underestimated in some circumstances.

Appropriate network detail (in the form of network constraints or sub-regional transfer limits) was added to adequately represent the network capability across major grid sections.

The outage (e.g. the loss of Directlink HVDC system) was modelled as occurring in perpetuity to approximately capture the effect of this occurring at any time.

The market impact was then quantified as the differential total system cost (as above) for each hour between a base case with Directlink HVDC available against the state of the world with an outage of Directlink HVDC. Both the hourly and a moving 24-hour differential cost were determined.

The values in the report tables capture the maximum differential total system cost for any 24-hour period (averaged over the 5-year analysis period) and the average differential total system cost for a 24-hour period (over the 5-year analysis period).

[2] AER, November 2024, "Regulatory investment test for transmission", p4

[3] AER, December 2024, "Values of customer reliability: Final report on VCR values" available at

[4] AER, May 2024, "Valuing emissions reduction: AER guidance and explanatory statement"

[5] The State of Queensland (Queensland Treasury), October 2025, "Energy Roadmap"

Project Scope Report

CP.03196

BS1009 Mudgeeraba to Terranora Refit

Concept – Version 1

Document Control

Change Record

Issue Date	Revision	Prepared by	Reviewed by	Approved by	Background
20/06/25	1	[redacted]	[redacted]	[redacted]	Initial issue

Related Documents

Issue Date	Responsible Person	Objective Document Name
04/06/2024	[redacted]	Project Initiation Form - BS1009 (Mudgeeraba - Terranora) Refit (A5624458)
5/11/2015	[redacted]	BS1009 Mudgeeraba to Terranora Condition Assessment Report 2015 (A2445602)

Document Purpose

The purpose of this Project Scope Report is to define the business (functional) requirements that the project is intended to deliver. These functional requirements are subject to Powerlink's design and construction standards and prevailing asset strategies, which will be detailed in documentation produced during the detailed scoping and estimating undertaken by DTS (or OSD), i.e. it is not intended for this document to provide a detailed scope of works that is directly suitable for estimating.

Project Contacts

Project Sponsor	[redacted]
Connection & Development Manager	[redacted]
Strategist – Lines Asset Strategies	[redacted]o
Planner – Main/Regional Grid	[redacted]
Manager Projects	[redacted]
Project Manager	TBA
Design Manager	TBA

Project Details

1. Project Need & Objective

Built section 1009 (Feeders 757 and 758) is a double circuit 110kV line that was commissioned in 1976 under Project 73/22. The line consists of 58 structures, with the ownership of the asset split between Powerlink and Essential Energy. Powerlink maintains the feeders from Mudgeeraba substation up to and including structure 1731 along a 13.5km corridor, comprising of 18 tension and 14 suspension structures.

This transmission line (BS1009) is nearing 50 years of age and operates in a coastal environment with elevated sections of the line exposed to marine pollutants. Earlier condition assessments in 2015 referred to isolated occurrences of G3 corrosion throughout the built section, although recent inspections have shown an increase in G3 and the emergence of G4 corrosion.

The objective of this project is to carry out targeted refit works to extend the service life of BS1009 by an additional 15 years, with completion targeted by 30th June 2028.

This project will follow the two (2) stage approval process.

2. Project Drawing

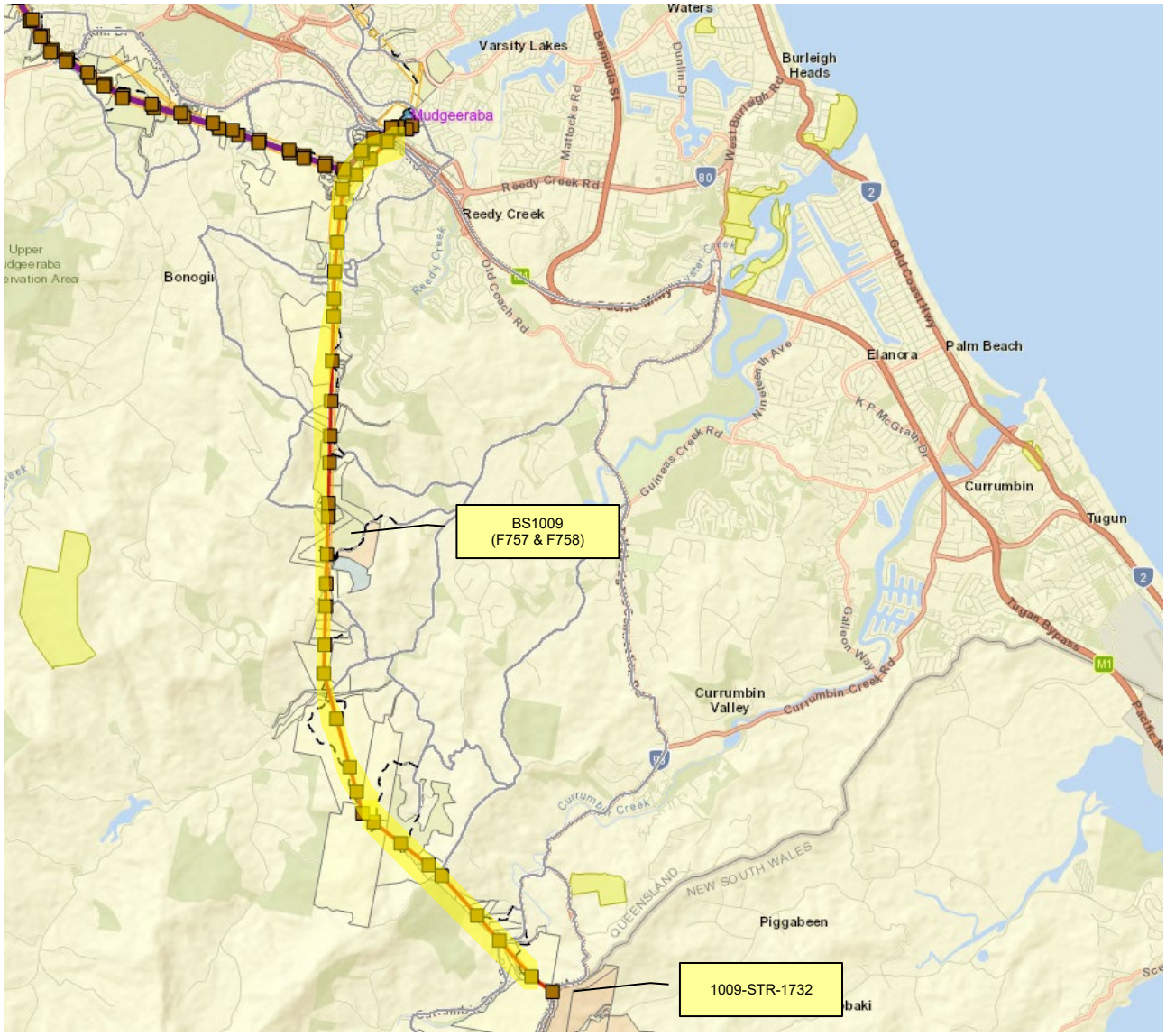


Figure 1: Geographical Location

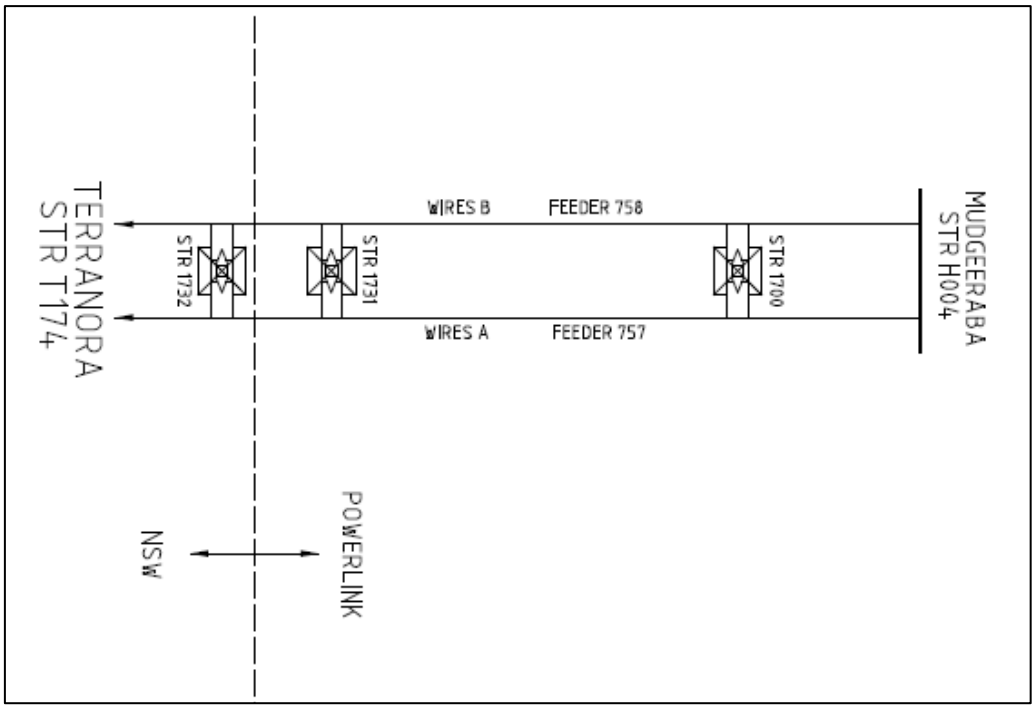


Figure 2: Feeders 757 and 758 Phasing Diagram – Powerlink & Essential Energy Asset Boundary

3. Deliverables

The following deliverables are to be provided in response to this Project Scope Report. The requirement dates for these deliverables will be communicated separately.

This project will follow the two stage approval process. The following deliverables are to be provided:

1. A report (e.g. Concept Estimate Report) detailing the works to be delivered, high level staging, resource requirements and availability, and outage requirements and constraints for each option.

2. A class 5 estimate (minimum) for each option.

3. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks for each option.

4. Project Scope

The following scope presents a functional overview of the desired outcomes of the project. The proposed solution presented in the estimate must be developed with reference to the remaining sections of this Project Scope Report, in particular *Section 7 Special Considerations*.

Briefly, the project consists of undertaking selective refit works to extend the service life of BS1009 for a further 15 years.

Two credible options have been identified to refit BS1009, as presented in Table 1 below. These options will be presented in the RIT-T public consultation. Concept estimates are required for each option to inform feasibility and cost assessments.

Table 1 – Options summary

Option	Stage	Works	Comm. Date
1	1	Refit all G3 or G4 fasteners and members, climbing attachments, foundation repairs, and upgrades to anti-climb barriers, signage, and structure earthing. Replacement of all remaining insulators and G3 or G4 insulator hardware that are original to the line.	June 2028
2	1	Replacement of all remaining insulators and G3 or G4 insulator hardware that are original to the line and climbing attachments to enable safe refit works. For structures with a Health Index of 8 or higher, undertake refit of all G3 or G4 fasteners and members, foundation repairs and upgrades to anti-climb barriers and structure earthing. The refit of the remaining structures will be deferred until their respective Health Index reaches 8 in future regulatory periods, in line with the Asset Reinvestment Review.	June 2028
	2*	For structures with a Health Index of 8 or higher, undertake refit of all G3 or G4 fasteners and members, foundation repairs and upgrades to anti-climb barriers and structure earthing. **Note: Stage 2 will be carried out under a separate project in the subsequent regulatory period. However, estimation of both stages are required to enable economic assessments to determine the preferred option*	June 2033

4.1. Option 1 - Refit BS1009 by 2028

4.1.1. Transmission Line Works

Undertake transmission line works on built section BS1009 as follows:

- Perform a full LAMP and condition assessment of all structures to inform scope and provide measuring point data for input into SAP;
- Upgrade climbing attachments to current standard;
- Replace all remaining original insulators including original hardware exhibiting G3 corrosion and above. For estimation purposes assume 222 x 125kN Porcelain Fog strings (refer Attachment 2);

- Replace tower members and fasteners with G3 corrosion and above. For estimation purposes assume an average of approximately 30% of fasteners and 1% of members on 31 of the 33 structures;
- Repair foundation interfaces of affected structures where required (assume 5%);
- Measure structure footing resistance of affected structures and upgrade where required (assume 10%);
- Repair/replace anticlimbing barriers of affected structures where required (assume 10%); and
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

4.2. Option 2 – Staged Refit BS1009

4.2.1. Transmission Line Works

Undertake staged transmission line refit works on built section BS1009 as follows:

Stage 1 by 2028

- Perform a full LAMP and condition assessment of all structures to inform scope and provide measuring point data for input into SAP;
- Upgrade climbing attachments to current standard;
- Replace all remaining original insulators including original hardware exhibiting G3 corrosion and above. For estimation purposes assume 222 x 125kN Porcelain Fog strings (refer Attachment 2);

For structures with a Health Index of 8 or higher:

- Replace tower members and fasteners with G3 corrosion and above. For estimation purposes assume an average of approximately 45% of fasteners and 1% of members on 15 of the 33 structures;
- Repair foundation interfaces of affected structures where required (assume 5%);
- Measure structure footing resistance of affected structures and upgrade where required (assume 10%);
- Repair/replace anticlimbing barriers of affected structures where required (assume 10%); and
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

Stage 2 by 2033 (Refer Special Considerations)

For structures with a Health Index of 8 or higher:

- Replace tower members and fasteners with G3 corrosion and above. For estimation purposes assume an average of approximately 45% of fasteners and 1% of members on 13 of the 33 structures;
- Repair foundation interfaces of affected structures where required (assume 5%);
- Measure structure footing resistance of affected structures and upgrade where required (assume 10%);
- Repair/replace anticlimbing barriers of affected structures where required (assume 10%);
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

4.2.2. Substation Works

Not Applicable

4.2.3. Telecoms Works

Not applicable

4.2.4. Easement/Land Acquisition & Permits Works

The transmission line is on existing Powerlink easements. Site access shall be reviewed for project work and include:

- Review of easement term and conditions to confirm the works to be undertaken can be completed under the easement conditions;
- Undertaking a desktop review to identify any sites of cultural heritage significance; and
- Securing any additional approvals or permits required to complete the project.

4.3. Key Scope Assumptions

The following assumptions should be included in the estimating of this scope:

- Nominal replacement quantities have been assumed for estimating purposes.

4.4. Variations to Scope (post project approval)

Not applicable

5. Key Asset Risks

Asset risk management shall be in accordance with the Asset Risk Management Process Guideline (A4870713).

6. Project Timing

6.1. Approval Date

The anticipated date by which the project will be approved is 31 December 2026.

6.2. Site Access Date

Access is available immediately.

6.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope is 30 June 2028.

7. Special Considerations

- The K-braces on many of the BS1009 structures are painted with an asbestos containing paint;
- While Option 2's Stage 2 refit works will be completed under a separate project within the regulatory period 2033 to 2037, an estimate is required for the purposes of an economic analysis to determine the most economical and efficient option.

8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

The Project Sponsor must be included in any discussions with any other areas of Network and Business Development including Asset Strategies & Planning.

Jay Tencate will provide the primary customer interface with Essential Energy. The Project Sponsor should be kept informed of any discussions with the customer.

9. Asset Ownership

The works detailed in this project will be Powerlink Queensland assets.

The asset boundary with Essential Energy is at structure 1732 (Structure 1732 is owned by Essential Energy). Powerlink is responsible for the feeders extending from Mudgeeraba Substation up to and including structure 1731, covering a 13.5 km corridor consisting of 18 tension structures and 14 suspension structures.

10. System Operation Issues

Operational issues that should be considered as part of the scope and estimate include:

- interaction of project outage plan with other outage requirements;
- likely impact of project outages upon grid support arrangements; and

- likely impact of project outages upon the optical fibre network.

11. Options

Not applicable

12. Division of Responsibilities

Not applicable

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
Other Related Projects			

Attachment 1: List of Structure Locations for Condition Assessment and Refit

The Project Sponsor shall be advised if any issue with data is detected so that the scope can be corrected, and the information updated.

FUNCTIONAL LOCATION	DESCRIPTION
1009-STR-1700	STRUCTURE D1T70+10
1009-STR-1702	STRUCTURE D1T20-10
1009-STR-1703	STRUCTURE D1S2+10
1009-STR-1704	STRUCTURE D1T50+10
1009-STR-1705	STRUCTURE D1T20+10
1009-STR-1706	STRUCTURE D1S2-0
1009-STR-1707	STRUCTURE D1T20+20
1009-STR-1708	STRUCTURE D1S2-10
1009-STR-1709	STRUCTURE D1S2-0
1009-STR-1710	STRUCTURE D1S2-0
1009-STR-1711	STRUCTURE D1S2+10
1009-STR-1712	STRUCTURE D1T20-10
1009-STR-1713	STRUCTURE D1T20-10
1009-STR-1714	STRUCTURE D1S2-10
1009-STR-1715	STRUCTURE D1S2+10
1009-STR-1716	STRUCTURE D1S2+40
1009-STR-1717	STRUCTURE D1T20-20
1009-STR-1718	STRUCTURE D1S2-10
1009-STR-1719	STRUCTURE D1T20-20
1009-STR-1720	STRUCTURE D1T20-10
1009-STR-1721	STRUCTURE D1T20+10
1009-STR-1722	STRUCTURE D1T20+20
1009-STR-1723	STRUCTURE D1S2+40
1009-STR-1724	STRUCTURE D1T50-0
1009-STR-1725	STRUCTURE D1S2-0
1009-STR-1726	STRUCTURE D1T20-20
1009-STR-1727	STRUCTURE D1S2+40
1009-STR-1728	STRUCTURE D1T20+30
1009-STR-1729	STRUCTURE D1T20-20
1009-STR-1730	STRUCTURE D1S2-20
1009-STR-1731	STRUCTURE D1T20-0
1009-STR-2701	STRUCTURE D2T40+3
1009-STR-H004	STRUCTURE MUDGEERABA

Attachment 2: List of Functional Locations for Insulator Replacement

List is based on BOM3 extract. The Project Sponsor shall be advised if any issue with data is detected so that the scope can be corrected, and the information updated.

FUNLOC	DESCRIPTION	INSTALLED	NO OF DISCS	QTY
1009-STR-1708-INSSUS_A	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1708-INSSUS_B	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1709-INSSUS_A	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1709-INSSUS_B	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1716-INSSUS_A	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1716-INSSUS_B	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1723-INSSUS_A	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1723-INSSUS_B	NGK PORCELAIN FOG DISC 125kN SUSPENSION	1973	9	3
1009-STR-1702-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1702-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1704-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1704-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1705-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1705-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1707-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1707-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1712-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1712-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1713-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1713-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1717-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1717-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1720-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1720-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1721-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1721-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1722-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1722-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1724-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1724-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1726-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1726-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1728-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1728-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1729-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1729-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1731-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1731-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6

1009-STR-1732-INSTEN_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-1732-INSTEN_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	6
1009-STR-H004-INSBEA_A	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	3
1009-STR-H004-INSBEA_B	NGK PORCELAIN FOG DISC 125kN TENSION	1975	10	3
			TOTAL	**222**

CP.03196 BS1009 Mudgeeraba to Terranora Refit

Concept Estimate

Table of Contents

1. Executive Summary

This Concept Estimate document is based on the CP.03196 BS1009 Mudgeeraba to STR-1731 Refit Reinvestment Project Scope Report (PSR).

Built section (BS) 1009 (Feeders 757 and 758) is a double circuit 110kV line that was commissioned in 1976. The line consists of 58 structures, with the ownership of the asset split between Powerlink and Essential Energy. Powerlink maintains the feeders from Mudgeeraba substation up to and including structure 1731 along a 13.5km corridor, comprising of 18 tension and 14 suspension structures.

This transmission line (BS1009) is nearing 50 years of age and operates in a coastal environment with elevated sections of the line exposed to marine pollutants. Earlier condition assessments in 2015 referred to isolated occurrences of G3 corrosion throughout the built section, although recent inspections have shown an increase in G3 and the emergence of G4 corrosion.

Two credible options have been identified for refitting BS1009 as below:

Option	Stage	Works
1	1	Refit all G3 or G4 fasteners and members, climbing attachments, foundation repairs, and upgrades to anti-climb barriers, signage, and structure earthing. Replacement of all remaining insulators and G3 or G4 insulator hardware that are original to the line.
2	1	Replacement of all remaining insulators and G3 or G4 insulator hardware that are original to the line and climbing attachments to enable safe refit works. For structures with a Health Index of 8 or higher, undertake refit of all G3 or G4 fasteners and members, foundation repairs and upgrades to anti-climb barriers and structure earthing. The refit of the remaining structures will be deferred until their respective Health Index reaches 8 in future regulatory periods, in line with the Asset Reinvestment Review.
	2	For structures with a Health Index of 8 or higher, undertake refit of all G3 or G4 fasteners and members, foundation repairs and upgrades to anti-climb barriers and structure earthing.

The objective of this project is to carry out targeted refit works to extend the service life of BS1009 by 15 years.

The assessment in this proposal has established that the project can be delivered by October 2028 for Option 1 and July 2033 for Option 2.

The project will follow the two (2) stage approval process.

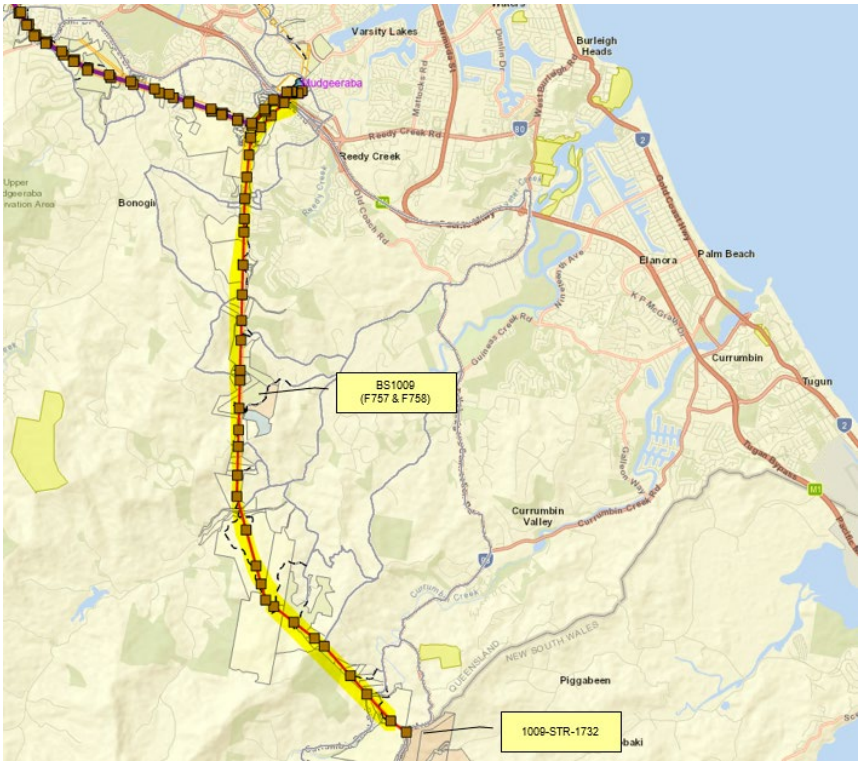


Figure 1: BS1009 Transmission Line Overview

1.1 Project Estimate

No escalation costs have been considered in this estimate.

1.1.1 Option 1 – Single Stage Refit BS1009

		Total ($)
Estimate Class	5	
Base Estimate – Un-Escalated (2025/2026)		9,669,525
TOTAL		**9,669,525**

1.1.2 Option 1 - Project Financial Year Cash Flows

DTS Cash Flow Table	Un-Escalated Cost ($)
To June 2026	228,528
To June 2027	447,180
To June 2028	1,090,459
To June 2029	7,881,818
To June 2030	21,540
TOTAL	**9,669,525**

1.1.3 Option 2 – Staged Refit BS1009

		Total ($)
Estimate Class	5	
Stage 1 Base Estimate – Un-Escalated (2025/2026)		6,492,244
Stage 2 Base Estimate – Un-Escalated (2025/2026)		4,525,821
TOTAL		**11,018,065**

1.1.4 Option 2 - Project Financial Year Cash Flows

DTS Cash Flow Table	Un-Escalated Cost ($)
To June 2026	52,856
To June 2027	211,424
To June 2028	1,019,854
To June 2029	5,208,110
To June 2030	0
To June 2031	0
To June 2032	0
To June 2033	4,301,195
To June 2034	224,625
TOTAL	**11,018,065**

2. Project and Site-Specific Information

2.1 Project Dependencies & Interactions

This project is potentially interacting with the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Other Related Projects			
CP.02729	H004 Mudgeeraba 110kV secondary system replacement	Dec 2029	May impact project outages

2.2 Site Specific Issues

Issues specific to the project are as follow:

- The project site is located in Gold Coast. The 15km built section passes through suburbs and rural properties.
- The built section crosses the Pacific Motorway. The Department of Transportation and Main Road (DTMR) permit for land closure is required prior to insulator replacement works.
- The site is likely subject to seasonal wet weathers, generally December to March each year.
- The K-braces on many of the BS1009 structures are painted with an asbestos containing paint.
- Cultural Heritage areas identified between 1009-STR-1709 and 1009-STR-1707. A Powerlink Cultural Heritage officer shall be consulted for ground disturbance or vegetation management works.
- The project site is an existing asset and will be subject to the standard maintenance-oriented conditions and controls i.e. weed wash downs, property access notifications.
- The Mudgeeraba area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule.

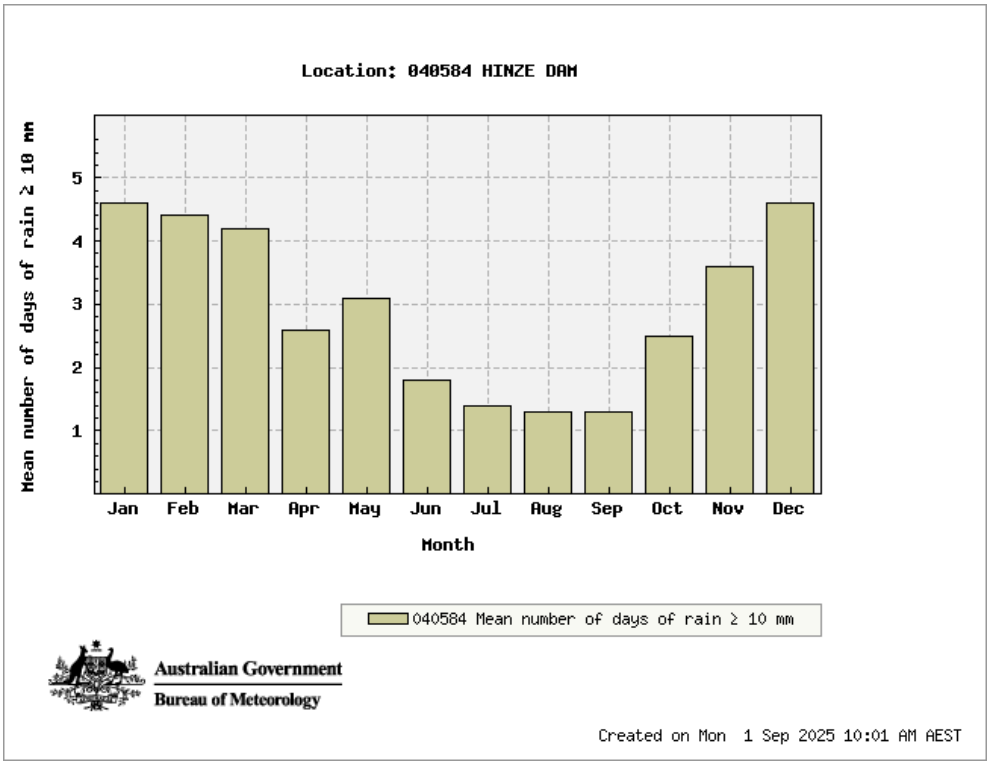


Figure 2: Number of Days of Rain >=10mm (Source: Bureau of Meteorology 1st of September 2025)

3. Project Scope

The project scope involves transmission line refit works to the 32 structures on Built Section 1009, 110kV double circuit line between Mudgeeraba Substation and Structure 1009-STR-1731 along a 13.5 km corridor. The scope will also involve aspects of vegetation management, access track repair, biosecurity management, cultural heritage assessment, landholder relations, to enable the required refit works.

3.1 Major Scope Assumptions

The following assumptions should be included in the estimating of this scope:

- No substantial new clearing or significant new access works required.
- Maintenance Service Provide (MSP) resources and Powerlink FAM (Field & Asset Management) will undertake the core works.
- Line refit scope will be performed by a Line Refit Contractor.
- Suitable outages will be available during non-peak load periods i.e. April to December.
- Access to site will be available at project approval.
- Each structure is assumed to have 200 step bolts, 325 members, and 1100 fasteners on average.
- Any existing paints on structures other than on the K-braces are free of any hazardous materials i.e. lead, asbestos, etc.
- Biosecurity issues could occur during delivery i.e. weeds.

3.2 Scope Exclusions

The below is excluded from the scope of works:

- Restricted Access Zone (RAZ) considerations at H004 Mudgeeraba substation.
- Any damage caused to extreme weather events i.e. cyclone, major floods, or major bushfire.
- Logistical issues due to geopolitical tension/conflicts.

3.3 Easement/Land Acquisition & Permit Works

The transmission line is on existing Powerlink easements. Site access shall be reviewed for project work and include:

- Review of easement term and conditions to confirm the works to be undertaken can be completed under the easement conditions.
- Undertake a desktop review to identify if the environmental permit is current.
- Undertake a desktop review to identify any sites of cultural heritage significance.
- Securing any additional approvals or permits required to complete the project.

Estimated cost of the above activities including Environmental Compliance, Safety Compliance, SAHVEA (Safe Access to High Voltage Electrical Apparatus) training and compliance have been included in the project cost estimate.

3.4 Option 1 – Single Stage Refit BS1009

The following works have been costed for in the estimate.

3.4.1 Transmission Line Works

Undertake transmission line refit works on Built Section 1009 as follows:

- Perform a full Line Asset Measuring Points (LAMP) and condition assessment of all structures to inform scope and provide measuring point data for input into SAP.
- Upgrade climbing attachments to current standard (30% or 1860 step bolts and all fall arrest brackets or 6200 fall arrest brackets).
- Replace all remaining original insulators including original hardware exhibiting G3 corrosion and above (222 x 125kN Porcelain Fog strings).
- Replace tower members and fasteners with G3 corrosion and above (30% or 10230 fasteners and 1% or 101 members).
- Repair foundation interfaces of affected structures (5% or 4 foundations).
- Measure structure footing resistance of affected structures and upgrade (10% or 4 structures).
- Repair/replace anticlimbing barriers of affected structures (10% or 4 structures).
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

3.5 Option 2 – Staged Refit BS1009

The following works have been costed for in this estimate. 15 structures in Stage 1 and 13 structures in Stage 2.

3.5.1 Transmission Line Works

Undertake the transmission line refit works on Built Section 1009 as follow:

Stage 1 (15 structures) by 2028 as Project 1

- Perform a full LAMP and condition assessment of all structures to inform scope and provide measuring point data for input into SAP.
- Upgrade climbing attachments to current standard (45% or 1350 step bolts and all fall arrest brackets or 3000 fall arrest brackets).
- Replace all remaining original insulators including original hardware exhibiting G3 corrosion and above (222 x 125kN Porcelain Fog strings).

For structures with a Health Index of 8 or higher:

- Replace tower members and fasteners with G3 corrosion and above (45% or 7425 fasteners and 1% or 49 members).
- Repair foundation interfaces of affected structures (5% or 2 foundations).
- Measure structure footing resistance of affected structures and upgrade (10% or 2 structures).
- Repair/replace anticlimbing barriers of affected structures (10% or 2 structures).
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

Stage 2 (13 structures) by 2033 as Project 2:

For structures with a Health Index of 8 or higher:

- Replace tower members and fasteners with G3 corrosion and above (45% or 6435 fasteners and 1% or 42 members).
- Repair foundation interfaces of affected structures (5% or 2 structures).
- Measure structure footing resistance of affected structures and upgrade (10% or 2 structures).
- Repair/replace anticlimbing barriers of affected structures (10% or 2 structures).
- Perform a LAMP and condition assessment of all affected structures on completion of works and provide measuring point data for input into SAP.

4. Project Execution

4.1 Project Schedule

Project schedule for Option 1.

4.1.1 Option 1 – Single Stage Refit BS1009

This project will follow the two (2) stage approval process.

A high-level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Undertake Condition Assessment	June 2026 – July 2026
Request for Class 3 Estimate	December 2026
Class 3 Project Proposal Submission	June 2027
RIT-T (assumed 9 months)	June 2027 - February 2028
ITT Submission (8 Weeks)	Jan 2028 – March 2028
Evaluate Tender, Reconcile Estimate and Submit PMP for Stage 2 Approval	March 2028 – April 2028
Stage 2 Approval (PAN2)	May 2028
Execute Delivery (including award of the contract)	July 2028
Refit Contractor Works	July 2028 – October 2028
MSP Works	July 2028 – September 2028
Project Commissioned	October 2028

4.1.2 Option 2 – Staged Refit BS1009

This project will follow the two (2) stage approval process.

A high-level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Undertake Condition Assessment	June 2026 – July 2026
Request for Class 3 Estimate	December 2026
Class 3 Project Proposal Submission	June 2027
RIT-T (assumed 9 months)	June 2027 - February 2028
ITT Submission (8 Weeks)	Jan 2028 – March 2028
Evaluate Tender, Reconcile Estimate and Submit PMP for Stage 2 Approval	March 2028 – April 2028
Stage 2 Approval (PAN2)	May 2028
Execute Delivery (including award of the contract)	July 2028
Refit Contractor Works – Stage 1 Project	August 2028 – November 2028
MSP Works	July 2028 – October 2028
Refit Contractor Works – Stage 2 Project	April 2033 – July 2033
Project Commissioned	July 2033

4.2 Network Impacts

These works will require suitable outages to allow the works to be undertaken. The known network constraint for Feeder 757 and Feeder 758 is not to arrange outages during summer. This overlaps with the wet season stand down period. Works and outages are planned for mid-April – early December.

4.3 Project Staging

Stage	Description/Tasks
1	Climbing and aerial inspection of BS1009 by a Line Refit Contractor or MSP
2	Line refit works by a Line Refit Contractor
3	Insulator replacement by MSP

4.4 Resourcing

Design for the project will be completed by internal design resources with support from external design partners. The construction works will be completed by a combination of the Maintenance Service Providers and Substation Panel contractors.

5. Project Asset Classification

5.1 Option 1 – Singel Stage Refit BS1009

Asset Class	Base ($)	Base (%)
Substation Primary Plant	-	0
Substation Secondary Systems	-	0
Telecommunications	-	0
Overhead Transmission Line	9,669,525	100
TOTAL	**9,669,525**	**100**

5.2 Option 2 – Staged Refit BS1009

Asset Class	Base ($)	Base (%)
Substation Primary Plant	-	0
Substation Secondary Systems	-	0
Telecommunications	-	0
Overhead Transmission Line	11,018,065	100
TOTAL	**11,018,065**	**100**

6. References

Document name and hyperlink	Version	Date
Project Scope Report	1.0	20 June 2025

Risk Cost Summary Report

CP.03196

BS1009 Mudgeeraba to Terranora Refit

Document Control

Change Record

Issue Date	Revision	Prepared by
19/01/2026	1.0	Asset Strategies

Related Documents

Issue Date	Responsible Person	Objective Document Name

Document Purpose

The purpose of this model is to quantify the base case and option risk cost profiles for the structures on the Mudgeeraba to Terranora 110kV transmission line (BS1009), which is proposed for a refit under CP.03196. These risk cost profiles are then included as part of an overall cost-benefit analysis (CBA) to understand the economic benefit of the proposed upgrades. This process provides a benchmarking and internal gate process to support Powerlink in effectively identifying prioritised infrastructure upgrades.

The CBA was designed to demonstrate and quantify the value to be gained through specific infrastructure investment. To evaluate the CBA, an NPV is derived based on the present values of costs and benefits. The flow chart in Figure 4 below designates the methodology used in designing the CBA process.

Key Assumptions

In calculating the risk cost arising from a failure of the ageing structures and associated insulators and hardware on the Mudgeeraba – Terranora line , the following modelling assumptions have been made:

- The capability of the structures to perform their function is assumed to decay according to decay curves calculated by Powerlink, and associated probability of failure (PoF).
- The health of structures with no condition data has been imputed from the known condition of nearby structures.
- Where structures in scope are refit, post project the structure's Health Index (HI) reverts to a HI such to meet a 15-year life extension beyond the original economic life.
- For the purposes of the cost-benefit analysis, the refit will extend the service life of BS1009 by a further 15 years.
- A feeder-specific value of customer reliability (VCR) of $25,056/MWh has been applied when calculating network risks.
- The consequence of bushfire risk was modelled by the FLARE Wildfire Research Group at The University of Melbourne as part of Project IGNIS.

Base Case Risk Analysis

Risk Categories

Four main categories of risk are assessed as part of this project as consistent with Powerlink's Asset Risk Management Framework:

- Financial Risk
- Safety Risk
- Network Risk (including market impact if applicable)
- Environmental / Bushfire

Risk Category	Failure Types	Equipment in scope
Safety Risk	Structural / Mechanical/ failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Financial Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Network Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Environmental Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Bushfire Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically

Table 1: Risk Categories

Base Case Risk Cost

The modelled and extrapolated total base case risk costs are shown in Figures 1 and 2 below.

Risk costs associated with the equipment in scope are expected to increase from $0.16 million in 2026 to $4.4 million by the end of the 2027-32 regulatory period. Key highlights of the analysis include:

- Network risk constitutes a significant portion of the base case risk, primarily because the towers serve as a single point of failure for both Mudgeeraba to Terranora Feeders.
- Financial risk accounts for approximately 6% of the total risk and is primarily driven by the emergency restoration costs associated with the failure of structures, insulators or associated hardware.
- Bushfire risk has been calculated and is immaterial to the overall base case risk.

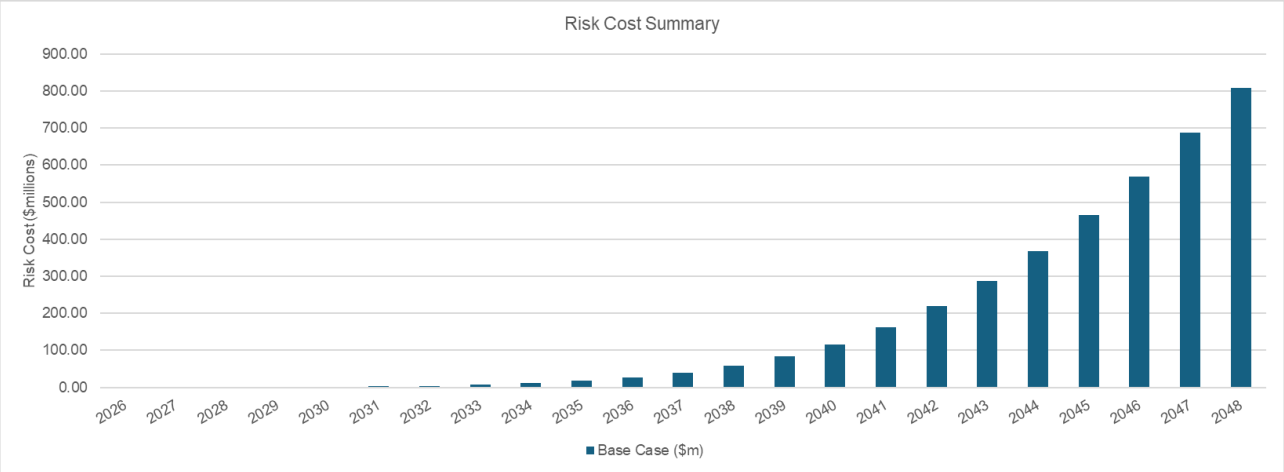


Figure 1: Total Risk Cost

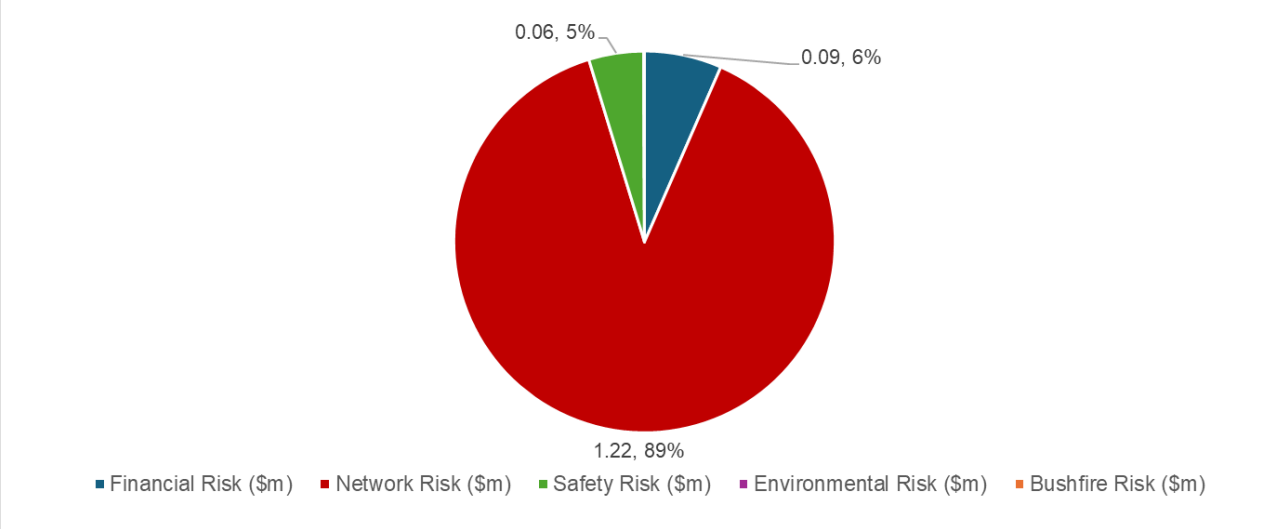


Figure 2: Base Case Risk Cost Contributions (2030)

Option Risk Cost

For modelling purposes, the refit of structures on BS1009 Mudgeeraba – Terranora transmission line reduces effective HI scores to 5.3, lowering its probability of failure and therefore risk cost. For the transmission line refit activities, a life extension of 15 years has been considered in the model.

The figures below set out the total project case risk cost, and associated risk cost savings incremental to the base case.

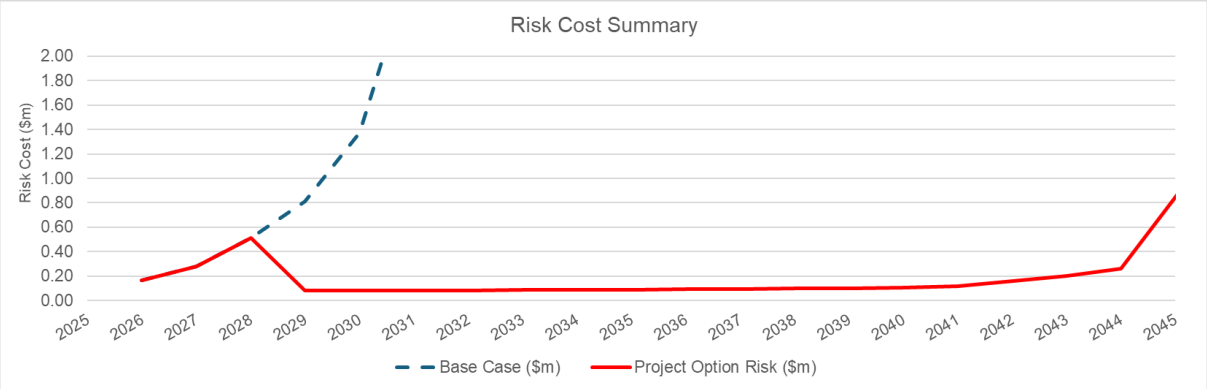


Figure 3: Project Option Risk Cost

Following the year of investment (2028) the risk cost associated with the equipment in scope effectively reduces to $0.08m. By 2044, the annualised risk cost of the project option is approximately $ 0.26 million, compared with the annualised base case risk cost of $367.78 million.

Cost Benefit Analysis

The methodology designed for the cost benefit is set out as per Figure 4 below.

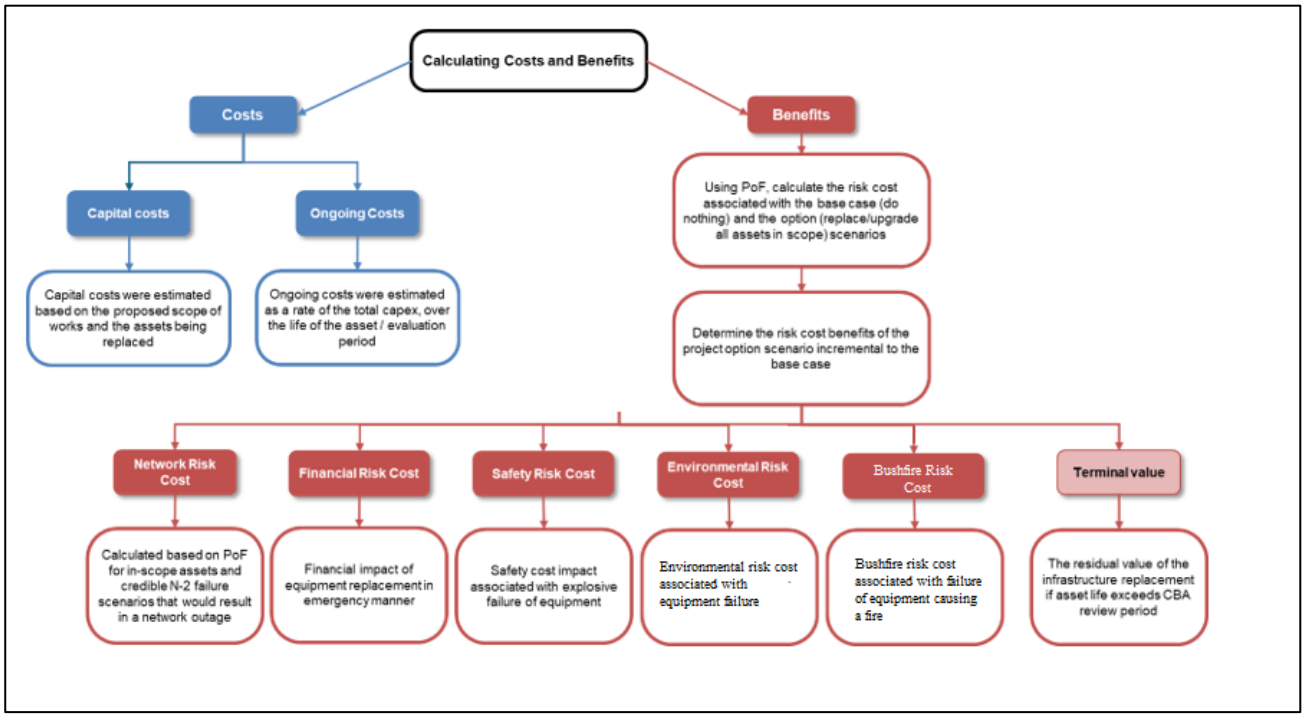


Figure 4: CBA Methodology

The project is estimated to cost approximately $9.67million. This represents a significant cost saving over the estimated financial risk cost of replacing assets individually in an emergency manner, due to the efficiencies associated with planned upgrades.

Based on a baseline discount factor of 7%, the project has a net present value (NPV) of $456.8 million over a 15-year period, and a benefit-cost ratio (BCR) >10.

The project also has a positive NPV and BCR when a discount factor of 10% is applied.

Given this, replacement of the nominated assets within this project is considered appropriate.

		Present Value Table ($m)		
Discount rate	**%**	**3%**	**7%**	**10%**
NPV of Net Gain/Loss	$m	$854.0	$456.8	$291.5
Benefit-Cost Ratio	ratio	>10	>10	>10

Table 2: Net Present Value and Optimal Year of Investment

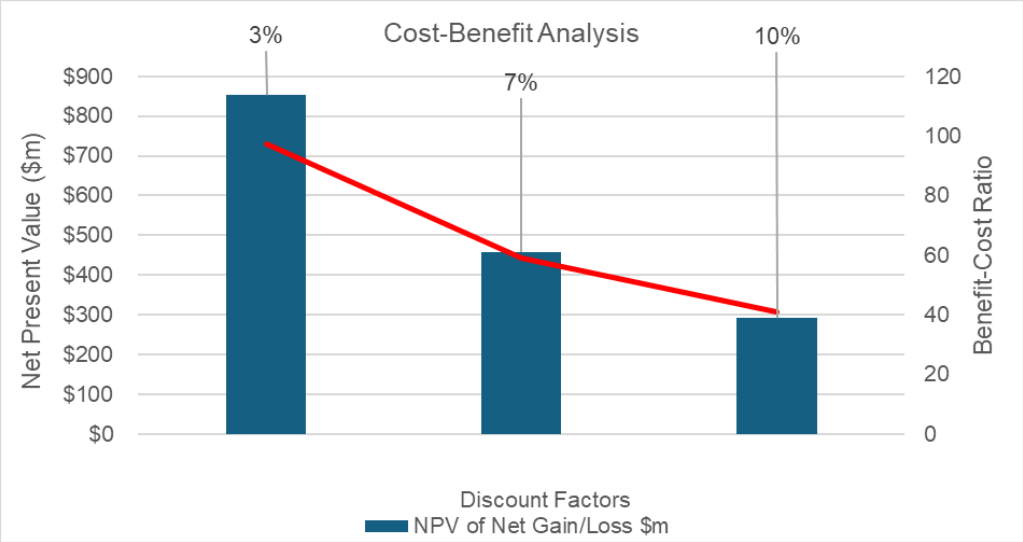


Figure 5: Cost Benefit Summary

Participation Factors

A sensitivity analysis was undertaken to determine the participation factors for key inputs to the risk cost models (i.e. to identify which inputs are most sensitive to overall risk cost).

The participation factor is defined as the ratio of percentage change in output (i.e. risk cost) to a percentage change in input (e.g. VCR). The participation factors for key model inputs are shown in the table below.

Due to the non-linear nature of the risk cost model, the participation factor can change depending on the magnitude of input percentage change.

The model is most sensitive to:

- **changes in the Value of Customer Reliability (VCR) or Restoration time** in the event of a network outage (halving the return to service time) represents decrease in risk cost of approximately $0.6 million, or approximately 44% of the original base case risk. This is due the tower representing a single point of failure for both Mudgeeraba to Terranora Feeders.

Input	Baseline value	Sensitivity value (-50%)	Change in risk cost at 2030 ($m)	Participation (%)
Safety				
Tower Collapse				
Local Road - Likelihood of Safety Incident	2.000%	1.000%	-$0.01	-0.76%
Main Road - Likelihood of Safety Incident	3.000%	1.500%	$0.00	-0.15%
Motorways - Likelihood of Safety Incident	5.000%	2.500%	$0.00	-0.01%
HV Distribution Lines - Likelihood of Safety Incident	2.000%	1.000%	-$0.01	-0.48%
Houses in Fall Zone - Likelihood of Safety Incident	10.000%	5.000%	-$0.01	-0.66%

Population 0-500 - Likelihood of Safety Incident	0.667%	0.333%	$0.00	-0.19%
Population 500 -2000 - Likelihood of Safety Incident	1.000%	0.500%	$0.00	-0.01%
Cost consequence of multiple fatality	$11,400,000	$5,700,000	$0.00	-0.35%
Cost consequence of single fatality	$5,700,000	$2,850,000	-$0.01	-0.52%
Cost consequence of multiple serious injury	$4,206,600	$2,103,300	-$0.02	-1.41%
Cost consequence of single serious injury	$2,103,300	$1,051,650	-$0.01	-0.64%
Financial				
Tower Collapse				
Emergency premium	20%	10%	$0.00	-0.071%
Unit Cost (Tension)	$451,245	$225,622	$0.00	-0.105%
Unit Cost (Suspension)	$428,683	$214,341	$0.00	-0.318%
Local Road - Financial Cost of 3rd Party Damage	$900,000	$450,000	-$0.01	-0.918%
Main Road - Financial Cost of 3rd Party Damage	$1,500,000	$750,000	$0.00	-0.201%
Motorways - Financial Cost of 3rd Party Damage	$2,100,000	$1,050,000	$0.00	-0.015%
HV Distribution Lines - Financial Cost of 3rd Party Damage	$60,000	$30,000	$0.00	-0.038%
Houses in Fall Zone - Financial Cost of 3rd Party Damage	$300,000	$150,000	$0.00	-0.053%
Population_0_500 - Financial Cost of 3rd Party Damage	$2,000,000	$1,000,000	$0	-1.534%
Population_500_2000 - Financial Cost of 3rd Party Damage	$2,000,000	$1,000,000	$0	-0.078%
Network				
Tower Collapse				
VCR ($/MWh)	$25,055.64	$12,527.82	-$0.60	-43.940%
Restoration Time (hrs)	72	36	-$0.61	-44.360%

Table 3: Participation Factors