

Jemena Gas Networks (NSW) Ltd

Pennant Hills Rd 350mm Steel Main Rehabilitation

Options Analysis

BAB-RAA-000035



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1. Summary

1.1 Project and Key Drivers

Pennant Hills Road is an important urban arterial road connecting Sydney and the Central Coast. Along this road is a critical gas main, consisting of 350mm steel it is 5.4km in length. This main is critical to servicing around 2,000 gas customers (mainly light commercial and residential) in the adjoining streets. It also interconnects and acts as a back feed to several parts of the local network.

Over the past 15 years the integrity of Pennant Hills Road 350mm ST main has deteriorated . The key driver of this project is to eliminate issues of integrity and reduce the risk of loss of supply, reputation and safety concerns due to confirmed leaks.

The principal drivers for this project are to:

- Facilitate the continuity of supply of natural gas to consumers by minimising ongoing repair and maintenance activities
- Satisfy all reasonable demands for the conveyance of gas; and improving levels of service with an asset deemed 'fit for purpose'

This project is justified on the basis that network rehabilitation will mitigate the issues associated with the deterioration of network integrity and subsequent gas leaks. The benefits include reducing the risk to public safety and unaccounted for gas (UAG) costs

1.2 Credible Options

Option	Option Name	Description	Cost (\$)
1	Do nothing	Maintain status quo and repair leaks as incidents occur.	0
2	Targeted rehabilitation of 350 mm ST main	Rehabilitate sections of the 350 mm steel main in targeted areas, focusing on mains lay, valve installation, syphon removal or repairs and cathodic protection reinstatement	2.53M
3	Full rehabilitation of 5.4 km of 350mm ST main	Completed full rehabilitation of the 5.4 km of 350 mm ST main along Pennant Hills Rd	12.00M

1.3 Recommendation

Option 2, targeted rehabilitation of the 350 mm ST main along Pennant Hills Road is recommended. This option is preferred as it reduces the safety risk to low.

The solution involves rehabilitating the 350 mm steel main in targeted areas focusing on mains replacement, valve installation, syphon removal or repairs and cathodic protection instalment . The new plastic mains follow a similar route as the existing steel main. The new mains will be laid in plastic. Synergi modelling has verified these mains have sufficient capacity for current and future demand. This option has been costed to be approximately \$2.53 M in capital expenditure and it is expected to be delivered between CY2028 and CY2029.

1.4 National Gas Rules

When developing the Options Analysis, we have confirmed the project is consistent to the National Gas Rules (NGR) and the National Gas Objective (NGO):

NGR 79(1)

- Prudent – The expenditure is required to maintain gas reliability and to comply with regulatory obligations. These are the requirements of a prudent operator. The work will reduce the current high rated risk to low.
- Efficient – Removing areas of the steel pipe that are in the poorest condition is the most cost effective option. The costs of this project were obtained through the Project Estimating Model (PEM). The field work will be carried out by an external contractor who is selected via competitive tender, and has demonstrated specific expertise in completing the installation of the assets in a safe and cost effective manner.
- Consistent with accepted and good industry practice – Targeting steel main areas that are in the poorest condition is consistent with good industry practice. Other Australian distribution companies are addressing areas of high corrosion due to CP failure. The installation of plastic will improve the safety and integrity of the gas mains in the area and is considered industry standard.

NGR 79(2)

The project is also consistent with rule 79(2)(c)(i), because it is necessary to maintain and improve the safety of personnel and the public living and working around ageing steel mains. The rehabilitation is also justified under NGR 79(2)(c)(v) as removing leaking steel mains will contribute to meeting emissions reduction targets.

2. Project Background and Key Drivers

2.1 Project Background

Pennant Hills Road is a 16 km long urban arterial road connecting Sydney and the Central Coast. For most of its length it contains medium pressure (210 kPa) gas mains. In 1983, over the course of four years 5.4km of 350mm steel main (Figure 1) were laid along Pennant Hills Rd from Pennant Hills to Normanhurst in response to the widening of Pennant Hills Road and to replace older cast iron mains. This section services around 2,000 gas customers (majority commercial and residential) and additionally provides security of supply to thousands of customers in the area. When the 350mm steel main was initially installed, this section was operated at 7kPa and was later increased to 210 kPa following the mains rehabilitation project ('Goldline') in the late 1980's.

Over the past 15 years the integrity of 350mm steel main has deteriorated. The key driver of this project is to eliminate issues of integrity and reduce the risk of loss of supply, reputation and safety concerns due to the leaks reported from the main. The main issues observed in the steel main are described below:

- Redundant offtakes with a history of leaks
- Lack of protective coating on flanged joints on road crossing at an average depth of 3-4m under Pennant Hills Road
- Excessive amount of syphons prone to leaks installed along the length of the main due to its original operating pressure of 7 kPa
- High volume of gas leakage resulting in risk to public safety and UAG losses
- The main is on the main northern arterial road that contains a high volume of heavy traffic, increasing the impact of a safety or integrity incident
- Time to repair integrity issues is higher due to the complexity of repairing steel mains
- Difficulty of isolating of the ferrous mains during emergencies, impacting response time and public safety
- Certain sections contain a high leakage rate due to insufficient cathodic protection (CP)

Many leakage repairs have been undertaken over the last 6 years (2017 to 2023), totalling over \$189,000 in expenditure. These leaks occurred predominantly at the off-take flanged adaptors, valves or syphons and the most recent leak in May 2022 resulted in an incident as a leak was detected from one of the valves. In response to this leak, the temporary and permanent repair cost approximately \$500,000 in reactive mobilisation, resources and repairs, over a three week period.

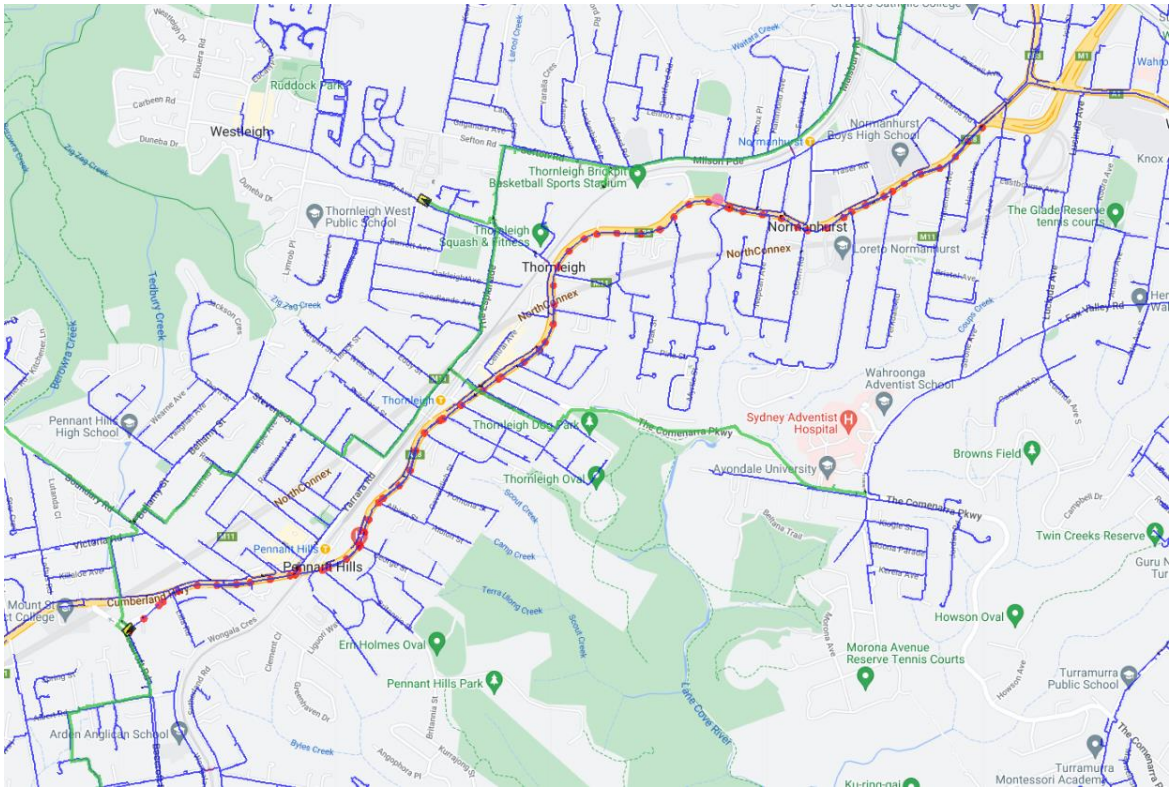


Figure 1: Map of Pennant Hills Road 350mm ST main – Red dots (Pennant Hills RD 350mm ST main),

2.2 Identified Need

ISO55000 defines level of service as: *...parameters, or combination of parameters, which reflect social, political, environmental and economic outcomes that the organisation delivers*". With respect to the Network, the outcomes that are required are the safe and reliable provision of gas supply.

2.3 Project Drivers

The principal drivers for this project are to:

- Facilitate the continuity of supply of natural gas to consumers by minimising ongoing repair and maintenance activities
- Satisfy all reasonable demands for the conveyance of gas; and improving levels of service with an asset deemed 'fit for purpose'
- This project is justified on the basis that network rehabilitation will mitigate the issues associated with the deterioration of network integrity and subsequent gas leaks. The benefits include reducing the risk to public safety and UAG costs

2.4 Assumptions and Constraints

Description	Implication	Criticality
Number of gas leaks and severity of leaks will increase	Network will continue to fail key KPI's, the activity and cost to maintain the network will increase	High
The effectiveness of the CP will continue to deteriorate and fail to protect the mains from corrosion	Feeder mains will continue to corrode causing an increase in leaks and leakage rate	High
Growth in network to increase	Minor impact on system capacity	Low
Pennant Hills Road is a major Sydney artery	The project will be constrained by hours of access and extent of disruption at any one time, therefore cost will be increased	High
There are sections of the main which are not accessible without major excavation of Pennant Hills Road	Disruption to general public, increase in cost to excavate main	High

2.5 Related Projects

Title
Integrity assessment Pennant Hills Rd All stages Rehab - 2017
Scope of works 1 - Pennant Hills Road main "Valve installation" - 2016
Scope of works 2 - Pennant Hills Road main "Mains Laying" - 2016
Scope of works 3 - Pennant Hills Road main "Road Crossing Removal and Reinstatement" - 2016
Scope of works 4 - Pennant Hills Road main "Steel Syphons" - 2016
Scope of works 5 - Pennant Hills Road main "Reinstatement of CP System" - 2016

The integrity assessment performed in 2017 will be reviewed closer to the planning and delivery date of this project (2028) to confirm all assumptions and recommendations are still relevant. See document in Appendix C

3. Credible Options

The following options were identified:

- Option 1: Do nothing
- Option 2: Targeted rehab of 350 mm ST main.
- Option 3: Full rehab of the 5.4 km of 350 mm ST main.

All options are explained in detail below.

3.1 Option 1: Do Nothing

Continue repairs as required and perform as emergency works. In this option the business continues to manage the safety and performance of the steel main through current controls of mains repairs, however, there would also be associated costs with attending to public reported leaks and the cost of UAG attributed to leakage, plus the reactive costs of doing emergency repairs. This option maintains a safety risk rating of high.

3.1.1 Benefits

No capital expenditure required, operational costs will continue as usual.

3.1.2 Limitations

- Fails to improve safety to a satisfactory level for customers as the likelihood of incidents will increase due to assets not containing adequate CP or corrosion control methods.
- Fails to improve reliability of supply and maintain level of amenity, as continuity of supply cannot be assured due to the level of repairs and continual maintenance needed.
- Fails to maintain and improve efficiency of the network and affordability to customers due to recurring operations and maintenance activities, increased UAG from leakage and other associated costs. This leads to a loss of revenue for the network and Jemena's reputation will be damaged.

3.2 Option 2: Targeted Approach

Rehabilitation of the 350 mm steel main in targeted areas focusing on mains replacement, valve installation, syphon removal or repairs and cathodic protection instalment. The new mains will be laid in either 40 mm PE or 110mm PE. Synergi modelling has verified these mains have sufficient capacity for current and future demand. This option has been costed to be \$2.53M in capital expenditure and it is expected to be delivered between 2028 and 2029.

3.2.1 Benefits

This option improves the integrity issues in the steel main by targeting the high leakage areas and reduces the risk of unplanned repairs and loss of supply and reputation.

3.2.2 Limitations

Approvals and licence requirements with TfNSW for Pennant Hills Rd.

3.3 Option 3: Full Rehabilitation

In this option the full 5.4km of 350mm ST main is upgraded over two financial years with a mix of mains isolation and mains replacement with PE, depending on access and feasibility. The new mains will be laid in either 40 mm PE or 110mm PE. Synergi modelling has verified these mains have sufficient capacity for current and future demand.

The project will incur in high costs due to the constraints imposed on a major road artery. This has been costed to be approximately \$12.00M in total to be spent over 2028-2030.

3.3.1 Benefits

This option improves the integrity issues in the steel main by targeting the high leakage areas and reduces the risk of unplanned repairs and loss of supply and reputation.

3.3.2 Limitations

Highest capital expenditure as it requires full extension of works along the steel main. Approvals and licence requirements with TfNSW for Pennant Hills Rd.

3.4 Comparison of Options

A full risk assessment for each option is provided in Appendix A: Network Risk Assessment Summary

Criteria	Option 1	Option 2	Option 3
Option description	Do Nothing	Targeted rehab of 350 mm ST main	Full rehab of 350 mm ST main
Project Driver	Reliability	Reliability	Reliability
Project Driver	Compliance and Safety	Compliance and Safety	Compliance and Safety
Complies with NGR	No	Yes	Yes
Delivery constraints	N/A	RMS road	RMS Road High Coast
Treated Risk Ranking	High	Low	Low
Cost Estimate ¹	0	\$2.53M	\$12.00M
Options Analysis	Does not addresses the issue	Fully addresses the issue	Fully addresses the issue
Recommendation	Not recommended	Recommended	Not recommended

¹ Cost estimates for non-preferred options are a desktop costing

3.4.1 NPV output

The preferred option meets all of the assessment criteria and reduces the business risk to low. The project is planned to start by 2028 and be completed by 2030.

The lowest cost NPV over the 20 years is therefore the lowest capital project that treats the risk. Please refer to file 'JGN - RIN - 4.3 - 10068673 - Pennant Hills Rd 350mm Steel Main Rehabilitation - CBAM - 20240628 - Public' for a summary of the output of the financial analysis.

4. Recommendation

4.1 Recommended Solution

It is recommended that Option 2 be implemented to target the poorest performing areas along the 5.4 km of 350 mm ST main. This option addresses the high operational issues and meets the objectives in the Gas Supply Act and WHS legislation. The cost of this option is \$2.53M and is to be delivered between 2028-2029.

4.2 Scope

This option includes the targeted rehabilitation of the 350 mm ST main by targeting the following areas:

1. Valve installations
2. Mains replacement
3. Road crossing removal and reinstatement
4. Steel syphons
5. Installation of CP system

(See related documents *Scope of Works Pennant Hills Rd 1 – 5*, covering each section above)

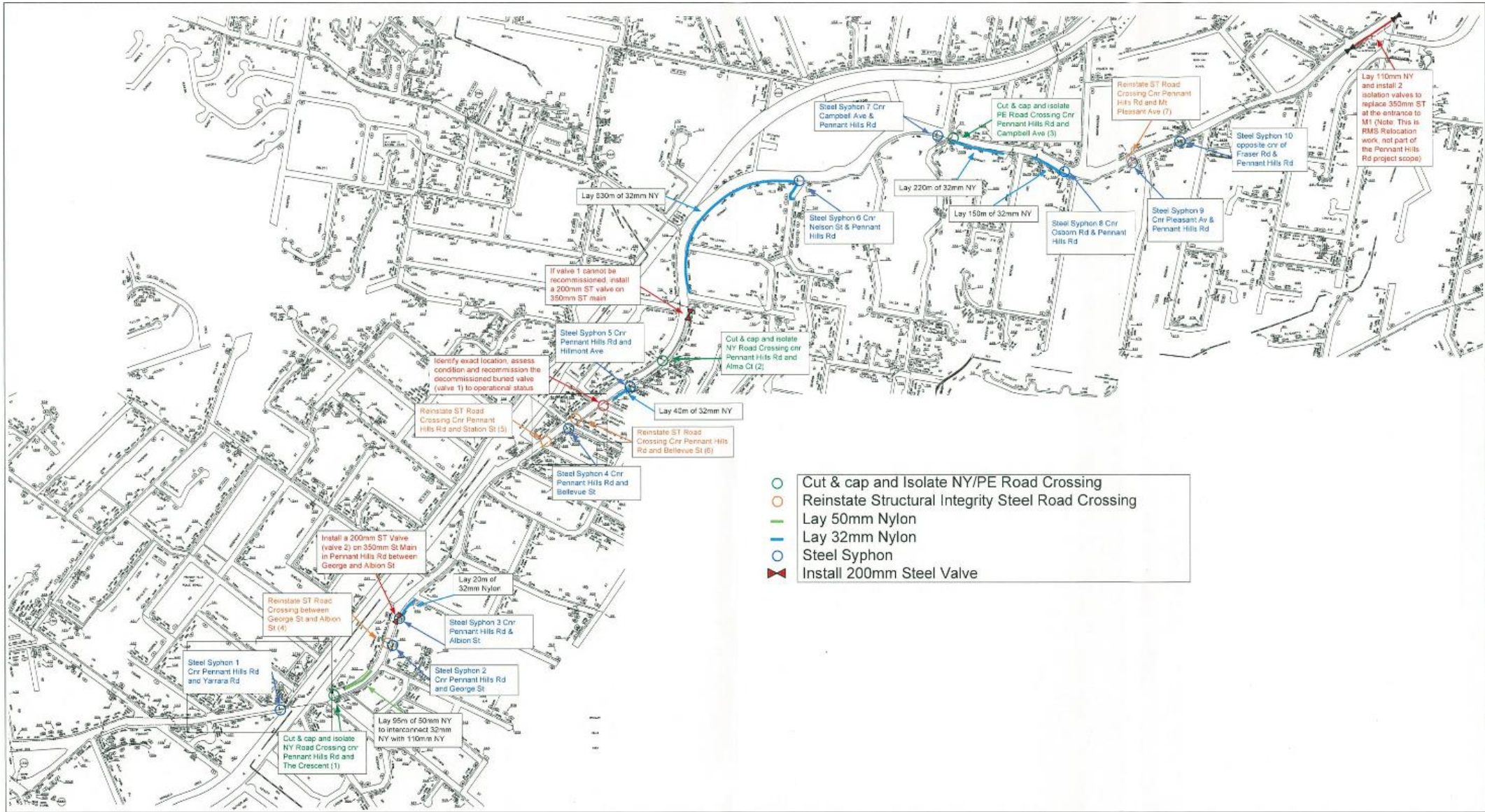


Figure 2: Overall Scope of works for Pennant

4.3 Cost Details

4.3.1 Cost Methodology

The costs for both of the preferred options were obtained through the Project Estimating Model (PEM) Methodology.

4.3.2 Summary of Costs

4.3.2.1 Option 2

Table 2: Project Estimation

Item	Project Estimate (\$M, 2024)
Materials	0.09
Contractor Costs	1.12
Jemena Internal Labour	0.20
Risk (excl overhead)	0.38
Total Direct Costs	1.79
Overheads	0.74
Total Project Estimate	2.53

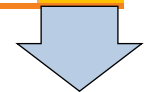
5. Terms and Definitions

Term	Definition
CP	Cathodic Protection
EAM	Enterprise Asset Management
JGN	Jemena Gas Networks
AS	Australian Standard
CDP	Capacity Development Project
MAOP	Maximum Allowable Operating Pressure
NGR	National Gas Rules
PEM	Project Estimating Model
PRL	Publicly reported leaks
RMS	NSW Roads and Maritime Service
R&M / O&M	Repair and maintenance / Operations and Maintenance

Appendix A Network Risk Assessment Summary

A risk assessment was conducted to determine the level of risk severity of the untreated risk. The table below shows the summary of results and then the treated risk summary for each option. The risk assessment was undertaken in accordance with the Jemena Risk Manual JAA MA 0050 Revision 10 (22/05/2023).

UNTREATED IMPACT/CONSEQUENCES								UNTREATED RISK SUMMARY		
Contributing Factors/ Scenario	Strategic	Financial	Safety	Operational	Regulatory & Compliance	Reputation	Comments	Consequence (Highest Impact)	Likelihood	Risk Level
The risk to general public from ignition of gas escapes, will continue to rise as network integrity continues to deteriorate. This may eventuate into injuries, investigation, court action and government/ regulatory involvement.	Significant	Moderate	High	Significant	Severe	Severe	<ul style="list-style-type: none"> o High number of public reported leaks. o Losses from the network and cost of UAG. o Potential impact to supply to >2,000 customers. o Breach of Gas Supply Act to facilitate the continuity of supply of natural gas to customers. o Reputation adversely affected with a potential for media attention. 	Severe	Likely	High



PREFERRED OPTION – Risk assessment summary				TREATED RISK SUMMARY		
Preferred Option/Treated risk	Cost	Benefit	Key Mitigations	Consequence	Likelihood	Risk Level
Option 2: Targeted rehab	\$2.53M	Reduces incidents and repairs due to leaks.	<ul style="list-style-type: none"> ○ Valve installations ○ Mains laying ○ Road crossing removal and reinstatement ○ Steel Syphons ○ Reinstatement of CP system 	Minor	Rare	Low

Appendix B PEM model (Preferred option)

Pennant Hills Road 350ST rehab Budget Summary

No Errors Found

Project Estimating Model (PEM) v.1.97R

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Pennant Hills Road 350ST rehab

Project Name	✔ Pennant Hills Road 350ST rehab	Jemena WBS	✔ BAB-RAA-000035
Asset (Capex/Opex)	✔ Jemena Gas Network (JGN) - Capex	Zinfra WBS	ABP-RAA-000035
Capital Program		Project Start Date	1-Jan-27
Project Initiator	✔	PEM Version	1.97R
Project Manager	✔		

Inclusions

Install 95m of 63PE
 Install 1100m of 40PE
 Transfer 26 services
 Cut and cap crossing or replace transition pieces at 4 x road crossings
 Remove or repair 10 syphons
 Reinstall or install 1 x 200mm ST valve
 Install 1 x 200mm ST valve
 Refurbish CP test points
 Install 4 x magnesium anode and run cables to the TP
 Assess and reinstall 3 x suspected U locations
 Install 1 x TP
 Remove syphon box

Exclusions

Testing for UAG
 Any HDD or bedbore
 Additional third party approvals/standbys (such as rail, transmission and RMS road authority)
 Environmental protections
 Latent ground conditions
 Mains >1.5m depth
 Shoring and benching
 Jemena standby where near secondary or primary
 Syphoning of low pressures mains

Assumptions

All services assumed to be full relay (all short <5m)
 Assumed no more than 14 connections to existing NY/PE
 Assumed alignment in verge for all new lay works

Constraints

Resource availability
 External approvals
 Supply required by end of 2030

Project Cost Splits - by Gate

Gates	First Month of Expenditure	Budget (\$) Direct Cost JEMENA ONLY	Budget (\$) Direct Cost ZINFRA ONLY	Budget (\$) Direct Cost Combined	% Split Direct Cost	Budget (\$) Risk Allocation	Budget (\$) Indirects (ZSS)	Budget (\$) Overheads	TOTAL Budget (\$) (DC+ RA+ IND + OH)
Gate 1 - Initiate	Jul-28	12,246	1,896	14,141	1.0%	1,420	5,632	763	21,956
Gate 2 - Plan & Define	Nov-28	18,695	83,922	102,617	7.3%	24,493	46,001	6,228	179,338
Gate 3 - Plan & Define	May-29	1,372	6,292	7,664	0.5%	739	3,041	412	11,856
Gate 4 - Deliver	Jul-29	106,122	32,682	138,804	9.8%	32,324	61,931	8,385	241,444
Gate 5 - Deliver	Dec-29	527,374	577,603	1,104,977	78.2%	318,353	515,103	69,743	2,008,176
Gate 6 - Deliver	Mar-30	1,244	28,493	29,737	2.1%	2,816	11,781	1,595	45,929
Gate 7 - Close	May-30	5,597	9,519	15,115	1.1%	1,352	5,959	807	23,233
Totals		672,648	740,406	1,413,054	100.0%	381,498	649,448	87,933	2,531,933