Regulatory Investment Test for Distribution (RIT-D)

North Street Zone Substation Network Limitation

Notice of No Non-Network Options

9 February 2023

Part of Energy Queensland

EXECUTIVE SUMMARY

About Ergon Energy

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres (around 97% of the state of Queensland) from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

Identified Need

North Street 33/11kV (NOST) zone substation is located on the northern side of Toowoomba. The substation supplies approximately 7,300 residential, industrial and commercial customers with a peak load of 21.9MVA.

NOST was originally established as a 33/6.6kV substation in 1942 and built to standards applicable at the time. Over the period 1962 to 1966 it was converted to 33/11kV with three 5MVA power transformers installed. During 1984 the 33kV yard was reconstructed and the three power transformers were upgraded to 10MVA units.

There are currently numerous plant having mis-matched age and condition profiles. Notably four 11kV circuit-breakers (CBs), nine 11kV isolators and sixteen protection relays have presently reached end of life based on asset modelling. Twelve 33kV rotary isolators have an expected retirement year of 2044 and the three 33/11kV transformers have an estimated retirement year of 2035.

The existing control building has been deemed to be structurally unsound due to internal structural wall being removed some time in the past. Temporary reinforcement of the building was undertaken in 2022 to enable it to remain in service until such time as a new building can be established.

The ongoing operation of these assets beyond their estimated retirement date presents a significant risk to safety and customer reliability. The purpose of this project is to remove the asset condition limitations at NOST in order to maintain continuity of supply to its customers and to reduce the safety risks SFAIRP (So Far As Is Reasonably Practicable).

A new $1.3 billion Toowoomba Hospital was announced as part of the 2022/23 QLD State Budget, is planned to be constructed over five years and open in the second half of 2027. It is proposed to supply the new hospital at 11kV from NOST which would require upgrading the 3 x 10MVA 33/11kV transformers to 2 x 32MVA units to accommodate the increased load.

Preferred Network Option

Ergon Energy have identified only one feasible option, which is to replace the individual assets. NPV analysis showed that the most cost-effective option is to rebuild NOST by replace the existing 3 x 10MVA 33/11kV transformers with 2 x 32MVA units and rebuilding the outdoor 11kV and 33kV yards with indoor switchboards.

Based on the age profile and estimated retirement year of these plant, it is proposed to remediate these issues in three stages. Stage 1 (completed Dec 2022) installed temporary reinforcement to address immediate concerns with the structural integrity of the control building and protection relays.

Stage 2 (RBD 2026) will replace the 11kV outdoor switchyard with an indoor 11kV switchboard in a new brick-and-mortar switchgear and control building which will house all protection, control, communications, SCADA and auxiliary equipment. The existing 3 x 10MVA transformers are to be replaced by 2 x 32MVA transformers.

Stage 3 (RBD 2044) will replace the 33kV outdoor switchyard with a new indoor 33kV switchboard within the control building constructed in Stage 2.

The completion of these works will provide the greatest reliability benefit for customers and increase network capacity to allow connection of the new Toowoomba Hospital in 2026. It will also reduce safety risks SFAIRP and reduce expenditure on obsolete, high maintenance assets. The combined estimated capital cost of the Stage 2 and Stage 3 works of this option, inclusive of interest, risk, contingencies, and overheads is $17.04 million. Annual operating and maintenance costs are anticipated to be 1.5% of the capital cost. The estimated project delivery timeframe has design commencing in July 2023 and construction completed by March 2026. Note that this RIT-D applies only to the Stage 2 and Stage 3 projects (Stage 1 was completed in 2022).

Approach

The National Electricity Rules (NER) require that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Ergon Energy has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the North Street supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. An internal assessment has been conducted and it has been determined that there is no non-network option that is credible, or that forms a significant part of a potential credible option that will meet the identified need or form a significant part of the solution. This Notice has hence been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(d) of the NER.

CONTENTS

1. BACKGROUND

1.1. Geographic Region

North Street 33/11kV zone substation (NOST) is located on the northern side of Toowoomba. Figure 1 shows a geographical view of the Toowoomba transmission and sub-transmission networks.

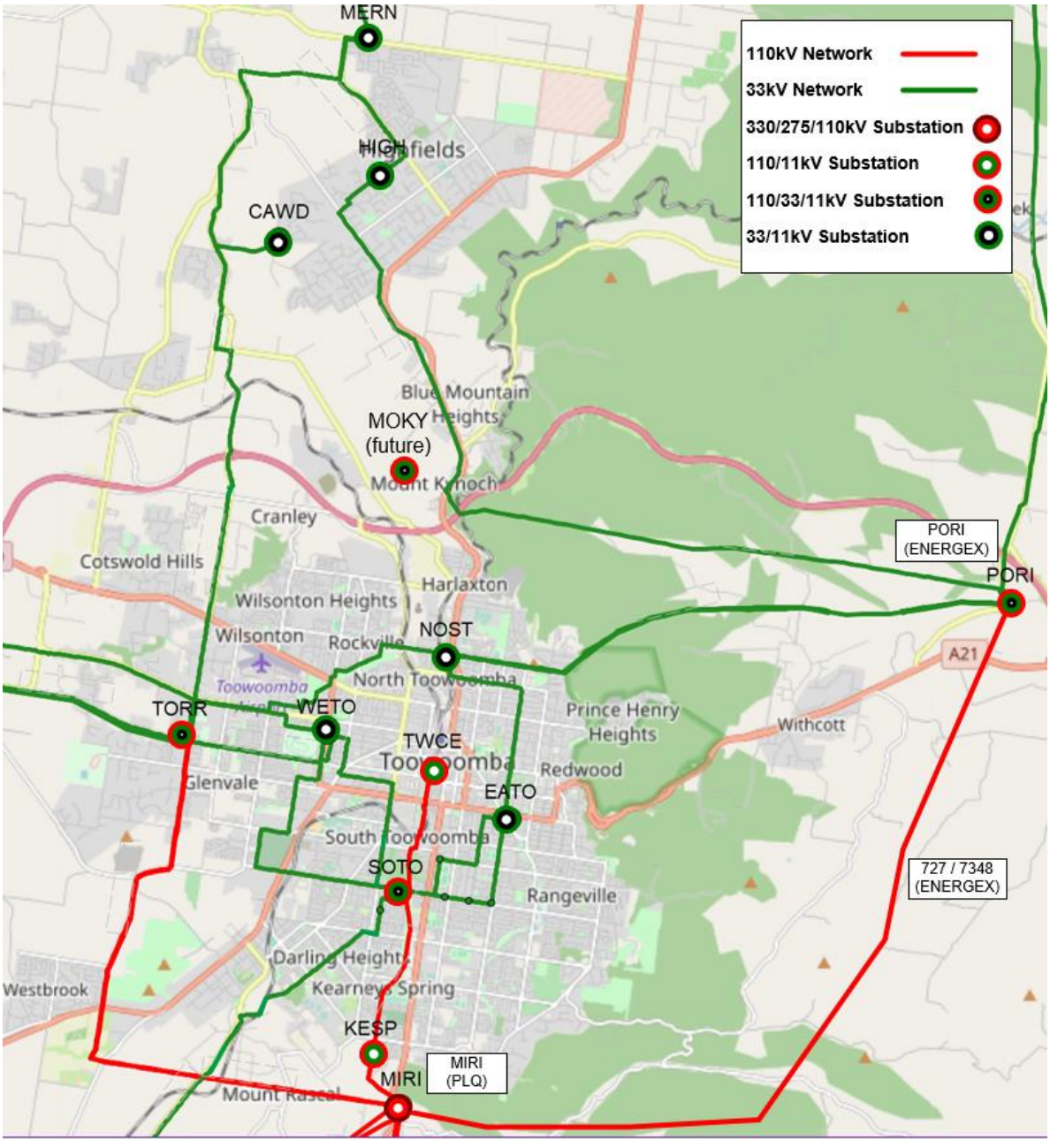


Figure 1: Geographic view of the Toowoomba transmission and sub-transmission networks.

1.2. Existing Supply System

NOST is normally supplied from Torrington BSP (TORR) via Boundary St 33kV feeder and the backup supply comes from Postman's Ridge BSP (PORI) via North St 33kV feeder. Historically an additional supply was available from South Toowoomba BSP (SOTO) via Jellicoe St 33kV feeder, however the Jellicoe St feeder bay at NOST has been decommissioned and so this supply option is no longer available.

The incoming 33kV feeders connect to a three-section 33kV outdoor bus which supply 3 x 10MVA 33/11kV transformers. These supply the outdoor 11kV bus and 9 x 11kV feeder circuit breakers (CBs). The 11kV feeders extend into the north Toowoomba area to bring supply to approximately 7,300 residential, industrial and commercial customers with a peak load of 21.9MVA.

A schematic view of NOST and the sub-transmission network arrangement is shown in Figure 2 and Figure 3 gives an aerial view of the NOST site.

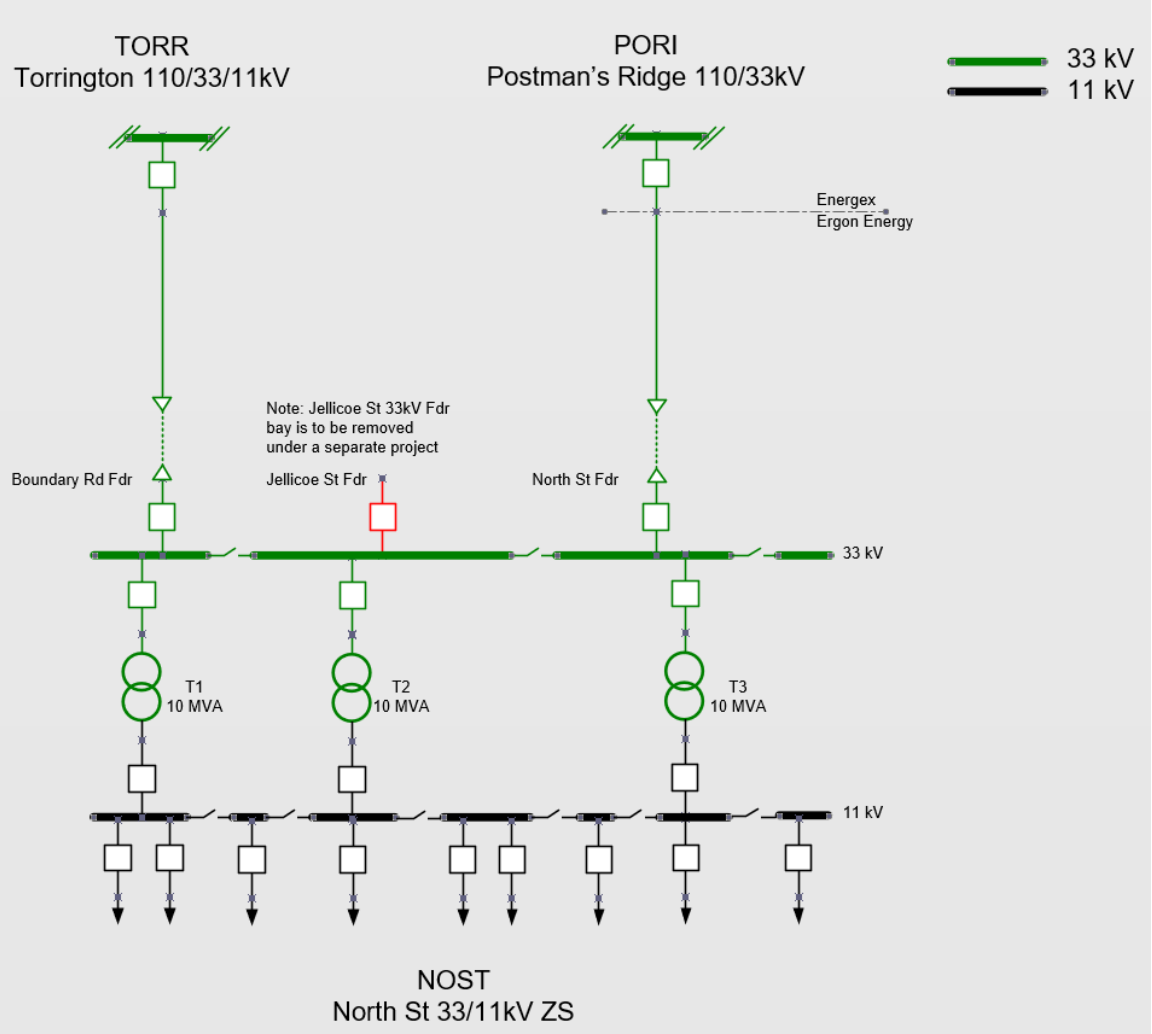


Figure 2: NOST network arrangement (schematic view).

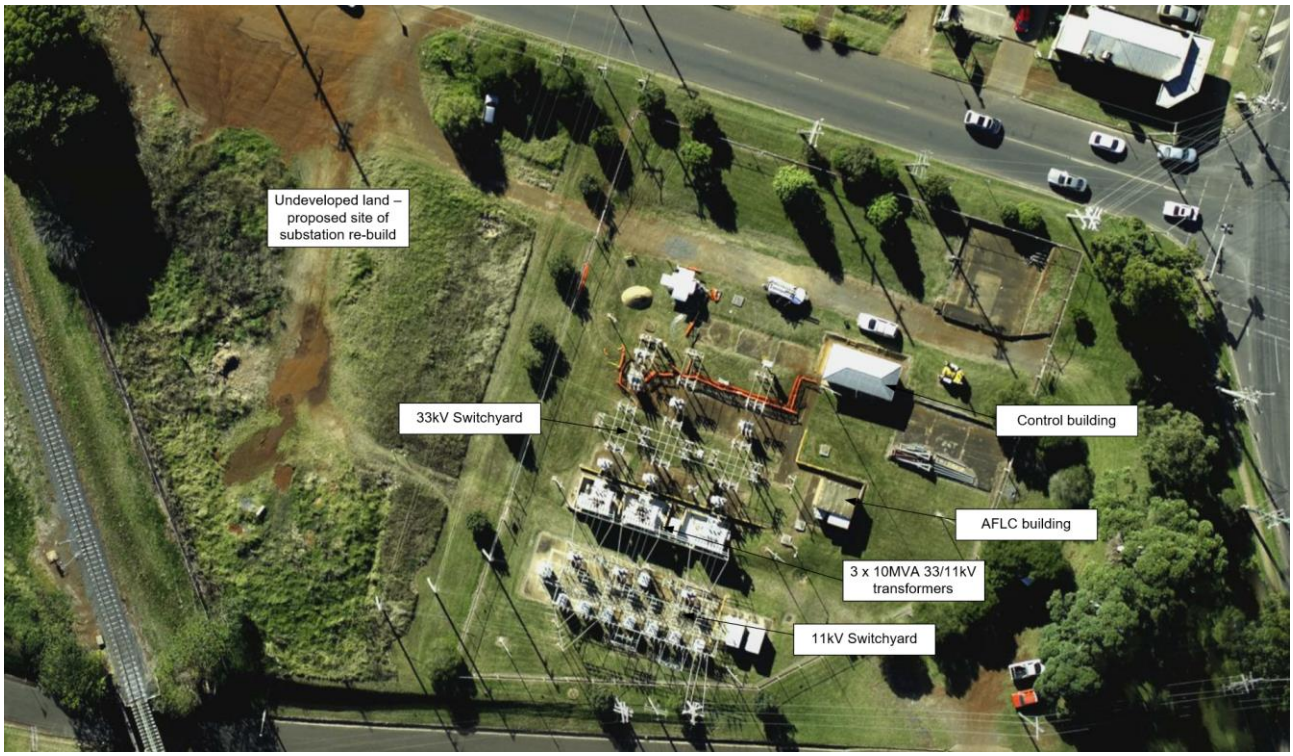


Figure 3: NOST site (aerial view).

1.3. Load Profiles / Forecasts

1.3.1. Annual Load Profile

The full annual load profile for NOST 33/11kV zone substation for the year 2022 is shown in Figure 4. Historically, peak loading occurs during the winter period however summer peaks can be significant as well. The substation N-1 capacity (26.5MVA Winter, 23.6MVA Summer) is not exceeded at any time during the year.

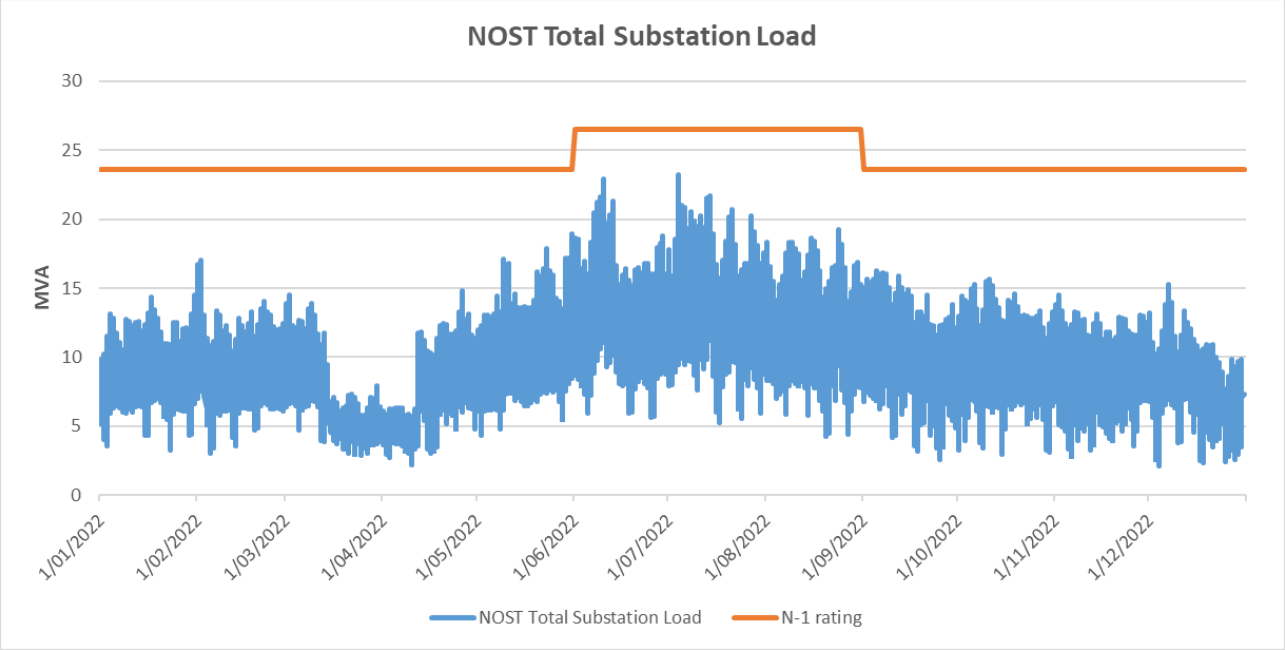


Figure 4: North Street ZS annual load profile (2022).

1.3.2. Load Duration Curve

The load duration curve for the NOST total substation load for 2022 is shown in Figure 5.

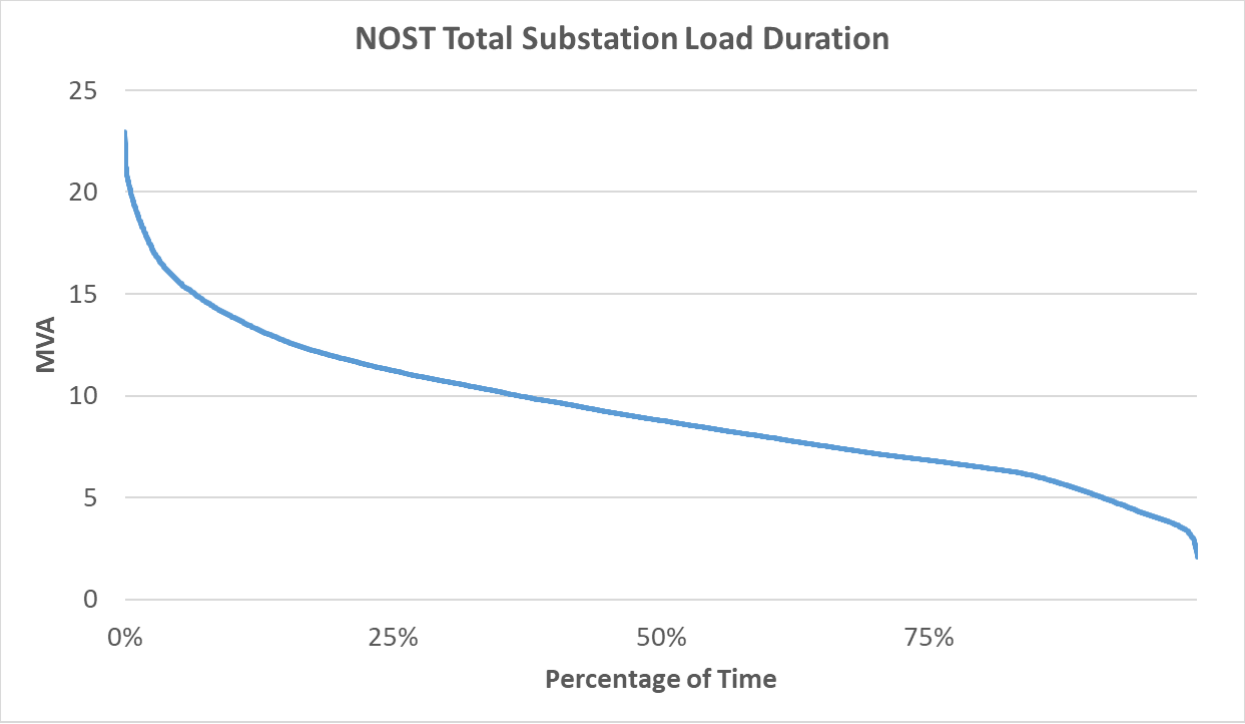


Figure 5: NOST Load Duration (2022)

1.3.3. Seasonal Weekday Load Profiles

The seasonal daily load profiles for the average, maximum and minimum and peak weekdays are illustrated below in Figure 6 and Figure 7. The summer peak loads for NOST are historically experienced in the late afternoon and evening. The winter peak is similarly in the afternoon / evening and shows a more pronounced load increase in the morning.

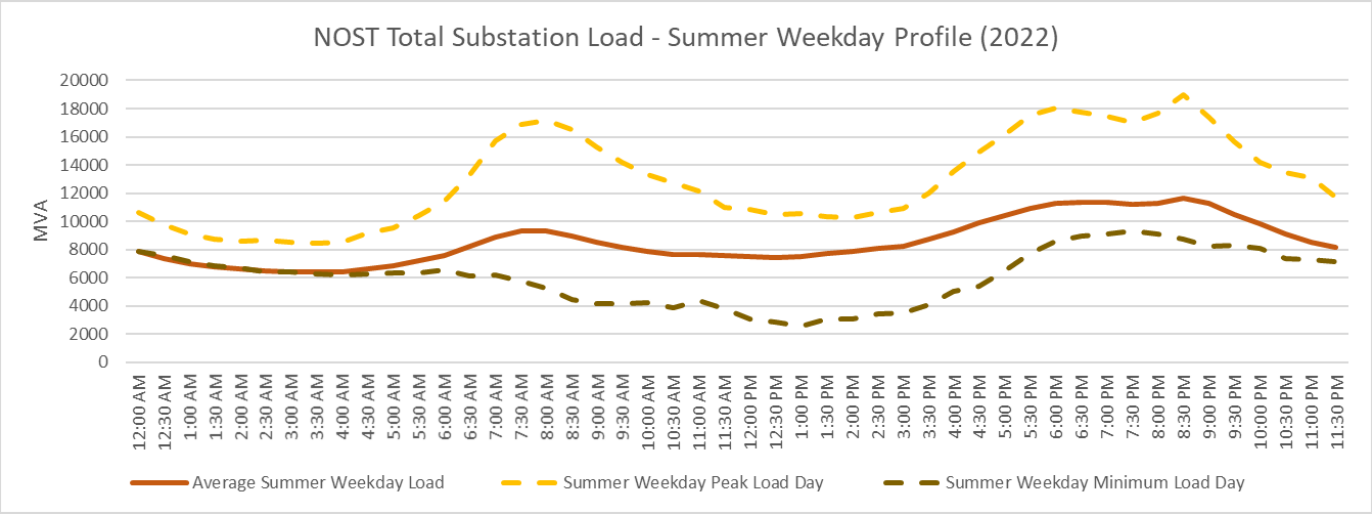


Figure 6: NOST Total Load - Daily Average, Maximum and Minimum Load Profiles (Summer)

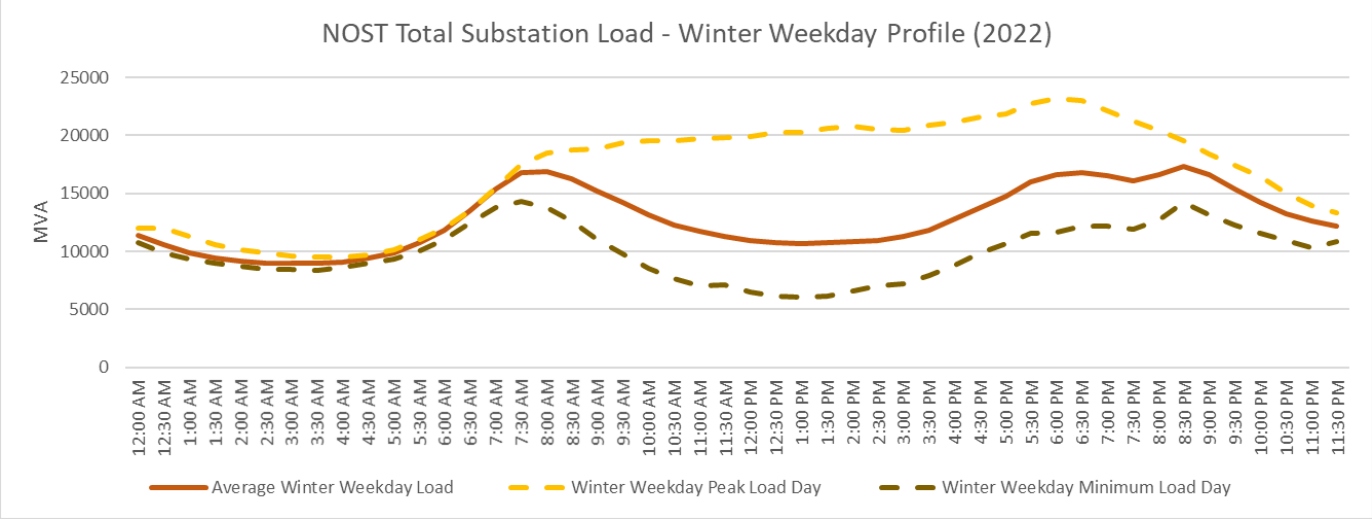


Figure 7: NOST Total Load - Daily Average, Maximum and Minimum Load Profiles (Winter)

1.3.4. Base Case Load Forecast

The 10 PoE and 50 PoE load forecasts for the base case load growth scenario are illustrated Figure 8. The historical peak load for the past five years has also been included in the graph. These are based on the winter night peak forecast. It can be seen the 50POE forecast load in the base case scenario begins to exceed the winter N-1 rating of 26.5MVA by 2031.

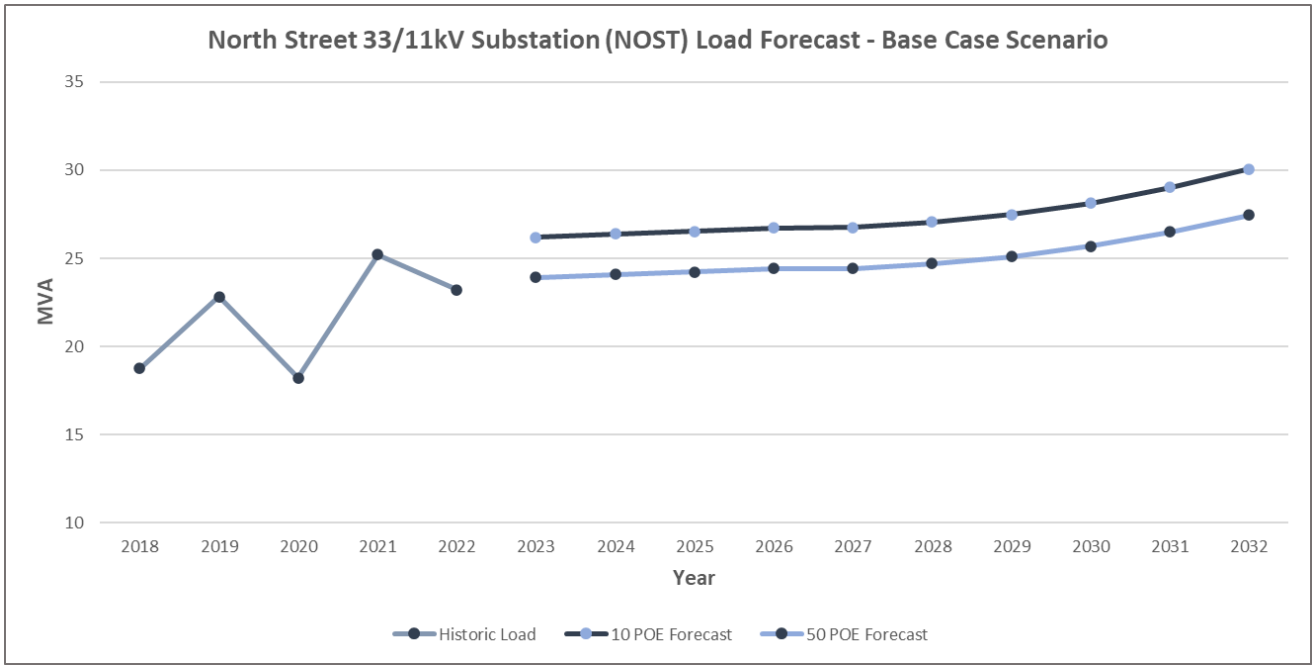


Figure 8: Network Base case load forecast

1.3.5. High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated Figure 9. With the high growth scenario, the peak load is forecast to increase at a slightly faster rate than the base case over the next 10 years. In this scenario the 50POE forecast load exceeds the winter N-1 rating of 26.5MVA in 2030.

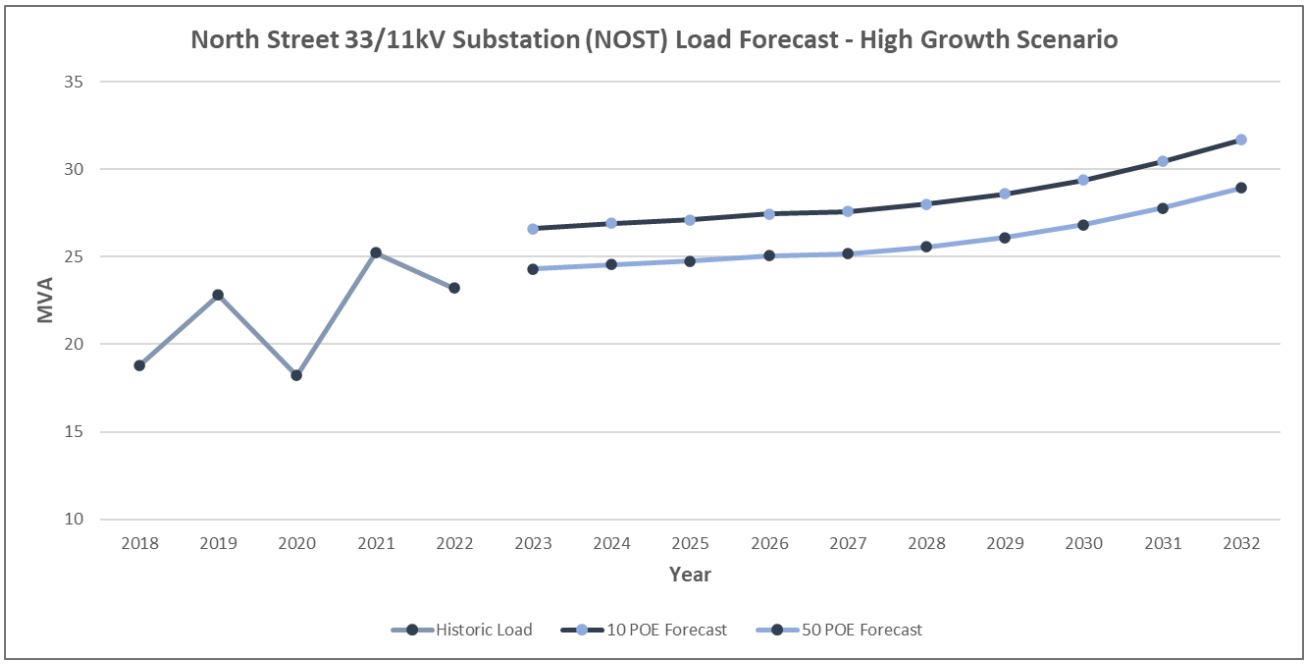


Figure 9: Network High Growth Load Forecast

1.3.6. Low Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the low load growth scenario are illustrated Figure 10. With the low growth scenario, the peak load is forecast to remain relatively steady over the next 10 years.

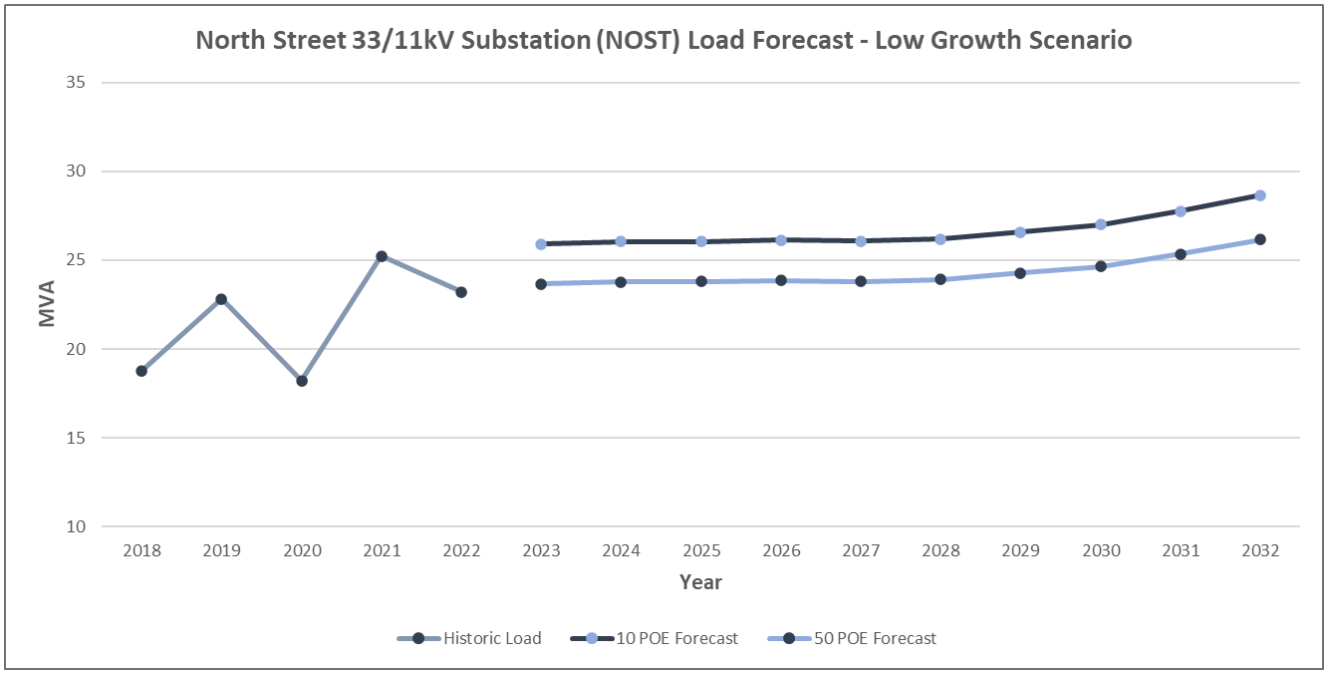


Figure 10: Network Low Growth Load Forecast

2. IDENTIFIED NEED

2.1. Description of the Identified Need

2.1.1. Poor Condition Assets

NOST was originally established as a 33/6.6kV substation in 1942 and built to standards applicable at the time. Over the period 1962 to 1966 it was converted to 33/11kV with three 5MVA power transformers installed. During 1984 the 33kV yard was reconstructed and the three power transformers were upgraded to 10MVA units.

There are currently numerous plant having mis-matched age and condition profiles. Notably four 11kV circuit-breakers (CBs), nine 11kV isolators and sixteen protection relays have presently reached end of life based on asset modelling. Twelve 33kV rotary isolators have an expected retirement year of 2044 and the three 33/11kV transformers have an estimated retirement year of 2035.

The existing control building has been deemed to be structurally unsound due to internal structural wall being removed some time in the past. Temporary reinforcement of the building was undertaken in 2022 to enable it to remain in service until such time as a new building can be established.

The ongoing operation of these assets beyond their estimated retirement date presents a significant risk to safety and customer reliability. The purpose of this project is to remove the asset condition limitations at NOST in order to maintain continuity of supply to its customers and to reduce the safety risks SFAIRP (So Far As Is Reasonably Practicable).

2.1.2. Toowoomba Hospital

A new $1.3 billion Toowoomba Hospital was announced as part of the 2022/23 QLD State Budget, is planned to be constructed over five years and open in the second half of 2027. It is proposed to supply the new hospital at 11kV from NOST which would require upgrading the 3 x 10MVA 33/11kV transformers to 2 x 32MVA units to accommodate the increased load.

3. INTERNAL OPTIONS CONSIDERED

3.1. Non-Network Options Identified

Ergon Energy has not identified any viable non-network solutions internally that will provide a complete or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the North Toowoomba area to address the identified need.

3.2. Network Options Identified

Ergon Energy has identified two credible network options that would address the identified need.

3.2.1. Option 1: NOST full substation rebuild. Rebuild outdoor 11kV and 33kV yards in situ.

This option involves replacement of primary and secondary plant by replacing the existing 3 x 10MVA 33/11kV transformers with 2 x 32MVA units and rebuilding the outdoor 11kV and 33kV yards in situ in three (3) stages.

- Summary of Stage 1 Works (RBD Dec 2022)
    - Reinforce existing control building to restore structural integrity.
    - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 1 Differential Protection within the AFLC building (currently empty).
    - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 2 Differential Protection within the AFLC building (currently empty).
    - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 3 Differential Protection within the AFLC building (currently empty).
    - Replace nine (9) electro-mechanical protection relays with two (2) relays (GE L90, Schneider P543) at the upstream TORR BSP to provide backup protection for Transformer 1, 2 and 3 at NOST.
    - Install new DC charger and batteries.
- Summary of Stage 2 Works (RBD Mar 2026)
    - Replace three (3) 10MVA 33/11kV transformers with two (2) 32MVA 33/11kV transformers installed in situ.
    - Rebuild the outdoor 11kV bus in situ.
    - Replace four (4) outdoor 11kV CBs in situ.
    - Replace nineteen (19) outdoor 11kV manual isolators in situ.
    - Build a new control building next to the existing building.
    - Replace twenty-seven (27) protection relays from the existing control building into the new control building.

- Decommission existing control building and AFLC building and installed panels. Recover if possible.

- Summary of Stage 3 Works (RBD Mar 2044)
  - Rebuild the outdoor 33kV bus in situ.
  - Replace four (4) outdoor 33kV CBs in situ.
  - Replace ten (10) outdoor 33kV manual isolators in situ.
  - Replace one (1) outdoor VT in situ.

3.2.2. Option 2: NOST full substation rebuild. Replace outdoor 11kV and 33kV yards with indoor switchboards.

This option involves replacement of primary and secondary plant by replacing the existing 3 x 10MVA 33/11kV transformers with 2 x 32MVA units and rebuilding the outdoor 11kV and 33kV yards with indoor switchboards in three (3) stages.

- Summary of Stage 1 Works (RBD Dec 2022)
  - Reinforce existing control building to restore structural integrity.
  - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 1 Differential Protection within the AFLC building (currently empty).
  - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 2 Differential Protection within the AFLC building (currently empty).
  - Replace three (3) electro-mechanical protection relays with single Schneider P642 for Transformer 3 Differential Protection within the AFLC building (currently empty).
  - Replace nine (9) electro-mechanical protection relays with two (2) relays (GE L90, Schneider P543) at the upstream TORR BSP to provide backup protection for Transformer 1, 2 and 3 at NOST.
  - Install new DC charger and batteries.
- Summary of Stage 2 Works (RBD Mar 2026)
  - Replace three (3) 10MVA 33/11kV transformers with two (2) 32MVA 33/11kV transformers.
  - Build a new masonry control and switchgear building an indoor 11kV switchboard and protection/control. Allow space for a future indoor 33kV switchboard. The control building shall be design based off the concept design standard Z7-32 and its requirements.
  - Replace twelve (12) outdoor 11kV CBs with a new indoor 11kV switchboard.
  - Replace nineteen (19) outdoor 11kV manual isolators with a new indoor 11kV switchboard.

  - Replace twenty-seven (27) protection relays from the existing control building into the new control and switchgear building.
  - Install cabling from the new 11kV switchboard to the new transformers.
  - Relocate existing 11kV OH feeder conductor and 11kV UG exit cables to connect to the new 11kV switchboard.
  - Decommission existing control building and AFLC building and installed panels. Recover if possible.

- Summary of Stage 3 Works (RBD Mar 2044)
  - Replace five (5) outdoor 33kV CBs with a new indoor 33kV switchboard.
  - Replace ten (10) outdoor 33kV manual isolators with a new indoor 33kV switchboard.
  - Replace one (1) outdoor VT with a new indoor 33kV switchboard.
  - Install HV cabling to connect the 33kV switchboard to the transformers.

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option 2: NOST full substation rebuild - replace outdoor 11kV and 33kV yards with indoor switchboards. Risk quantification and NPV options analysis showed that the proposed scope to rebuild the substation with indoor switchgear results in a net positive NPV of more than $30M over a 60-year timeframe when compared to the option of replacing plant in situ (see Figure 11 NPV summary). The large positive benefits for the indoor switchgear option (as per Option 2) are largely attributed to the increased VCR benefits of introducing 11kV and 33kV bus section CBs when compared to maintaining the existing arrangement of no bus section CBs (as per Option 1).

Upon completion of these works, the asset safety and reliability risks at NOST will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete, non-compliant and high maintenance assets, while ensuring more efficient use of design and construction resources.

The estimated capital cost of the proposed project, (combined costs of Stage 2 and Stage 3 of Option 2) inclusive of interest, risk, contingencies and overheads is $17.04 million. Annual operating and maintenance costs are anticipated to be 1.5% of the capital cost. The estimated project delivery timeframe has detailed design commencing in July 2023 and construction completed by April 2026. Note that this RIT-D applies only to the Stage 2 and Stage 3 projects (Stage 1 was completed in 2022).

BASE CASH FLOWS NPV ANALYSIS						
PROJECT:	North Street Asset Limitation					
Results displayed in $000s						
WEIGHTED AVERAGE RESULT ACROSS ALL SCENARIOS						
AVERAGE Option	Option Name	Rank	Net NPV	Capex NPV	Opex NPV	Benefits NPV
1	Option 1: Full substation re-build in situ	2	**112,205**	-15,850	-4,702	132,757
2	Option 2: Full substation re-build with indoor 11kV and 33kV switchboards	1	**145,480**	-14,271	-4,245	163,996

Figure 11: Base Cash Flow NPV Options Analysis

4. ASSSESSMENT OF NON-NETWORK SOLUTIONS

Ergon Energy has assessed the potential non-network alternative options required to defer the network option and determine if there is a viable option to replace or reduce the need for the network options proposed.

Credible options must be technically and commercially viable and must be able to be implemented in sufficient time to satisfy the identified risk to the public and/or the network due to the identified constraints.

Once the aged, identified 11kV and 33kV assets at NOST reach their retirement age and can no longer be safely operated, the existing load would need to be supplied via non-network alternative solutions while satisfying the Service Safety Net Targets as specified in the Distribution Authority issued to Ergon Energy.

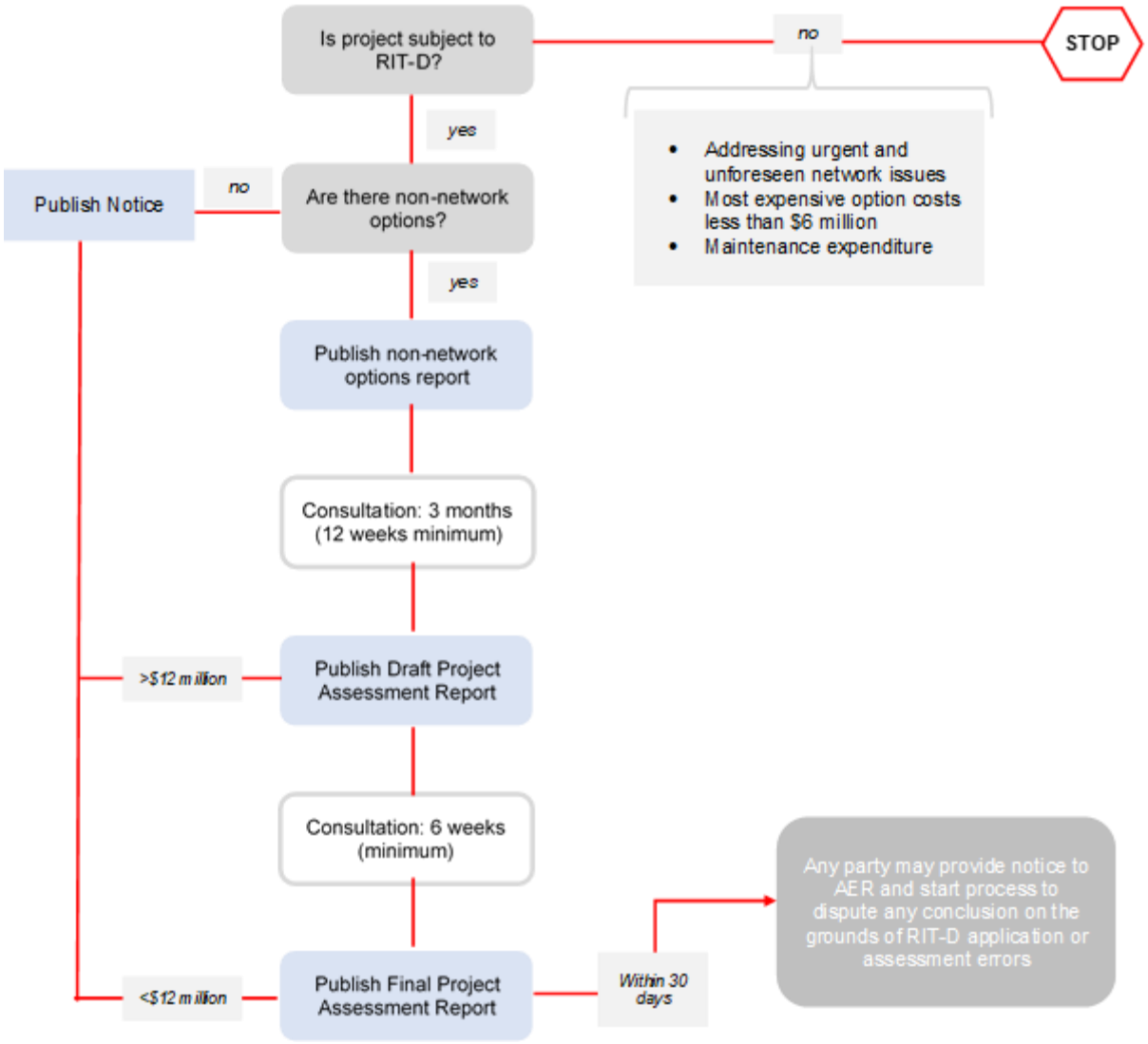
It is considered that no available demand management products or strategies can provide sufficient demand support at NOST to address the identified need. It is evident that an economically feasible non-network option would not be available to defer or eliminate the requirement to replace the aged primary and secondary plant at NOST and continue to provide a safe, sufficient and reliable supply to customers in the North Toowoomba area.

5. CONCLUSION AND NEXT STEPS

Considering the nature of the project, being the safety risk from failure of aged assets and as per clause 5.17.4(c) of the NER, Ergon Energy has determined that there are no credible non-network options to address the identified need at NOST.

The preferred network option is Option 2: NOST full substation rebuild - replace outdoor 11kV and 33kV yards with indoor switchboards. This Notice of No Non-Network Options is therefore published in accordance with rule 5.17.4(d) of the NER. As the next step in the RIT-D process, Ergon Energy will now proceed to publish a Draft Project Assessment Report.

APPENDIX A – THE RIT-D PROCESS



Source: AEMC, *Rule determination: National Electricity Amendment (Replacement expenditure planning arrangements) Rule 2017*, July 2017, p. 64.