Powerlink Queensland

June 2021

Preparatory Activities - QNI Medium and Large

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1 Executive summary

The 2020 Integrated System Plan (ISP) [1] defined the projects and timing of 18 network investments in the optimal development path (ODP). Future ISP projects are a subset of these projects that are not yet ‘actionable’ under the new ISP Rules, but are expected to become actionable in the future. Those projects categorised as ‘future ISP projects’ require the responsible TNSP to carry out preparatory activities including providing a report of these activities to the AEMO by 30 June 2021.

Appendix A3.5.1 of the 2020 ISP [2] describes the future ISP project associated with the QNI Medium project as ‘single 500kV circuit between NSW and Queensland strung on a double circuit tower via western part of the existing QNI…’ and the Large project ‘second 500kV circuit…’.

Due to NSW government initiatives announced subsequent to the 2020 ISP, Powerlink and TransGrid agreed a lower capacity 330kV transmission line would be more likely to form part of the ODP. This report summarises the preparatory activities undertaken by Powerlink to the Queensland border for these updated project scopes for the purposes of the 2022 ISP.

2 Preliminary Engineering Design

2.1 Single Line Diagrams

The following diagram presents an overview of the proposed works as part of the future ISP project associated with the QNI Medium upgrade at 330kV.

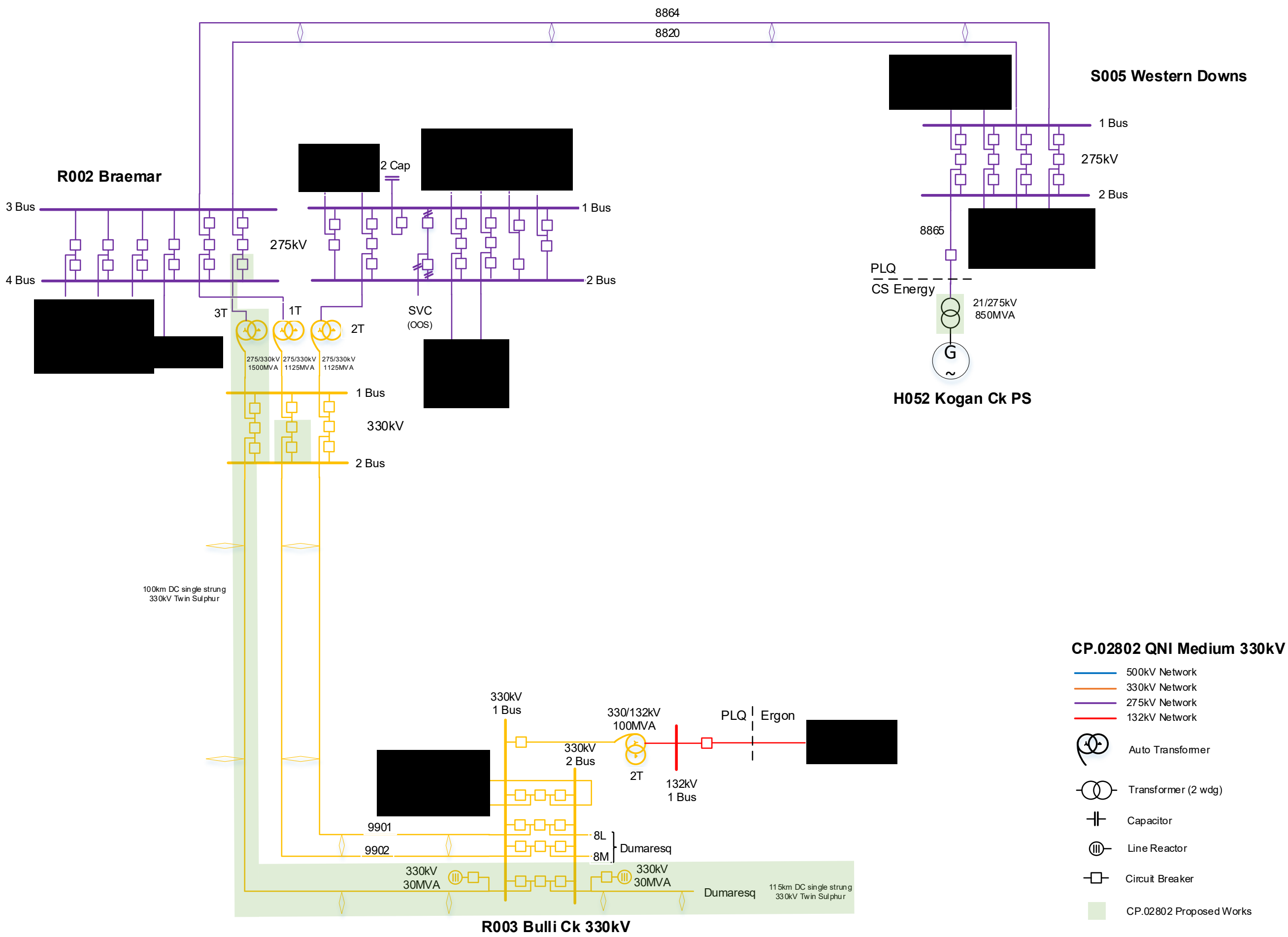

Figure 1 – Overview of proposed works (QNI Medium)

In addition to the overview presented in Figure 1, detailed single line diagrams have been prepared for each substation to inform estimating. These have been included in the report provided to AEMO, but are not included in the publicly available version of this report.

Figure 2 – Single line diagram for Braemar Substation (330kV) – QNI Medium

Figure 3 – Single line diagram for Braemar Substation (275kV) – QNI Medium

Figure 4 – Single line diagram for Bulli Creek Substation (330kV) – QNI Medium

The following diagram presents an overview of the proposed works as part of the future ISP project associated with the QNI Large upgrade at 330kV.

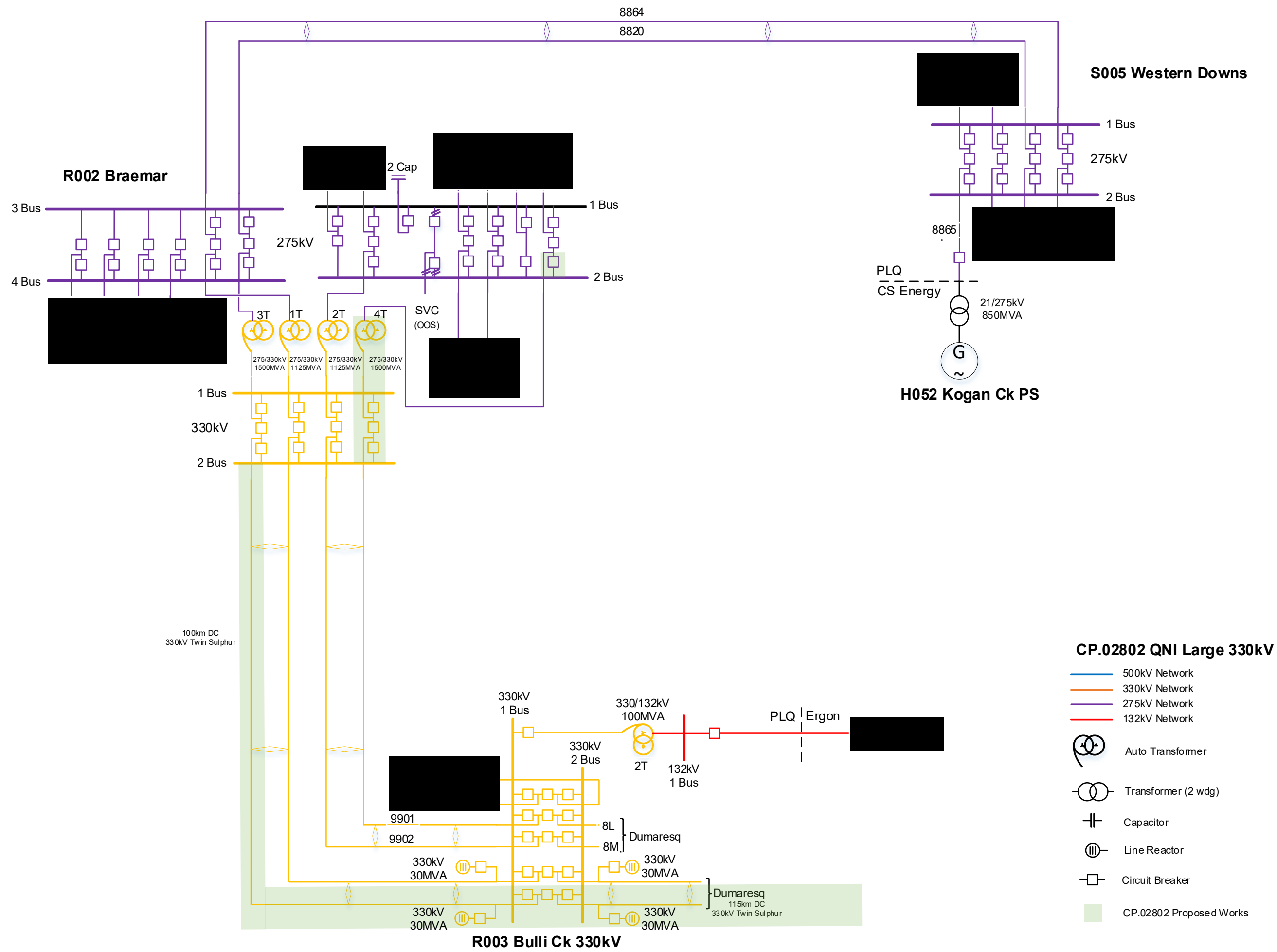

Figure 5 – Overview of proposed works (QNI Large)

In addition to the overview presented in Figure 5, detailed single line diagrams have been prepared for each substation to inform estimating. These have been included in the report provided to AEMO, but are not included in the publicly available version of this report.

Figure 6 – Single line diagram for Braemar Substation (330kV) – QNI Large

Figure 7 – Single line diagram for Braemar Substation (275kV) – QNI Large

Figure 8 – Single line diagram for Bulli Creek Substation (330kV) – QNI Large

2.2 Site Layout

Indicative site layout (general arrangement) diagrams have been produced for both Braemar and Bulli Creek substations to inform estimating. However, these have not been presented due to the complexity in the diagrams and the indicative nature of the layout.

2.3 Asset List

The total procurement costs for each broad asset grouping is provided in the cost estimate provided in Table 20. Powerlink does not present itemised costs for specific plant items to external parties, as this is commercially sensitive information subject to confidentiality.

2.4 Network Parameters and Transfer Limits

2.4.1 Network Parameters

As shown in Figure 1, QNI Medium builds a double circuit 330kV line (single side strung) from the Queensland border to Braemar 330kV Substation via Bulli Creek Substation. The scope of QNI Medium also includes a 330/275kV transformer connecting the western Braemar 275kV bus to the Braemar 330kV bus.

QNI Large strings the second side of this 330kV double circuit line with further switching at the Bulli Creek and Braemar 330kV substations and another 330/275kV transformer connecting to the eastern Braemar 275kV bus.

Table 1 and Table 2 present the electrical network parameters required to model the Queensland component of the projects, when performing loadflow, fault level and dynamic analysis.

Table 1 – QNI Medium/Large transmission line electrical parameters (using 100MVA/330kV base quantities)

Circuit	R	X	B	R0	X0	B0
Braemar – Bulli Creek 330kV feeder	0.210%	2.489%	38.638%	1.504%	7.036%	22.248%
Bulli Creek – QLD/NSW Border 330kV feeder	0.264%	3.144%	48.776%	1.962%	9.01%	28.011%

Table 2 – QNI Medium/Large transformer electrical parameters (using 100MVA/330kV base quantities)

Circuit	R12	X12	R23	X23	R13	X13
1500MVA 330/275/33kV Braemar transformer (PSS®E connection code 113 auto wye-wye-delta)	0.004%	0.448%	0.249%	8.177%	0.273%	9.285%
	R01	**X01**	**R02**	**X02**	**R03**	**X03**
	0.036%	0.608%	0.001%	-0.197%	0.218%	7.867%

30MVAr line reactors are to be connected to each new circuit connected to Bulli Creek Substation (4 reactors in total, 2 feeders per project x 2 projects).

The transmission line parameters are consistent with the existing 330kV twin Sulphur double circuit line between Braemar and Bulli Creek (100km) and Bulli Creek to the Queensland/NSW border (115km). Thermal ratings would be consistent with the existing lines with summer/shoulder/winter normal ratings of 1,246/1,358/1,434MVA and summer/shoulder/winter emergency ratings of 1,456/1,568/1,653MVA. Thermal ratings of the 3 winding transformers assumed a normal cyclic rating of 1,645MVA and emergency cyclic rating of 1,649MVA.

2.4.2 Transfer Limits

Power system analysis has been undertaken to increase the accuracy of applicable limits prior and after the QNI Medium and Large projects as part of the preparatory activities. QNI transfer limits, expressed as a flow from Bulli Creek into Dumaresq 330kV that corresponds to a limiting condition along any 330kV section of the QNI corridor (from Braemar to Liddell), are generally sensitive to the location and magnitude of generation and load. The following generation and load assumptions were made in this analysis:

- Existing and committed (e.g. New England Solar Farm) generation was modelled for the establishment of the transfer limits applicable prior to the QNI Medium project.
- The Central West Orana REZ was included in the model when determining transfer limits following the QNI Medium and Large projects.

- Demand levels were based on system conditions experienced over the last 2 years. That is, historical correlations with the following ranges were simulated for the following geographical zones whose extent is illustrated as Figure 9:
    - North East NSW demands : 85 – 240MW
    - North West NSW demands: 95 – 250MW
    - Central Coast NSW demands: 110 – 285MW.

Source: https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/maps/2016-nem-regional-boundaries-map-web.pdf?la=en

Figure 9 – Northern and Central NSW demand zone definitions used in transfer limit assessment

Whilst AEMO requested (QNI) limits be specified in a simplified manner (single number/s) that can be used in the DLT, Powerlink is not in a position to resolve the simplifying assumptions leading to a trigger / timing commensurate with higher levels of accuracy. Therefore, a mechanism to create limits to various degrees of accuracy is provided.

Post contingency flow equations that include a QNI southerly MW flow term can be manipulated to provide a QNI southerly MW flow limit as follows[1]:

$$\text{Post Contingency MVA Flow} = \alpha_0 \text{ QNI southerly MW flow} + \sum \alpha_i \text{ Term}_i \leq \text{Rating}$$

$$\text{QNI southerly MW flow} \leq (\text{Rating} - \sum \alpha_i \text{ Term}_i) / \alpha_0$$

$$\text{QNI southerly MW limit} = (\text{Rating} - \sum \alpha_i \text{ Term}_i) / \alpha_0$$

where Rating is the applicable emergency rating for the prevailing conditions.

Limits are based on thermal assessment, which was found to be the predominant system normal limitation following the delivery of the QNI Minor project. Whilst these may be optimistic for the QNI Medium and Large project, stability limits will be dependent on new entrants. Alternatively, the assessment makes the implicit assumption that impediments to achieving this transfer due to stability limitations could be addressed by relatively low cost investments.

2.4.2.1 Existing Transfer Limits for DLT studies

The so called 'existing transfer limits' assume delivery of the QNI Minor project which is expected to be operational by the end of the year but full transfer capability only released to the market by mid-2022. Following this project, southerly limits to QNI are found to be predominantly set by thermal limitations either on the Armidale to Tamworth 330kV corridor or Sapphire to Armidale 330kV circuit. Accurate and simplified flow equations are provided with sample points for a summer night condition.

Table 3 - Sapphire to Armidale 330kV (8E) MVA flow prediction (for loss of Dumaresq to Armidale 330kV (8C))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	-129.0
QNI southerly MW flow	1.156
Sapphire WF MW Generation	1.074

[1] Note in NEMDE other dispatchable and semi-dispatchable terms would appear on the LHS to be co-optimised with QNI flow.

Given *Sapphire WF MW Generation* term can vary between 0 and 270MW, for an emergency rating of 1,372MVA (current summer night rating):

QNI southerly MW limit = (1,372 - (-129.0) - 1.074 [0 to 270]) / 1.156

QNI southerly MW limit = (1,298 - 0.929 [0 to 270])

QNI southerly MW limit = 1,045MW to 1,300MW (due to post contingent transfer on 8E over summer night periods)

Table 4 - Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	14.0
QNI southerly MW flow	0.846
Directlink southerly MW flow	0.877
Sapphire WF MW Generation	0.836
White Rock WF MW Generation	0.705
White Rock SF MW Generation	0.705
Metz SF MW Generation	0.808
Moree SF MW Generation	0.387
Gunnedah SF MW Generation	0.027
New England SF MW Generation	0.881
North East NSW MW Load	-0.871
North West NSW MW Load	-0.240
Central Coast NSW MW Load	-0.627

Table 5 - Simplified Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	24.0
QNI southerly MW flow	0.843
Influencing Net MW Generation	0.881

where Influencing Net MW Generation = Southerly MW flow on Directlink
+ MW Generation from (Sapphire WF + White Rocks WF + White Rocks SF + Metz SF + New England SF)
- MW Load from (North East NSW + Central Coast NSW)

Influencing Net MW Generation term ranged from -620MW to 1,130MW over all the conditions studied. At night, the range reduces to -620MW to 290MW, for an emergency rating of 1,040MVA (current summer night rating):

QNI southerly MW limit = (1,040 - 24.0 - 0.881 [-620 to 290]) / 0.843

QNI southerly MW limit = (1,205 - 1.045 [-620 to 290])

QNI southerly MW limit = 900MW to 1,850MW (due to post contingent transfer on 85 over summer night periods)

Table 6 - Tamworth to Armidale 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	-9.0
QNI southerly MW flow	0.868
Directlink southerly MW flow	0.896
Sapphire WF MW Generation	0.858
White Rock WF MW Generation	0.723
White Rock SF MW Generation	0.723
Metz SF MW Generation	0.830
Moree SF MW Generation	0.400
Gunnedah SF MW Generation	0.023
New England SF MW Generation	0.893
North East NSW MW Load	-0.889
North West NSW MW Load	-0.245
Central Coast NSW MW Load	-0.640

Table 7 - Simplified Tamworth to Armidale 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	1.0
QNI southerly MW flow	0.864
Influencing Net MW Generation	0.896

where Influencing Net MW Generation takes the same definition as Table 5.

For an emergency rating of 1,017MVA (current summer night rating):

QNI southerly MW limit = (1,017 - 1.0 - 0.896 [-620 to 290]) / 0.864

QNI southerly MW limit = (1,176 - 1.037 [-620 to 290])

QNI southerly MW limit = 875MW to 1,815MW (due to post contingent transfer on 86 over summer night periods)

During summer night conditions QNI may be limited over the range of 875MW to 1,300MW depending on loading conditions and wind farm generation (Sapphire and White Rocks wind farms).

Daytime variability in the limit is more extreme due to impact of solar generators and lower ratings.

2.4.2.2 Augmentation Transfer Limits

2.4.2.2.1 QNI Medium Transfer Limits

Figure 10 illustrates a simplified representation of the NSW portion of the QNI Medium project.

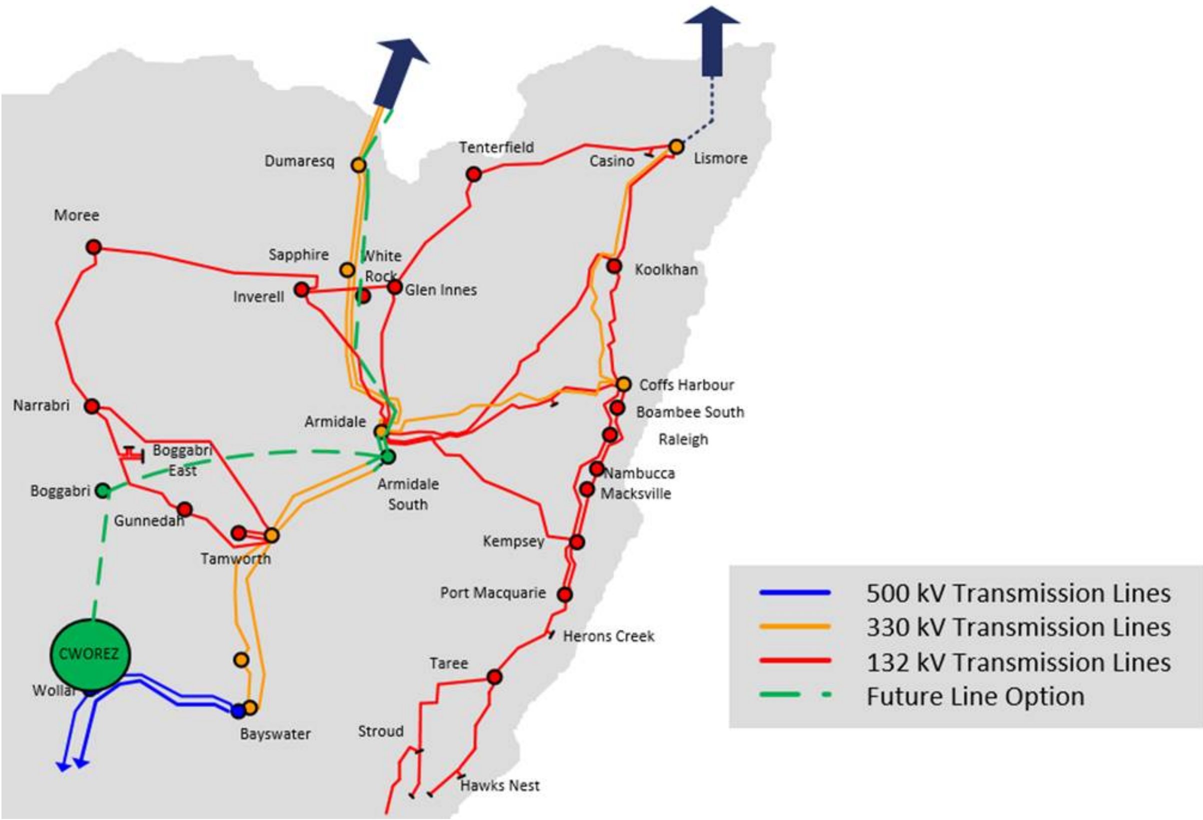

Figure 10 – Simplified representation of NSW portion of QNI Medium project

Expansion of Queensland's Darling Downs REZ can be assumed at Bulli Creek bus. No schemes are assumed to extend limits.

Table 8 - Sapphire to Armidale 330kV (8E) MVA flow prediction (for loss of Sapphire to Armidale 330kV (8C-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	-150.0
QNI southerly MW flow	0.647
Sapphire WF MW Generation	0.691

For an emergency rating of 1,372MVA (current summer night rating)

QNI southerly MW limit = (1,372 - (-150.0) - 0.691 [0 to 270]) / 0.647

QNI southerly MW limit = (2,352 – 1.068 [0 to 270])

QNI southerly MW limit = 2,065MW to 2,350MW (due to post contingent transfer on 8E over summer night periods)

Table 9 - Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale South 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	97.0
QNI southerly MW flow	0.389
Directlink southerly MW flow	0.399
Sapphire WF MW Generation	0.384
White Rock WF MW Generation	0.299
White Rock SF MW Generation	0.299
Metz SF MW Generation	0.363
Moree SF MW Generation	0.056
Gunnedah SF MW Generation	-0.221
New England SF MW Generation	0.460
Central West Orana REZ Generation	0.062
North East NSW MW Load	-0.374
North West NSW MW Load	0.067
Central Coast NSW MW Load	-0.265

Table 10 - Simplified Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale South 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	99.0
QNI southerly MW flow	0.374
Influencing Net MW Generation	0.465

where Influencing Net MW Generation = Southerly MW flow on Directlink
+ MW Generation from (Sapphire WF + New England SF)

With the additional transmission associated with QNI Medium project, the post-contingent flow over New England to Tamworth 330kV is primarily determined by Sapphire and New England generation. The overall range of the *Influencing Net MW Generation* term is 0MW to 1,170MW, at night however the maximum value becomes 450MW. For an emergency rating of 1,040MVA (current summer night rating):

QNI southerly MW limit = (1,040 - 99.0 - 0.465 [0 to 450]) / 0.374

QNI southerly MW limit = (2,516 - 1.243 [0 to 450])

QNI southerly MW limit = 1,955MW to 2,515MW (due to post contingent transfer on 85 over summer night periods)

Table 11 - Tamworth to Armidale South 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	83.0
QNI southerly MW flow	0.389
Directlink southerly MW flow	0.397
Sapphire WF MW Generation	0.384
White Rock WF MW Generation	0.299
White Rock SF MW Generation	0.299
Metz SF MW Generation	0.368
Moree SF MW Generation	0.050
Gunnedah SF MW Generation	-0.232
New England SF MW Generation	0.403
Central West Orana REZ Generation	0.061
North East NSW MW Load	-0.377
North West NSW MW Load	0.066
Central Coast NSW MW Load	-0.257

Table 12 - Simplified Tamworth to Armidale South 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	86.0
QNI southerly MW flow	0.373
Influencing Net MW Generation	0.417

where Influencing Net MW Generation takes the same definition as Table 10.

For an emergency rating of 1017MVA (current summer night rating):

QNI southerly MW limit = (1,017 - 86.0 - 0.417 [0 to 450]) / 0.373

QNI southerly MW limit = (2,496 - 1.118 [0 to 450])

QNI southerly MW limit = 1,990MW to 2,495MW (due to post contingent transfer on 86 over summer night periods)

2.4.2.2.2 QNI Large Transfer Limits

Figure 11 illustrates a simplified representation of the NSW portion of the QNI Large project.

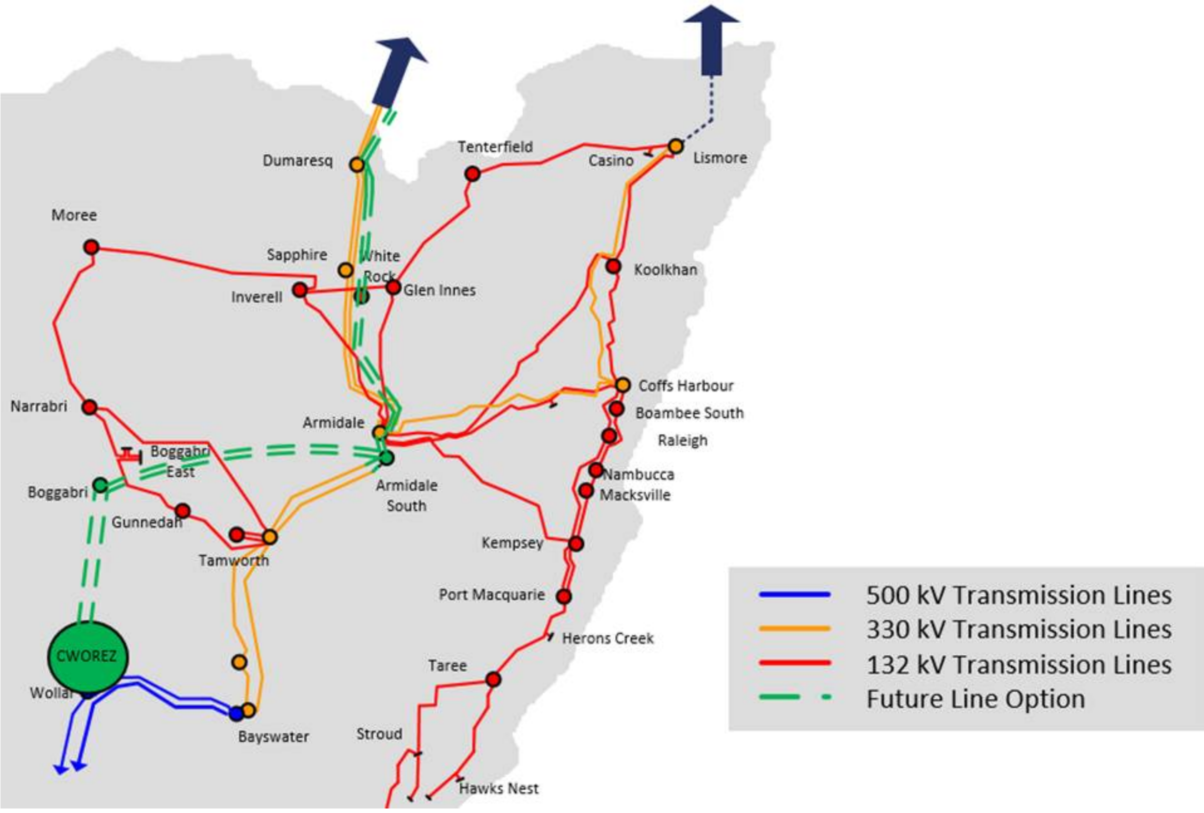

Figure 11 – Simplified representation of NSW portion of QNI Large project

Table 13 - Sapphire to Armidale 330kV (8E) MVA flow prediction (for loss of Sapphire to Armidale 330kV (8C-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	-87.0
QNI southerly MW flow	0.434
Sapphire WF MW Generation	0.535

For an emergency rating of 1,372MVA (current summer night rating)

QNI southerly MW limit = (1,372 - (-87.0) - 0.535 [0 to 270]) / 0.434

QNI southerly MW limit = (3,362 – 1.233 [0 to 270])

QNI southerly MW limit = 3,030MW to 3,360MW (due to post contingent transfer on 8E over summer night periods)

Table 14 - Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale South 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	125.0
QNI southerly MW flow	0.283
Directlink southerly MW flow	0.291
Sapphire WF MW Generation	0.281
White Rock WF MW Generation	0.205
White Rock SF MW Generation	0.205
Metz SF MW Generation	0.264
Moree SF MW Generation	-0.019
Gunnedah SF MW Generation	-0.277
New England SF MW Generation	0.362
Central West Orana REZ Generation	0.080
North East NSW MW Load	-0.274
North West NSW MW Load	0.137
Central Coast NSW MW Load	-0.174

Table 15 - Simplified Tamworth to New England 330kV (85-1) MVA flow prediction (for loss of Tamworth to Armidale South 330kV (86))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	142.0
QNI southerly MW flow	0.273
Influencing Net MW Generation	0.323

where Influencing Net MW Generation takes the same definition as Table 10.

The overall range of the *Influencing Net MW Generation* term is 0MW to 1,170MW, at night however the maximum value becomes 450MW. For an emergency rating of 1,040MVA (current summer night rating):

QNI southerly MW limit = (1,040 - 142.0 - 0.323 [0 to 450]) / 0.273

QNI southerly MW limit = (3,289 - 1.183 [0 to 450])

QNI southerly MW limit = 2,755MW to 3,289MW (due to post contingent transfer on 85 over summer night periods)

Table 16 - Tamworth to Armidale South 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	120.0
QNI southerly MW flow	0.279
Directlink southerly MW flow	0.285
Sapphire WF MW Generation	0.276
White Rock WF MW Generation	0.200
White Rock SF MW Generation	0.200
Metz SF MW Generation	0.255
Moree SF MW Generation	-0.022
Gunnedah SF MW Generation	-0.274
New England SF MW Generation	0.288
Central West Orana REZ Generation	0.079
North East NSW MW Load	-0.268
North West NSW MW Load	0.141
Central Coast NSW MW Load	-0.174

Table 17 - Simplified Tamworth to Armidale South 330kV (86) MVA flow prediction (for loss of Tamworth to New England SF 330kV (85-1))

Measured Variable	Coefficient
Intercept (95% Confidence Level)	138.0
QNI southerly MW flow	0.268
Influencing Net MW Generation	0.281

where Influencing Net MW Generation takes the same definition as Table 10.

For an emergency rating of 1,017MVA (current summer night rating):

QNI southerly MW limit = (1,017 - 138.0 - 0.281 [0 to 450]) / 0.268

QNI southerly MW limit = (3,279 - 1.048 [0 to 450])

QNI southerly MW limit = 2,805MW to 3,279MW (due to post contingent transfer on 86 over summer night periods)

2.5 Corridor / Route Selection

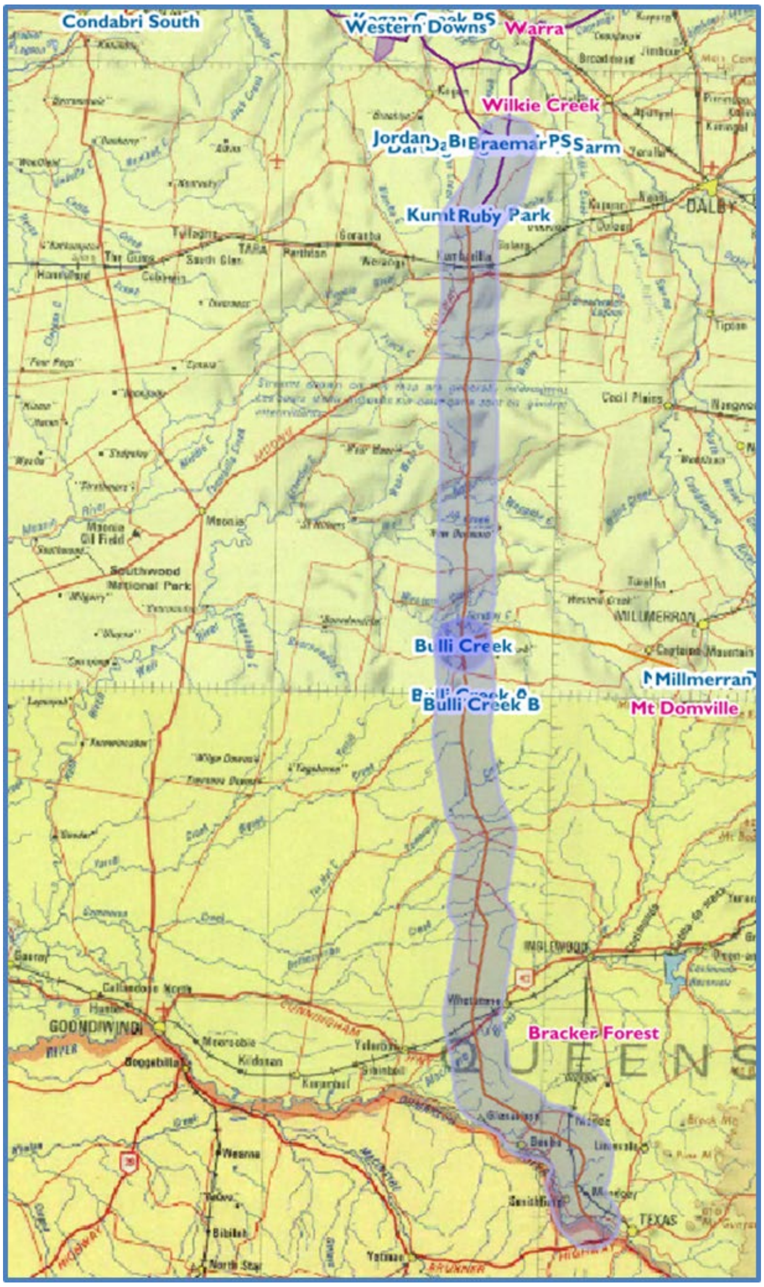

Figure 12 – Indicative alignment

A high-level desktop assessment has been conducted, exploring potential transmission line route options between Braemar and Dumaresq (NSW border crossing) via Bulli Creek. It is concluded that nominally following the existing QNI route, which connects the same substations, is the preferred option, as it is the most direct and is likely to be the lowest cost alternative, both for acquisition and construction phases. A notional corridor 20km wide surrounding the existing easement is assumed, and widening the existing easement, or creating a separate “parallel” easement are both possible within this corridor. A decision regarding separation between existing and proposed lines will be made at a later stage, taking into account all the relevant factors.

No provision is made for land acquisition at either Braemar or Bulli Creek substations. Both existing sites have vacant area available for the required expansion.

2.6 Project schedule and staging

A high level staging plan for an assumed commissioning date of June 2033 for QNI Medium is presented in Table 18.

Table 18 – High level schedule and staging (QNI Medium)

Activity	Target Completion
Project Approval – Property Acquisition	June 2025
Project Approval – Delivery	June 2030
Substation Site Access	June 2029
Transmission Line Site Access	June 2029
Substation Construction Complete	March 2033
Complete Transmission Line	March 2033
Commission	June 2033

An incremental high level staging plan for QNI Large with an assumed commissioning date of June 2036 is presented in Table 19. These dates are in addition to those presented for QNI Medium in order to deliver the full scope of works to deliver the QNI Large upgrade.

Table 19 – Incremental high level schedule and staging (QNI Large)

Activity	Target Completion
Project Approval – Delivery	June 2034
Substation Site Access	June 2034
Transmission Line Site Access	June 2034
Substation Construction Complete	December 2035
Complete Transmission Line	March 2036
Commission	June 2036

3 Cost estimates

The cost estimate for QNI Medium is presented in Table 20. This has been assessed as a class 5 estimate.

Table 20 – Estimate breakdown (QNI Medium)

QNI Medium 330kV Upgrade Class 5	Base Cost $k, real 2020
Overheads	**55,125**
Project Management, Coordination and Other Support	26,318
Property Acquisition, Environmental & Cultural Heritage	23,807
Environmental Offsets	5,000
Transmission Lines	**301,722**
Design	2,539
Procurement	27,612
Construction	271,571
Commissioning	-
Post Commissioning	-
Substations	**69,911**
Design	1,609
Procurement	37,323
Construction	29,852
Commissioning	1,060
Post Commissioning	68
Telecoms	**335**
Network Operations	**360**
Estimate Allowances	**23,542**
Estimate Total (include Project Allowance)	**450,995**
Total Contingency	**135,298**
Mitigated Risk (Known Risk)	-
Contingency (Unknown Risk)	135,298
Estimate Total (include Project Allowance, Risk & Contingency)	**586,293**

The cost estimate for QNI Large is presented in Table 21. This has been assessed as a class 5 estimate.

Table 21 – Estimate breakdown (QNI Large)

QNI Large 330kV Upgrade (Incremental cost in addition to QNI Medium) Class 5	Base Cost FY20
Overheads	**14,439**
Project Management, Coordination and Other Support	14,439
Property Acquisition, Environmental & Cultural Heritage	-
Environmental Offsets	-
Transmission Lines	**97,140**
Design	1,435
Procurement	31,406
Construction	64,299
Commissioning	-
Post Commissioning	-
Substations	**33,341**
Design	894
Procurement	22,026
Construction	9,596
Commissioning	789
Post Commissioning	36
Telecoms	**301**
Network Operations	**240**
Estimate Allowances	**8,050**
Estimate Total (include Project Allowance)	**153,511**
Total Contingency	**46,053**
Mitigated Risk (Known Risk)	-
Contingency (Unknown Risk)	46,053
Estimate Total (include Project Allowance, Risk & Contingency)	**199,564**

A detailed summary of the risks considered and included in each estimate are not available at this stage of development, therefore estimate allowances and risk costs have been based upon the class of estimate presented.

4 Approvals and stakeholders

4.1 Stakeholder engagement plan

Powerlink is committed to genuine and timely stakeholder engagement that leads to improved decision-making and better outcomes for our stakeholders. A detailed stakeholder engagement plan will be developed prior to engagement activities commencing, which will apply the principles established in our Stakeholder Engagement Framework [3]. Key stakeholders include customers, consumer advocacy groups, landholders, Traditional Owners, our Customer Panel, State and Local Government representatives.

Early engagement is anticipated with the key stakeholders, with a Project Participation and Access Allowance being made available to eligible landholders, in accordance with normal Powerlink practice. Engagement is expected to predominantly take the form of presentations and briefings, community briefings and one on one meetings. Powerlink will work with stakeholders to identify engagement preferences.

4.2 Stakeholder assessment

It is anticipated that landholder issues can be identified at an early stage and accommodated during the route finalisation process.

Consultation with the Traditional Owners is a significant component of the route selection process. Powerlink will engage and establish relationships with the relevant Traditional Owners and develop a Cultural Heritage Management Plan / Agreement in conjunction with the identified groups. This will also include a comprehensive on-site Cultural Heritage Survey conducted with the Traditional Owners. Measures will be implemented for the avoidance of impacts or management of Aboriginal Cultural Heritage.

Investigations into historical heritage will be conducted, and measures established to avoid impact on historic or other heritage.

4.3 Relevant planning overlays

Detailed geospatial data and planning overlays are not available at this stage of development. This information will be made available as the route alignment becomes more firm following appropriate engagement with landholders, Traditional Owners and relevant State and Local Government representatives.

4.4 Estimate of planning approval complexity

Planning approval for the transmission line will be facilitated under the Ministerial Infrastructure Designation process, per the Queensland Government's *Planning Act 2016*. No planning approval is required for the proposed substation works as the existing approval covers 330kV development at both Braemar and Bulli Creek. Impact on landholders is expected to be mainly along the existing corridor with very few, if any, additional properties affected by the easement. Overall the project has been assessed as having medium planning approval complexity, due to the number of stakeholders to be engaged, but risk of delays can be mitigated through early and effective engagement on the route selection.

5 References

1. 2020 Integrated System Plan, July 2020, https://aemo.com.au/-/media/files/major-publications/isp/2020/final-2020-integrated-system-plan.pdf?la=en, accessed 16 June 2021, Australian Energy Market Operator.

2. 2020 ISP Appendix 3. Network Investments, July 2020, https://aemo.com.au/-/media/files/major-publications/isp/2020/appendix--3.pdf?la=en, accessed 16 June 2021, Australian Energy Market Operator.

3. Stakeholder Engagement Framework, https://www.powerlink.com.au/engagement-framework, accessed 28 June 2021, Powerlink Queensland.