Business Case
Telecommunications Network Capacity & Coverage

ERGON. ENERGY NETWORK

Executive Summary

The existing Ergon Energy telecommunications network (comprising of fibre optic cables, microwave links, Time Division Multiplexing (TDM) equipment, Internet Protocol (IP) networking equipment, collectively called CoreNet) provides for a high speed, high capacity and robust telecommunications network, supporting the primary power distribution network in order to meet legislative, safety, business and customer requirements.

The number of Telecommunications services catered for on the network continues to grow despite the low growth in load on the power network. The number of services has approximately doubled in the current control period between 2015 and 2019. As the services have grown in number and utilisation, they have consumed capacity on the network such that capacity constraints are now being experienced. Key strategic directions including the various programs associated with the Intelligent Grid Strategy, including the likely impact of Internet of Things (IoT) devices and expanded monitoring of the Distribution Network to improve Asset Management for primary network assets, will cause increasing capacity and congestion issues during the 2020-25 regulatory period. As the number of services increases on existing links, the risk associated with failure of links without redundancy or loop diversity increases. These increasing risks can be mitigated by the strategic implementation of diversity to the existing network.

Two options were considered but rejected for this business case. A counterfactual, 'do nothing' option was rejected on the basis that it would pose unacceptable risk to the network. Another option to completely offset the cost of Telco Transmission Augmentation using DWDM was also rejected. This option is not considered reasonable, as DWDM would not be able to provide the necessary outcomes in all cases, so additional fibre rollout would always need to be included. Three network options were evaluated for this business case:

Option 1 – Upgrade Telecommunications capacity like for like before needs arise

Option 2 – Upgrade Telecommunications capacity like for like as constraints are projected to occur

Option 3 – Upgrade Telecommunications capacity with new technologies and like for like upgrades as constraints are projected to occur

Ergon Energy aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g. safety, bushfire), regulatory obligations (e.g. safety), customer reliability and security and preparing the network for the ongoing adoption of new technology by customers (e.g. solar PV). In this business case both the need to support the adoption of new technology by customers and reliability are strong drivers, based on the need to address existing and forecast network capacity and congestion issues.

To this end, Option 3 is the preferred option, as it has the least negative Net Present Value (NPV) result of the three options (-$10.9M), while still addressing the identified need for expanding network capacity.

The direct cost of the program for each submission made to the AER is summarised in the table below. Note that all figures are expressed in 2018/19 dollars and apply only to costs incurred within the 2020-25 regulatory period for the preferred option.

Regulatory Proposal	Draft Determination Allowance	Revised Regulatory Proposal
$13.0M	N/A	$11.7M

Contents

1. Introduction

The existing Ergon Energy telecommunications network (CoreNet) is vital to support operational requirements. Operational services across the distribution network support critical voice and data services to co-ordinate safe and efficient work activities, access medical or emergency services, and monitor and control the power network. CoreNet operates over sites and infrastructure that is directly owned by Ergon Energy or leased from third parties. Existing arrangements are reviewed periodically to identify prudent options to take advantage of network changes.

1.1 Purpose of document

This document recommends the optimal capital investment necessary to increase the capacity and resiliency of the communication network by increasing the communication coverage across the State.

This is a preliminary business case document and has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Energy Revised Regulatory Proposal to the Australian Energy Regulator (AER) for the 2020-25 regulatory control period. Prior to investment, further detail will be assessed in accordance with the established Energy Queensland (EQL) investment governance processes. The costs presented are in $2018/19 direct dollars.

1.2 Scope of document

The scope of this proposal consists of three key areas; telco technology introduction, telco transmission augmentation, and external removal of third-party infrastructure. Assets replaced under replacement expenditure (Repex) programs were excluded from this program. Details of the scope of each of these areas are given in Table 1 below.

Table 1: Scope of each area addressed by this proposal

Area	Scope
Telco Technology Introduction	A range of activities involved with the integration of industry accepted telecommunication technologies into CoreNet. These include lab testing, trailing, system integration and process modifications. This is an ongoing program that covers a range of technology introductions including: • **Firmware upgrades** to improve security, provide additional functionality and increase reliability. • **Dense Wavelength Division Multiplexing (DWDM)** which is a technology that provides significant network capacity increase with no requirement for additional fibre installation. • **5G Integration** which provides new opportunities for Ergon Energy to connect new equipment or increase the services available from existing equipment. This will mitigate the need to increase the coverage of the telecommunication network. • **WIFI at Substations to** remotely connect compatible Intelligent Electronic Devices (IED) and corporate devices such as phones and laptops.
Telco Transmission Augmentation	To address assets that are at or near capacity, augmentation measures considered include new technologies tested under the Telco Technology Introduction stream described above. If such new technologies are not acceptable then existing technology platforms will be utilised which will include the new installation of the following; • Overhead or Underground Fibre • Microwave Links • Internet Protocol (IP) Networking Equipment

Area	Scope
	The implementation of the existing technology platforms requires significant resources and materials compared to new technologies such as Dense Wavelength Division Multiplexing (DWDM) which will increase the capacity of the existing fibre network with no additional infrastructure requirements.
External Removal of Third Party Infrastructure	The program to maintain the integrity of CoreNet with the purchase of Powerlink sites and infrastructure is forecast to continue in 2019-20 and 2020-21. A total of 9 Powerlink sites have been identified for purchase and negotiations with Powerlink have commenced.

It should be noted that there are dependencies between Telco Transmission Augmentation and Telco Technology Introduction. Successful implementation of Dense Wavelength Division Multiplexing (DWDM) should reduce the need for additional fibre installation. However, utilising new fibre cable instead of the DWDM equipment could mitigate potential future diversity issues, and this would need to be assessed on a case by case basis. As such, there is a balance between these two programs that will need to be determined during detailed planning of each case.

1.3 Identified Need

Ergon Energy aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g. safety, bushfire), regulatory obligations (e.g. safety), customer reliability and security and preparing the network for the ongoing adoption of new technology by customers (e.g. solar PV). In this business case both the need to support the adoption of new technology by customers and reliability are strong drivers, based on the need to address existing and forecast network capacity and congestion issues.

The program is required to ensure we can meet current and future business requirements that will support meeting our obligations for legislated compliance, by ensuring ongoing and reliable carriage of protection and control communications services. There are current constraints on localised sections of the existing network that require investment to address, which are described in more detail in Section 1.7. Given the need to provide Telecommunications for mission critical protection and Supervisory Control and Data Acquisition (SCADA) applications, there are no viable alternative methods to provision the network.

Similar to power network Augmentation activities, ideally Telecommunications network would provide capacity ahead of the demand, rather than reacting to the required demand. This needs to be balanced with cost of providing the capacity to ensure investments are prudent. This program will support the business to deliver on the future grid roadmap, providing the technology platform to enable the digital platform. This is essential to enable an intelligent grid.

In addition, the introduction of industry accepted telecommunication related technologies to CoreNet is an ongoing requirement to support changing business and customer needs. These technologies are used to provide new functionality required by the organisation and efficiently increase capacity and utilisation of the existing network.

These are described in the following sections. This proposal aligns with the CAPEX objectives, criteria and factors from the National Electricity Rules as detailed in Appendix C.

1.4 Energy Queensland Strategic Alignment

Table 2 below details how the proposed works contribute to Energy Queensland's corporate and asset management objectives. The linkages between these Asset Management Objectives and EQL's Corporate Objectives are shown in Appendix D.

Table 2: Asset Function and Strategic Alignment

Objectives	Relationship of Initiative to Objectives
Ensure network safety for staff contractors and the community	Provides communication services at substations field sites to reduce risk to staff, contractors and the community, which offers the business the opportunity to reach the safety objective goals.
Meet customer and stakeholder expectations	Continued service availability supports network reliability and promotes efficient delivery of a standard quality electrical energy service. Customers have indicated they want prudent investments in technology to modernise the network, to enable them to interact with the network, manage their electricity costs and take advantage of new products and technology developments. A modern communication network is a critical part of the intelligent grid of the future that will enable this for our customers.
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	This proposal promotes an approach that balances the need for investment to reduce risks and support the delivery of services at a quality expected by the community, against the need to prudently manage costs. An example of this is workforce efficiencies and reduced ICT costs achieved by provision of corporate data services between locations and access to corporate ICT applications and systems in substations and other field locations, aligning with the digitalisation of processes and practices.
Develop Asset Management capability & align practices to the global standard (ISO55000)	Development of a well-planned and integrated communication system in a systematic and timely manner to support the primary electricity network is consistent with the requirements of asset management standards
Modernise the network and facilitate access to innovative energy technologies	Promotes the development and introduction of new technology to provide modern communications capabilities and provide operational efficiencies. In addition, increasing the capacity of communications networks will be key to enabling greater value to be realised from new technologies. An example is the provision of data communications which deliver reliability and power quality improvement as well as enabling Demand Management and Load Control applications and systems.

1.5 Applicable service levels

Corporate performance outcomes for this asset are rolled up into Asset Safety & Performance group objectives, principally the following Key Result Areas (KRA):

- Customer Index, relating to Customer satisfaction with respect to delivery of expected services
- Optimise investments to deliver affordable & sustainable asset solutions for our customers and communities

1.6 Compliance obligations

Table 3 shows the relevant compliance obligations for this proposal.

Table 3: Compliance obligations related to this proposal

Legislation, Regulation, Code or Licence Condition	Obligations	Relevance to this investment
QLD Electrical Safety Act 2002 **QLD Electrical Safety Regulation 2013**	We have a duty of care, ensuring so far as is reasonably practicable, the health and safety of our staff and other parties as follows: • Pursuant to the Electrical Safety Act 2002, as a person in control of a business or undertaking (PCBU), EQL has an obligation to ensure that its works are electrically safe	This program is important to assist Ergon to meet its obligations in relation to staff and public safety. This is achieved through

Legislation, Regulation, Code or Licence Condition	Obligations	Relevance to this investment
	and are operated in a way that is electrically safe.[1] This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work.[2]	providing communication with substation field sites.
Distribution Authority for Ergon Energy or Energex issued under section 195 of *Electricity Act 1994* (Queensland)	Under its Distribution Authority: • The distribution entity must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services. • The distribution entity will ensure, to the extent reasonably practicable, that it achieves its safety net targets as specified. • The distribution entity must use all reasonable endeavours to ensure that it does not exceed in a financial year the Minimum Service Standards (MSS)	This program is in line with good practice in design. It balances the introduction of new technologies against the need for reliable communications systems. This should support Ergon to meet its compliance obligations.
National Electricity Rules, Chapter 5	Schedule S5.1 of the National Electricity Rules, Chapter 5 provides a range of obligations on Network Services Providers relating to Network Performance Requirements. These include: • Section S5.1.9 Protection systems and fault clearance times • Section S5.1a.8 Fault Clearance Times • Section S5.1.2 Credible Contingency Events	This program ensures ongoing and reliable carriage of protection and control communications services.

1.7 Limitation of existing assets

Growth of Telecommunications services utilized in Ergon Energy continues at a rate much larger than the load growth experienced in the power network. Figure 1 below show the year on year growth of Ethernet services in the network.

[1] Section 29, *Electrical Safety Act 2002*
[2] Section 30 *Electrical Safety Act 2002*

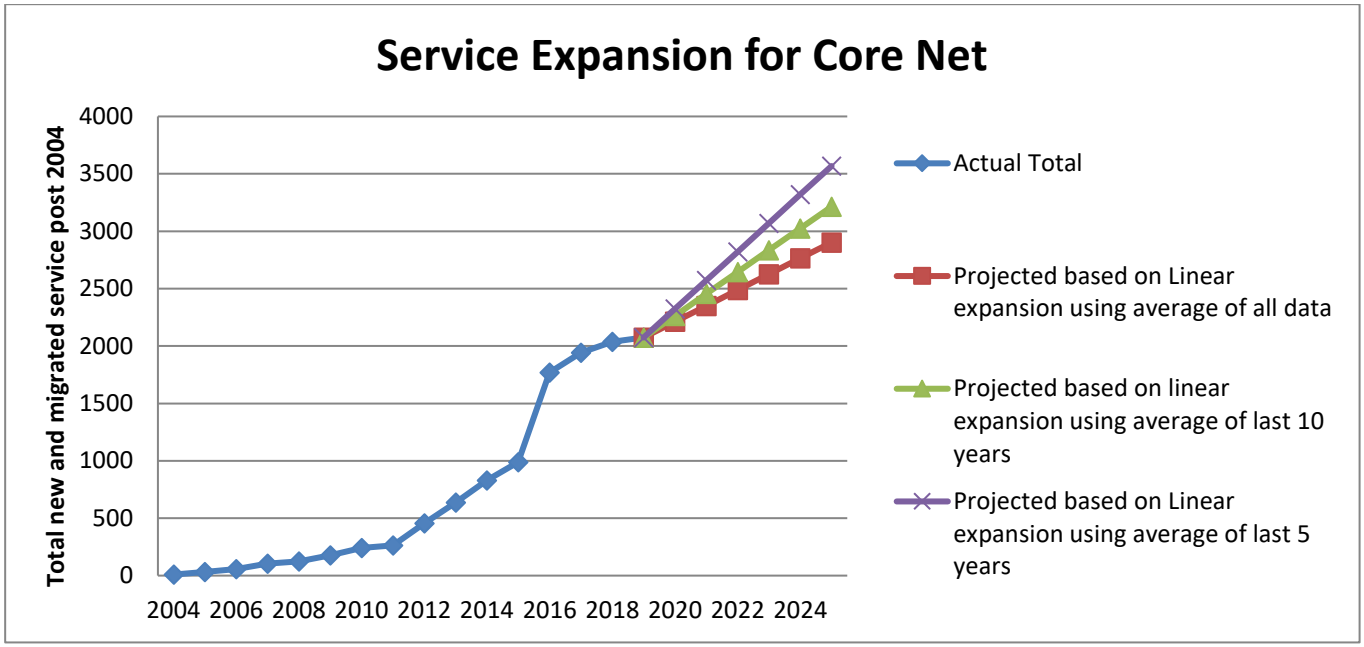

Figure 1 – growth of services commissioned on the Ergon Telecommunications network

As the services have grown in number and utilisation, they have consumed capacity on the network such that capacity and coverage constraints are now being experienced.

Key strategic directions including the various programs associated with the Intelligent Grid Strategy, likely impact of Internet of Things (IoT) devices and expanded monitoring of the Distribution Network to improve Asset Management of the power network will cause increasing capacity and congestion issues during the 20-25 regulatory period.

As the number of services increases the following limitations result: -.

- Congested Fibre Optic Cables where no cores are available for extra services currently or will be by the end of the regulatory period
- Microwave links and other infrastructure that are congested
- Non – diverse systems architecture. Increasing risk from failure of an ever-increasing number of services provisioned in non-diverse architectures.
- Need to secure non-Ergon Energy owned communications sites that are critical to the performance of the network that are proposed to be disposed of by the site owners.

Below is a discussion on each of these limitations.

- **Congested Fibre Optic cables**

In the Ergon fibre network a number of cables are full (no cores are available) or are on the verge of being full. This is occurring on the older cables which have lower per cable fibre counts. Core counts in the network vary from 2 to 96 cores per cable, with 9% of total cables having 6 or less cores and 50% of total cables having between 12 and 36 cores. Data gathered in our recent analysis suggests that 4.75% by count or 2.9% by length of fibre cables will experience capacity issues within the 2020-25 regulatory control period, as shown in Table 4. However, it is likely that the true figure will exceed this amount due to the limitations of current data sources. While the percentage of fibres exceeding threshold are be small, these are concentrated in specific areas resulting in a greater need for action.

This proposal is targeted specifically at only these key areas of constraint, which is a relatively small investment as compared to the overall size of the network. Some examples of the issues currently being experienced relating to these limitations have been included in Appendix G.

Table 4: Current status of fibres in the Ergon Energy telecommunications network

Fibre Capacity	Number of Fibres	% of total Fibre numbers	Length (km)	% of total length of Fibre network
Total Fibres	2947	100%	2,106.1	100%
Fibres Completely Full	38	1.29%	2.6	0.12%
Fibres Exceeding Threshold	102	3.53%	58.5	2.78%
Total Fibres currently exceeding performance thresholds (< 2025)	**140**	**4.75%**	**61.1**	**2.90%**

- **Microwave links and other infrastructure that are congested**

Because of the increased demand, the network is experiencing capacity restraints in microwave radio links, ports on IP networking equipment and in many instances capacity data services running on fibre cabling. Some examples of the issues currently being experienced relating to these limitations have been included in Appendix G.

It is vital to the business operations that there is sufficient network capacity to ensure that operational requirements can be met, and the safety of the network, customers and employee are not put a risk.

- **Non – diverse systems architecture**

The fibre cable and microwave networks have grown organically based on power network augmentation works. The resulting network has a range of areas where diversity is not present and as more services are implemented, and the capacity and importance of existing services increases risk of failure escalates to a point that will justify the implementation of redundant paths / rings allowing rerouting of traffic during failures. Ideally only extra fibre cabling and associated equipment would be implemented however in many cases this will not be cost effecting and microwave links would be utilised. Appendix G contains existing implementations where fibre cabling could be installed to improve diversity. These total to 61km of fibre cable.

- **External Removal of Third-Party Infrastructure**

Powerlink is one of the third-party providers used by Ergon Energy to establish CoreNet. Powerlink advised in 2016-17 that they were selling their radio sites and infrastructure across the majority of Queensland. To maintain the integrity of CoreNet in 2018-19 Ergon Energy purchased eight communication sites. Powerlink will continue to sell their remaining radio sites.

There is an inherent risk of the loss of critical services if Ergon Energy does not purchase these sites. The cost to rearrange/relocate services from the identified Powerlink sites is significantly greater than the Powerlink sell price.

Using technology to overcome issues

Issues associated with congestion can be overcome without the need to implement like for like cable infrastructure. Use of Dense Wave Division Multiplex (DWDM) can effectively provide the capacity requirements without the need of extra fibre cable implementation.

While the introduction of this technology will be able to moderate the need for additional infrastructure investments to overcome congestion, non-redundant architecture can only be resolved by the implementation of new capacity.

Increasing requirements driving service and capacity increases

The current limitations of these assets will also be exacerbated by the increasing need for network capacity to support the move towards smart grid capabilities and growing role of internet of things (IoT) devices. The drivers for this growth and our strategic approach to leverage these technologies is outlined in Energy Queensland's Future Grid Roadmap and Intelligent Grid Technology Plan (2019).

Other business cases that will rely on the increased use of sensors or the capacity of the network include the following:

- Energy Queensland – LV Network Safety
- Energy Queensland – Intelligent Grid Enablement
- Energex – Power Quality
- Ergon Energy – Power Quality

In addition, CoreNet needs to account for a forecasted dramatic increase in cyber threats and the likely legislated and business needs to mitigate risks associated with these threats and ensure adherence to Australian Energy Market Operator (AEMO) standards for protection network expansion. It is unclear what extra capacity may be necessary, potential requirements include increasing firewalling, encryption and other data protections pervasively within Corenet.

2 Counterfactual Analysis

2.1 Purpose of asset

The assets addressed in this program form an essential part of Ergon Energy's telecommunications network and are vital to support operational requirements and meet safety and protection obligations as detailed in the sections above.

2.2 Business-as-usual service costs

The business as usual (BAU) service costs for these assets are the maintenance costs associated with ongoing operations. In addition to these costs, significant emergency response and replacement costs would be incurred for the counterfactual BAU case if failures occur. These have not been explicitly costed in this case due to the significant safety, reliability and compliance risks associated with asset failures.

2.3 Key assumptions

The assumptions made include:

- There is an expectation that additional capacity constraints will occur and will be included in the program
- No delay or extended material procurement times greater than 3 months.
- Assets replaced under Repex projects are excluded from the program.

2.4 Risk assessment

This risk assessment is in accordance with the EQL Network Risk Framework and the Risk Tolerability table from the framework is shown in Appendix E.

Table 5: Counterfactual risk assessment

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Corporate Voice / Data: Failure of corporate voice, data and internet communication. This leads to inability to access corporate IT systems. Inability to remotely control or manage the network across multiple sites.	Business	4 *(Inability to control ≥2 bulk supply substations supply area)*	3 *(Unlikely)*	**12** ***(Moderate Risk)***	2020
Cyber security: Obsolete technology leads to vulnerabilities in corporate voice, data and internet communications. Ergon Energy unable to meet the AEMO standards for protection network expansion. Compliance breach with external standards.	Business	3 *(Compliance breach with external standards)*	4 *(Likely)*	**12** ***(Moderate Risk)***	2020
Technology obsolescence: Obsolete technology leads to capabilities below acceptable industry best practice in corporate voice, data and internet communications. Ergon Energy is unable to implement incremental changes to update or extend existing technology. Resulting lost opportunity >$1 million.	Business	4 *(Asset impact (including obsolescence) Lost opportunity >$1 million)*	3 *(Unlikely)*	**12** ***(Moderate Risk)***	2020

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Infrastructure Procurement: Radio towers are owned by Powerlink who sell to 3rd party providers. Ergon Energy is unable to purchase currently used radio tower assets at a reasonable cost resulting in the requirement to construct or procure assets elsewhere. Additional costs to the business >$5 Million.	Business	5 *(Strategic Direction - Additional Costs to the business >$5 million)*	3 *(Unlikely)*	**15** ***(Moderate Risk)***	2020

Further Details of the risk ratings and descriptions can be found in Energy Queensland's Network Risk Framework.

The network (business) risk the organisation would be exposed to if the project was not undertaken is not deemed to be as low as reasonably practicable (ALARP). Addressing the risks as detailed above through implementation of the preferred option will reduce Ergon Energy's risk exposure.

The relationship of each area of this program to these risks is as follows:

Telco Technology Introduction

The introduction of industry accepted telecommunication related technologies to CoreNet is based on a needs basis. The forecasts are conservative, and costs are based on completion of previous similar activities completed since 2009.

Telco Transmission Augmentation

Without additional transmission, augmentation projects specific CoreNet transmission paths will not have sufficient transmission capacity to meet service growth needs and will find itself in breach of applicable standards.

External Removal of Third-Party Infrastructure

Without purchase of the identified Powerlink sites, critical CoreNet transmission paths will not be maintained resulting in loss of critical services and loss of transmission redundancy.

2.5 Retirement decision

Due to the nature of these assets in providing essential communications, they are not considered for retirement and must be continued. New technologies introduced as part of this program will be used to mitigate the need for investment in additional infrastructure.

3 Options Analysis

3.1 Options considered but rejected

The counterfactual case where no action is taken has been rejected due to the unacceptable level of risk it would introduce.

In addition, the option to completely offset the cost of Telco Transmission Augmentation using DWDM was considered. However, this option is not considered reasonable as DWDM would not be able to provide the necessary outcomes in all cases (specifically to overcome non-diverse architecture), so fibre rollout would always need to be included.

3.2 Identified options

Three main options were identified for this program:

- **Option 1: Upgrade Telecommunications capacity like for like before needs arise.**
  - Implement 124km of cable to overcome congestion and diversity issues
  - Acquire communications sites
- **Option 2: Upgrade Telecommunications capacity like for like as constraints are projected to occur (similar to Option 1, but with Telco Transmission Augmentation and Telco Technology Introduction spread over more years)**
  - Implement 124km of cable to overcome congestion and diversity issues
  - Acquire communications sites
- **Option 3: Upgrade Telecommunications capacity with new technologies and like for like as constraints are projected to occur**
  - Offset a portion of fibre Augmentation with an expanded and accelerated DWDM rollout.
  - Implement 61km of fibre cable to overcome diversity issues
  - Acquire communications sites

Further details of how each area of the program would be impacted by these options is described in Table 6.

Table 6: Options identified for this program

	Option 1: Like for like before need arises	Option 2: Like for like as constraints are projected to occur	Option 3: Accelerated Technology Introduction and like for like as constraints are projected to occur
Telco Transmission Augmentation	Transmission augmentation related projects would be completed only as forecast service needs are confirmed.	The transmission augmentation related projects would be completed only as forecast service needs are confirmed.	Fibre augmentation for congestion would be replaced in this case, with use of DWDM technology. Implementation of fibre cable will continue to be necessary to overcome non-diverse architecture constraints.

	Option 1: Like for like before need arises	Option 2: Like for like as constraints are projected to occur	Option 3: Accelerated Technology Introduction and like for like as constraints are projected to occur
Telco Technology Introduction	This option brings forward and expands the range of introduced industry accepted telecommunication related technologies to CoreNet in advance of business needs.	The introduction of industry accepted telecommunication related technologies to CoreNet would be based on a needs basis. The forecast technology introduction requirements are conservative, and the costs used are based on the completion of previously similar activities since 2009	This option includes significant additional investment in DWDM over the 2020-25 regulatory control period. Through this expanded and accelerated adoption of DWDM, fibre installation to relieve congestion related initiatives could be offset.
External Removal of Third Party Infrastructure	Would involve purchasing Powerlink sites that will in the future assist with the expansion of CoreNet.	Powerlink sites have been individually assessed and only where there is an identified immediate need to maintain the integrity of CoreNet would purchases be considered.	Powerlink sites have been individually assessed and only where there is an identified immediate need to maintain the integrity of CoreNet would purchases be considered.

3.3 Economic analysis of identified options

3.3.1 Cost versus benefit assessment of each option

Costs for these options were developed based on previous programs of work. A summary of the total cost of each of the options over the 2020-25 regulatory control period is shown in Table 7 below. Mitigation of the high-risk counterfactual approach will result in reactive solutions; this option is more expensive than any of the options considered.

Table 7: Cost breakdown by program for each of the options considered

Program	Option 1 or Option 2 (Total costs 2020-25, $)	Option 3 (Total costs 2020-25, $)
Telco Transmission Augmentation	$11,251,061	$6,001,061
Telco Technology Introduction	$887,827	$4,887,827
External Removal of Third Party Infrastructure	$890,313	$890,313
TOTAL (All Programs)	**$13,029,201**	**$11,698,201**

The costs of Option 1 and Option 2 are the same, but these are spread differently across the years as shown in Table 8 and Table 9. The cost breakdown for each year of Option 3 is shown in Table 10.

Table 8: Costs per year for Option 1: Like for like before need arises

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Telco Transmission Augmentation	$5,183,001	$6,068,060	-	-	-
Telco Technology Introduction	$443,710	$444,117	-	-	-

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
External Removal of Third Party Infrastructure	$890,313	-	-	-	-
TOTAL (All Programs)	**$6,517,024**	**$6,512,177**	-	-	-

Table 9: Costs per year for Option 2: Like for like as need arises

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Telco Transmission Augmentation	$2,240,145	$1,892,358	$2,100,997	$3,065,333	$1,952,228
Telco Technology Introduction	$147,890	$147,890	$295,861	$148,296	$147,890
External Removal of Third Party Infrastructure	$890,313	-	-	-	-
TOTAL (All Programs)	**$3,278,348**	**$2,040,248**	**$2,396,858**	**$3,213,629**	**$2,100,118**

Table 10: Costs per year for Option 3: Accelerated Technology Introduction and like for like as need arises

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Telco Transmission Augmentation	$1,190,145	$842,358	$1,050,997	$2,015,333	$902,228
Telco Technology Introduction	$947,890	$947,890	$1,095,861	$948,296	$947,890
External Removal of Third Party Infrastructure	$890,313	-	-	-	-
TOTAL (All Programs)	**$2,947,348**	**$1,790,248**	**$2,146,858**	**$2,963,629**	**$1,850,118**

These comparisons reveal that Option 3 provides the lowest cost option from a direct cost perspective.

Additional Net Present Value (NPV) analysis was undertaken for each option, discounting the annual CAPEX for each option over a 20-year period from 2019/20 to 2039/40, at the Regulated Real Pre-Tax Weighted Average Cost of Capital (WACC) rate of 2.62%. The results of NPV analysis are shown in Table 11. Once again, Option 3 provided the strongest performance, with an NPV of -$10.9M, as compared to Option 1 and 2 which had more negative NPVs.

Table 11: NPV of options considered

Option	NPV
Option 1: Like for like before needs arise	-$12,534,533
Option 2: Like for like as constraints are projected to occur	-$12,093,135
Option 3: New Technology and like for like upgrades as constraints are projected to occur	-$10,856,747

3.4 Scenario Analysis

3.4.1 Sensitivities

The proposed works are sensitive to the implications of any upcoming changes to requirements and the successful implementation of the new technologies introduced such as DWDM.

If increased capacity were needed, or an increased percentage of fibres were to exceed their performance thresholds, this would require the work schedule to be brought-forward as needed.

Failures of these assets could result in inability to contact emergency help, or the inability to control areas of the network, resulting in safety and business risks as detailed above.

The costs of Option 3 are considered to be more uncertain than the traditional approach outlined in Options 1 & 2, due to the increased reliance on the introduction of new technologies in this case. While cost variations were uniform for the NPV analysis in above, a further scenario was considered with cost variation of +/- 10% for Option 1 & 2 as above, and +/- 20% for Option 3. The results of the NPV analysis for this scenario are given in Table 12 below. It is evident that Option 3 remains the preferred option even in the event of greater cost variation.

Table 12: NPV of Options 1-3 with differing levels of variability to cost

Option	Average NPV	Maximum NPV	Minimum NPV
Option 1: Like for like before need arises	-$12,553,012	-$11,661,267	-$13,352,886
Option 2: Like for like as constraints are projected to occur	-$12,123,912	-$11,480,124	-$12,637,144
Option 3: Accelerated Technology Introduction and like for like as constraints are projected to occur	-$10,852,213	-$10,506,431	-$11,209,319

3.4.2 Value of regret analysis

In terms of selecting a decision pathway of 'least regret', Option 3 has a significantly lower cost while providing relatively similar outcomes to the other two options. The costs saved by selecting Option 3 must be considered in conjunction with the risks introduced by using DWDM rather than investing in additional fibre that would resolve congestion but could also improve diversity. Given the magnitude of these cost savings and combined with the fact that only a portion of the fibre rollout is being reduced in favour of DWDM, this is a balanced approach to dealing with the existing constraints on the network.

The approach selected is staged and risk-assessed and can be accelerated if required. Given the options available, Option 3 can be considered the least regret option.

3.5 Qualitative comparison of identified options

3.5.1 Advantages and disadvantages of each option

Table 13 below details the advantages and disadvantages of each option considered.

Table 13: Assessment of options

Option	Advantages	Disadvantages
Option 1: Like for like before needs arise	**Risk** This is the lowest risk approach. There is a risk of delays in service provision if un-forecast service growth occurs and transmission augmentation projects have not been completed. However, this will be mitigated with close monitoring of service growth and regular stakeholder consultation to confirm assumed service growth. The purchase of additional Powerlink sites may prove beneficial in future.	**Cost** This option would result in higher initial costs than Option 2, and significantly more expense than Option 3.
Option 2: Like for like as constraints are projected to occur	**Risk** This Option provides a balanced approach to reducing risks to ALARP. **Cost** This option provides a cost-effective method for meeting the identified needs. The forecast technology introduction requirements are conservative, and the costs used are based on the completion of previously similar activities since 2009.	**Risk** There is a risk of delays in service provision if un-forecast service growth occurs. **Cost** While this option provides a favourable option in terms of costs relative to Option 1 and the counterfactual, it is significantly more expensive than Option 3.
Option 3: New Technology and like for like upgrades as constraints are projected to occur	**Risk** This Option provides a balanced approach to reducing risks to ALARP. **Cost** This is the least-cost option and provides a cost-effective method for meeting the identified needs.	**Risk** Likely that the diversity provided by this option is lower than that which would be provided by Options 1 and 2 as cabling implemented to resolve congestion issues could also improve diversity outcomes.
Counterfactual		**Risk** This option would result in the greatest risk of any option considered, with the risks introduced not being ALARP. **Cost** This option would defer the investments discussed in this proposal, but the reactive works required to deal with the resulting issues would have a higher overall cost.

3.5.2 Alignment with network development plan

Option 3 aligns with the Asset Management Objectives in the Distribution Annual Planning Report. In particular it manages risks, performance standards, and asset investment to deliver balanced commercial outcomes while modernising the telecommunications network to facilitate access to innovative technologies.

3.5.3 Alignment with future technology strategy

This program of work supports Energy Queensland's transition to modern communications network technologies. This is in alignment with the Future Grid Roadmap and Intelligent Grid Technology Plan, which promote the use of modern technology in maintaining affordability of the distribution network while also maintaining safety, security and reliability of the energy system, and supporting optimal customer outcomes and value across short, medium and long-term horizons.

Additionally, customers have indicated they want prudent investments in technology to modernise the network, to enable them to interact with the network, manage their electricity costs and take advantage of new products and technology developments. A modern communication network is a critical part of the intelligent grid of the future that will enable this for customers.

3.5.4 Risk Assessment Following Implementation of Proposed Option

While Option 1 and 2 would reduce the risks detailed in Section 2.4, however these options provide poor cost efficiency. Option 3 would reduce the risk to ALARP as described in

Table 14.

Table 14: Risk assessment showing risks mitigated following Implementation

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Corporate Voice / Data: Failure of corporate voice, data and internet communication. This leads to inability to access corporate ICT systems. **Inability to remotely control or manage the network across multiple sites.**	Business	*(Original)* *4* *(Inability to control ≥2 bulk supply substations supply area)* (Mitigated) 4 *(Inability to control ≥2 bulk supply substations supply area)*	*3* *(Unlikely)* 1 *(Almost no likelihood)*	***12*** ***(Moderate Risk)*** **4** ***(Very Low Risk)***	2020
Cyber security: Obsolete technology leads to vulnerabilities in corporate voice, data and internet communications**.** Ergon Energy unable to meet the **AEMO standards for protection network expansion. Compliance breach with external standards.**	Business	*(Original)* *3* *(Compliance breach with external standards)* (Mitigated) 3 *(Compliance breach with external standards)*	*4* *(Likely)* 2 *(Very Unlikely)*	***12*** ***(Moderate Risk)*** **6** ***(Low Risk)***	2020
Technology obsolescence: Obsolete technology leads to capabilities below acceptable industry best practice in corporate voice, data and internet communications**.** Ergon Energy is unable to implement incremental changes to update or extend existing technology. **Resulting lost opportunity >$1 million.**	Business	*(Original)* *4* *(Asset impact (including obsolescence) Lost opportunity >$1 million)* (Mitigated) 4 *(Asset impact (including obsolescence) Lost opportunity >$1 million)*	*3* *(Unlikely)* 1 *(Almost no likelihood)*	***12*** ***(Moderate Risk)*** **4** ***(Very Low Risk)***	2020
Infrastructure Procurement: Radio towers are owned by Powerlink who sell to 3rd party providers**.** Ergon Energy is unable to purchase currently used radio tower assets at a reasonable cost resulting in the requirement to construct or procure assets elsewhere. **Additional costs to the business >$5 Million.**	Business	*(Original)* *5* *(Strategic Direction - Additional Costs to the business >$5 million)* (Mitigated) 5 *(Strategic Direction - Additional Costs to the business >$5 million)*	*3* *(Unlikely)* 1 *(Almost no likelihood)*	***15*** ***(Moderate Risk)*** **5** ***(Very Low Risk)***	2020

4 Recommendation

4.1 Preferred option

The preferred option is Option 3, as this provides a balanced approach between risk reduction and cost efficiency. The work will be prioritised and organised into bundles to reduce overall program costs. The risk exposure is greater than Option 1 as the program will be completed over a longer time frame however, this is a prudent approach to the delivery of the program.

4.2 Scope of preferred option

The delivery timeframes for each area of the recommended option are as follows:

- **Telco Technology Introduction:** Ongoing program - Projects commenced in 2018-19 and will continue across the 2020-25 regulatory control period and beyond.
- **Telco Transmission Augmentation:** Ongoing program - Projects commenced in 2018-19 and will continue across the 2020-25 regulatory control period and beyond.
- **External Removal of Third Party Infrastructure:** The present Powerlink third party driver will see purchase of additional sites from 2018-19 through to 2020-21. At present, there are no further known changes to existing third-party arrangements that require augmentation funding.

The forecast CAPEX profile of the preferred Option 3 in this program is as shown in Table 15. The total CAPEX associated with the next regulatory period 2020-2025 is $11,698,201 (real $2018/19)

Table 15: Costs per year for Option 3: Accelerated Technology Introduction

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25	Total
Telco Transmission Augmentation	$1,190,145	$842,358	$1,050,997	$2,015,333	$902,228	**$6,001,061**
Telco Technology Introduction	$947,890	$947,890	$1,095,861	$948,296	$947,890	**$4,887,827**
External Removal of Third Party Infrastructure	$890,313	-	-	-	-	**$890,313**
TOTAL (All Programs)	**$2,947,348**	**$1,790,248**	**$2,146,858**	**$2,963,629**	**$1,850,118**	**$11,698,201**

Appendix A. References

Note: Documents which were included in Energy Queensland's original regulatory submission to the AER in January 2019 have their submission reference number shown in square brackets, e.g. Energy Queensland, *Corporate Strategy [1.001], (31 January 2019).*

Energy Queensland, *Asset Management Overview, Risk and Optimisation Strategy [7.025]*, (31 January 2019).

Energy Queensland, *Corporate Strategy [1.001],* (31 January 2019).

Energy Queensland, *Future Grid Roadmap [7.054],* (31 January 2019).

Energy Queensland, *Intelligent Grid Technology Plan [7.056],* (31 January 2019).

Energy Queensland, *Network Risk Framework*, (October 2018).

Ergon Energy, *Distribution Annual Planning Report (2018-19 to 2022-23) [7.049]*, (21 December 2018).

Appendix B. Acronyms and Abbreviations

The following abbreviations and acronyms appear in this business case.

Abbreviation or acronym	Definition
$M	Millions of dollars
$ nominal	These are nominal dollars of the day
$ real 2019-20	These are dollar terms as at 30 June 2020
2020-25 regulatory control period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ALARP	As Low as Reasonably Practicable
AMP	Asset Management Plan
BAU	Business as Usual
CAPEX	Capital expenditure
Current regulatory control period or current period	Regulatory control period 1 July 2015 to 30 June 2020
DAPR	Distribution Annual Planning Report
DC	Direct Current
DWDM	Dense Wavelength Division Multiplexing
EQL	Energy Queensland Ltd
ICT	Information and Communications Technology
IED	Intelligent Electronic Devices
IoT	Internet of Things
IP	Internet Protocol
IT	Information Technology
KRA	Key Result Areas
MSS	Minimum Service Standard
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules (or Rules)
Next regulatory control period or forecast period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025
NPV	Net Present Value

Abbreviation or acronym	Definition
PCBU	Person in Control of a Business or Undertaking
Previous regulatory control period or previous period	Regulatory control period 1 July 2010 to 30 June 2015
PV	Present Value
Repex	Replacement Expenditure
RIN	Regulatory Information Notice
RTS	Return to Service
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
WACC	Weighted average cost of capital

Appendix C. Alignment with the National Electricity Rules (NER)

The table below details the alignment of this proposal with the NER capital expenditure requirements as set out in Clause 6.5.7 of the NER.

Table 16: Alignment with NER

Capital Expenditure Requirements	Rationale
6.5.7 (a) (3) **The forecast capital expenditure is required to:** **(iii) maintain the quality, reliability and security of supply of supply of standard control services** **(iv) maintain the reliability and security of the distribution system through the supply of standard control services**	This program of work ensures the integrity of vital communications functions, which are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
6.5.7 (a) (4) **The forecast capital expenditure is required to maintain the safety of the distribution system through the supply of standard control services.**	This program of work ensures the integrity of vital communications functions that support numerous systems. They are critical in ensuring safety, and the availability of communications during all routine and emergency events.
6.5.7 (c) (1) (i) **The forecast capital expenditure reasonably reflects the efficient costs of achieving the capital expenditure objectives**	The options considered in this proposal take into account the need for efficiency in delivery. The preferred option has utilised a delivery approach that provides for a staging of work timing to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs. Specialised contractors are utilised as appropriate to ensure that costs are efficiently managed through market testing. Cost performance of the program will be monitored to ensure that cost efficiency is maintained. The Unit Cost Methodology and Estimation Approach sets out how the estimation system is used to develop project and program estimates based on specific material, labour and contract resources required to deliver a scope of work. The consistent use of the estimation system is essential in producing an efficient CAPEX forecast by enabling: • Option analysis to determine preferred solutions to network constraints • Strategic forecasting of material, labour and contract resources to ensure deliverability • Effective management of project costs throughout the program and project lifecycle, and • Effective performance monitoring to ensure the program of work is being delivered effectively. The unit costs that underpin our forecast have also been independently reviewed to ensure that they are efficient (Attachments 7.004 and 7.005).
6.5.7 (c) (1) (ii) **The forecast capital expenditure reasonably reflects the costs that a prudent operator would require achieving the capital expenditure objectives**	The prudency of this proposal is demonstrated through the options analysis conducted and the quantification of risk and benefits of each option. The prudency of our CAPEX forecast is demonstrated through the application of our common frameworks put in place to effectively manage investment, risk, optimisation and governance of the Network Program of Work. An overview of these frameworks is set out in our Asset Management Overview, Risk and Optimisation Strategy (Attachment 7.026).

Appendix D. Mapping of Asset Management Objectives to Corporate Plan

This proposal has been developed in accordance with our Strategic Asset Management Plan. Our Strategic Asset Management Plan (SAMP) sets out how we apply the principles of Asset Management stated in our Asset Management Policy to achieve our Strategic Objectives.

Table 2: "Asset Function and Strategic Alignment" in Section 1.4 details how this proposal contributes to the Asset Management Objectives.

The Table below provides the linkage of the Asset Management Objectives to the Strategic Objectives as set out in our Corporate Plan (Supporting document 1.001 to our Regulatory Proposal as submitted in January 2019).

Table 17: Alignment of Corporate and Asset Management objectives

Asset Management Objectives	Mapping to Corporate Plan Strategic Objectives
Ensure network safety for staff contractors and the community	**EFFICIENCY** ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Meet customer and stakeholder expectations	**COMMUNITY AND CUSTOMERS** ***Be Community and customer focused*** Maintain and deepen our communities' trust by delivering on our promises, keeping the lights on and delivering an exceptional customer experience every time
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	**GROWTH** ***Strengthen and grow from our core*** Leverage our portfolio business, strive for continuous improvement and work together to shape energy use and improve the utilisation of our assets.
Develop Asset Management capability & align practices to the global standard (ISO55000)	**EFFICIENCY** ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Modernise the network and facilitate access to innovative energy technologies	**INNOVATION** ***Create value through innovation*** Be bold and creative, willing to try new ways of working and deliver new energy services that fulfil the unique needs of our communities and customers.

Appendix E. Risk Tolerability Table

The Energy Queensland Network Risk Framework assesses individual risks in dimensions of Likelihood and Consequence according to a six by six risk matrix.

Risk Analysis 6x6 multiplication R=C x L	Consequence → 1	2	3	4	5	6
Likelihood ↑ 6	6	12	18	24	30	36
5	5	10	15	20	25	30
4	4	8	12	16	20	24
3	3	6	9	12	15	18
2	2	4	6	8	10	12
1	1	2	3	4	5	6

Network Risks - *Risk Tolerability Criteria and Action Requirements*

Risk Score	Risk Descriptor		Risk Tolerability Criteria and Action Requirements	
30 – 36	***Intolerable*** *(stop exposure immediately)*			
24 – 29	*Very High Risk*	*ALARP Risk in this range managed to As Low As Reasonably Practicable	**Executive Approval** (required for continued risk exposure at this level)	May require a full Quantitative Risk Assessment (QRA) Introduce new or changed risk treatments to reduce level of risk Periodic review of the risk and effectiveness of the existing risk treatments
18 – 23	*High Risk*		**Divisional Manager Approval** (required for continued risk exposure at this level)	Introduce new or changed risk treatments to reduce level of risk Periodic review of the risk and effectiveness of the existing risk treatments
11 – 17	*Moderate Risk*		**Group Manager / Process Owner Approval** (required for continued risk exposure at this level)	Introduce new or changed risk controls or risk treatments as justified to further reduce risk Periodic review of the risk and effectiveness of the existing risk treatments
6 – 10	Low Risk			
1 to 5	*Very Low Risk*		No direct approval required but evidence of ongoing monitoring and management is required	*Periodic review of the risk and effectiveness of the existing risk treatments*

**Note: SOFAIRP to be used for Safety Risks and ALARP for Network Risks*

Figure 1: A Risk Tolerability Scale for evaluating Semi-Quantitative risk score

Appendix F. Reconciliation Table

Reconciliation Table Conversion from $18/19 to $2020	
Business Case Value	
(M$18/19)	$11.70
Business Case Value	
(M$2020)	$12.13

Appendix G. Examples of limitation on the Ergon Energy fibre network

Congestion

Maryborough Town Fibre - High Priority

Maryborough town fibre loops between all sites are full and require urgent attention. There is no additional capacity to provision additional services or to re-route services via an alternative path if a fibre break occurs.

Below is an example of fully utilised 24 core fibre cable (Cable #5001:24c – highlighted red) between MARYCS (T59 Maryborough Substation) and MASRCS (Maryborough Searle St Depot). Figure 2 shows the cable location.

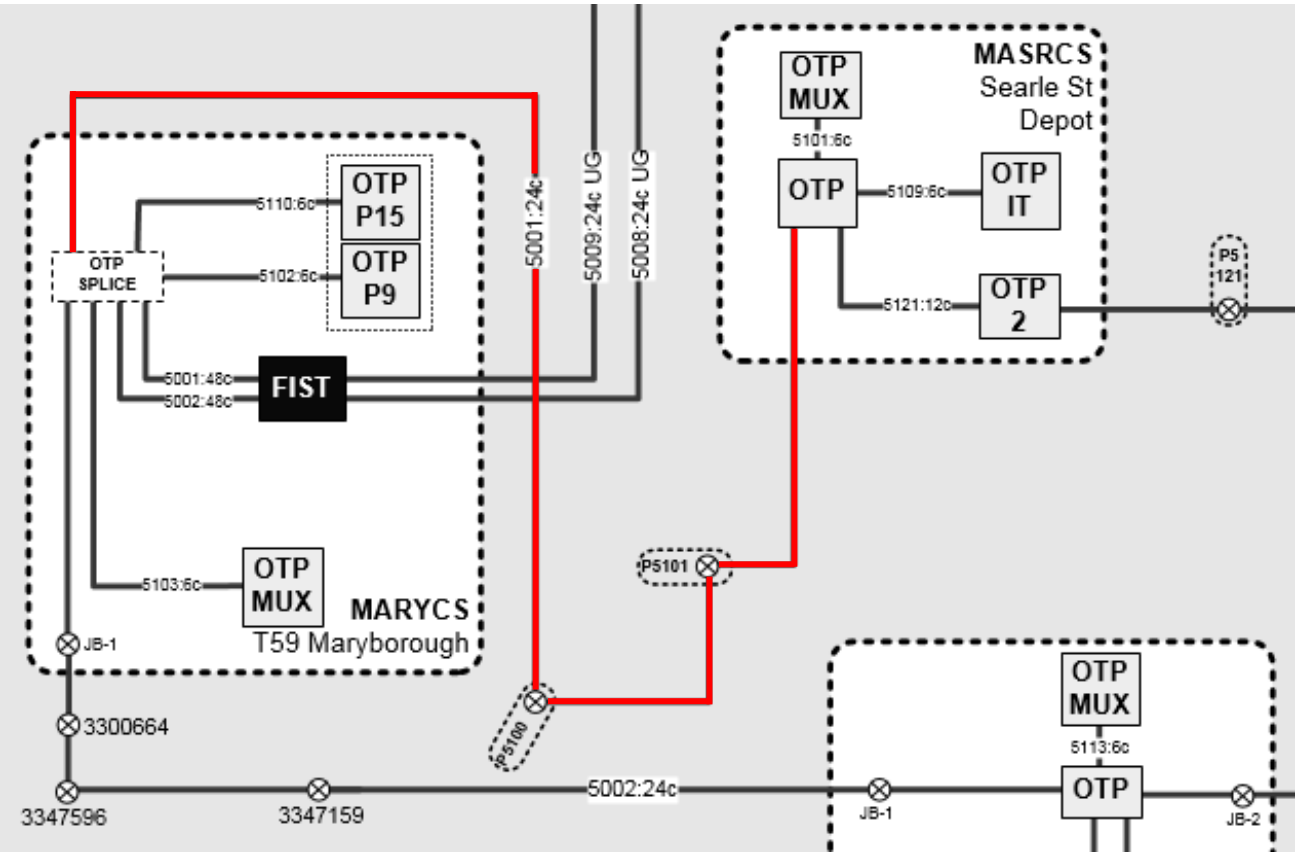

Figure 2: Cable #5001:24c - highlighted red, a fully utilised fibre cable in the Maryborough Town area

Table 18: Core utilisation for Cable #5001:24c

Core No	Circuit ID	Description
1	F5015	SDH Mux Rx T059 from SESD
2	F5016	SDH Mux Tx T059 to SESD
3	F5315	STM-16 Intra City Link B/Up Tx ADST-MASR
4	F5316	STM-16 Intra City Link B/Up Rx ADST-MASR

Core No	Circuit ID	Description
5	5001-05	SESD - T059 #05
6	5001-06	SESD - T059 #06
7	F5401	Widelinx MAWX - GHWX Circuit #1
8	F5402	Widelinx MAWX - GHWX Circuit #2
9	F5403	Widelinx MAWX - GHWX Circuit #3
10	F5404	Widelinx MAWX - GHWX Circuit #4
11	F5405	Widelinx MAWX - GHWX Circuit #5
12	F5406	Widelinx MAWX - GHWX Circuit #6
13	F5407	Widelinx MAWX - GHWX Circuit #7
14	F5408	Widelinx MAWX - GHWX Circuit #8
15	F5301	Sparq WAN Tx SESD to ADST via T059
16	F5302	Sparq WAN Rx SESD from ADST via T059
17	F5409	Widelinx MAWX - GHWX Circuit #9
18	F5410	Widelinx MAWX - GHWX Circuit #10
19	F5305	Corenet Tx ADST to TEMB Backup Path
19	F5494	MASR-SURI CORENET TX
20	F5306	Corenet Rx ADST from TEMB Backup Path
20	F5495	MASR-SURI CORENET RX
21	F5411	Widelinx MAWX - GHWX Circuit #11
22	F5412	Widelinx MAWX - GHWX Circuit #12
23	F5317	Corenet NEXTGEN to ADSTCS (BUDECS)
24	F5318	Corenet NEXTGEN to ADSTCS (BUDECS)

Maryborough / Hervey Bay

Only 12 cores are available for half the Hervey Bay loop and the fibres in this area are mostly full. The remaining 12 cores are dark fibres for WideLinx. Overall there is limited capacity and diversity in Hervey Bay, in particular between Hervey Bay and Maryborough.

Diversity

FN

- Cairns Hartley Street – to – Turkinje - 40km
    - Currently a single PLQ fibre from Cairns Terminal (132kV) to Turkinje (132kV)
    - Turkinje provides services to 20 communications sites
        - 5 - P25 base stations
        - 8 – Substations
        - 4 – Depots
    - Cost Estimate - **$3,345,945**

- McLeod Street Depot Pit Entry <1km

- Single entry point to the Core Critical PoP of McLeod St Depot
    - 4 fibre cable come though one pit into the depot
        - The 4 fibre cables are the complete Cairns fibre network which service a total of 36 sites
- Cost Estimate - **$83,648**

NQ

- Bohle (66kV) – to – Dan Gleeson (132kV) – 8km
    - Provide loop topology for Bohle Sub
    - Cost Estimate - **$669,189**

WB

- Bundaberg T20 (132kV) – to – Bundaberg Depot - 5km
    - Completes loop topology for Bundaberg
    - Provide diverse path between Bundaberg T20 and Bundaberg Depot which are both Core Critical PoP Sites.
    - Bundaberg T20 provides services to 6 substations
    - Cost Estimate - **$418,243**

CA

- Gladstone South (132kV) – Common pits P1323 and P122 – 1.25kms
    - Cable 121 and 126 utilise common pits for 1.25kms
    - Single point of failure for the completed Gladstone fibre loop, which includes 18 sites
    - Cost Estimate - **$104,560**
- Rockhampton Alma Street – Common pit P1105A – 750m
    - Single point of failure for both Rockhampton fibre loops, which includes 33 sites
    - Cost Estimate - **$131,650**

MK

- Whitsunday's Depot – Cannonvale Substation (66kV) - 4km
    - Closes the loop for the spur of 10 sites from Mackay to Cannonvale Substation
        - 2 – P25 Base stations
        - 5 – Substations
        - 1 – Depot
    - Cost Estimate - **$357,696**