

# Solutions for Improved Digital Connectivity in FNQ:

*Building community and disaster resilience in the Gulf Savannah.*

SEPT 2021

---



*“Our members face ongoing challenges of isolation and poor communications options and are negatively impacted by the lack of services that most Australians take for granted.*

*Impacts of under service for telecommunications and broadband extend to every aspect of modern life, from education, productivity, and ability to attract staff. These impacts are felt more deeply in times of natural disaster, economic hardship, and recovery phases that follow.*

*Our Association recognises the importance of a cohesive, well-designed plan to identify current limitations and the best path forward to provide place-based digital connectivity options to Gulf residents.”*

**Barry Hughes**

*Mayor, Etheridge Shire Council  
President, Gulf Cattlemen’s Association*

# Executive Summary

The 2019 monsoon trough event exposed both strengths and weaknesses in the resilience of the Gulf Savannah region, its communities, its businesses, its families, and its people. A key factor influencing the region's response and recovery to the disaster relates to digital connectivity. This includes the capacity of people in the region to take advantage of existing telecommunications services, and the strength and resilience of mobile and broadband infrastructure itself.

In a cohesive and resilient response, this project has supported the Gulf Savannah to bring together property owners, councils, communities, development organisations, businesses owners, technical experts, and telecommunications service providers to collaboratively identify and define mobile and broadband challenges during the 2019 event and the recovery phase. Funded under the Queensland Governments' FNQ and NQ Monsoon Trough (Category C Flexible Funding) Grants Program, the aim of the project has been to develop legitimate, practical, and affordable options for individuals, businesses, and organisations to get connected, and pathways to developing greater digital capability to respond to challenges and to capitalise on opportunities in the future.

Taken together, the qualitative and quantitative research identified and grouped types of *needs* (at individual, family, and community level) and *responses* (ranging from quick wins to long-term propositions) for consideration in proposing solutions. A comprehensive assessment of the needs and responses can be found in the **Needs Analysis** and **Technical Audit** reports that accompany this strategy document. Within this document, Section 5 outlines overall priority areas for solutions and opportunities for digital connectivity in the Gulf Savannah that cut across geographies and sectors. Then, Section 6 proposes a suite of 10 solutions which inform place-based connectivity packages.

Broadly, the solutions identified include three broad approaches:

- (i) strategies to lift the capacity of people in the region to use existing communications infrastructure;
- (ii) strategies to support families, businesses, and communities to close last mile gaps to accessing existing services and infrastructure; and
- (iii) strategies aimed at resolving the larger scale infrastructure gaps in the region.

Now the project is completed, this document provides the evidence base needed to support the Gulf Savannah to establish strong delivery partnerships that will enable the effective implementation of these proposed solutions. The key project partners will now plan out the most appropriate implementation pathways, bringing the community together with service providers, and state and federal agencies.



## Funding

This project is funded under the Community Development Program, which is jointly funded under the Commonwealth/State Disaster Recovery Funding Arrangements 2018. Although funding for this product has been provided by both the Australian and Queensland Governments, the material contained herein does not necessarily represent the views of either Government.



## Partners

### Lead organisation



### University partners



### Industry partners



**Suggested citation:** Marshall, A., Tsakissiris, A. Dale, A.P., Williams, Z., Irvine, D., Ryan, G., Wilson, C-A., Hourigan, A., and Stephens, D. (2021). *Solutions for Improved Digital Connectivity in FNQ: Building community and disaster resilience in the Gulf Savannah*. Gulf Savannah NRM, Mareeba, Queensland, Australia.

## Table of Contents

1. Introduction .....	1
2. Contextual review .....	2
3. Policy context.....	4
4. Methodology .....	8
5. Priority areas.....	11
6. Solutions matrix .....	16
7. From here .....	23
8. References .....	24
Appendix A: Place-based connectivity packages .....	25

## List of Tables

Table 1: ADII scores in 2020 .....	3
Table 2: Funded MBSP projects within (or just outside) Gulf Savannah region .....	5
Table 3: Solutions matrix .....	16
Table 4: Place-based connectivity packages for focal communities .....	25

## List of Figures

Figure 1: Gulf Savannah region .....	2
Figure 2: ADII scores in Queensland in 2020 .....	3

# 1. Introduction

This project has brought together Gulf Savannah property owners, councils, communities, development organisations, businesses owners, technical experts, and telecommunications service providers to collaboratively identify and define mobile and broadband challenges during the 2019 monsoon trough event and recovery phase, and to devise novel technical solutions and systemic improvement options going forward.

Funded under the Queensland Governments' FNQ and NQ Monsoon Trough (Category C Flexible Funding) Grants Program, the aim of the project was to develop legitimate, practical, and affordable options for individuals, businesses, and organisations to get connected, and pathways to developing greater digital capability to respond to challenges and to capitalise on opportunities in the future.

Importantly, while the initial focus was on responding to and recovering from disaster events, this report delivers greater community resilience into the future through viable digital connectivity and inclusion solutions to improve everyday life in the Gulf Savannah, as well as foster development, growth, and social cohesion across Far North Queensland.

The work was undertaken in three phases:

1. A **needs analysis** was undertaken to identify the mobile and broadband needs of Gulf Savannah locals, i.e., what people needed the technology for/to do;
2. A **technical audit** of telecommunications infrastructure and services in the region was undertaken to provide baseline understanding of existing services to Gulf Savannah locals; and
3. An **expert panel** of service providers operating in the region was engaged to help to devise bespoke solutions to meet community-identified needs and priorities.

This document outlines place-based, viable, and affordable solutions for getting people connected, or improving quality of service, in the Gulf Savannah. It further provides well defined pathways to execute and to fund the solutions through leveraging Commonwealth and State grants programs and fostering strategic partnerships across government and community organisations.

This project and strategy document has been delivered through a partnership of organisations committed to place-based solutions for digital connectivity and inclusion: Gulf Savannah NRM, QUT Digital Media Research Centre, The Cairns Institute JCU, Far North Queensland Organisation of Councils, Gulf Cattlemen's Association, and AirBridge Networks.

This report is focused on technical needs and solutions for Gulf Savannah residents. We acknowledge that several social and economic factors must be included in development and implementation of the recommendations flowing from this report. For example, affordability in relation to household or business income, and access in relation to social disadvantage, should be integrated into the three strategic pathways outlined in Section 7: 'From here'.

## 2. Contextual review

This section provides a high-level summary of the broader contextual review detailed in the preceding FNQ Digital Connectivity Needs Analysis (Marshall, Dale & Wilson, 2021). This study describes the Gulf Savannah region and information relevant to the region and this project, namely regional telecommunications and digital inclusion, emergency and disaster communications, and known issues and recent developments.

The Gulf Savannah region is located in the north-west corner of Queensland, just below Cape York Peninsula (Figure 1). The total population for all five LGAs within the region in 2016 was 29,719, with over 70% located in Mareeba Shire. Mareeba Shire is home to the major regional service centre of the Mareeba township. The other 30% of the population live in small remote and coastal townships with limited services and accessibility, especially during the monsoon season. Some 99% of the Gulf Savannah region is grazing land. Rainfall is variable across the large, diverse landscape, with falls averaging between 600mm (more to the west) and 1500mm (more to the east) annually.



Figure 1: Gulf Savannah region (Source: <http://plan.northerngulf.com.au/our-region/>)

The Gulf Savannah region is indicated by a blue circle in Figure 2, which has been drawn from the 2020 Australian Digital Inclusion Index (ADII) (Thomas et al., 2020). The ADII is an annual ‘census’ of digital inclusion across Australia funded by Telstra based on three measures: *access* (to internet devices and connections), *affordability* (cost relevant to income and value for money), and *digital*

ability (internet attitudes and skills). Importantly, the ADII only considers mobile services where they are used to access the internet.

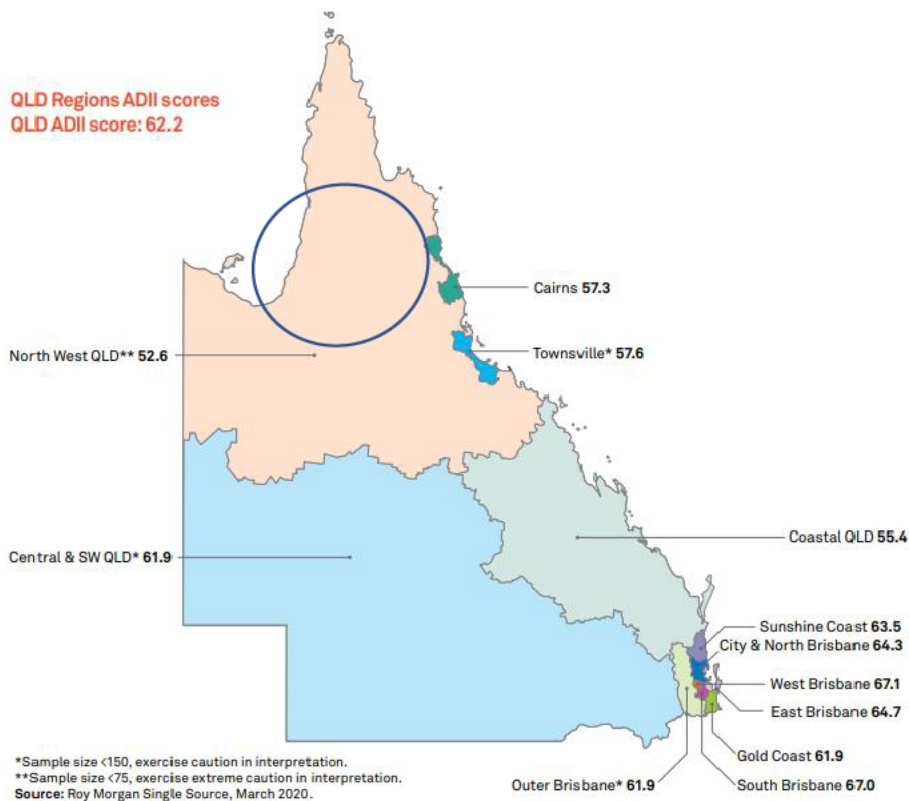


Figure 2: ADII scores in Queensland in 2020 (Thomas et al., 2020).

The Gulf Savannah is located in the North West Queensland (NWQ) region as defined by the Index. Table 1 also shows a breakdown of NWQ’s 2020 scores into the three measures comprising the overall score. Due to the small sample sizes in NWQ, the ADII recommends that these scores should be read with ‘extreme caution’. However, NWQ has consistently returned these low scores from 2016-2021.

The available data show that North West Queenslanders are below the state and national averages in terms of their digital inclusion. There is a particular disparity in the *digital ability* scores between urban and rural Queenslanders, which is very pronounced in NWQ. This shows that the challenge to improve digital connectivity in the Gulf Savannah should also be focused on promoting individual- and community-level capacity to make use of connections once they are in place.

	Australia	Queensland	Rural Qld	NWQ
<b>Access</b>	76.3	76.1	72.5	67.7
<b>Affordability</b>	60.9	59.7	52.3	54.0
<b>Digital Ability</b>	52.0	50.7	45.2	36.1
<b>Overall Digital Inclusion</b>	63.0	62.2	56.8	52.6

Table 1: ADII scores in 2020.

These digital inclusion challenges, combined with interruptions to mobile services caused by disasters such as the 2019 monsoon event, put regions like the Gulf Savannah at risk in terms of immediate



response and longer-term recovery. Known, long-standing digital connectivity gaps and issues in the Gulf Savannah include but are not limited to:

- Inter-reliance for power and communications infrastructure;
- Numerous mobile black spots along arterials;
- Reliance on satellite broadband in many instances (e.g., homesteads), whose functionality is weather-dependent, impacted by latency, and data restrictions;
- Dissatisfaction and confusion of telecommunications consumers in remote areas regarding plan options, cost, installation, maintenance, interoperability, and service;
- Thin telecommunications market in remote areas; and
- Only one backhaul supplier (Telstra).

Ongoing enhancement of mobile and broadband technology (both quality and coverage) is vital for the effective management of emergencies and disasters, and the safety of emergency responders. It is also essential for doing business, accessing government services, and participating in civic life. Focus is also needed on mobile depth of coverage (capacity) to ensure the network better copes with seasonal loads. Further network coverage expansion also has the advantage of extending the mobile IoT network reach.

Additional backhaul infrastructure providers or options remain limited. Telstra's announcement to spin off their network assets into the InfraCo entity has seen a shift in policy. Recently InfraCo announced it will offer dark fibre options for parties which, coupled with better access to Telstra's radio structure assets, may provide alternative new services offerings to the region.

### 3. Policy context

The strategies laid out in this report consider the regulation, policy, programs, and funding that already exist. Below is a high-level review of the policy context as it relates to digital connectivity in the FNQ region. This is a summary and update of a more comprehensive policy analysis undertaken in 2019 (Marshall et al., 2019).

#### Australian Government

In Australia, the telecommunications industry is governed and guided by three key pieces of legislation: *Telstra Corporation Act*, *Telecommunications Act*, and *Competition and Consumer Act*. This top-tier legislation outlines the *Universal Service Guarantee* (USG) (which replaced the *Universal Service Obligation* in 2020) that all Australians must have access to voice and broadband services regardless of where they live. The Regional Telecommunications Review (RTR), undertaken every three years, is an independent assessment of the state of telecommunications infrastructure and services based on broad consultation with industry, government, community groups, advocacy bodies, and the general public. The 2021 RTC committee was announced in June.

#### Mobile Black Spot Program (MBSP)

The MBSP is a co-investment scheme that funds new mobile base stations to be built in black spots (where no mobile service from any provider is currently available). Since 2015, under the first five

rounds of the MBSP, the federal government has generated more than \$836 million of investment (\$380 million in government contribution), which has delivered over 1,200 new base stations. Funding rounds are ongoing. It is important to note that the MBSP does not fund projects to improve backhaul capacity (Australian Government Department of Infrastructure, Transport, Regional Development and Communications, 2020a).

Important infrastructure and services enhancement in the Gulf Savannah region have been undertaken under the Mobile Black Spot Program, and further works could be announced in Round 6. Base stations funded under the first five rounds of the Program are scheduled to be operational by 30 June 2022 (Australian Government Department of Infrastructure, Transport, Regional Development and Communications, 2020a). The region did not have any funded projects in Round 4, or 5A of the Mobile Black Spot Program.

Location	LGA	Provider/Cell type	Funding Round
Watsonville	Mareeba	Telstra macrocell	Round 1
Julatten	Mareeba	Telstra macrocell	Round 1
Irvinebank	Mareeba	Telstra macrocell	Round 2
Petford	Mareeba	Telstra small cell	Round 5
Mungana Mine (Chillagoe)	Mareeba	Telstra small cell	Round 5
Forsayth	Etheridge	Telstra macrocell	Round 1
Gulf Developmental Road, between Georgetown and Croydon	Etheridge	Telstra macrocell	Round 1
Mount Carbine	Mareeba	Telstra macrocell	Round 2
Glenmore Station	Carpentaria	Telstra small cell	Round 5
Greenville	Charters Towers	Telstra macrocell	Round 1

*Table 2: Funded MBSP projects within (or just outside) Gulf Savannah region.*

### Regional Connectivity Program (RCP)

The more recently initiated RCP funds more diverse, telecommunications infrastructure projects in regional, rural, and remote Australia. In 2021 the federal government awarded funding to 81 projects to the value of \$90.5 million. Shortly after, 51 meritorious projects were funded to the value of \$24.6 million (Australian Government Department of Infrastructure, Transport, Regional Development and Communications, 2020b). These projects range from improvements to mobile coverage and backhaul, to increased footprint of NBN fixed line/wireless services in the regions. In round one, Field Solutions Group received funding to deploy a fixed wireless network in the wider Mareeba region, west of Cairns. The network will extend high-speed broadband connectivity into areas with limited existing coverage such as Petford and Chillagoe, enabling the uptake of new agricultural and business technologies and improving access to telehealth and education services.

### Other schemes

The federal government also supports telecommunications infrastructure projects through various disaster response and recovery initiatives. The recently amalgamated National Recovery and Resilience Agency has programs that support communities to improve telecommunications access and service during and after the 2019 monsoon flood disaster event, such as the North Queensland Telecommunications and Energy Improvement Grants (\$15 million specifically for the 14 hardest hit Local Government Areas). Also, in 2021/22, the Strengthening Telecommunications Against Natural

Disasters (STAND) program funded temporary telecommunications infrastructure deployment to the value of \$7.7 million. Further telecommunications projects have also been funded through more general funding schemes related to disaster response and recovery (Australian Government National Drought and North Queensland Flood Response and Recovery Agency, 2021).

In recognition of the importance of human capacity development, the National Farmers' Federation is partnering with the Australian Communications Consumer Action Network (ACCAN) to ensure that Regional Tech Hub content is relevant to regional, rural and remote consumers. The [Regional Tech Hub](#) – which launched in 2020 as a recommendation of the 2018 RTIRC and is administered by the National Farmers' Federation in partnership with ACCAN – offers independent advice and support and helps regional Australians navigate often confusing phone and internet options and technical issues. The Regional Tech Hub continues the work of Better Internet for Rural, Regional and Remote Australia (BIRRR), who pioneered this outstanding work. Information provided by ACCAN and BIRRR will be transitioned to the Regional Tech Hub over time as the website is further developed. While this is a welcome initiative, the Hub's few staff members have limited capacity to assist all of regional Australia, and knowledge of the Hub in the Gulf Savannah is limited.

Finally, NBN Co has announced a \$300 million Regional Co-investment Fund (RCIF), which invites expressions of interest from federal, state, territory, and local government agencies for the co-funding of projects to lift the digital capabilities of communities in regional and rural Australia. The fund is designed to uplift digital capability in regional and remote areas with eligible project types supporting transition from satellite or fixed wireless to fibre to the premises (FTTP) services, amongst other options (NBN Co, 2021).

## Queensland Government

Given that telecommunications are a federal-level responsibility, state-level policy, programs, and funding have traditionally tended to focus more on digital capacity and economy-building. For example, [Advance Queensland](#) and [DIGITAL1ST](#) aim to assist Queensland to transition into the digital economy by facilitating pathways to digital business and service delivery.

Nonetheless, the Queensland Government has made investments and co-investments into nation-building digital infrastructure, including in FNQ. For example, in 2017 the Queensland Government awarded \$7.7 million in grants to local infrastructure projects in North West Queensland, including \$1.74 million awarded to Carpentaria Shire Council for the Normanton to Karumba fibre optic project (Barry, 2017).

Notably, in 2021, a Queensland Government subsidiary company, QCN Fibre, was established to trade in wholesale access to broadband in regional areas through fibre owned by the state's energy providers. While the current QCN network only extends as far north as Cairns, the company has plans to expand, and there are further opportunities to leverage the co-placement of telecommunications and energy infrastructure. The Queensland Government is due to release a new Digital Strategy in late 2021.

In 2019, funding from the [North Queensland Telecommunications and Energy Improvement Grants](#) (NQTEIG) scheme funding, administered by the Queensland Rural and Industry Development

Authority, has enabled number of successful project to extend mobile coverage, broadband internet and specialized services to areas in the Gulf Savannah region. The projects included:

- Installation of a new Telstra mobile base station at Copperfield River at Etheridge (Einasleigh Shire);
- Installation of a new Telstra mobile small cell at Karumba North (Carpentaria Shire);
- New Telstra mobile base station built at Reaphook Range (Normanton) on an existing Telstra structure (Carpentaria Shire);
- New Telstra mobile base station built at Haydon (Normanton) on an existing Telstra structure (Carpentaria Shire); and,
- Upgrading and construction of 17 telecommunications towers along the 453 km corridor between Cloncurry and Normanton/Karumba by Wi-Sky Queensland (Carpentaria Shire).

Overall, the telecommunications deficits in FNQ, and the associated risks and disadvantages, are gaining increasing attention from policy makers at the state and federal levels. The current policy context is ripe for making bold, strategic recommendations for future-proofing FNQ through ongoing, targeted investment in place-based solutions that are for purpose.



# 4. Methodology

A summary of the three-phased methodology is below. Please refer to the supporting **Needs Analysis** (Marshall, Dale & Wilson, 2021) and **Technical Audit** (Tsakissiris, 2021) documents for more details.

## Phase 1: Needs analysis

Undertaken by QUT and JCU researchers, the needs analysis aimed to understand the digital connectivity needs and priorities of Gulf Savannah populations. This qualitative research was undertaken in four stages:

1. **Contextual review:** Desktop-based research the Gulf Savannah's geo-socioeconomic profile and relevant digital inclusion and infrastructure challenges.
2. **Interviews:** Approximately 25 semi-structured interviews (60 mins) undertaken in-person and via Zoom to canvas needs and lived experience of digital connectivity.
3. **Community workshops:** Community engagement workshops with over 60 participants in three locations (Croydon, Einasleigh, Dimbulah) to identify and discuss issues and consider potential solutions for homes, businesses, and communities.
4. **Online survey:** Distributed through partner networks to help prioritise emerging needs and inform effort for solutions (34 respondents with an 85% completion rate). NB: Results gleaned from this small sample were combined with other data to inform findings.

The needs analysis provided essential insights from end users about the kind of connections and services they require to pursue the economic and social opportunities of most importance to them (see the FNQ Digital Connectivity Needs Analysis (Marshall, Dale & Wilson, 2021) for complete details of the study). This work directly informed the five priority areas for this strategy.

## Phase 2: Technical audit

As technical consultants to the project, AirBridge Networks undertook a digital connectivity audit focused on mobile service coverage, satellite internet, fixed internet, and Internet of Things (IoT) services.

A summary of the relevant telecommunications services for the region was compiled using information from provider websites, discussions directly with providers, and industry knowledge. Ubiquitous services, such as satellite mobile and UHF/VHF radio, were not included as they are broadly available and are seen as last resort options.

The primary categories covered are:

- Mobile Voice and Data Coverage;
- Satellite Internet;
- Fixed Internet; and
- IoT Services.

Service provision within each category was identified and mapped in a matrix for each nominated community within the project region. Only core service providers were included in the summary. For

example, NBN Sky Muster satellite is the core service sold by many different Retail Service Providers (RSP). The specific measurement of mobile voice and data coverage was not the primary focus of the survey report. Instead, data was gleaned from numerous sources to provide a holistic picture of the communications landscape. The presented data was based on desktop assessments with information procured directly from the carriers for the study.

In conjunction with the needs analysis assessment, proposed solutions were developed. These solutions or solution packages address:

- Local, self-help quick win outcomes;
- Community enablement initiatives;
- Regional enablement initiatives; and
- Cross-regional enablement initiatives.

These solution packages support recommendations for enhancing regional digital enablement.

### Phase 3: Expert panel

A technical panel of service providers operating in FNQ was assembled to inform the project, comprised of representatives from Telstra, NBN Co, Optus, QCN Fibre, Wi-Sky Queensland, Field Solutions Group, and BIRRR. The panel were engaged in a group consultation on Zoom to share their expertise and provide feedback on the project's understanding of issues and possible solutions.

The intent of the panel was threefold: (1) to bring together major players in the region to generate a shared understanding of the challenges reported by locals about telecommunications service provision in the region; (2) to seek feedback from domain experts on the proposed solutions; and (3) to seek panel members' interest in ongoing collaboration to bring solutions to fruition in the future.

The panel enthusiastically engaged with the research findings and offered clarification and correction on some aspects of service provision. The panel also broadly agreed with the strategy direction and its proposed solutions and were supportive of further collaboration with the project team and each other. This was a critical phase of the project in seeking to ensure that solutions are actionable and achievable. The process also established a basis for ongoing collaboration for delivery of the potential solutions identified through this work.

### Findings summary

Taken together, the qualitative and quantitative research identified and grouped types of *needs* (at individual, family, and community level) and *responses* (ranging from quick wins to long-term propositions) for consideration in the development of the solutions proposed. These needs and responses included those of/for individual properties, business, communities, industries, and Councils (for more detail see Marshall, Dale & Wilson, 2021; Tsakissiris, 2021). Some typical needs identified in the study are summarized here as they relate to the three focus communities for this project.

- **Croydon:** Members of this community (mostly grazing families) expressed specific concerns about telecommunications for disaster response. Local leaders almost exclusively rely on mobile phones to coordinate community responses, though mobile network connectivity

outside of town, including on the major arterial road, is patchy, somewhat unreliable, and vulnerable in disaster events.

- **Einisleigh and Forsayth:** Members of these communities (representing mostly grazing and tourism interest) expressed particular concern that current mobile and broadband services were unable to cater for the influx of visitors/tourists that occur at various times, such as during rural events.
- **Dimbulah and Mutchilba:** Members of these communities (particularly horticultural farmers) expressed concern about productivity and profit losses resulting from unreliability and outages of 4G, which they rely on to operate packing facilities, for example. This is having flow-on effects for the local horticultural sector in terms of long-term viability and competitiveness.

The possible technical responses to these and other needs are defined as enablement categories:

- **Category 1: Individual, family or business:** Localised solutions to improve last mile connectivity that can be implemented through self-help or education (i.e., 'quick wins').
- **Category 2: Community organisation or community:** Solutions undertaken by community or a community group for wider improvement to access or quality of connectivity services through local investment.
- **Category 3: Regional:** Solutions and co-investment undertaken by local/state government or regional bodies along with service providers to achieve regional-level outcomes.
- **Category 4: Cross-regional:** High-level, major initiatives requiring engagement and investment of local/state/federal government and other external stakeholders.

A comprehensive assessment of the needs and responses can be found in the **Needs Analysis** and **Technical Audit** reports that accompany this strategy document. Section 5 outlines overall priority areas for solutions and opportunities for digital connectivity in the Gulf Savannah that cut across geographies and sectors. Then, building on these findings, Section 6 proposes a suite of 10 solutions which further inform the place-based connectivity packages outlined in Section 7.

## 5. Priority areas

Priority areas for this strategy document emerged directly from the needs analysis, which places the people most experienced in and impacted by digital connectivity challenges at the centre of the proposed solutions. The scope and parameters of the solutions are informed by the technical audit to ensure existing infrastructure and services are leveraged and not duplicated. Finally, the expert panel interrogated the scope and viability of recommendations.

### 5.1 Remote domestic telecommunications

**Need:** People living and working remotely need to be able to communicate with others from any (or more) places on their property, which is particularly imperative for getting help during an emergency or disaster. Calls or messages should ideally be able to be made/sent to and from remote workers. People also require reliable, affordable home-based internet services for essential tasks like accessing government websites and banking, and voice and text communications for community and personal interaction.

**Shortfall:** Existing telecommunication systems on remote properties are often insufficient because they are usually only accessible from the home (e.g., landlines are fixed, and Wi-Fi routers have limited distribution capacity). Devices currently used beyond the house are also problematic (e.g., two-way radios lock communications down to a single channel used by only a few people, and satellite phones/sleeves are relatively expensive and often require that a separate/different phone number (other than the person's usual number) be called).

**Effort:** Remote domestic telecommunications could be improved through a combination of end user education and investment in last mile broadband infrastructure. Solutions should ideally allow end users to use their everyday smart devices to communicate with others via text, call, or mobile app. Effort could be focused on education about the most appropriate service providers and plans for localised needs, as well as technical packages for increasing Wi-Fi footprint on properties, including affordable last mile infrastructure (e.g., antennas, boosters, routers, etc.). Also, a Government-provided broadband allowance/subsidy should replace the current telephone allowance which needs reworking to bring it up to date with modern day communications.

### 5.2 Agricultural digital technologies

**Need:** Farmers/graziers are increasingly interested in adopting new digital technologies to improve productivity (e.g., remote sensors for water tanks, GPS ear tags, and weighbridges), all of which involve IoT devices and software, including data storage. Many of these technologies can work on mobile, Wi-Fi and/or IoT-specific networks, all of which have different capacities, capabilities, and coverage.

**Shortfall:** Many farmers/graziers are unaware of the types of technologies available to them and lack capacity to make informed decisions about investments (i.e., types and brands of hardware, installation and use of software, management and interpretation of data, and digital connectivity options (Wi-Fi, IoT, mobile) to link devices to the cloud or local network). Owing to lack of



information, some farmers have previously invested in AgTech apps requiring 4G reception which is unavailable on many properties on the Gulf Savannah. Also, there is a misconception that all AgTech devices require mobile reception when satellite or IoT are sufficient/preferred.

Effort: Effort could be directed towards untangling farmers' requirements for telecommunications (mobile, broadband) networks from IoT networks, so that farmers can make informed decisions about investments. This could include:

- Education about existing access to IoT access (e.g., LTE-CAT M or NB-IoT) whose coverage exceeds mobile networks in the region;
- Packaged solutions that enable farmers to leverage telecommunications networks for IoT applications (where appropriate); and
- Scoping of regionally based technology and service providers able to deliver packages at affordable prices with long-term technical support and service.

### 5.3 Connectivity for community events and visitors

Need: Demand for telecommunications in remote areas is uneven temporally and geographically (e.g., rodeos and races can attract hundreds or even thousands of people to venues on the periphery of small towns). This can result in mobile phone services becoming overwhelmed causing interruptions to COVID app check-ins, electronic scoring, and communication between event organisers. These events are critical for social and economic prosperity in rural communities, and connectivity is essential to sustain them into the future.

Shortfall: It is economically unsustainable for permanent infrastructure to be installed to meet peak demand that lasts only a few days per year. However, the services offered by telecommunications providers are often mismatched with the localised needs of rural and remote consumers (e.g., the best value mobile plans offer annual contracts that are not compatible for high demand in short spurts). Standardised internet hardware (e.g., modem and router) are designed to be stationary in homes and offices, and are not easily transported to club houses, for example.

Effort: Novel solutions are required to meet the need for connectivity on demand in remote areas. This could include:

- Education about portable satellite internet technologies currently available;
- Design of new portable, high-capacity broadband hardware;
- Design of different service plans to match the demand patterns of remote consumers (which could be better supported by improved backhaul availability); and
- Provision of service plans that meet the needs of specific consumer groups ways (e.g., students, transient workers, travellers, low-income families) in a more nuanced way.

### 5.4. Enterprise-grade connections for businesses

Need: People conducting business in remote townships and other locations (e.g., Cobbold Gorge, Undara Caves) require enterprise-grade devices, platforms, software, and connections to be viable and competitive. Critical organisational processes (e.g., point of sale, booking, ordering) depend on

ubiquitous connectivity, with failover options in case of network/power outages. Tourists, workers, contractors, and visitors require Wi-Fi (and/or mobile) connections to be available to them.

Shortfall: Typically, services and plans in remote areas accommodate domestic rather than commercial needs. NBN satellite broadband has capped data and speeds (dependent on specific product), and if 4G mobile broadband is available, capacity is limited (i.e., not unlimited). Consumers have little awareness of remote enterprise solutions (e.g., Business NBN satellite service). High-capacity networks are often funded privately by big businesses who can afford them (e.g., mining companies can afford to lay fibre for their operations).

Effort: Effort could be directed toward increasing broadband knowledge, capacity, and backhaul in business hubs in the region. This could include:

- Education for business owners about enterprise-grade services that are available to them now;
- Fostering co-ops of businesses (with council and other organisations) to invest in shared networks;
- Packaged solutions that meet business requirements (e.g., splitting 'public' guest Wi-Fi network from 'private' operational network);
- Co-design of new services (providers/users) that meet specific requirements of remote businesses; and
- Increased investment in backhaul competition would potentially provide alternative options.

## 5.5 Robust telecommunications for disaster response

Need: Local councils and community organisations, along with state and federal agencies like the Queensland Parks and Wildlife Service, are first responders during disasters and are responsible for coordinating efforts to save lives and property. Often physically unable to access major centres and resources (e.g., by flooded or damaged roads), leaders and residents need to be able to communicate with officials, media, and each other across vast and remote distances. Unlike business connections that may be concentrated in discreet areas, telecommunications for disaster and governance must be as widespread as possible.

Shortfall: The interdependency of power, mobile, and internet connections (often fixed on a single physical tower) presents high risks to communities, especially in disaster events. When telecommunications networks fail, communities, families, and individuals can become completely cut off from help and information. Nonetheless, formal emergency response protocols rely on mobile phones and coverage, as well as fixed or other broadband connections in command centres in regional centres.

Effort: Placed-based, strategic investment in telecommunications infrastructure is required to give certainty and safety to remote communities. Efforts could include:

- Brokering community-level partnerships for co-investment in improved mobile and/or other connectivity (capacity, coverage, reliability) in and around townships, along arterials, and other strategic locations (e.g., boat ramps);

- Advocacy for more strategic governance of federal and state funding to programs (such as Mobile Black Spot Program and Regional Connectivity Program) to meet actual needs of remote people (e.g., facilitation of solution-sharing across regions; consideration of proposals without co-contribution from communities who cannot afford it);
- Advocacy for USG to be further strengthened and enforced in remote areas, including relieving the onus on individuals to acquire high levels of expertise to enact their rights to voice and internet services; and
- Longer battery backup at towers and generator availability for emergencies, as well as education for consumers around the importance of having battery backup for communication methods.





## 6. Solutions matrix

The matrix below (Table 3) cross-references the priorities (identified in the needs analysis) with the technical solutions (identified in the technical audit) and broader capacity-building solutions. Several solutions are applicable across priorities, as indicated by the ticks in the matrix. The most viable and appropriate (rather than all possible solutions) for each priority are identified.

Priority/ Solution categories	1. Remote domestic telecomms	2. Agricultural digital technologies	3. Community events & visitor connectivity	4. Enterprise connections for business	5. Robust disaster telecomms	Capacity type
A. Connectivity/ digital literacy interventions	✓	✓	✓	✓	✓	Digital capability
B. NBN Satellite awareness campaign	✓		✓	✓	✓	
C. IoT awareness education		✓			✓	
D. Private network extension	✓	✓	✓	✓	✓	Last mile connectivity
E. Local mobile coverage expansion	✓	✓	✓	✓	✓	
F. Community mobile coverage expansion		✓	✓	✓	✓	
G. Brokerage of last mile solutions	✓	✓	✓	✓	✓	
H. Macro mobile coverage expansion		✓	✓	✓	✓	Major infrastructure & initiatives
I. NBN Fixed service enablement			✓	✓	✓	
J. Regional digital investment strategy	✓	✓	✓	✓	✓	

Table 3: Solutions matrix.

## Solution A: Connectivity and digital literacy interventions

(Enablement Category 1: Individual, family or business/ 2: Community organisation or community)

Initiatives: A range of community-based connectivity literacy (how to get connected) and digital literacy (how to use digital connections/devices) building initiatives could be undertaken in domains of interest to local individuals, families, businesses, and councils. While outsider expertise may be required, regionally based service providers should be employed in the first instance to deliver training to constituents and/or be conduits to service delivery from broader state or federally based digital literacy agencies. Options include:

- Devising a register of awareness, capability, and use of existing mobile and internet connectivity and opportunities in the region, to increase awareness of under-recognised options such as [NBN SkyMuster Plus](#) and [NBN Business Satellite service](#);
- Bolstering existing digital extension programs in the agricultural industries (e.g., Gulf Savannah NRM's [eBeef Smart Farming program](#));
- Supporting IT/digital services in remote communities attached to existing businesses and organisations. This could be achieved through:
  - Upskilling existing service providers (e.g., library, post office workers); and
  - Funding new 'digital ranger' positions in communities who are employed in or share resources with council and other community organisations.
- Expansion of the federal [Be Connected program](#) (digital skills for over 50s) and Infoxchange's [Digital Springboard program](#) (job-ready digital skills) into FNQ through actively recruiting community partner organisations into FNQ;
- Active promotion of the [Regional Tech Hub](#) and other resources that are already available to consumers for information and independent advice, but which are not promoted widely in FNQ, as well as telcos' own resources such as IoT coverage maps and solutions, and dedicated regional and enterprise services support (e.g., [Telstra Enterprise](#), [NBN Local](#)); and
- Significant expansion of the Regional Tech Hub to convert to a 'Hub & Spoke' model whereby 'digital rangers' are deployed to regional areas (temporarily or permanently) to provide impartial advice to consumers about their options for telecommunications. These digital rangers could be housed in existing social infrastructure organisations such as libraries, NRMs, local councils, community organisations, health clinics or training organisations.

Funding: This approach likely requires a negotiated federal/state investment for a limited time period (perhaps three to five years) to substantively lift the social and economic benefit currently available in the region. Funding and support for the other above-mentioned programs is often included in the program packages. For example, Be Connected has [grants](#) of up to \$50,000 to support network partners to building digital skills and capacity in their communities. [Infoxchange](#) also has a range of free/subsidised programs and resources to support individuals and not-for-profits to get connected, such as discounted hardware and software, and access to affordable IT support. With regard to option of significantly expansion of the Regional Hub, or creating a separate digital rangers (or similar) program, we suggest this should be primarily funded by telcos whose on-the-ground service

footprint has diminished over recent years. Co-investment from state and federal government and other businesses could also be considered.

### Solution B: NBN satellite awareness campaign

(Enablement Category 1: Individual, family or business/ 2: Community organisation or community)

Initiative: Develop and extend an education program to ensure all users of NBN satellite broadband discuss with their provider the option to migrate to NBN Sky Muster Plus. The benefits include:

- Improved performance; and
- Significant inclusion of unmetered data.

Funding: Funding for such education programs could be provided by relevant industry engagement groups such as NBN and satellite service providers. Development of programs should occur in consultation with end users and be informed by research and best practice principles.

### Solution C: IoT awareness education

(Enablement Category 1: Individual, family or business/ 2: Community organisation or community/ 3: Regional)

Initiative: Engage with industry and research to leverage current IoT network capability to ensure awareness of NB IoT and LTE-CAT-M2 coverage within the region. Establish a panel of suppliers for compatible IoT devices that is readily accessible. The benefits include:

- Leverage the existing extensive IoT carrier footprint;
- Simple pricing model and affordable solution;
- IoT SIM data plans ranging from \$1 to \$5 per month; and
- Enhance AgTech uptake to enable new and competitive opportunities.

Funding: Funding could be sought through:

- Efforts being directly purchased by business or individual (e.g., a panel of suppliers to be established for reference); and
- An education program funded by relevant industry engagement groups such as NGRMG.

NB: While large areas of the Gulf Savannah remain serviced by IoT networks, the aim here is to leverage what is available in the short term while working towards solutions for growing the network in the medium-long term.

### Solution D: Private network extension

(Enablement Category 1: Individual, family or business/ 2: Community organisation or community)

Initiative: More extensively utilise microwave radio networks to extend fixed broadband service to smaller regional communities or properties. The options may provide point-to-point or point-to-multipoint solutions potentially servicing multiple endpoints. The benefits include:

- Access to high speed 'unlimited' internet services;
- Improved performance over satellite or low bandwidth mobile data; and
- Extend broader Wi-Fi coverage for data (e.g., CCTV) and voice (Wi-Fi Calling).

Funding: Funding could be sought through:

- Direct purchase of services from local service provider by business or individual (panel of suppliers in FNQ region to be established for reference) or the federal [Regional Connectivity Program](#) (submissions made by telcos or NBN in consultation with community sponsor); and
- State-level grants, such as the [Small Business COVID-19 Adaption Grant Program](#) and the [Small Business Disaster Recovery Grants](#), which fund digital connectivity solutions for small businesses up to \$10,000.

### Solution E: Local mobile coverage expansion

(Enablement Category 1: Individual, family or business/ 2: Community organisation or community)

Initiative: Deploy small mobile repeaters to enhance localised mobile coverage at businesses or on rural properties. There is demonstrated benefit in having an upfront desktop assessment completed to determine the solution's viability and recommend the most suitable equipment. The service can be self-installed or professional assistance provided. The benefits include:

- Extend mobile network footprint;
- Extend mobile data footprint; and
- Simple pricing model and affordable solution.

Funding: Funding could be sought through:

- Directly purchased by business or individual (panel of suppliers to be established for reference); and
- A part subsidy model to offset the cost of having an upfront desktop assessment completed.

### Solution F: Community mobile coverage expansion

(Enablement Category 2: Community organisation or community/ 3: Regional)

Initiative: Engage with mobile carriers (primarily Telstra) to deploy macro repeater or small cell services to target specific community locations. Small cell options are significantly cheaper than full mobile base stations to deploy but have the drawback of providing limited coverage. They are best targeted for locations where isolated coverage is needed. For example, Council facilities, tourists stopping point at national parks and other similar facilities. The benefits include:

- Address safety and emergency communications needs for locals and visitors;
- Extend mobile data footprint;
- Extend IoT network footprint; and
- Simple funding models with generally no ongoing costs.

Funding: Funding could be sought through:

- Regional Connectivity Program (RCP): A federally funded program with submissions from telcos and & NBN to extend network coverage – fixed and/or mobile. Submissions generally prepared in consultation with community sponsor (e.g., Local member, Council, Community/Industry group or association);
- Telstra's \$200 million co-investment fund to extend and enhance coverage in regional Australia;

- Mobile Black Spot Program: A federal program to extend mobile network coverage to regional communities. Submission via funding agency in partnership with a mobile carrier with support from community sponsor (e.g., Local member, Council, Community/Industry group or association); and
- Direct Funding: Council or commercial entity engage the carrier to provide service.

## Solution G. Brokerage of last mile connectivity

(Enablement Category 2: Community organisation or community/ 3: Regional)

Initiative: Connecting local consumers to independent advice and brokerage support for acquiring suitable and affordable last mile mobile and broadband solutions for the home, business, or organisation. This can be achieved through education about existing support, namely the federally-funded [Regional Tech Hub](#) which was established in 2020 following several years of volunteer support provided by the Better Internet for Rural, Regional and Remote Australia [Facebook group](#) and [website](#). Free services provided by the Hub include:

- A Monday to Friday hotline (1300 081 029) to ask a real person questions;
- Desk check of connectivity options for specific addresses;
- Lists of provider options for different types of technologies and connections; and
- Online resources about how to Get Connected, Stay Connected, Improve Connections and Use Connections effectively.

At a community-level, brokerage could be undertaken by civic organisations, such as FNQROC or NGRMG, with appropriate education, support, and funding from state and federal governments, and major service providers in the region. This could include preparation of resources specifically for Gulf Savannah communities, facilitation of information sessions in communities, and coordination of stakeholders to co-invest in solutions.

To illustrate this concept, Appendix A provides examples of the place-based connectivity packages that could be brokered to meet the specific needs of the Croydon, Einasleigh and Forsayth, and Dimbulah and Mutchilba communities identified in the Needs Analysis.

Funding: Funding could be sought through co-investment of industry (telcos), government (local/state) and community organisations for public awareness and education programs relating to last mile options and existing support services. Independent brokerage roles (beyond what is provided by the Regional Tech Hub) could be sought through co-investment arrangements of community development grants, such as through Regional Development Australia. Importantly, these campaigns/programs should be co-designed with communities using local media vehicles to ensure messaging is targeted and ultimately useful.

## Solution H: Macro mobile coverage expansion

(Enablement Category 3: Regional/ 4: Cross-regional)

Initiative: Engage with mobile carriers (primarily Telstra) to develop a progressive funding model to establish coverage along the Gulf Developmental Road extending from Karumba via Normanton to Mt Surprise. The aim is to fill the broad gaps in highway coverage progressively. The benefits include:



- Address safety and emergency communications needs for locals and visitors;
- Extend mobile data footprint;
- Extend IoT network footprint;
- Establish core network access points along the highway route to provide for access to other telco services; and
- New approaches to coverage such as the Field Solution’s Group Regional Australia Network, funded under the RCP MBSP5A, which delivers regional coverage with the possibility of roaming to other mobile network operators.

Funding: Funding sought through:

- Regional Connectivity Program (RCP): A federally funded program with submissions from telcos and NBN to extend network coverage – fixed and/or mobile. Submissions generally prepared in consultation with community sponsor (e.g., Local member, Council, Community/Industry group or association);
- Mobile Black Spot Program: A federally program to extend mobile network coverage to regional communities. Submission via funding agency in partnership with a mobile carrier with support from community sponsor (e.g., Local member, Council, Community/Industry group or association); and,
- Telstra’s \$200 million co-investment fund to extend and enhance coverage in regional Australia.

### Solution 1: NBN fixed service enablement (Enablement Category 3: Regional/ 4: Cross-regional)

Initiative: NBN fixed services do not exist within the project region. There are direct benefits in enabling the larger townships with fixed NBN technology options (FTTP/C/N) such as:

- More choice of retail service providers;
- Providing broader service offerings (speeds, data plans, extras), such as no lock-in contracts already offered by many providers;
- Support for business enablement with business-specific services;
- Pricing comparable with major regional centres;
- Remove large groups of users from satellite platform, improving service for remote users; and
- Future-proofing the connectivity needs of communities.

The barrier to enablement for NBN has been the cost of backhaul infrastructure. With the prospect of Telstra InfraCo offering dark fibre options, it may now prove practical for NBN to reassess the viability of such community enablement projects. The townships to be targeted are:

- Normanton;
- Karumba;
- Croydon;
- Georgetown;
- Mt Surprise;

- Dimbulah;
- Mutchilba; and
- Chillagoe.

These communities are serviced by Telstra InfraCo fibre today, presenting a backhaul option for service provision.

Funding: Funding could be sought through:

- Regional Connectivity Program (RCP): A federally funded program with submissions from telcos and NBN to extend network coverage – fixed and/or mobile. Submissions generally prepared in consultation with community sponsor (e.g., Local member, Council, Community/Industry group or association); and
- Regional Connectivity Infrastructure Fund (RCIF): NBN funded program (\$300M) to extend/flip NBN service delivery capability to regional communities. Submission via NBN from community sponsor (e.g., Local member, Council, Community/Industry group or association).

### Solution J: Regional digital investment strategy

(Enablement Category 3: Regional/ 4: Cross-regional)

Initiative: Leveraging partnerships developed during this project (and other projects carried out in parallel), progress a partnership-based Regional Digital Investment Strategy. Initial activities could include:

- Engagement of key organisations in the region to lead region-wide efforts to address digital connectivity holistically in Far North Queensland and the Cape and Torres Strait;
- Engagement of key federal and state agencies to assist in progressing the strategy through existing policy and funding frameworks (e.g., National Disaster Recovery Fund);
- Establish local working groups to cost and advocate for specific investments over the next 5-10 years;
- Continued engagement of Tech Panel to collaborate to design and implement placed-based digital connectivity solutions; and
- Discuss and develop new approach to digital enablement funding not focused on commercial return but greater bias to digital/social criteria for remote communities.

Funding: Funding for planning and engagement to achieve a Regional Digital Investment Strategy will include significant in-kind contributions from relevant stakeholders and grants to assist with coordination and travel costs.

## 7. From here

The solutions identified above include three broad approaches:

- (i) Strategies to lift the capacity of people in the region to use existing communications infrastructure;
- (ii) Strategies to support families, businesses, communities, and industries to close last mile gaps to accessing existing services and infrastructure (including access, affordability, optioneering, and gaining independent advice); and
- (iii) Strategies aimed at resolving the larger scale infrastructure gaps in the region.

As strong social, economic, and even environmental benefits are likely to emerge, we consider that there is value in strong public and private sector investment in all three solution types. Indeed, investing solely in larger scale communications infrastructure without digital capacity and last mile service brokerage will likely diminish the benefits that could have been gained otherwise.

Importantly, now completed, this strategy document provides the evidence base needed to support the Gulf Savannah to establish strong delivery partnerships that will enable the effective implementation of these proposed solutions.

The project partners will now aim to plan out the most appropriate implementation pathways, bringing the community together with service providers and state and federal agencies to plan out appropriate responses to secure targeted investment.

The work has also helped forge a stronger relationship between the Gulf Savannah region and the Cape York and Torres Strait (via the Torres and Cape Indigenous Councils Alliance); both regions being within the wider Tropical North Queensland RDA region. Where appropriate, the Gulf Savannah will explore a collaborative approach to the implementation of these strategies across the wider region.

Finally, we hope this approach sets a template for a stronger place-based approach to improving digital connectivity across northern Australian regions.



## 8. References

- Barry, D. (2017, October 18). \$7m in funding grants for North West. *North Queensland Register*. <https://www.northqueenslandregister.com.au/story/4997472/7m-in-funding-grants-for-north-west/>
- Australian Government Department of Infrastructure, Transport, Regional Development and Communications. (2020a). *Mobile Black Spot Program*. <https://www.communications.gov.au/what-we-do/phone/mobile-services-and-coverage/mobile-black-spot-program>
- Australian Government Department of Infrastructure, Transport, Regional Development and Communications. (2020b). *Regional Connectivity Program*. <https://www.communications.gov.au/what-we-do/internet/regional-connectivity-program>
- Australian Government National Drought and North Queensland Flood Response and Recovery Agency. (2021). *Grants for improved connectivity and energy supply for North Queensland*. <https://www.droughtandflood.gov.au/latest-news/grants-improved-connectivity-and-energy-supply-north-queensland>
- Marshall, A., Dale, A., Babacan, H., & Dezuanni, M. (2019). *Connectivity and digital inclusion in Far North Queensland's agricultural communities: Policy-focused report*. The Cairns Institute, James Cook University, Cairns.
- Marshall, A., Dale, A. & Wilson, C-A. (2021). *FNQ digital connectivity needs analysis: Qualitative insights to inform technical solutions for improved telecommunications in Northern Gulf communities*. QUT Digital Media Research Centre. <https://eprints.gut.edu.au/211146/>
- NBN Co. (2021). *nbn™ Regional co-investment fund guidelines*. <https://www.nbnco.com.au/content/dam/nbn/documents/about-nbn/reports/nbn-rcif-guidelines.pdf>
- Thomas, J., Barraket, J., Wilson, C.K., Holcombe-James I., Kennedy, J., Rennie, E., Ewing, S. & MacDonald, T. (2020). *Measuring Australia's digital divide: The Australian digital inclusion index 2020*. RMIT and Swinburne University of Technology, Melbourne, for Telstra.
- Tsakissiris, A. (2021). *FNQ digital connectivity project: Northern Gulf Resource Management Group*. AirBridge Networks.

# Appendix A: Place-based connectivity packages

The table below (Table 4) outlines some place-based opportunities for each of the focus communities, combining several solutions into a cohesive package. These packages could form the starting point of community-level brokerage of solutions that meet community needs, leverage local opportunities, and mitigate against constraints.

	<b>Croydon</b>	<b>Einasleigh</b>	<b>Dimbulah</b>
<b>Opportunity</b>	Improving livability and safety	Bolstering tourism and community cohesion	Enabling digital agriculture
<b>Key constraints</b>	Limited mobile and broadband backhaul capacity	Geographic isolation from ICT service, providers, and support	Pressure on local mobile networks to deliver voice and data capability
<b>Solutions packages</b>	B. NBN satellite awareness campaign C. IoT awareness campaign H: Macro mobile coverage expansion I. NBN fixed service enablement	A. Digital literacy interventions B. NBN satellite awareness campaign D. Private network extension J. Regional digital investment strategy	C. IoT awareness campaign D. Private network extension H. Marco mobile coverage expansion I. NBN fixed service enablement
<b>Benefits</b>	- Leverage existing NBN services for leisure and entertainment - IoT for monitoring river levels in real time independent of mobile networks - Address mobile black spots on arterials for safety	- Empower individuals to find information and assistance - Devise fit-for-purpose solutions for community events - Planning for future demand in other industries, like agriculture	- Leverage existing IoT networks for AgTech - Improve quality of mobile voice services in high-demand area (residents and tourists) - Improve interoperability issues for local consumers between Optus only service at Mutchilba and Telstra only service at Dimbulah
<b>Risks</b>	- Lack of commitment from providers/gov to execute campaigns - Inability of local council/orgs to co-invest (e.g., MBSP)	- Lack of local capability to deliver programs - Lack of backhaul infrastructure	- Inability of local council/orgs to co-invest (e.g., RCP)
<b>ROI</b>	- Community wellness, improved disaster response and resilience	- Remote industry stability, growth, and diversification	- Enablement of ag production and productivity in high farm density area

Table 4: Place-based connectivity packages for focal communities.