Regional District of Kitimat-Stikine Regional Connectivity Strategy

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Contents

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1 EXECUTIVE SUMMARY

Now more than ever, reliable, high speed connectivity is an essential service. As recently highlighted in world events, the need to be connected reliably, anywhere, anytime is only increasing and Canadians need the ability to function when faced with external forces impacting our ability to receive education, health care and do our work. We are all living in a world of remote connectivity and the economic engine relies on reliable connectivity. This is particularly true in remote and rural parts of Canada. Remote and rural connectivity needs improvement now. Online meetings shouldn't have to start with the rural participants asking, "Am I still frozen" or "Can you hear me now?".

The Regional District of Kitimat-Stikine ("RDKS") has achievable potential to become a highly connected region. It is uniquely positioned to succeed and collaboration with industry players, regional neighbours and private business to create a solution that improves connectivity for as many people as possible. The RDKS's best option for improving connectivity within the region is to take an approach that involves parties from outside the region in recognition that a multi-region solution leverages existing infrastructure and creates a sum that is greater than its parts in addition to collaborative efforts with stakeholders within the region. There is a strong desire to work together in solutioning and implementing connectivity projects that solve real connectivity issues.

Through our work with the RDKS project team, well defined, realistic, and achievable high-level goals for the region were established. Additionally, potential specific connectivity initiatives (projects) were developed based on the analysis of the RDKS. Several are in the Kitimat – Terrace – Hazelton corridor (the KTH Corridor). As the KTH Corridor is generally served with numerous providers competing for business, the list can be used as a starting point for further discussions with providers.

Of paramount importance in improving connectivity, is the completion of the announced Tahltan fibre backbone extension project ("the Tahltan Project") which creates connectivity from Gitanyow to Dease Lake in the North. The Northwest Transmission Line ("NTL") provides a significant portion of the backbone fibre which will be leveraged by the Tahltan Project. The fibre along the NTL is a highly valuable connectivity asset in the region and must be maximized. When combined with the existing Lisims networks, the Tahltan Project sets the stage for resolving some of the RDKS concerns and goals including:

- ✓ improved service to northern communities;
- ✓ addressing internet route diversity and resiliency within the RDKS and neighbouring regions;
- ✓ creating infrastructure that cellular service can be layered onto.

To achieve the goals created as part of this project, the RDKS plays an important role which aligns with its own vision as a facilitator for the region and advocate to stakeholders, providers, and higher levels of government. The RDKS is blessed with significant infrastructure and the interest of providers, industry and progressive First Nations that support to goal of improved connectivity. The Regional District's role should be one of articulating priorities, aligning stakeholders, and acting as the coordinator of all efforts to a unified and collaborative execution plan.

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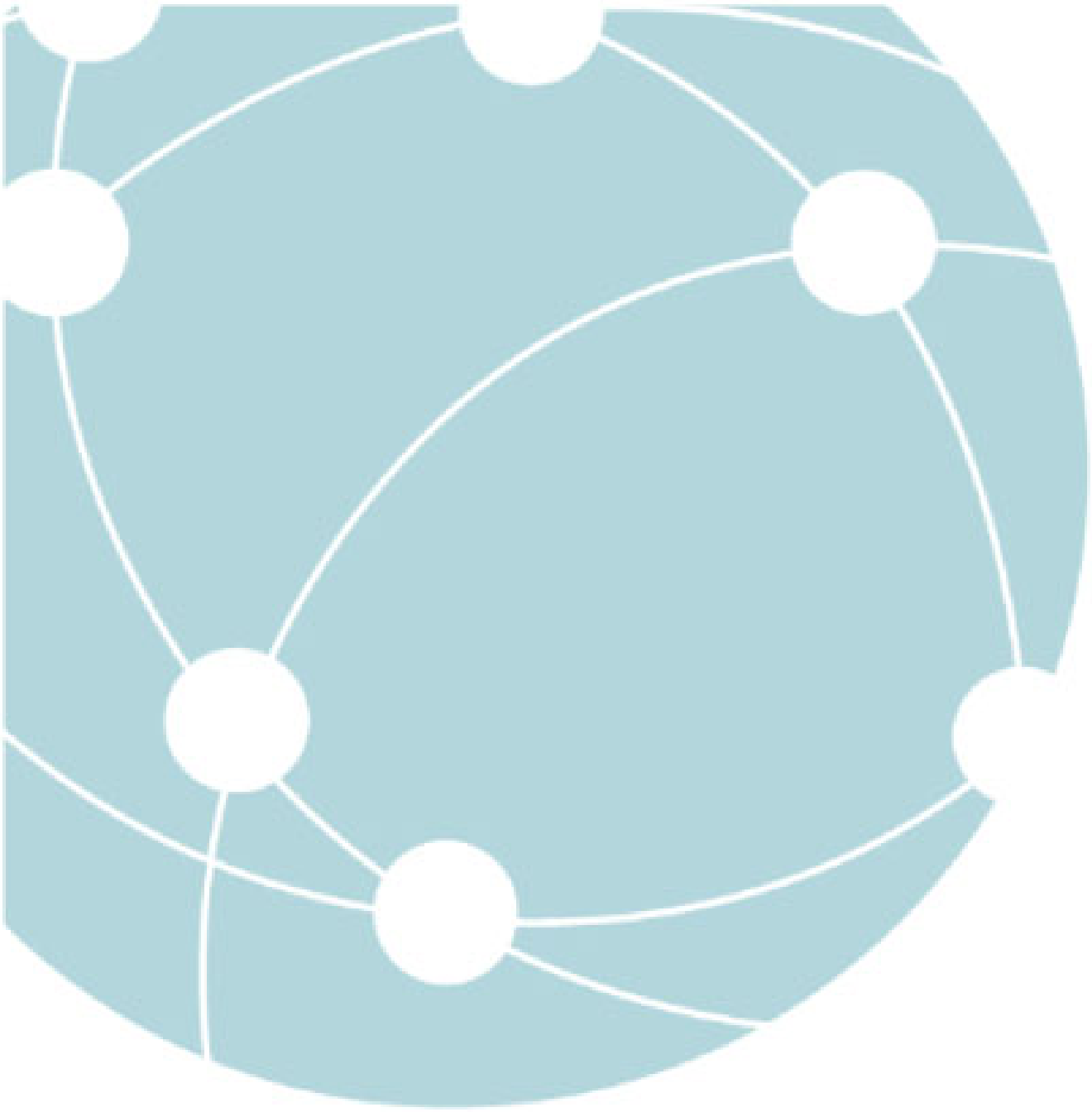

2 INTRODUCTION

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2.1 Purpose and Organization of Report

The RDKS issued a Request for Proposals in connection with the development of a regional connectivity infrastructure strategy for the RDKS. TANEx was chosen to work with RDKS staff to develop a strategy to inform and support investments in connectivity infrastructure in the Regional District.

The objective of the project is to develop a strategy that will support the RDKS in improving connectivity in its rural areas to help realize established priority goals of the RDKS. The project aims to identify the existing state of connectivity within the Regional District and inventory the providers providing service and then to provide a path forward to improve connectivity in the region. It seeks to identify realistic, actionable steps that can be taken that are coordinated with other initiatives in the region. The strategy is to provide for infrastructure that is scalable for future demands, cost effective and helps achieve important Regional District goals.

The report has been organized in a manner that steps the reader through relevant background information, vision for the future, and regional analysis including current state and feedback from stakeholders. It then goes on to identify gaps and strategies to fill those gaps with specific potential project areas identified along with high level costs estimated. Finally, a list of next steps were identified to advance connectivity in the rural RDKS.

2.2 Intended Audience

This report is intended to be utilized internally by RDKS staff and its Board of Directors for education, guidance and planning purposes to guide decision making and advocacy efforts to improve access to, and availability of, high speed connectivity throughout the RDKS. This regional connectivity infrastructure strategy has been provided along with ancillary supporting information and documentation to the RDKS for its sole benefit and reference. This is not intended to be used by third parties.

2.3 Project Scope & Assumptions

The scope of the project focused on the rural areas of the RDKS and included an assessment of the existing connectivity in the rural areas of the RDKS along with developing a strategy to improve internet connectivity. It did not include the member municipalities as they are generally well served. As the project progressed, however, it became clear that the line did not always follow the line of municipality vs. non-municipality. The electoral areas in the RDKS are rural in nature except Electoral Area E – Thornhill which, because of its location, connectivity levels and density of population, is more closely compared to an urban area than rural, so it was excluded from the current state analysis just like the member municipalities. Conversely, while the District of Stewart is a member municipality, because of its remote location, size and connectivity levels, it is more closely compared to a rural community than urban, so it was included in the analysis.

Attached to the RDKS' Request for Proposals was the framework template provided by Northern Development Initiative Trust ("NDIT") for the Connecting BC program. TANEx was not required to follow the framework but rather was to include its general concepts.

2.4 General Approach

A team of resources from both TANEx and the RDKS worked collaboratively to complete the strategy through various phases of the project. At a high level, developing this strategy included a series of

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activities including project kickoff, information gathering, public and stakeholder outreach, vision and objective setting, presentation of draft strategy to the Board of Directors, receiving feedback, and report preparation and finalization.

The current state of internet connectivity in the RDKS was assessed by:

- undertaking public domain research;
- survey of area residents and businesses;
- direct outreach to service providers, stakeholders and community representatives identified as key by the RDKS;
- direct outreach to area First Nations.

TANEx remotely facilitated a vision development session with the RDKS team which resulted in a draft vision statement and benefit statement which were finalized and ultimately approved by the RDKS. The strategic objectives were then identified through collaboration with the RDKS team.

An analysis of the difference between the current state of connectivity in the RDKS and the future desired state identified in the RDKS vision was completed. A technical analysis of alternatives to fill those gaps was completed and then a draft strategy was prepared and reviewed with the RDKS staff team. The draft strategy incorporated feedback from the RDKS project team and was then presented to the Board of Directors remotely. Feedback was then incorporated into a draft report which was provided to the RDKS prior to this final report being completed.

2.5 Impact of COVID-19 on the Project

This project was completed through the first wave of the COVID-19 pandemic which had significant impacts on the project. Adding to the difficulty of the project in some ways, COVID-19 meant that outreach was more challenging and less successful than hoped for. It is believed that the COVID-19 health emergency caused lower survey participation and First Nations' engagement simply because people were too busy with other serious priorities.

On the positive side, COVID-19 shone a bright light on the critical importance of connectivity for everyone as people all tried to work from home, see their doctors remotely, and homeschool their children. The restart of the economy is highly driven by the ability to work remotely and be productive. The right to do so and engage in the economy belongs to every Canadian and connecting rural Canadians to broadband service must be of the highest importance as Canada navigates its way through the COVID-19 pandemic.

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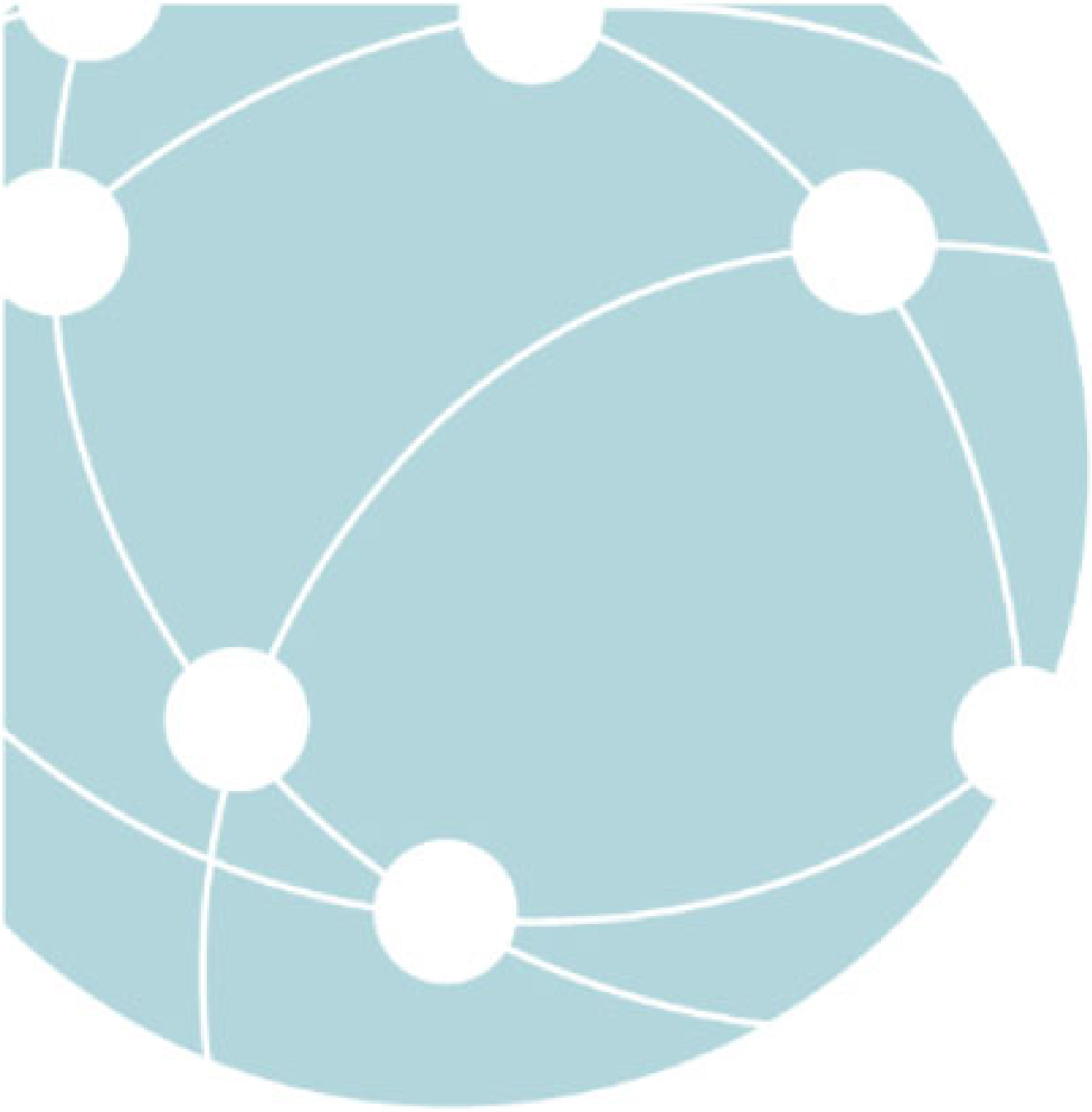

3 RDKS SUMMARY

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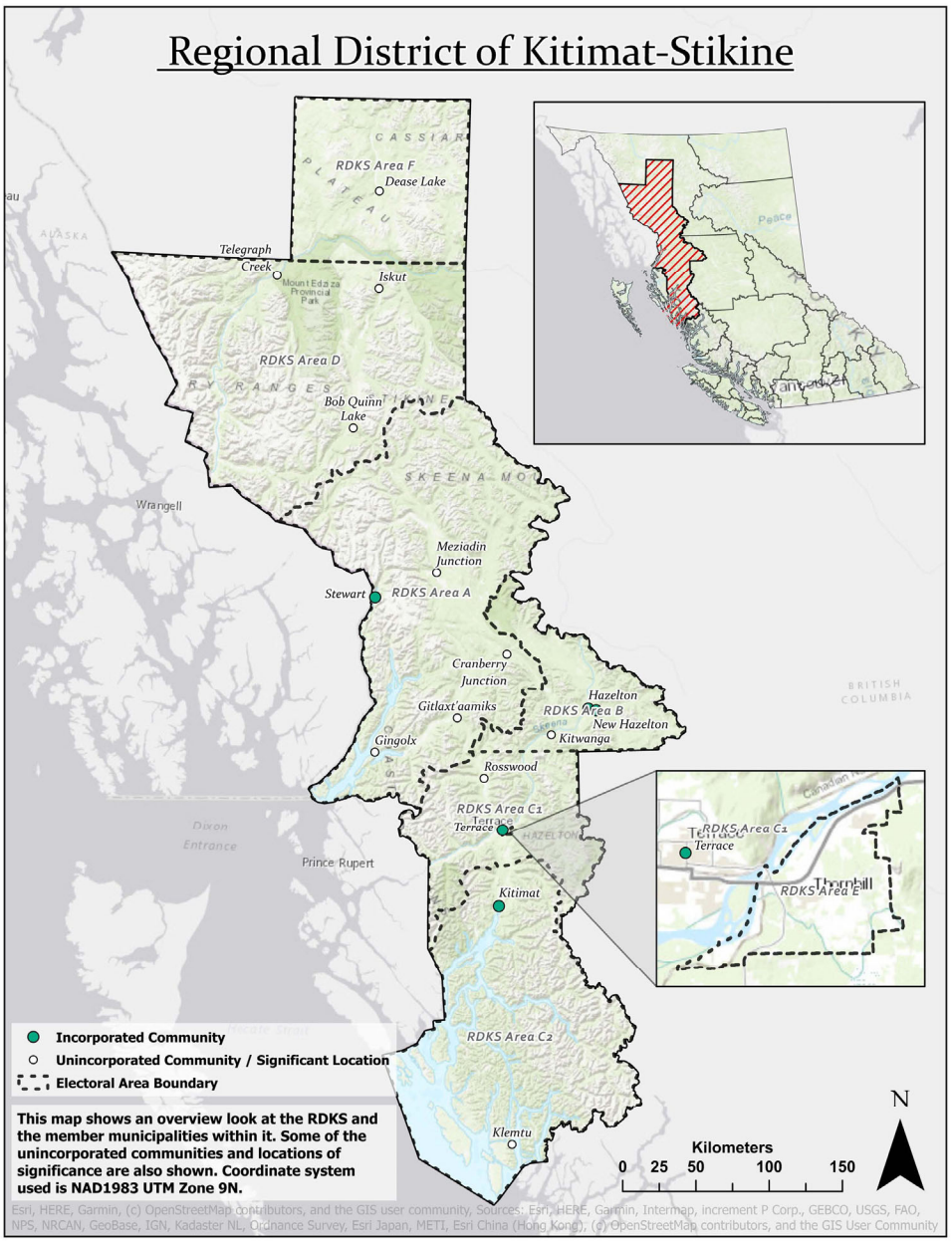
This provides a background understanding of the Regional District as a whole and a lens through which to view this report, the strategy, and the recommendations.

3.1 Geographic Location

The RDKS is situated in northwestern British Columbia. It is a vast region comprised of almost 105,000 square kilometres and as the crow flies from North to South, it measures over 750 km. Because it is so large, the geography of the Regional District is highly varied and includes coastal, mountainous and northern plateau areas.



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3.2 Population and Communities

Federal census population numbers at the time of writing are relatively out of date as the most recent census numbers are from the census of 2016. Those census numbers indicate the population of the RDKS as a whole is 37,367[1]. Updated estimates from British Columbia for 2019, however, estimate the region's population at 39,150[2].

Canada, as a country, has very low population density at about 3.9 people/km^2 and British Columbia's population density is a little higher at 5.0 people/km^2 [3]. Contrast those density numbers with the RDKS population density of about 0.4 people/km^2. It has vast regions that are extremely sparsely populated.

The RDKS is comprised of member municipalities, Nisga'a Lands, First Nations' reserves and rural communities. Rural communities are located within electoral areas throughout the region and as noted above, are the focus of this project. Population numbers noted below have been drawn from the census data. Electoral Area population numbers do not include population from within member municipalities or from First Nations' reserve lands.

3.2.1 Electoral Areas

As shown on the map above, the RDKS is made up of six electoral areas entitled A through F. The rural Electoral Areas were the focus of the connectivity strategy as they are home to the rural communities that the strategy seeks to connect more effectively. The electoral area population totals 8,784 but rural communities are home to about 4,800 people once Electoral Area E is excluded[4].

[1] Statistics Canada, 2016 Census Data, RDKS Census Profile
[2] B.C. Government, Population Estimates
[3] Statistics Canada, 2016 Census Data, Canada & BC Census Profiles
[4] Statistics Canada, 2016 Census Data, RDKS Electoral Areas Census Profiles

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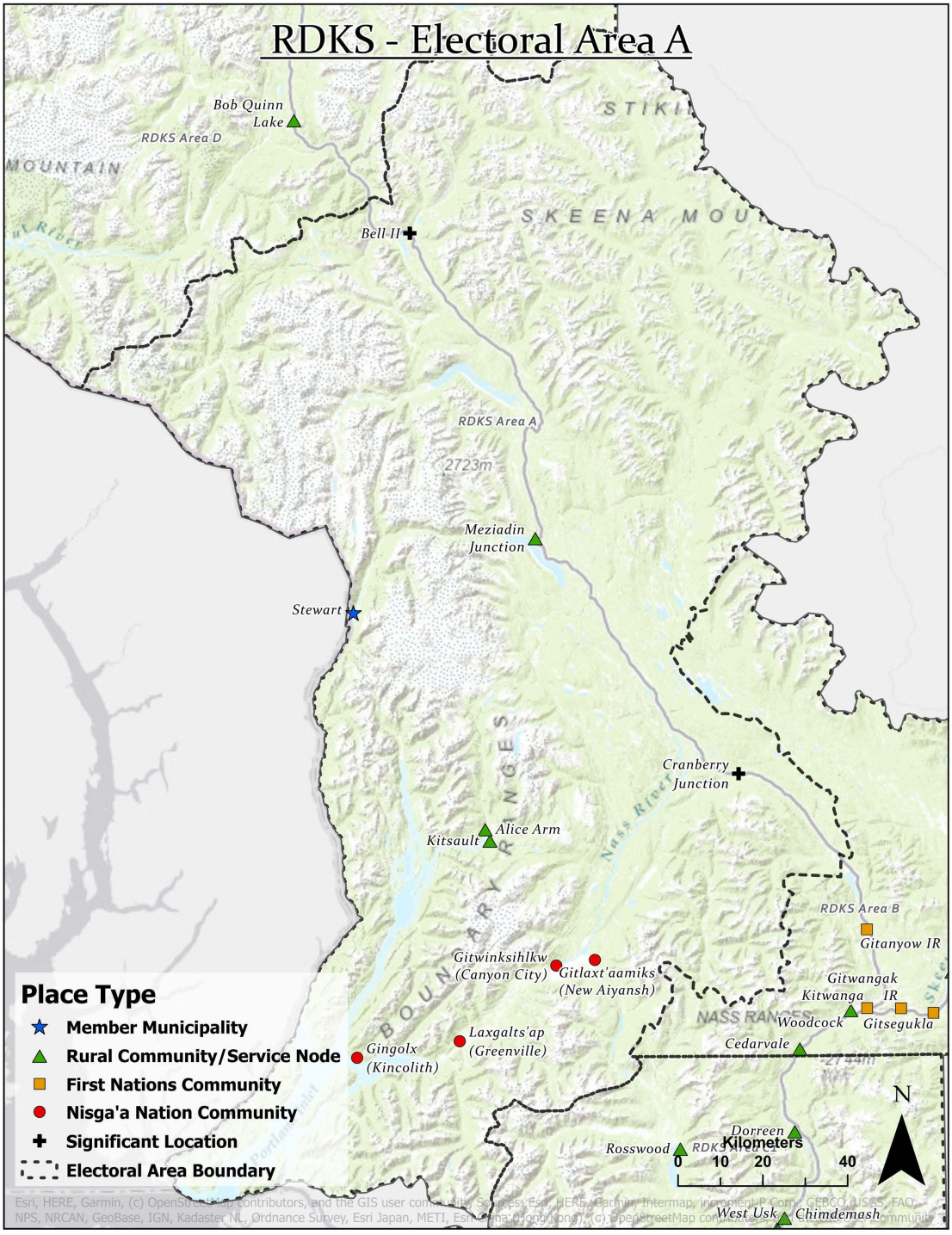
3.2.1.1 Area A

Area A is a 25,000 km^2 electoral area located in the central part of the Regional District. Census data confirms that the vast majority of the population resides in the Nisga'a Nation (for more details, please see Nisga'a Lands section 3.2.3 below) and in the member municipality of the District of Stewart.



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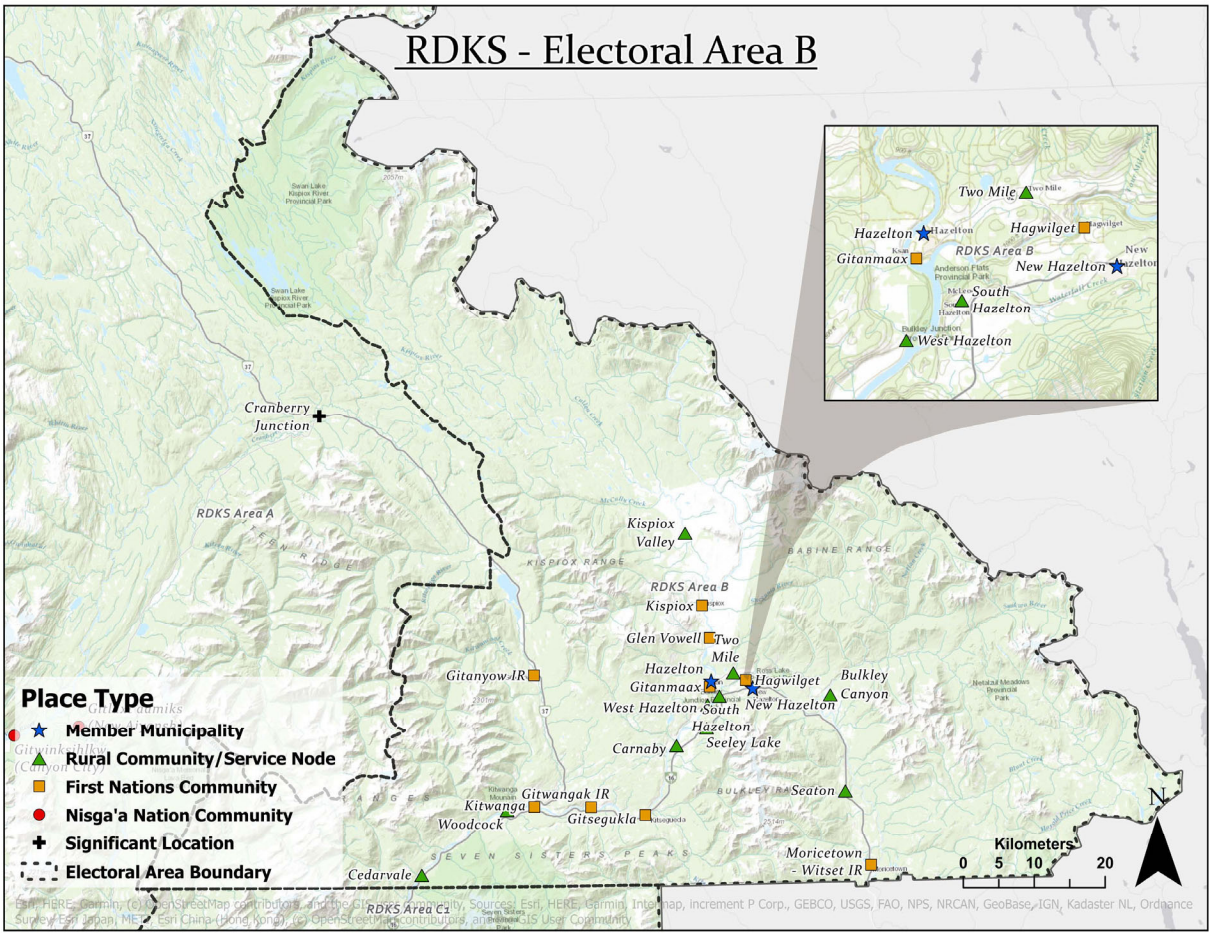
3.2.1.2 Area B

Area B is roughly 7500 km^2 and is located in the central eastern part of the RDKS. Census data indicates a rural population in Area B of about 1500 people. It is home to a number of First Nations communities, the member municipalities of the District of New Hazelton and the Village of Hazelton as well as a number of rural communities.



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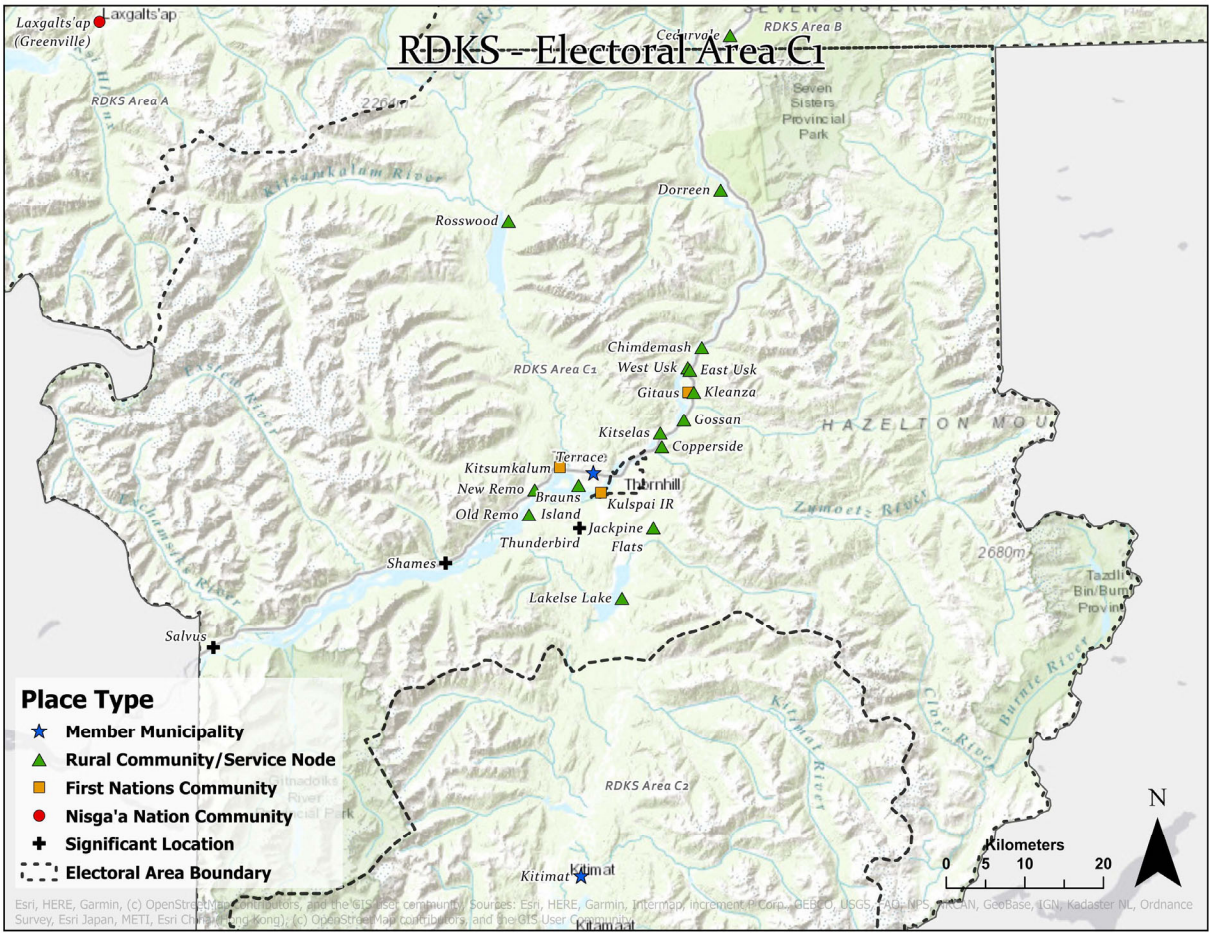
3.2.1.3 Area C

Area C is a vast geographical area located in most southerly portion of the RDKS. It is referenced by two subsections -- almost 10,000 km^2 in C1 with a population of around 2800 people not residing on reserve or in a municipality and 18,000 km^2 in C2 with very few people not residing on reserve or in a municipality. The largest member municipalities, Terrace and Kitimat, are in this Area as well as a large contingent of First Nations and rural communities.



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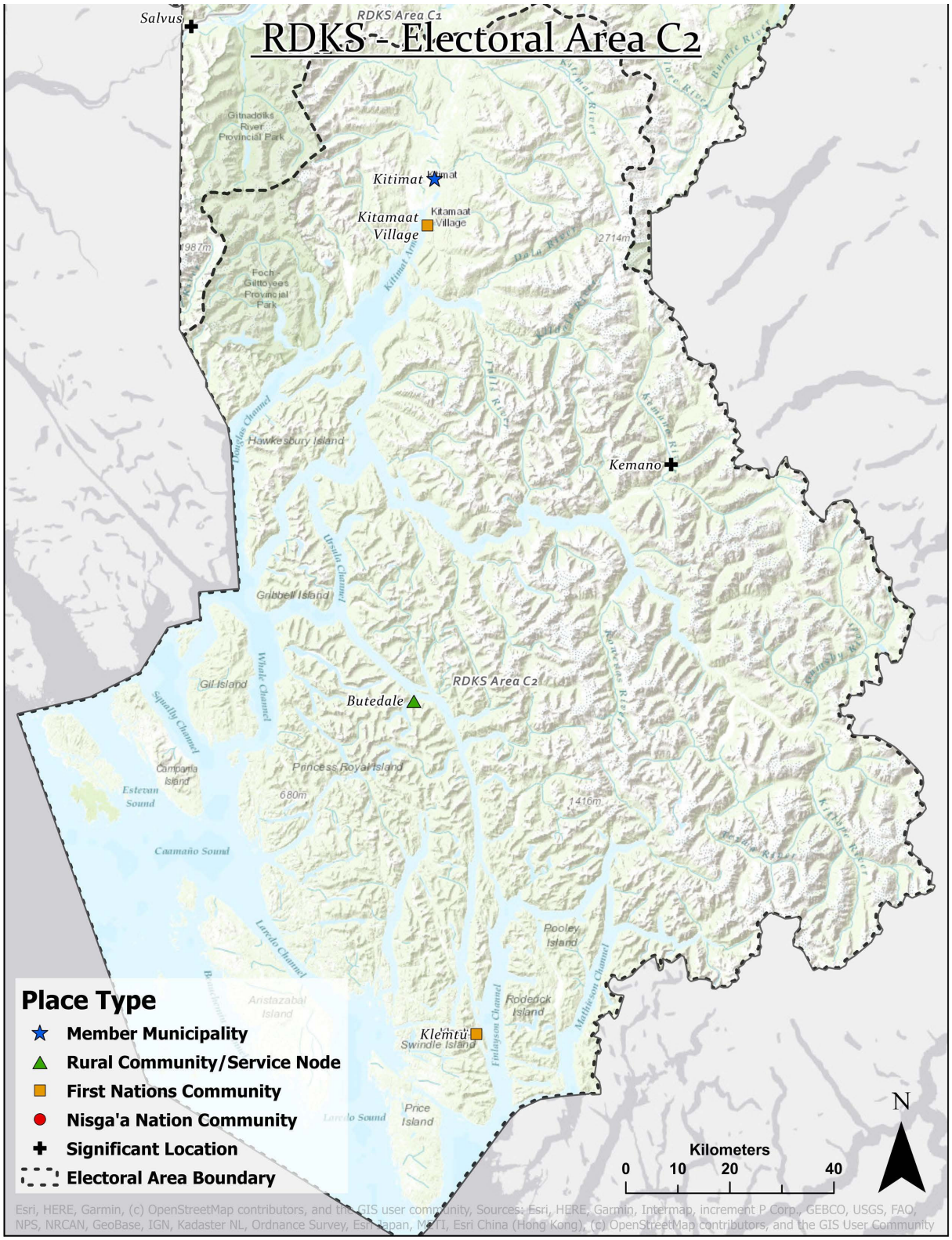

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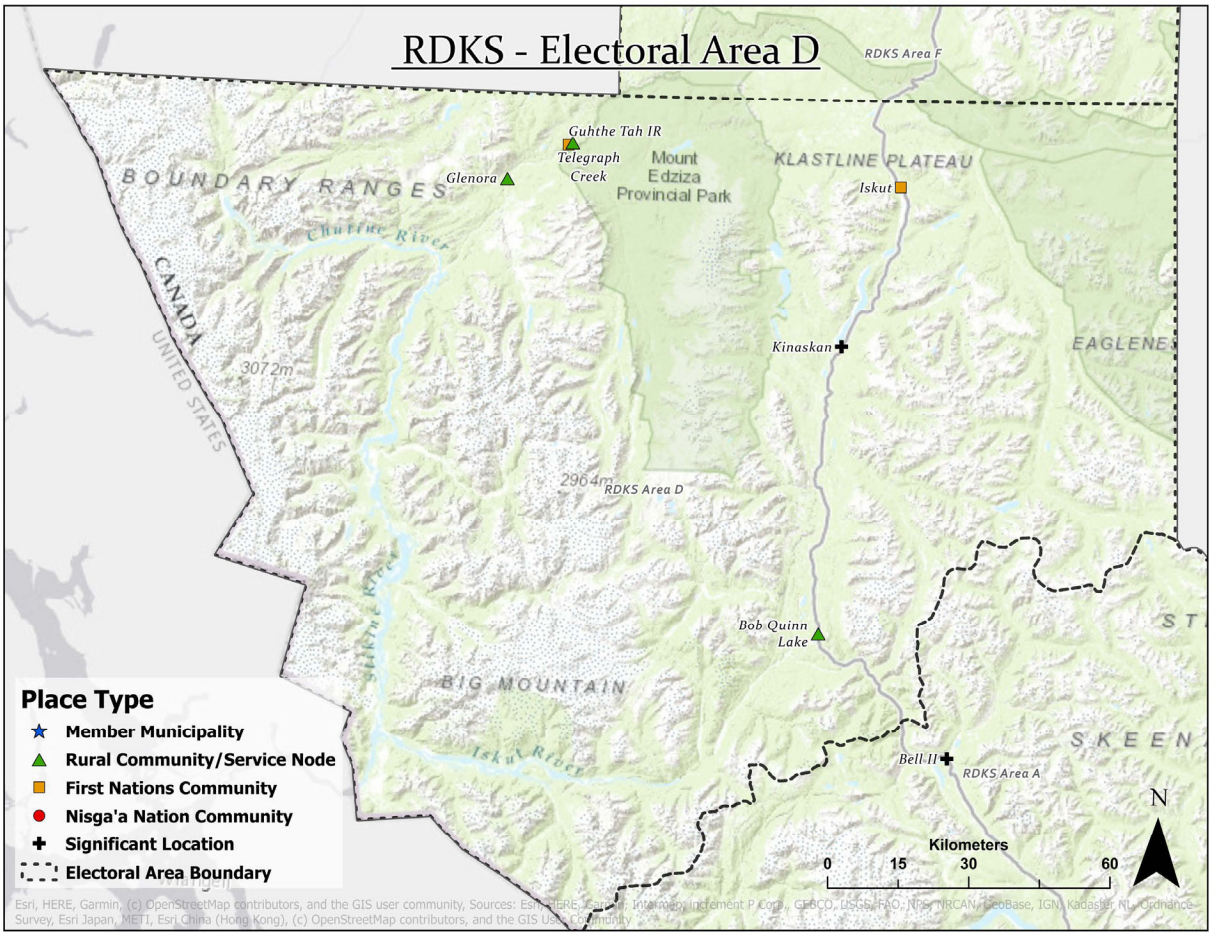
3.2.1.4 Area D

Area D is the second most northerly electoral area in the RDKS and is a very large and remote area. It contains 28,000 km^2 of land mass. There are no member municipalities in Area D, but area communities include Telegraph Creek and Iskut. There are also two area First Nations – Tahltan First Nation in the Telegraph Creek area and Iskut First Nation in the Iskut area. Census data shows a population of 99 people outside of the First Nation reserve lands.



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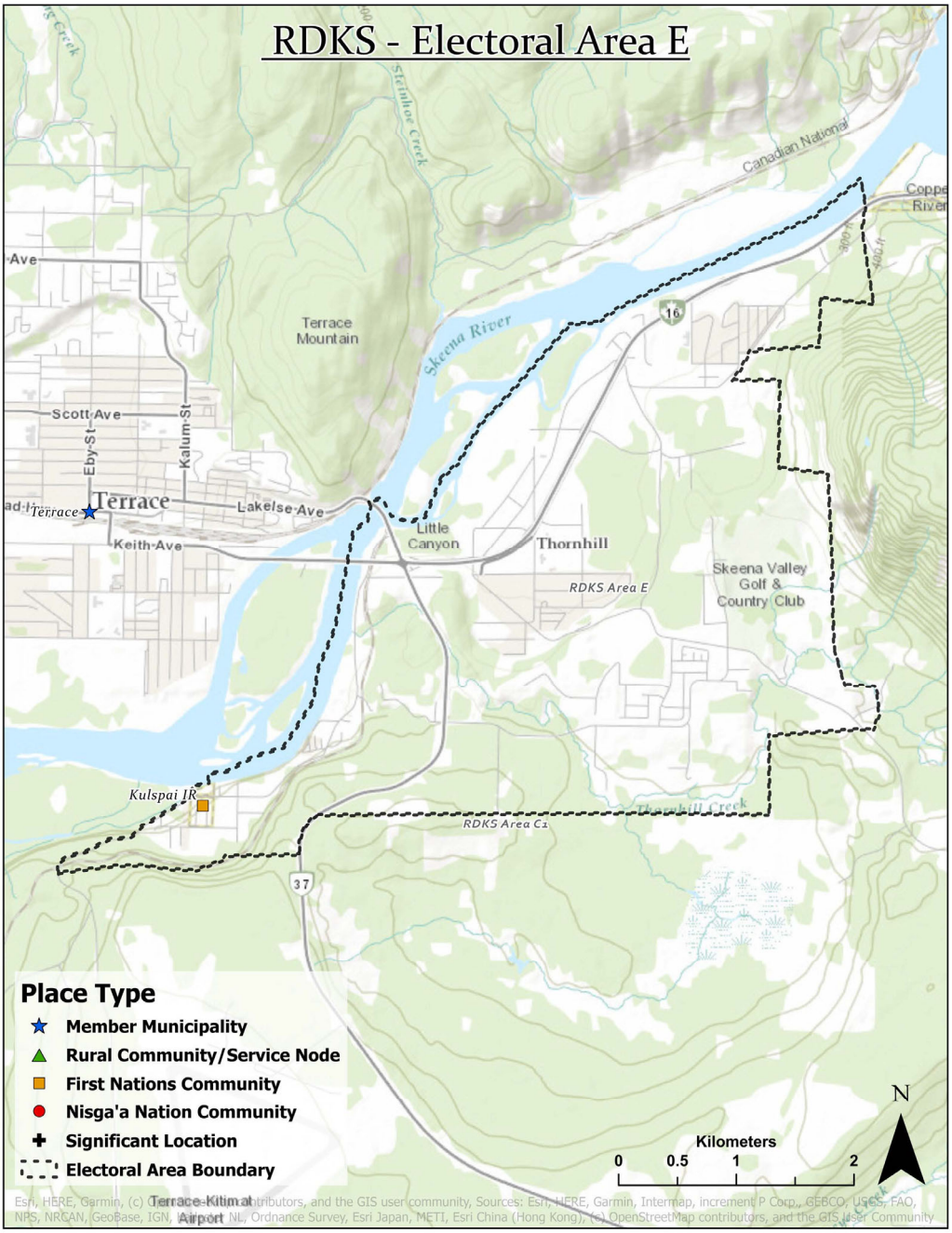
3.2.1.5 Area E

Area E is the community of Thornhill located just south and east of Terrace across the Old Skeena Bridge. It is a very small electoral area that behaves more like an urban municipality in some ways than an electoral area. Its population is almost 4000 people within 16 square kilometres. Because of its urban characteristics and close in geographic location, it has been excluded from the analysis.



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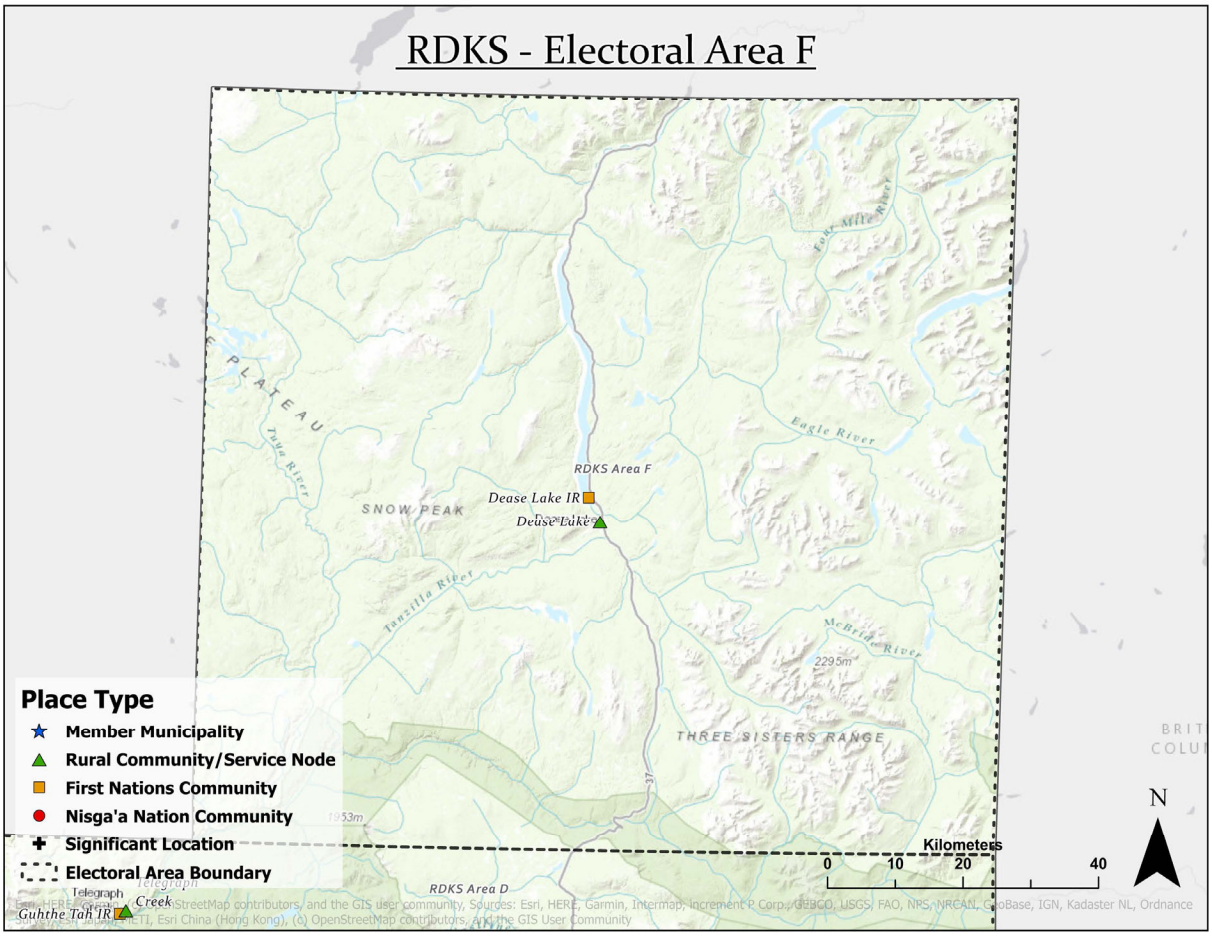
3.2.1.6 Area F

Area F is the northernmost electoral area in the RDKS and has no member municipalities in it. It has only one community which is located at Dease Lake. The electoral area is about 13,000 square kilometres and has a population of a little less than 400. Dease Lake is a few hours south of Yukon Territory and is the last major centre before the Alaska Highway. The Dease Lake Indian Reserve is also located in Area F.



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3.2.2 Member Municipalities

Along with the electoral areas noted above, there are five member municipalities within the RDKS:

Member Municipality	Population 2016 Census
City of Terrace	13,663
District of Kitimat	6,394
District of New Hazelton	580
District of Stewart	401
Village of Hazelton	313

As explained in section 2.3 above, member municipalities except for the District of Stewart were not included in the analysis but are, obviously, key locations in the RDKS.

3.2.3 Nisga'a Lands and First Nations Reserve Lands

Nisga'a Lands are located within Area A. Nisga'a Lands include 2,000 km^2 and have a population of almost 2,000 people[5]. There are four Nisga'a villages which are home to the vast majority of people in Area A -- Gitlaxt'aamiks Village, Gitwinksihlkw, Laxgalts'ap, and Gingolx**.**

In addition to the Nisga'a Nation, there are another 20 First Nations communities located on reserve lands within the RDKS. The First Nations' population in the RDKS on reserve totals over 5,600 people. Communities range in size from about 50 people to over 600[6].

[5] Statistics Canada, 2016 Census Data, Nisga'a Land Census Profile
[6] Statistics Canada, 2016 Census Data, First Nation IRI Census Profiles

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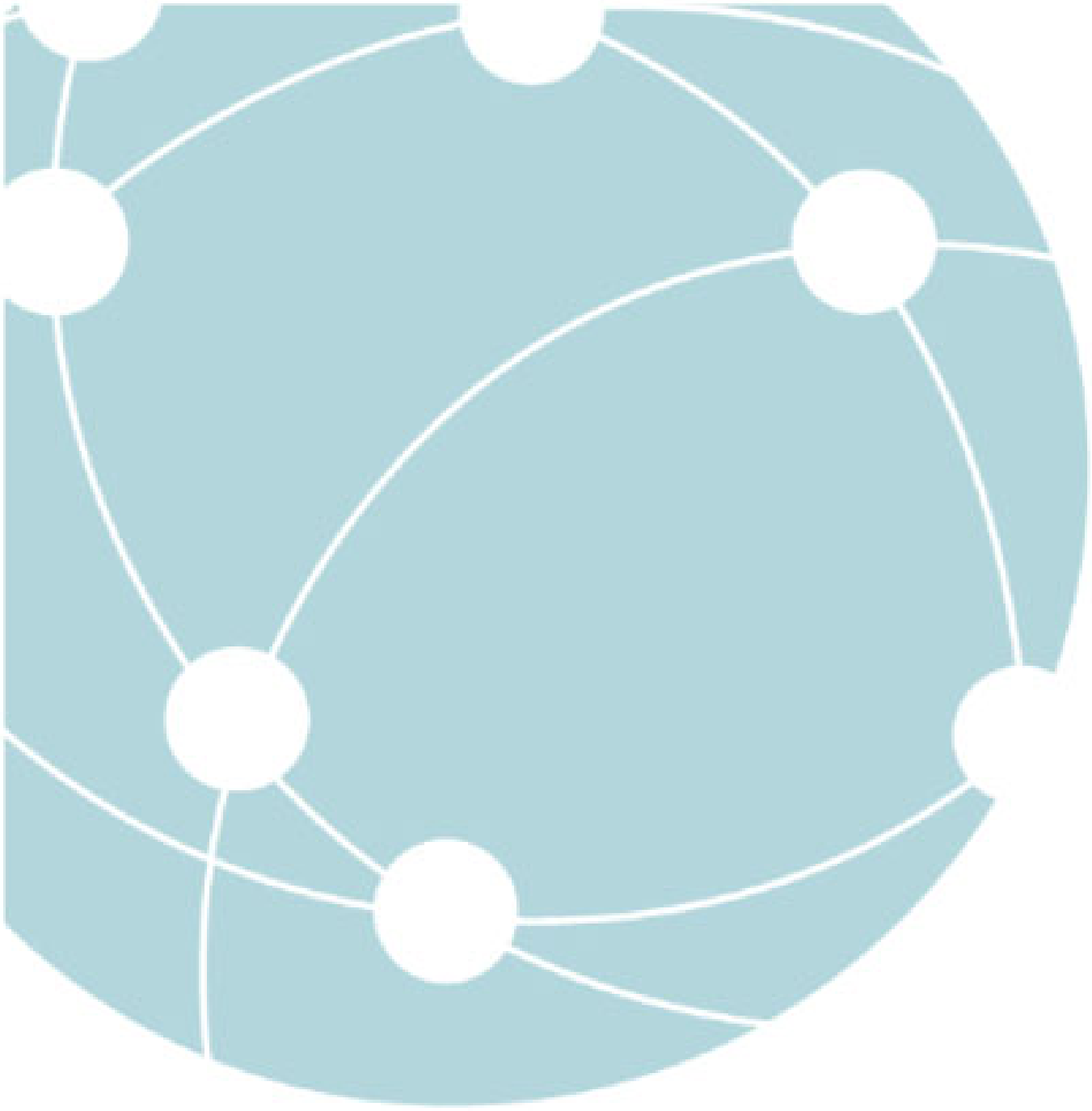

4 STRATEGIC PERSPECTIVE

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As set out above, the RDKS is a large geographical region in BC with sparse population. Accordingly, the business case for rural broadband connectivity is a difficult one to make but affordable access to high speed broadband is absolutely vital to keep this region from falling further behind the information curve. Cost effective access to high speed broadband service throughout the Regional District has been identified by the RDKS in both its Strategic Plan adopted March 23, 2018 and its Workforce and Resident Attraction Plan adopted April 10, 2018. This strategy builds on that work.

TANEx used the NDIT framework at a general level to provide some structure to the strategy. Broadly, the NDIT framework is broken into the Why, the What and the How of the initiative. It contemplates understanding why the initiative is important through enunciation of a vision for a region as a highly connected region, the identification of the particular benefits that will be derived by a region as well as the setting of strategic objectives or goals of the initiative.

4.1 Vision

TANEx facilitated workshops with the RDKS connectivity project team to define where the RDKS wants to go with connectivity. A vision of the RDKS as a highly connected region resulted from this work as described in the following vision statement:

> "RDKS is a **progressive region** that is **not left behind** in the modern digital economy. Its natural beauty and economic vitality provide a **high quality of life** to its residents, which is supported by **affordable, high-speed internet connectivity**. All communities, including remote, rural, and First Nations' **communities are thriving and vibrant**. They **attract business and residents** with infrastructure that supports **access to remote work, online education, skills training and healthcare** in a way that allows residents to take advantage of local opportunities, while remaining connected globally."

4.2 Benefit Statement

One of the unique characteristics of the RDKS is that it is an extremely vast geographic area which means that connectivity plays an extraordinarily significant role in the economy, governance, and building relationships. Part of the work completed in the workshops facilitated by TANEx for the RDKS connectivity project team resulted in a definition and greater understanding of the benefits to be realized by achieving the vision. Improving access to affordable high-speed internet connectivity will provide benefits to the RDKS such as:

1. Diversifying the economy of the region by spawning enhanced employment opportunities throughout the Regional District, even in less densely populated areas.

2. Increased attraction and retention of professionals and families, including not only those who provide services locally but also those who want to work remotely from within the RDKS. Reliable connectivity in all locations creates flexibility in where people can reside and promotes broad economic benefit.

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3. Improved communication between residents and the Regional District government including access to RDKS online resources and communication of emergency information, natural disasters and road closures.

4. Making monitoring and controlling remote infrastructure sites possible, including providing secure access to control systems for remote RDKS personnel. This minimizes travel to facilities and results in in faster emergency response times, lower risk to human resources and less environmental impact.

5. Enhanced vitality in First Nations communities through better communication and improved economic opportunities that leverage the existing vibrancy and innovation of those communities.

6. Greater remote access to education, skills training and professional development as well as health care services in one of the largest regional districts having some of the most remote areas in the province.

7. Enhanced public safety for both residents and visitors due to the reduction in the number and size of areas in the Regional District without connectivity.

8. Improved communication between constituents and the Regional District government promoting inclusion of all Regional District residents, regardless of where they live, by giving residents remote access to the political process.

Better connectivity provides key support for the Strategic Areas already identified in the Economic Development Commission Strategic Plan for the region including Workforce and Resident Retention, Community Infrastructure, Skills Training, Business Retention and Expansion and Tourism Marketing.

4.3 High Level Objectives/Goals

The work done to identify the vision for the region and the benefits to be gained once that vision was achieved led to the development of a set of high-level objectives to frame the strategy. The CRTC universal service objective of 50 million bits per second download speed and 10 million bits per second upload speed (“50/10” or the “USO”) was used to set the connectivity objective in the high-level goals. With respect to the rural areas in the RDKS outside of member municipalities other than Stewart, those objectives were articulated as:

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Strategic Goals – Goal #1

100% of anchor tenant locations such as schools, libraries, health care facilities and emergency responder facilities in the RDKS are connected with 50/10 service by 2025.

Strategic Goals – Goal #2

80% of dwellings and businesses within 3 km of a community* along a major highway in the RDKS have access to 50/10 service by 2030.

Strategic Goals – Goal #3**

By 2030, cellular service is available within 20 kilometers of RDKS service nodes*** along all major highways, with the eventual goal of cellular coverage along the entirety of our highway corridors.

* Community means a rural community within the jurisdiction of the Regional District although the RDKS is fully supportive of collaborating with their First Nations neighbours to promote and achieve connectivity for all.

** Please note that while Goal #3 is a strategic goal for the RDKS, it is beyond the scope of this strategy to provide an analysis of how to improve cellular service in the region.

*** Service Node means a location of interest identified by the RDKS as such.

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5 METHODOLOGY

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5.1 Methodology

This section described the methodology used in gathering information used in the report for mapping and outreach. The information obtained will be summarized later in the document.

5.1.1 Mapping Methodology

Part of the information gathering process involved obtaining available GIS data from the RDKS along with other sources and using it to create maps. The methodology and discussion of elements used for creating the important layers in these maps is generally laid out below.

Sources – The sources used in the analysis include the RDKS, various stakeholders corresponding to the affected areas, the CRTC, Statistics Canada, and BC Open Data. The main dataset of analysis was sourced from the RDKS and included the Points which are discussed in more detail below. The material sourced from the CRTC included the hexagons that differentiate between areas eligible for funding and those that are not eligible. These hexagons also have subsequent data that indicate which type of service is available in a location[7]. Examples of the types of service include cable, fibre, DSL, wireless among others. Data from Statistics Canada included census data that determined the number of people and the number of dwellings in certain communities within the RDKS. Another important layer sourced from the CRTC/ISED is the National Broadband Road Segments layer which is discussed in more detail below[8]. The existing infrastructure dataset that came from the TANEx Project Team and other sources showed where existing cell towers and fibre lines were located[9]. Contextual information sourced from BC Open Data included anchor institutions such as schools, hospitals, government buildings, etc[10]. Road networks, administrative boundaries, and other layers were also sourced from BC Open Data and the RDKS.

Potential Subscriber Points – Potential subscriber points ("Points"), are one of the most important datasets in the analysis. The GIS dataset used by TANEx to create Points was provided by the RDKS as a collection of address points, building locations, and centroid points derived from parcel layers. Together, these layers make up a collection of Points that are an approximation indicating where a potential subscriber may be located. The Points were then assigned both density and available internet speed characteristics which are discussed in more detail below. The combination of where these Points are located, currently available internet access speeds available to them, and what level of density they are dispersed in created the foundations for understanding where to delineate project areas and the overall characteristics of those project areas as discussed in the project areas section below.

Density & Density Buffer Areas – In order to gauge the density of certain areas, three buffer zones around the Points were created. The three buffer distances used were 200m, 1km, and 2km. These distances were used for their ease of understanding and implementation. Individual buffer zones emanating from the Points were then dissolved into contiguous areas. If any of the buffer zones contained only one Point, they were erased. The result are contiguous areas that contain two or more Points. If a Point falls within a buffer zone it is designated as Type 1 (200m), Type 2 (1km), Type 3 (2km) density, defaulting to the higher designation if it falls within two or more of the buffer zones. If a Point does not fall within the lowest buffer zone designation, it is designated as Type 4 which means it is outside the 2km buffer area. Such Points are very remote and very rare.

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[7] Government of Canada, *National Broadband Data Information*, Hexagonal Grid of Canada
[8] Government of Canada, *National Broadband Data Information*, National Broadband Data Road Segments
[9] Steven Nikkel, 2020, *Canadian Cell Towers Map*
[10] Government of British Columbia, BC Open Data

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Speeds & Speed Buffer Areas – The Canadian Federal Department of Innovation, Science and Economic Development (ISED) maintains a dataset of national broadband road segments which give a sense of what level of internet speed a person could expect if they lived in the area around that road. This data is based on information provided annually by service providers[11].

A buffer of 200m was created using this dataset of road segments. The results are areas that were used to determine what type of download and upload speeds a Point could expect to have if they fall within one or more of these areas. The range of speed combinations (download speed/upload speed in Mbps are as follows: 50/10, 25/5, 10/2, 5/1, or Less than 5/1. If a Point fell within two or more of these areas, then they were designated with the higher speed of the areas depicted.

Project Areas – Once Points were characterized by their speed and density a clearer picture manifested of what areas should be selected for upgrading infrastructure and internet access. Points and the areas around them that already had 50/10 service speeds available to them per the National Broadband Data (NBD) road segments were excluded from project areas. Points that have a density designation of Type 3 or 4 are more difficult and more costly to serve due to their remoteness. Points in higher density areas and had speeds below 50/10 were ones that the project areas tried to capture. Project areas often have one or more service providers operating in or near them. These providers are the most likely to implement upgrades needed to bring better service within the identified project areas. The potential project areas illustrate the location of underserved areas, current level of service, estimated number of potential subscribers, and what providers operate in or near the area who could be approached for help to improve service.

Fibre Lines – The routes of fibre lines were sourced from public domain. Fibre lines and an understanding of where they are situated are important since they form a key element of the network infrastructure needed to serve potential customers.

Cell Towers – Cell tower locations and data were also sourced from public domain. Cell towers are another important element in providing existing and potential future internet service to underserved areas and their constituents.

Service Provider Coverage – Service provider coverage was sourced from ISED databases and where possible, verified with the service provider. The databases derive their information directly from individual service providers. Some of the information is older and may be out of date but nonetheless gives a sense of what service providers operate in which area and what types of technology they utilize in those areas. Examples of such technology include coaxial cable, DSL, fixed wireless, or Fiber-to-the-Premises/Home.

UTM Zone 9N – The geographic coordinate system used for analysis and mapping was the Universal Transverse Mercator Zone 9N. This coordinate system was chosen since it covers and aligns nicely with the entire RDKS and therefore the distances between geographic features are relatively reliable and accurate.

[11] Government of Canada, *National Broadband Data Information*, National Broadband Data Road Segments

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5.1.2 Outreach Methodology

5.1.2.1 Public

Public outreach was addressed by developing a survey with the RDKS connectivity team. That survey was available online and in paper form. Public surveys were available to residents, businesses, organizations, First Nations, and institutions and delivered feedback about different aspects of internet and cellular service. A summary of the results of the surveys are available later in this report. Reported results are simply as reported by the participants with it being beyond the scope of this report to undertake any form of validation including with respect to cost and speed of service. The sample size of respondents was insufficient to confidently extrapolate the findings across the Regional District, so survey results are included only for general information. The small sample size is believed to be largely attributable to the COVID-19 pandemic.

5.1.2.2 Key Stakeholders and First Nations

A list of key stakeholders was received from the RDKS and telephone or email contact was made or attempted to be made with those stakeholders to obtain information and views on the state of connectivity, future goals, benefits and challenges from their perspective. Stakeholders included community leaders, community champions, First Nations, industry representatives and other parties holding valuable insight into the connectivity challenge. A summary of the feedback obtained from those key stakeholders is contained later in this report.

5.1.2.3 Internet Service Provider

A list of service providers was created from information provided by the RDKS as well as research of publicly available sources of providers in the area. TANEx attempted to schedule telephone interviews with all known area service providers and almost every service provider participated in a telephone interview along with some providers not currently providing services in the RDKS.

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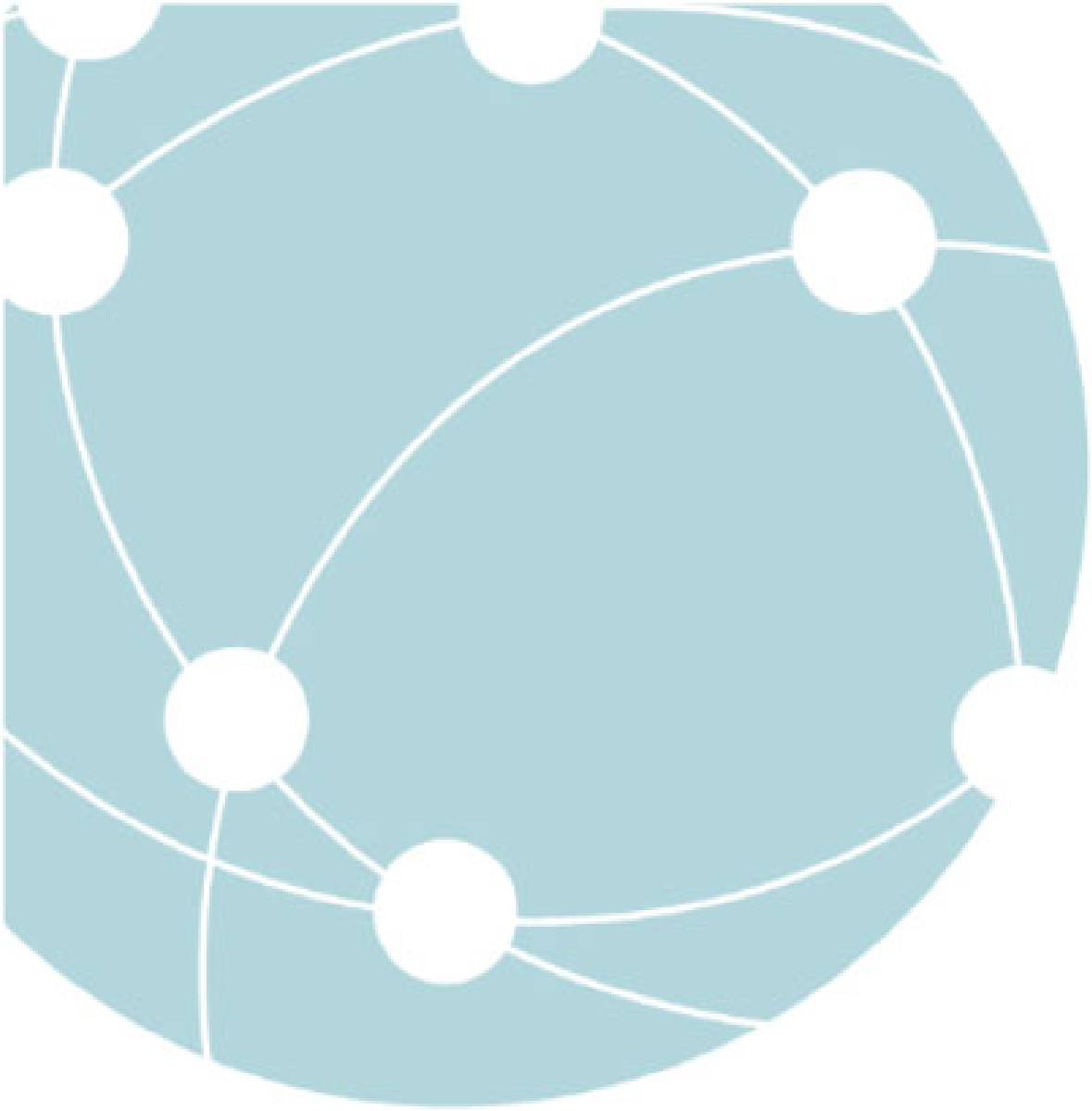

6 RDKS CURRENT STATE

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In order to formulate a strategy for the Regional District, a thorough understanding of the current state of the region is necessary to form the basis of the analysis, identify the gaps and define the steps that must be taken to reach the strategic objectives.

6.1 Infrastructure

6.1.1 Transportation

6.1.1.1 Ground Transport

By roadway, the movement of people and goods in the region is primarily defined by two major road transportation corridors. In short, one paved highway runs from the saltwater port at Kitimat in the south to the northern boundary of the RDKS (and ultimately BC) and another traverses the region from east to west, cutting through Terrace to connect Prince George to Prince Rupert.

Highway 37 is a paved highway running north from Kitimat, through Terrace and running the full length of the Regional District through to the northern BC boundary. Continuing north on 37, the highway connects to Highway 97 (Alaska Highway) near Upper Liard, Yukon. Most of the 875 km of Highway 37 is in the RDKS. About half-way up the Regional District, Highway 37A spurs off Highway 37 (at Meziadin Junction) and runs west and south 65 km on Highway 37A to Stewart. Access to Telegraph Creek is on Highway 51, a 114 km unpaved road that connects to Highway 37 at Dease Lake. Highway 113, the Nisga'a Highway, extends north from just west of Terrace and provides access to the Nisga'a Valley.

Highway 16 (Yellowhead Highway) is an important east-west corridor that bisects the region at Terrace in the southern part of the Regional District. Highway 16 connects Prince Rupert in the west to Prince George in the east. Prince George is a major transportation hub at the intersection of Highway 16 (connecting east to Alberta) and Highway 97 (connecting south to Vancouver and north to Fort St. John and Dawson Creek). Prince Rupert is home to BC's second largest port after Port Metro Vancouver.

6.1.1.2 Rail Transport

In addition, a Canadian National rail line crosses through the Regional District following the same route as Highway 16. A connecting rail line extends south from Terrace to Kitimat following a right of way to the west of Highway 37.

6.1.1.3 Ocean Shipping

An important transportation characteristic of the RDKS is that it has two seawater ports, Kitimat and Stewart, with access to the Pacific Ocean. Important marine transport corridors include: (i) Douglas Channel that runs south through the Regional District from Kitimat to the Pacific; (ii) Portland Canal that runs south from Stewart to the Pacific near Prince Rupert; and (iii) the BC Ferry route between Prince Rupert and Port Hardy that runs through a passage east of the coastal islands at the southern extent of the Regional District[12][13].

[12] District of Stewart, Port of Stewart
[13] District of Kitimat, Port of Kitimat

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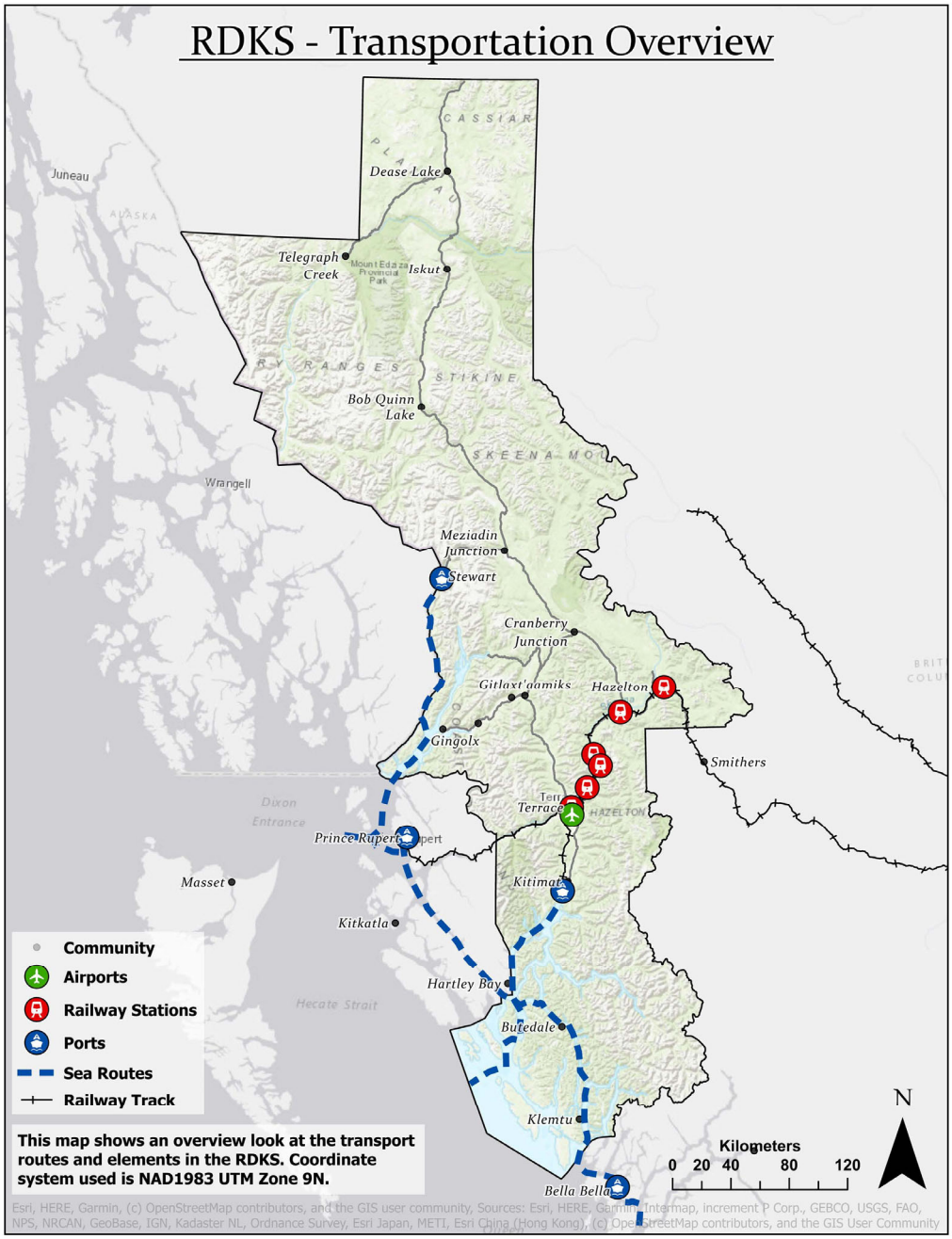
6.1.1.4 Air Transport

The Northwest Regional Airport Terrace-Kitimat (YXT) is located 5 km south of Terrace. There are daily non-stop flights to Vancouver[14]. In addition to the primary airport, there are paved air strips at Stewart and Dease Lake as well as many smaller air facilities scattered throughout the District including those that are, or were, associated with resource development projects.



[14] Northwest Regional Airport (YXT)

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6.1.2 Large Industry

BC Hydro high voltage transmission lines connecting Prince George to Prince Rupert cut through the RDKS from east to west, passing just south of Terrace[15]. In addition, there are also BC Hydro high voltage transmission lines south from Terrace to Kitimat along Highway 37 and north from Terrace along the Nisga'a Highway and Highway 37 to Bob Quinn Lake (NTL)[16].

Rio Tinto's Kemano generating station located about 80 km south and east of Kitimat, provides hydro-electric power for the Rio Tinto aluminum smelter in Kitimat. The station has a rated capacity of 896-MW. The generating station was built in the 1950s to serve the aluminum smelter. The station was automated in the 1990s, and the village of Kemano subsequently abandoned. Most of the power generated is used by the aluminum smelter, with the remainder sold to BC Hydro.

Three hydro-electric generating stations were built and commissioned by AltaGas on Tahltan First Nation territory, south and west of Bob Quinn Lake. These stations include: (i) 195-MW Forrest Kerr station commissioned in 2014; (ii) 16-MW Volcano Creek also commissioned in 2014; and (iii) 66-MW McLymont Creek station commissioned in 2015. These tie into the provincial grid at BC Hydro's Bob Quinn Lake substation[17].

Pacific Northern Gas operates a pipeline that runs from Summit Lake north of Prince George (where it connects with the Enbridge Westcoast Energy natural gas pipeline) to Prince Rupert. The pipeline cuts through the Regional District on an east west line that runs close to Terrace. A spur off this line, near Terrace, runs south to Kitimat[18].

The planned Coastal GasLink Liquified Natural Gas (LNG) pipeline is set to run due east from Kitimat for 670 km, crossing out of the RD on its way to Dawson Creek in the north east (near the Alberta border). Contractors for TC Energy, the pipeline owner, have been taking delivery of pipe at storage sites in Kitimat and Chetwynd. After some delays, construction is expected to ramp-up this year (2020)[19].

[15] BC Hydro, BC Hydro Transmission System
[16] BC Hydro, BC Hydro Transmission System
[17] Energy BC, Electricity Map
[18] Energy BC, Gas Map
[19] TC Energy, Coastal GasLink

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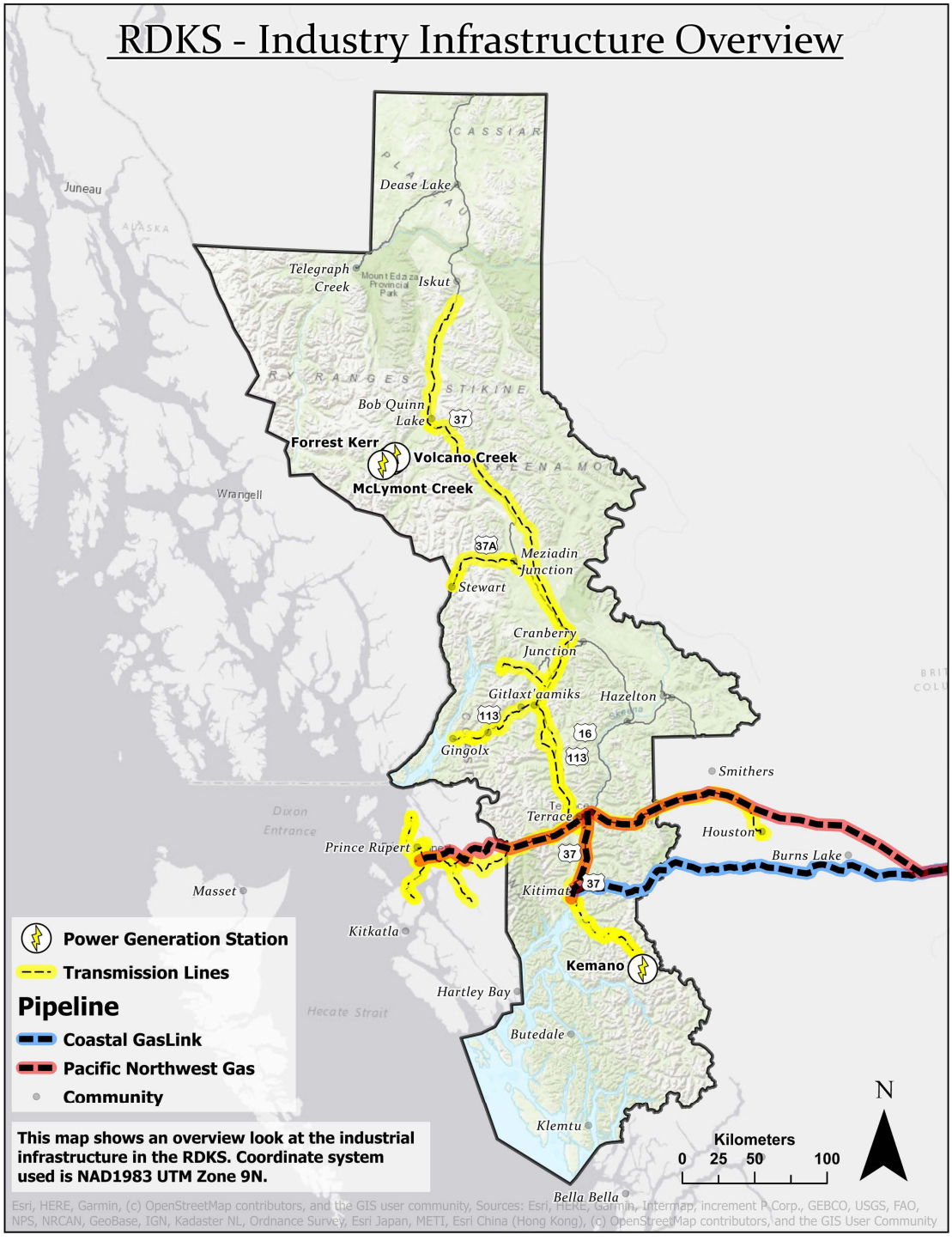

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6.1.3 Health

There are 12 health facilities in the Regional District administered by the Northern Health Authority which appear in the table below as well as numerous health facilities on First Nations reserve lands throughout the region.

Northern Health Authority Health Facilities in the RDKS	
School Name	**Location**
Wrinch Memorial Hospital	Hazelton
Kitimat General Hospital	Kitimat
Mills Memorial Hospital	Terrace
Terrace Community Mental Health Services	Terrace
Terrace View Lodge	Terrace
Seven Sisters Residence	Terrace
Stewart Health Centre	Stewart
Stikine Health Centre	Dease Lake
Nisga'a Valley (Gosnell) Health Centre	Gitlaxt'aamiks (New Aiyansh) Nisga'a Nation
Gitwinksihlkw Health Centre	Gitwinksihlkw (Canyon City) – Nisga'a Nation
Laxgalts'ap Health Centre	Laxgalts'ap (Greenville) – Nisga'a Nation
Gingolx Health Centre	Gingolx (Kincolith) – Nisga'a Nation

Although current connectivity to each facility was not confirmed during the course of the project, the health facilities in Hazelton, Kitimat and Terrace are in communities with access to fiber connectivity and the Nisga'a Nation facilities are located in Villages served by Lisims cable and fiber facilities. The Dease Lake facility can be served by digital subscriber line service from NorthwesTel with advertised internet speeds up to 15 Mbps download and 1 Mbps upload. Based on the ISED National Broadband Database, Stewart appears to have less than 5 Mbps download speeds over terrestrial circuits.

Note that all areas have access to satellite service which can offer 10 to 25 Mbps download speeds; however, network delay is a recognized impediment to satellite service. In addition, all non-fiber areas have high usage costs, particularly if monthly usage caps are exceeded and this affects true accessibility to service.

Broadband internet connectivity is seen as an enabling technology for health services. The current Strategic Plan for Northern Health includes communications, technology and information as an enabling priority[20]. Specific provisions in the plan include:

[20] Northern Health, 2016, *Mission, Vision, & Strategic Plan 2016-2021*

- Use technology to reduce the impacts of distance and time in bringing health services to people and their families.
- Using technology, deliver a range of clinical and diagnostic services to support primary care, community services, and specialized services.

6.1.4 Educational Institutions

RDKS School Districts are shown in the table below:

SD#	Name	Number of Schools	Student Population
82	Coast Mountain	21	5760
92	Nisga'a	4	630
87	Stikine	2	286

The following table lists the schools from readily available information and includes the existing internet connectivity speeds for most schools from records maintained by TELUS.

Grade Schools in the RDKS				
SD	**School Name**	**Location**	**Grades**	**Speed**
87	Dease Lake School	Dease Lake	K-12	30 Mbps
87	Tahltan School	Telegraph Creek	K-12	20 Mbps
92	Gitwinksihlkw Elementary School	Gitwinksihlkw	K-7	20 Mbps
92	Alvin A. McKay Elementary School (Laxgalts'ap Elementary School)	Laxgalts'ap	K-7	30 Mbps
92	Nathan Barton Elementary School	Gingolx	K-7	20 Mbps
92	Nisga'a Elementary Secondary School (and Gansiwilaaks)	Gitlaxt'aamiks	K-12	100 Mbps
82	Bear Valley School	Stewart	K-12	50 Mbps
82	Caledonia Senior Secondary School	Terrace	10-12	100 Mbps
82	Cassie Hall Elementary School	Terrace	K-6	30 Mbps
82	Suwilaawks Community School	Terrace	K-6	SD Fiber
82	Hazelton Secondary School	Hazelton	8-12	200 Mbps
82	Majagaleehl Gali Aks Elementary	Hazelton	K-7	30 Mbps
82	New Hazelton Elementary School	New Hazelton	K-7	30 Mbps
82	Kildala Elementary School	Kitimat	K-7	30 Mbps
82	Kitimat City High School	Kitimat	8-12	50 Mbps
82	Kitwanga Elementary School	Kitwanga	K-7	30 Mbps
82	Mount Elizabeth Middle/Secondary School	Kitimat	8-12	50 Mbps
82	Nechako Elementary School	Kitimat	K-7	50 Mbps
82	North Coast Distance Education School	Terrace	K-12+	100 Mbps
82	Parkside Secondary School	Terrace	8-12	50 Mbps
82	Skeena Middle School	Terrace	8-10	SD Fiber
82	Thornhill Elementary School	Terrace	4-6	SD Fiber
82	Thornhill Primary School	Terrace	K-3	SD Fiber
82	Uplands Elementary School	Terrace	K-6	50 Mbps
82	Witset Elementary & Secondary School	Moricetown	K-12	No Telus Info
82	Gitsegukla Elementary School	Gitsegukla	K - 7	No Telus Info
82	Kispiox Community School	Kispiox	K - 7	No Telus Info

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Three post-secondary institutions have campuses in the RDKS: Northern Lights College, Coast Mountain College (previously Northwest Community College) and University of Northern British Columbia.

Post Secondary Education Facilities in RDKS	
Name	**Location**
Northern Lights College	Dease Lake
Coast Mountain Community College - Hazelton Campus *	Hazelton
Coast Mountain Community College - Kitimat Campus *	Kitimat
Coast Mountain Community College - Main Campus *	Terrace
Coast Mountain Community College - Canyon City *	Gitwinksihlkw (Canyon City)
University of Northern BC (UNBC) Northwest Campus	Terrace
University of Northern BC (UNBC) Wilp Wilxo'oskwhl Nisga'a Institute	Gitwinksihlkw (Canyon City)
*Previously Northwest Community College	

Education facilities in the Hazelton-Kitimat-Terrace triangle can access high speed fiber connectivity. Schools and college campuses in the Nisga'a Nation can access reasonable speeds on cable and fiber facilities. All other schools are currently limited by the lack of access to transport network capacity.

The 2020 health crisis has focused attention on the need for residential broadband to support students during pandemic orders to shelter-at-home. However, as students return to physical classrooms, school connectivity will regain importance. Pending guidance from the provincial Ministry of Education, the connectivity requirements can be estimated by interpolating recommendations for the 2023-24 school year from the State Educational Technology Directors Association[21]. From this, schools with up to 50 students may require the minimum connectivity speed to be sized based on 5 Mbps per student; with about 65 to 100 students, 4 Mbps per student; and over about 135 students, 3 Mbps per student. This means that, within the next 3 years, even a school with only 20 students should have at least 100 Mbps connectivity; and a school with 100 students, at least 400 Mbps. These requirements will increase over time, with a doubling or more possible over a further five years, leading to the 2028-29 school year.

[21] State Educational Technology Directors Association (SETDA), 2019-11, *Broadband Imperative III, Driving Connectivity, Access and Student Success*

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6.2 Telecommunications

6.2.1 Service Provider Overview

Provider	Summary
ABC Communications	Primarily provides fixed wireless services in the Terrace and Kitimat regions deployed using cellular infrastructure.
City West	Primarily provides services in the Terrace, Kitimat and Hazelton regions deployed using a mix of coaxial cable and fibre optic infrastructure.
Cybernet	Primarily provides fixed wireless services in the Terrace, Hazeltons and surrounding area.
Lisims (Nisga'a Nation)	Lisims, operated by the Nisga'a Nation, provides service to the four Nisga'a villages via NTL backbone fibre from Terrace to Gitlaxt'aamiks, and Lisims' fibre from Gitlaxt'aamiks to Gingolx. Local access by primarily coaxial cable infrastructure.
NorthwesTel	Provides services to the most Northern communities of the RDKS including Dease Lake, Telegraph Creek and Iskut. Backbone provided by microwave radio and local access via copper based DSL infrastructure.
Rogers	Primary interest in cellular services. Willing to work with the RDKS and other entities on providing solution where it makes business sense to do so.
Rhicomm	Primarily provides fixed wireless services in the Terrace and surrounding area.
Shaw	Does not currently provide services in the area but is looking to projects like Connected Coast to expand their service delivery area to include regions like the RDKS.
Sienna	Primarily provides fixed wireless services in Terrace, north of Terrace along highway 113 and Stewart.
Telus	Primarily provides services in the Terrace, Kitimat and Hazelton and surrounding regions deployed using a mix of fixed wireless, fibre optics and DSL infrastructure.

6.2.2 Internet Connectivity

For the purposes of analysis of available services in the RDKS, the region has been broken into two main areas, the KTH corridor and the northern region roughly defined as everything north of the communities of Terrace and Kitwanga. The area south of Kitimaat Village has not been disregarded but is extremely sparsely populated and the majority of that population is centered in Klemtu so it has not been analyzed as a region but rather simply Klemtu itself.

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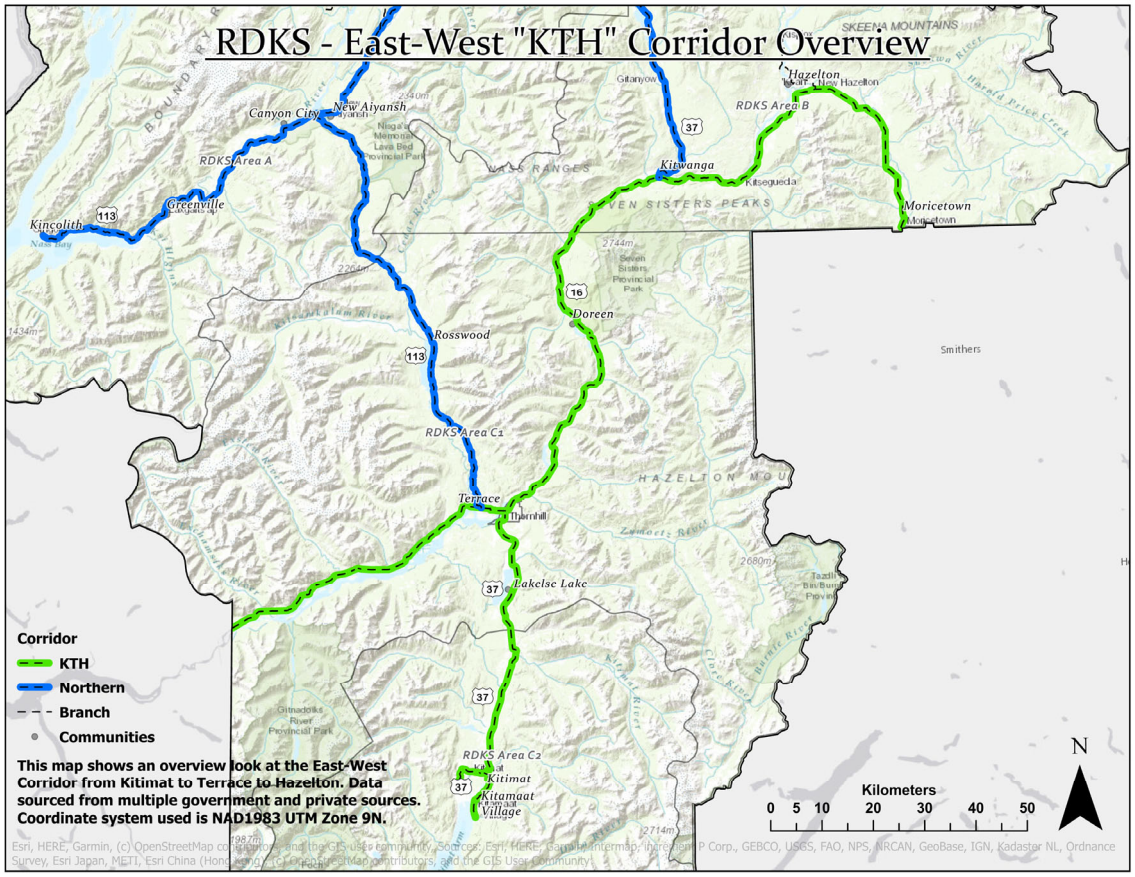
6.2.2.1 KTH Corridor

The following provides an overview of the area described as the KTH corridor.



The state of internet connectivity in this area can be summarized as follows:

- Represents the highest population density in the RDKS.
- Although there are rural areas without 50/10, generally connectivity coverage in the three points in this area would be considered good with many providers offering a variety of services over a number of different technologies.
- This area is a center of major industry which is driving a large investment in telecommunications services from a number of providers.

Refer to Appendix A and B of this document for detailed mapping of service providers and service offering.

The providers offering services in the KTH corridor include:

ABC Communications	CyberNet	Rogers	Telus
City West	Rhicomm	Sienna	

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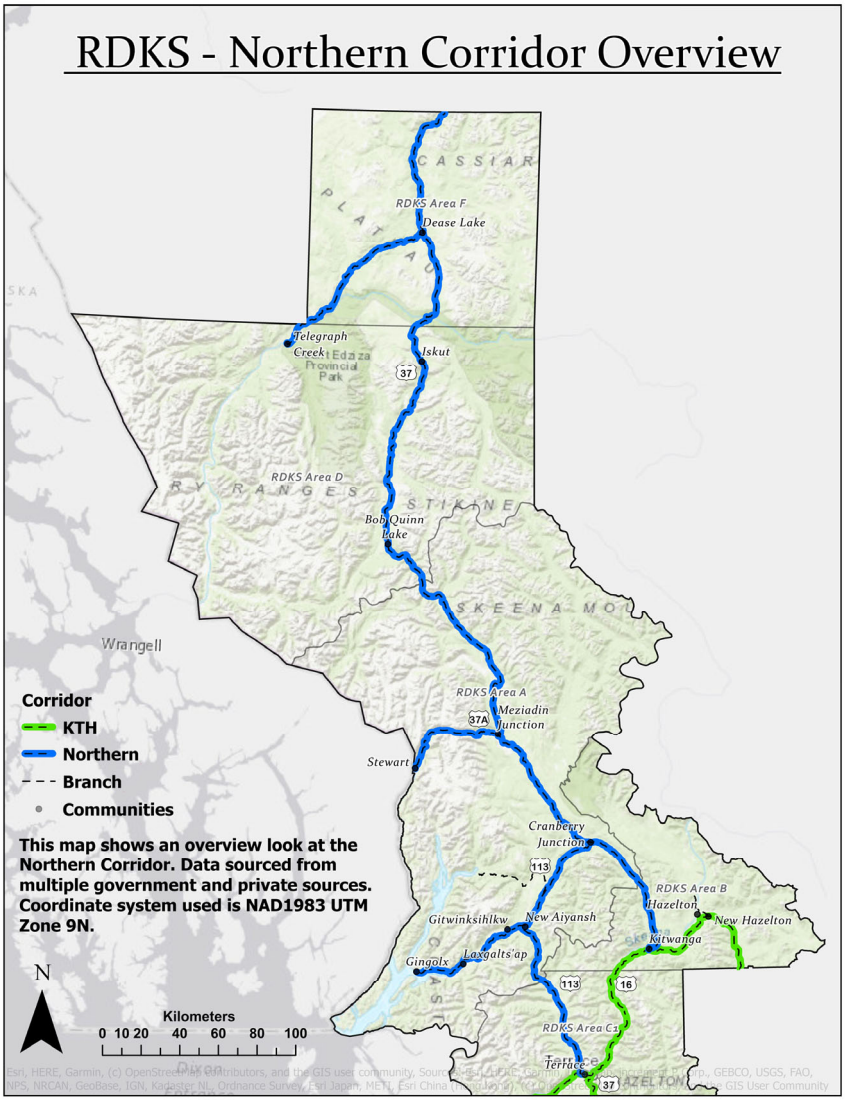
6.2.2.2 Northern Region

The following provides an overview of the area described as the northern region.



In contrast to the KTH corridor, the northern region state of connectivity can be summarized as follows:

- Most areas identified in the northern region do not have access to 50/10 and in general, with the exception of the Villages located in the Nisga'a Nation, connectivity would be considered poor with a single provider offering service.
- This area has small, remote communities with expensive infrastructure costs and consequently, the business case for improved connectivity is weak.
- There are very few providers offering services in this area.

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- There are unique initiatives underway that can dramatically improve services to communities in this area.

The providers offering services in this area include:

- Lisims (only Nisga'a Nation)
- NorthwesTel
- Sienna

6.2.3 Cellular Services

Most of the highways in the RDKS have no cellular coverage as shown on the map below. The lack of cellular coverage throughout the RDKS is a huge concern. In particular, from the KTH corridor north to Dease Lake represents approximately 700+ kilometers of major highway infrastructure with very little to no coverage. This is a serious safety concern outlined by the RDKS and a strategic goal to be resolved.

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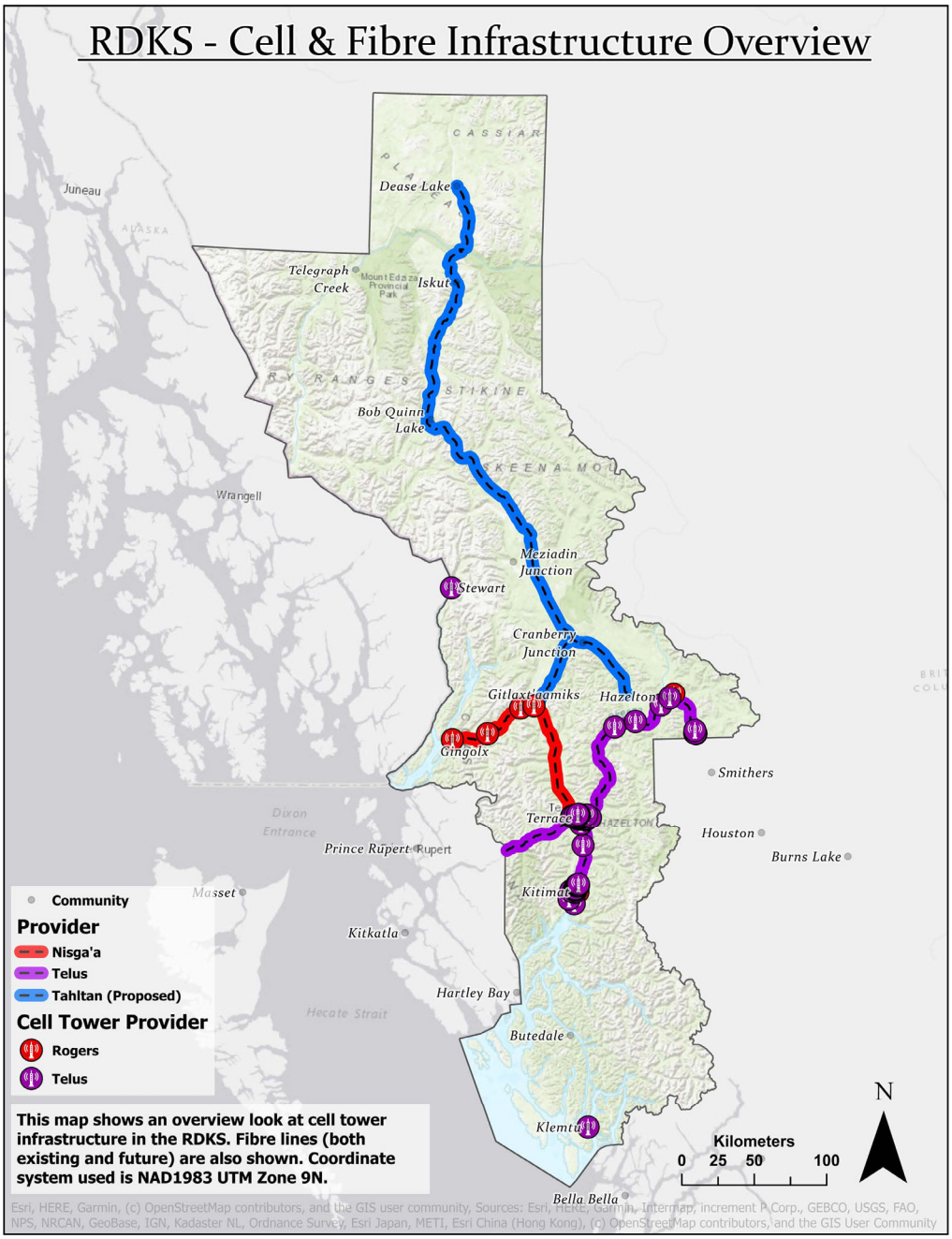

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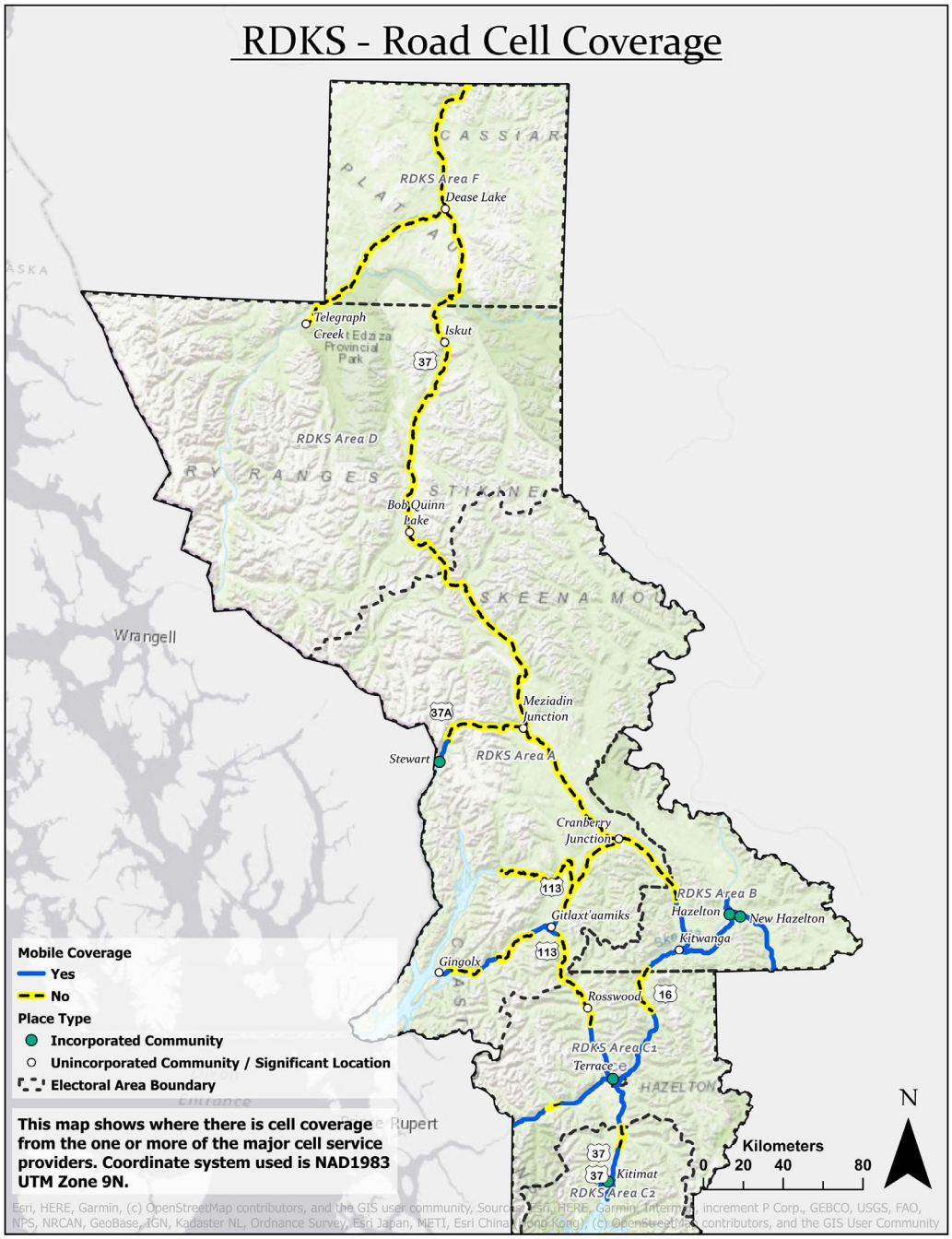

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6.2.4 Announced Projects

While not necessarily a complete list, there are a number of telecommunications related projects active in the RDKS that should be highlighted including:

- Tahltan Nation Development Corporation ("TNDC"): Actively working on a project to complete a fibre optic network to Iskut and Dease Lake in the RDKS[22].
- Connected Coast: A partnership project between City West and the Strathcona Regional District ("SRD") to complete a fibre optic network along the west coast of BC from Prince Rupert, to Vancouver Island and Vancouver[23].
- City West: A number of active projects announced under the federal Connect to Innovate funding program for regions of the RDKS.
- Telus and LNG Canada: Completing network and cellular enhancements to support large industry construction requirements.
- Witset: Cellular service enhancements to provide new coverage along highway 16[24].
- Sienna Networks: Expanding infrastructure into Rosswood[25].

6.3 Public Feedback on State of Connectivity

As part of the information gathering, a survey of the residents and businesses located in the RDKS was completed. The survey was intended to gather information including about available service, costs, satisfaction, and service providers. A paper copy of the survey was distributed through various locations deemed as higher need by the RDKS as well as being online through the RDKS website. It remained open for 54 days. The survey was publicized by the RDKS on their official website and advertised via posters/flyers at community gathering points, news release, social media promotion as well as distribution of business cards with survey information, and active personal promotion to contacts and community groups by RDKS resources. Unfortunately, the timing of the public outreach coincided with the outbreak of the COVID-19 pandemic and it is believed that that had a significant dampening effect on survey participation.

While of limited weight because of the small sample size, the following provides an overview of the general trend and responses that were received:

6.3.1 Summary of Residential Survey Results

[22] Tahltan Nation Development Corporation, 2019, *TNDC to Provide Fibre Optic Communication to Iskut and Dease Lake in Northwest British Columbia*
[23] Connected Coast, 2020
[24] Government of British Columbia, 2018, *New cell service increases safety along Highway of Tears.*
[25] Sienna Networks, Current Events

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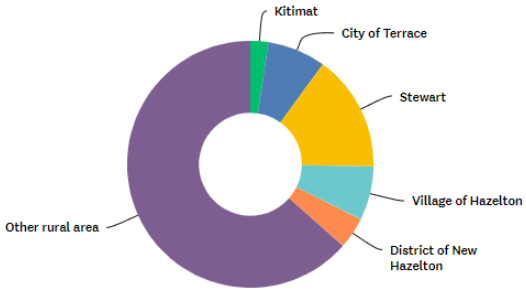
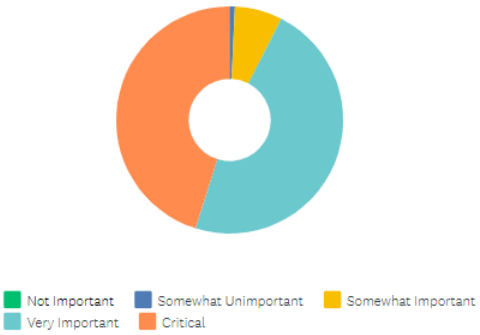
A total of 172 RDKS residents completed the residential survey. Of those respondents, almost 80% of respondents were responding from the District of Stewart or a rural area outside of the other member municipalities.



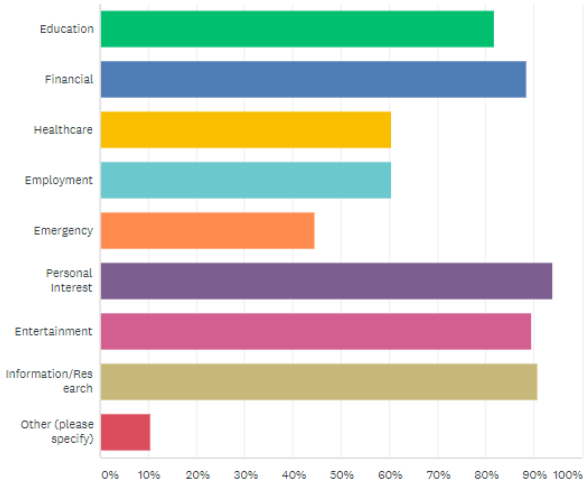
Almost 94% responded that they viewed internet service as very important or critical.

Over 80% of the residents participating strongly agree that internet service needs to improve and saw significant benefits associated with better internet.



As a result of the recent COVID-19 pandemic, our lives have changed and the need for reliable internet has only increased. Survey results indicate a strong need for internet outside of just entertainment as supported by the respondents.

Well over 50% of usage for the internet is indicated to be for social programs such as education, healthcare, employment and financial needs. It is suspected that survey results today may show an even higher use of internet for those programs.



When asked about cellular coverage in the RDKS, rural respondents expressed dissatisfaction with cellular coverage with over 60% indicating some level of dissatisfaction with coverage.

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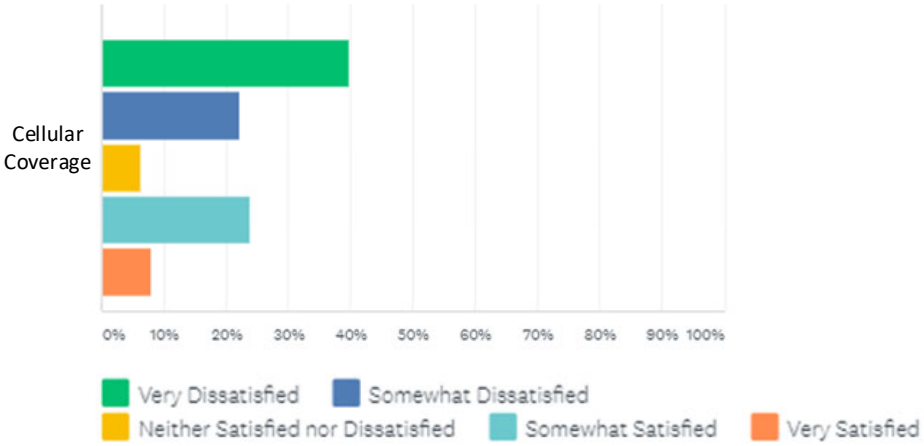

6.3.2 Summary of Business/Organization Survey Results

Only 12 RDKS businesses responded to the business survey and such a small sample size cannot be used to extrapolate general business views on connectivity in the RDKS.

6.3.3 Stakeholder Response

In addition to the surveys, a list of key stakeholders including community champions, businesses, government, First Nations, non-profits was prepared by the RDKS and an attempt was made by TANEx to contact each key stakeholder by direct telephone contact to gather insight and additional detail. The following provides a summary of the themes identified in these discussions.

Stakeholder Summary: Government Representatives/Employees
Summary of Information Reported: • Wide support for better connectivity even though within the member municipalities, service is generally good. • Access to education, health care and justice are social justice issues. • Difficulties reported for families where parents are working from home and children are trying to do their schoolwork. • Lack of connectivity threatens economic survival. • Strongly held belief that affordable, high speed, reliable broadband connectivity is vital to economic development – without it very little economic development is possible. • Government employees working in areas without connectivity have to change how they do their work. Without access to their team, problem solving is extended and inefficient. • Confidentiality is challenged for communication in areas without cellular service.

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Stakeholder Summary: Public Safety
• Public safety is a very significant concern – extensive tracts of the regional district without cellular service. • Connectivity in the 2018 fire season was a huge problem. • Public safety is sacrificed with lack of connectivity. Northern areas of the RDKS have no 911 service but there is no initiative to get it because there is no cell service anyways.
Narratives: • In the summer of 2019, two murders occurred in the Dease Lake area and there was no way to warn people of the danger. There is no 911 service and no cellular service to call 911 on. • In the 2018 fire season, communication was a big issue. Emergency responders responding to emergencies on highway 37 North of Kitwanga must get all of the relevant information they need before they lose service 8 minutes north. Once they lose service heading north, they have to travel more than 6 ½ hours before they get to an area with viable internet service. This obviously impacts response times and means that there are gaps in information which is unacceptable in an emergency situation. Firefighting teams that are split between Terrace and Telegraph Creek result in a 12-hour lag in information transfer. Evacuation communications are also difficult and put lives at risk. • The “Highway of Tears” (a portion of Highway 16) goes through RDKS and is recognized for being the last known location of many missing and murdered (primarily indigenous) women between Prince George and Prince Rupert. Cellular service should be available all along the corridor to improve safety.

Stakeholder Summary: First Nation
Summary of Information Reported: • Unfortunately, the timing of outreach to First Nations overlapped with First Nations having to deal with the COVID-19 pandemic and accordingly, not all First Nations were able to respond to the outreach. • Some First Nations report concerns with a lack of connectivity – the more remote the worse it is in terms of reliability, cost and capacity. • Some First Nations have taken the initiative to develop their own connectivity infrastructure and are taking steps to improve internet service. • Economic development is stalled in certain cases due to lack of reliable high-speed connectivity.
Narratives: • A connectivity project was announced with approved funding in late 2018. Accordingly, the First Nation that is the primary economic driver in the area invested in construction of a large, new training center with the expectation it was able to be served with reliable high-speed internet service. The building is almost complete, but connectivity had still not been established as of April 2020. The internet service provider cannot get access to service poles in order to bring internet service to the building and so First Nation economic development is stalled.

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Stakeholder Summary: Service Providers
Summary of Information Reported: • Access to aerial poles is difficult, time consuming and includes extensive capital and operation costs that often change dramatically over time. • Business case is very difficult for the rural areas. • Providers would like to be given a list of regional priorities. • Challenging terrain. • Stakeholder consultation process is extensive. • Providers are encouraging collaborative discussions on partnerships to achieve the regional vision.
Narratives: • A connectivity project was announced with approved funding in late 2018. Connectivity has not been established as of April 2020 due to the inability to access to service poles and the extensive costs involved in doing so. Despite the investment by the service provider in gaining funding and doing the construction, nearly two years later, still no customers served in that portion of the project and accordingly, no income to the service provider.

6.3.4 Industry Stakeholder Response

Stakeholder Summary:
Summary of Information Reported: • Significant investment in telecommunications infrastructure enhancements to support construction activities. • Recognized need for diversity out of the region to support operations. High level of concern to develop redundancy. Looking at options with Connected Coast and possibly pipeline right of ways. • Significant investment in communications infrastructure to support business requirements. • Outages can impact communications for several days. • Would like to see diversity addressed in the next few years to support business operations.
Narratives: • Industry players wish to leave legacy infrastructure in place but don't know community priorities so legacy may be less effective than it could be.

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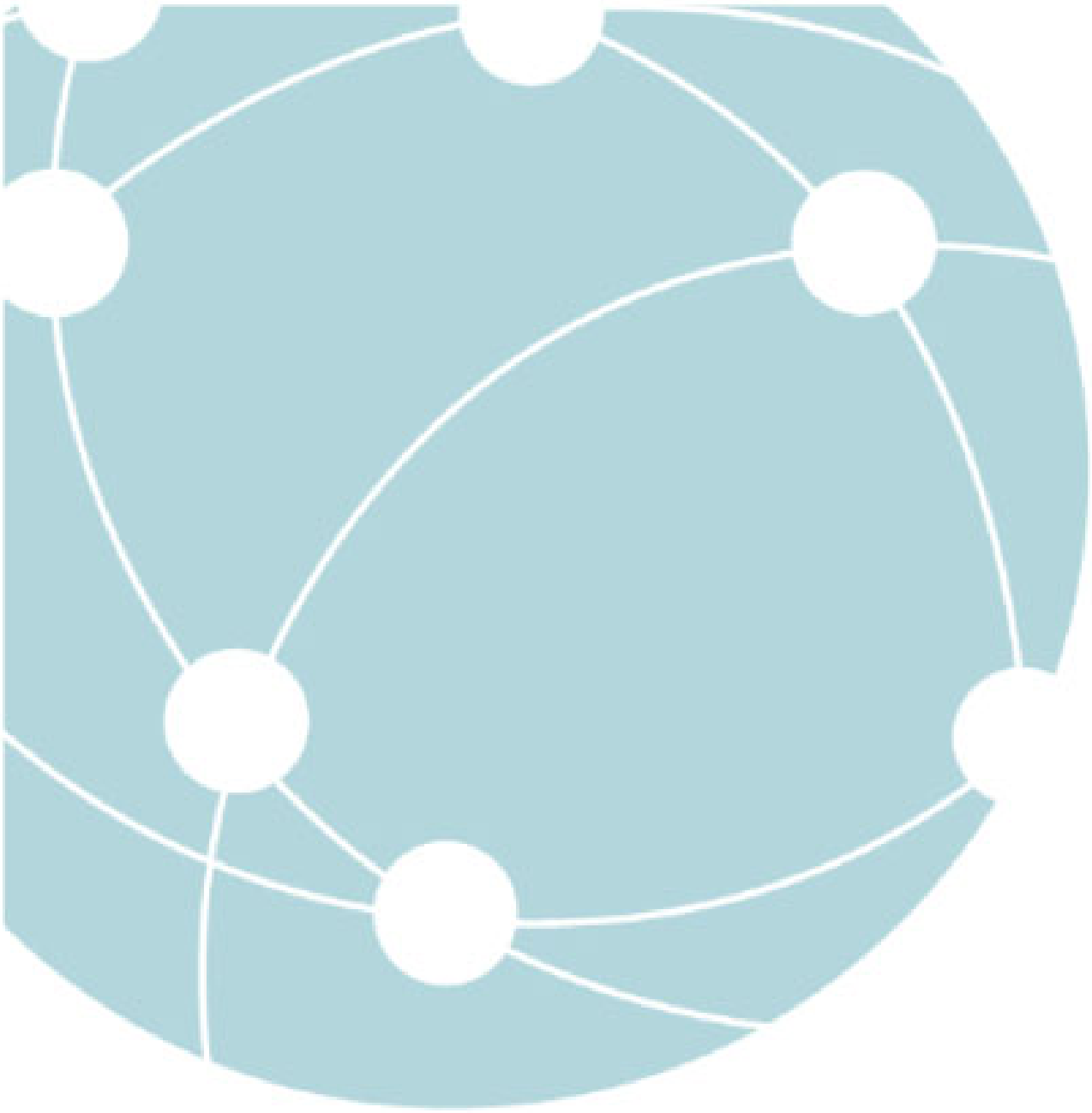

7 SITUATIONAL ANALYSIS

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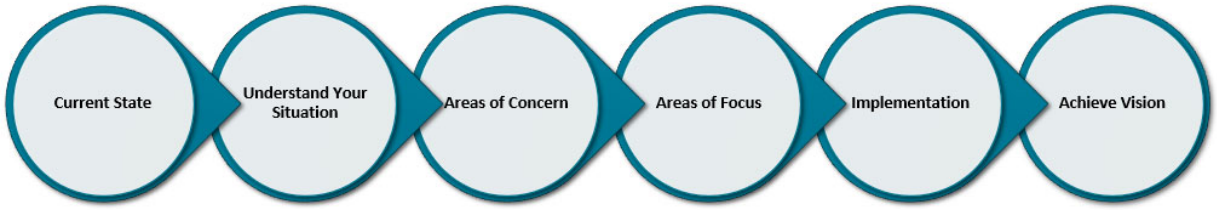
7.1 Moving from Current State to Vision

Earlier in the report, the RDKS' vision of itself as a highly connected region was articulated followed by the analysis of its current state. In order to achieve the vision, a number of logical steps must be completed from documenting the current state through to achieving the vision as shown below.



7.2 Bridging the Gap

7.2.1 Service Delivery Pyramid

This section provides a technical overview of the technology and concepts required to solve the connectivity challenge. This section will act as a reference guide and provide a conceptual overview to aid the RDKS to generally understand the terminology and concepts for broadband connectivity.

Connectivity in rural and remote areas can be characterized by low subscriber density and high capital and operational costs which creates a problem for these areas as there is often simply no business case for a for-profit company to provide needed services. While this is the primary issue in rural and remote areas, delivering broadband service in such areas can also have additional challenges such as:

- Low or sparse demand
- Low economic activity
- Lack of good transportation infrastructure
- Lack of local skills
- Climate/weather extremes
- Small projects lacking scale for volume discounts
- Lack of low-cost power infrastructure

From a technical aspect, solving the connectivity challenge for rural and remote areas is the same as an urban environment and requires a service delivery model that encompasses a number of layers that all need to be addressed. The following Service Delivery Pyramid ("SDP") provides a visual depiction of the layers of infrastructure that must be present to solve the connectivity issue:

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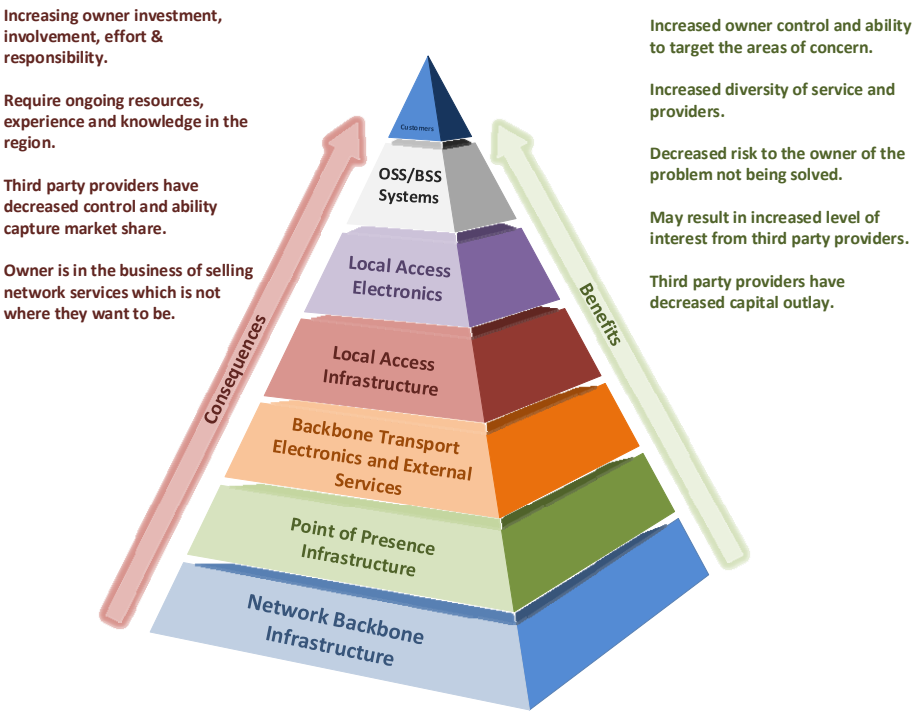

The diagram above outlines the SDP and delineates the individual layers that must be provided and the relative levels of responsibility the network owner must address to satisfy the goal of improved services to the residents and businesses. Solving the connectivity problem for constituents requires that all layers of the SDP be realized in some fashion, either by one entity or by the collaborative efforts of numerous parties.

As the network owner commits to, and moves up the layers of the pyramid, increasing levels of complexity and involvement are required. Although this may seem intimidating, the benefit of increased control and influence on improvement of services may outweigh the hurdles.

The layers of the SDP are as follows:

Backbone Infrastructure: This is the physical infrastructure required to bring long distance connectivity to a community. For high capacity modern networks, this would typically be fibre optic cable but in some cases, high capacity microwave may also be suitable. The term backbone is also synonymous with “transport infrastructure”.

Points of Presence: POPs are the infrastructure required in each community (or along the backbone route) used to locate the electronic components required to enable connectivity as well as act as a termination point for the backbone infrastructure. For example, in the case of a fibre optic backbone, the physical cable would be installed inside the POP and the cable connected to the electronic components within the POP. A POP houses sensitive electronic components so suitable environmental controls are including, but not limited to, air conditioning, battery, backup power, and security.

Backbone Transport Electronics and External Services: This layer represents the electronic components and services required for the POP to enable connectivity outside of the local area to other POPs and ultimately, the global internet.

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Local Access Infrastructure: This includes the physical assets required to connect the local POP to the subscriber's home or business. There are numerous choices for technology, but for modern, high capacity, scalable networks, fibre optic connectivity is the preferred option. Different options for local access technology are more detailed in supplementary documentation.

Local Access Electronics: This layer of the SDP represents the electronic components required in the POP and in the subscriber's home or business that enable connectivity to underlying layers of the SDP. This is the final physical component required to enable connectivity.

OSS/BSS Systems: All the lower levels of the SDP, require management to ensure they are operating correctly and to provide the business operations of the network. These operations include, but are not limited to, network monitoring and management systems, billing, provisioning, technical support, customer service support, maintenance, among others.

Customers: The final layer to a successful broadband network is the existence of customers subscribing and paying for services on the network. In the case of rural and remote networks, anchor tenants or institutional customers can be particularly beneficial in supporting the sustainability of the network.

7.2.2 RDKS Connectivity Factors

Understanding the RDKS connectivity situation requires identifying the strengths and weaknesses of the region from a connectivity perspective. The RDKS strengths, weakness, opportunities, and threats have been summarized below:

STRENGTHS
• Recent Economic Development Plan that recognizes the need for good internet connectivity and advocates for improvement. • Major east-west rail and highway (#16) transportation corridor to the Port of Prince Rupert. • North-south highway (#37) transportation corridor from Kitimat, north through Terrace, to the north and the Alaska Highway in Yukon. • Significant mineral and forest resources. • Clean electrical power generation and transmission line assets. • Large, high budget industry projects are very active in the RDKS driving the need for bandwidth and infrastructure. • Existing fiber optic backbone networks on the east-west and part of north-south transport corridor as far north as Iskut. • Competitive telecom market in the KTH corridor. • First Nations forethought to obtain rights to fibre on the NTL providing connectivity in remote areas. • Innovative First Nations have constructed and own infrastructure. Competent development organizations continue to address telecommunications network and service deficiencies. • Potential to coordinate different government levels to combine efforts and initiatives. • Established history of collaborative efforts (Resource Benefits Alliance).

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STRENGTHS
• Key geographic location - highly accessible and in the middle of multiple regions AND multiple projects both from the perspective of industry as well as connectivity. • Manufacturing in south (Kitimat Smelter) and resource extraction potential in North. • Terrain forces population into narrow areas making communities more densely built out.

WEAKNESSES
• Fiber optic backbone networks lack path diversity creating a significant reliability risk. • Limited backbone network competition. Competition is focussed in only two to three primary communities Terrace, Kitimat and the Hazeltons supporting significant economic activity. • Lack of services in the north, not just connectivity. • Lack of competition/monopolistic environment elsewhere in the region. • Communities north of Terrace (and certainly north of the Nisga'a Valley) are under-served, lacking adequate telecommunication infrastructure. • Remoteness, long distances between communities and low-density population means business cases require subsidy. • Huge geographic area which has very remote areas and is expensive to build although a large portion of the backbone fibre required is already exists. • Terrain is challenging. • Lack of economic diversity. • Limited access to locally based technical resources outside the major centers to support telecommunications networks.

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OPPORTUNITIES

- Continue and accelerate existing initiatives to deliver fixed broadband and cellular mobile service to communities close to existing transport fiber routes (proverbial low hanging fruit).
- Facilitate interested parties, both from within the region and outside, to collaborate on construction and development of fibre routes to provide ring diversity, strengthening the network for local residents, businesses and large industry.
- ISPs generally express willingness to cooperate and partner to improve service in under-served areas. Greater success can be achieved by collaboration, leveraging resources and government subsidies to solve a bigger problem for more people.
- A variety of subsidy funding sources are available currently and it remains to be seen what additional programs may roll out in connection with COVID-19.
- The COVID-19 pandemic reinforces the important need for improved connectivity to rural and remote communities for vital services like education and medical care.
- Employment opportunities for skilled technical resources in smaller rural locations.

THREATS

- Economic impact of commodity market weakness in general and COVID-19 related.
- Economic impact of energy market weakness in general and COVID-19 related.
- COVID-19 pandemic may have significant near-term negative impact on tourism revenues.
- Although ISPs expressed a willingness to cooperate in completing network and facilitate access networks, the difficulty of achieving cooperation should not be under-estimated when it involves other RDs and multiple parties that are fundamentally competitors.
- Applications for subsidy funding are complex and involve significant effort. Further, applications to different funding sources often need to be combined in order to create a viable business case; increasing the complexity and effort required.
- Demonstrated challenge in completing already funded infrastructure projects.
- Network projects and funding need to align to mitigate the risk of stranded investments and failure to achieve full potential of these projects.
- Minimum level of local operations and maintenance capability. Commitment is necessary for community networks to be sustainable long-term. Smaller communities have a small economic base that may be eroding and limited growth potential.
- Incumbent providers may leverage dominant position in the market to inhibit competition.
- Failure to move connectivity ahead as a priority may result in rural RDKS falling further behind.

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7.2.3 Areas of Concern

CONCERN	COMMENTS
Lack of Fibre Diversity	• Complete reliance on single fibre along Highway 16. • Large impact to business and residents if fibre breaks. • Connected Coast likely still years away.
Insufficient Connectivity in Rural & Remote Areas	• Incumbent providers not focused on rural and remote areas. • Business case to serve rural and remote communities insufficient. • Existing process is plagued with excessive delays. Even when connectivity projects are announced and funded, it still takes years to complete them. • Funding process favors providers with more resources / experience.
Insufficient Backbone Capacity to Some Communities	• Communities of Stewart, Telegraph Creek, Dease Lake and Iskut suffer from insufficient capacity into the community resulting in poor performance during peak times.
NorthwesTel Monopoly in Northern RDKS	• Infrastructure needs improving (Digital Subscriber Line - DSL). • High cost and poor reliability and capacity. • Pricing subject to CRTC tariffed rates. • Lack of competition-driven improvements.
Current Initiatives Need to Get Completed and Enhanced	• No funding secured to increase backbone capacity to areas subject to constrained capacity (Stewart and Telegraph Creek). • Announced Tahltan project does not include funding for local access (Iskut and Dease Lake).
Time to Complete	• Projects that are of major benefit to the region experience significant delays even after funding announcement. • Examples include: City West and Tahltan infrastructure builds. • Process, approvals, cost, environment, and other delays contribute to project completion times that can be several years.
Highway 113/37 Underserved	• 600km+ major roadway with no cellular service. • Lack of safety and convenience on the only route to northern RDKS.

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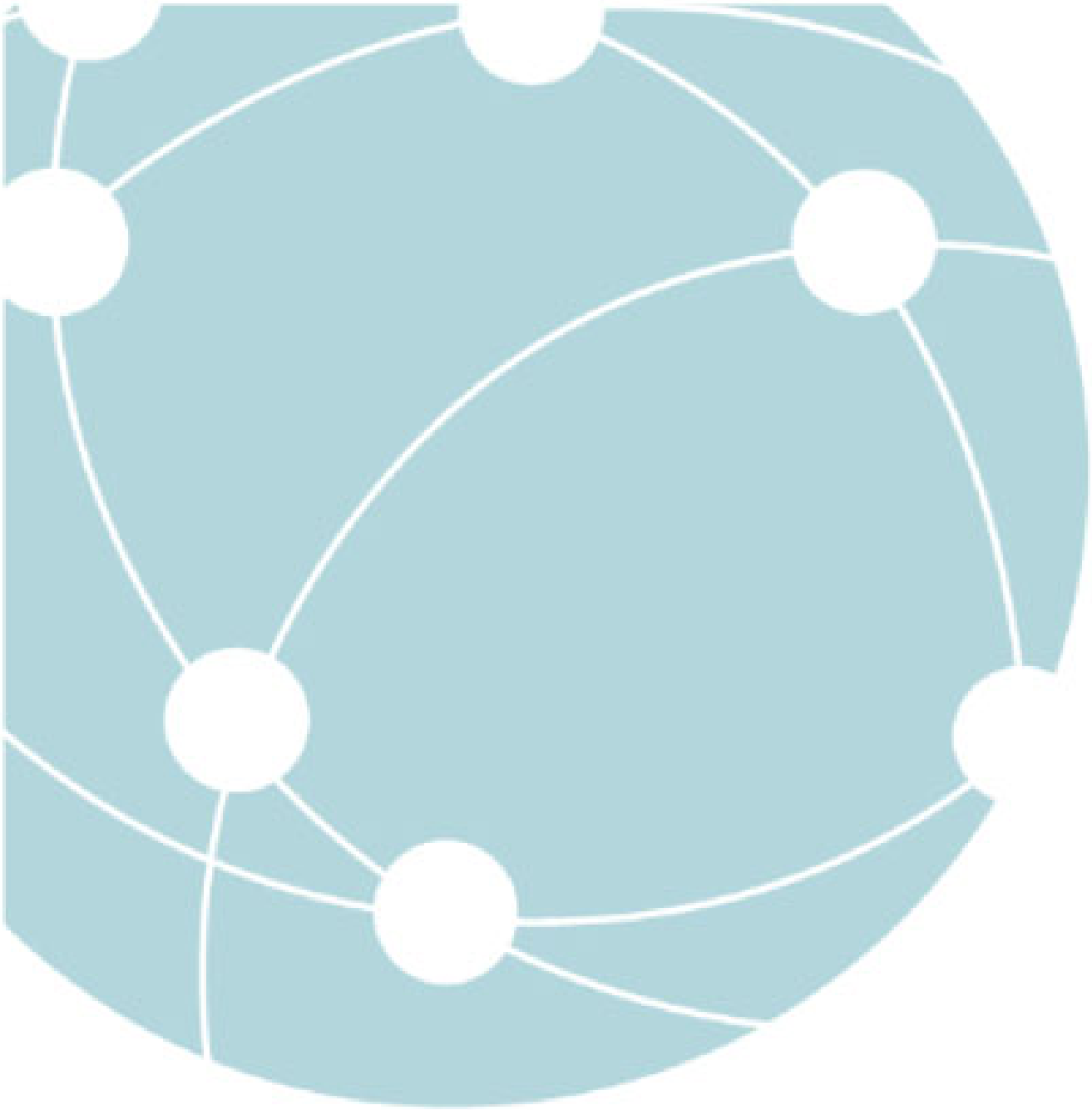

8 STRATEGY IMPLEMENTATION

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8.1 RDKS Role and Areas of Focus

One of the key components to the strategy is understanding the role that the regional district desires to play in advancing the connectivity initiative. Part of the information gathering phase of the project included exploring the RDKS' vision of its role in the solution. The RDKS does not see itself providing internet service, but rather sees its role as an entity to facilitate the solution, advocate for funding, and lobby senior government to move the connectivity initiative forward in the region.

Given this self-defined role, the regional district will focus its efforts on completing actions that fall within its defined mandate but keep a keen eye on the vision to ensure progress to achieving it.

To move from current state to the vision, strategic goals were developed for the rural areas of the RDKS and are summarized below:

- Goal #1: Connect all anchor institutions.
- Goal #2: 50/10 access available to 80% within 3km of a community.
- Goal #3: Realize cellular service along all major highways.

The following graphic provides a snapshot of the estimated progress towards these goals

The graphic below illustrates how each cog helps to advance connectivity:

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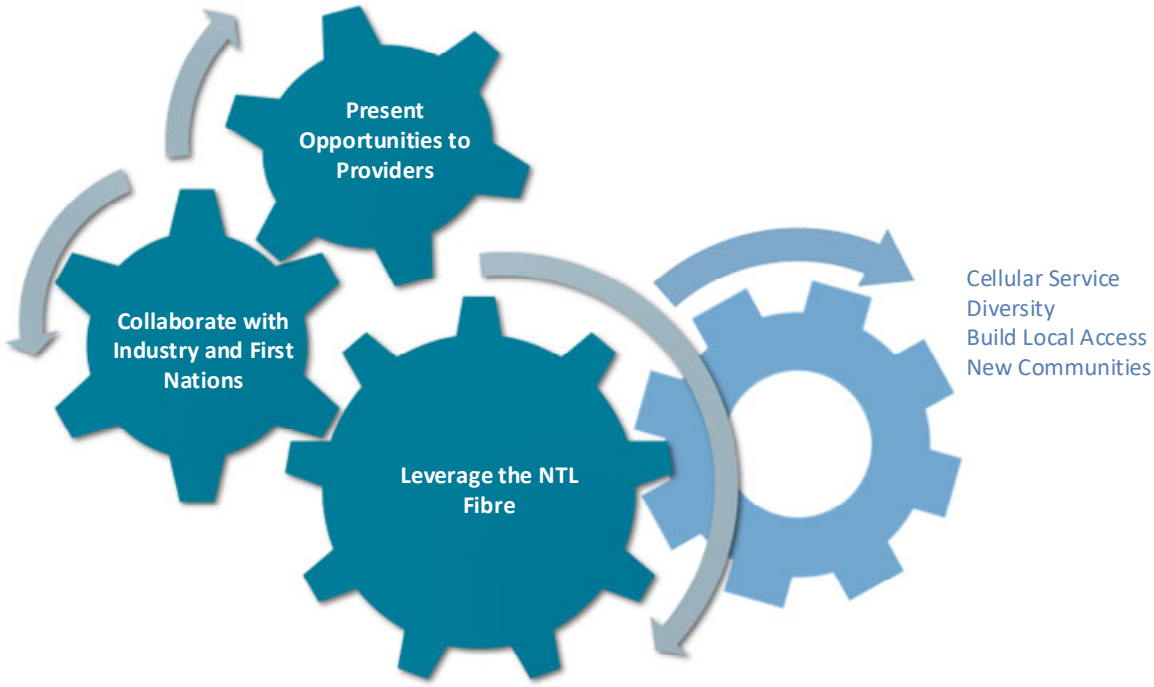

This table identifies, at general level, the roles that the RDKS can play in moving forward the connectivity initiative for the rural RDKS that are consistent with its self-defined role above with detailed steps found later in Section 9:

Task	Focus	Success Criteria
Prioritize and Communicate	• Consolidate list of regional priority projects from TANEx potential projects shown in section 8.4. • Communicate priority list to service providers.	Action plan to address each of the priority areas.
Collaborate	• Establish General Connectivity Working Group to move connectivity forward which includes the Tahltan, Nisga'a, community representatives and other key stakeholders. • Provides a unique opportunity for the RDKS.	Connectivity Working Group works together to achieve connectivity for different rural areas in the region and create a robust and redundant network for communication including cellular service.
Recognize and Support	• Recognize the importance of the Tahltan backbone fibre extension project which leverages the NTL and facilitate its completion using all means within its mandate. • Completion of a cooperative Lisims / TNDC network.	Completion of the Tahltan project and achievement of backbone connectivity from Terrace / Kitwanga to Dease Lake.
Local Access	• Detailed design for local access projects leveraging existing and planned backbone. • Funding plan and application(s) for local access projects.	Funding and implementation plan to complete local access projects for underserved communities.

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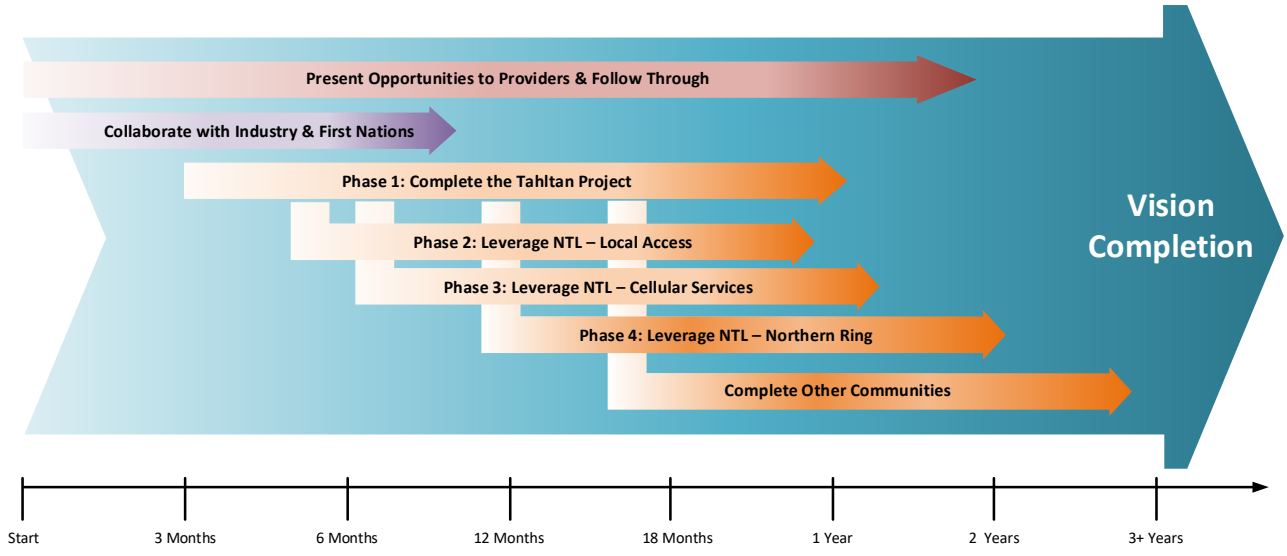
Task	Focus	Success Criteria
Cellular	• Establish a business relationship with interested cellular provider(s) and TNDC to use Tahltan fibre POP locations to provide cellular service on highway 113/37 corridor. • Determine priority areas for cellular service. • Detailed design for cellular projects. • Funding plan and application(s) for cellular projects.	Funding and implementation plan to complete identified priority cellular projects.
North Ring	• Establish focused sub-group to focus on the Northern Ring potentially with the RDKS, Regional District of Bulkley Nechako ("RDBN"), Northern Rockies Regional Municipality ("NRRM"), TNDC, Lisims and NorthwesTel. • Detailed design for backbone infrastructure to complete a northern ring. • Funding plan and application(s).	Commitment of large industry and stakeholders to leverage a northern ring to create network diversity. Failure of the NTL fibre would result in days or weeks of outages Funding and implementation plan to complete northern ring.
South Ring	• Addresses the need for diversity for the Kitimat region. • Opportunities such as Connected Coast and major pipeline rights of way may need to be considered.	Fibre route diversity achieved for the Kitimat region of the RDKS.
Other Communities	• Detailed design for local access and backbone projects. • Funding plan and application(s) for local access and backbone projects.	Funding and implementation plan to complete local access and backbone projects for underserved communities.

The following graphic summarizes the initiative objectives and demonstrates the criticality of the NTL fibre and the Tahltan network on the state of connectivity in the RDKS.



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8.2 Lisims and TNDC

A collaborative effort between First Nations and the Regional District creates benefits for the RDKS and the province of BC. In addition to the possibility of a northern fibre ring, a collaborative effort between the regional district, Tahltan and Nisga'a Nations brings other benefits to the region and ability to meet the stated goals of the RDKS in a more efficient and cost effective manner as follows:

- Operational cost savings realized for both organizations in consolidated internet backhaul by combining these services. This provides the ability to increase network capacity at reduced costs for both organizations due to efficiencies gained.
- Ability to provide additional network resiliency by pooling resources and creating redundant, load sharing backhaul networks able to be used by both organizations at a lower operational cost.
- Ability to provide services to large industry in a more effective manner by creating a continuous network from Terrace to Dease Lake.
- Ability for the regional district to more cost effectively reach its goal of cellular coverage along the major highways corridors of 113 and 37. A collaborative fibre network provides the ability for cellular service providers to connect once and provide cellular services along the entire fibre route without having to duplicate infrastructure.

The following provides a conceptual overview of the current state of the Lisims (Nisga'a) and Tahltan networks.

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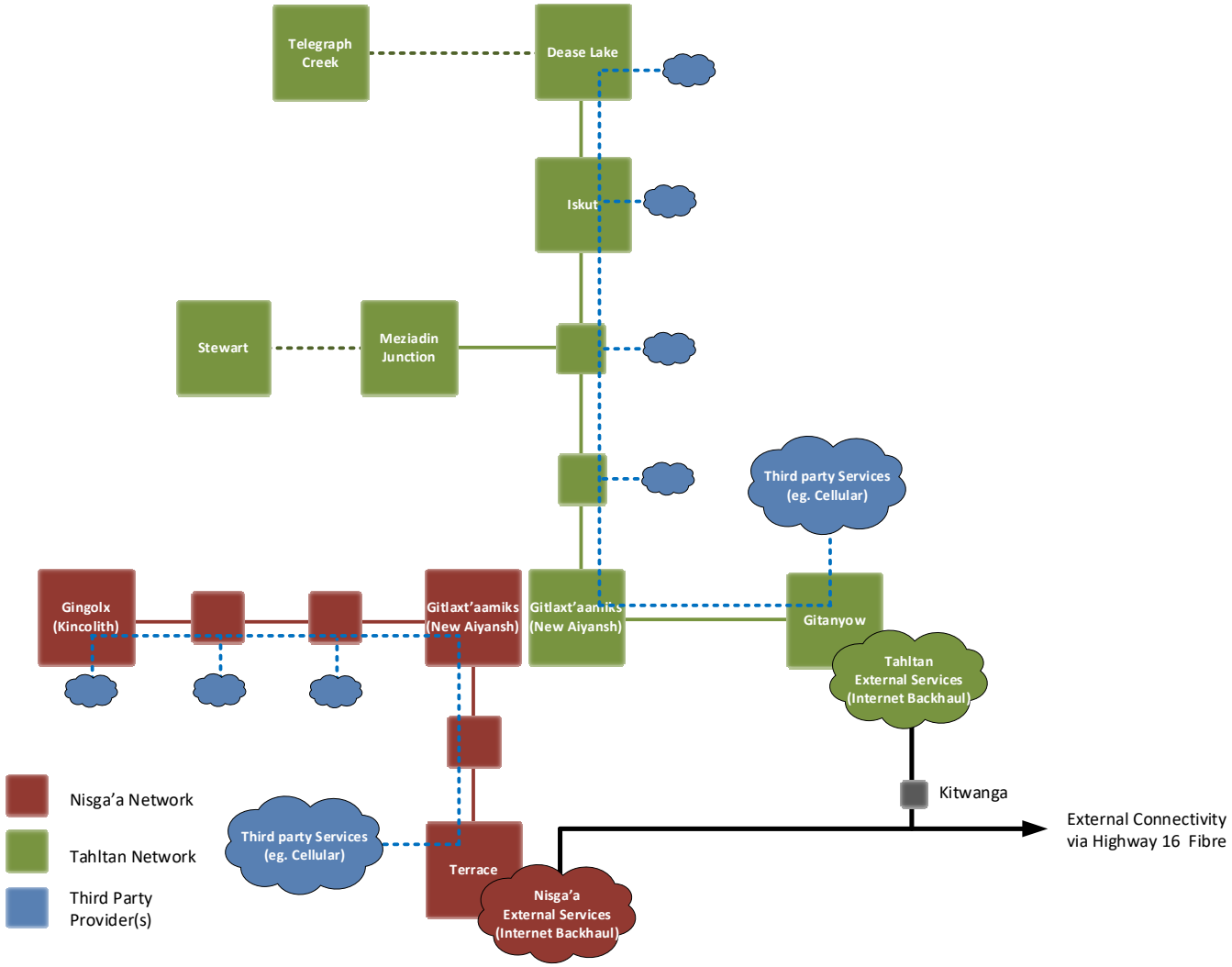

While the above network is valid, given the close proximity of the networks and intent, there are some efficiencies that can be gained by adjusting the deployment model including:

- Investment in external connectivity represents a significant operational cost for any standalone network. Sharing such costs would reduce costs for both networks.
- Each network must make the investment in connectivity to third party services, such as connectivity for cellular services. Shared infrastructure reduces the cost.
- Both networks rely on the fibre route through highway 16 as the only effective connectivity outside of the region.
- Any connectivity required between the two organizations, perhaps for business dealings or anchor institutions like schools, will rely on the external internet connectivity which reduces performance and adds operational costs due to increased internet usage.
- The above topology is not as efficient in providing access to the external parties such as large industry that may desire connectivity between locations that can be connected to each network.

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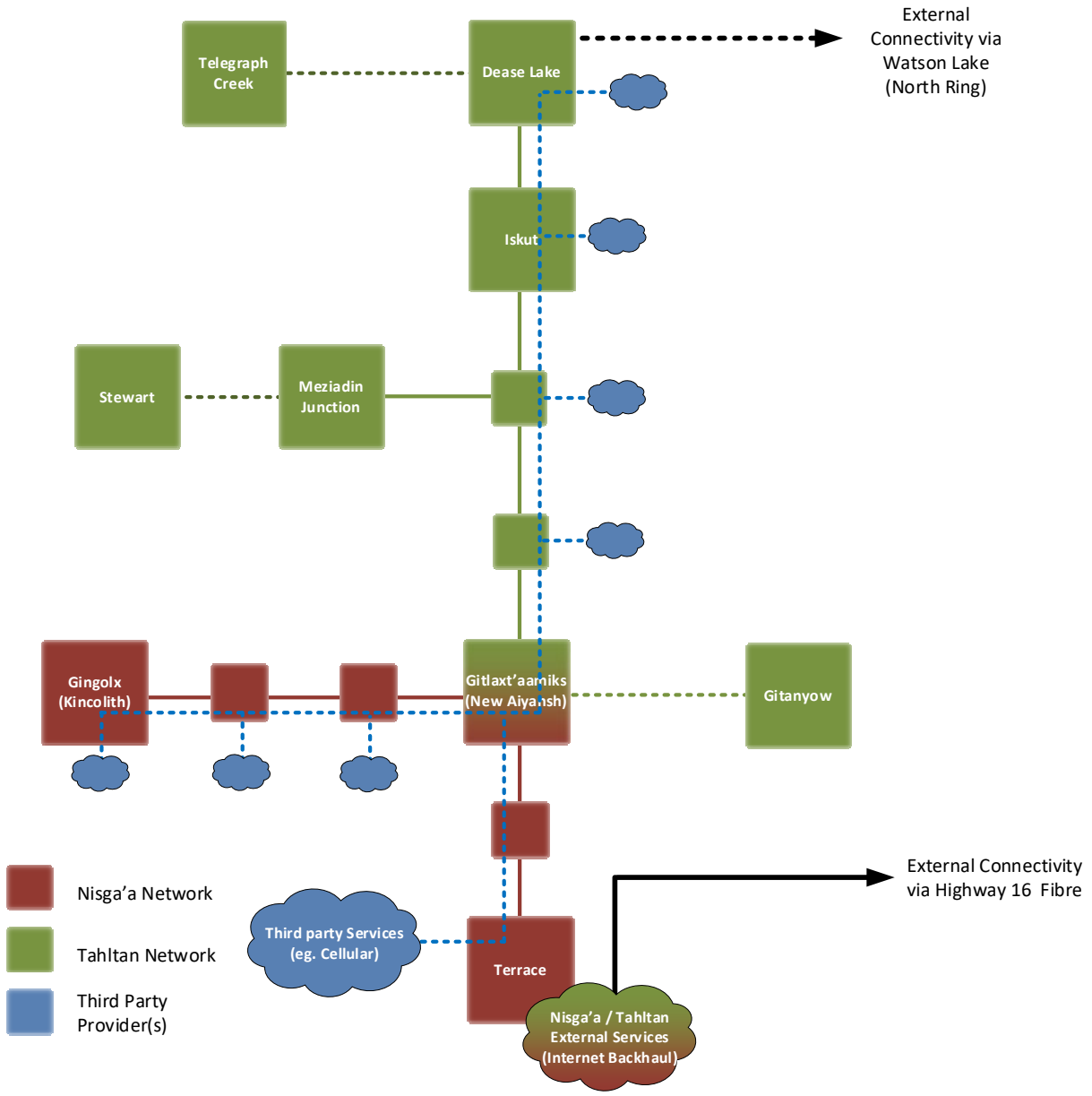
- The above topology is not as efficient in providing access to a north ring which can address a diverse fibre route for a number of stakeholders.

In a collaborative effort, the following provides a conceptual overview of a collaborative Lisims / Tahltan network.



The above conceptual network:

- Reduces operational costs.
- Increased ability to bring third party services to the networks.
- Creates opportunity for route diversity.

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- Increased access to funding and capital.
- Provides efficiencies in traffic routing between parties.
- Increased opportunity.

For clarity, the above model does not suggest a combined Nisga'a / Tahltan company. Each can continue to operate as separate entities and continue to prioritize and support their own initiatives. Service deployment models for internet services to respective customers can continue with no need for daily coordination and agreement between parties. The collaborative effort simply highlights that coordination between each party's deployment should be consistent and joining the networks (or network peering) at a location such as Gitlaxt'aamiks (New Aiyansh) provides significant benefits to the Nisga'a, Tahltan and the regional district.

The most logical method for achieving this concept is for each party to agree on the deployment of an optical transport system (i.e. DWDM network) as the backbone layer. Implementing a DWDM network expands the capability of the NTL fibre asset dramatically so that enough capacity exists for subscribers on this network to enjoy very high speed, reliable and cost-effective connectivity.

8.3 Network Diversity

In reviewing the current state and known plans for connectivity in the RDKS, a unique opportunity exists as a collaborative effort between the Regional District, TNDC, and Nisga'a that may provide a significant benefit to all parties in addition to some neighboring regional districts.

Large industry in the RDKS expressed concern with the current state of the connectivity arising from the lack of a redundant fibre route in the event of a failure of the main fibre into the region. The main fibre route is provided along highway 16 from Prince George (Fraser Fort George - RDFFG), through the RDBN in to Terrace and to Prince Rupert. Fibre in northern BC also extends from Prince George to Dawson Creek, to Fort Nelson and ultimately to Watson Lake north of Dease Lake. This route is shown highlighted in GREEN on the following diagram.

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This current state creates significant exposure to stakeholders using this primary fibre route and any fibre failure from Prince George – west to Prince Rupert and from Fort Nelson – northwest to Watson Lake, has a large impact to services on the other side of the fibre impact. Failure of the NTL fibre will likely result in an outage measured in days or weeks of impact to the network.

This problem has been recognized by multiple parties and plans are being made to address it including announced projects such as the Connected Coast[26]. Connected Coast in a highly complex project that is a number of years out. Completing the northern ring through the RDKS provides a more immediate benefit for not only the RDKS but also, the RDBN, and NRRM.

The line shown in the above diagram highlighted in PURPLE shows the existing Nisga'a Nation fibre network. The BLUE line represents the proposed, and already funded, fibre network from the Tahltan Nation. The portion highlighted in YELLOW, is approximately a 250km route that if completed, and in combination with the other existing fibre, completes a northern ring providing significant benefits to the RDKS and province of BC including:

- Alternate capacity available for service providers and major industry located in the RDKS.
- Ability for NorthwesTel to reach southern markets in the RDKS.
- Ability for other providers to reach markets in the northern portion of the RDKS.
- Redundant route for all traffic west of Prince George and Fort Nelson.

[26] Connected Coast, 2020

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As can be seen benefits to the RDKS and neighboring regions is significant and currently this is the most conceivable short-term opportunity to provide a redundant route for not only the RDKS, but the RDBN and NRRM region as well.

While the northern ring provides diversity for most areas in the RDKS, it does not address diversity for the Kitimat area. In concert with the northern ring, a connection to a southern ring needs to be considered and to achieve this, other opportunities such as Connected Coast and pipeline rights of way are possibilities. The following map provides an overview of this ring concept in conjunction with other possible options to achieve this benefit to the RDKS.

The following highlights the need for diversity into Kitimat. Missing portions are highlighted in yellow, and opportunities such as Connected Coast and pipeline right of way are shown as possible alternatives.

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8.4 Initiative Objectives

In order to achieve the high-level objectives, it is necessary to break down the rural RDKS connectivity gap into smaller bite sized pieces so that the projects can be prioritized, funded and constructed as time and budget allow. All projects in the table below are assumed to be fibre as a base case. Candidates for wireless and/or satellite combination are provided as alternate costs. The following table provides summary of projects identified as a result of this project. An companion document outlining additional detail for each of the identified project areas will be provided.

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Initiative Objective Summary

Jun 30, 2020

Major Project Name	Name	Backbone	Local Access	Total Subs	Current Service Levels				
					Primary Svc	5/1	10/2	25/5	50/10
Nass Valley	Rosswood	No	Yes	185	10/2	185	1	0	0
Nass Valley	Nisga'a Villages	No	Yes	820	5/1	820	0	0	0
Tahltan	Cranberry Junction	Yes	No	0	N/A	0	0	0	0
Tahltan	New Aiyansh	Yes	No	0	N/A	0	0	0	0
Tahltan	Bell II	Yes	No	0	N/A	0	0	0	0
Tahltan	Iskut	Yes	Yes	154	5/1	154	0	0	0
Tahltan	Dease Lake	Yes	Yes	359	5/1	359	0	0	0
Tahltan	Meziadiin	Yes	Yes	45	5/1	45	0	0	0
Tahltan	Gitanyow TNDC POP	Yes	No	0	N/A	0	0	0	0
Telegraph Creek	Telegraph Creek	Yes	Yes	69	5/1	69	0	0	0
Stewart	Stewart	Yes	Yes	431	5/1	431	0	0	0
Lakelse Lake	Lakelse Lake	No	Yes	372	25/5	282	0	90	0
Kitwanga - Cedarvale	Kitwanga / Cedarvale	No	Yes	440	5/1	373	0	2	0
New Remo - Salvus	New Remo - Salvus	No	Yes	22	5/1	19	3	0	0
Kitselas - Chimdemash	Kitselas - Chimdemash	No	Yes	295	25/5	235	0	60	0
S Hazelton - Gitsegulka	S Hazelton - Gitsegulka	No	Yes	476	25/5	101	0	375	0
Mosquito Flats - Seaton	Mosquito Flats - Seaton	No	Yes	68	5/1	63	0	3	0
Klemtu	Klemtu	No	Yes	103	N/A	0	0	0	0
Gitanyow	Gitanyow	No	Yes	136	5/1	135	0	0	0
Thunderbird - Old Remo	Old Remo	No	Yes	46	10/2	6	37	0	0
Thunderbird - Old Remo	Thunderbird	No	Yes	56	25/5	0	45	11	0
Glen Vowell - Kispiox	Kispiox Valley	No	Yes	144	5/1	144	0	0	0
Glen Vowell - Kispiox	Glen Vowell	No	Yes	168	5/1	168	0	0	0
Northern Ring		Yes	No	0	N/A	0	0	0	0

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8.5 Cost Estimate

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The scope of this project is to provide a regional district strategy outlining the recommended actions to be completed by the regional district and an order of magnitude cost to complete the strategy. The cost model presented in this section works under the following assumptions:

- The accuracy of the costs is a rough order of magnitude cost and as indicated in the NDIT framework under which this report has been completed, are approximately +/- 75%.
- Estimates provided are not based on a detailed design or business plan and no site visits have been completed in preparing these cost estimates. Costs are based on an approximation of typical unit costs to complete various aspects of the network.
- It is understood in this cost model that many assumptions have been made, including for the density and proximity of subscribers and that there are inaccuracies with this approach.
- Cost estimates are not based on detailed quotations from suppliers or manufacturers.
- Some aspects of the cost estimates may show $0. This can be for a number of reasons including that committed funds are already established for that portion by a third party, that portion already exists, that portion is not applicable for some reason or the ability the provide an estimate is not available at this time due to the inability to obtain some information. The project summary sheets provided a matrix outlining the level of estimates available.
- The cost estimate assumes FTTP to all identified subscribers. It is understood that constructing FTTP to all subscribers may not be practical and that alternate technologies may be more appropriate to reduce the cost. Identifying these alternatives is considered out of scope for this high level estimate and would need to be completed as part of a more detailed design and business analysis phase.

Detailed cost estimates for identified projects are found in the project summary companion document.

8.6 Funding

Funding for rural broadband is an evolving topic for government leadership, especially in light of the COVID-19 pandemic. The following are some of the potential sources of funding which may be accessed by the RDKS or its partners for funding for projects of this nature but in light of the shifting sands of government priorities at the time of writing, these funds may be augmented or eliminated depending on senior government objectives:

- The Broadband Fund (the “BBF”). – In connection with upgrading infrastructure to meet the USO, the BBF was established by the CRTC to provide funding of $750 Million over five years. The first call for applications was announced June 3, 2019 and the second call closed on June 1, 2020. A detailed review of the current guide should be a priority item so that appropriate work is commissioned in time to be ready to go once the decision is made to proceed with a project. This fund provides funding for backbone projects, local access projects and mobile wireless projects. The next call is not expected until 2021.

  The RDKS can apply to the BBF directly or as a member of a joint venture, partnership, or consortium with other eligible entities – eligible entities include other regional districts, first nations, municipal governments and private for-profit or not for profit service providers. BBF

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requires that "**the applicant, or at least one member of a partnership, joint venture, or consortium must have at least three years of experience in deploying and operating broadband infrastructure and must be eligible to operate as a Canadian carrier**." If this criterion is not met by the applicant or a member of the consortium, the applicant must enter contract with an entity that does.

- Connecting British Columbia is a BC government program administered by NDIT on behalf of Network BC open to local, regional, or national service providers, local governments; First Nations or BC not-for-profits. This program has, as its objective, the acceleration of the delivery of internet connectivity at minimum target speeds of 50/10 to homes and businesses in rural BC. The most recent intake for phase 3 closed on June 15, 2020. Projects should be completed by March 31, 2022. A pre-screening process is required which ensures that an applicant either has the experience requirement for an application or will work with an ISP with the experience requirement (3 years' experience deploying and operating the proposed broadband infrastructure in Canada). In addition, the applicant must agree to own, operate, and maintain the resulting network for 3 years after the project is complete.
    - There are two streams of funding announced under this program at the time of writing:
        - Transport Infrastructure – 50% of eligible costs for new infrastructure projects, upgrades to existing infrastructure or expanding existing transportation infrastructure.
        - Last-Mile Project - 50% of eligible costs to improve last mile connectivity in underserved rural areas in BC but follows a baseline funding level of $250,000 per community.
    - In addition, there was emergency funding made available for upgrading networks in the immediate term to promote better rural connectivity driven by the COVID-19 pandemic with projects to be completed by June 30, 2020.
- Gas Tax Fund – funding provided by Infrastructure Canada. The federal government transfers funding to BC who then flows it out to municipalities for investment in local infrastructure priorities, specifically including use for broadband and connectivity.
    - In BC, the Gas Tax Fund is administered through the Community Works Fund. This is a direct annual allocation to assist local government with local priorities. The funds may only be utilized by one of the entities set out in the "Ultimate Recipient" definition within the GTA; the funds must be applied towards the eligible expenditures of an eligible project as set out within an "Eligible Project Category", and the project must meet the definition of "Infrastructure", as defined in the Agreement. "Infrastructure" is defined in Annex A as: "municipal or regional, publicly or privately-owned tangible capital assets in British Columbia primarily for public use or benefit."
- Universal Broadband Fund – funding through Innovation, Science and Economic Development Canada which is currently being developed and release is expected to be imminent.
- Pathways to Technology – A program managed by All Nations Trust Company with the goal of connecting all 203 BC First Nation communities to high-speed internet. It identifies communities in need and engages with the community to identify priorities and then solutions connectivity for that community.

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- Trusts or non-profits that have support for the RDKS or parts thereof as part of their mandate.
- Private industry partners.

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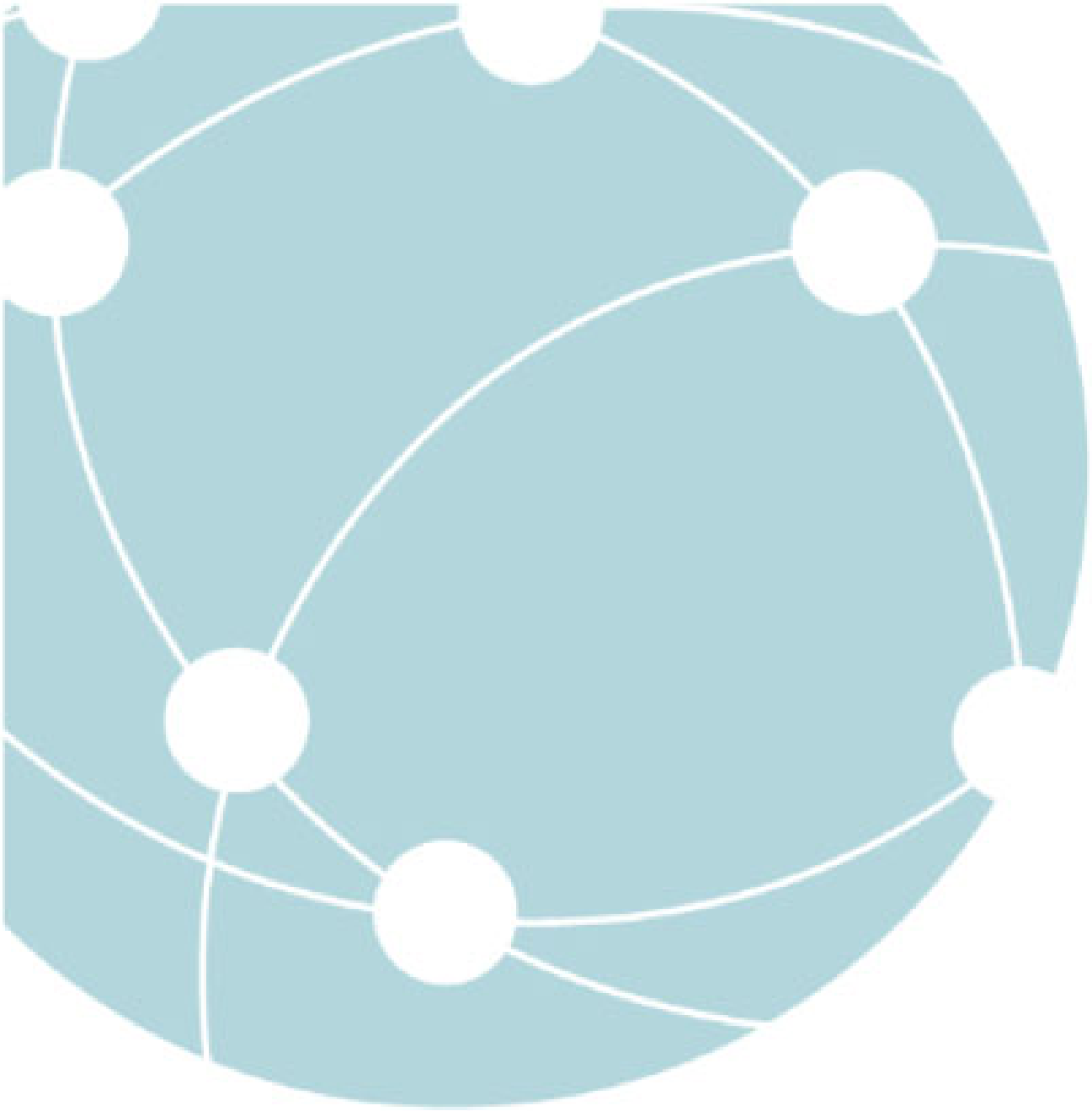

9 NEXT STEPS

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9.1 Next Steps

The following provides a summary of the next steps and specific action items for consideration in the RDKS' role of a facilitator, advocate and conduit for funding.

Faciltator, Advocate, Conduit for Funding, Path to Higher Levels of Government

Background Tasks

- Establish aninternal broadband working group focused on the connectivity challenge.
- Identify a lead internal staff resource to manage and advance connectivity initiatives.
- Complete the inventory of assets available to the RDKS that may be of benefit in solving the problem.
- Reach out and collaborate with other local governments to identify and solve a larger problem for more people.
- Align with other regional district initiatives that may be ongoing.
- Actively provide intervenor feedback to the CRTC in collaboration with other local governments.
- If not already, become a member of the BC Broadband Association.
- Participate in broadband conferences, especially those focused on rural and remote communities.

Planning

- Create a terms of reference for the working group.
- Prioritize the list of potential projects.
- Create a project plan for the region's strategic objectives.
- Understand and detail the stakeholder requirements.
- Identify allies to execute on the priorities.
- Obtain and allocate funding.
- Identify potential resources.

Execution and Implementation

- Facilitate group strategy and coordination between stakeholders to achieve regional goals.
- Create a connectivity working group comprised of providers, industry stakeholders and other external parties.
- Advocate and demand accountability for progress on priorities.
- Provide support for active projects.
- Provide specific actions and milestones in letters of support to providers.

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About TANEx Engineering

TANEx is a professional engineering firm located in British Columbia, Canada focused on providing engineering consulting services specializing in telecommunications and networking. TANEx provides design, commissioning and operational services to its clients from varied industries and has a wide variety of expertise in connectivity technologies, infrastructure and services. For more information, please refer to our website at www.tanexengineering.com.

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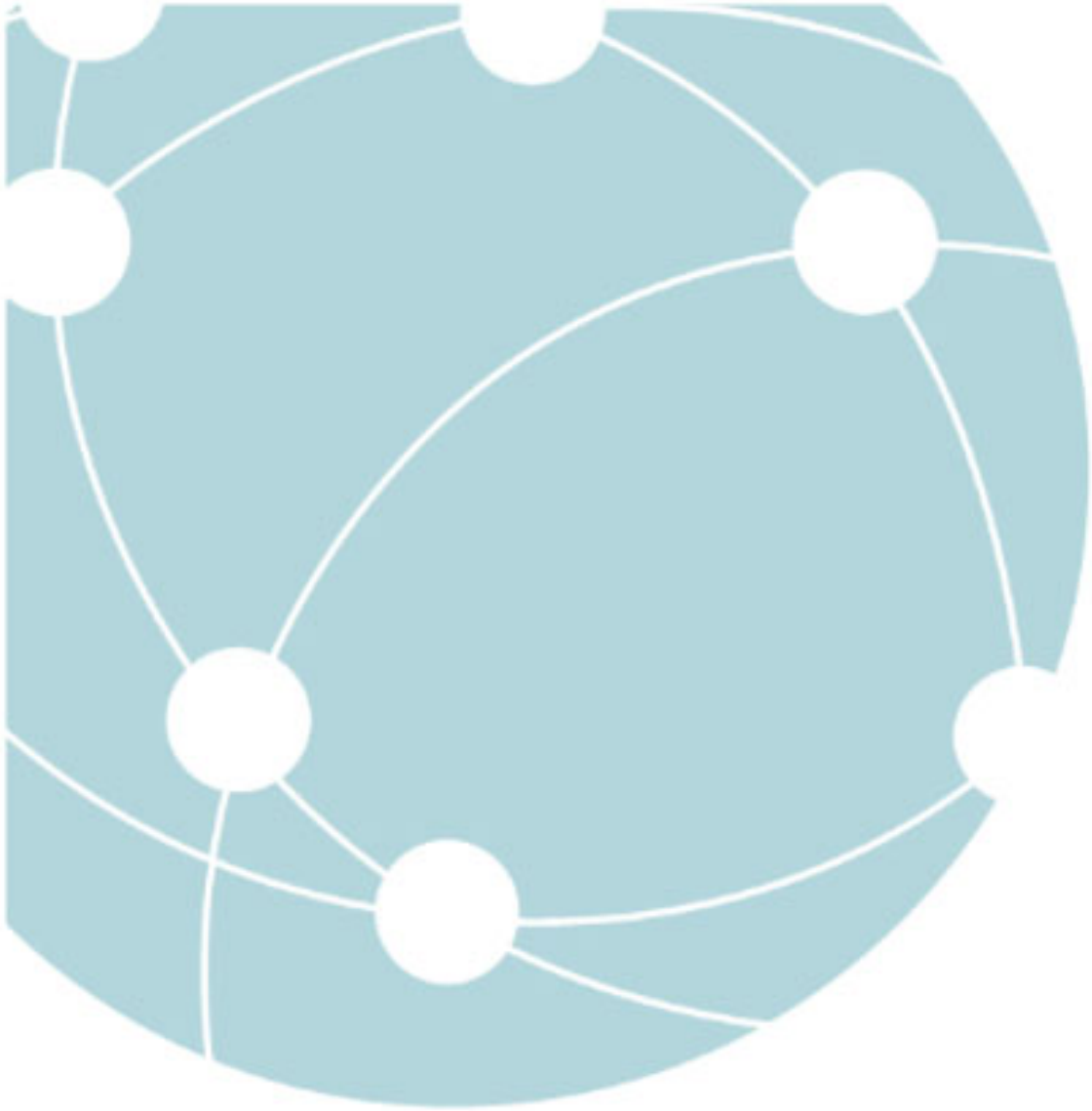

10 APPENDICES

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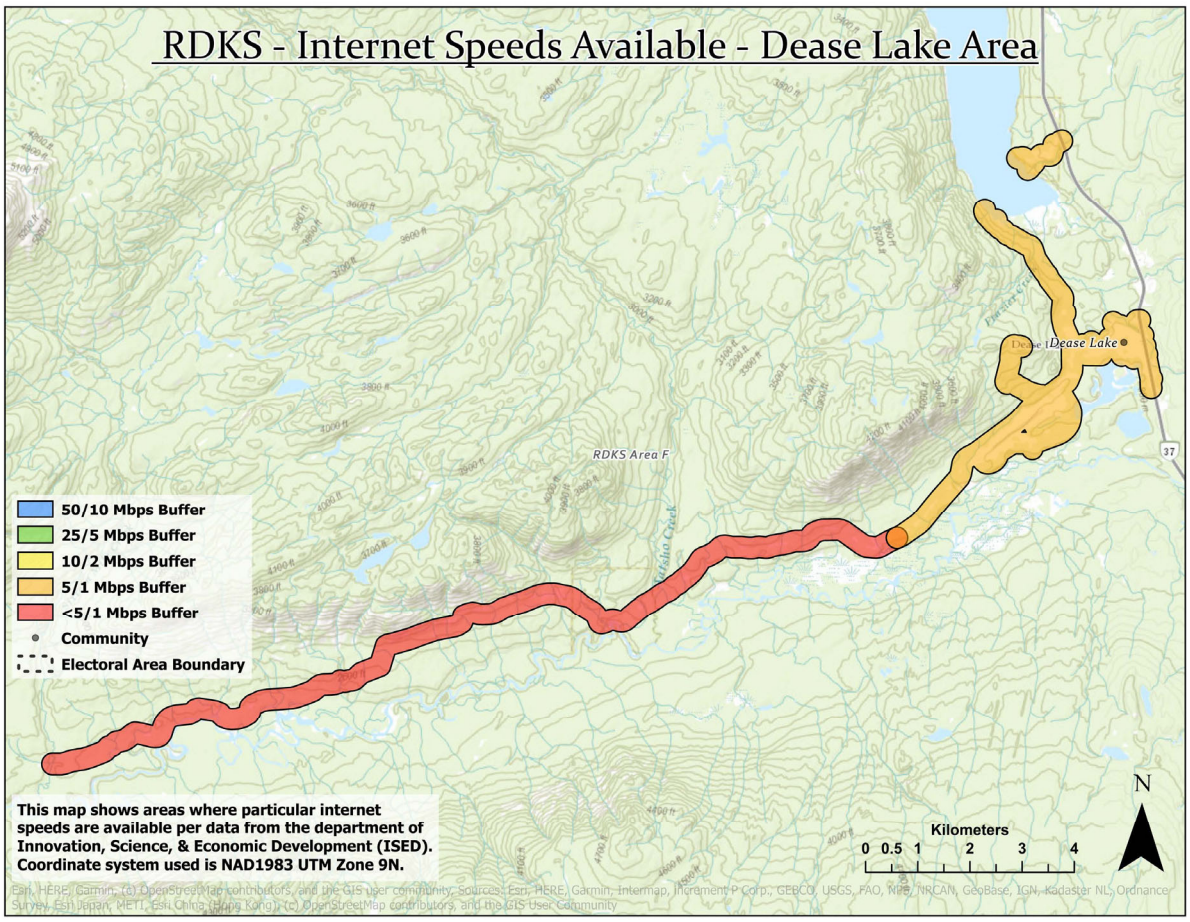
10.1 Appendix A - Mapping - Internet Speeds Available

As part of the development of this report, a number of maps were created to provide a visual depiction of various aspects of the RDKS. While not all maps are included as part of this appendix, some have been included to assist in the understanding of the region.



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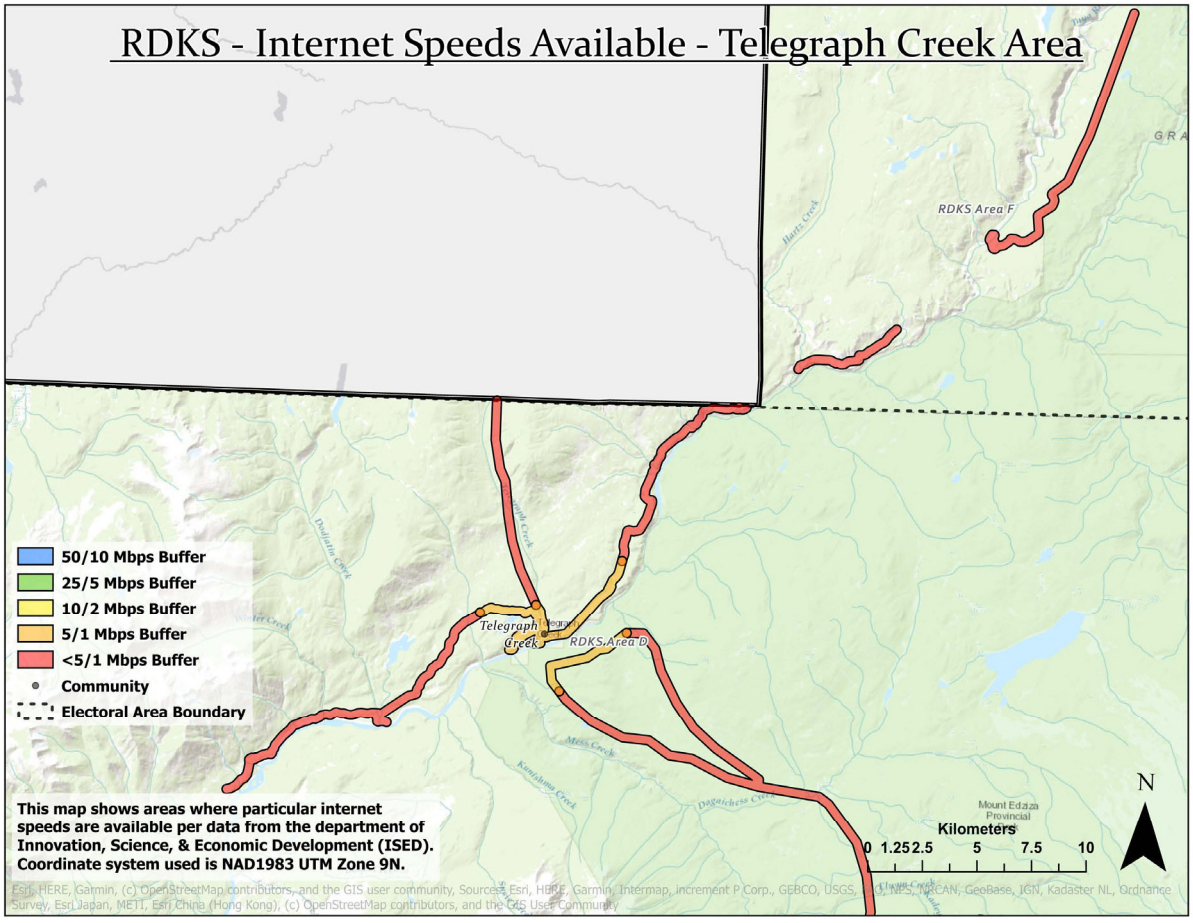

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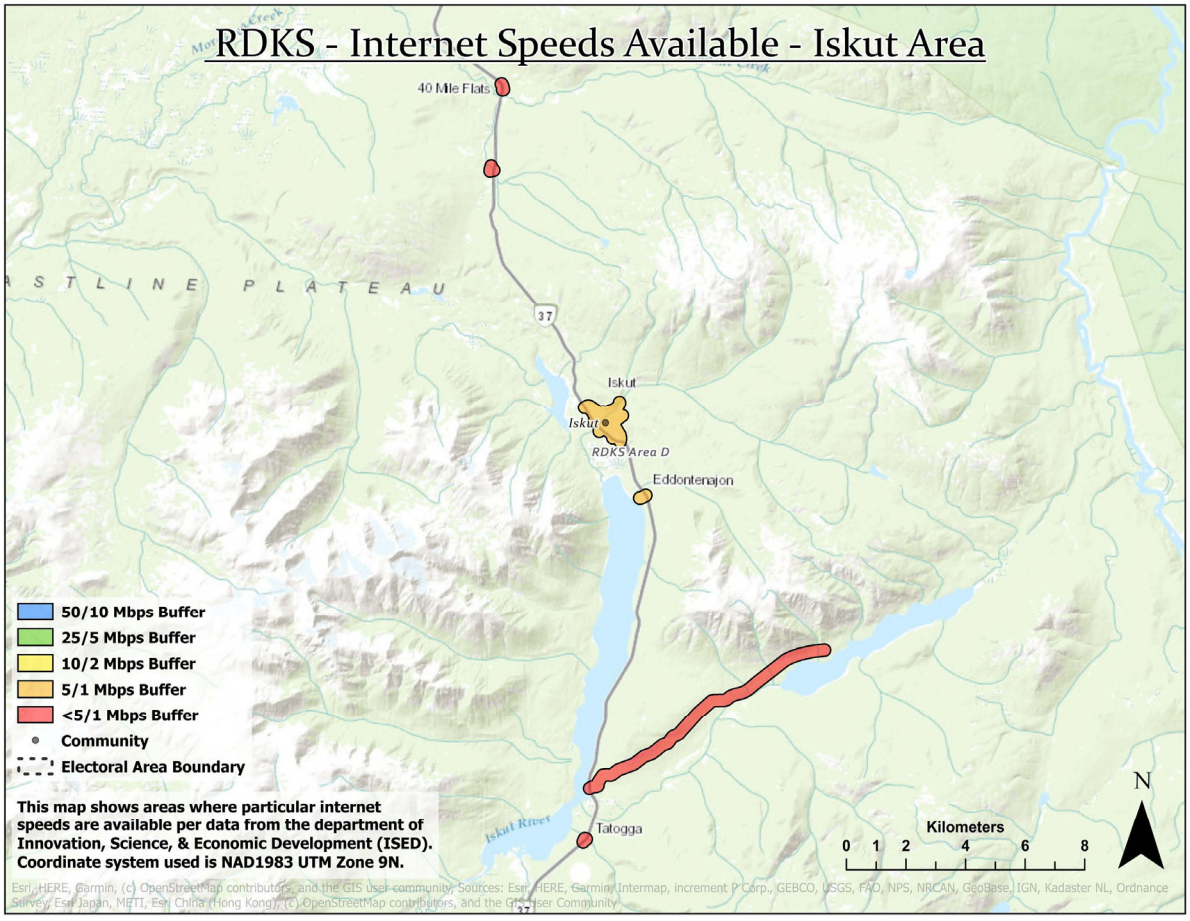

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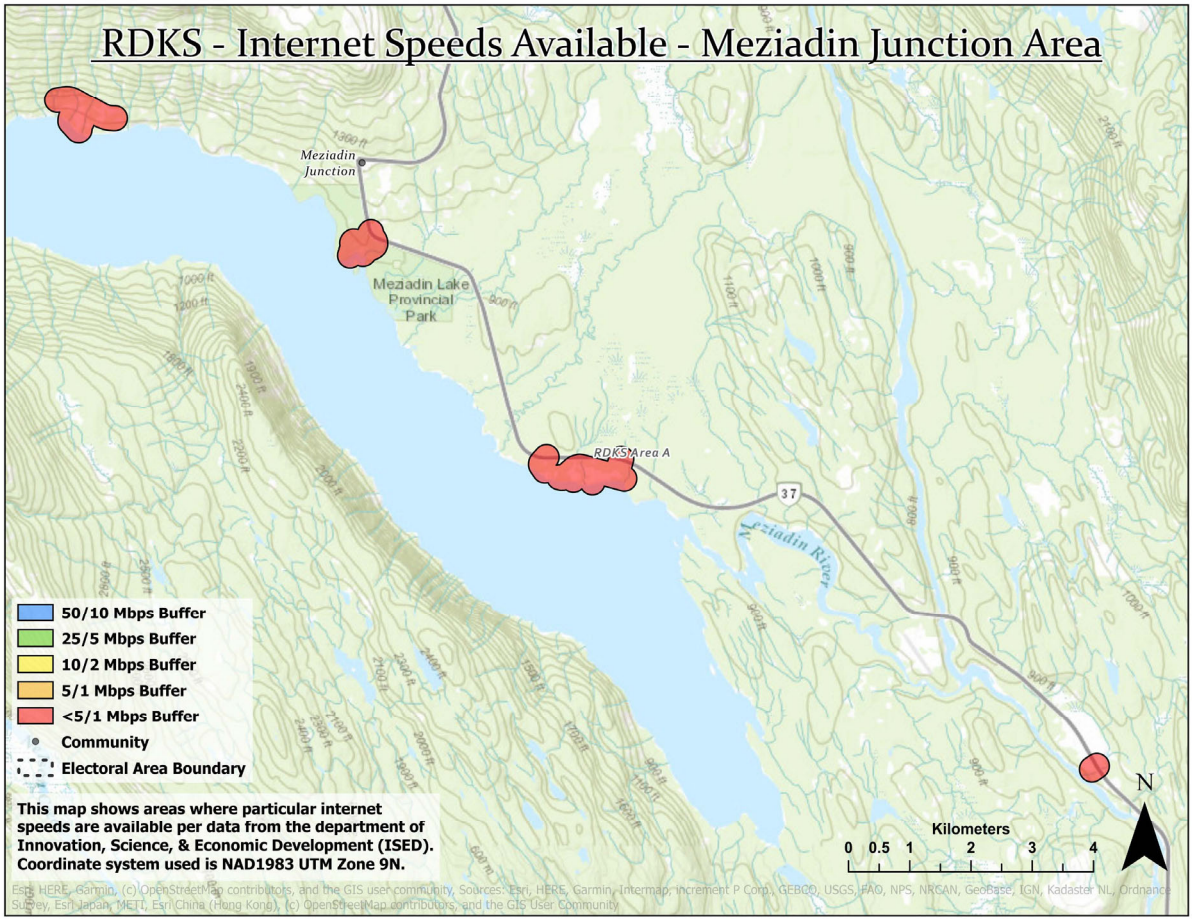

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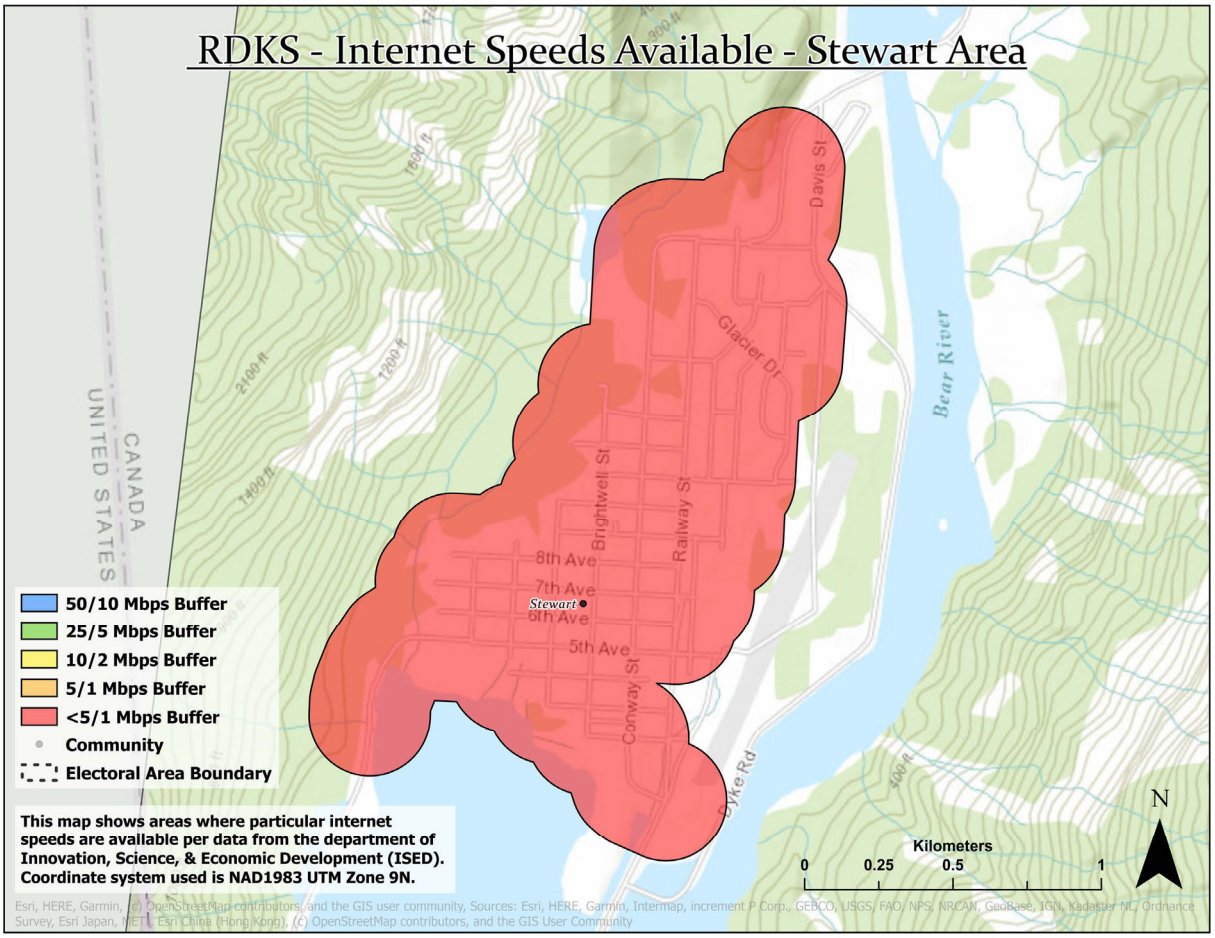

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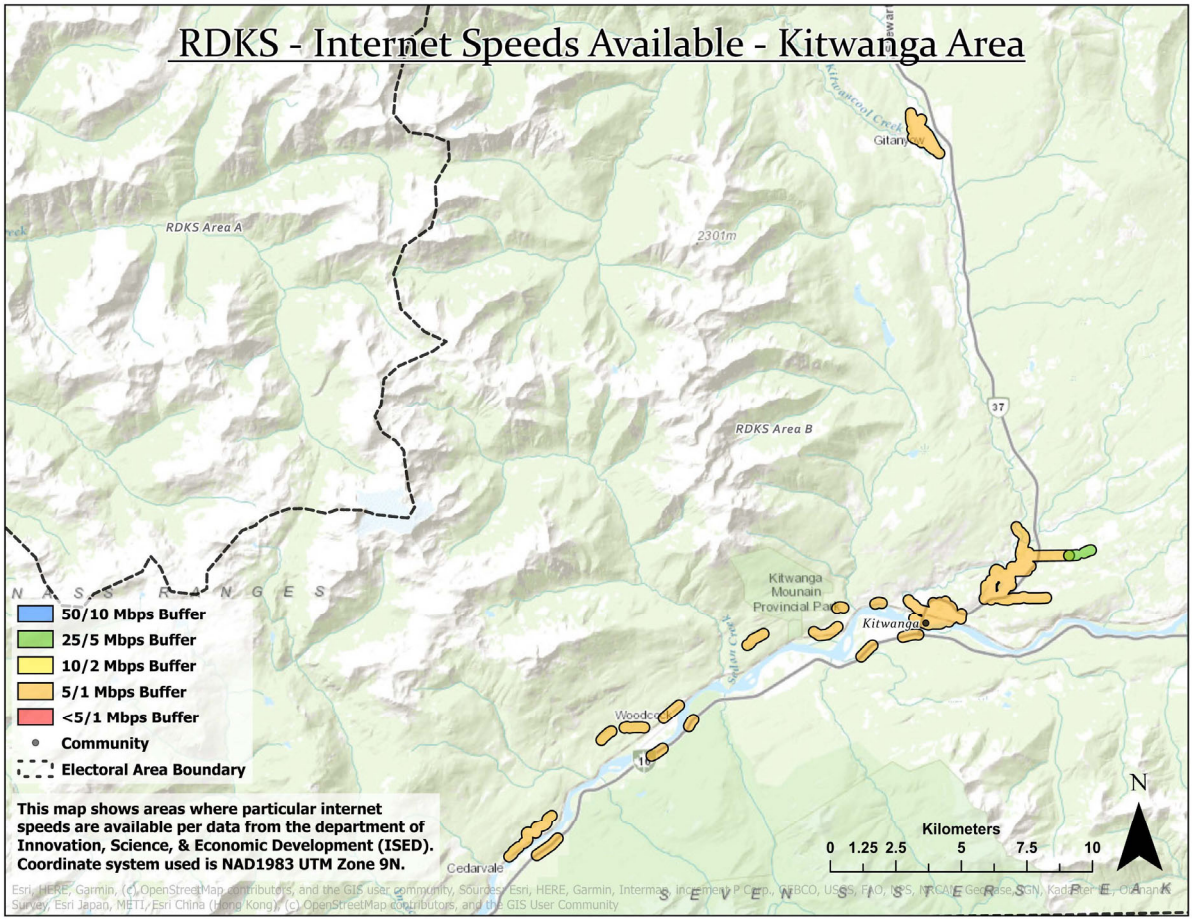

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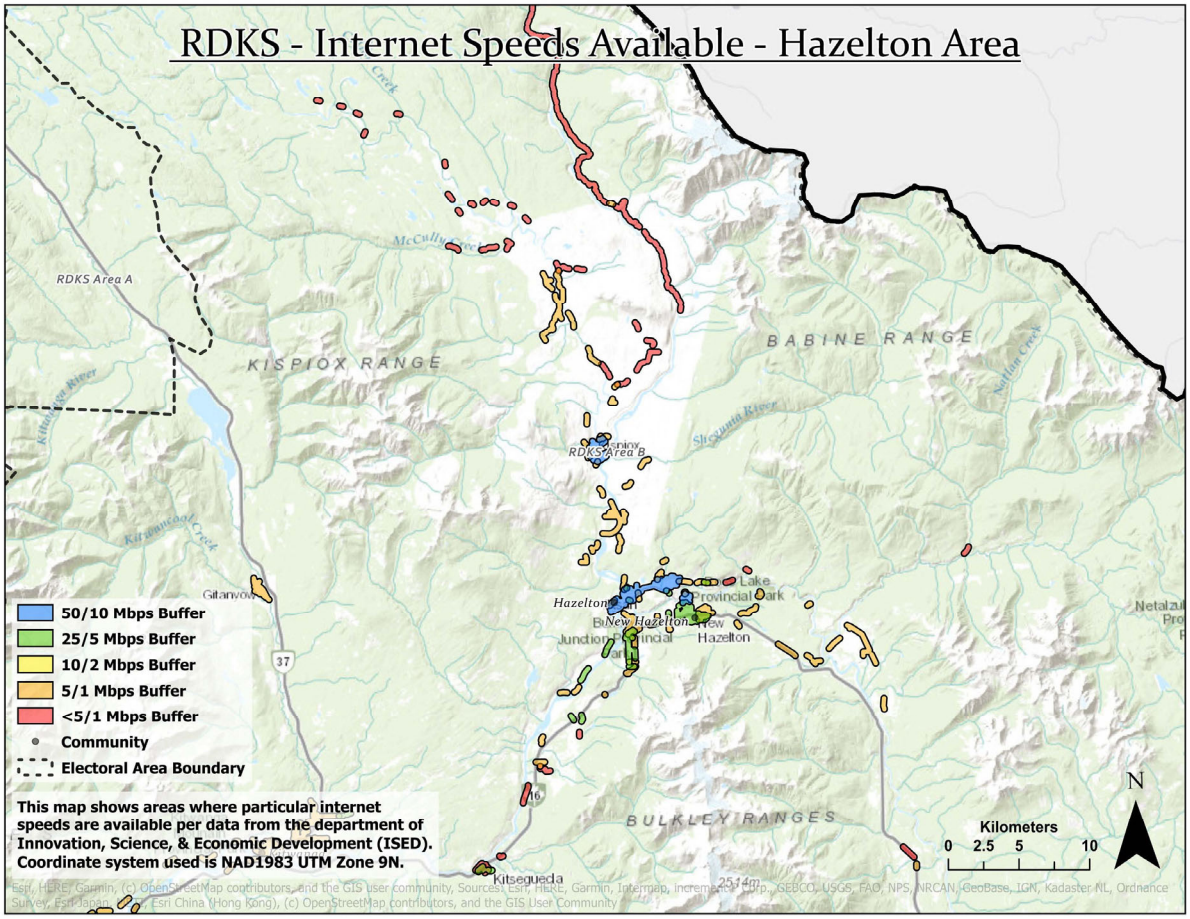

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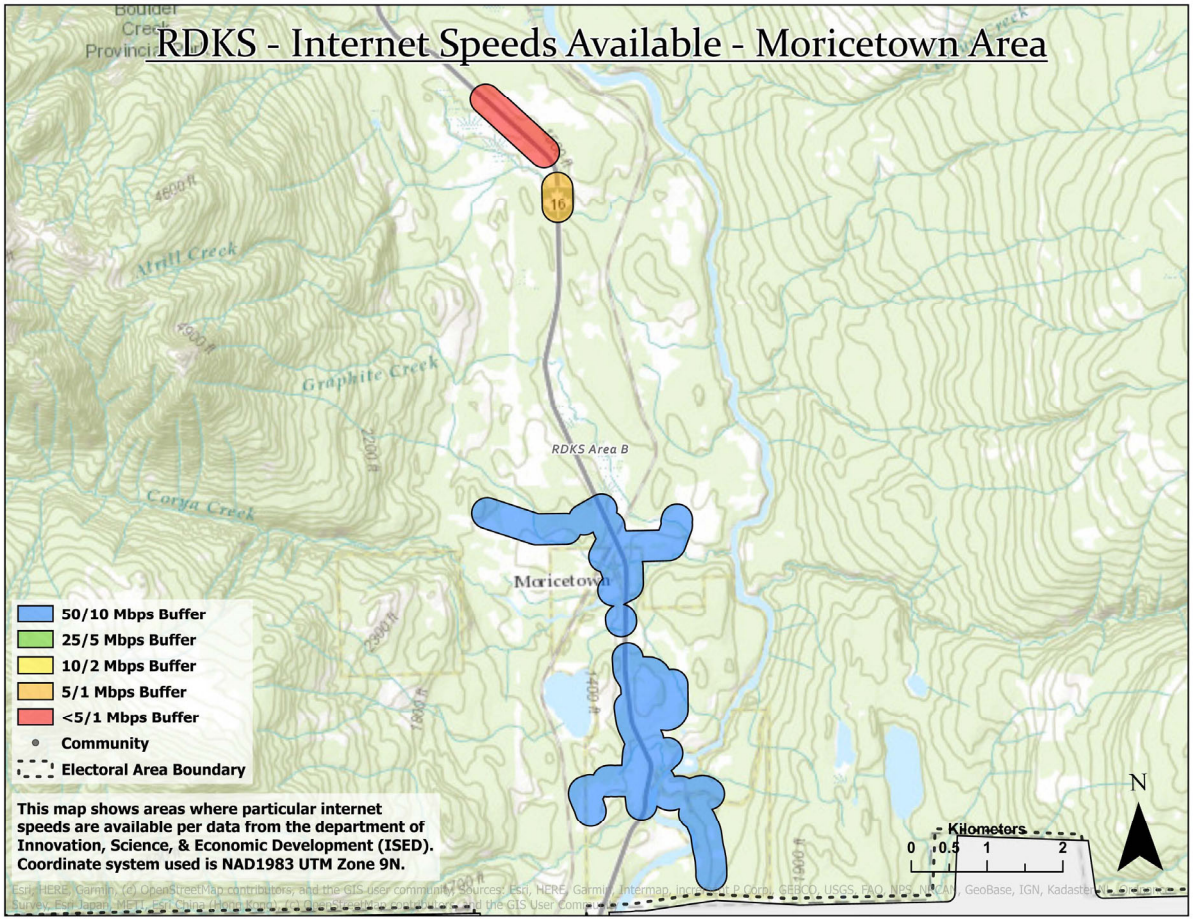

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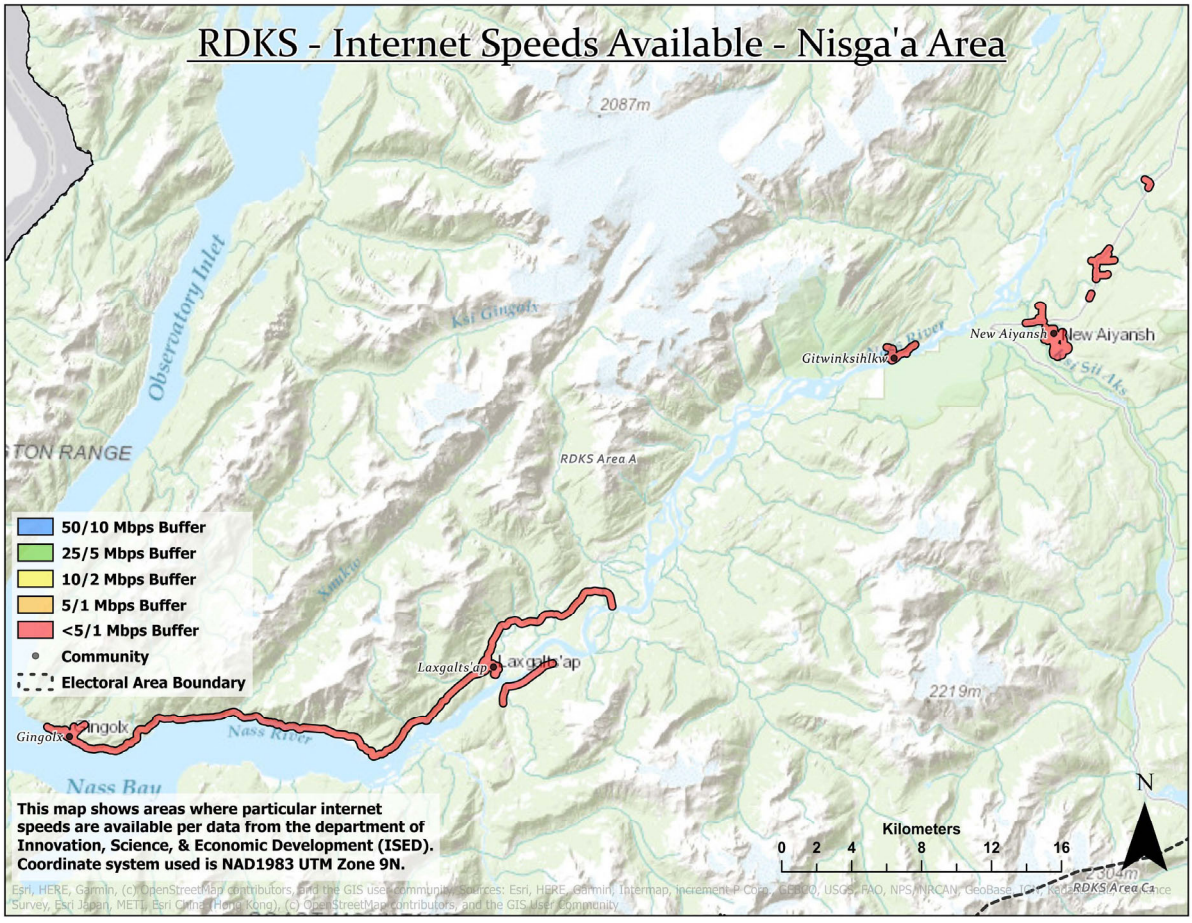

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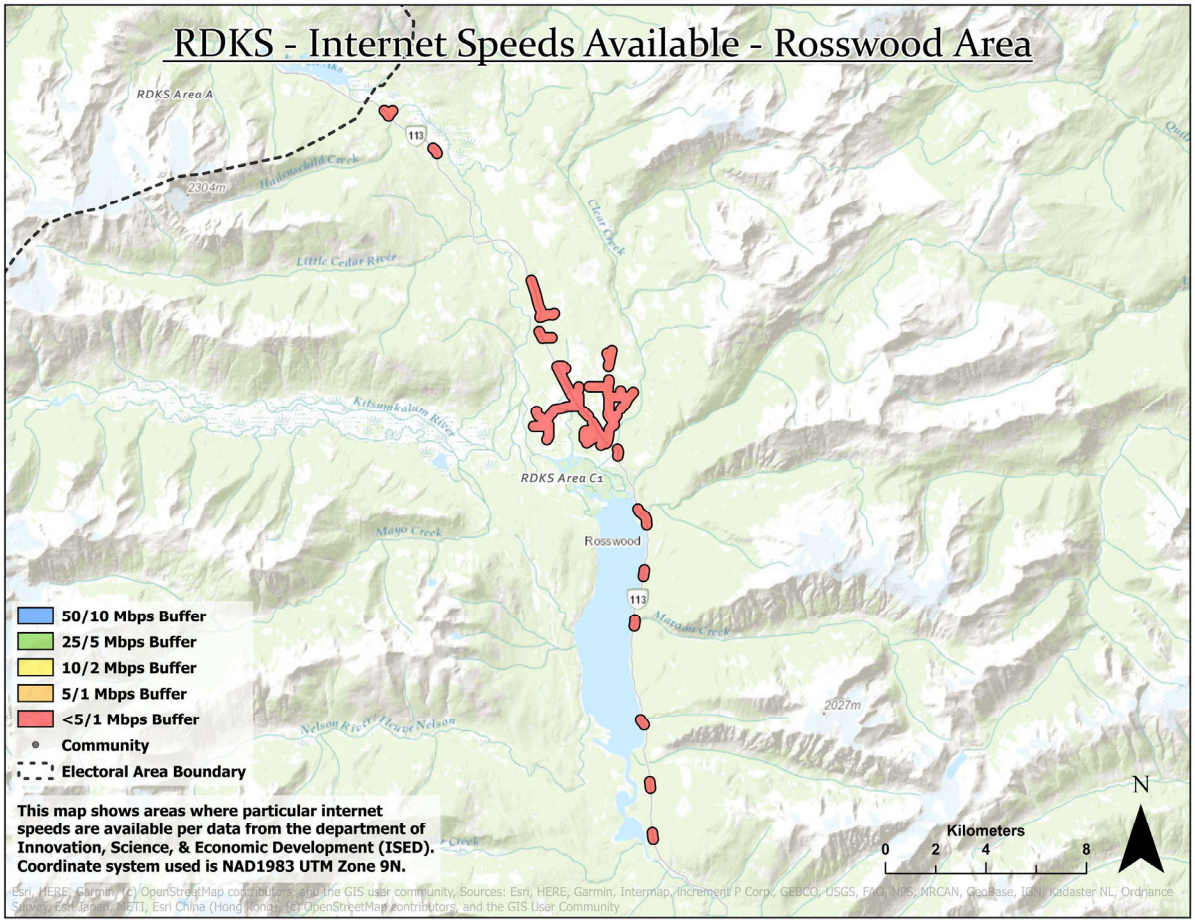

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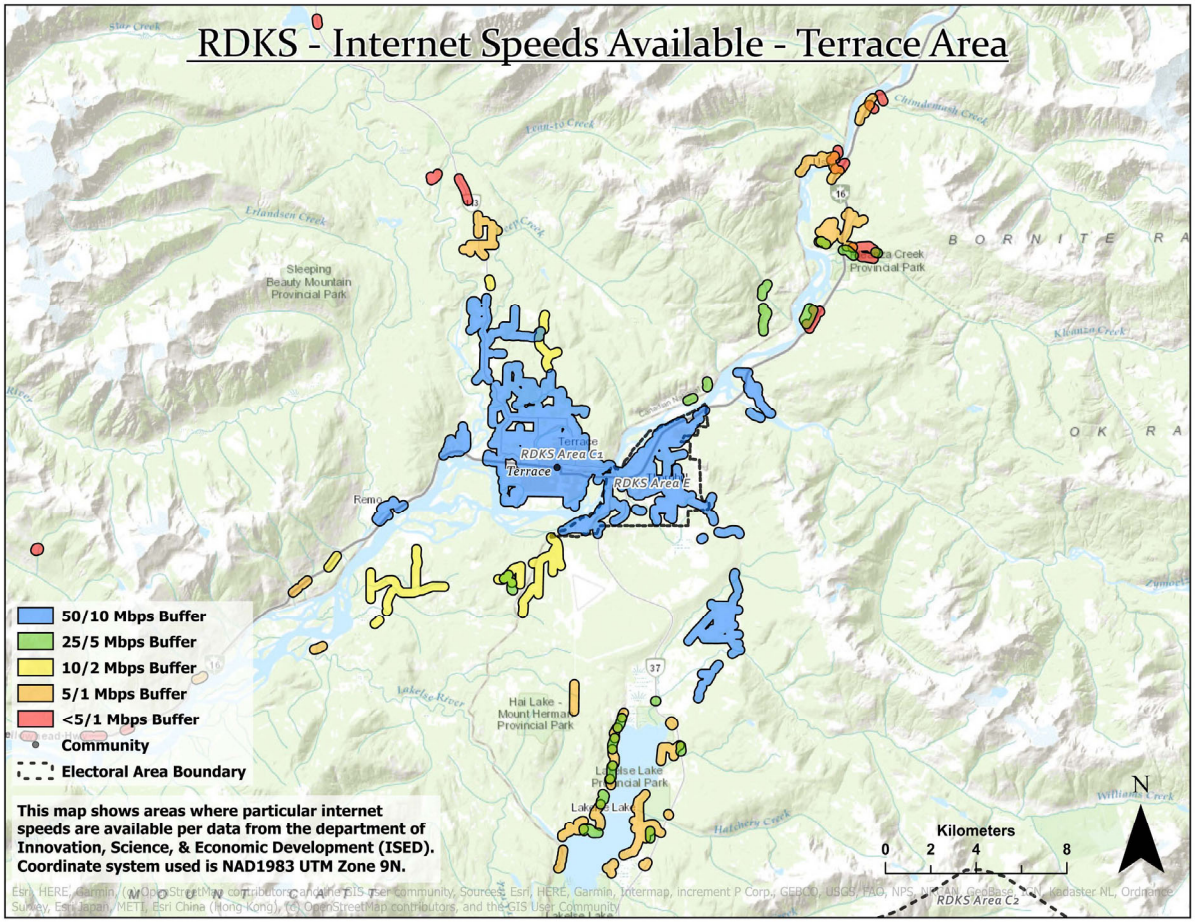

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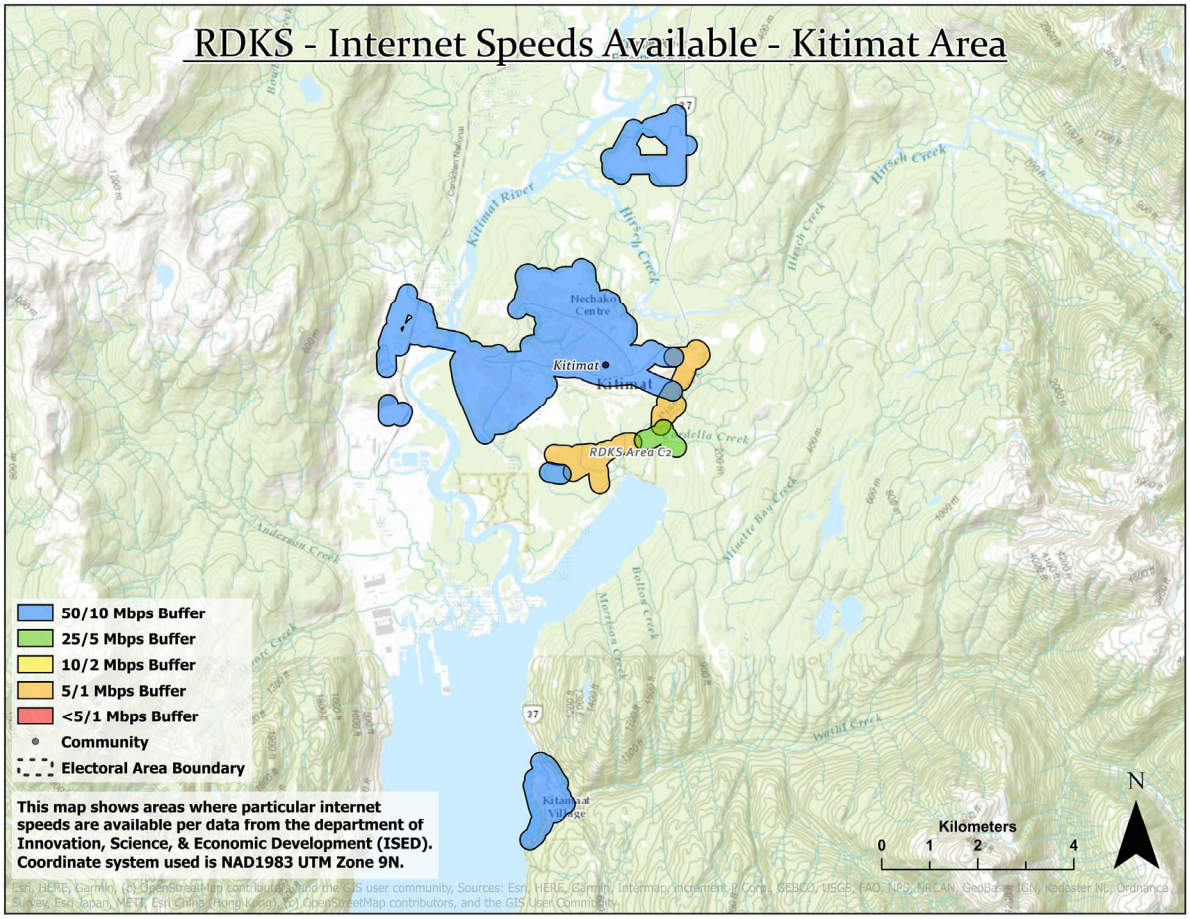

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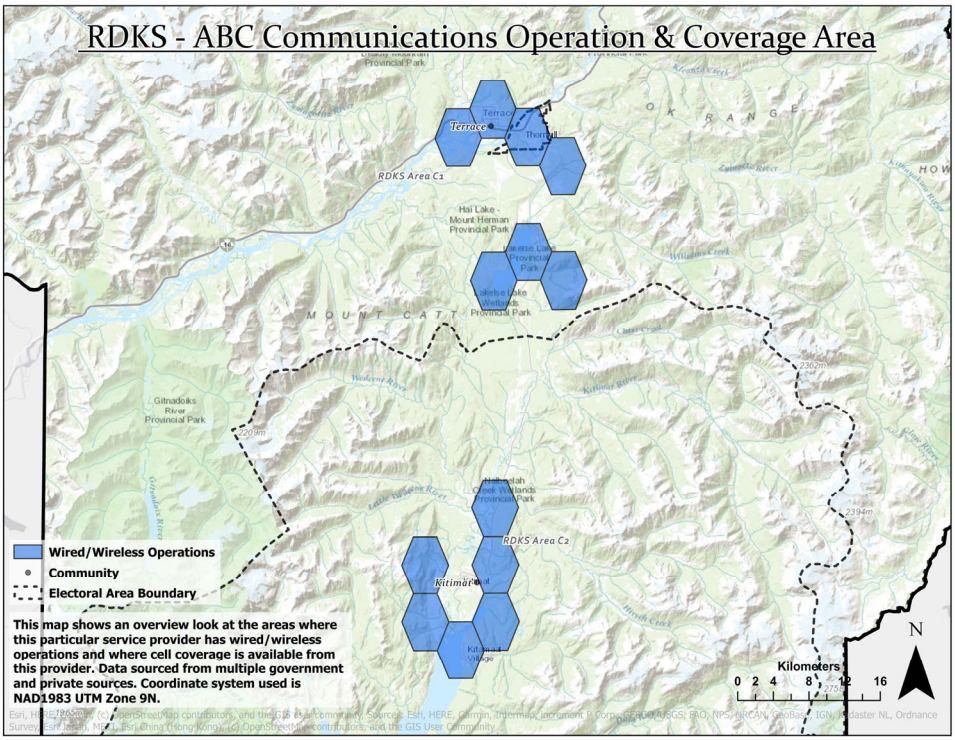
10.2 Appendix B – Service Provider Service Areas

These maps show the advertised service areas of the various providers. Where a statement is provided, the statement has been obtained from the provider itself.

10.2.1 ABC Communications



ABC Communications has been one of BC's top connectivity companies since it was founded in 1989. After recognizing the value or its team and network TELUS purchased ABC in 2020 with a plan to continue to operation the company in much the same fashion that has brought it success over the years.

They have the largest fixed wireless network in BC and have regularly been named in the top 20 Telecom companies in BC by Business in Vancouver. ABC has been a pioneer in providing connectivity to the rural regions of BC providing ever improving internet delivery systems to rival urban speeds in some areas. ABC has regional offices in 100 Mile House, Vanderhoof, Burns Lake, Kelowna, Penticton, Prince George and Vancouver. ABC has three principal divisions –Telecom, Wireline Internet and Wireless. These three divisions work closely together, supporting and complementing one another to provide seamless solutions to customers.

ABC's solid business model is further reinforced by its parent company TELUS. Capital investment is expected to increase substantially provided improved performance to consumer and business connections across the network. ABC's product suite includes Fixed Wireless services delivered primarily over LTE technology, Fibre Optic and DSL connectivity over TELUS' network and business telephone systems using traditional and VOIP technologies.

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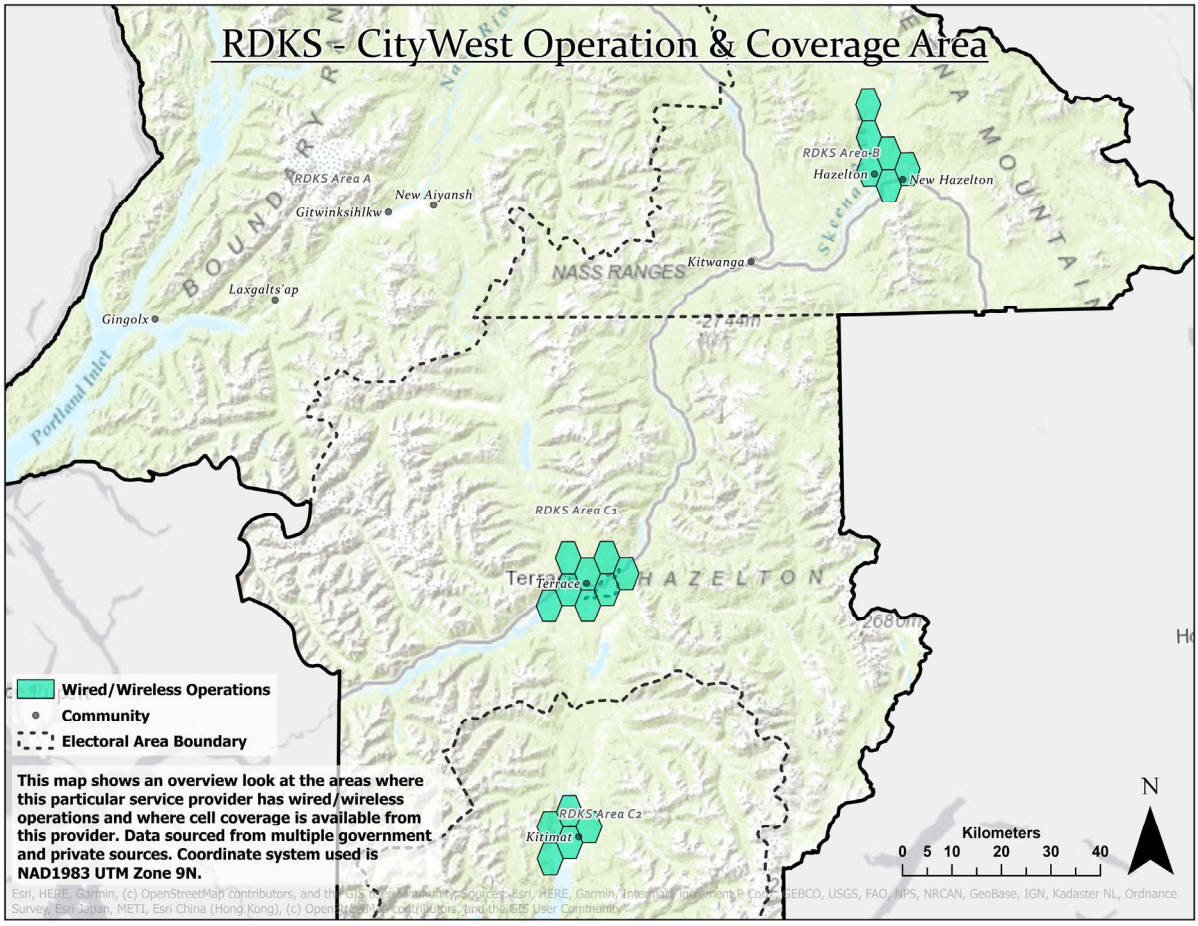
10.2.2 City West



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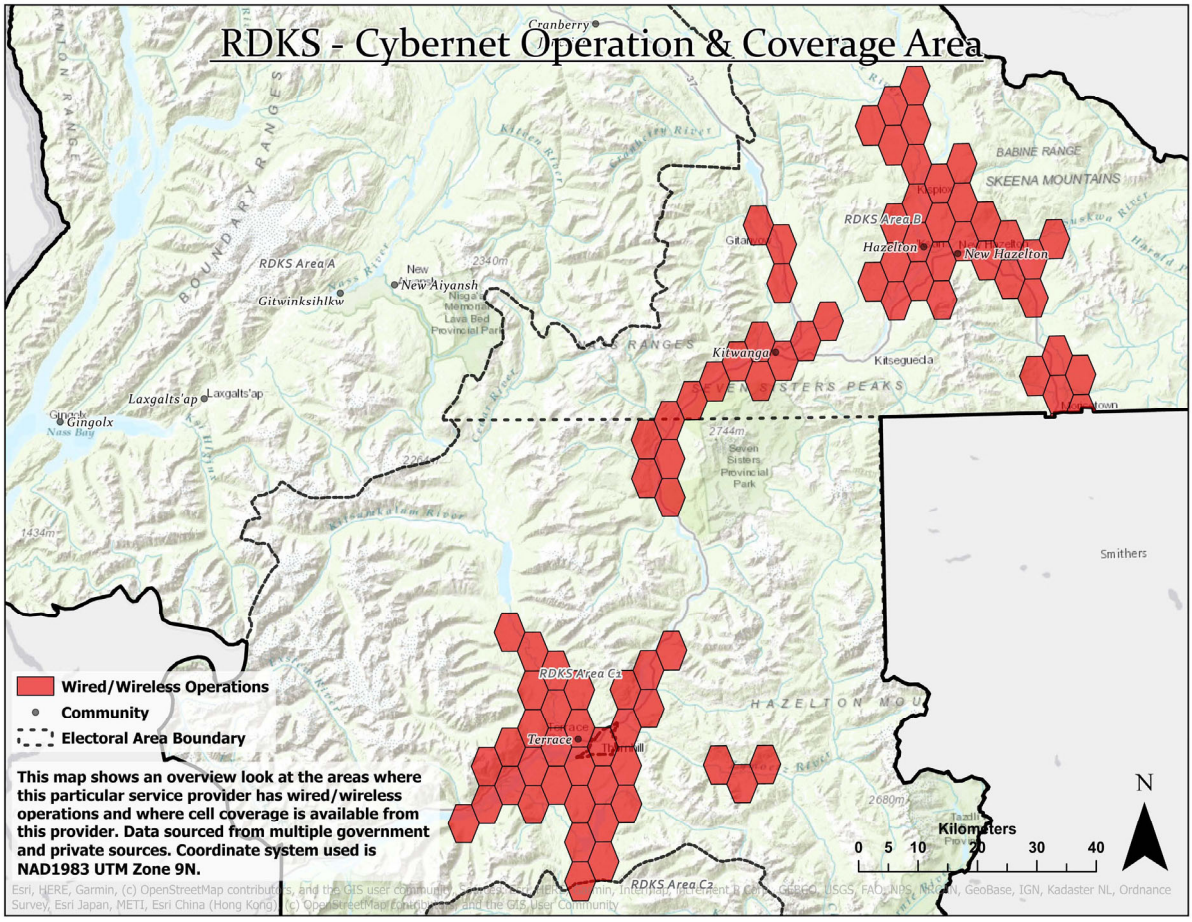
10.2.3 Cybernet



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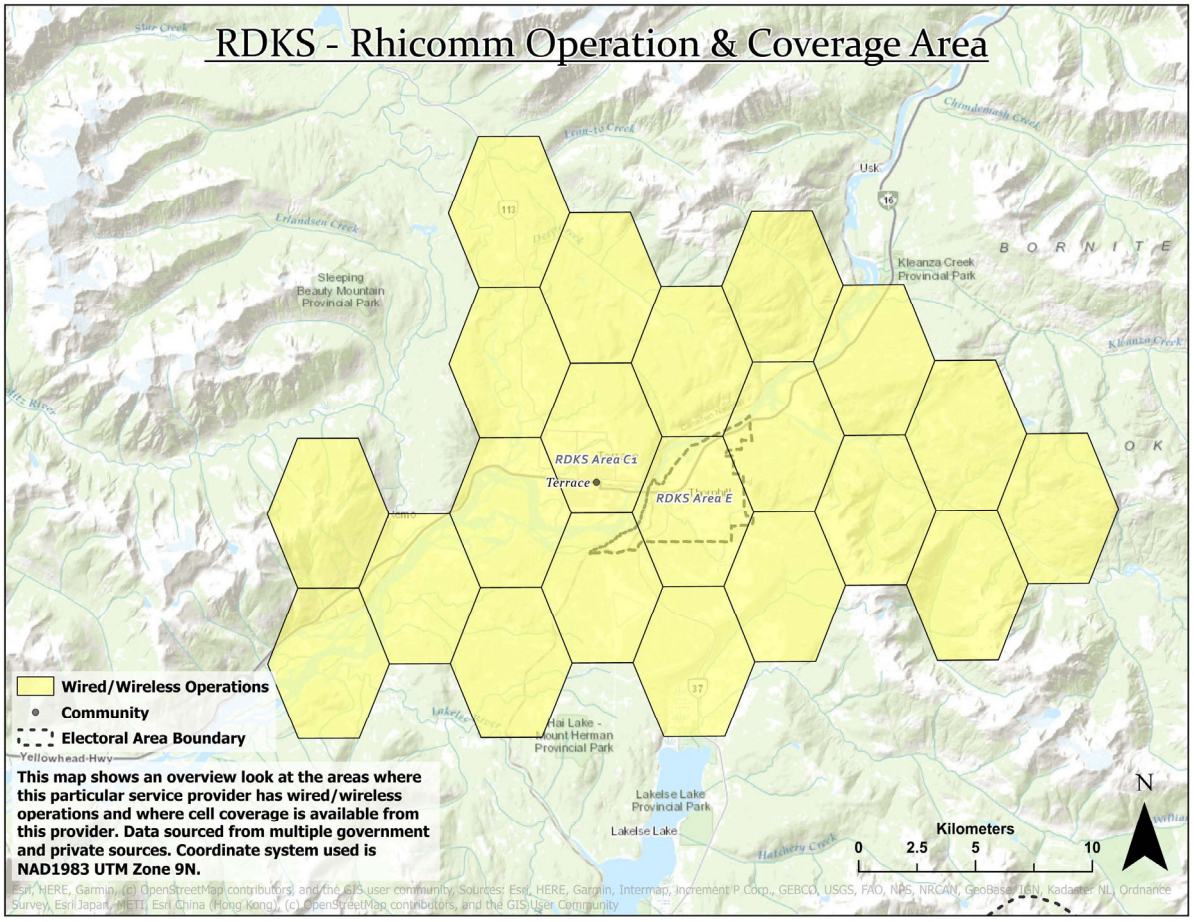

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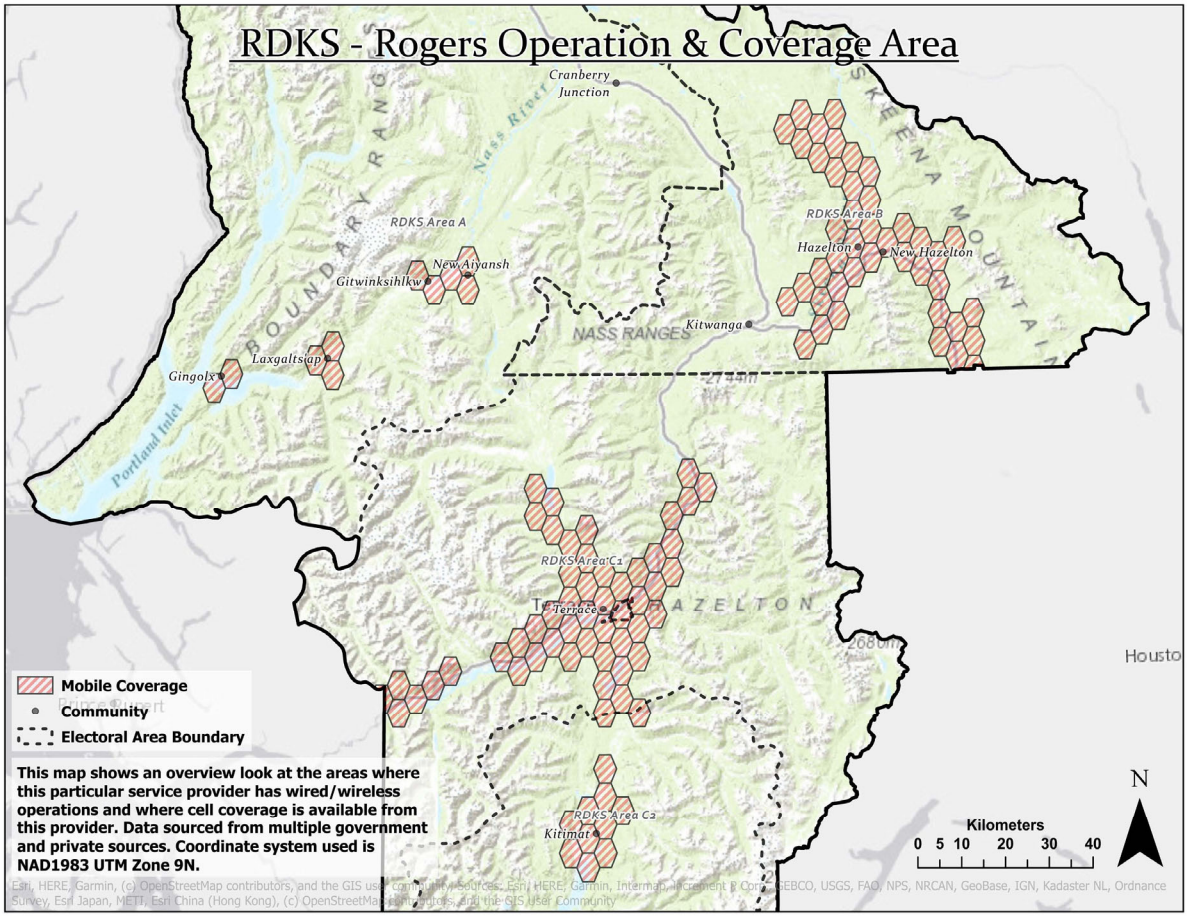

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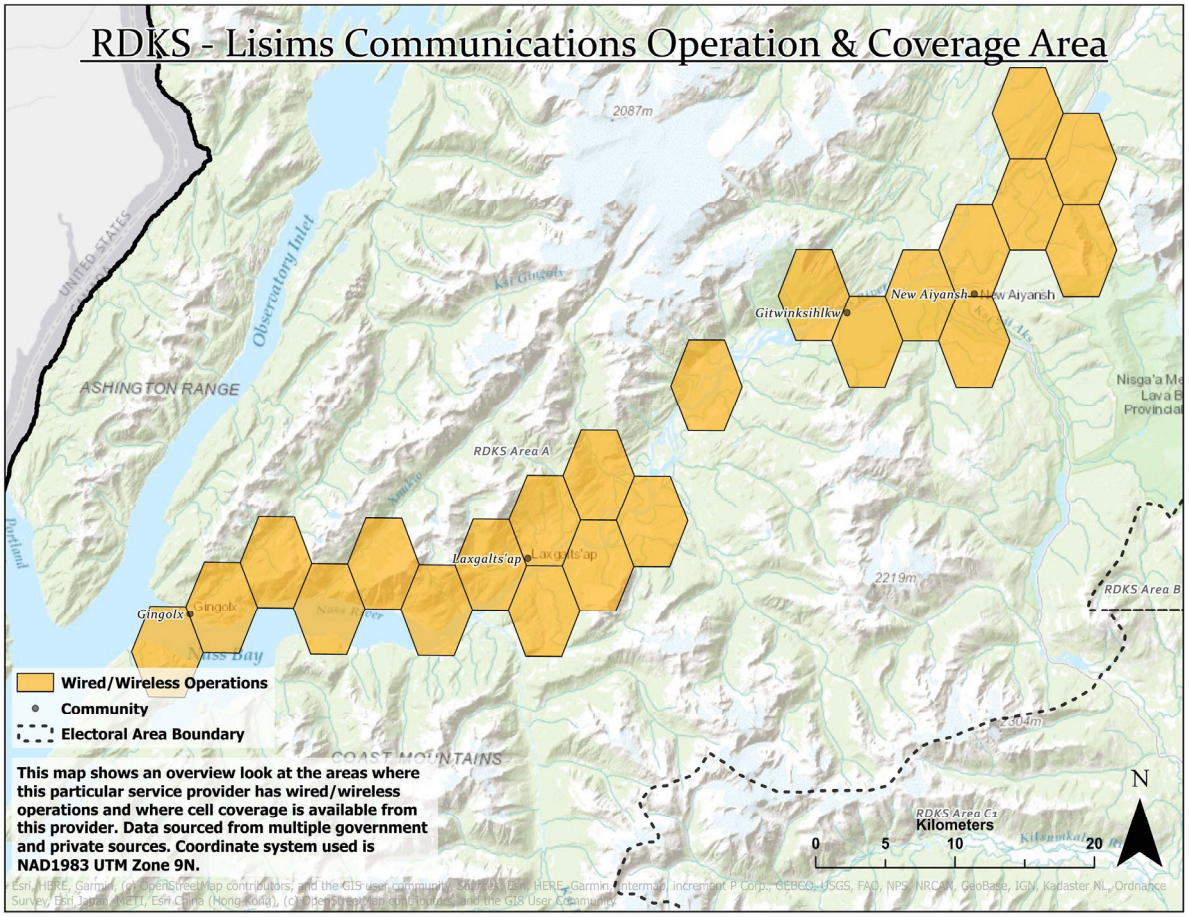

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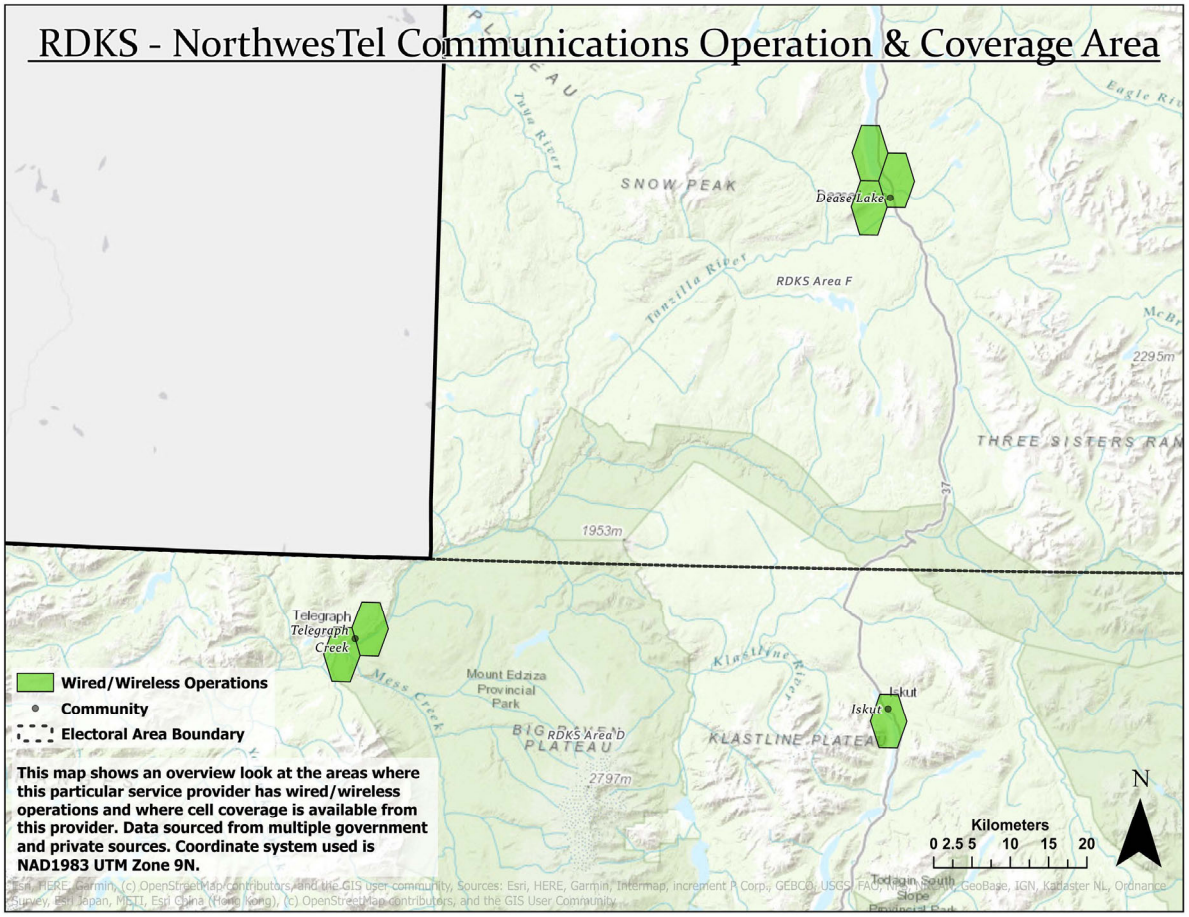

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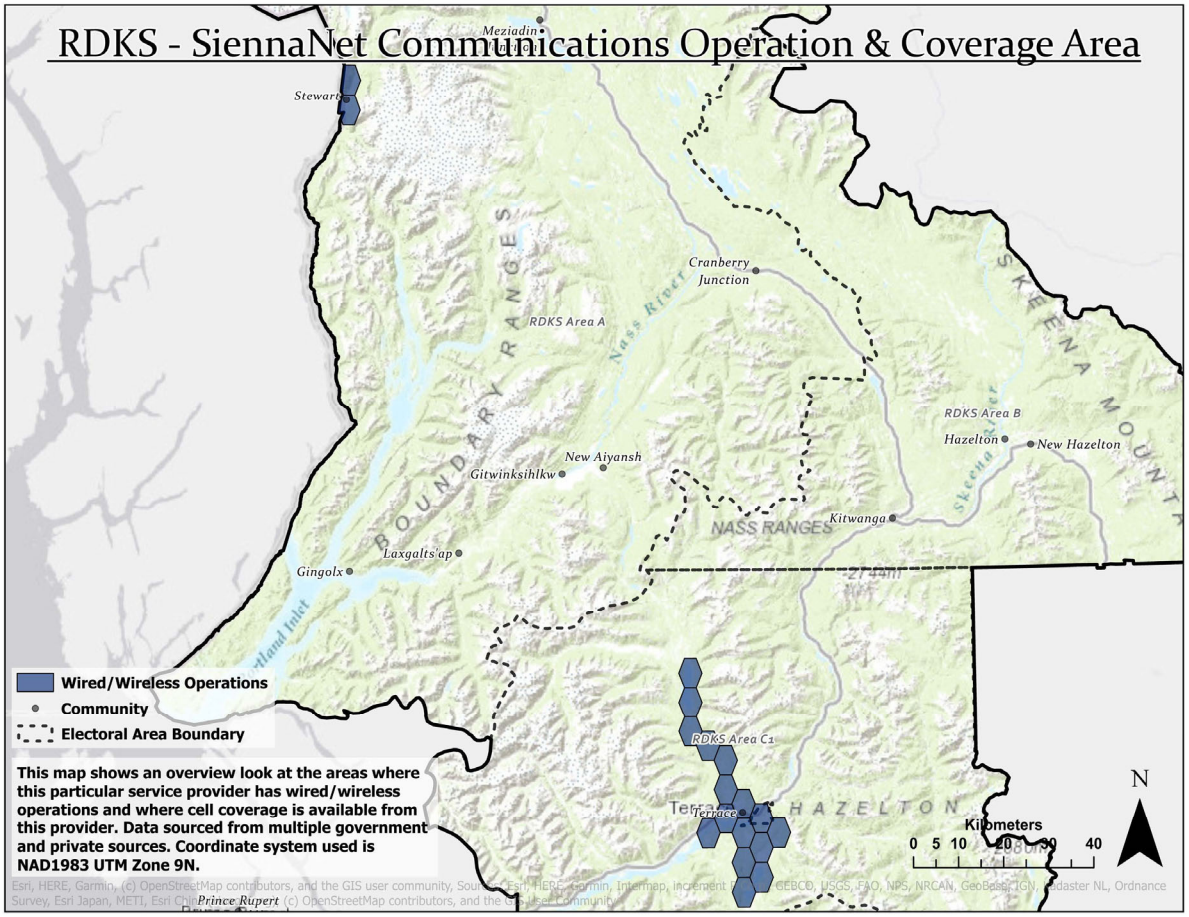

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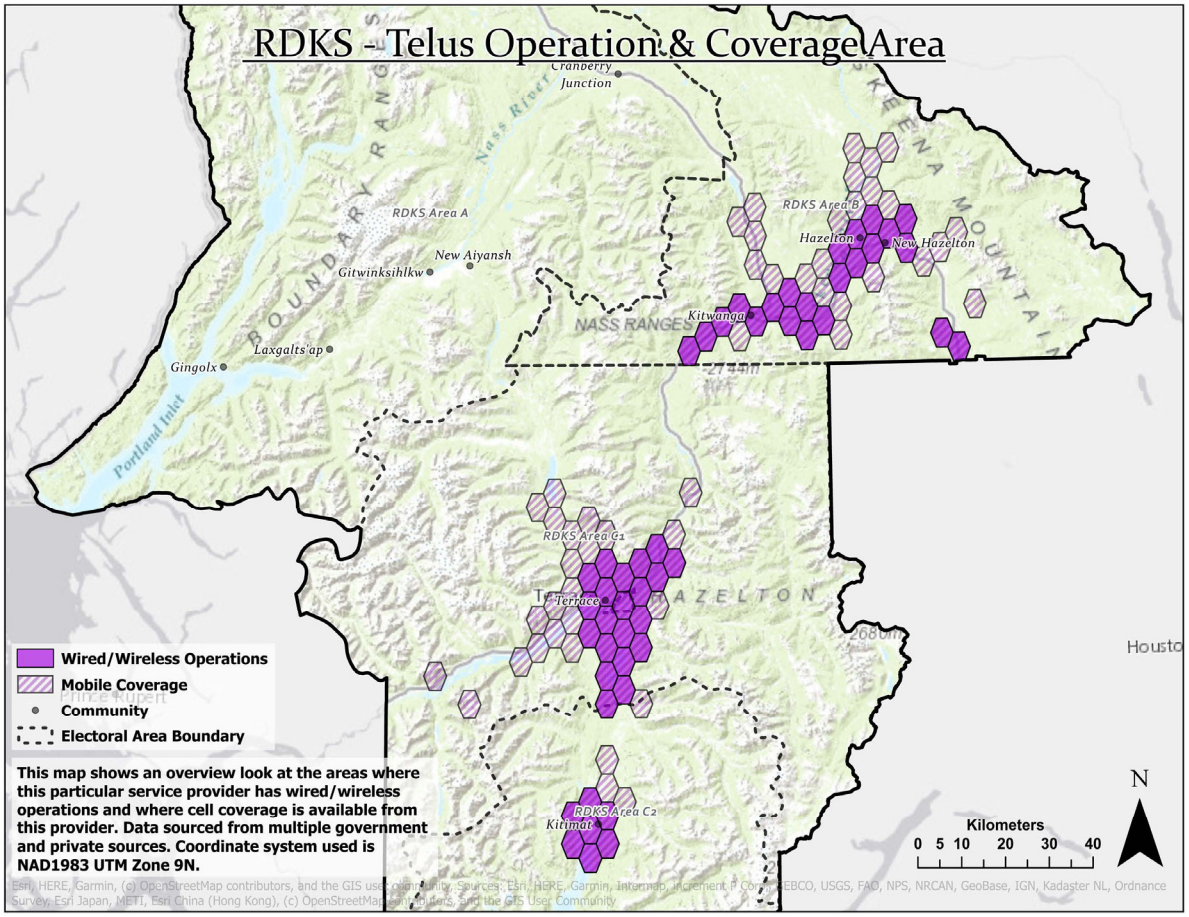
10.2.9 Telus



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10.2.10 Shaw

While Shaw does not currently provide services in the RDKS, Shaw did provide the statement below to communicate their interest in the area.

“As a leading Canadian connectivity provider, Shaw is committed to innovating and investing in our networks to expand and improve broadband connectivity throughout British Columbia. Shaw is proud to provide to our over 2.9 million subscribers in B.C. high quality, affordable cable, video and phone services, as well as provide wireless network coverage through our Freedom Mobile LTE network.

Robust and resilient telecommunication networks are complex ecosystems where partnerships are vital. Within the Regional District of Kitimat-Stikine (RDKS), Shaw would be interested in learning more and potentially participating in partnership to expand service. While we currently to do not have network infrastructure within the RDKS (apart from Shaw Direct Satellite service), we do offer Freedom Mobile services in Prince Rupert and full services in Prince George. When we expand to new markets, we typically start with a high capacity fibre optic transport line, serving businesses along the route, and regional ISPs (who then work to extend Last Mile). We would design fibre spurs to support regional ISPs in extending service to nearby underserved communities. As demand for services grow, we would then consider expanding Last Mile service, connecting individual households with our FibrePlus network or provide wireless LTE service.

Shaw is potentially interested in participating in a high capacity fibre optic build moving west to east in the RDKS as well as along Hwy 37 to service Kitimat. As a regional connectivity plan develops, Shaw continues to be interested in finding opportunities to partner with other service providers, businesses and the RDKS to expand service.”

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10.3 Appendix C – Technology Overview

10.3.1 Technology Alternatives

In terms of technology, the primary obstacle for rural broadband is cost. Depending on the most suitable technology, the primary cost consideration may be associated with either the backbone or local access networks. A wide range of options are available and broadband services can be provided through a variety of technologies each with advantage and disadvantages. These technologies trade off high capital and operating costs with capacity, scalability and the ability to support the desired applications. The choice of technology needs to be assessed against the requirements for the particular situation and the cost of providing the services. While some technologies represent higher capital costs, the life expectancy may be factored over a long period of time (ie. 20 – 30 years) so capital costs need to be amortized over the lifetime of the asset when comparing technologies. This section of the document is a high-level introduction to these technologies.

Alternative technologies used to connect locations together are outlined below. Technology choice is dictated by the needs and circumstances of the service area. The challenge is to select technologies and configure them into systems that meet those requirements while minimizing life cycle cost.

As summarized above, **backbone or transport infrastructure** is the technology used to transmit and receive data over long distance to connect towns, cities, provinces and countries. Fibre optic cable (optical fibre), microwave radio, and satellite are the three principal transmission medias but fibre is, by far, the most desirable with very high scalable capacity, long life cycle and low operating cost. The challenge with fibre is the high initial cost and as such high capacity terrestrial microwave radio solutions, or even satellite, may be considered depending on the requirements.

Local access networks connect users to the backbone network in order to reach distant locations and applications. In broadband, the term applications, refers the services that people (subscribers) use including things such as the internet, video streaming or broadcast, voice communications, email, access to business services such as Microsoft Office 365, security services, business to business communications. These applications require high capacity, reliable connectivity.

Fibre to the Premise (FTTP, FTTH, FTTx) is the gold standard for broadband service to fixed locations such as homes, businesses and institutions, providing very high capacity, reliability and support for almost any application. As with backbone fibre, FTTP can be expensive to deploy as it requires a physical cable (or optical strand) to be connected from a local POP to every subscriber location.

Like fibre, **coaxial cable** service (typically used for Cable TV broadcast) and **Digital Subscriber Line (DSL)** service (over phone lines), share the requirement of installation of a physical cable from a local POP to the subscriber's premises. These technologies would typically be deployed in locations where this cable infrastructure already exists, thus avoiding the cost of construction. It would now be considered uncommon for a provider to construct new DSL or coaxial cable infrastructure rather than a fibre deployment. While coaxial cable can deliver capacity meeting, and exceeding, the CRTC Service Objective, DSL technology is limited in its ability to scale to these capacities. That said, neither technology can approach the capacity of fibre

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and as such, will likely not scale to meet the capacity requirements in the long term. Coaxial cable is also a shared technology as described below in Fixed Wireless.

The alternative to wired technology like optical fibre, coaxial cable or DSL is a radio-based "wireless" technology. **Fixed wireless** technology and unlicensed radio spectrum has been used as a low cost means of kick-starting internet service in low density rural markets. Fixed wireless is considered to be infrastructure that is fixed to a specific location, unlike technology used for mobile wireless described later. While no physical connection is required between the local POP and the subscriber's premises, high capacity wireless services typically requires "line of sight" to deliver reliable, high speed services. Any obstructions, including buildings, trees, or hills impair the signal resulting in no or poor service. Wireless technology, like coaxial cable, is a shared technology meaning that all subscribers using the wireless network are "sharing" the available capacity. The more subscribers using the service at one time, the less capacity each gets. The requirements to scale wireless service to high numbers of subscribers and capacities must be considered during the deployment of the network.

Cellular mobile technology, a variation of wireless, has become the de facto standard for voice and internet service direct to individual mobile devices. The data communication capability of current 4G (4th generation or LTE for Long-Term Evolution) cellular systems make this a viable broadband technology in appropriate circumstances. The emergence of 5G (5th generation) cellular over the next 5 to 10 years is expected to reinforce this trend (see emerging technologies below). While 5G technology is promising, it will require heavy investment in fibre to connect the local, high density of antennas to the backbone and ultimately globally provided services.

Finally, to reach isolated premises that are beyond terrestrial transport networks, fixed, or mobile wireless, direct to home **satellite** is the only viable choice. While this technology is acceptable when no other choice exists, it suffers from high latency (the time it takes to send or receive information) resulting in some applications not functioning optimally. Satellite can also have a relatively high cost for high capacity and usage.

The following summarizes the key characteristics, advantages and disadvantages of the technologies used for broadband service delivery.

10.3.2 Backbone and Local Access Technologies

Fibre optic cable - Backbone & Local Access
Extremely high capacity that is scalable for backbone / transport and local access. 10 Gbps already very common and 100 Gbps emerging.
[+] Long life cycle: 20 - 30+ years. Cost can be amortized over a long period of time.
[+] Low operating cost.
[+] High capacity, low latency, high subscriber counts.
[+] Very reliable.
[+] Very scalable. Upgrades to high capacity for relatively low cost.
[+] Supports a wide variety of applications.
[-] High initial (capital) cost.

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[-] Acquiring right of way permits can be challenging
[-] Accessing existing underground and aerial infrastructure can be time consuming and expensive.
[-] Repair time can be long when cables break impacting network if redundant routes are not available.
[-] Not cost effective where low long-term capacity needs and long distances.
[-] Fixed to a specific location.

High capacity microwave - Backbone

High capacity microwave provides capacity up to approximately 1Gbps.
[+] Long hop distance is possible under optimal conditions (30 - 50 km). Higher distances may require multiple hops.
[+] Can be engineered for high reliability.
[+] Can be cost effective for one or two hops.
[+] Supports a wide variety of applications.
[-] Issues accessing or permitting to construct towers in some locations.
[-] High initial cost if tall tower required.
[-] High initial and recurring cost if remote tower sites are required.
[-] Can be support and power challenges for remote areas such as accessing mountain tops.
[-] Relatively low capacity: scales from under 100 Mbps to over 1 Gbps.
[-] Appropriate spectrum scarcity an increasing issue.
[-] Fixed to a specific location.

High-throughput satellite (Geostationary) - Backbone & Local Access

Well established technology with a competitive marketplace.
[+] Can be used direct to home (DTH).
[+] Cost does not vary with distance within the coverage footprint.
[+] Good capacity.
[+] Relatively low initial capital costs.
[-] High cost for usage (bytes per month).
[-] Can be susceptible to service impacts with severe weather.
[-] Larger antenna sizes needed at high latitude sites.
[-] Fixed to a specific location.
[-] May not be well suited to some applications.

Cellular mobile – Local Access

Open standards allowing mobility and connectivity anywhere, anytime.
[+] Huge global market and competitive ecosystem with ongoing evolution.
[+] Low cost for user equipment (competitive market).
[+] Versatile user equipment.
[+] Mobile services.
[-] Relatively high usage costs compared to fixed services (bytes per month).
[-] High initial costs for network build (poor return in low density markets).
[-] Relatively high operating cost (management and evolution).
[-] Limited competition in lower density markets.
[-] Shared technology. Additional subscribers degrade overall performance.
[-] Performance can be inconsistent. Latency can be high.

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[-] Higher capacity usually requires significant investment in network upgrades to new technology.
[-] May not be well suited to some applications.

Fixed wireless– Local Access
Different technology with different coverage and capacity characteristics. A range of proprietary and semi-proprietary products are available.
[+] Can be fast to deploy (if antenna tower permitting is not an issue).
[+] Can have high capacity if high frequency (trade-off with coverage).
[-] Limited spectrum and licensed spectrum can be expensive.
[-] Unlicensed spectrum: performance may degrade from interference.
[-] Susceptible to weather and local weather can cause service issues.
[-] Usually needs fibre for sufficiently high capacity backhaul.
[-] Requires line of sight for high capacity and reliability.
[-] Shared technology. Additional subscribers degrade overall performance.
[-] Fixed to a specific location.
[-] May not be well suited to some applications.

10.3.2.1 Emerging Technologies

Low and medium earth orbit satellite (LEO, MEO)
Market viability is untested; only one system in operation (Company called “O3b by SES”).
[+] High capacity (O3b delivering 10 Gbps channels).
[+] Potential to lower the cost of usage.
[-] Not all early market hopefuls may launch service (OneWeb, Starlink).
[-] Not all market entrants may succeed.
[-] Ground station complexity (at least 2 tracking antennas).
[-] High inclined and polar orbits required for high latitude coverage.
[-] Fixed to a specific location.
[-] Not currently available

Cellular 5G – Local Access
Next generation 5G cellular
[+] Potential for low usage costs with 5G and mmWave frequencies.
[+] Mobile and fixed services.
[-] Requires a heavy investment in fibre to connect numerous 5G antennas..
[-] Not currently available

10.3.3 Summary of Technology Alternatives

In summary, rural and remote areas are low density, meaning network links are required over long distance and all else being equal, rural telecom service costs per subscriber will always be higher than urban.

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- Fibre optic infrastructure for both transport and access is the long-term end game for fixed broadband. No other currently available technology can match the speed and reliability of fibre connectivity or scalability for the future.

- Cellular mobile to open global standards is, and will remain, the delivery mechanism of choice for mobile voice and data communications direct to individuals.

- Proprietary radio access systems in license-exempt and licensed bands can have a role to play if they are sufficiently inexpensive that payback is within their expected service life.

- Satellite remains the service of last resort for remote locations. Although the cost per byte per month is high, service is inexpensive to deploy and is easily redeployed. Geostationary earth orbit satellites have long delay (go-return times up to 1 second) but will continue to serve the direct-to-home market.

10.3.4 Business and Operational Considerations

Infrastructure enables services to subscribers, but it does not provide the resources required to effectively manage, monitor and obtain revenue from the network. When referring to the SDP introduced earlier in this report, the OSS/BSS layer provides all the infrastructure required to perform the operational and business functions required for the network to operate successfully.

The OSS/BSS layer of the SDP includes many components that enable and support service to the customer. In summary:

- Personnel with appropriate knowledge and experience with operating a network.

- Customer support to effectively support subscribers of the network such as technical support and customer service support.

- The infrastructure and software applications required to effectively monitor, manage and operate the network.

- Business operations for the business such as customer service and billing.

- Equipment, tools and assets required to complete onsite activities.

The OSS/BSS layer must include, but is not necessarily limited to:

Resources:

- The personnel required to:
    - support and provision network services.
    - provide maintenance activities on the network electronics and other infrastructure.
    - manage subscriber requests for adding, removing and changing existing services.
    - Provide the expertise required to enhance services on the network.
- The support system, which includes the personnel, required to effectively support subscribers of the network such as technical support and customer service support.
- The processes and procedures related to the operation of the business.

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- The equipment and tools required to complete onsite activities such as vehicles, tools, fibre splicing and testing equipment, network testing equipment, etc.

The personnel required to operate the network need the following skill sets:

- Overall management resources that are familiar with the operation of a network and can provide the overall guidance for the network operations.
- Technical resources that can effectively design, commission and support the electronic components of the network.
- Technical resources that can effectively design, commission and support the infrastructure components of the network such as POPs, power systems, environmental systems, outside plant, fibre, etc.
- Installation and maintenance skills that can provide the onsite support for the infrastructure, electronic components and subscribers.
- Customer service resources that can provide effective assistance to subscribers of the network.
- Sales resources that can manage new opportunities.

Business Systems:

- Customer database containing customer information.
- Billing systems to issue invoices and accept payments.
- Documentation storage.
- Reporting systems to gather, consolidate and report on customer usage that may be used for customer billing.
- Scheduling systems to book and schedule customer site visits and technician tracking that may be required.
- Remote access systems used to provide key support and business technicians access to the systems 7x24x365.

Operational Systems:

- Monitoring systems to monitor the network, locate problems, send alerts to support technicians, gather statistics, report on trends, etc.
- Trouble reporting systems to gather and maintain information on problems reported by customers for timely resolution.
- Provisioning systems to add, change and remove services to customers.
- Logging systems to log network and customer events.
- Documentation storage.
- Manufacturer specific software required to operate and maintain network equipment.
- Backup and restore systems to maintain configuration backups and restore when required.
- Network maintenance software.
- Network operation systems that are required to make Internet services function. Eg. Domain Name Service (DNS)
- Network authentication and registration systems such as RADIUS and DHCP that are required to activate subscribers on the network.

The hardware and software systems are typically located in one or more datacenters (or POPs) on the network. The intent is to have a location suitable for the equipment required to run the software applications required to effectively operate the network. As these systems will contain sensitive

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operational and subscriber information, they would typically be implemented in a manner that provides security from external sources such as the internet. These systems contain the infrastructure that provide the daily operational functions for the network.

Along with appropriate resources and software applications the OSS/BSS systems include all the processes and procedures and physical equipment required to perform these functions. An example of a process would include the step by step procedure to install and activate a new subscriber on the network as a number of components need to be considered including the physical installation of the fibre drop, the equipment at the subscriber premises, connection of the subscriber in the POP, the activation of the service on the network, etc. Each of these functions needs to be completed in order for the service to be ready for the subscriber.

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10.4 Appendix D – Open Access Overview

British Columbia and Canada face a problem with connectivity in remote and rural communities of Canada. Many of these communities are faced with absolutely no connectivity or connectivity that is poor or unreliable. The primary challenge is that rural connectivity lacks a business case to invest capital and operational funds. Private enterprises do not provide services in these areas because it simply does not make business sense to do so. As a result, providers position requests for funding to build transport where it creates opportunities for them and local access in areas that may already be served leaving rural areas untouched as a lower priority.

Government funding programs often require that infrastructure constructed using funds from these programs be available for other providers to use at pre-determined rates ("quasi open-access"). The challenge with this approach is that the lack of a business case makes it nearly impossible for one provider to provide services in these areas, let alone more than one. While it may be physically possible for more than one provider to service these areas, the business case dictates that it will likely be a single provider thus excluding any form of competitive services or pricing.

Government support to address the connectivity problem is appropriate but the distribution of funds is typically in the form of grants of funds to an existing (often for-profit incumbents) provider on the basis that it will provide new or enhanced services. Funds are granted to the provider on the basis that they use them to solve connectivity issues in these un/underserved regions. While quasi open-access is a step in the right direction, it doesn't go far enough.

The connectivity problem in rural BC is not going to fix itself and using public funds to benefit private enterprise that are not motivated to solve the rural challenge is not the right approach. We need to think bigger. We need to think differently. Rural funding programs should support government priorities not the priorities of the service providers. Rural funding should be done as part of much larger vision with affordable choice for consumers.

In the traditional model, for a service provider to service a customer, they must construct all levels of the Service Delivery Pyramid ("SDP"). While this model may be acceptable in larger centers where there are enough subscribers to make a suitable business case for providers to essentially overbuild each other with different types of technology, in remote and rural communities, there is not enough subscribers to justify one provider building this infrastructure let alone more than one. Once a provider has built the infrastructure, there is virtually no chance that a second provider will provide any competitive services. In the short term, the funding can be considered a success and area residents do get improved services. In the long term though, as service requirements change due to progression in technology and connectivity requirements, these areas will lag behind once again and the problem of second-class connectivity will again be reality. Then government must, again, incent the provider to upgrade the service.

True Open Access ("TOA") networks alleviate the above problem by architecting the solution in a way that addresses the problem at a broader regional level and encourages competition, provides support for government initiatives, choice of services and providers for the consumer. A TOA network leverages technology and a business model to allow multiple providers to share the network and deliver a variety of services to the consumer. In the end, the consumer is the winner with a choice of providers and services in a competitive market forcing providers to deliver innovative services at improved price points and high levels of customer service. In the case of rural connectivity, using this model over a larger number of communities, aggregating the costs under a single entity provides the opportunity to make more attractive business case with the benefit of choice to the consumer.

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10.5 Appendix E – References

Bibliography

BC Hydro. 2017. "BC Hydro Transmission System." *BC Hydro.* Accessed April 23, 2020. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/suppliers/transmission-system/maps/transplt.pdf.

Connected Coast. n.d. *Connectedcoast.ca.* Accessed June 29, 2020. https://connectedcoast.ca/.

District of Kitimat. 2020. *Investment Ready Community Profile.* Accessed April 22, 2020. https://www.kitimat.ca/en/business-and-development/resources/Documents/Investment-Ready-Community-Profile.pdf.

District of Stewart. 2020. *Port of Stewart.* Accessed April 22, 2020. http://districtofstewart.com/business-resources/port-of-stewart/.

Farris, Andrew, Charlotte Helston, Colin Etienne, and Dr. Michael Whiticar. 2012. "Electricity Generating Stations in British Columbia Map." *Energy BC.* Accessed April 23, 2020. http://www.energybc.ca/electricitymap.html.

—. 2012. "Natural Gas in British Columbia Map." *Energy BC.* Accessed April 23, 2020. http://www.energybc.ca/gasmap.html.

Government of British Columbia. n.d. *BC Open Data.* Accessed June 29, 2020. https://data.gov.bc.ca/.

—. 2018. *New cell service increases safety along Highway of Tears.* October 26. Accessed June 29, 2020. https://news.gov.bc.ca/releases/2018CITZ0028-002072.

—. 2020. *Population Estimates.* March. Accessed June 29, 2020. https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates.

Government of Canada. 2020. *National Broadband Data Information.* March 31. Accessed June 29, 2020. https://www.ic.gc.ca/eic/site/139.nsf/eng/00007.html.

Nikkel, Steven. 1997. *Canadian Cell Towers Map.* September 1. Accessed June 29, 2020. https://www.ertyu.org/steven_nikkel/cancellsites.html.

Northern Health. 2016. *Mission, Vision and Strategic Plan.* Accessed May 7, 2020. https://www.northernhealth.ca/about-us/mission-vision-strategic-plan.

Northwest Regional Airport (YXT). 2020. *YXT.ca.* Accessed April 22, 2020. https://yxt.ca/.

Sanders, Daren, and Shane Hiebert. 2016. "Request for Input on Non-Integrated Area Rates, Terms & Conditions and Customer Service." *BC Hydro.* October 26. https://www.bchydro.com/content/dam/BCHydro/customer-

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portal/documents/corporate/regulatory-planning-documents/regulatory-matters/tsay-keh-dene-presentation-20161026.pdf.

Sienna Networks. 2020. *Sienna Networks - About Us.* Accessed June 29, 2020. https://www.siennanetworks.ca/about-us.html.

State Educational Technology Directors Association (SETDA). 2019. "Broadband Imperative III, Driving Connectivity, Access and Student Success." *SETDA.org.* November. Accessed May 7, 2020. https://www.setda.org/wp-content/uploads/2019/11/SETDA_Broadband-Imperative-III_110519.pdf.

Statistics Canada. 2019. *Census Profile, 2016 Census.* August 9th. Accessed June 29, 2020. https://www12.statcan.gc.ca.

Tahltan Nation Development Corporation (TNDC). 2019. *TNDC - News Releases.* July 3. Accessed June 29, 2020. https://www.tndc.ca/news/2019/tndc-to-provide-fibre-optic-communication-to-iskut-and-dease-lake-in-northwest-british-columbia.

TC Energy. 2016. *Coastal Gaslink Pipeline Project.* Accessed April 23, 2020. http://lnginnorthernbc.ca/index.php/proposed-projects/coastal-gaslink-pipeline-project/.

