VantagePoint
EMPLOYEE OWNED

MARCH 17, 2017

Town of Fraser
Town of Winter park

Broadband Feasibility Final Report

VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301

Table of Contents

BACKGROUND

Vantage Point Solutions was awarded a competitively bid contract to conduct a Broadband Feasibility Study (Study) for the Town of Fraser (Fraser) and the Town of Winter Park, (Winter Park) Colorado.

The two towns are located at elevations of approximately 9,000 ft. and are situated within five miles of each other in Grand County, Colorado. From Denver, the Fraser Valley sits about 90 minutes northwest of Denver and is accessed via Highway 40 over Berthoud Pass, which reaches an elevation of 11,315 ft. The valley is surrounded by the Arapaho National Forest.

The collective population of Fraser and Winter Park is approximately just under 1500. The Town of Winter Park spans 7.5 square miles, and includes the village of Winter Park Resort. The Town of Fraser spans approximately six square miles. There are a total of six incorporated towns in rural Grand County with a population just over 12,000.

Tourism is the prime economic driver in this region. There are also a significant number of home-owners that reside elsewhere the majority of the time.

Similar to most rural mountainous regions in Colorado, current broadband connectivity in the Fraser Valley is not sufficient. Broadband is not available, lacking in terms of speed and reliability, or cost-prohibitive.

The purpose of this Study was to investigate options for bringing a robust broadband solution to the Fraser Valley. The study primarily included the following 5 elements:

- Conducting community outreach to potential stakeholders;
- Conducting a residential and business study;
- Examination of Network Models;
- Conducting an assessment of existing assets;
- Identification of a high-level potential network design;
- Provide a funding gap and cost analysis;
- Provide options and recommendations for moving forward.

This Report provides a detailed overview of the data gathered and provides recommendations and a roadmap forward for Fraser and Winter Park for how the towns can best achieve the goal of bringing ubiquitous broadband to the region.

EXECUTIVE SUMMARY

The Report explores the benefits of broadband, critical infrastructure for 21st century communities, and examines what Fraser and Winter Park's peer Colorado communities are doing with respect to broadband solutions.

To obtain local information Vantage Point conducted community outreach to key groups and individuals as well as fielding two online surveys. Based on the overall feedback, it appears that there is citizen and business concern with the current state of broadband connectivity, cost, and access.

The surveys reveal that the current cost of internet service is a big concern for residents. Other key findings include the following:

- » More than half of respondents that submitted data currently have internet speeds greater than 10 mbps downstream and 1 mbps upstream (10/1). Overall, speed tests, perception and satisfaction show mixed results.
- » Respondents surveyed are open to the towns taking a role in helping bring better broadband to the Valley, but they are unsure what the solution should look like.
- » Businesses surveyed show a desire for better broadband and would be willing to pay more to have it.

For consideration, the Report explores the various types of middle-mile networks (does not serve homes or businesses directly) and last-mile networks (provides direct service to homes and businesses) and provides detailed information on a variety of operating models including Public-Private Partnerships (PPP). Additionally, the Report provides three last-mile network models and one middle-mile option for consideration that include:

- 100% penetration to every premise;
- 60% penetration to selected premises;
- 30% penetration to selected premises.

Finally, the Report explores possible funding avenues including identification of several federal grant opportunities that would require Fraser and Winter Park to partner with a provider and/or other regional entity.

Included in the final section of this Report are recommendations for moving forward with a middle-mile broadband solution specific to Fraser and Winter Park. This includes investigating a possible opportunity for Fraser and Winter Park to work with Mountain Parks Electric, Inc. (MPEI). MPEI is currently in the final process of completing a feasibility study regarding becoming an internet provider in their service territory which includes Grand County.

1. Case for Broadband

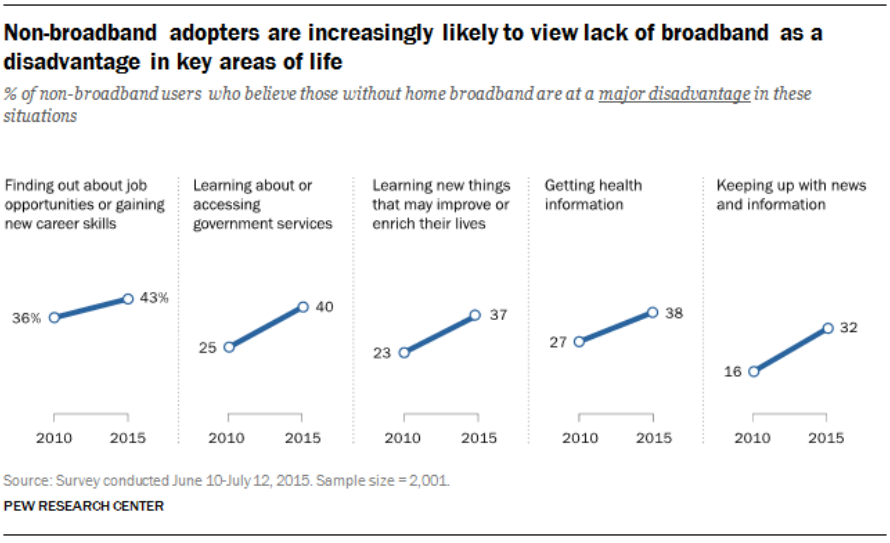
1.1 Broadband Generally

Over the last few years, municipalities across the country have been engaged in the process of actively seeking solutions to help bring high-speed broadband to unserved and underserved neighborhoods and communities within their jurisdictions.

Today broadband is not a luxury, but rather a necessity. Residents, businesses, tourists and others need broadband in order to (among other things):

- Apply for jobs;
- Access web-based government services;
- Work from home or a secondary location;
- Access educational services and conduct research;
- Conduct business and support business services directly tied to revenue;
- Stay connected to family;
- Access the internet and watch web-based programming.

However, access to broadband is not the only issue. Individuals, families, and organizations must also utilize broadband to benefit from it. For example, according to a PEW Survey conducted in July of 2015, "non-broadband adopters[1] are increasingly likely to view lack of broadband as a disadvantage in key areas of life." The below chart shows the disadvantage has increased significantly in all areas over a 5 year period.



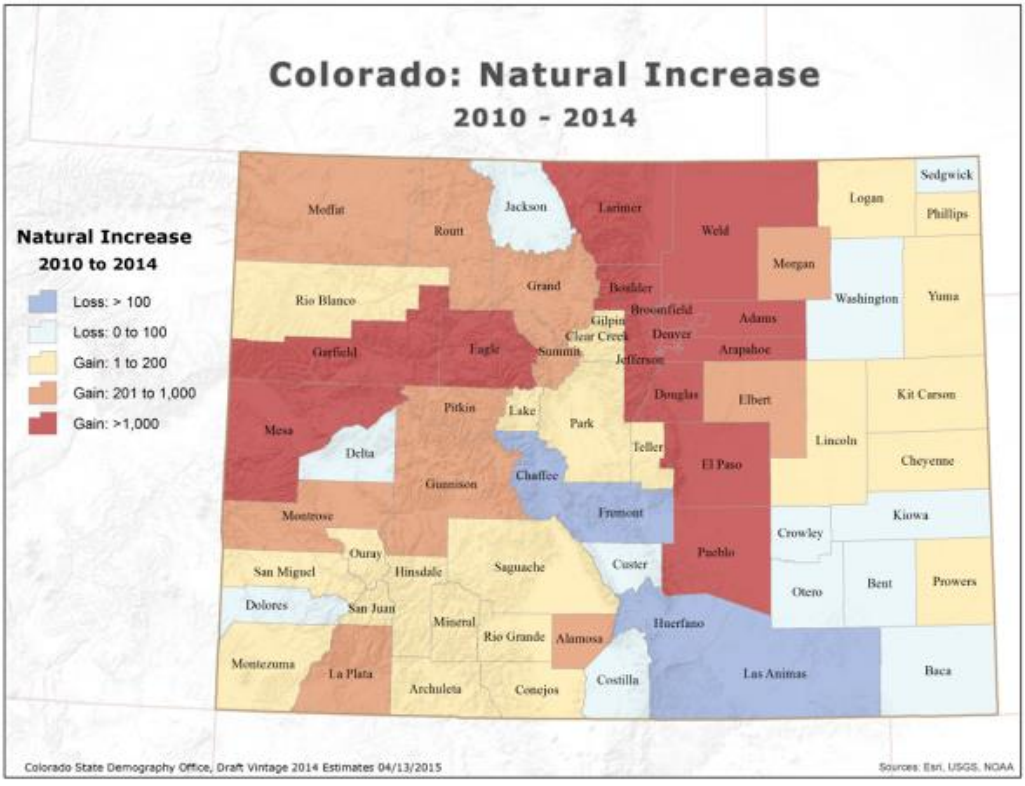
[1] Non-broadband adopters is defined as either those without access to broadband or those who have access but do not go online for a variety of reasons.

In addition, the PEW research[2] found that:

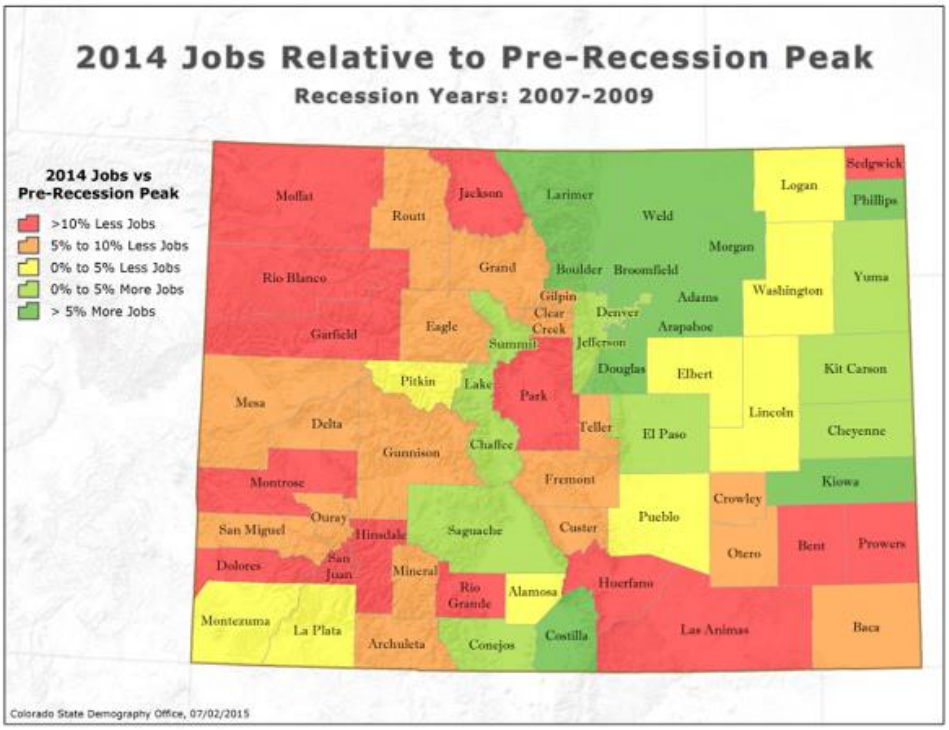
- 40% of non-high speed users say that being without broadband is a major disadvantage for learning about or accessing government services, compared with 25% in 2010.
- 37% say that lacking broadband at home is a major disadvantage for learning new things that might enrich their lives, up from 23% in 2010.

For a local government – and over time, the cost of funding a broadband solution can be significantly less than the cost of not having robust broadband. This is particularly true in Colorado, where communities across the State are actively trying to bring better broadband to their jurisdictions to fill in the gaps where service is non-existent or insufficient. Data provided by the Colorado Department of Local Affairs shows why this is so important.

Between the years of 2010 – 2014, Grand County has seen a slight population gain but has sustained a 5 - 10% job loss relative to the pre-recession peak.



[2] See John Horrigan and Maeve Duggan, *Home Broadband 2015 Report*; Pew Research Center, December 21, 2015. http://www.pewinternet.org/2015/12/21/home-broadband-2015/.



As you can see from these two charts, some of the counties that border Grand County are similarly positioned while others continue to see both population and job growth. Grand County must determine ways to sustain population growth while competing with neighboring communities for jobs and tourist dollars. Is broadband a way to do that?

The counties that border Grand County are all looking at ways to improve broadband. Routt County is building a middle-mile network to serve anchor institutions and encourage last-mile providers to build out additional infrastructure serving homes and businesses. Summit County is in the process of evaluating proposals from providers to build a last-mile solution in the county. Gilpin and Clear Creek Counties are conducting broadband studies. The City of Boulder is also evaluating proposals from providers regarding the possibility of moving forward with a fiber-to-the-home solution. This is just to name a few – many Colorado communities are also exploring broadband solutions.

The purpose of this Study is to examine the feasibility of bringing a broadband solution to the Fraser Valley. The first step is to examine the current landscape.

1.2 Overview of Current State of Broadband in Fraser and Winter Park

As an initial first step in this Study, VPS, along with representatives from Fraser and Winter Park, conducted community outreach. Community outreach is critical to hearing directly from key groups regarding their personal experience with broadband in the community, and this outreach

set the stage for understanding the microcosm that is the Fraser Valley. This outreach is a pre-cursor to conducting the residential and businesses surveys which will be discussed in Section 2.

As part of the community outreach process, we spoke to the following groups:

- Fraser Economic Development Committee;
- IT Department;
- School System;
- Library;
- Winter Park Resort;
- Chamber;
- Real Estate Developers;
- Business Owners.

These discussions focused mainly on obtaining feedback regarding what the perceived issues were with respect to broadband in the Fraser Valley and what the towns should do to resolve the problems. The following represents a summary of those discussions. Some of these points were repeated by multiple groups.

Comments received include the following:

- There are bigger broadband problems with the unincorporated areas versus within the town boundaries;
- We need to encourage telecommuters and try to keep the 2nd home owners here longer;
- Biggest issue is getting what they expect to get in the big city;
- We cannot get good pricing (commercial and residential);
- Need more bandwidth;
- Sometimes the house or business next door doesn't have same service;
- Need more Wi-Fi access points;
- Critical services on current cables do not have diverse pathway (at risk of losing service if cut);
- Better and faster internet is needed;
- Some businesses have sufficient service while others do not;
- Costs are a barrier to changing providers;
- Some businesses paid big money to bring fiber to their location;
- Need to take into account growth as well as solving problems of now.

Some of these comments are reflected in trends identified in the results of the market studies discussed next.

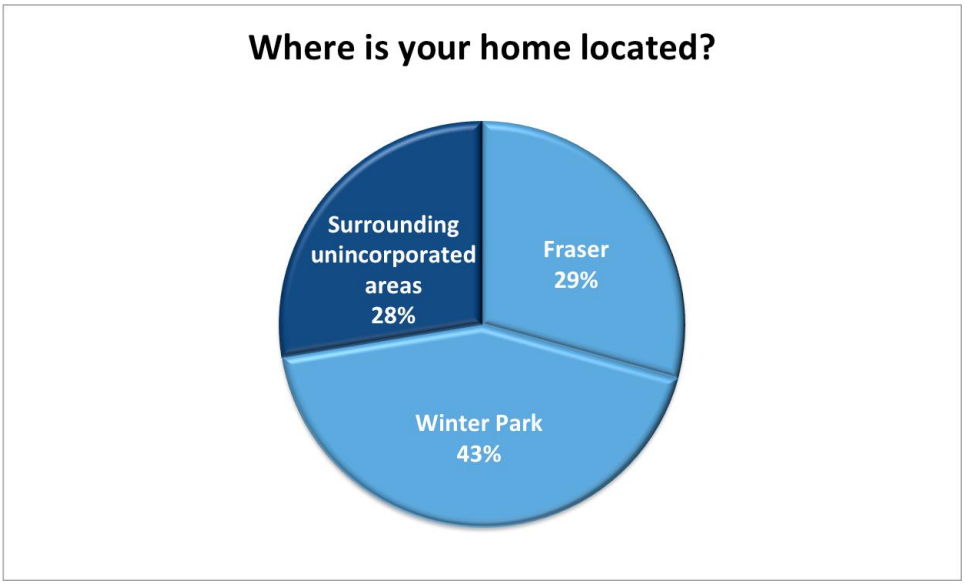
1.3 Residential Survey

Seeking feedback on the "current state" of broadband service and citizen satisfaction with current service, VPS reached out to residents of Fraser, Winter Park, and the surrounding areas. Fraser and Winter Park published links to the survey on their websites, sent information via email to email lists, and both towns mailed survey notification and instructions in utility bills. Additionally, the Chamber and a few groups also emailed the links to their lists.

What follows are highlights from the answers we received from 171 households and 28 businesses. It is important to note that the data received from these surveys is directional research – meaning that while these insights are not a scientific market research exercise, they do in fact provide valuable feedback.

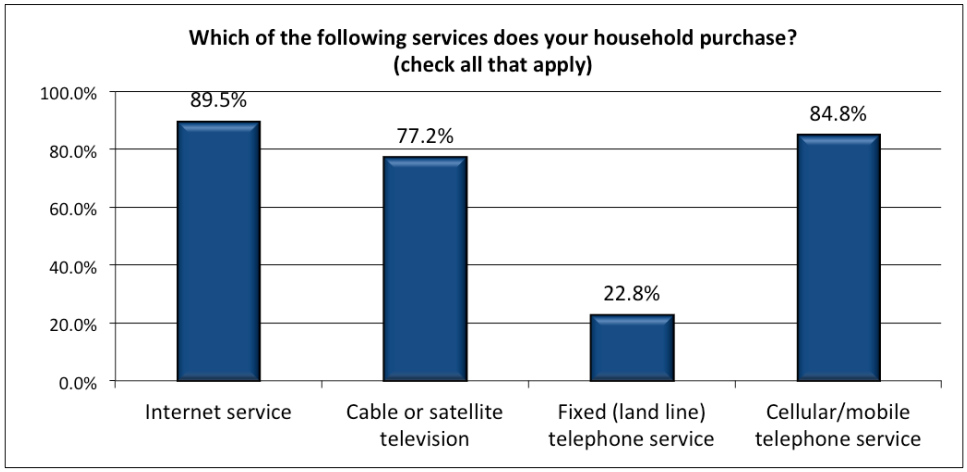
1.3.1 Geographical Responses

Responses were not evenly distributed between Fraser and Winter Park, but both are well represented in this survey.

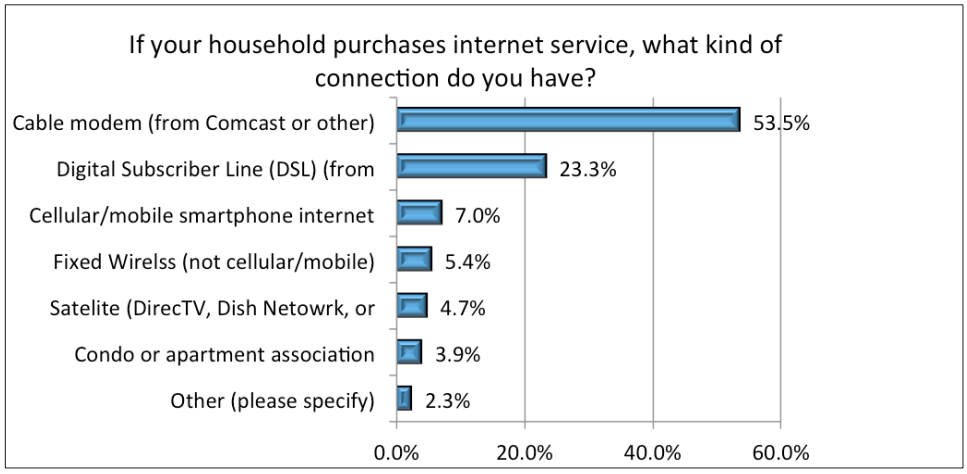


1.3.2 Household Services Purchased

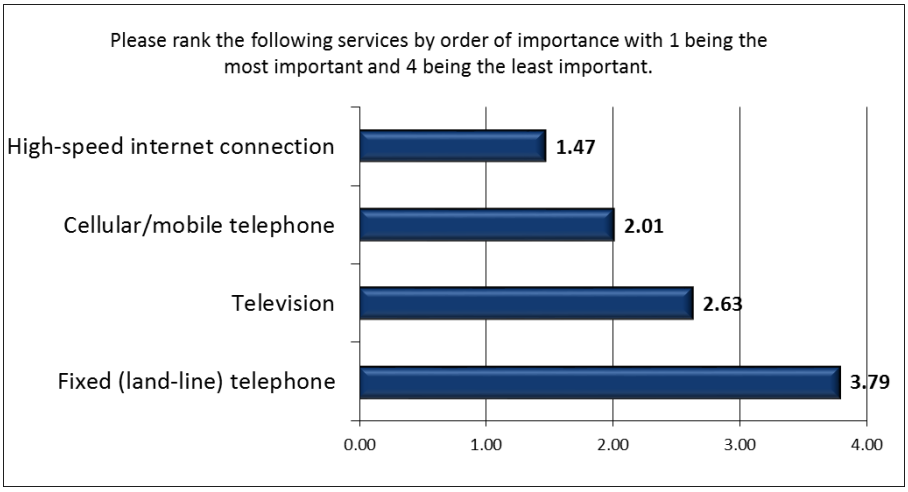
Less than a quarter (24%) surveyed still purchase telephone landline service, while 'cord cutting' is not overly evident as three-fourths (77%) still purchase cable TV. Interestingly, only 90% purchase Internet service, indicating mobile device reliance amongst 10%.



For those who purchase internet service, cable (54%) and DSL (23%) are the main delivery means for the service.

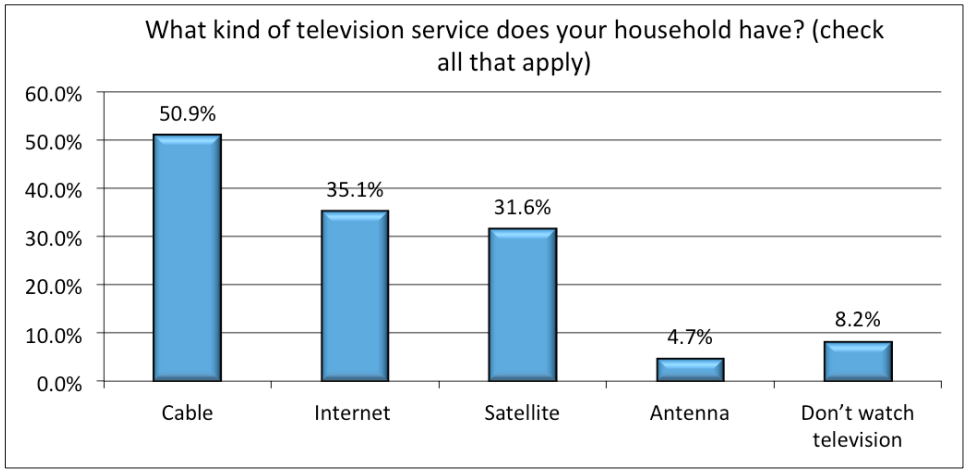


A high-speed internet connection is seen as most important by Fraser and Winter Park citizens – more than telephone (cellular or landline), and more than television.

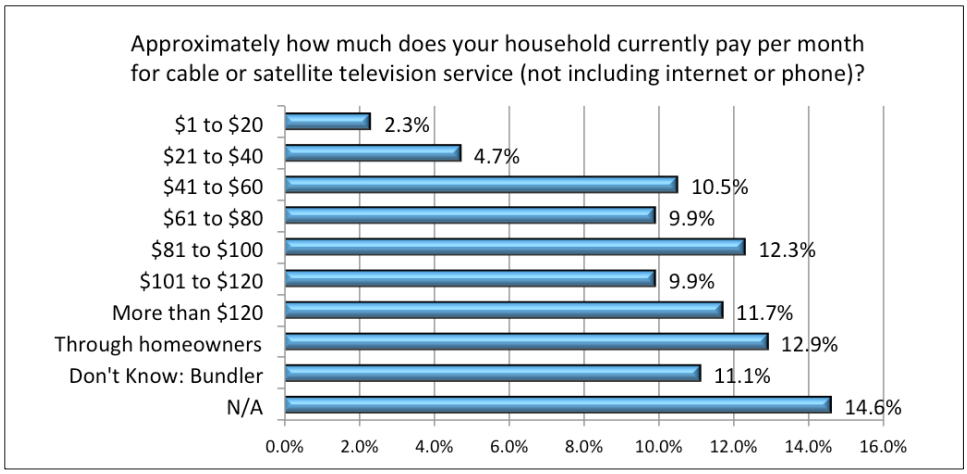


1.3.3 Television

An overwhelming majority (82.5%) receives television from either cable or satellite. The large number of satellite subscribers suggests that television being a part of an internet package is not as important to Fraser and Winter Park residents as it is in other communities.

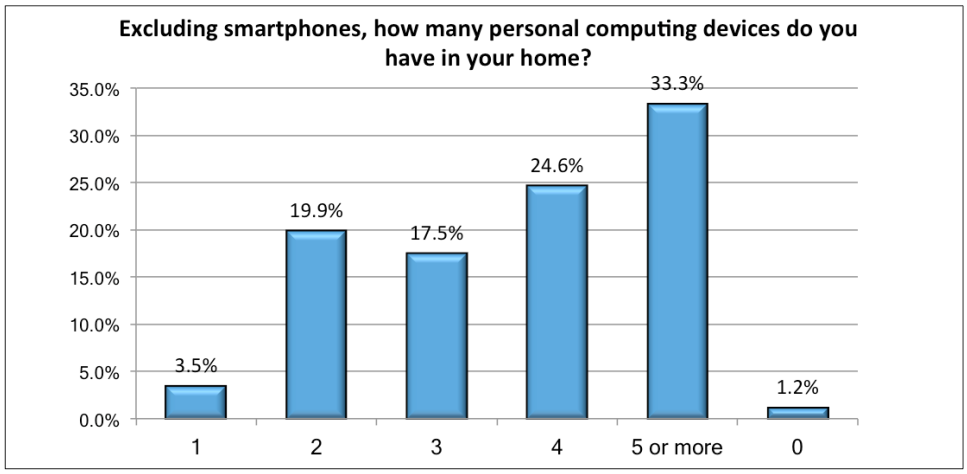


When asked how much television service costs households, respondents' answers varied widely with 34.5% paying more than $100/month.



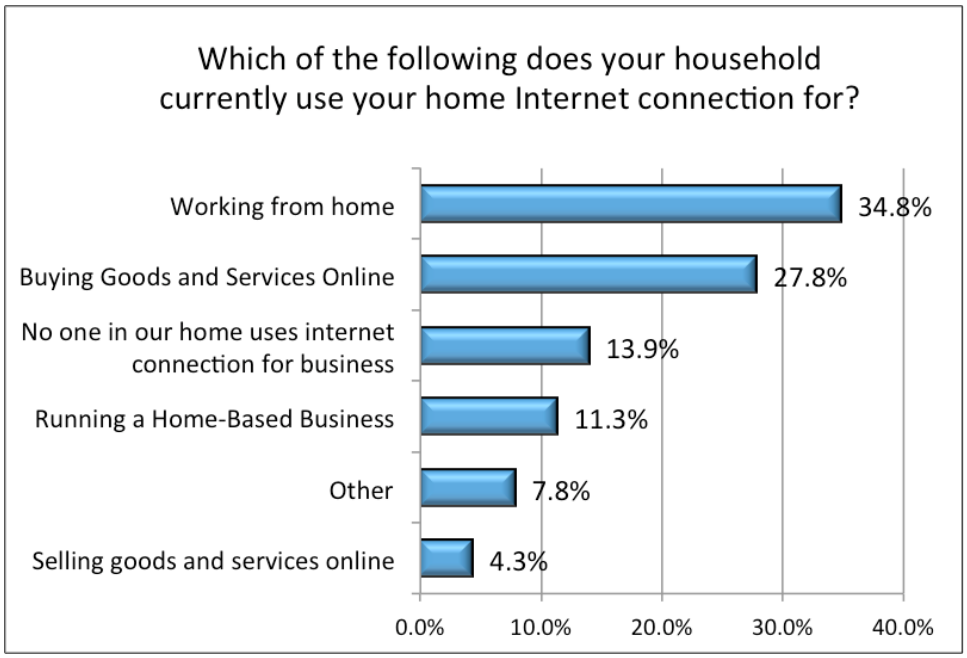
1.3.4 Devices

Three-fourths of surveyed households (75.4%) have at least three computing devices in their home that, undoubtedly, rely on an internet connection to maximize their effectiveness.



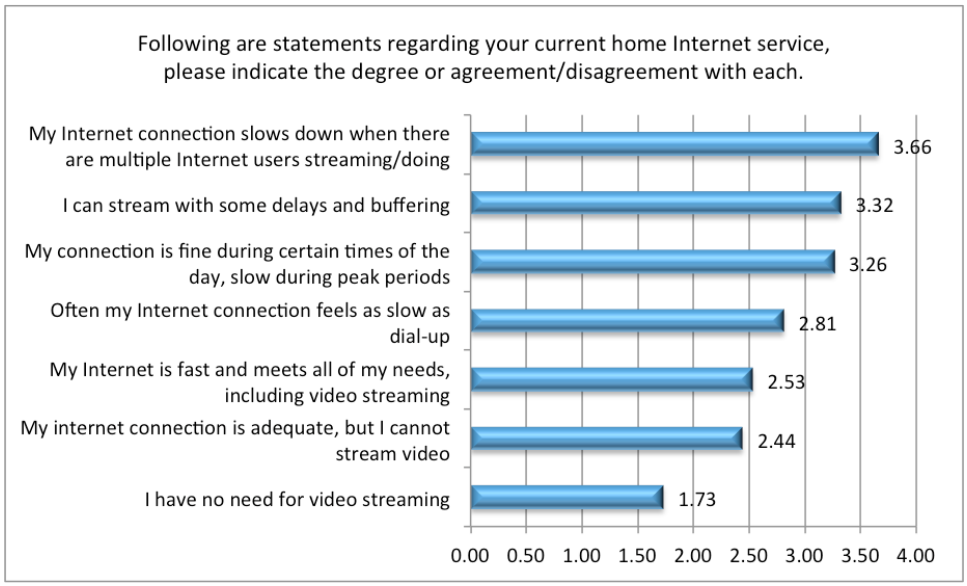
1.3.5 Economic Activities

In terms of online economic activities, more than a third of respondents said they work from home while more than a quarter buy and sell online.



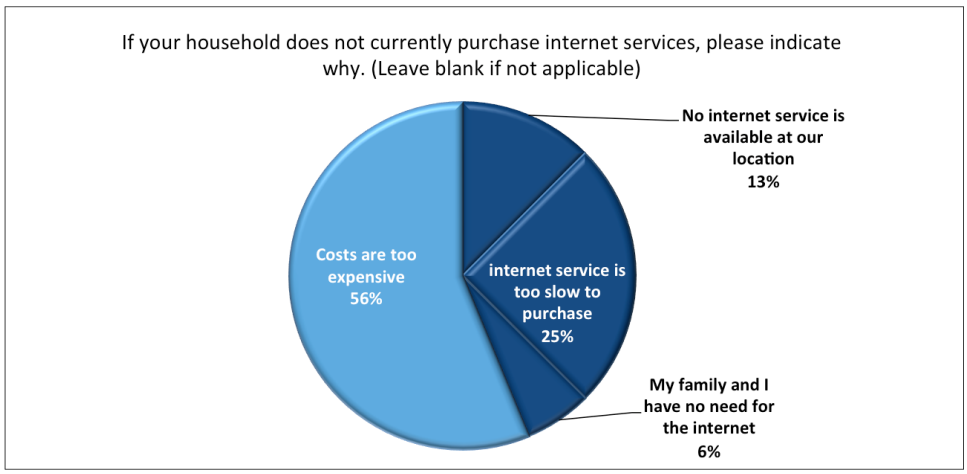
1.3.6 Current level of internet service

The following shows statements and their agreement level amongst respondents – 4 being the highest level of agreement. Most respondents report internet speeds slowing down when multiple users are online, video services being slow, and experiencing slower service during certain day parts. Many say their service is often "as slow as dial up," (a qualitative, not quantitative, observation). Lower levels of agreement are seen when respondents are asked to rate if current service levels meet their needs.

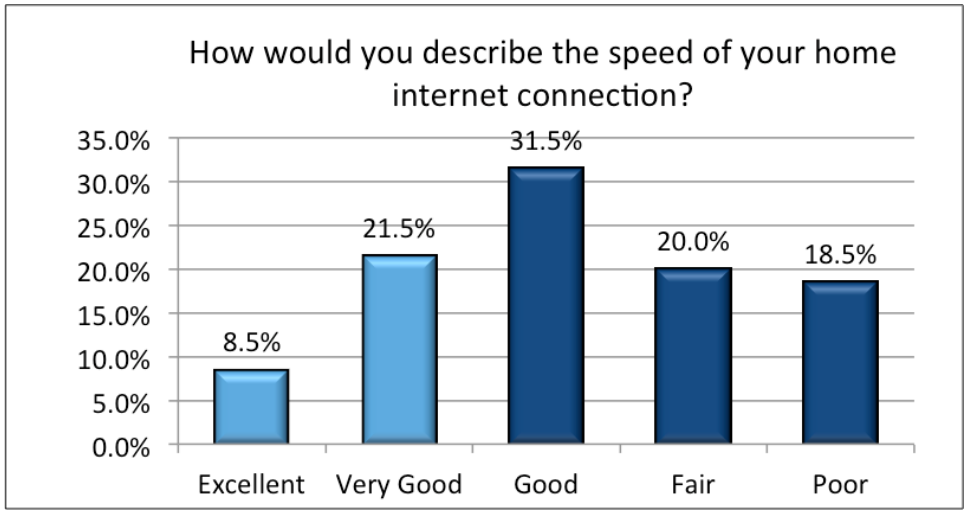


1.3.7 Citizen Satisfaction

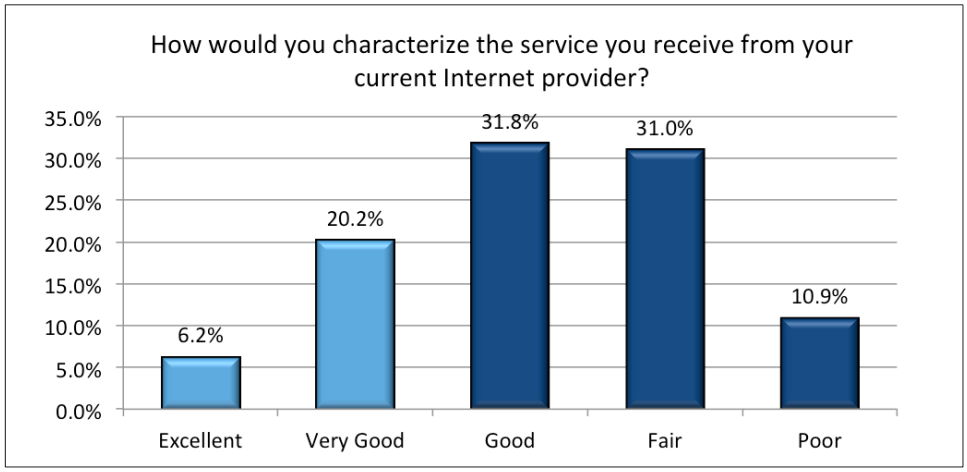
The area households that did NOT purchase Internet service were asked why. High costs and inadequate speeds are the number 1 and 2 reasons, respectively.



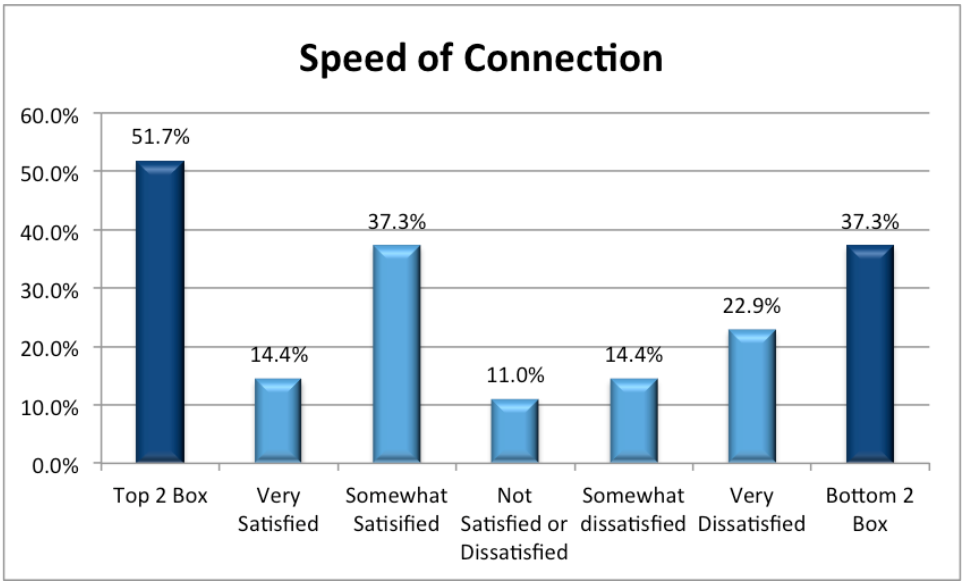
Overall, the internet speed Fraser and Winter Park homes are currently receiving is being met with mediocre rankings as more citizens see their service as “fair’ or “poor” than see their service as “excellent or “very good.”



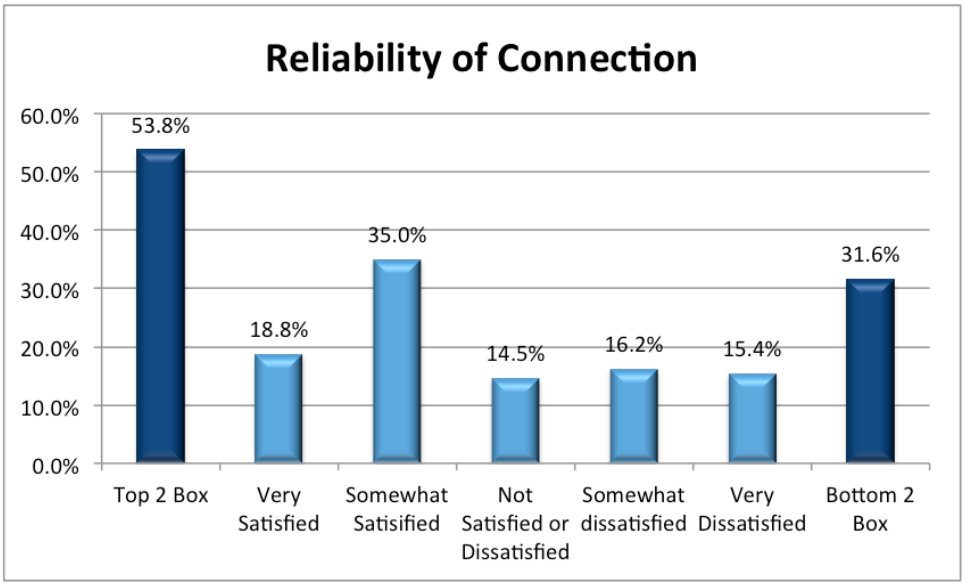
The same is seen when households were asked to rate the service received from their current Internet Service Providers (ISP).



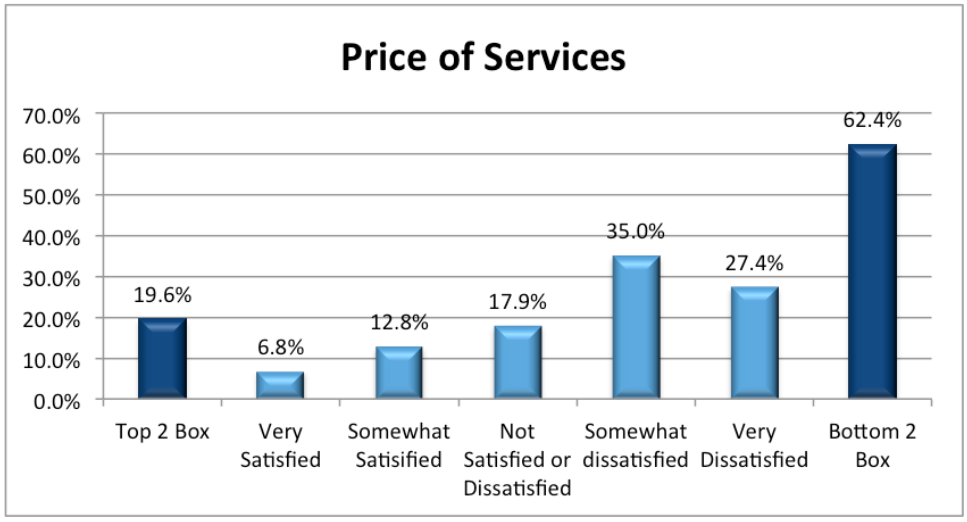
More specifically, we asked citizens about their current satisfaction levels with different aspects of their internet service. What follows are specific attributes along with a “top 2 box” (combination of very and somewhat satisfied) and “Bottom 2 box” (combination of somewhat and very dissatisfied). For speed, more than a third are dissatisfied while more than half are indeed satisfied with current speeds.



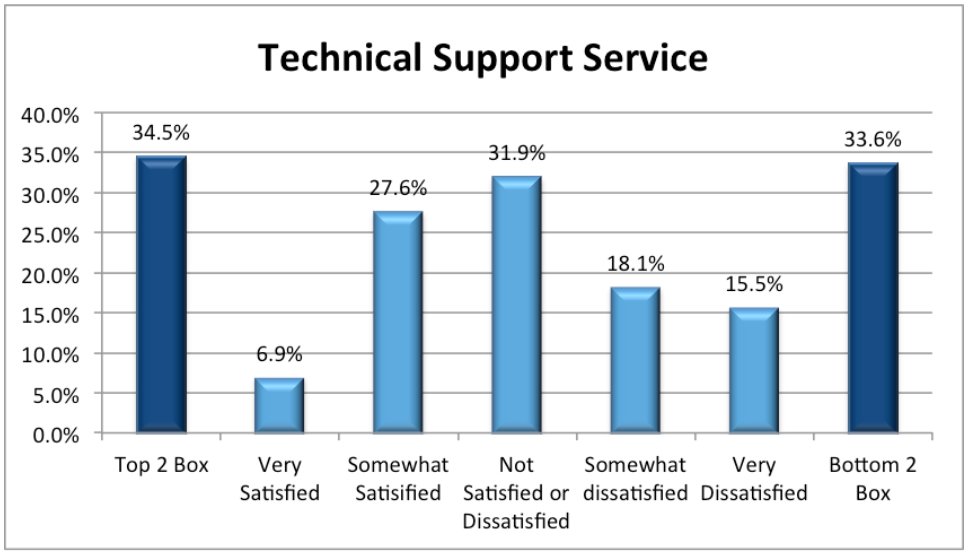
Rankings for reliability are very similar to satisfaction levels for speed – more than a half satisfied with approximately a third dissatisfied.

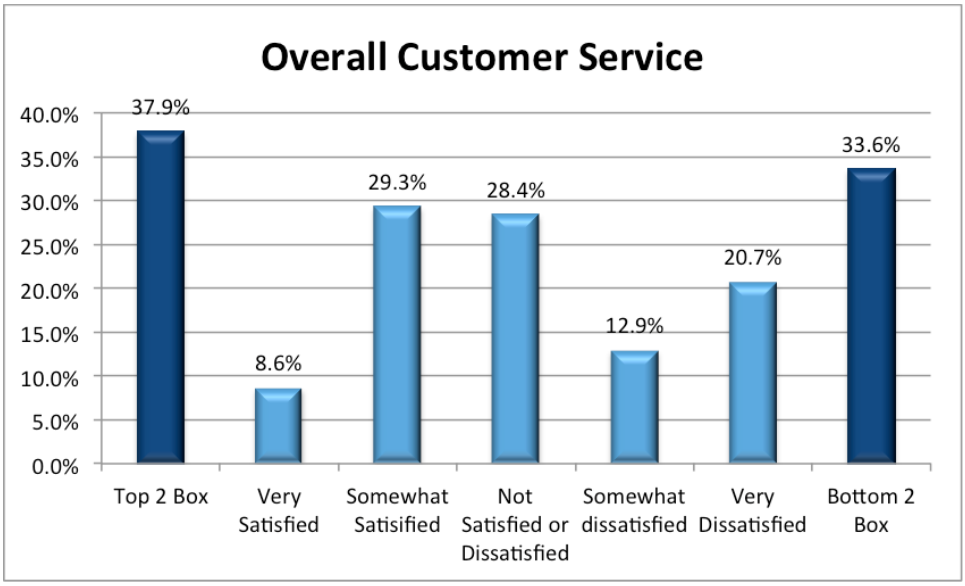


However, dissatisfaction triples satisfaction when it comes to the price of internet service in Fraser and Winter Park.



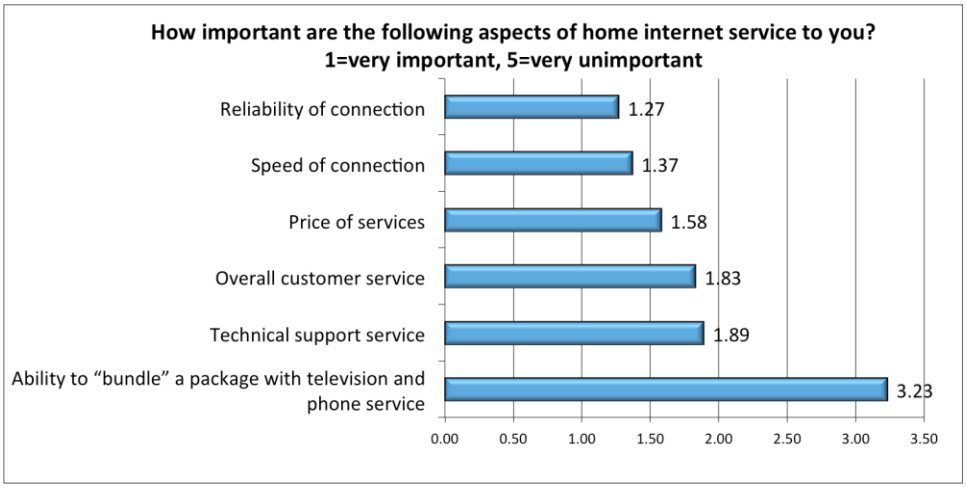
Dissatisfaction (33.6%) is identical for both technical support service and overall customer service with satisfaction for each slightly above a third of respondents. Both charts are below.



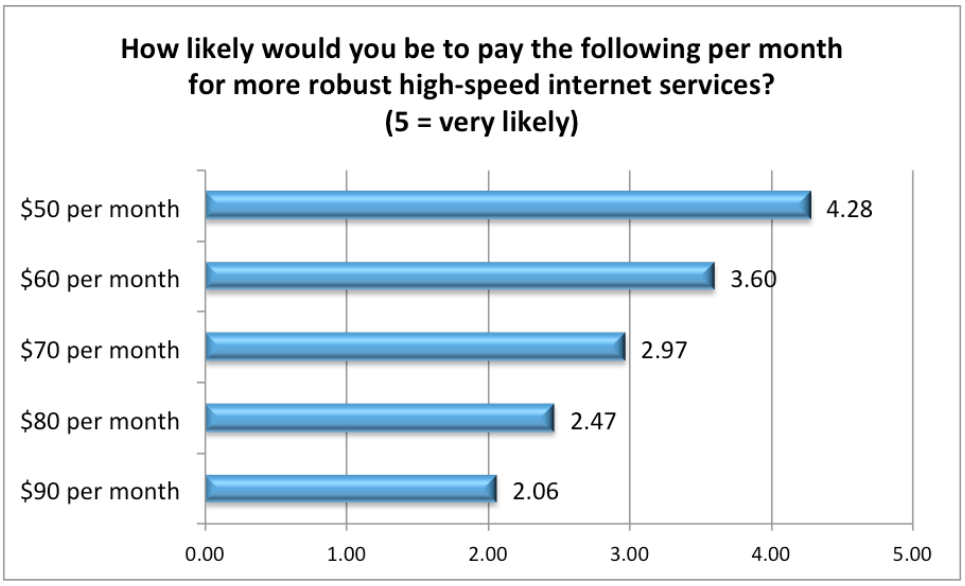


1.3.8 Citizen Preferences

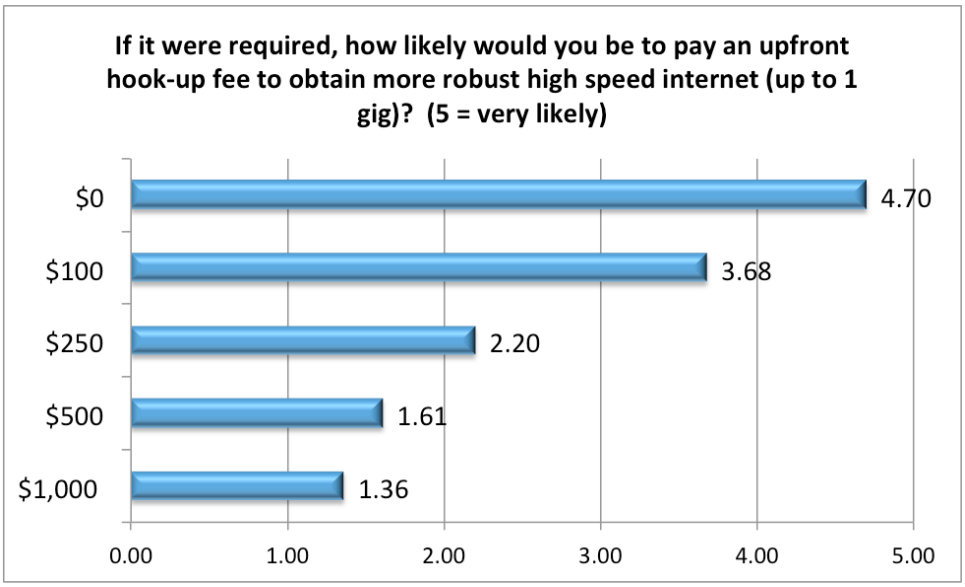
If Fraser and Winter Park decide to move forward with providing Internet service, speed, reliability and price all hover only slightly lower than "very important" on average. Bundling television and telephone appear to be less important.



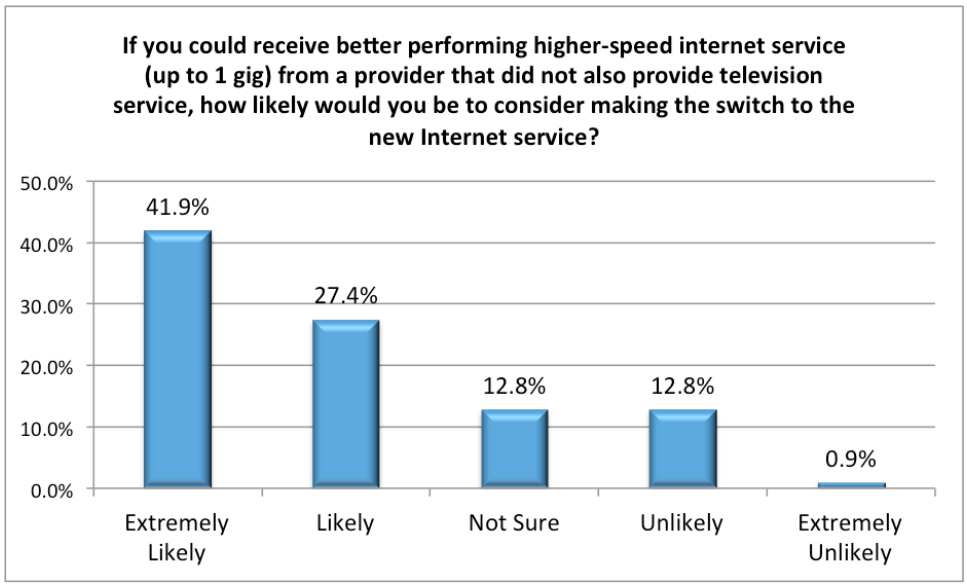
We measured willingness to pay for new, robust service. Charging much more than $60/month would seem to be a risky endeavor.



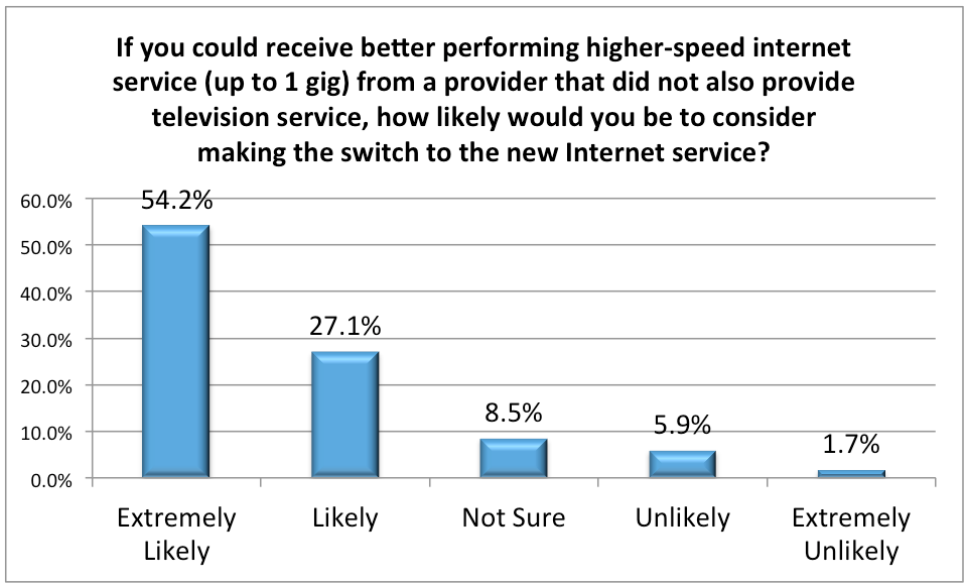
Additionally, it does not appear that dissatisfaction with current service or a desire for new service equates with citizens paying any more than a $100 installation fee.



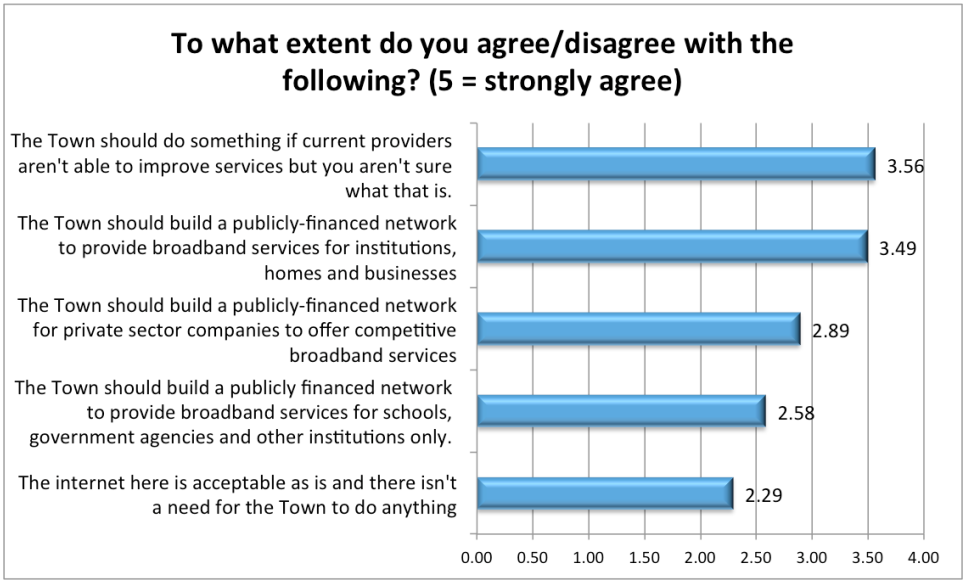
Responses detailed earlier suggest that television service is not imperative for most respondents; nonetheless we would advise to tread carefully and make the effort to provide video services as part of any service offerings.



Telephone service however seems much less important to respondents.



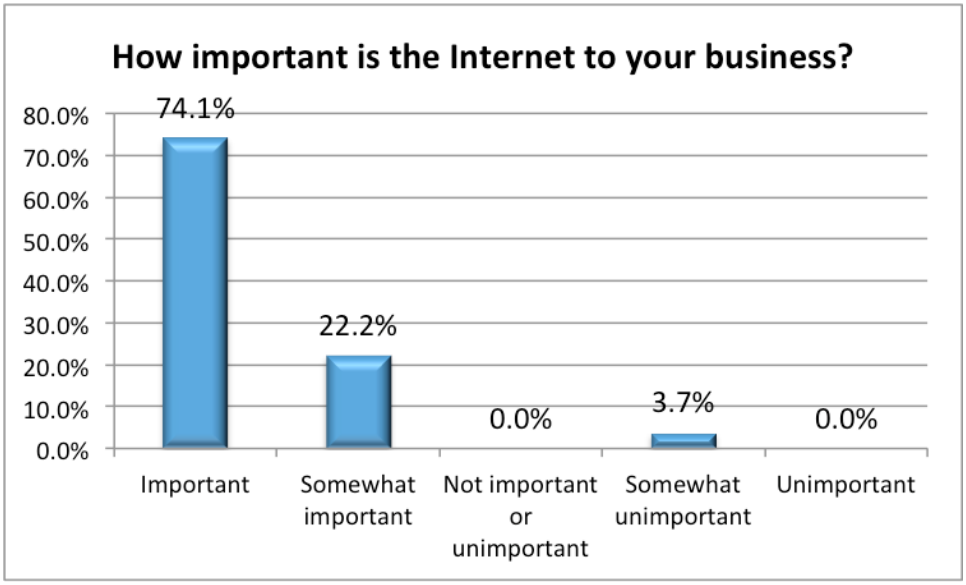
Opinions vary on the towns' responsibility level for improving internet service, but more people than not think Fraser and Winter Park has a role here in providing broadband.



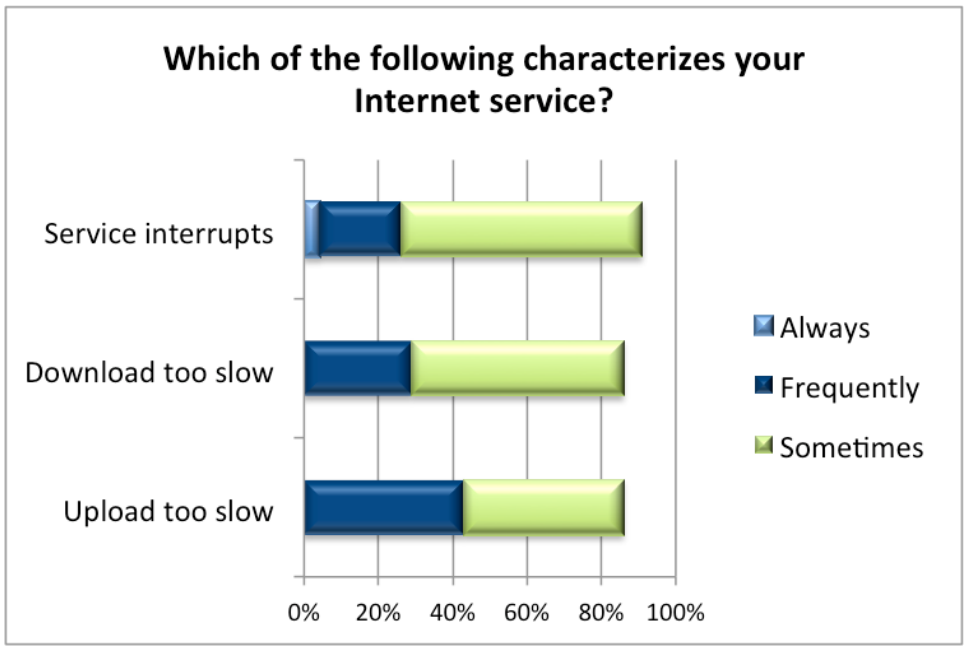
1.4 Business Study Highlights

With only 28 responses to the business survey, results should be seen as qualitative; the feedback should be viewed as akin to focus group feedback. The following represents the highlights of the survey findings.

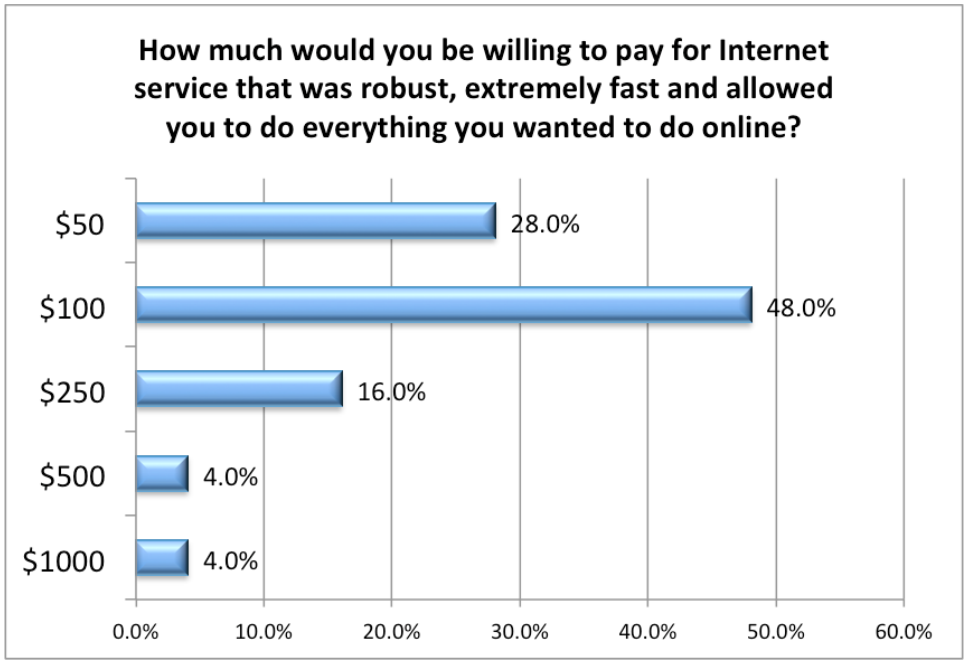
Almost all businesses surveyed expressed the importance of internet service to their business.



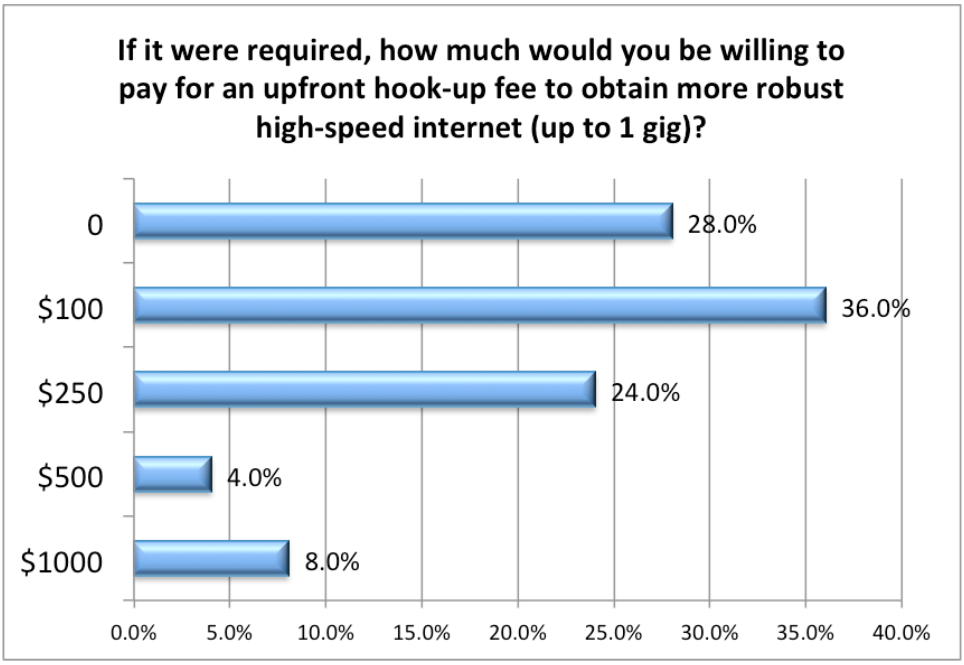
Unfortunately for more than 80% of businesses surveyed, they are experiencing service that interrupts and is too slow.



Slightly less than 3 in 4 businesses surveyed said they would pay at least $100/month for robust, "extremely fast" service.



The same number of businesses (72%) would pay at least $100 for an installation fee.



1.5 Residential Survey Key Findings

There are several key findings to highlight from the residential survey.

1.5.1 Television

Generally television is considered a must-have service that helps to attract and keep more subscribers – which is critical for new providers trying to make a profit. This is especially true in rural communities.[3]

In Fraser and Winter Park, almost 60% of respondents currently receive their television from cable. The remainder receive television through either the internet (35.1%) or satellite (31.6%). Over 8% do not watch television.

When asked how much they were paying for television, many were unsure. Of those that knew the cost - 34.5% report paying more than $100/month. Costs will be explored more in Section 1.5.4, however over $100/month suggests that those that do watch – have premium packages.

[3] A recent study of rural telco customers showed that while "subscription video has declined by 10% over the past decade, it is not due to streaming" and "only 1% of homes rely exclusively on over-the-top content." See Cronin, Independent Telco Subscription Video and Broadband Study (2016).

» ***Key Finding: Data suggests that television being a part of an internet package is not as important to Fraser and Winter Park residents that it is in other communities. However, it may be advantageous for a new provider to partner with Direct TV in order to offer premium television services along with an internet package to provide comprehensive services and increase take-rates.***

1.5.2 Internet Speeds

The Federal Communications Commission (FCC) currently defines broadband as speeds that reach a minimum of 25mbps downstream and 3mbps upstream (25/3). Other FCC programs for high cost rural areas, through the Connect America Fund, require minimum speeds of 10mbps downstream and 1mbps upstream (10/1).

As previously, stated – high speed internet is seen as the most important service when compared to cell service, television and fixed land-line telephone. To gauge the current level of internet service, we asked respondents to take a speed test and submit results. Of those surveyed, 77 submitted speed test results. Of those:

- 23 recorded speeds greater than 25/3
- 41 recorded speeds greater than 10/1
- 36 recorded speeds of less than 10/1

Aside from the speed-test, 31% of respondents indicated that they perceive their speed to be "good". However, more respondents indicated that they viewed their speed as "fair" or poor" compared to "excellent" or "very good".

In one final question, we asked about respondent's satisfaction with the speed of their internet connection. The results show that more than a third are dissatisfied while more than half are indeed satisfied with current speeds.

» ***Key Finding: More than half of respondents that submitted data, have internet speeds greater than 10/1. However, speeds ranged greatly from 0/0 to 237/12. Overall, speed tests, perception and satisfaction show mixed results.***

1.5.3 Cost of Services

Of those that do not buy home internet services, over 56% said that the single biggest reason is cost. As a result, we researched packages available from current providers in the Fraser Valley. The following table shows the range of services and packages. Note that the lowest level of internet service is priced at $39/month.

Internet													
Companies	1.5 Mbps	2.5 Mbps	5 Mbps	8 Mbps	10 Mbps	15 Mbps	25 Mbps	40 Mbps	100 Mbps	200 Mbps	250 Mbps	1,000 Mpbs	2,000 Mbps
CenturyLink	-	-	-	-	$34.95/mo	-	$44.95/mo	-	$69.95/mo	-	-	$109.95/mo	-
Comcast (Xfinity)	-	-	-	-	$29.99/mo	-	$39.99/mo	-	$49.99/mo	$59.99/mo	$79.99/mo	-	$2999.95/mo
Grand County	-	$40/mo	$55/mo	$80/mo	-	-	-	-	-	-	-	-	-
Mountain Broadband	$39/mo	-	$49/mo	-	$59/mo	$69/mo	-	-	-	-	-	-	-
SlopeSide Internet	-	-	-	-	-	-	-	-	-	-	-	-	-
*Unable to obtain pricing for SlopeSide Internet													

TV & Internet Bundle													
Companies	1.5 Mbps	2.5 Mbps	5 Mbps	8 Mbps	10 Mbps	15 Mbps	25 Mbps	40 Mbps	100 Mbps	200 Mbps	250 Mbps	1,000 Mpbs	2,000 Mbps
CenturyLink	-	-	-	-	$64.94/mo	-	-	$69.94/mo	-	-	-	-	-
Comcast (Xfinity)	-	-	-	-	-	-	$69.99/mo	-	$89.99/mo	$99.99/mo	-	-	-

Triple Play Bundles (TV, Internet, and Phone Service)													
Companies	1.5 Mbps	2.5 Mbps	5 Mbps	8 Mbps	10 Mbps	15 Mbps	25 Mbps	40 Mbps	100 Mbps	200 Mbps	250 Mbps	1,000 Mpbs	2,000 Mbps
CenturyLink	-	-	-	-	$101.89/mo	-	-	$104.94/mo	-	-	-	-	-
Comcast (Xfinity)	-	-	-	-	-	-	$89.99/mo	-	$109.99/mo	$119.99/mo	-	-	-

Internet and Phone Bundle													
Companies	1.5 Mbps	2.5 Mbps	5 Mbps	8 Mbps	10 Mbps	15 Mbps	25 Mbps	40 Mbps	100 Mbps	200 Mbps	250 Mbps	1,000 Mpbs	2,000 Mbps
CenturyLink	-	-	-	-	$34.95/mo	-	$44.95/mo	-	$69.95/mo	-	-	$109.95/mo	-
Comcast (Xfinity)	-	-	-	-	-	-	$49.99/mo	-	-	-	-	-	-

In addition, below is a sampling of comments submitted by survey respondents with respect to cost:

- Comcast internet is good but very expensive (and there really isn't any other viable option at the moment so they can pretty much charge what they want). High speed internet in this day and age is almost a necessity but it is a big drain financially;
- We are part time residents & can't get affordable internet but want it;
- I'm interested in better internet service (i.e. better than 10 Mbps download) if it costs me less than $40/month. Otherwise, I'm satisfied with whatever I have now. Or perhaps I'll agree to $50-$60 more for 1 gig internet if it helps the underserved portion of my community;
- Beggars can't be choosers, I'll take what I can get. I would love to see municipal broadband and would be very happy to pay my share to get a system like that running;
- It would be awesome to have a single cable come into the home to provide TV, internet and phone services at a reasonable price. $100/month would be acceptable.

Overall, cost is a big concern for respondents with 62% responding that they were dissatisfied with the current pricing of services.

Regarding willingness to pay for a new robust service, responses showed that pricing over $60/ month would be a risky endeavor. As previously noted respondents do not appear willing to pay more than $100 for an installation or hookup fee.

» ***Key Finding: New providers would need to price services very aggressively in order to attract customers.***

1.5.4 Meeting Citizen Needs

As previously stated, while opinions vary, more respondents than not think that town government has a role in improving internet service. Some citizen comments submitted include the following:

- My answer on a publicly funded network - Not sure actually. If Google (for example) came in - do they require the town to fund? Did they require Austin to fund to bring their high speed into Austin? If the answer is yes, then my answer to the question on a publicly funded internet would change. But generally, I think the internet provider should fund the project with the town's encouragement;
- The idea of a publicly financed Wi-Fi in downtown Winter Park is very appealing, but I can't imagine the costs to incorporate the entire Fraser Valley and the amount of infrastructure that would potentially be required. Additionally, tourists/renters would more than likely be the ones that benefited the most from owners/tax payer dollars who already purchase private home internet services;
- I may be interested in a public/private partnership. Town provides right of use at no charge to company but they have to pay to install cable/fiber. I am NOT in favor of any tax dollars being used to fund this initiative;
- The current broadband situation is a significant problem. I urge the Town of Fraser to address the issue if possible;
- We have a home in Fraser that we use mainly on weekends. Our primary residence is in Longmont, CO. Longmont recently started providing 1G internet. It has been hugely successful. Service is very fast and reasonably priced. If Fraser were able to do something similar that would be amazing.

In addition, the following comments were submitted regarding need for a broadband solution:

- Need to invest in infrastructure. Many homes are 10+ years behind in internet accessibility;
- When I was taking an online class, I was unable to upload many of my assignments from home. I had to go to work (Winter Park Resort) to submit them. At the time I had internet access there but I no longer work in a position where I have access;
- My neighbors below me have two kids at Fraser Valley Elementary. They cannot get any Internet other than dial up at their house. They have to take the kids to the library to do their homework;
- We also have a rental property up here and even in this climate of a critical housing shortage, we have had people decide not to rent from us because of the poor internet.

Overall, this translates into the following key finding:

» ***Key Finding: Respondents surveyed are open to the town taking a role in helping bring better broadband to the Valley, but they are not entirely sure what the solution should look like.***

1.6 Business Survey Key Finding

Business respondents indicated the following regarding their service:

- Internet is very important to their business (74%);
- Current internet service is too slow and interrupts (80%);
- Only 11% do not have an internet connection at their business location;
- More business have cable internet connections (61%) than wireless (27%);
- Businesses are paying a range of $40/ month to $1200/month for internet.

Overall, slightly less than 3 in 4 said they would pay at least $100/month for robust "extremely fast service". The same number would pay at least $100 for an installation fee. From the information provided, we have one key finding:

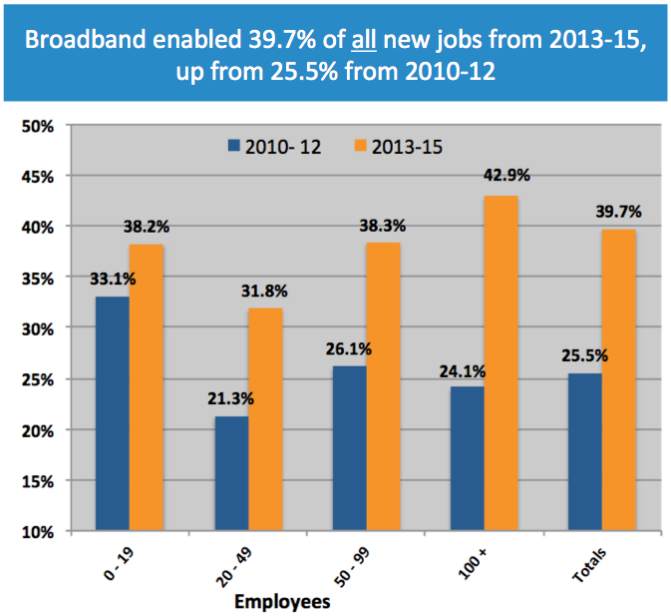
» ***Key Finding: Businesses surveyed show a desire for better broadband and would be willing to pay more to have it.***

2. Use Cases for The Fraser Valley

In addition to the results of the community outreach and studies discussed above, this section provides some additional information and data regarding the impact of broadband.

2.1 Economic Development

Broadband is the economic engine of any locality. For example, Strategic Networks Group (SNG) surveyed 10,400 US businesses and found that broadband is more critical than ever in driving economic development. [4]

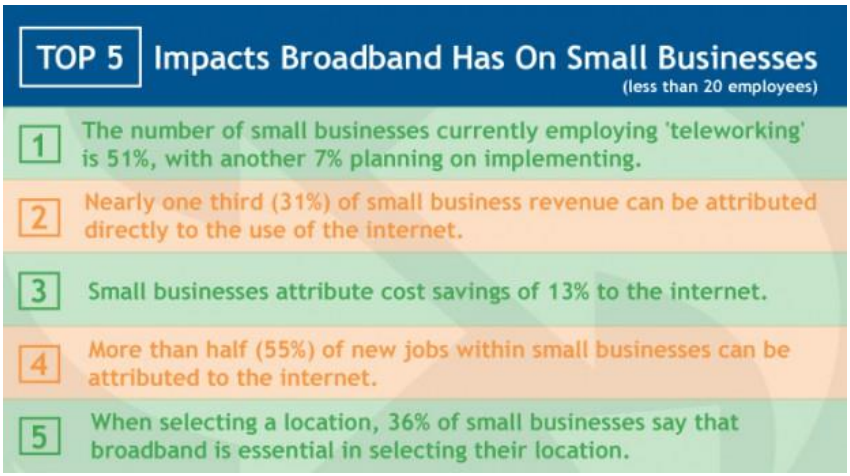


SNG's research also shows that if communities dedicate themselves to driving broadband utilization and achieve a meager 10% success rate, business revenues will increase 24% while costs will decrease by 7%.

Broadband is critical for job creation, keeping jobs in a community, and revenue generation. In addition, SNG found that broadband directly impacts small businesses in the following ways:[5]

[4] See http://sngroup.com/information-resources/research-library. SNG is the world leader of broadband econometrics and they work to help countries, states, counties, and municipalities maximize the impacts of broadband investments.

[5] http://sngroup.com/information-resources/research-library



The results of the Fraser and Winter Park residential and business survey showed that more than a third of respondents work from home. In a study VPS conducted last year[6] in a rural community that recently received broadband, we found that over 7% of those surveyed had plans to start a home-based business in the next three years.

For a mountain community where there are a significant number of second home owners, these are important trends to note.

2.2 Aging in Place

More than half of the respondents of the residential study were over the age of 55. The older adult population faces challenges that are unique when it comes to broadband access and usage. For example, according to a 2014 PEW Internet study, the older-adult community:[7]

- Experiences physical challenges to using technology;
- Possesses skeptical attitudes about the benefits of technology;
- Has difficulties in learning to use new technologies.[8]

Moreover, "only one in three U.S. senior citizens have a broadband connection at home, part of a wider problem of isolation and marginalization."[9] Yet, older adults need broadband as much as

[6] See https://blandinonbroadband.files.wordpress.com/2016/08/ctc-broadband-impact-study-final-report.pdf
[7] See Aaron Smith, *Older Adults and Technology Use*; April 3, 2014. http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/
[8] For these reasons, there are now programs that specifically assist adults over the age of 55 with digital literacy. For example, OATS is a New York City based non-profit dedicated to providing technology training, education and support to older adults.
[9] See OATS Press Release published on Business Wire. http://www.businesswire.com/news/home/20150715005199/en/OATS-Launches-Program-Increase-Broadband-Technology-Adoption.

everyone else in order to stay connected to family, access health care and government services and even to generate revenue through e-commerce opportunities.

In 2014, 14.5% of the national population was over the age of 65.[10] The National Aging in Place Council (NAIPC) says that "more than 90 percent of older adults would prefer to age in place rather than move to senior housing. But the group acknowledges that a gap exists between their desire and the reality of the modifications their home may require."[11] Broadband is a big part of what can help the older population age in place and improve their quality of life.

In 2012, the Foundation for Rural Service (FRS) issued a white paper entitled, *"Aging in Place and the Role of Broadband*." FRS found that "broadband access provided by small, rural telephone companies, coupled with recent health care reforms and cutting-edge technology, is making it possible for more rural seniors to comfortably and safely spend their final years in their own homes."[12]

Ensuring that the older adult population has access to broadband (and is utilizing the technology) is just as important as it is for the younger generation.

[10] See U.S. Department of Health and Human Services, Administration on Aging Statistics; http://www.aoa.acl.gov/Aging_Statistics/index.aspx.

[11] See Michele Lerner, *New online Service Targets Aging-in-place residents*; Washington Post, January 19, 2016; https://www.washingtonpost.com/news/where-we-live/wp/2016/01/19/new-online-services-targets-aging-in-place-residents/

[12] See National Telecommunications Cooperative Association Press Release; "*Broadband Makes Aging Place Possible for Seniors Living in Rural America*." https://www.ntca.org/2012-press-releases/broadband-makes-aging-in-place-possible-for-seniors-living-in-rural-america.html.

3. Municipal Network Models

This next section begins to explore what a municipal broadband solution could look like. In the municipal broadband space across the country, there is much talk about models. What is the best model for a local government to follow to deploy a broadband network in the community? What are the emerging models?

It is important to note that while there are quite a few different model variations in development around the country, there are actually very few municipal networks that are completed and in operation. Below is a chart describing a sampling of these networks. Some of these examples are also discussed throughout this section as it relates to the type of model.

Examples of Different Municipal Network Models

Location	Type of Network	Status	Description
Longmont, Colorado	Municipal electric/last-mile	In Service	Longmont's municipal electric utility deployed an FTTP network leveraging its utility pole assets to help defray the costs of deployment. The City primarily used initial bond funding ($40 million) for capital. The network is often touted as an example of municipal network success. Longmont has 38K premises that have access to gigabit broadband at costs starting at $50/month for early subscribers. Other Municipal Electric networks in service include: Lafayette, LA; Chattanooga, TN; Huntsville AL (with a Google partnership).
Rio Blanco, Colorado	Municipal last-mile with network operator	In Process	The City of Rio Blanco utilized City funds and Colorado DOLA grant funds to construct an FTTP network serving rural communities. The technologies deployed are a mix of fiber and wireless. The goal is ubiquitous coverage by 2018. This is one of the few municipal last-mile project that does not involve a municipal electric utility.
Hudson Oaks, TX	Municipal last-mile with private provider operator	In Process	The Town of Hudson Oaks is in the process of building an FTTP network. The rural town (located outside of Dallas) has a population of less than 2,000. The town is self-funding the infrastructure build and will own the network assets. The town has found a wireless ISP that is going to become the FTTP service provider. The provider will be leasing the assets back from the town. The town has not yet started construction.
Westminster, MD	Municipal last-mile PPP	In Process	The City of Westminster leveraged a middle-mile network built by the County that utilized County general funds and federal grant funds for the capital investment. (Part of same project as Howard County noted below). The City is now utilizing bond funding to build FTTP infrastructure. The City has a PPP agreement with Ting who is the service provider

			and will share revenue with the City. This network is often cited as an example of a successful PPP model, but it should be noted that this is still a work in progress.
Ammon, ID	Municipal last-mile	In Process	The City of Ammon, Idaho has a very unique model. Ammon has built an open access network that lets multiple private ISPs offer service to customers over city-owned fiber. The City self-funded a portion of the network. However, Ammon is using a model similar to Google Fiber's "Fiberhoods," in which construction happens first in communities where lots of residents commit to buying service. Those who opt in will pay a tax assessment of about $10 to $15 a month (roughly $3,000 over 20 years), plus a utility fee of $16.50 a month. This is optional: homeowners who want nothing to do with the network don't have to opt in. They can also opt out later on, though they would lose access to the fiber network unless they sign up again. Ammon has been piloting this project and has yet to sign up a large scale of residents. This is also often touted as the “model of the future” but it is far from being complete. Success is yet to be determined.
Centennial, CO	Municipal middle-mile with last-mile provider	In process	The City of Centennial is in the process of building a middle-mile network. The City is self-funding the middle-mile portion of the network build and will own the assets. The city is in discussions with Ting (same company that has a PPP with Westminster MD) to be the FTTP service provider. Construction will begin in 2017. Price points published are in the $89/month range for residential gigabit service.
Howard County, MD	Municipal middle-mile	In service	Howard County, Maryland has a network of over 175 miles that was funded by a combination of County general funds, bonds and federal grants. The County owns and operates the middle-mile network with the help of outside vendors for maintenance and other technical needs. The County has now become an ISP and is the internet provider and E-Rate provider for the entire County School system. The network also leases dark fiber and provides internet service to some commercial businesses. This is one of the most unique and successful municipal middle-mile models in the country. Other examples include: One Community in Cleveland, Boston, Chicago, and Austin, TX.
Steamboat Springs, CO	Municipal middle-mile with network operator vendor	In process	In Steamboat Springs, the City has teamed with Routt County and 4 other entities to form a nonprofit. The partners are supplying some of the capital along with DOLA grant funds to build a middle-mile network through Steamboat Springs. The nonprofit hopes to lease dark fiber to attract last-mile providers to build out to homes and business. Construction will be complete in 2017.

While these above examples provide helpful information – they do not serve as a blanket template for municipalities to follow. There is no one-size fits all model. The reality is that the right solution is solely dependent on factors within the community. The model that fits best for Fraser and Winter Park is one that must be customized based on local financial, legal, political, and practical considerations. The first step to determining what model is best is to examine the elements that help define "model". In this case, a model is a solution that combines the following elements:

- Type of network (middle-mile and/or last-mile);
- Ownership and operating structure;
- Financial, cost and revenue plan.

In a sense, the model builds itself after examining the three elements listed above.

3.1 Network Types

There are two main types of municipal networks that serve end-users (other than networks built exclusively for internal government use) and they are middle-mile and last-mile. Both networks are explored below. For the purpose of this discussion, the term network is inclusive of all technologies. Networks built in rural communities may need to consider different technologies. It may not be feasible, due to cost or terrain challenges, to construct fiber to every premise in a rural community.

3.1.1 Middle-Mile

A middle-mile network is typically defined as a network that serves community anchor institutions (i.e. schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses. A middle-mile network could either be operated directly by the municipality or outsourced to a network operator.

The purpose of middle-mile networks is generally to build a high fiber count (fiber cables with strand counts of 144 and above) backbone[13] that provides direct lateral connections to key institutions and enables infrastructure assets to be leveraged by others to service homes and businesses. Third-parties may have an interest in leasing these assets because it helps with reducing their costs of deployment. A provider, then, would only need to invest in the lateral connections to homes and businesses and would not have to build the backbone.

An example of this in Colorado is with the City of Centennial. The network is still under construction; however, it's a middle-mile design that will pass by many of the neighborhoods and

[13] A backbone is literally the spine of the network. Backbone's are usually built along main corridors and provide transport to and from the hub site where the electronics are located to the connected entity.

apartment complexes within the City. Although the City does not intend to provide any residential services directly through its network, it is actively engaging broadband providers to determine strategic partnerships that will use the City's network to accelerate broadband providers' fiber to the home deployments in the area.

Middle-mile networks cost less to deploy because they are only designed to reach anchor institutions. Middle-mile networks usually also bring in revenue from the leasing of conduit and fiber. These are explained below.

3.1.1.1 Conduit

The most expensive part of deploying a broadband network is the construction. The cost of the actual assets (fiber and conduit) are nominal. Therefore, it is cost-effective to install extra conduit banks and install high-count fiber during the initial construction phase to cover all current and future needs. You only want to have to dig once.

In most cases, excess[14] conduit and fiber deployed is leased through an agreement called an Indefeasible Right of Use (IRU). IRUs are commonly used in the industry to provide long-term access to assets. The term of an IRU typically runs between 10-20 years. Conduit pricing is usually based on a per-foot basis. Pricing varies based on demand in the region and amount of conduit available.

Below is a chart that provides examples of three different pricing structures for conduit:

Location	Price	IRU Term	Total Cost
Boulder, Co	$5.50 per foot	20 years	$722,271 in a one-time payment
Lincoln, NE	$65,000 per year	20 years	$1.3 million paid monthly over 20 years with an escalation clause not exceed CPI.
Baltimore, MD	$3.00 per foot (appx)	Negotiable	Depends on how much leased. City requires any new conduit built by provider to be owned by City

3.1.1.2 Dark Fiber

Dark fiber refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. Dark fiber is also referred to as excess capacity. Fiber optic cable comes in strand counts ranging from 12 strands to 1400+ strands. Any strands not in use by the owner (or other entity) are considered dark fiber strands that can leased.

[14] Conduit and fiber strands that will not be used by the municipality.

Similar to conduit, dark fiber pricing is subjective and includes but is not limited to the following criteria:

- Availability of dark fiber in the area;
- Market rate of other dark fiber in the area (sometimes very difficult to ascertain);
- Number of strands to be leased (minimum of two);
- Amount of footage to be leased (per mile);
- Term of years requested;
- Payment up-front versus over time;
- Amount of strands remaining that may not be marketable (i.e. if an entity only leases a portion of a route, the corresponding strands on the remainder of the route may not be usable. Often you will see a provider require the entire route to be leased for this reason.)

Unlike conduit, dark fiber is not based on price per foot but rather based on a per-strand, per mile, per month basis. Prices can range from $5-$750 per pair of strands with a typical IRU term of 10-20 years. Similar to conduit, payments can be made on monthly, annually or on a one-time payment. One-time payments require less administrative work and book keeping. It also provides a large infusion of cash. However, smaller entities may not be able to provide one-time payment and it is difficult to estimate market value over the course of twenty years. Ultimately, all of these considerations are discussed in the negotiating process.

Below is a chart that shows some dark fiber pricing in rural communities across the country.

Rural Community	Rates Per Pair and Per Month	Maintenance	Up-Front Fee per pair	Term
California	$9	$250	$1,000	20
Illinois	$7	$150	$750	20
North Carolina	$7	$250	$750	20-25
Maryland	$90	0	0	20

Maintenance can be included in the cost of the IRU or added as an additional fee. Maintenance fees range from about $200-700 per mile, per year.

The below chart shows what a rate schedule would look like for a price per pair of strands ranging from $10 - $100 exclusive of any up-front or maintenance fees.

Rate Schedule Based on Flat Fee Per Pair of Strands										
Per Pair	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**
$10	1	$10	$120	$1,200	$2,400	10	$100	$1,200	$12,000	$24,000
$20	1	$20	$240	$2,400	$4,800	10	$200	$2,400	$24,000	$48,000
$30	1	$30	$360	$3,600	$7,200	10	$300	$3,600	$36,000	$72,000
$40	1	$40	$480	$4,800	$9,600	10	$400	$4,800	$48,000	$96,000
$50	1	$50	$600	$6,000	$12,000	10	$500	$6,000	$60,000	$120,000
$60	1	$60	$720	$7,200	$14,400	10	$600	$7,200	$72,000	$144,000
$70	1	$70	$840	$8,400	$16,800	10	$700	$8,400	$84,000	$168,000
$80	1	$80	$960	$9,600	$19,200	10	$800	$9,600	$96,000	$192,000
$90	1	$90	$1,080	$10,800	$21,600	10	$900	$10,800	$108,000	$216,000
$100	1	$100	$1,200	$12,000	$24,000	10	$1,000	$12,000	$120,000	$240,000

In Colorado, we have received data regarding a recent dark fiber leasing agreement. We cannot disclose the parties, however this took place in a rural community similar to Grand County.

The agreement resulted in an up-front payment of $300,000 for 2 strands of dark fiber priced at $156 per pair of strands. The term of the agreement was for 10 years and the entity received a discount in exchange for an up-front payment.

If Fraser/Winter Park were to charge $156 per pair of strands for the 8.3 miles of backbone route along Route 40, this could result in the following revenue (excluding any discounts applied for up-front payments and any maintenance charged).

Per Pair	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**
$156	1	$156	$1872	$18,720	$37,440	8.3	$1294	$15,537	$155,376	$310,752

Finally, when leasing conduit and dark fiber, the owner of the network must take into account the following considerations:

- A map and inventory of all assets leased and available to be leased must be kept current and active;
- Maintenance of the conduit and the fiber generally falls to the network owner and so the owner must have policies and procedures in place to meet any service level agreements (SLAs) that the lessees have in place. In other words – the network owner must be able to repair fiber cut within an emergency window to prevent downtime outages to the network customers;

- The network owner must have a plan in place for third-party network access;
- The network owner must have a process in place for interested third-party applications as well as templates for legal agreements and other documents.

Enabling third-party access of the network must be part of the implementation plan. Municipalities sometimes have difficulty executing this process internally and need to outsource these activities to a vendor.

3.1.2 Last-Mile

A last-mile network (also known as FTTP) is one that provides services directly to homes and businesses in the community. Last-mile networks can also serve anchor institutions. It is more unusual, however, for last-mile networks to also lease assets. This will be further discussed in the open access section below.

Last-mile networks are the most expensive to deploy but provide the biggest benefit to the community. In addition, municipal last-mile networks generally need an operator to partner with the municipality. Most of the municipal last-mile networks in existence are in communities with a municipal electric utility. This is because the utility already has pole infrastructure in place to offset costs as well as billing systems in place to serve customers. The best example in Colorado is the City of Longmont, which deployed a fiber-to-the-home network through its municipal electric utility. The Cities of Loveland and Fort Collins are also considering this solution through their municipal electric utility.

Last-mile networks usually require a take-rate that is between 40-60%. This means that the provider needs to obtain 40-60% of the residential and business accounts in order to recoup a capital investment, make a profit and be sustainable.

Other options for last-mile networks include establishing a public-private partnership as discussed in Section 3.2.2 below.

3.1.3 Open Access

An open access network is one where the infrastructure assets (conduit and fiber) are made available under certain policies and procedures to multiple non-network owners. Usually this occurs in the form of dark fiber leases as described above. Publicly funded grant programs offered by the federal and state government often require networks to be open access.

On paper, open access seems like a great idea. Middle-mile networks that lease dark fiber and conduit are by definition open access – otherwise, networks would be limited to one customer. Middle-mile networks need multiple users to be sustainable. Further, allowing multiple providers

to access a network should mean increased competition and lower prices. A municipality should benefit from more users on the network.

However, open access is a hotly debated topic particularly as it relates to last-mile networks because the greater the number of providers, the harder it is for a new-entrant provider to meet its take-rate goals and make a profit. This will be of particular concern for providers that are also making a financial investment. Will a provider be able to meet take rates of 40-60% while other providers are invited to compete for the same customers? Ultimately, the open access question will be determined by all the investors and stakeholders.

3.2 Ownership and Operating Structures

There are multiple kinds of ownership and operating structures. The below chart details four basic types:

Type of Operating Structure	Description
Internally Managed	This is a municipal network that is 100% owned and internally managed and operated. There are very few of these around the country. This can be middle-mile or last-mile.
Oversight of Outsourced Management	In this structure, the municipality owns the assets and provides oversight, but outsources the management and operations to a third-party entity that could be a private provider or a nonprofit. This can be middle-mile or last-mile.
Third-Party Owned and Operated	This is a network entirely owned and operated by a third-party but one where the municipality provides some resources (not financial) and benefits from the service. This is usually a last-mile structure and one where the municipality has little control.
Hybrid	Another option is to create a hybrid model that combines one or more of the above options. An example of a hybrid option is a public-private partnership discussed in Section 3.2.2.

3.2.1 Internally Managed and Outsourced Operating Structures

While rare, there are municipalities in other parts of the country that have successfully built and internally managed middle-mile networks without private sector investment. In Maryland, there are at least 10 municipalities that own and operate their own networks.[15] These networks are thriving with each jurisdiction continuing to make ongoing investments.

[15] Maryland ICBN jurisdictions funded their initial build in large part due to a $115 million dollar federal grant under a Broadband Technology Opportunities Program grant awarded in 2010. However, jurisdictions did contribute more than $20 million dollars in cash and in-kind matching funds. Prior to receiving the grant, each jurisdiction operated its own smaller fiber network.

An example of a middle-mile network with outsourced management is actually happening in Colorado. Northwest Colorado Broadband (NCB) is a nonprofit formed by 6 partner entities including Routt County, City of Steamboat Springs, Steamboat Springs School District, the Steamboat Springs Chamber, Yampa Valley Electric Association, and Yampa Valley Medical Center. In this project, the partners are providing some funds for the initial build but with the bulk of the costs paid for by a grant awarded from Colorado Department of Local Affairs (DOLA). Multiple partners actually own the assets but they are granting an IRU to NCB for use of the assets. NCB will oversee a contract with a network operator, and other vendors. This middle-mile network will be making its assets available to lease to third parties.

There is more flexibility with middle-mile networks because the costs are not as great as last-mile networks.

3.2.2 Hybrid Structure - Public-Private Partnerships

Public-private partnerships (PPPs) are a relatively new phenomenon in broadband. A PPP is a legal partnership wherein the partners balance and apportion risk, benefit and control. Recently, more and more municipalities are exploring establishing a PPP for deploying and operating last-mile networks. But what does that mean?

There are many different types of PPPs. They include but are not limited to the following:

- An investment entity that steps forward to provide funding for the network in exchange for a long-term payback on their investment. This is a traditional PPP. The investment entity usually requires an ownership stake in the assets and sets other conditions such as requiring the municipality to provide a credit backstop to guarantee investments. The municipality generally does not need to provide cash contributions. An investment entity is only likely to be drawn to projects that cost a minimum of $15 million dollars.
- A partnership wherein both the municipality and provider contribute funding and resources to the project. Both may share in ownership of the assets.
- A partnership wherein the municipality provides all funding and owns the network, but does not operate or manage the network.

The type of PPP depends on a number of factors, including:

- Whether the provider can make a profit with take rates that justify an investment;
- The sum total amount of financial resources the municipality can provide;
- Whether the municipality is willing to be flexible on asset ownership;
- Whether there is a private entity that is interested and viable;
- Whether the municipality and private partner can come to agreement on terms and requirements.

A recent trend by communities interested in exploring PPPs is for the municipality to issue a Request for Information (RFI) to invite potential interested partners to submit proposals. It is unclear whether this strategy is entirely effective in ultimately establishing a PPP. However, we have seen instances where the RFI itself has created confusion and significant delay in network planning – particularly where the RFI is issued prematurely, is open ended, vague, or includes too many difficult to meet requirements.[16] In some cases, communities have had to re-issue the RFI with new requirements and/or hold multiple rounds of interviews. Communities thinking of utilizing this RFI approach to finding partners should do so cautiously and should identify potential local partners first.

Despite the fact that PPPs are widely pursued as options for last-mile municipal broadband networks, a PPP is difficult to establish. This is particularly true in rural areas where the cost of the build is high and the number of potential customers makes it difficult to justify the investment. That being said, Fraser and Winter Park may have a PPP opportunity to investigate.

3.2.2.1 Possible PPP Opportunity with Mountain Parks Electric

During the course of the Study, we learned that MPEI is exploring options for becoming a broadband service provider in their service territory which includes Fraser and Winter Park.

We held a meeting with MPEI and learned that:

- MPEI conducted a market research survey and is moving forward with a network design and business plan;
- Fraser and Winter Park would be critical areas within their broadband service territory;
- MPEI does not have a schedule yet as to when construction would begin and where the network would be deployed first;
- At this time, MPEI is not considering providing television services as a part of their package offerings;

Additional meetings would be required to fully explore this opportunity for Fraser and Winter However, this seems to be a viable option for bringing in a new provider.

[16] PPP proposals are time consuming and expensive to develop. Vendors can be hesitant to respond to RFIs where they are unclear on what is expected or they are unsure if it is likely to result in a contract for any vendor.

4. Fraser Valley Infrastructure Assessment and Network Options

The next piece of analysis needed in order to make a network model determination is to ascertain what a Fraser and Winter park network could look like and identify high-level capital costs. Below is an analysis of existing infrastructure as well as four different network design options.

4.1 Existing Infrastructure

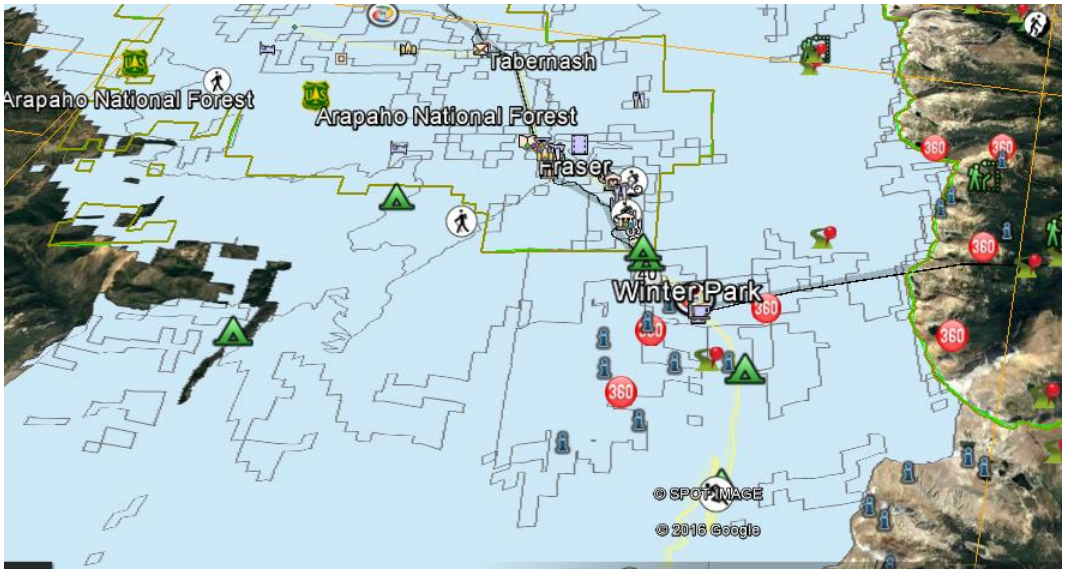
The first step to developing a high-level network design is to evaluate existing infrastructure in the region to determine if any existing assets can and should be leveraged in order to save costs in network construction.

VPS reviewed the following publicly available information for this task:

- Data and information provided by the State of Colorado, Northwest Colorado Council of Governments (NWCCOG), the Towns of Fraser and Winter Park and Mountain Parks Electric (MPEI);
- Data and information obtained by searching for registered towers;
- Data and information obtained through internet searches.

The State of Colorado collects some information regarding broadband coverage. However, the State says that they do not collect data on existing asset or fiber infrastructure. What they did provide was a map showing broadband coverage areas based on *advertised* speeds and community anchor institution data.

According to this information shown in the below map, the entire Fraser/Winter Park area is covered with broadband. Without information regarding existing asset or fiber infrastructure, this map is not very helpful.



In 2013, NWCCOG issued a Regional Broadband Strategic Plan. From that Report (as well as our survey) we know that the following providers (broadband and mobile) serve Fraser and Winter Park:

- Century Link
- Comcast
- Grand County Internet
- Slopeside Internet
- AT&T (Fraser only)
- Spring
- T-Mobile
- Verizon

We were not able to obtain maps showing location of provider facilities.[17] We do know that there is fiber running along the railroad. Anecdotally, we also know that Comcast and Century Link share the same pathway meaning that underground cuts to one carrier's fiber network could put both at risk.

In addition, we conducted a search to locate registered towers in an expanded radius around Fraser and Winter Park. The results showed three registered towers in the vicinity. However, two of the three are old Commnet cellular towers that appear to be dismantled as of 2003. The remaining tower is near the Winter Park resort, not visible on Google Earth 2015 aerial imagery. According to Winter Park Resort, they have 2 cell sites. However, only one of them has space for additional equipment.

[17] Location and mapping of carrier facilities is considered to be confidential and proprietary.

MPEI did provide VPS with GIS data regarding the locations of their utility poles. By VPS count, there are 636 poles located in Fraser and Winter Park that could be leveraged for deploying fiber.

It should also be noted here that NWCCOG is about to launch a project to establish a transport network in northwest Colorado. The project is still being developed and they expect to start construction in 2017. Right now, however, we were told that there is not a plan for the transport network to be deployed along Highway 40.

The bottom line is that aside from MPEI utility poles, there is limited existing infrastructure in the Fraser Valley to leverage.

4.2 Network Options

Below are three last-mile models and one middle-mile option for consideration.

4.2.1 FTTP Models (Last-Mile)

VPS developed three models to provide a high-level capital cost estimates only[18] for the design and construction of a Fiber-To-The-Premise (FTTP) network build. The three models are:

- 100% penetration to every premise (home, business, government entity);
- 60% penetration to selected premises;
- 30% penetration to selected premises.

For each model, we provided estimates for a build that is 100% underground and one that is partially underground while also utilizing MPEI utility poles. VPS made the following basic assumptions for each model:

- RF or IP video expenses, switching costs, data network equipment, or transport to exchange fees are not included;
- Assumes serving all locations from an existing CO building;
- Estimates include engineering fees or taxes;
- Electronics & fiber management costs assume GPON (type of equipment);
- Does not include any costs for right-of-way acquisitions;
- Outside Plant (OSP) costs do not include any additional fees for construction in rocky soil conditions (this is to be determined).

The following chart summarizes the total estimated costs of the three FTTP options.

	100% Penetration	60% Penetration	30% Penetration
100% Buried	$10,686,000	$8,024,000	$6,341,000
Aerial/Buried	$9,148,000	$6,944,000	$5,290,000

As you can see, there is a $5,396,000 difference between the network that reaches 30% of the premises in Fraser and Winter Park and the one that reaches all premises constructed 100% underground. Actual market penetration would likely not approach the 100% mark. Although market penetration varies greatly from project to project, it is common to achieve between 30% to 60% penetration in areas where existing broadband speeds are lacking.

[18] Note: VPS was not tasked to develop a full business plan around one or all of the models at this phase of the project. We do not recommend conducting a business plan until a network design and operating model are selected. This may or may not include the selection of a provider to manage the network.

The full details and assumptions for each option **as a total project** are provided on the following pages as well as a map of the network with 100% penetration. Breakdowns of each option by town are attached as Appendix B for the Town of Fraser, and Appendix C for the Town of Winter Park.

We have also provided a Key to reading the three models.

Key to Reading FTTP High Level Estimates

CO Electronics	Description
CO Electronics	This includes the electronics, spares, miscellaneous materials needed for network operations, installation, and Optical Network Terminals (ONTs) that are attached to each premise. Note that the costs of the electronics do not depend on whether the network is constructed on aerial or underground. The costs will stay the same.
Spares	
Misc. Materials	
Installation (10%)	
ONTs	
ONT Installation	
OSP	OSP stands for Outside Plant
Cable	This includes the cost of the fiber, conduit, miscellaneous materials needed for the construction of the network. Drops refers to the cost of fiber drops to each premise. These cost estimates also includes the cost of construction (labor) and engineering.
Drops	
Fiber Management	
Housing Units (Approx.)	Number of housing units included in the network design
Single Family/Business (Approx.)	Number of single family/business units included in the network design
MDU (Approx.)	Number of multi-dwelling units included in the network design
Average Cost per Housing Unit	Average cost per unit
Mainline miles - Aerial - 52%	This refers to miles of backbone built on utility poles
Mainline miles - Buried -48%	This refers to miles of backbone built underground
Drops Miles - Aerial - 52%	This refers to the number of miles of fiber constructed from the backbone to the premise on utility poles
Drops Miles - Buried - 48%	This refers to the number of miles of fiber constructed underground from the backbone to the premise

FRASER/WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 100% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$562,000**	**$562,000**
Spares	**$23,000**	**$23,000**
Misc. Materials	**$12,000**	**$12,000**
Installation (10%)	**$67,000**	**$67,000**
ONTs	**$1,654,000**	**$1,654,000**
ONT Installation	**$919,000**	**$919,000**
OSP		
Cable	**$3,488,000**	**$4,330,000**
Drops	**$1,980,000**	**$2,676,000**
Fiber Management	**$443,000**	**$443,000**
Total	**$9,148,000**	**$10,686,000**
Housing Units (Approx.)	4100	4100
Single Family/Business (Approx.)	2000	2000
MDU (Approx.)	230	230
Average Cost per Housing Unit	$2,231	$2,606
Mainline miles - Aerial - 52%	22.2	0.0
Mainline miles - Buried -48%	20.5	42.7
Drops Miles - Aerial - 52%	39.5	0.0
Drops Miles - Buried - 48%	36.5	76.0
TOTAL MILES	**118.7**	**118.7**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 2000 single family units and 230 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $482,000 for the backbone along Hwy. 40. (Aerial/Buried) or $704,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

FRASER/WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 60% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$339,000**	**$339,000**
Spares	**$23,000**	**$23,000**
Misc. Materials	**$12,000**	**$12,000**
Installation (10%)	**$42,000**	**$42,000**
ONTs	**$992,000**	**$992,000**
ONT Installation	**$552,000**	**$552,000**
OSP		
Cable	**$3,488,000**	**$4,330,000**
Drops	**$1,188,000**	**$1,606,000**
Fiber Management	**$308,000**	**$308,000**
Total	**$6,944,000**	**$8,204,000**
Housing Units (60%)	2460	2460
Single Family/Business (60%)	1200	1200
MDU (60%)	138	138
Average Cost per Housing Unit	$2,823	$3,335
Mainline miles - Aerial - 52%	22.2	0.0
Mainline miles - Buried -48%	20.5	42.7
Drops Miles - Aerial - 52%	23.7	0.0
Drops Miles - Buried - 48%	21.9	45.6
TOTAL MILES	**88.3**	**88.3**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 60% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 2000 single family units and 230 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $482,000 for the backbone along Hwy. 40. (Aerial/Buried) or $704,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

FRASER/WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 30% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$170,000**	**$170,000**
Spares	**$23,000**	**$23,000**
Misc. Materials	**$12,000**	**$12,000**
Installation (10%)	**$23,000**	**$23,000**
ONTs	**$496,000**	**$496,000**
ONT Installation	**$276,000**	**$276,000**
OSP		
Cable	**$3,488,000**	**$4,330,000**
Drops	**$594,000**	**$803,000**
Fiber Management	**$208,000**	**$208,000**
Total	**$5,290,000**	**$6,341,000**
Housing Units (30%)	1230	1230
Single Family/Business (30%)	600	600
MDU (30%)	69	69
Average Cost per Housing Unit	$4,301	$5,155
Mainline miles - Aerial - 52%	22.2	0.0
Mainline miles - Buried -48%	20.5	42.7
Drops Miles - Aerial - 52%	11.9	0.0
Drops Miles - Buried - 48%	10.9	22.8
TOTAL MILES	**65.5**	**65.5**

Assumptions:

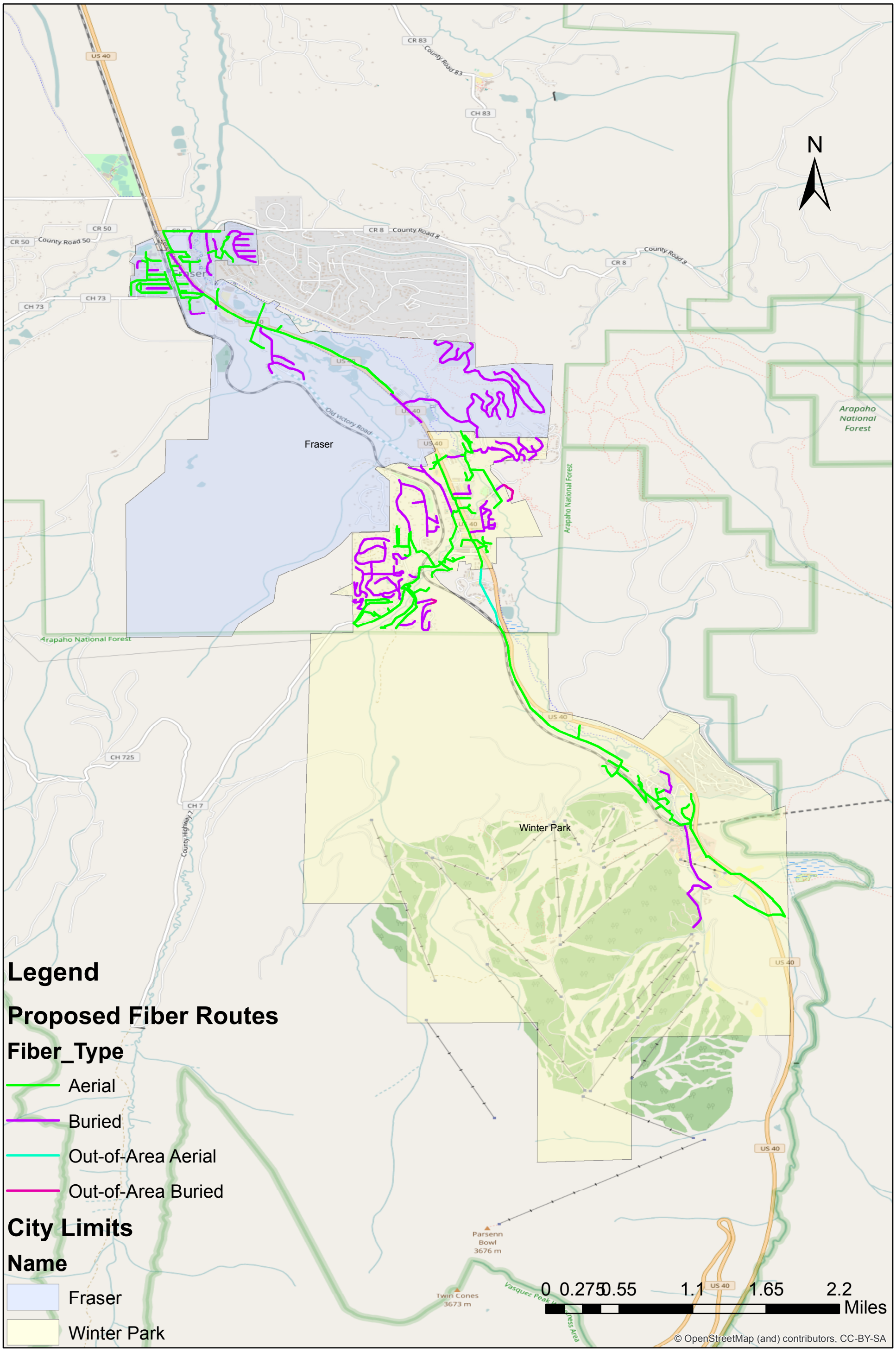
- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 30% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 2000 single family units and 230 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $482,000 for the backbone along Hwy. 40. (Aerial/Buried) or $704,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

Fraser/Winter Park Proposed Fiber



4.2.2 Backbone Only Model (Middle-Mile)

VPS also looked at one other cost-option model that is a middle-mile backbone-only model. The benefit of this model is that it would deploy a high-count fiber optic cable along Highway 40 for third parties to access and leverage via an IRU. This will be discussed more in Section 6.

In each of the three FTTP examples, a footnote has been provided as to the cost of constructing the backbone only along highway 40. This reflects the cost of building fiber mainline for 8.3 miles along highway 40 between the northern boundaries of the Fraser town limits south to the Winter Park ski resort. Two costs were provided. The first cost was a mixture of aerial and buried for an estimated cost of $482,000 and the second cost was 100% buried at an estimated cost $704,000. Both of these costs are for backbone only and do not include the cost of electronics, drops, or buildings for fiber termination.

Splitting out the costs between the two towns results in the following breakdown:

Town	Aerial/Buried	Buried
Fraser	$85,000	$113,000
Winter Park	$397,000	$591,000
Total	$482,000	$704000

The exact location of the termination points, access points to the internet and operating costs would be determined in the business planning phase. Overall, however, this backbone only model is significantly more cost-effective than the last-mile models.

4.2.3 Capital Costs vs. Operating Costs

The prior data provided high-level capital costs for the construction of four different network options. This was developed to give the towns a sense of the cost of network design, engineering, electronics, materials and construction for each model. This also provides critical data necessary for making recommendations and decisions on how best to move forward.

If and when a model is selected, the next phase would be to develop a full business plan to determine the following:

- **5-10 Year Forecast** that includes:
  - Estimated market penetration, service offering rates and information
  - Capital expenditure costs and depreciation
  - Balance sheet, income statement (operating revenues, expenses) and cash flows
- **Forecasted financial schedule Deliverables** that include:
  - Projected Balance Sheet
  - Projected Income Statement
  - Projected Cash Flow

    - Projected Rate of Return (ROR) on Investment
- **Projected Capital Expenditures** - Detail the cost of the property plant, equipment and real estate as needed, to provide service over the years of the plan for the customers anticipated.
- **Projected Depreciation Schedule** - Detail the depreciation expense on investments. Rates would be based upon regular business practices and industry standards.
- **Projected Personnel Expense** - Determine positions, salaries and total personnel expense needed.
- **Projected Operating Expenses** - Detail necessary operational expenses including but not limited to: network operations, contracted inside wiring, leased facilities, billing, maintenance, and various other corporate, legal, accounting, marketing and customer operating expenses.

The full business plan will also determine the pricing for offerings such as video, phone, and broadband services. Pricing of services should not be developed without a business plan. Development of a full business plan was not part of the scope of this project due to the fact that a network model has not been selected and it is too cost-prohibitive to develop full business plans for each of the four models. Additionally, if a last-mile option is selected, it is helpful to include a potential provider in the business planning to help ensure cost accuracy.

However, based on our experience in developing business plans for providers across the country we can provide examples of what we have seen in terms of operating costs on a per mile and per location basis. First we want to define operating costs before providing the ranges. Operating costs for a FTTP network include the following items:

- Personnel Expenses – network, customer service, corporate;
- Operational Vehicles;
- Electronics and Equipment Warranty and Support;
- Insurance;
- Electricity/Utilities;
- Transport/Bandwidth;
- Marketing/Billing;
- Legal/Consulting/Accounting;
- Depreciation;
- Maintenance.

The range of operating costs based on Per Mile/Per Month are as follows:

- $965.77
- $1,857.22
- $5,997.29

The range of operating costs based on Per Location/Per Month are as follows:

- $93.71
- $99.05
- $156.31

Using the data from the high-level Fraser/Winter Park FTTP estimates developed, and applying the range of costs identified above – we provide the below range of operating costs to be viewed **as an example only.** Actual costs would be developed during the business planning phase.

	100% Penetration		60% Penetration		30% Penetration	
Total Cost Per Month for Total Miles	118.7 miles	$114,636 $220,452 $711,878	88.3 miles	$85,277 $163,992 $529,560	65.5 miles	$63,257 $121,647 $392,822
Total Cost Per Month for Total Units	4100 Units	$384,211 $406,105 $640,871	2460 Units	$230,526 $243,663 $384,522	1230 Units	$115,263 $121,831 $192,261

5. Gap and Cost Analysis

Once a network model and operating structure has been determined, it is recommended to complete a sound business plan that includes costs, revenue projections and a financing plan. While some high-level costs need to be estimated prior to completing a full business plan, it is recommended that the full plan is completed in coordination with any financial contributors or provider-partners.

A key component in developing that business plan is to identify all funding sources and identifying funding gaps. This last section explores network funding options for municipalities separate from any private-sector partners.

5.1 Self-funding

Aside from allocating capital project funds as part of the budget process, bond funding is something municipalities can consider to assist with funding network construction, and to support startup and maintenance costs. There are two main types of bonds utilized for capital projects – Revenue Bonds and General Obligation bonds. General Obligation bonds are typically the kind of bond utilized for this kind of funding. However, an option would be to pursue revenue bonds secured with sales tax or other revenues.

5.2 Federal Funding

Federal funding opportunities change year to year. With a new Administration, it's difficult to predict what new sources of funding may be available. However, we provide below information on several grant funding opportunities currently available on the federal level.

5.2.1 Connect America Fund

The FCC created the Connect America Fund (CAF) to help expand access to voice and broadband services to areas where services are currently unavailable. In 2015, through a competitive auction, the FCC awarded carriers nearly $1.7 billion annually for six years to bring broadband to unserved parts of their local service territories. Carriers accepted or declined funding on a state-by-state basis and were required to build out to 95% of the funded areas. Century Link accepted funding for areas in Colorado under this program.

Recently, the FCC announced there would be a second round called the CAF Phase II (CAF II) auction. The FCC has tentatively determined that census block groups or tracts will be the minimum geographic unit for bidding. Bidders will be required to bid on all of the locations within eligible census blocks of a census block group or tracts. The FCC has also released a primary list (final list TBD in late winter/early spring) of eligible census blocks to be up for auction. The Bureau

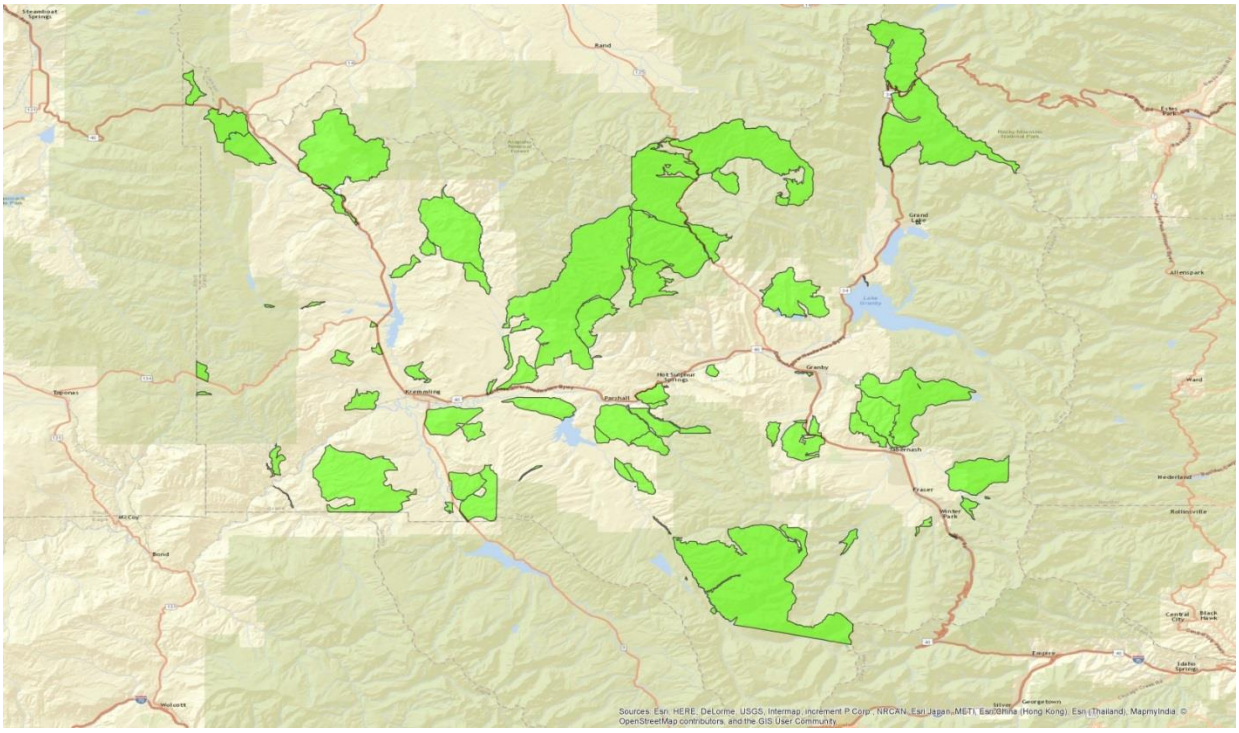
will release the final list of eligible census blocks roughly three months prior to the short-form application deadline. The FCC will also clarify service performance requirements prior to the auction.

Under CAF II, there are census blocks that will be up for auction in Colorado. Based on an analysis of the FCC preliminary list, in Grand County, CO there will be:

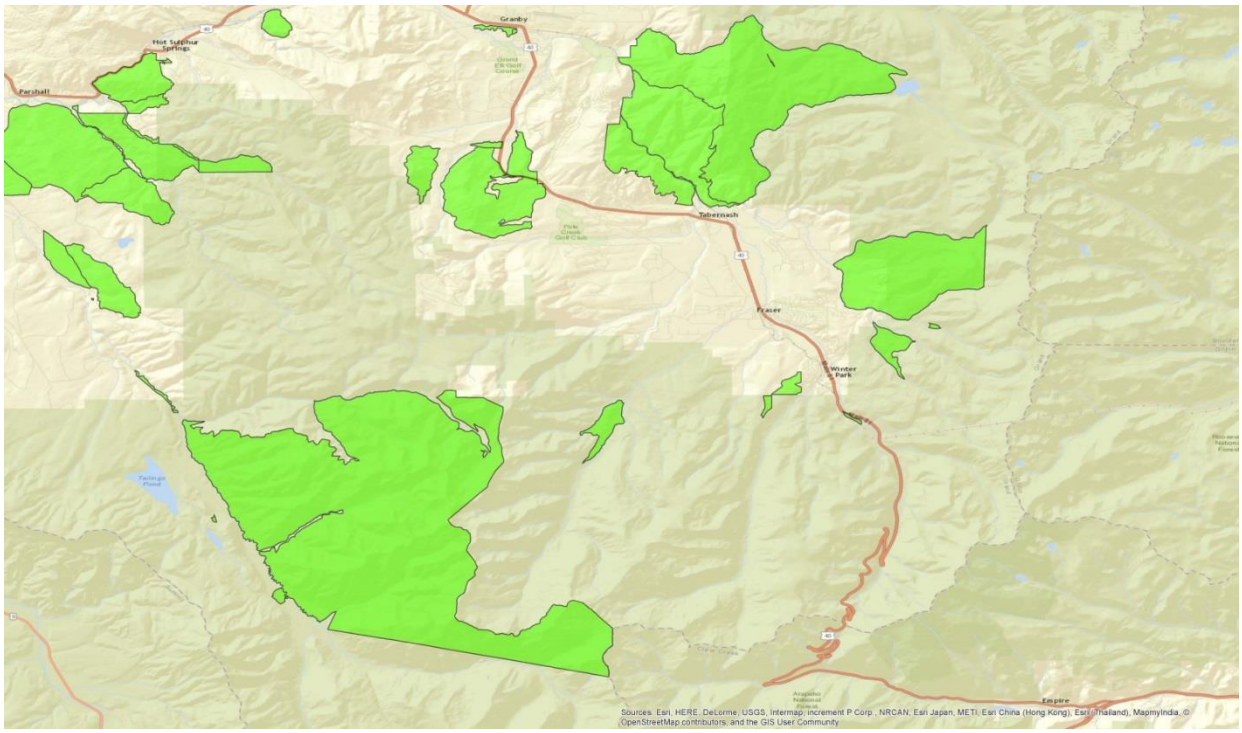
- 82 eligible census blocks representing 373 total locations
- $414,056 available in annual support
- $1,110 available in average annual support per location
- $4,140,560 of funding over 10 years

The following maps are highlighted to show the location of these census blocks in Grand County.

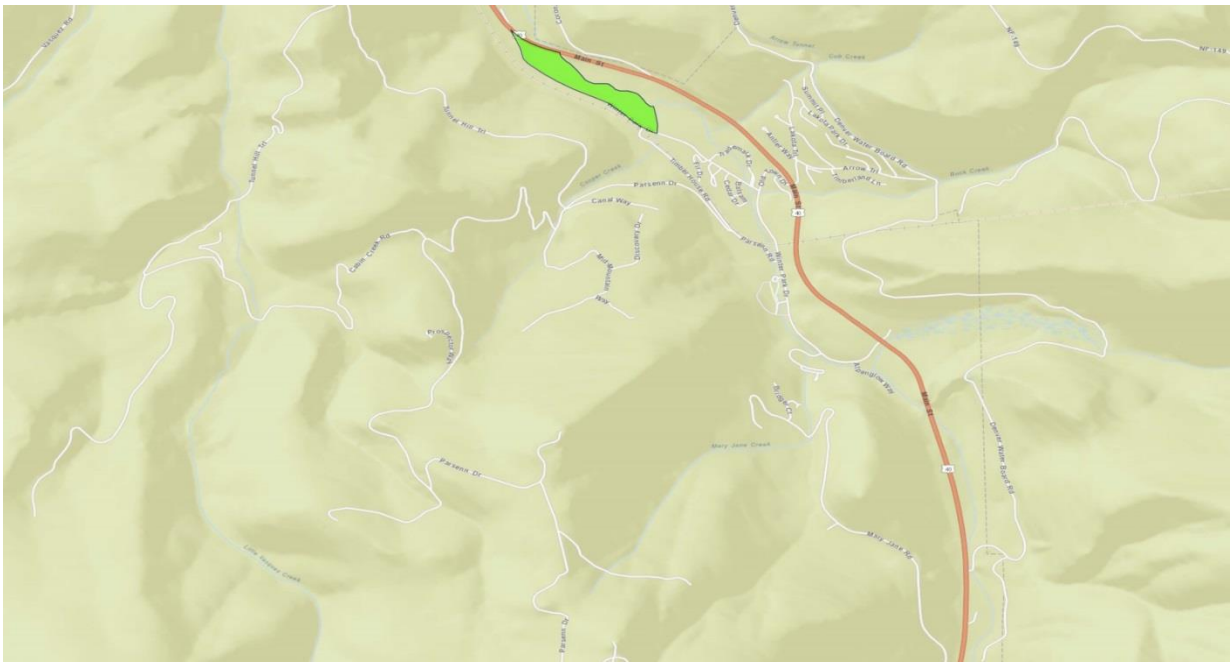
Grand County Map of Eligible Census Blocks for CAF II Funding



Cut out of Areas Surrounding Fraser and Winter Park



Cut Out of Area Surrounding Winter Park Resort



While this does not directly impact the incorporated towns of Fraser and Winter Park, this could be a significant source of funding for a potential last-mile provider partner in the region.

5.2.2 E-Rate

E-Rate is a federal program that provides reimbursement funding for telecommunications services to schools and libraries based on free and reduced lunch program percentages within an applying jurisdiction. E-Rate funds are only available to qualifying service providers. This may be an option to pursue for a third-party network provider partner.

5.2.3 Public Safety Communications Research (PSCR)

PSCR is a federal program that anticipates awarding up to $30,000,000 in grants and cooperative agreements by May 2017. The purpose of the program is to rapidly accelerate research and development related to public safety broadband communications.

This funding opportunity focuses on the following six key technology areas that have the potential to transform the future of public safety communications and operations:

- Mission Critical Voice;
- Location Based Services;
- Public Safety Analytics;
- Public Safety Communications Demand Model;
- Research and Prototyping Platforms;
- Resilient Systems.

Applicants may propose projects specific to one or multiple technology areas as well as cross-cutting projects that address objectives within those technology areas.

The funding opportunity is open to all non-federal entities. In addition, applicants are strongly encouraged to partner with public safety organizations to create innovative and impactful proposals.

Again, while Fraser and Winter Park could not apply for these funds alone, this could be another source of funding for a potential last-mile provider partner in the region as well as other government entities.

5.3 State of Colorado

Over the last few years, the Colorado Department of Local Affairs (DOLA) has awarded broadband grant funding to local governments in Colorado. This has been the sole source of grant funds

made available to local governments. Fraser received a DOLA grant to assist with the funding of this Study.

As of the drafting of this report, however, any remaining broadband funds available through DOLA for grant award are frozen. It is unknown when and if more funding will be directly available. There is also a possibility that municipalities will have to compete for broadband funding with other non-broadband related projects.

The bottom line is that this is not a reliable source of potential funding.

6. Options and Recommendations

Based on the information in this comprehensive Report, this section provides options and recommendations for moving forward with bringing better broadband to Fraser and Winter Park.

Below is a summary of five key observations:

1. Broadband is critical infrastructure for communities. Fraser and Winter Park do not currently have a ubiquitous broadband solution serving all residents and businesses equally. Based on survey responses, it appears that there are issues with connectivity, cost, and access. There is a wide range of opinions on the quality of current services.

2. Based on survey responses, the cost of paying for service is a significant concern for residents. Initial research indicates that a new provider would need to aggressively price services to attract customers and keep cost of broadband below $60. This may be difficult to achieve.

3. The capital cost alone of building an underground Fiber-to-the-Home network to 100% of the premises in the towns exceeds $10 million dollars. While the capital cost of building a middle-mile (backbone) network could be less than $500,000.

4. MPEI is moving forward with plans to provide internet service in their service territory. MPEI has expressed that offering service in Fraser and Winter Park are critical components for their business model to work. MPEI has also expressed an interest in working with the towns. There are also questions regarding:
    - Timing of network deployment;
    - Whether MPEI intends to serve all homes/businesses;
    - Pricing of services;
    - Service offerings;
    - What a potential partnership could look like

    If MPEI moves forward on their own it is highly unlikely that the towns could support two new providers, both competing for the same customers to achieve acceptable take rates.

5. Grant funding opportunities may be available if Fraser and Winter Park partner with a provider and/or other regional entity. However, direct grant funding from the State or other sources are unlikely to be available.

As a result, VPS presents the following options:

6.1 Option 1: Develop a FTTP Network with a Provider-Partner[19]

Section 4.2.1 detailed the capital costs for three FTTP models. As noted, there is an estimated $5,396,000 difference between a network that reaches 30% of the premises in Fraser and Winter Park and one that reaches all premises constructed 100% underground.

At a minimum this would require a capital investment of over $5 million (not including the costs of operating the system). The question to be answered is whether the benefits would justify an investment of this size.

6.1.1 Benefits

An FTTP Network could, among other things:

- Bring gigabit speeds to the Fraser Valley;
- Increase economic development opportunities;
- Increase real estate value (particularly for those areas that are currently unserved by fiber);
- Deploy infrastructure that will serve the Valley for the next 30+ years (including WiFi);
- Enable the Fraser Valley to compete with neighboring communities.

However, there are some significant challenges associated with deploying an FTTP Network.

6.1.2 Challenges

Although market penetration varies greatly from project to project, it is common, but not guaranteed, to achieve between 30% to 60% penetration in areas where existing broadband speeds are lacking. Because it is premature (unknowns include pricing, timeline, etc.…) to attempt to obtain commitments and sign-ups from residents wishing to purchase service, it is unclear where those possible penetration areas are located. However, by building to fewer than 100% of the premises, it could exclude potential customers.

In addition:

- As evidenced by the survey responses, the take rates will depend significantly on the cost of services to residents as well as other variables; and the 30% to 60% penetration may not be achievable;
- This option carries the most financial risk;
- The operational costs are high;

[19] Based on our recommendations and discussions with the towns, it is not a viable option for the towns to deploy and self-operate a FTTP network. This option was not considered.

- It may not be possible to find a provider-partner who is willing to invest;
- If a provider-partner is not willing to make a financial investment, the burden of financing the network would rest squarely on the towns;
- If a provider is willing to invest, the provider may ask for full or partial ownership rights, thus potentially locking the towns into a long-term relationship with the provider;
- An open access network would be difficult to sustain with an FTTP model because additional providers would be competing for the same customers and would impact take rates. Thus, it would probably not be feasible for the towns to lease the network assets to anyone else.

6.1.3 Next Steps in Exploring this Option

If this path is selected, this option requires the most legwork to explore fully. A general overview of next steps is provided below. The towns must:

1. Determine what self-funding amounts (if any) the towns are willing and able to commit to the project. The towns must also determine what (if any), assets the towns will own. If public funds are being utilized, it is recommended (and may be required) that the towns own those assets.

2. Identify one or more potential companies that can serve as a last-mile provider. This can be done by one or all of the below:

    - Directly reach out to known potential providers such as MPEI;
    - Issue a specific targeted RFI/RFP seeking last-mile providers that includes an interview process. (This process may or may not result in the legal formation of a PPP).

    Note: If this process fails to identify a provider partner, nothing further can be done and this option is not viable.

3. Engage in negotiations with the identified provider to determine:
    a. Ownership and operational model;
    b. Open access policy;
    c. Whether to pursue grant or other types of funding.

4. Complete a business plan with the provider that includes a deployment schedule and determine if the network will reach 100% of premises or at what level it will serve.

5. Complete engineering and construction (including issuing any RFPs for these services).

6.2 Option 2 - Deploy a Middle-Mile Network

The cost of building a fiber mainline for 8.3 miles along highway 40 between the northern boundaries of the Fraser town limits south to the Winter Park Resort is significantly less expensive than any of the FTTP models. As detailed in Section 4.2.2, the cost estimates range from $482,000 to $704,000 depending on whether the fiber is constructed as a mix of aerial and underground or all underground. As a reminder, these costs are for backbone only and do not include the cost of electronics, drops, or buildings for fiber termination.

The middle-mile network model has been effectively deployed by numerous municipalities.

6.2.1 Benefits

Similar to an FTTP network, a middle-mile Network could also:

- Bring gigabit speeds to the Fraser Valley;
- Increase economic development opportunities;
- Increase real estate value (particularly for those areas that are currently unserved by fiber);
- Deploy infrastructure that will serve the Valley for the next 30+ years (including Wifi);
- Enable the Fraser Valley to compete with neighboring communities.

In addition there are these added benefits:

- The investment cost is much smaller and the risk is much less significant;
- The towns would own the network and this would be a valuable long term asset;
- This would need to be an open access network to maximize the amount of users and the towns could lease excess capacity (fiber and/or conduit) to providers and others. The return on the capital investment could be realized much more quickly;
- This could significantly increase competition.

6.2.2 Challenges

However, there are some challenges associated with deploying a middle-mile network including:

- It may be difficult to find an operator partner who is willing to manage less than 10 miles of infrastructure;
- The towns would need at least one provider to lease a large portion of the fiber to offset a large portion of the costs. As previously noted, one provider leasing fiber at the rate of $156 per strand pair could net approximately $155,376 for a ten year lease term. This would not entirely pay for the investment;

- The fiber backbone may not be enough of an incentive to attract potential last-mile providers to lease the network and build out to unserved neighborhoods.

6.2.3 Next Steps in Exploring this Option

A general overview of next steps is provided below for this option. The towns must:

1. Determine whether the towns can provide the full self-funding amounts for the capital and operating costs. It is not recommended that the towns share the infrastructure cost with a provider who may want ownership stake in assets.

2. Complete a business plan and determine asset/lease rates, financing plan and deployment schedule.

3. Identify one or more potential companies that can serve as a network operator as well as a last-mile provider. This can be done by one or all of the below:

    - Directly reach out to known potential providers such as MPEI;
    - Issue a specific targeted RFI/RFP seeking a network operator and last-mile providers that includes an interview process.

4. Develop legal/lease agreements for the network operator and users;

5. Engineer and construct the network.

6.3 Option 3 – Encourage Investment

This option carries the least amount of risk and the least likelihood of achieving the goals of bringing better broadband to the Fraser Valley.

6.3.1 Benefits

The benefits of this option include:

- It requires no financial investment on the part of the towns other than possibly utilizing town resources to conduct meetings and engage in procurement activities;
- MPEI may invest in building an FTTP network on their own which could bring most of the benefits and none of the risk;
- There may be others interested in investing.

6.3.2 Challenges

The challenges of this option include:

- Timing is dependent on the schedule of others;
- The towns may not find anyone willing to make an investment;
- Offering incentives for investment is not a strategy that has worked well for similarly unserved communities – otherwise the incumbents and others would have stepped in to provide service to those that are unserved by broadband.

6.3.3 Next Steps in Exploring this Option

The next steps would be:

1. Meet with MPEI to discuss network deployment in Fraser and Winter Park and determine what their network deployment plans are.

2. Issue specific and targeted RFI to encourage other providers to invest;

3. Meet with providers and businesses to try to encourage investment.

6.4 Final Recommendations

After reviewing the key observations noted in this section, and examining all the options, VPS provides the final following two recommendations:

1. Based on the totality of information discussed in this report, we recommend that the towns explore Option 2 – to design and build a middle-mile backbone network. While still in development, the neighboring Northwest Colorado Broadband model is promising and there could be ways to work with them that would be cost-effective (i.e. utilize NCB for network operations of the Fraser and Winter Park network).

   A middle-mile network would enable the towns to more cost-effectively build and own valuable infrastructure assets that could increase competition, provide revenue, and serve the community for the next thirty years. A middle-mile network can be pursued independently or in conjunction with MPEI. Additionally, a middle-mile network can form a foundation for an FTTP network down the road. However, if an FTTP network build is the initial model selected, you must commit to that model 100% and right now, the information analyzed in this Study does not suggest that an FTTP model is the best one to pursue.

2. Meet with MPEI to gain greater understanding of what the network plans are and what potential partnership could look like including whether MPEI would be interested in leasing a dark fiber backbone. This will also help determine whether MPEI will serve the needs of Fraser and Winter Park communities.

APPENDIX A – GLOSSARY

Backbone: A high-fiber count fiber optic mainline that provides connectivity to the internet. Connections to buildings from the backbone are called lateral connections.

Conduit: A means by which something is transmitted. The conduit houses the fiber.

Dark Fiber: Refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. *Also referred to as excess capacity.*

E-Rate: A federal program that provides reimbursement funding for telecommunications services to schools and libraries based on free and reduced lunch program percentages within an applying jurisdiction.

Fiber-to-the-Premise (FTTP): A last-mile network that connects all buildings in a community.

Gigabit Passive Optical Networks (GPON): This is equipment based at the premise that supports triple-play services, high-bandwidth, long reach, etc.

Indefeasible Right of Use (IRU): Commonly used in the industry to provide long-term access to assets. Conduit and fiber deployed is leased through an agreement called an IRU.

Last-Mile Network: Network that provides services directly to homes and businesses in the community.

Middle-Mile Network: Typically defined as a network that serves community anchor institutions (i.e. Schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses.

Open-Access Network: Network where the infrastructure assets (conduit and fiber) are made available under certain policies and procedures to multiple non-network owners.

Outside Plant (OSP): Commonly used to refer to construction of fiber assets.

Public Safety Communications Research (PSCR): A federal program that anticipates awarding up to $30,000,000 in grants and cooperative agreements by May 2017.

Public-Private Partnerships (PPPs): A relatively new phenomenon in broadband where partners establish a legal partnership that balances and apportions risk, benefit and control of a last-mile network.

APPENDIX B– FRASER FTTP NETWORK BREAKDOWN

FRASER		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 100% PENETRATION		
	Aerial & Buried	**100% Buried**
CO Electronics		
CO Electronics	**$188,000**	**$188,000**
Spares	**$11,000**	**$11,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$21,000**	**$21,000**
ONTs	**$525,000**	**$525,000**
ONT Installation	**$292,000**	**$292,000**
OSP		
Cable	**$1,360,000**	**$1,620,000**
Drops	**$628,000**	**$849,000**
Fiber Management	**$141,000**	**$141,000**
Total	**$3,172,000**	**$3,653,000**
Housing Units (Approx.)	1300	1300
Single Family/Business (Approx.)	634	634
MDU (Approx.)	73	73
Average Cost per Housing Unit	$2,440	$2,810
Mainline miles - Aerial	6.8	0.0
Mainline miles - Buried	9.2	16.0
Drops Miles - Aerial	12.5	0.0
Drops Miles - Buried	11.6	24.1
TOTAL MILES	**40.1**	**40.1**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 634 single family units and 73 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**

- **OSP cable costs include $102,000 for the backbone along Hwy. 40. (Aerial/Buried) or $135,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

FRASER		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 60% PENETRATION		
	Aerial & Buried	**100% Buried**
CO Electronics		
CO Electronics	**$118,000**	**$118,000**
Spares	**$11,000**	**$11,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$14,000**	**$14,000**
ONTs	**$315,000**	**$315,000**
ONT Installation	**$175,000**	**$175,000**
OSP		
Cable	**$1,360,000**	**$1,620,000**
Drops	**$377,000**	**$509,000**
Fiber Management	**$98,000**	**$98,000**
Total	**$2,474,000**	**$2,866,000**
Housing Units (Approx.)	780	780
Single Family/Business (Approx.)	381	381
MDU (Approx.)	43	43
Average Cost per Housing Unit	$3,172	$3,674
Mainline miles - Aerial	6.8	0.0
Mainline miles - Buried	9.2	16.0
Drops Miles - Aerial	7.5	0.0
Drops Miles - Buried	7.0	14.5
TOTAL MILES	**30.5**	**30.5**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 381 single family units and 43 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**

- **OSP cable costs include $102,000 for the backbone along Hwy. 40. (Aerial/Buried) or $135,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

FRASER		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 30% PENETRATION		
CO Electronics	**Aerial & Buried**	**100% Buried**
CO Electronics	**$65,000**	**$65,000**
Spares	**$11,000**	**$11,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$8,000**	**$8,000**
ONTs	**$158,000**	**$158,000**
ONT Installation	**$88,000**	**$88,000**
OSP		
Cable	**$1,360,000**	**$1,620,000**
Drops	**$189,000**	**$255,000**
Fiber Management	**$66,000**	**$66,000**
Total	**$1,951,000**	**$2,277,000**
Housing Units (Approx.)	390	390
Single Family/Business (Approx.)	190	190
MDU (Approx.)	22	22
Average Cost per Housing Unit	$5,003	$5,838
Mainline miles - Aerial	6.8	0.0
Mainline miles - Buried	9.2	16.0
Drops Miles - Aerial	3.8	0.0
Drops Miles - Buried	3.5	7.3
TOTAL MILES	**23.3**	**23.3**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 190 single family units and 22 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**

- **OSP cable costs include $102,000 for the backbone along Hwy. 40. (Aerial/Buried) or $135,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

APPENDIX C– WINTER PARK FTTP NETWORK BREAKDOWN

WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 100% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$376,000**	**$376,000**
Spares	**$12,000**	**$12,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$40,000**	**$40,000**
ONTs	**$1,129,000**	**$1,129,000**
ONT Installation	**$628,000**	**$628,000**
OSP		
Cable	**$2,127,000**	**$2,711,000**
Drops	**$1,353,000**	**$1,828,000**
Fiber Management	**$302,000**	**$302,000**
Total	**$5,973,000**	**$7,032,000**
Housing Units (Approx.)	2800	2800
Single Family/Business (Approx.)	1366	1366
MDU (Approx.)	157	157
Average Cost per Housing Unit	$2,133	$2,511
Mainline miles - Aerial	15.3	0.0
Mainline miles - Buried	11.4	26.7
Drops Miles - Aerial	27.0	0.0
Drops Miles - Buried	24.9	51.9
TOTAL MILES	**78.6**	**78.6**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 1366 single family units and 157 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $477,000 for the backbone along Hwy. 40. (Aerial/Buried) or $709,000 for the 100% buried version.**

NOTE:
We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 60% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$221,000**	**$221,000**
Spares	**$12,000**	**$12,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$25,000**	**$25,000**
ONTs	**$678,000**	**$678,000**
ONT Installation	**$377,000**	**$377,000**
OSP		
Cable	**$2,127,000**	**$2,711,000**
Drops	**$812,000**	**$1,097,000**
Fiber Management	**$211,000**	**$211,000**
Total	**$4,469,000**	**$5,338,000**
Housing Units (Approx.)	1680	1680
Single Family/Business (Approx.)	820	820
MDU (Approx.)	94	94
Average Cost per Housing Unit	$2,660	$3,177
Mainline miles - Aerial	15.3	0.0
Mainline miles - Buried	11.4	26.7
Drops Miles - Aerial	16.2	0.0
Drops Miles - Buried	15.0	31.2
TOTAL MILES	**57.9**	**57.9**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 820 single family units and 94 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $102,000 for the backbone along Hwy. 40. (Aerial/Buried) or $135,000 for the 100% buried version.**

NOTE:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.

WINTER PARK		
PROPOSED FTTP HIGH LEVEL ESTIMATE - 30% PENETRATION		
	Aerial & Buried	100% Buried
CO Electronics		
CO Electronics	**$105,000**	**$105,000**
Spares	**$12,000**	**$12,000**
Misc. Materials	**$6,000**	**$6,000**
Installation (10%)	**$13,000**	**$13,000**
ONTs	**$339,000**	**$339,000**
ONT Installation	**$189,000**	**$189,000**
OSP		
Cable	**$2,127,000**	**$2,711,000**
Drops	**$406,000**	**$549,000**
Fiber Management	**$142,000**	**$142,000**
Total	**$3,339,000**	**$4,066,000**
Housing Units (Approx.)	840	840
Single Family/Business (Approx.)	410	410
MDU (Approx.)	47	47
Average Cost per Housing Unit	$3,975	$4,840
Mainline miles - Aerial	15.3	0.0
Mainline miles - Buried	11.4	26.7
Drops Miles - Aerial	8.1	0.0
Drops Miles - Buried	7.5	15.6
TOTAL MILES	**42.3**	**42.3**

Assumptions:

- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building.**
- **Assumes 100% penetration.**
- **Estimates include engineering fees or taxes.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **Drop costs assume approx. 410 single family units and 47 MDU units (Derived from Grand County GIS Data) $500 per aerial drop and $1000 per buried drop.**
- **OSP cable costs include $102,000 for the backbone along Hwy. 40. (Aerial/Buried) or $135,000 for the 100% buried version.**

NOTE:
We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

These are estimates of the total project costs and do not consider any limitations due to the FCC's Capital Investment Allowance (CIA). Please contact Vantage Point if you would like assistance determining your CIA limits.