Maine West Regional Technology Plan

Full Report

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June 25, 2018
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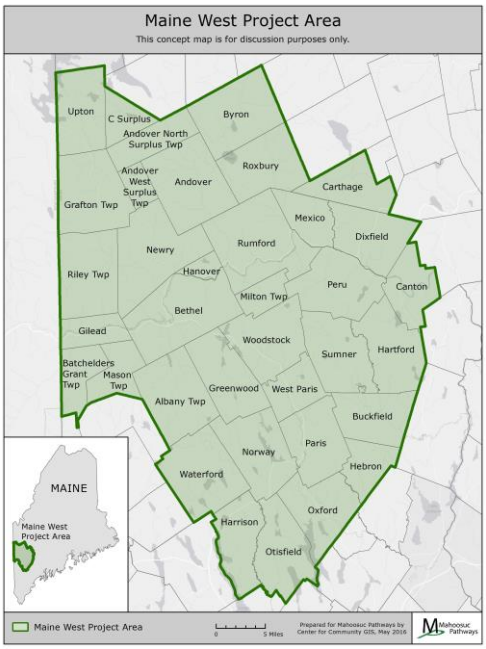
I. Maine West

Development of this plan was funded by a grant from the ConnectME Authority secured by the Northern Forest Center on behalf of Maine West – a partnership of local and regional organizations dedicated to addressing systemic rural challenges and enhancing community well-being in western Maine through increased collaboration across the economic, education, health and conservation sectors.



Focused in the Oxford Hills, River Valley and Bethel areas of northern Oxford County, Maine West advances its mission through a three-part, multi-sector program strategy:

- Broadband Access & Adoption – Identify and advance local and regional strategies to expand access to and utilization of broadband internet services to create jobs and support public safety, education, healthcare, tourism and overall quality of life.
- Active Communities – Improve local health outcomes, encourage youth and school groups to get outside and exercise, promote recreation on local conservation lands, and position rural communities as attractive places to live and raise families.
- Educational Aspirations & Attainment – Work with area school districts to develop new programs to expand learning opportunities and improve the linkages between schools, communities and local businesses.

Development of this plan was coordinated by Maine West partner Community Concepts Finance Corporation as part of its county-wide economic development program, and represents a first step in advancing a regional Broadband Access & Adoption strategy for the Maine West area. Moving ahead, Maine West partners are committed to working with local communities, businesses, and non-profits to implement recommendations outlined in this report and help the Maine West area capitalize on the promise of digital technology to enhance rural quality of life.

MAINE WEST PARTNERS

- Northern Forest Center (coordinator)
- Community Concepts Finance Corp.
- Androscoggin River Watershed Council
- Bethel Area Chamber of Commerce
- Appalachian Mountain Club
- Bethel Area Non-Profit Collaborative
- Mahoosuc Pathways
- Mahoosuc Land Trust
- Oxford County Wellness Collaborative
- Trust for Public Land
- Appalachian Trail Conservancy
- Western Foothills Land Trust
- U. Maine Coop. Ext., Bryant Pond 4-H Camp
- Cathy Newell (at large/ Adult Ed)
- Steve Wight (at large)

To learn more about Maine West and its regional program strategy, or to access resources identified in this report visit: www.mainewest.org

II. Axiom & Its Vision for the Future

Axiom is a telecommunications and professional services company specializing in last-mile, rural deployments.

Axiom believes every connection counts.

Axiom believes that broadband access is vital in today's digital age to create and sustain jobs and provide equal opportunity healthcare and education to all. We strive to create economic opportunity for everyone and to advance rural telecommunications models that are sustainable, scalable and replicable.

Axiom's Company mission is to deliver strategic and customized rural broadband deployment solutions to remote communities everywhere.

Since our beginnings with the first fixed wireless internet connection in Washington County over 13 years ago, Axiom has grown to be a leading authority on rural broadband planning and deployments with innovative out of the box thinking that can save money, time and headaches. We work closely with leaders and area residents to design and deliver products and solutions specifically designed for each community's needs.

Axiom uses the best combination of product solutions to help build networks.

Our deployment framework provides a methodology that allows for flexibility, but at the same time adheres to a clearly defined path. This helps ensure that the best product mix and execution is used for each community. Axiom is unique in Maine because we utilize the technologies that we recommend in our own network that includes Fiber Optics, Fixed Wireless, and DSL while always pushing the boundaries to test and deploy new technologies that include TV White Space with Microsoft as our partner and licensed LTE wireless technology that can reach customers in the remotest and most difficult areas to serve.

"At Axiom, we believe rural broadband deployment is about much more than a fast connection- it is about people's livelihoods, education and well-being"

Axiom's vision for the future

Communities across Maine West are looking for solutions to help preserve their way of life. But in the digital age that we live in healthcare, education, job growth, even shopping and entertainment, are impacted by the type of broadband connections available to the citizens who live, work and play in each and every one of your communities. At the end of the day, people just expect the broadband connection to work, they do not care about the technology (DSL, Cable, Wireless or Fiber) but rather if the connection does what they need to it to do.

We believe that all of you reading this report have an opportunity to change the economic status of the Maine West area by investing in regional and individual community projects that will bring business prosperity and social fairness and give individual citizens the tools they need to create their own economy through better internet connections.

Right now, the majority of the connections in the region are either DSL or Cable, and both run on essentially the same technology. These technologies have limitations that make them less than ideal, although they are making some strides in addressing the needs of their customers.

In many regions across Maine fixed wireless technology is deployed to address difficult and expensive to reach rural areas but is not ideal without line of sight from the home to the tower on which the equipment is broadcasting.

An emerging tool that widely viewed as the standard to replace these less than optimal technologies is Fiber Optics as a last-mile connection solution. For many years fiber has been used to transport large amounts of data at the speed of light across the world. Because it is expensive, it is only in the past few years that it this technology has begun to be used to directly connect the internet to each home or business.

The optical fiber cable in the foreground has the equivalent capacity of the copper cable in the background.

Fiber optics is more expensive than other technologies to deploy, however, it is also much more futureproof with a life of 20, 30 even 40 years or more – often making this costlier investment up front, the least expensive option over time.

While expanding or enhancing current technologies may make sense today, rapid changes in how the internet is being used is driving decision making toward a more permanent solution, that can withstand the increased demand and reliability that only fiber will allow.

Business Development. Much of the region has micro- or home-based businesses and the lack of better connectivity is hurting their prospects to grow. The location of a home or small business dictates the reliability, speed and cost of the connection. High-speed internet is one tool that can address the economic lag that is created by lack of connectivity.

Business Attraction. Communities across Maine look to bring new businesses to their communities, helping to rebuild Main Street and bring vibrancy to their downtowns. However, in rural communities the challenge is to differentiate themselves from other, equally attractive places. We often hear that a business will not move to a location with a poor internet connection.

Workforce Development. Because Maine is one of the oldest states in the nation, we often struggle with keeping our young people or attracting new families to our communities. World class connectivity allows working-age families, who can increasingly work from anywhere, to move to Maine for our way of life while still maintaining a job elsewhere.

Telemedicine. We have already mentioned that we are an aging state, and that will require better solutions for our seniors who wish to stay in their homes longer and are increasingly able to receive care through tools that are fully enabled by a robust internet connection.

Education. Lifelong learners and our children are increasingly being left behind by not being able to do their homework or educational work online because of the lack of connectivity, expanding what is commonly called the Digital Divide.

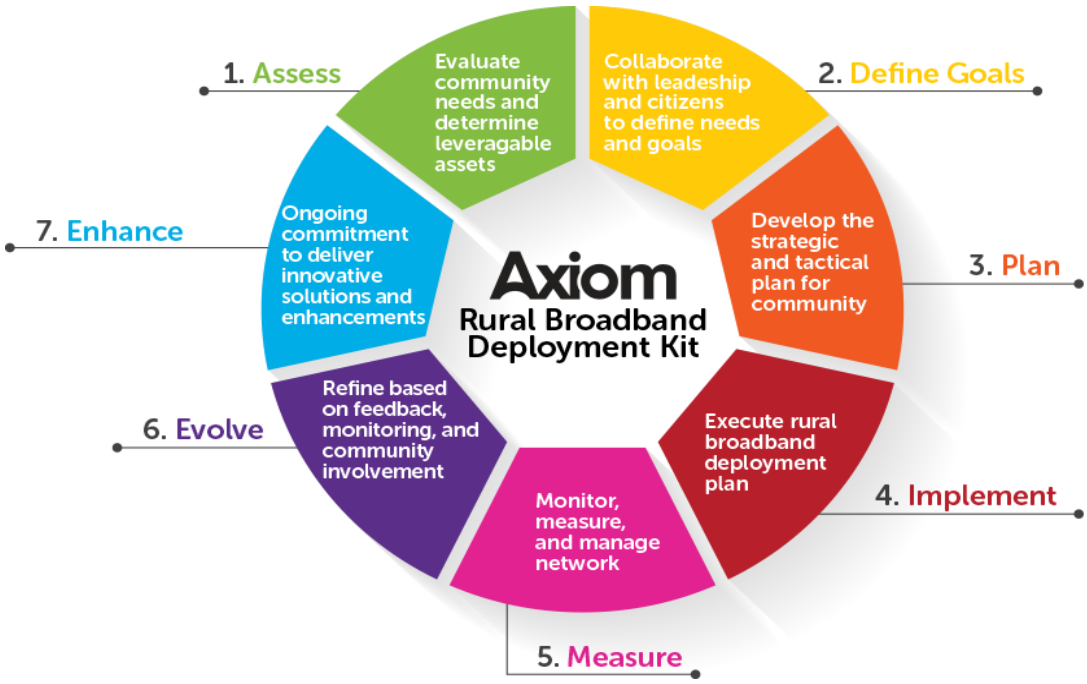
The technology tradeoff is cost versus capability. If the region wants to transform itself and build a 21st Century economy and leapfrog much of Maine and the rural U.S., Axiom strongly recommends fiber as the technology to consider. It helps Maine West reach all of its goals, makes the region even more attractive than it is already, and will support future internet demand with little to no upgrades. The region currently has a significant amount of fiber that with some concrete steps and this vision can be utilized to better serve homes and businesses.

While we recommend the use of fiber wherever feasible and practicable, we recognize the cost and other factors that might lead a community to consider other technologies or expanding current provider coverage as a lower cost option.

See Appendix A for a more complete explanation of the long-term benefits of investment in fiber optic networks.

III. Study Background and Structure of Report

Axiom uses a planning and deployment methodology that helps move partners through the process of planning, building and managing a Broadband Deployment Project. For the purposes of this report, we have worked both regionally and at the community level through the first 3 steps of this process and begun to look for opportunities to implement Step 4 projects. Steps 5-7 are beyond the scope of our planning work but are a visual guide on how projects are managed once they are constructed and operational.



Assess

Work with existing Internet Service Providers to obtain coverage areas and assess any gaps in coverage that needs to be addressed. Identify any assets that exist and might be utilized.

Define Goals

We interviewed almost all 25 communities in the Maine West area and worked with them to develop goals on what they would like to achieve. We also asked each community to form a Broadband Committee as a mechanism to disseminate information to the community about Broadband connectivity in their town and to be a champion for future investments.

Plan

The plan for Maine West includes:

- As much documented mapping as available for current provider coverage areas in the region

- Fiber plans for those communities that requested them
- Wireless solutions for communities looking for a low-cost solution for unserved or underserved areas
- HotSpots that can serve high-traffic areas, or as a limited replacement for poor cellular data service
- A series of regional recommendations
- A Digital Inclusion Plan that addresses four components:
  - Affordable Internet
  - Affordable Computers
  - Digital Literacy
  - Public computer access

Implementation

The planning document is meant to provide a springboard for implementing local and regional recommendations. We provide a menu of options, based on the goals of the community, to identify actionable projects to help communities build their internet capacity. To this end, we have included a list of potential federal and state grant programs that towns or the region may consider for funding these projects.

Axiom stands ready, long after this planning phase is completed, to answer questions, attend meetings and work with Maine West or any community to implement these recommendations. This document is a beginning to a process of bringing better internet connectivity to the region or individual communities.

IV. Technology Terms

Like other industries, the internet technology sector and Internet Service Providers use a set of common terms to the industry that are not commonly understood by the public. This section is designed to give definition to the terms you will encounter throughout this document.

Mbps – Megabits per second are a unit of measurement for bandwidth and throughput on a network. Practically speaking, the higher the Mbps, the better user experience will occur or the more devices that can use the same connection easily and without lag or interruption.

Broadband – Is a general term used to define high speed internet connections to the premise. The Federal Communications Commission defines Broadband minimally as a 25/3Mbps connection.

Download vs Upload Speeds – An internet connection has two speeds that indicate "download" and "upload" speeds. The service level always has the download speed first and the upload speed second (e.g. 25/3Mbps; 25 indicates download, 3 indicates upload).

Most connections are designed to download much faster than upload since the majority of online activates, like loading web pages or streaming video consists of downloads. Upload speed is how fast you send data from your computer to others.

Symmetrical service – Internet connections that have the same download and upload speeds (e.g. 25/25Mbps).

DSL – Digital Subscription Lines is a term used for internet connections using your copper telephone lines.

Fixed Wireless – Is the use of a microwave wireless signal to connect two fixed locations, typically from a tower to a subscriber's home.

Fiber Optics – refers to the transmission of information through a flexible fiber of glass using pulsating light.

Cable - also called coaxial cable (thicker copper than DSL) to transmit telephone, television and internet signals.

Public-Private Partnerships– For the purpose of this document is defined as a contractual relationship between an Internet Service Provider (ISP) and a community that delineates each other's roles and responsibility in owning and operating a network.

Technology comparison

Technology	Pros	Cons	Cost
DSL (Digital Subscriber Line)	▪ Already covering most of county ▪ Can reach low density areas effectively, but requires equipment upgrades	▪ Old Technology ▪ Copper is susceptible to corrosion ▪ Distance the signal can push is limited (3 miles) ▪ Very limited bandwidth (less than 25Mbps) ▪ Not symmetrical	$70,000 per new Remote terminal
Cable	▪ Recent upgrades are able to achieve over 100Mbps ▪ Provider is open to expansion ▪ Reliable ▪ Can bundle, phone data and TV	▪ Not as scalable, expensive to upgrade ▪ Not truly symmetrical- limited on how bandwidth can be pushed in both directions ▪ Shared system, demand on system effects user experience ▪ Expensive to consumer	A recent quote to serve 5-7 homes in a 2-mile stretch was $250,000
Fixed Wireless	▪ Reach areas not covered by current providers ▪ Lower cost solution ▪ Line of Sight best application for Wireless	▪ Can be affected by weather ▪ Less reliable than fiber ▪ No guarantee that all homes can be served in an area ▪ Terrain and other factors affect the signal	$100,000-$150,000 per 100 connections
Fiber	▪ Current technology allows for up to 1Gig (1000Mbps) of service to each home ▪ Easily and inexpensively scalable ▪ Top reliability among all technologies ▪ Futureproof- 20 years or much longer ▪ Symmetrical- built for the future ▪ Can deliver data, phone and streaming TV content	▪ Up-front costs are much more expensive ▪ Financial model is more difficult to achieve in very rural applications ▪ Often requires subsidy of outside (taxpayer) dollars to deploy	$30,000 per mile, $800-$1000 per connection to the home

V, Internet Providers

The Maine West region has several internet providers who use two main types of connections from the internet to the subscriber premise -- DSL and Cable. Spectrum offers co-ax cable connections that can deliver high-speed internet, phone and television. Consolidated Communications and FirstLight offer DSL service to homes and generally cover the more rural parts of the Maine West area. All three do have fiber in the region, but it is expensive to access and is typically reserved for business use. We are aware that other Internet Service Providers also provide internet service, including GWI and satellite services, such as HughesNet.

Spectrum
(Formerly Time Warner Cable) Spectrum serves some area communities, typically in their downtown, or more populated residential areas. Since becoming Spectrum, company officials have been reaching out to communities to renew their franchise agreement. Spectrum, like many cable TV operators, has non-exclusive rights to offer their television service to a specific town or territory in the form of a Franchise Agreement. These agreements typically return a certain percentage of the revenue collected from subscribers back to the municipality while the cable operator is typically required to reach a specific threshold of numbers of homes served.

Many of these agreements are out of date and were signed many years ago. Renewing these agreements can provide an opportunity the community to review the old document to ensure that Spectrum is living up to the terms of that agreement, while simultaneously, giving the community a leverage point for further negotiations to expand service, or adjust franchise fee payments to the town.

Many Maine West communities are currently in negotiation with Spectrum and results of those negotiations will emerge over the next few months.

Spectrum has service in the following communities:

Andover	Bethel	Buckfield	Dixfield	Woodstock
Greenwood	Otisfield	Newry	Norway	West Paris
Roxbury	South Paris	Waterford		

Spectrum's main offering is cable TV delivered through co-ax cable. Internet and phone service is also offered as part of Spectrum's Triple Play. Spectrum also offers on-demand fiber service, typically on a case-by-case basis and only to businesses. Recently, Spectrum has been aggressively increasing Broadband service speeds to the home, going from a 50Mbps to a 100Mbps offering, and a second plan that offers up to 120Mbps. Legacy Time Warner customers can keep their current plans, but Spectrum has rolled out these new plans across the state and only offers the two tiers of internet to new customers.

Because of the way that Spectrum's technology works, the internet service that each home receives can vary depending on usage from other homes along the cable route. At heavy use times (i.e., after school or in the evening), speeds can be slowed considerably by the demand on a finite amount of bandwidth that can travel along that route.

Consolidated Communications (formerly FairPoint Communications)

Consolidated is an ILEC (Incumbent Local Exchange Carrier) that provides local phone service via the Telecommunications Act of 1996. Over time, ILECs like Consolidated have evolved to offer internet service (i.e., DSL) over the same infrastructure that provides local phone service.

Consolidated has service in the following communities:

Rumford	Dixfield	Norway	Oxford	Mexico
South Paris	Paris	Waterford	Peru	Hanover

DSL is a technology that has several limitations but is also available in more remote areas. Currently, through an influx of federal dollars, Consolidated Communications continues to upgrade eligible census blocks throughout the state. For Oxford County, those upgrades have been completed and Consolidated reports no new upgrades will occur in 2018. For those that received upgrades, new offerings allow for up to 25Mbps and minimum speeds of 10Mbps. Because of the age of the copper and the rural nature of their service, reliability and speeds can vary widely. The farther away from the equipment a subscriber is, the lower the maximum speeds are available, and reliability can also suffer.

However, as mentioned, DSL offerings from Consolidated often serve remote areas where no other alternative (other than satellite or cellular hotspots) can bring service, making Consolidated DSL service indispensable in many areas in Maine.

In addition, Consolidated Communications operates an extensive fiber optic network in Maine and offers fiber service to businesses that need this type of connectivity.

FirstLight (formally Oxford Networks)

FirstLight is also an ILEC and their technology (DSL) and service offerings are typically comparable to Consolidated. Offerings to residents range from 20Mbps to 3Mbps or less, dependent on the location of their equipment and the quality of the lines. They have aggressively worked on obtaining business customers with a robust fiber optic trunk through western Maine and beyond. In our discussions with FirstLight they are focused on utilizing their fiber assets and are aggressively marketing to businesses, while not indicating any desire to enhance their DSL.

FirstLight has service in the following communities:

Buckfield	West Paris	Bethel	Sumner
Canton	Greenwood	Bryant Pond	Andover

VI. Regional Recommendations

The following recommendations represent opportunities for organizations and communities across the Maine West region to work together to address common issues, leverage shared interests and capacities, and demonstrate tangible progress:

- Build momentum through a Regional Public Awareness Campaign
- Create a series of HotSpots throughout the region to support connectivity for visitors and the unconnected
- Fund a Digital Inclusion program that invests in your citizens
- Develop a Last Mile Fund
- Leverage the Willing
- **Aspirational**: Begin to address inequity by building a regional, open access fiber loop

Regional Recommendation #1- Public Awareness Campaign

One of the concerns we have in any planning project is the uneven understanding of internet technology and the varied opinions of communities, citizens and thought leaders about their connectivity needs. Many come to these issues with a healthy skepticism about the need at all for better connectivity. Through our engagement with Maine West communities there was quite a range of understanding about internet services and how to craft achievable connectivity goals. This is not uncommon.

We are convinced, though, that additional federal and state resources are going to be available over the next year and beyond. Making sure the region is ready to move quickly on these opportunities with public support for implementation plans, will go a long way toward successfully securing funding and implementing projects.

Axiom's Recommendations are to:

- Enhance the Maine West website as critical resource of information, dialog and handouts
- Create a "Community Kit" of tools that can be used by Maine West communities to hold community meetings and begin to discuss why better connectivity is so important to the region
- Celebrate every win, and make sure local media is invited and covers these events
- Write op-ed pieces and ask to go and visit the local papers to help them understand and write about the Maine West collaborative and the connectivity issues in the region

This is a start, but with sustained effort results will follow as demonstrated through other efforts like the Island Institute or Our Katahdin, both of which have made Broadband a centerpiece of their economic and social development strategy. Build on the success and increasing recognition of the Maine West collaborative.

Regional Recommendation #2- Regional HotSpot Plan

Community HotSpots are open access networks in a downtown or other public space. This is a simple, straightforward way to help the region get better connected.

Creating a comprehensive regional series of free or low-cost Wi-Fi HotSpot locations would meet two strategic regional objectives. First, HotSpots help support local citizens who cannot receive an internet connection because of the location of their home or cannot afford a connection, giving them

locations to access the internet, without using expensive and unreliable cellular data plans. Second, HotSpots provide an important service to visitors and tourists to the area – enabling them to connect to home networks and enabling critical online access to information about local assets and amenities.

HotSpots offer several advantages to traditional cellular networks. A HotSpot provides faster downloads, which make surfing the web much easier and allow users to both work and play on the internet more efficiently. HotSpots also offer the flexibility to connect to a variety of devices, including tablets and laptops. Last, HotSpots allow cellular data use, without eating up costly data plans.

Maine West communities that have a goal to install one or more HotSpots include:

- Bethel- Downtown coverage (3)
- Andover- Serve hikers, day visitors (2)
- Dixfield- Downtown park (1)
- Hartford- Town Office (1)
- Norway- Downtown/town commons (3)
- Paris- Park/downtown (3)
- Roxbury- Boat launch/cellular substitute (6)
- West Paris- Town Office (1)

Rather than have communities compete with each other for resources to install HotSpots, a regional plan would have the communities working together to install the proposed HotSpots as a collaborative project.

Estimated Regional HotSpot Project Costs:

Year 1

$3000 per install x 20 HotSpots = $60,000
Included:

- Installation at each site (must have power and a place to mount hardware)
- Phone Tech support (Monday- Saturday, normal business hours)
- On site break/fix support, including any replacement of units
- Monthly usage reports for each site that includes the number of unique and recurring users, where traffic is being directed and how much bandwidth is being used and when

Not Included:

- Cost of electricity at each site (nominal)—typically the cost of a 60-Watt light bulb at each site
- Monthly cost of the internet- typically between $49.99—$119.99, depending on the carrier and amount purchased
  - Consider contracting with one company at all sites to perhaps receive a wholesale price
- Cost of signage ($50—$75 per sign) advertising the HotSpots

Year 2 - 5

Annual fee of $1000/per HotSpot = $20,000, reduced to $5000 a year
Included:

- Phone Tech support
- On site break/fix support, including any replacement of units
- Monthly usage reports for each site that includes the number of unique and recurring users,

where traffic is being directed and how much bandwidth is being used and when

Not Included:

- Cost of electricity at each site (nominal)—typically the cost of a 60-Watt light bulb at each site
- Monthly cost of the internet- typically between $49.99—$99.99, depending on the carrier and amount purchased

Sponsorships:

Contained in the individual plans for each of the communities interested in installing HotSpots are ideas for how these HotSpots have been funded in other areas by local businesses, regional entities and local donors. For a regional approach like this, Axiom recommends focusing on the recurring costs of the project in Years 2—5, assuming that a grant can be identified to cover the initial cost of installation and Year 1 costs.

Each of the HotSpots can advertise a sponsor by directing users to the sponsor's homepage, giving the sponsor potentially many 1,000s of eyeballs on its products or services. Maine West could also create a landing page that has all of the sponsors on it and advertises regional amenities, such as pharmacy, restaurant or gas/convenience store locations, recreational amenities and more. A home page can be customized in any way.

Regional Recommendation #3- Digital Literacy Training

This report includes a Digital Inclusion and Regional Workforce Plan. The 4-part Digital Inclusion Plan includes a Digital Literacy section that focuses on helping local residents become digitally literate by utilizing your internet connection. The non-profit National Digital Equity Center is part of the Axiom Education & Training Center and is focused exclusively on a national model for training through a program focused entirely on Digital Training and Digital Inclusion.

As more people's livelihoods are based on their proficiency with digital tools and processes, investing in local citizen's skill levels in the digital economy can help change the economic status of the Maine West region.

Axiom recommends development of a coordinated Regional Digital Literacy initiative that can be customized to fit the needs of the Maine West region based on the survey results and the needs of local employers and individual educational needs.

Estimated Regional Digital Literacy Budget: $104,000/year

Includes:

- Instructor/Teacher
- All Travel costs
- All supplies needed for each class
- Curriculum
- Administrative oversight of program

Budget is based on:

- One Year program
- 6 classes per week

- 10 students per class

For more details on this recommendation please see the accompanying Digital Inclusion and Workforce Investment Plan.

Recommendation #4- Last Mile Fund

Axiom recommends raising a $100,000 fund to seed small connectivity projects across the region. This is an idea that builds on the Our Katahdin Kickstarter campaign (www.ourkatahdin.com) where small project funds are raised through an online portal right on the Our Katahdin website. In the Maine West case, Axiom suggests using this method to raise money for connectivity projects that help businesses and residents gain connectivity while building momentum of a public awareness campaign about connectivity issues and why 21st Century communications is a critical asset to helping Oxford County stay vibrant. Following are recommended guidelines for development and implementation of a Last Mile Fund.

- Projects are limited to $5000 or less, with a required match from the project recipient
- Must be related to meet a specific connectivity goal of the region, such as closing the Homework Gap
- Could be used to connect unserved homes that fit a particular profile, such as qualifies for reduced school lunch program
- Pay for HotSpots, a computer/tablet lending library, or other connectivity devices such as Mobile Mi-Fi Hotspots for home use

Axiom is confident that this approach will attract other local and regional funding and encourages Maine West to develop goals and criteria for such a fund and begin to look for funders. Small wins, and celebrating those wins is a wonderful way for regional citizens to become aware of the importance and the lack of connectivity around the Maine West region.

Recommendation #5- Leverage the willing

Axiom strongly recommends that the Maine West area prioritize projects that are most likely to succeed and help build momentum for those projects that might take a bit more time, effort and consensus building. Projects that are ready have several key ingredients that place them at the top for consideration.

- They have a funding source available to them
- Project has strong local or regional support that includes a willingness to self-fund or match a funding source
- The project meets a specific objective or goal

There are several community-level recommendations in this report that have the ingredients to move ahead in the near-term. We urge the region to aggressively move forward with these local projects and begin to demonstrate momentum with concrete and visible actions. The following section of Community Plans (Section VII) includes three examples of ambitious projects that are already underway or achievable, meet specific goals, and can help other communities learn and build momentum for a project.

By leveraging the willing, you can build a public awareness campaign that helps explain why we believe better connectivity will lead to regional prosperity and is an essential ingredient in a 21st Century economy.

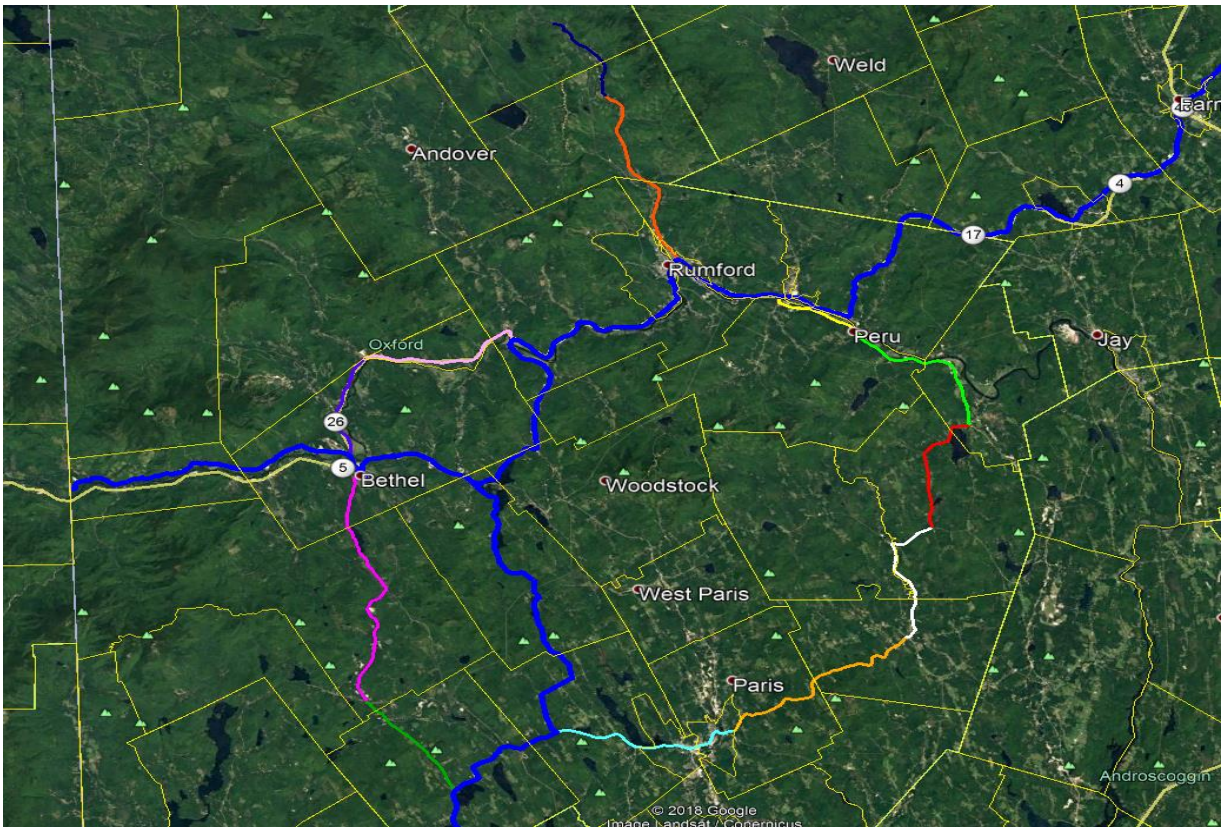
Recommendation #6 - Open Access Regional Fiber Optic Loop

Oxford County has a significant amount of fiber optic cabling that Spectrum, FirstLight, Consolidated and GWI own or operate. However, these assets are not utilized to bring service to the home and act only as transport to service private operators' equipment and power their current technology. They do not establish fiber to the premise solutions, except in the case of individual businesses that can afford the cost of hooking up directly to the fiber.

The area is also served by the Three Ring Binder – a middle mile, high capacity fiber optic network designed to provide open access at consistent pricing as a way to level the playing field for smaller providers who do not have the capital to build their own fiber networks. The intent of the Three-Ring Binder is to create a more competitive environment where prices might come down for consumers.

While the Three Ring Binder (3RB) brings significant capacity to the area, it only serves part of the region, and is being underutilized to connect subscribers by other potential providers.

Axiom recommends a long-term plan to build a high capacity extension off the Three Ring Binder to expand this network to more communities and create the conditions for those communities to have open-access fiber. By connecting this new loop to the 3RB, the region can preserve open access, promote competition, dictate terms of use, and generally provide access to participating private ISPs.



Axiom
every connection counts

Proposed Regional Open Access Fiber Loop

In the graphic above, the 3RB is depicted in blue; the other colored lines represent the proposed segments that would need to be built to create the loop. There is one spur that would run from Mexico through Roxbury and Byron on Route 17.

While this recommendation does not deliver direct connections to homes or businesses, it provides the conditions and backbone of fiber necessary to support individual community build-outs to the premise. This is a big, multi-year project that should be viewed as an aspirational idea that might be considered if a significant federal program were established similar to the one that built the $32 million 3RB. The idea here is to extend the idea and concept of the 3RB as a regional approach that could help more communities consider fiber networks that can support near and long-term connectivity demands of the region.

Total Cost of Project:

Fiber Materials	$1,047,861.00
Fiber Labor	$1,679,195.00
Licensing and Make Ready	$598,815.00
Replacement Poles (10%)	$681,000.00
Total	**$4,006,871.00**

There are several options for ownership and management of this type of new open access fiber loop:

Public Ownership - Maine law allows a region or band of communities to come together a form a Broadband utility. This model is based on older regional cooperatives with a Board of Directors of local elected officials who would manage the system and contract out various aspects of the network operation. Recently, the communities of Calais and Baileyville have formed this type of Broadband utility to manage the construction and operation of a new FTTH project in each community that they hope to build. This is a model that is being utilized in Islesboro, where the town maintains ownership, and the cost of break/fix including equipment and has hired a network operator for a fixed yearly fee to operate the network.

Public-Private Partnership - This model can have several options, but in general public partners secure funding, an RFP would be issued for contractor services to build the network and/or operate it once it was built. In this scenario, a public-private partnership agreement (franchise) would be negotiated with a private operator who would take responsibility for the network maintenance and upkeep in exchange for operating and serving customers on the network exclusively.

Private – This is essentially how the region is served now – a series of operators (ISPs) who deliver service based on market profitability and customer demand, with pricing and service levels entirely dictated by the ISP. In the case of the fiber loop proposal, there would be a substantial, if not entire public subsidy, for the system to be built, and an ISP would essentially take it over, either immediately or over time. This is the least risky to the towns or region, but it also offers little to no control once the system is in place and handed over to the ISP for operation.

Moving forward with a project of this scale will require a significant amount of thought and research on collaborative structures, how ownership would work, and many options within each of the three ownership scenarios listed above.

While is an ambitious proposal, it also represents an opportunity for communities take charge of their connectivity future, to share infrastructure costs, and to provide truly high-speed, future-proof internet connective to towns and rural residents and businesses across the Maine West region.

Axiom recommends the following steps to move this concept forward:

- Form a regional entity or task the regional Broadband Committee to explore all options and make a recommendation
- Apply for a grant to help fund such a study
- Begin to outreach to the communities to discuss options
- Look for federal funding to support the construction

For more explanation of this recommendation and a complete budget, see Appendix B Fiber Street-Level Budgets.

VII. Community Plans

Over the last several months, each of the communities in this section were tasked with setting goals and interviewed. Communities have three basic choices:

Work with their current provider(s) to expand or enhance service

For those communities that have an opportunity to work with their current providers, this path offers the least risk, and possibly the least amount of public subsidy. However, it also does not offer a transformational project that will last for many years to come and likely would be built on DSL or co-ax cable, the two predominant connections for residential homes in the region that both suffer from technology limitations that will make them both less than ideal solutions in the future.

Serve unserved or underserved with a new service

Many of the communities are hearing from their citizens that service, especially in the outlying areas of their community, is less than adequate. Getting good service to these areas is challenging and can be very expensive. As mentioned, one way to extend service is to work with a current internet service provider. If that is not feasible Axiom recommends that a community consider a fixed wireless solution. Fixed wireless offers good service at a reasonable cost and is typically used in difficult to reach areas, where the cost of other types of technology makes it unaffordable. Wireless offers good reliability but suffers when a home is in an unreachable area, either behind a hill or mountain or in a location that is heavily forested. Wireless performs best when the tower from which the signal is broadcast is in the line of sight of the home. A typical wireless deployment can reach 80% of the homes in the area to be served.

Fiber is a second, more expensive option to connect homes. Because of fiber's superior reliability, the unlimited speeds that it can deliver and its scalability, it is a technology that can not only serve unserved areas but can easily compete with all of the other technologies currently being utilized in communities. While more expensive up front, four times or five times as expensive as fixed wireless or DSL, fiber can actually be less expensive over time because the network design, once in place, would remain for over 20 years and up to 40 years. Some of the communities requested a fiber solution that can be compared and contrasted with the alternatives asked for by other communities.

Demonstrating importance of Broadband Connectivity

For almost half of the communities Axiom interviewed, Community HotSpots were a goal. This is a very low-cost demonstration project for the community to understand the demand for Broadband. Axiom's experience with HotSpots around the state has been that 1000s of users access this free service in the towns in which Axiom has installed them. HotSpots provide free service and attract local residents who either cannot afford or don't have internet service available at their home. They also are an amenity for visitors want a free connection to use their laptop or tablet, or cellular phone to avoid data usage. HotSpots often create momentum in a community by helping policy makers and elected officials understand the demand for internet services.

Strategy:

Below are three examples of projects that highlight how the goals of each community can be met.

Project example #1: Better Service, feeling left behind

Roxbury and Byron expressed frustration about their inability to engage current providers to upgrade service. Axiom recommends piggy backing on a fiber extension being built in Rumford. This would be a transformational project for the two communities and would demonstrate the power of fiber in helping to bring renewed economic prosperity to very rural communities. While the project would not serve homes, it would create the conditions to bring Fiber-to-the Premise to homes in each of the two communities.

Some next steps would need to occur, including engaging an Internet Service Provider to connect to the built fiber trunk and string fiber to homes in each of the communities. This would likely require additional incentives or subsidies to entice a provider.

Cost of Fiber running up Route 17 into Roxbury or Byron: $170,000 (estimated)

Project example #2: Business Attraction

The Town of Oxford is becoming a regional hub for business, and the Route 26 corridor between the New Balance Outlet and the Oxford Casino is a targeted area for business growth. Some communities in other states have created Gig Business Districts that provide high capacity fiber connections (up to a Gig or 1000Mbps) of service to businesses at a subsidized cost provided for by the community. These Districts attract businesses that require high-capacity, symmetrical internet connections and are a new tool to diversify and attract businesses that would not consider moving to Oxford, but for the connection opportunity that a Gig Business District might provide.

Cost of Fiber: $120,000 (estimated for 4 miles of fiber)

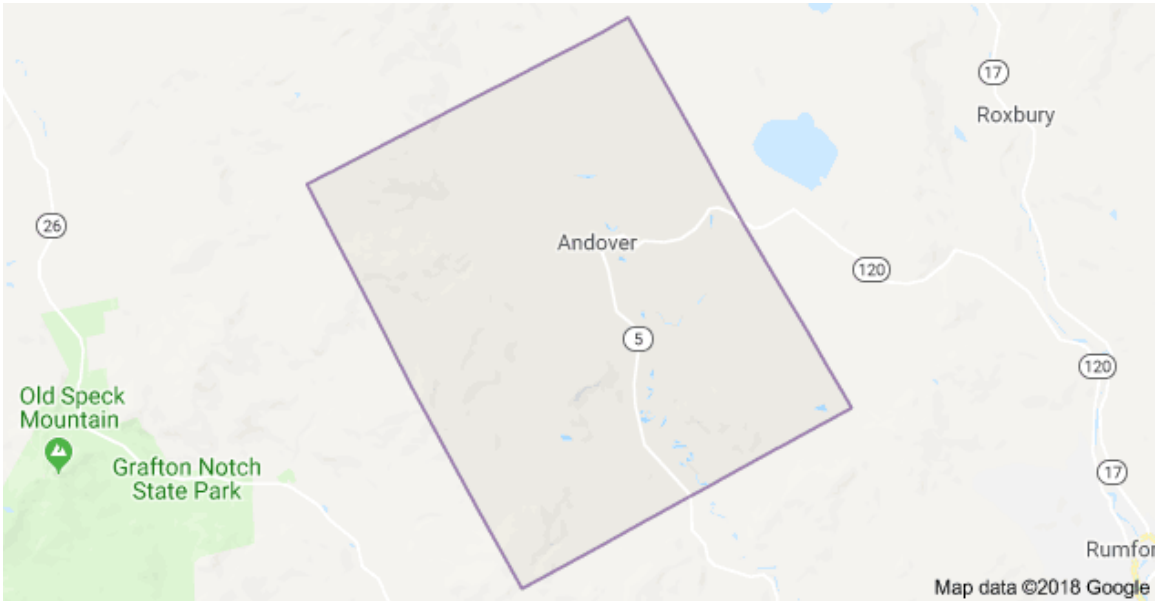
Project example #3: Fiber-to-the-Premise

Rumford is working on a transformational project to bring natural gas to the downtown and, as part of that project, is including FTTP for those buildings being connected to the gas. The town was successful in receiving grant funding to help launch the project. Axiom suggests that recreating a similar FTTH project in Bethel would have equal impact, essentially acknowledging Bethel as a major economic driver in the region and building on its downtown village area and extending fiber into West Bethel, an underserved area of the community.

Cost of FTTH project: $1,550,000 (estimated)

These are just examples from the many options laid out in the individual plans described below.

Andover



Andover Goals:

- Expand Spectrum service area
- Create wireless solution as an alternative to serve outlying areas
- Downtown HotSpot for hikers

Axiom recommendations:

- Work with Spectrum to assess and recommend areas for expanded service. Spectrum will partner with the town on a ConnectME grant if there are areas that currently can only receive 1.5Mbps or less of service or can price out the cost of expanding service

- Downtown HotSpots are an attractive, inexpensive way to bring better connectivity to an area, and giving hikers this amenity could bring more activity and potentially economic benefit to the community. Axiom is a leader in these deployments and would be happy to work with the town.

An investigation of certain conditions outside of Spectrum's service area could make a wireless solution feasible, further investigation is needed. Axiom and Maine West can help begin that process of evaluating next steps.

Spectrum:

The majority of Andover currently has Spectrum service. The town reports recently signing a new Franchise Agreement with Spectrum. Axiom believes opening a dialog with Spectrum to discuss the cost and criteria to expand service to other parts of the community would be the most cost-effective

way to bring 100Mbps or more internet service to the outer reaches of the community. This would be important if the renewed agreement did not include any expansion plans for the community.

Below is a map of Spectrum's current coverage area.

Spectrum typically expects a minimum of 20 homes per mile to expand its service. Spectrum offers home internet packages of 100 or 120Mbps and a Triple Play of Internet, Phone and Television.

FirstLight (formerly Oxford Networks)

FirstLight covers the majority of Andover with a DSL offering that competes with Spectrum and serves areas of the community that are currently not served by Spectrum. DSL relies on copper that was made for phone service 30-40 years ago and can be unreliable and suffers from speed issues as you move farther from the location of the equipment that powers the system. Often, outer areas of DSL networks can receive no more, and often much less, than 3Mbps. On the positive side, FirstLight covers the more difficult remote areas that would not be served, but for their commitment. FirstLight did not provide a map of its coverage area upon request, and it is Axiom's understanding from FirstLight that its business model does not include DSL enhancements or expansion.

Wireless Alternative:

A wireless solution requires a location on a tower or other structure that has height and can broadcast to multiple homes that are not obstructed and can see the tower. The tower equipment will broadcast an internet signal to an antenna that be installed on a home. This is a very common way to receive the internet and provides a lower cost solution for remote locations than other types of technology. Axiom has 100s of customers who receive their internet connection in this way.

Axiom's investigation of FCC licensed towers (towers over the height of 190' must be registered with the FCC) in Oxford County did not indicate that a tower is within range of covering Andover. If

Andover is interested in working with Axiom to identify a suitable location to erect a tower or if there are towers that are in or around the community that can be identified, Axiom would provide a coverage map for the community to evaluate if an investment makes sense to give better service to areas outside of the Spectrum coverage area. Often these towers are harder to identify, because they are less than 190' and not required to register with the FCC. Local knowledge is best to understand tower locations.

Generally, the cost of serving 100 homes with a wireless solution is between $100,000- $150,000, depending if an existing tower can be used or there would be a need to build a tower. (Tower builds can range between $30,000 and $50,000, sometimes more). Wireless solutions are a cost-effective way to serve a part of the community that is suffering with poor or no service. If the town would like to explore this option, Axiom stands ready to help; however, this is not something Axiom would recommend without a more thorough investigation of service coverage reliability and speeds outside of Spectrum's service area.

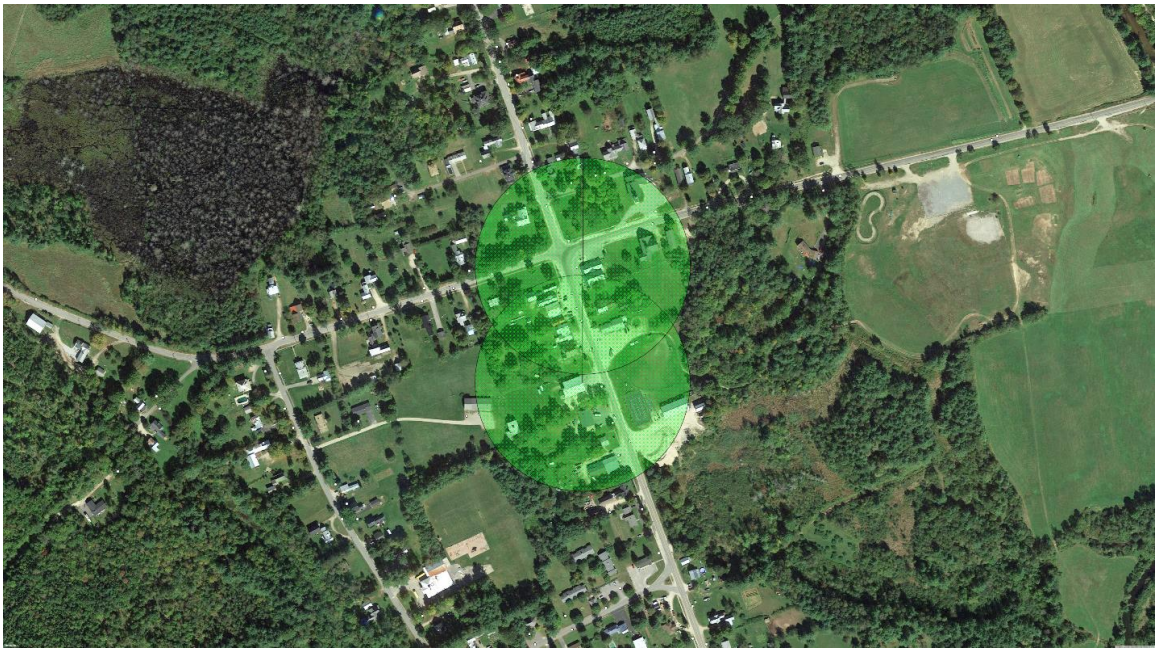
HotSpots:

HotSpots are great ways to help bring the community together around an achievable connectivity goal. In the case of Andover, attracting more hikers to the area with the lure of free Wi-Fi, is a very savvy economic development idea, with relatively little cost.

These HotSpots are meant to broadcast to outdoor areas where people may congregate. The equipment has a maximum coverage area between 400'-600' feet and is mounted to a building where power and internet is available.

HotSpots have:

- The ability to customize a splash page where users can see who is providing the HotSpot and read and acknowledge the terms and conditions of using the service
- Equipment that can be configured to be a free service, combined free and paid for enhanced service, or paid service
- The ability to promote a sponsor by connecting the user a sponsor's website prior to allowing the user access to the internet



Potential locations of two Andover HotSpots

Costs:

One-time installation fee: $3000/per HotSpot (2) = $6000
Annual maintenance fee $1500/ year starting year two

The costs **do not** include the cost of monthly bandwidth (typically between $49.99- $99.99 per month) needed to support the HotSpots or the cost of electricity (typically very nominal).

Bethel

Bethel Goals:

- Bethel residents have access to state standard of 10/10Mbps
- Wi-Fi HotSpots on Main Street to Bethel Town Common
- Better service outside of the downtown core

Axiom Recommendations:

- Work with regional partners (Community Concepts Finance Corporation, Northern Forest Center and Axiom) to develop a strategic plan for funding fiber optic build out
- Arrange a meeting to talk to FirstLight about its fiber network and how it might be leveraged
- Consider a HotSpot project in the downtown as a first step
- Partner with Newry to explore a wireless coverage solution for areas currently underserved or unserved

The Three Ring Binder runs through the community, and this asset could be tapped to create a fiber optic network that can deliver speeds up to a Gigabyte (1000Mbps) to the home. Given that Bethel has an attractive and vibrant downtown, a number of restaurants and lodging options and proximity to four season outdoor activities, better connectivity would strongly enhance the desirability to live, work and play in Bethel.

That said, outside of the core Spectrum network, FirstLight DSL does not currently deliver the same level of service as Spectrum, because it uses a different type of technology. The level of internet service depends on location in the town, with poorer service outside of the downtown core. However, FirstLight has fiber in Bethel which offers another potential option for fiber service.

Spectrum

Spectrum service covers a good section of Bethel and, with current upgraded speeds of 100Mbps and 120Mbps, this is giving Bethel residents, whose home or business is within the Spectrum footprint, solid internet service. Typically, price is a concern with Spectrum, but recent upgrades, without changes in price, have been helpful to consumers.

Spectrum Coverage Map

FirstLight

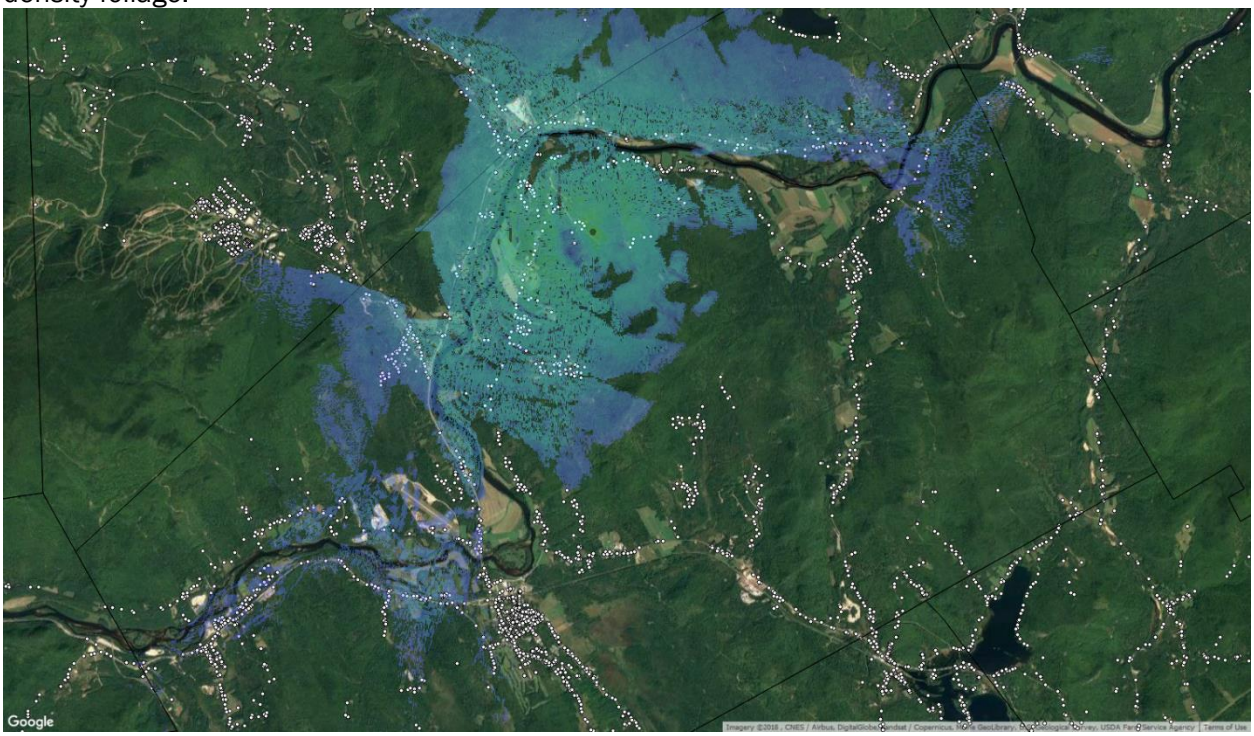
FirstLight is the DSL provider that serves most of the area not served by Spectrum. Customers' reports of the quality of service provided range from characterizing it as "horrible" while others are satisfied. FirstLight has provided fiber maps to Axiom with a Non-Disclosure Agreement but has not provided their DSL coverage area.

Working with current providers would be the least costly option for expanded service. Recently, Spectrum began offering service that meets the state standard of 10Mbps, "upload" speed. FirstLight DSL cannot meet the state standard of 10Mbps "upload." As a short explanation, typically Internet Service Providers advertise "download" speeds. An example of an advertised speed may be: 25/1Mbps, the second number being the upload speed. Maine set a high standard of upload that can typically only be achieved with Spectrum upgraded service or a fiber optic connection that can allow for "symmetrical speeds", meaning both the download and upload speeds are equal (e.g. 10/10Mbps). FirstLight is not interested in building out its DSL network and is focused on its fiber optic assets in the region and businesses that need high capacity connections. It is possible that FirstLight might be interested in connecting the town to its fiber assets, and Axiom recommends having a conversation with FirstLight to discuss this possibility.

Wireless

As an alternative to the two current providers and to try filling in the gaps in service, Axiom used an existing tower to provide a hypothetical coverage map. Computer generated wireless models are used to predict potential coverage areas based off of certain characteristics, location, height and

existing terrain/foliage. With these factors taken into account a radiation map can be generated that shows what type of coverage might be possible in a location. This map was generated using a 100' tower height, and equipment that uses 3.6GHz licensed broadcast frequency. Using this frequency provides a reasonable cost point, while still having attributes that can penetrate low to medium density foliage.



Coverage Area for Northeast Bethel and parts of Newry

Because the coverage of the wireless signal reaches parts of Newry, if Bethel were interested in exploring this option to serve some underserved areas of the community, working in partnership with Newry could make sense.

According to the 2010 Census the number of households in Bethel was 1121, Newry, 157. The towns of Newry and Bethel have a tower that is centrally located that can serve portions of both communities. Based on the coverage map above, it is estimated that 80% of Bethel and 30% of Newry can be reached from this tower.

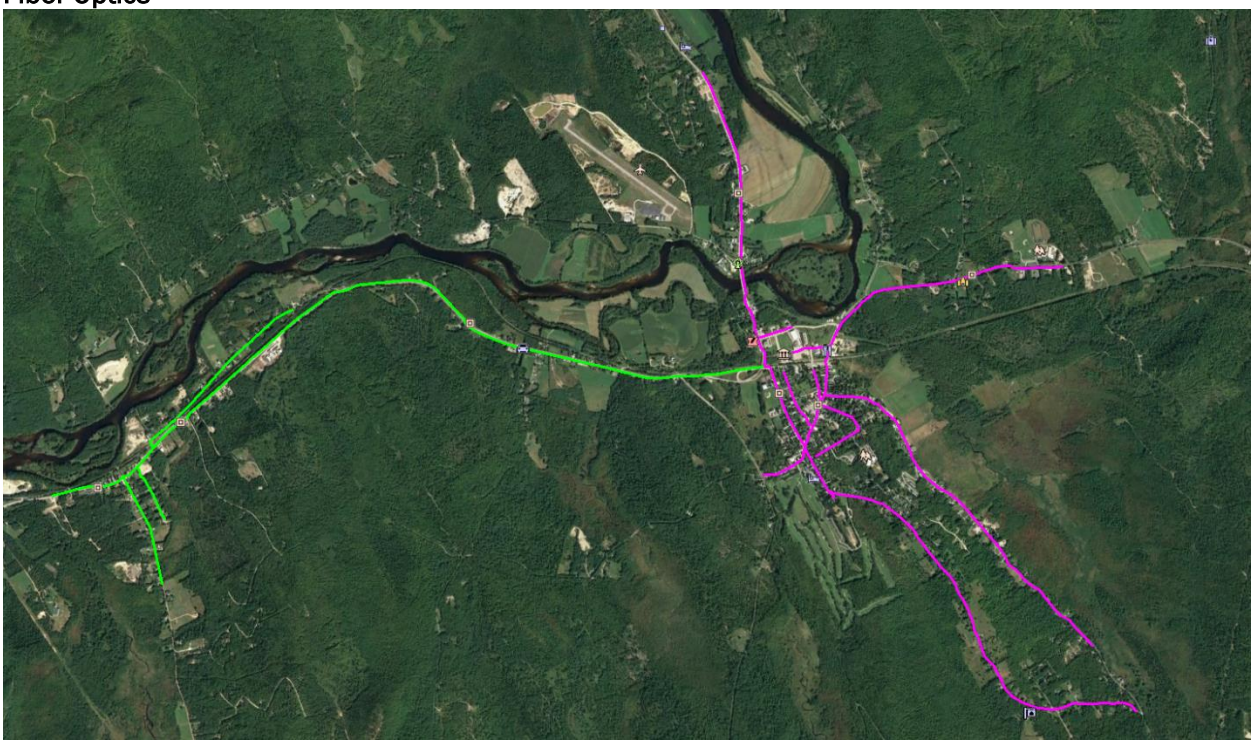
Taking the household numbers listed above and the approximate percentage of coverage for each town, it is estimated that a total of 463 households can be reached and, using the standard wireless take rate of 30%, the total households served would be 139 in both communities.

The costs listed below use the above numbers to figure an approximate cost to install service onto the existing tower.

Bethel and Newry Telrad 3.6 LTE Fixed Wireless Solution	
Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$69,500.00
Material Total	**$138,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$27,800.00
Labor Total	**$44,000.00**
Total Non-Recurring Cost	**$182,000.00**

While this is a lower cost option, it is still quite expensive for the communities to handle on their own. By working with an Internet Service Provider open to partnering, this might be a viable solution in the short term (over the next 10 years). Below is a description of an investment that would last the community well over 20 years and allow unlimited speed upgrades while also having unrivaled reliability.

Fiber Optics



Bethel Fiber Plan
Downtown in Pink
West Bethel in Green

Estimated Total Cost of Project: $1,550,000

Total cost includes trunk fiber and the cost of hooking up each customer along the proposed fiber route.

Trunk fiber cost	
Fiber Materials	$227,397.30
Fiber Labor	$318,753.50
Licensing and Make Ready	$137,055.00
Replacement Poles (10%)	$156,000.00
Total	**$839,205.80**

The above cost is the breakdown to installing the trunk fiber (the fiber that would pass by each premise).

Customer Premise Drops	
Hardware Costs	$149,300.00
Customer Premise Installation	$560,000.00
Total	**$709,300.00**

The customer premise installation figure was derived from the Federal standard take-rate for fiber services of 50%, meaning that if 100 homes had service available to them, half (50) would take service. Using this figure and the number of households based on the 2010 census of 1120, it is estimated that 560 homes and businesses would take this service.

Multiplying this number by $1000 per location for a standard installation, the end figure comes to $560,000. Because there are other providers in the community offering internet service, it is difficult to predict the take rate. An informational campaign that would be necessary to implement this project could yield good clues of what a provider might expect for demand.

While this plan is expensive, over the life of the equipment, it becomes a much more achievable investment. Axiom believes the benefits are worthy of serious consideration. The benefits of fiber are well documented and described throughout this document.

One way to save costs, could be to work with FirstLight. FirstLight has a fairly extensive network of fiber throughout the community. If FirstLight was interested, partnering with them is an option worth exploring to save cost by not overbuilding on existing fiber.

These costs are provided to assist the municipality in determining budget requirements if the community decides to move forward and RFP the proposal to prospective vendors/providers. The proposed technology is described in detail in the technology section of this report. The benefits of fiber are important to consider.

Built to Last

Once fiber is strung on utility poles, and a home or business is served, that fiber becomes an investment that will last well over 20 years. Even as demand and technology change, the fiber lines will remain in place.

Scalable

The proposed system is capable of delivering a Gig (1000Mbps) of service to each premise. So as awareness of the capability of fiber grows, on-line e-services expand, and the demand for bandwidth increases, the system can accommodate that demand with little to no investment in additional equipment.

Fast and Reliable

The two biggest complaints about current service are inadequate speed levels and the lack of reliability with the connection. Both of these issues are solved with fiber, giving residents and businesses blazing fast speeds and unrivaled reliability.

Other Benefits

Building a new system also offers the community the ability to better control the fiber and dictate terms to potential operators of the new system. By creating a public-private partnership with a potential provider, there is more opportunity for the town to dictate terms of that agreement, including speed tiers, costs and service levels. In short, communities willing to make the investment in fiber can have more control over their own destiny.

Economic benefits can also flow to the community as those businesses that need fiber connectivity could see Bethel as attractive place to relocate. And those folks that can work from anywhere with a strong, reliable connection see the feasibility of remote mountain living as a viable option.
Fiber can offer affordable, cost cutting for homeowners, who would be able to receive streaming content (e.g., Hulu, Netflix, etc.), phone service and internet, all through one pipe, while shedding satellite cable service (DirectTV, Dish) and expensive add on phone service as part of their current bundle.

Fiber offers the promise to differentiate a community and bring better opportunities for economic development, telemedicine and a host of the Internet of Things at a reasonable cost, considering that fiber will be an investment that will last well over 20 years.

Last, cost savings are something to explore by utilizing FirstLight's existing fiber network.

Fiber Costs by Street:
Below is a street-by-street breakdown of fiber costs, if Bethel decides to phase in a system over time. These breakdowns can help the community determine estimated costs for different build out scenarios.

Cost of Each Segment – See Appendix 1 Fiber Budgets

Downtown HotSpots

HotSpots can be an affordable way to increase the attractiveness of your downtown. HotSpots allow a user to log into an internet system that is typically much faster than their cellular networks and can be accessed by any device, laptop, tablet or a cell phone. Many communities around Maine have installed these devices and marveled at the amount of people who use them. A HotSpot in Greenville attracts over 2,000 users a month in the summer, and Axiom's Machias downtown HotSpot attracts over 500 users a month in the winter months.

Each community that utilizes these has paid for them in different ways. In Greenville, the local economic development corporation underwrote the cost. In Millinocket, an Internet Service Provider and a local donor paid for the installation. In South Portland, the City paid. In Machias, and several

other locations, a local bank paid. These sponsorships are usually in exchange for prominent display or a redirect to the sponsor's website, once a person logs on.

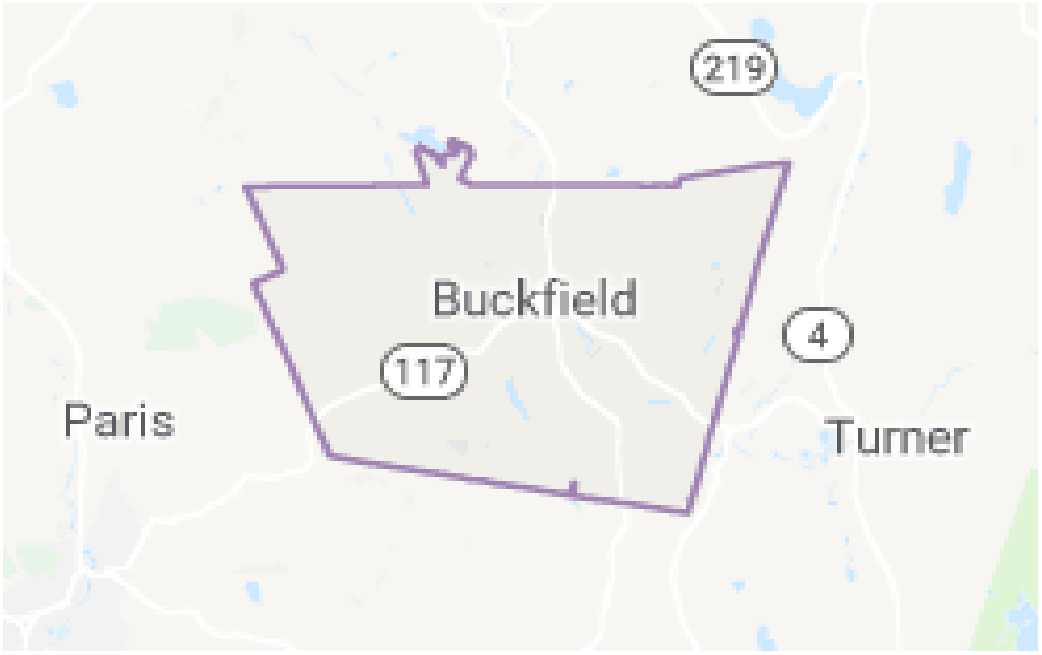
Main Street HotSpot Proposal

Costs:
$3000 per HotSpot (3) = $9000 one-time installation cost
Annual Maintenance: $2000/year starting in year 2

This does not include the price of an internet connection $49.99-$99.99/month or electricity (nominal)

Axiom was asked to cover Bethel Town Common and it appears that a slight adjustment of the location of one of the HotSpots would work, saving the cost of an additional installation. Another HotSpot can be added to cover that area of Broad Street.

Buckfield



Community Goals:

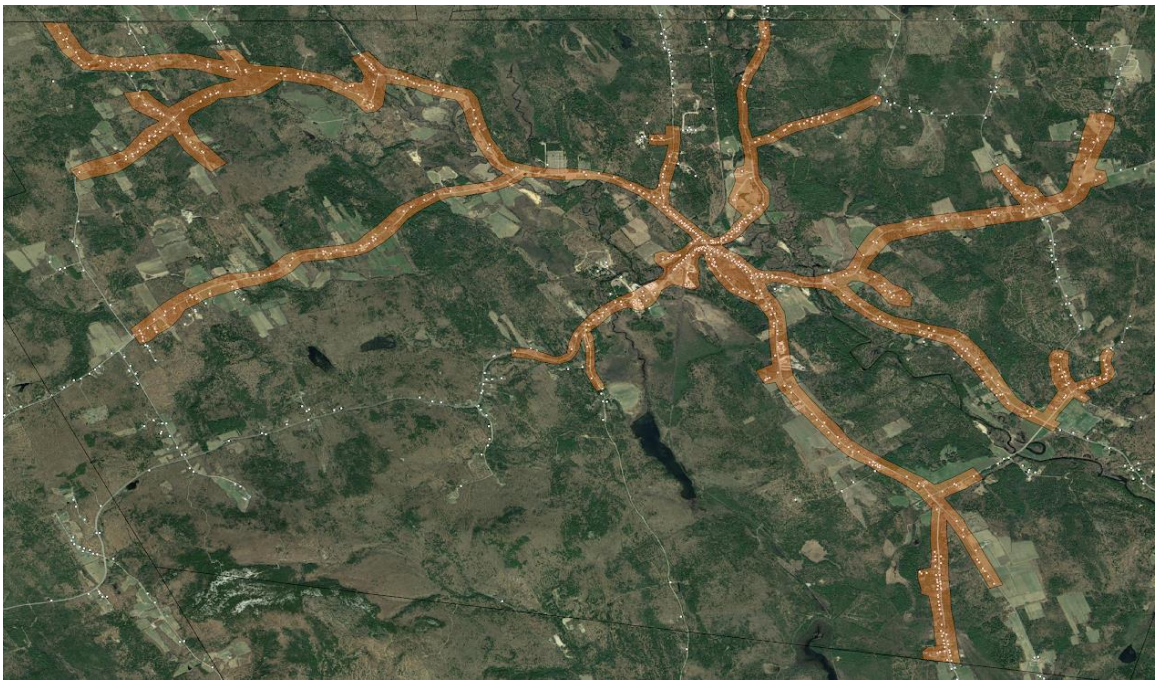
- Updating Spectrum Franchise Agreement
- Asking Spectrum or FirstLight to expand service, with a preference for fiber
- Wireless plan to unserved areas (i.e., Streaked Mountain)

Axiom Recommendations:

- Work with Spectrum to expand service coverage area with the opportunity to renew Buckfield's Franchise Agreement. This is a good time to engage Spectrum to build out to new areas or receive other concessions
- If FirstLight will not help with expanded fiber coverage, a wireless plan should be explored. Axiom would be pleased to engage the community more fully on this possibility

Spectrum

Working with Spectrum is a way to work with a current provider to create better service. For those that are served by Spectrum, recent aggressive internal upgrades have given residential customers speeds of a 100Mbps or more.



Spectrum current coverage map

Working with Spectrum to update the town's current Franchise Agreement can open the door to discussions about expanded service. Typically, there are multiple components to a Franchise Agreement, but almost the entire focus is on the revenue sharing aspect of the agreement, which can return up to 5% of the revenue back to the town. Revenue sharing is typically contributed to the general fund of the town. A good negotiation tactic with Spectrum could be asking for a commitment to build out to parts of the community that are not served well, in lieu of some amount of the profit share or as part of a multi-year strategy to have every home covered by Spectrum.

Some towns have older agreements that also promise that a certain percentage or the whole town will be built out over time, without the promise of suspended franchise fees. If that is the case with Buckfield, ensuring that Spectrum delivers on that contractual agreement would be important to entertaining a new, updated agreement.

Buckfield's preference for fiber expansion is not something that Spectrum would be willing to entertain. Typically, Spectrum reserves its fiber to enhance its cable delivery system, or work with individual businesses to deliver a fiber solution upon request.

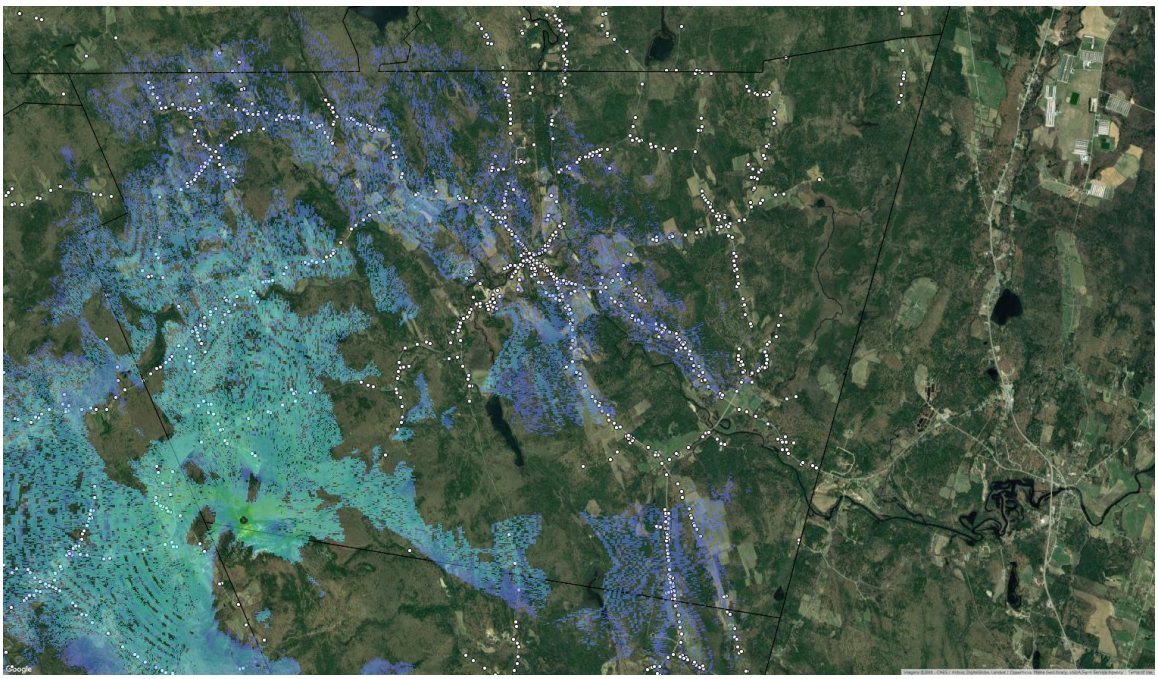
FirstLight

FirstLight is a Local Exchange Carrier (ILEC) that delivers phone and DSL internet to the community. It covers most, if not all, of Buckfield. However, there are pockets of unserved or underserved areas, including the Streaked Mountain area. While FirstLight provided fiber mapping of its assets upon request, no individual town maps of its DSL service areas were provided. FirstLight has fiber in Buckfield. A discussion with them about increased fiber coverage could be an important next step to helping the town meet its goal of expanded fiber service.

Wireless

Axiom investigated the possibility of creating a wireless plan off an existing tower that might serve the Streaked Mountain area or other parts of the outer reaches of the community.

According to the 2010 census, Buckfield had 2009 residents and 821 households. There are several towers located on Streaked Mountain; however, due to the mountain's location in the southwest corner of the community, it provides minimal coverage to the majority of the town. Based on the radiation map provided above, there is a possibility of reliably reaching approximately 30% of the households. From these numbers it is estimated that 247 households can be reached using the coverage figure and, taking into consideration a typical take rate for wireless service of 30%, the total number is estimated at 74 homes taking service, although a better take rate could be expected.



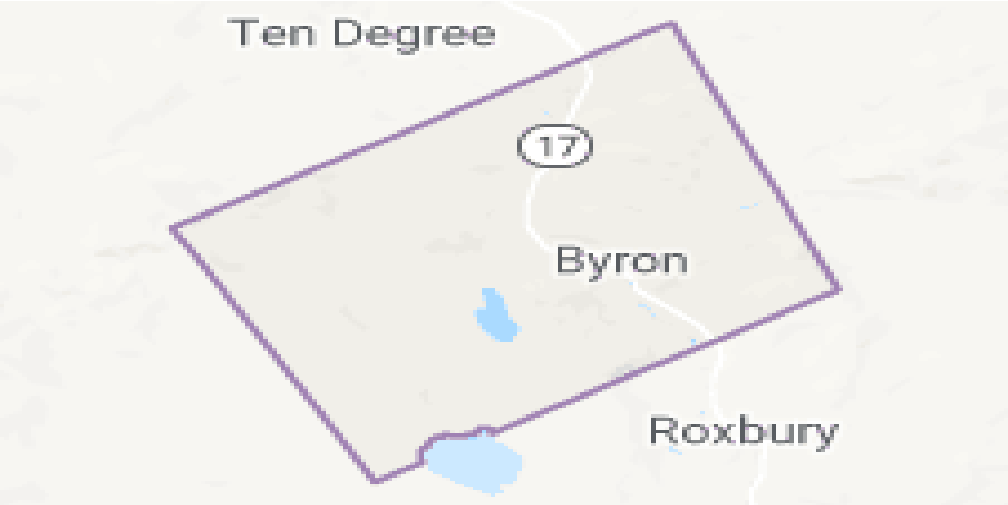
Wireless Coverage Area served by Streaked Mountain

The costs listed below use the above numbers to figure an approximate cost to install service onto the existing tower and serve 74 homes (30% take rate).

Materials Cost	
Access Point Hardware	$51,500.00
Installation Hardware	$8,500.00
CPE Hardware	$43,000.00
Material Total	**$103,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00

CPE Installation	$14,800.00
Labor Total	**$31,000.00**
Total Non-Recurring Cost	**$134,000.00**

Byron



Community Goals:

- Initiate conversation with Consolidated Communications (formerly FairPoint)
  - Are Connect America Fund (CAF) II funds planned?
  - Do they have nearby fiber?
  - What is the cost to build a Remote Terminal to extend service into town?
- Are there any existing towers that can be used for wireless service?
- Extend fiber down Route 17

Axiom recommendations:

- Work with regional partners to solidify goal of Rt. 17 fiber project
  - Search for federal funding
- Identify any possible towers that could provide service to unserved areas of the community
  - Work with Axiom to develop engineering plan and cost for project

Consolidated Communications

Consolidated (formerly FairPoint) shared a map of Byron with Axiom and some areas were identified for possible expansion using some reserved money at the ConnectME Authority from a legal settlement available to Consolidated only and that is dedicated to Broadband expansion. These unserved areas are not on the list of CAF II upgrades, but this additional funding source is being explored by Consolidated for Byron. Because there are lots of demands on this settlement money, internal decision making is ongoing.

While Consolidated did not provide details about the location of its fiber in the area, it is known to have fiber to its Central Offices and to its Remote Terminals, so it is nearby. The cost to build a new Remote Terminal that would expand Consolidated's footprint is approximately $70,000. This would bring a higher level of service to those served around the new RT. If Byron is interested in working with Consolidated, Axiom can set up a meeting to explore this option.

Wireless

Wireless could enhance or bring coverage to areas of Byron that are currently unserved. There are no FCC licensed towers in the area (towers over 190' in height need to be licensed with the FCC). There may be towers under 190' which would need to be evaluated for feasibility. Using an existing tower can save cost if the equipment used to broadcast from that tower covers the desired service area. Building a new tower can cost between $50,000- $100,000 or more depending on conditions.

If the community would like to further explore a wireless solution, clusters of homes that want service would need to be identified and the feasibility of using an existing tower or installing a new tower would need to be assessed.

Equipment that would use 3.6 GHz licensed spectrum and have light to medium foliage penetration is needed. A system to serve approximately 100 customers would cost between $100,000-$180,000 (depending on if there would be the added cost of a tower).

Fiber

The goal of running fiber down Route 17 is an exciting possibility that could attract federal funding as a stand-alone project or part of a larger regional plan for fiber connectivity. Running fiber up Route 17 through Roxbury and Byron would give both communities options to expand fiber optics throughout the community. For details of the Route 17 fiber cost, please see the Regional Plan section of this document.

Dixfield

Community Goals:

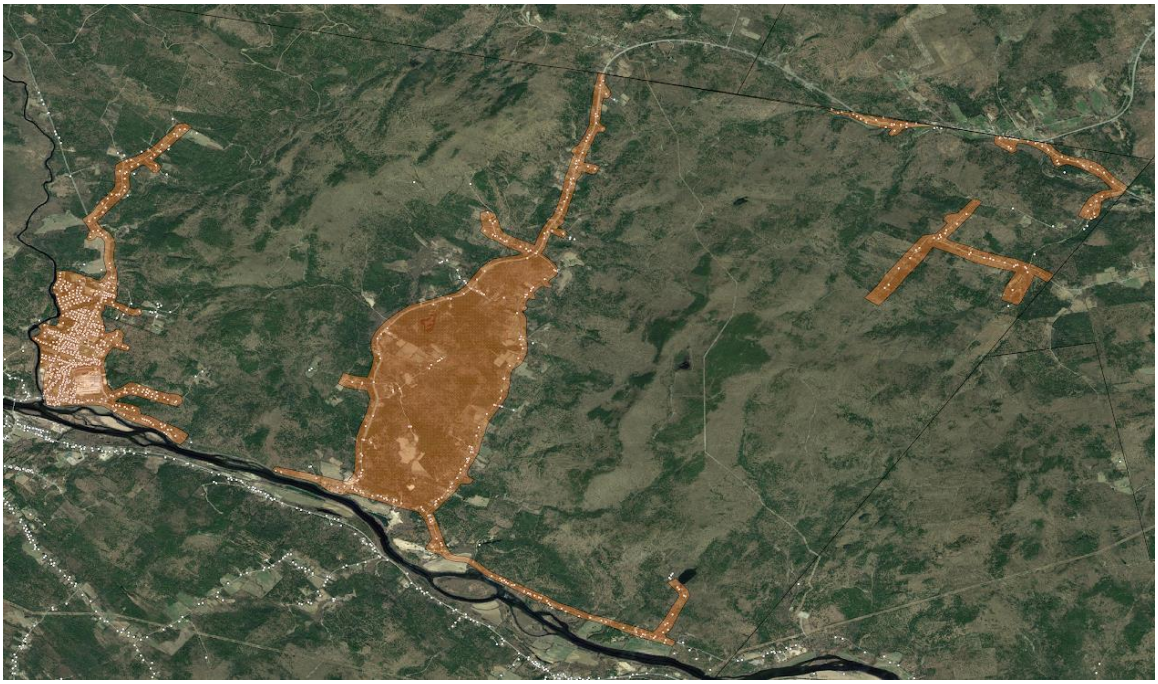
- Renew Spectrum franchise agreement
- Downtown HotSpot
- Wireless plan for areas outside of Spectrum coverage

Axiom Recommendations:

- Pursue a Franchise Agreement renewal with Spectrum
  - Potentially leverage franchise fees for expansion or other services
  - Identify gaps in service
- HotSpot installation which is a low-cost approach to understanding demand for internet in the community and creating an achievable project
  - Sponsorship opportunities for private sector businesses
- Wireless plan in partnership with Peru

Spectrum

Working with Spectrum to renew the community's Franchise Agreement is a good start to understanding what areas of the community are covered and what areas may need improved connectivity. Axiom sent a guidance document to help the community think through what, if any, improvements it would like to see. The town should work toward expanding service with Spectrum as it offers Triple Play (TV, phone and internet) and residential internet speeds, currently 100Mbps or more.



Spectrum coverage map

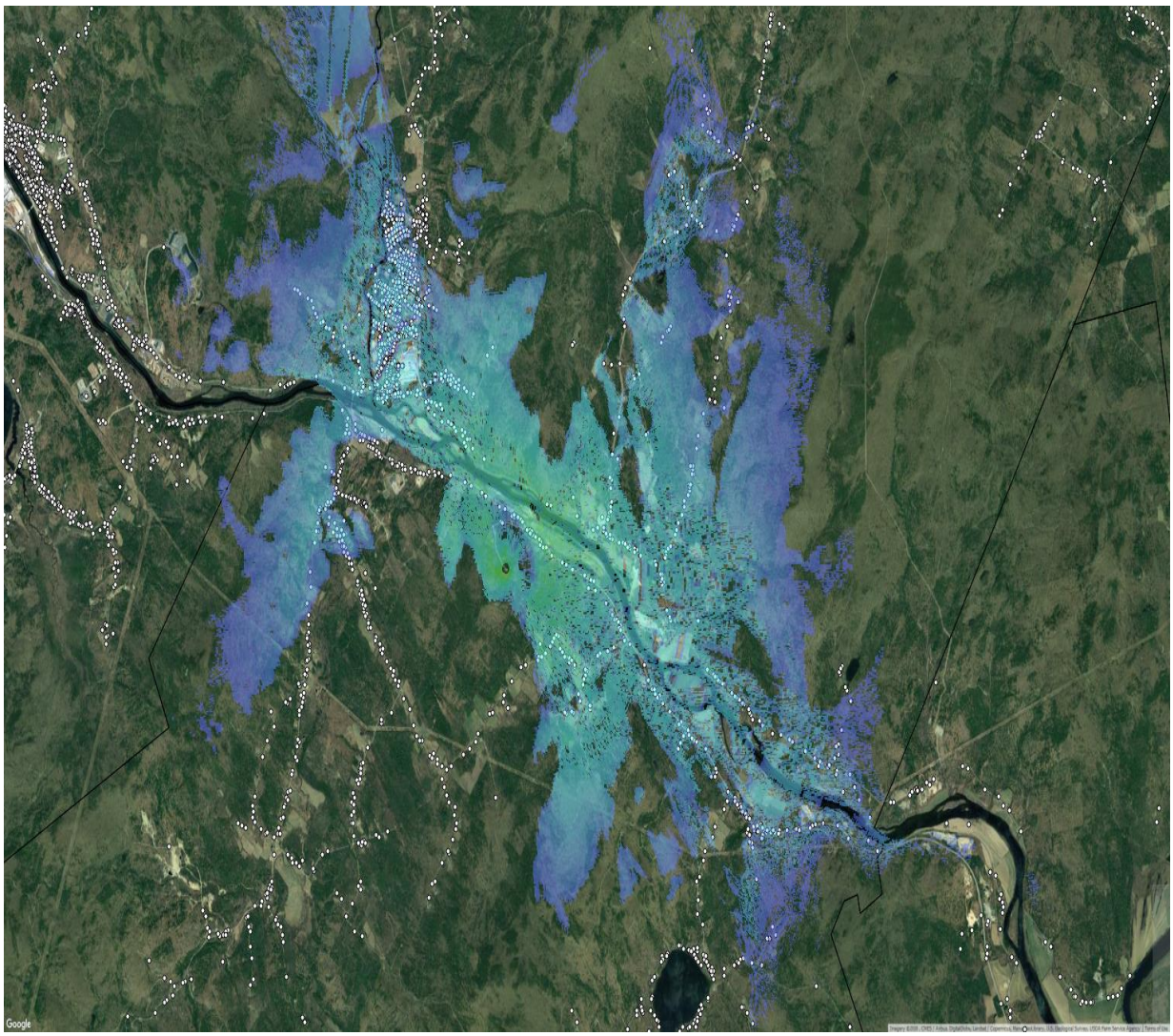
Consolidated Communications

Consolidated Communications is the telephone provider in Dixfield and it offers internet service to the community, through its copper phone lines, commonly called DSL. While Axiom did not obtain a map of Consolidated's coverage area, it typically serves up to 95% of the community with a DSL product that can range from 25Mbps down to 1.5Mbps up, depending on the location of a home in relationship to the DSL equipment. Consolidated has indicated that it will not be expanding service in Oxford County in the foreseeable future. Given that fact, a regional wireless plan is an option to serve Dixfield.

Wireless

There is an existing tower that could be used to bring wireless service to both Dixfield and Peru. Working in collaboration and cost sharing could help both communities fill in gaps in service and create a competitive internet service to Consolidated DSL.

According to the 2010 census Dixfield has 1044 homes and Peru 629. It can be estimated that 50% of Dixfield and 70% of Peru can be reached from the tower. This translates into approximately over 900 homes that could be reached. With an estimated 30% of the homes taking new service, wireless service would possibility serve 289 homes or more.



Dixfield/Peru predicted Wireless Coverage map

Cost of Project:

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$144,500.00
Material Total	**$213,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$57,800.00
Labor Total	$74,000.00
Total Non-Recurring Cost	**$287,000.00**

Because of the propagation of the signal into Peru, this would be an opportunity to work together with a cost sharing arrangement, or joint application for funding.

HotSpot

HotSpots are an inexpensive way to help community members and visitors to the downtown have a place to use their computer, tablet or phone, without incurring data charges on their cellular network. Typically, HotSpots cover a radius of approximately 400-600'. Axiom was asked to engineer and price a HotSpot at the Village Green, next to the Historical Society located at 59 Main Street.

The nature of the propagation would extend the signal down Main Street in either direction, as long as there are no obstructions. This type of equipment does not have enough broadcast power to penetrate building walls.

There are a variety of ways that towns can pay for HotSpots:

- Directly from town budget- (South Portland)
- Sponsorship from a local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Axiom would be happy to discuss all options to help facilitate an installation.

HotSpot Cost:

- One time install fee- $3000
  - Includes one year of technical support and equipment maintenance as needed
  - Monthly usage reports

- Annual maintenance- $1000/year- starts in year 2
  - Includes technical support
  - Equipment maintenance/replacement
  - Monthly usage reports

The cost above does not include the monthly fee for internet service which can be $49.99- $99.99 a month and the nominal cost for electricity, which is typically covered by the building owner as a courtesy.

Greenwood

Community Goals:

- Every resident has access to affordable, high speed internet
- Focus on lakes area along the Greenwood Road for second home owners and Mt. Abram Ski Resort area
- A large percentage of Greenwood homeowners are non-residents. A focus on improving connectivity to those homes, to keep these seasonal visitors longer is a good economic development strategy for Greenwood

Axiom Recommendation:

- Work with regional entities to identify federal funding to expand fiber service to the lakes
- As an alternative, initiate conversation with FirstLight on availability and usage of their fiber network

Spectrum

Spectrum Coverage Map

Spectrum covers only a small geographic area of the community, leaving coverage of the remainder to FirstLight, the incumbent telephone provider. It appears that Spectrum coverage in Greenwood is a spillover from the more populated Bethel to the north and West Paris to the south. In looking at the population distribution in Greenwood, it would be difficult to have Spectrum expand service without some type of public subsidy. Depending on the status of the current Franchise Agreement with Spectrum, perhaps an arrangement could be worked out for expanded service. Greenwood should look closely at its current agreement to determine if any opportunities exist for enhancements that could benefit the town, while working toward a fiber solution that would be a much-improved connection for the areas in which it would serve.

FirstLight

Axiom believes FirstLight can have a large role to play, given its coverage in the community. FirstLight offers a copper DSL connection to the home of up to 20Mbps, depending on the proximity to their equipment. FirstLight did not provide a map of its service area, so it is hard to tell where there are underserved or unserved homes. Direct engagement with FirstLight by the town may get them to disclose service areas and identify potential gaps in their service. FirstLight shared its fiber network mapping with Axiom which includes Greenwood. FirstLight fiber is an asset worth exploring between the town and the company to ascertain the willingness of partnering with FirstLight to provide a FTTH solution for the lakes region.

As an alternative to FirstLight expanding or enhancing its current service, Axiom looked closely for an existing tower (all towers over 190' must be registered with the FCC) to locate a fixed wireless system that could serve the more isolated/remote areas of the community. Unfortunately there are no towers within close enough proximity to provide a wireless solution. Axiom could work with the

town to identify a suitable tower location or an existing tower (under 190') that could serve some parts of the community. The general cost for a wireless system is $100,000-$180,000.

Plan for Fiber

Fiber offers unparalleled ability to increase speeds as demand increases over time with little to no reinvestment, is very reliable technology and can give the community a strong economic development tool. In short, fiber is an investment in Greenwood's future and in particular would serve the Mt. Abram Ski area as well as many second homeowners. Below is a preliminary look at the path and cost of a fiber build to the lakes and to support Mt. Abram area. The project is divided into segments so that it can be built out over time, as funding becomes available. That said, it is recommend that the project be built all at once to save on cost and avoid the stalling of the project over multiple years.

Cost:

	Greenwood Lakes Fiber	
	Fiber Materials	$290,781.30
	Fiber Labor	$179,283.50
	Licensing and Make Ready	$73,035.00
	Replacement Poles (10%)	$78,000.00
	Regen Hardware	$93,775.00
	Customer Prem. Hardware & Installation	$168,750.00
	Total	**$883,624.80**

Fiber Path of Greenwood Project

Cost of Each Segment – See Appendix 1 Fiber Budgets

Hartford

Community Goals:

- Regional meeting with FirstLight (include Sumner and Buckfield)
- HotSpot at town office, 1196 Main Street
- Attract Spectrum to serve community

Axiom Recommendations:

- HotSpot at the Town Office is strongly recommended
- Continue to investigate relationship with Spectrum
- Consider a wireless plan, if current providers cannot make a business case to expand service

Axiom believes a first step is to provide a low-cost HotSpot solution for those with no service because of lack of current coverage or affordability. Second, some investigation may be necessary to hone in on the areas that currently are not covered by any service provider to determine the feasibility for federal or state grants to assist in building out service.

Internet Provider meetings

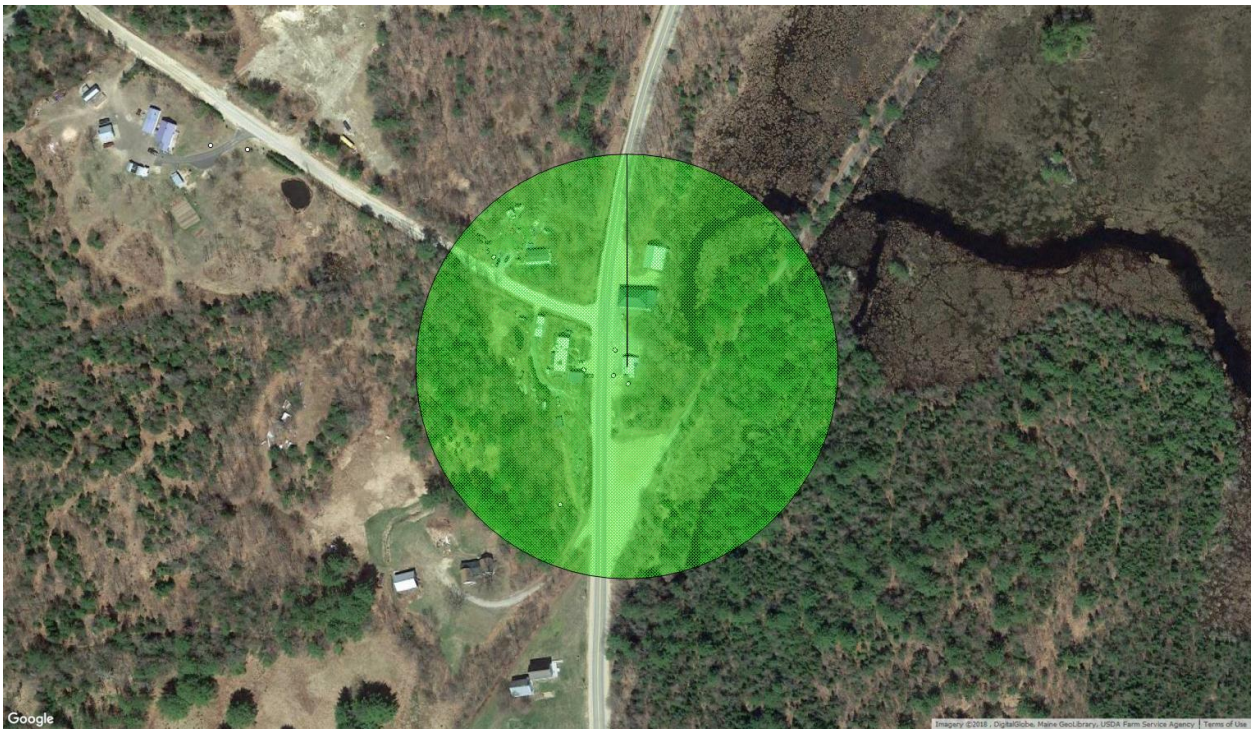
Axiom has had discussions with both FirstLight and Spectrum about their service and a meeting with Spectrum was hosted by Community Concepts Finance Corporation in S. Paris to discuss its willingness to work with communities or the region to expand service.

Spectrum is willing to discuss expanded service into Hartford. Hartford does not meet Spectrum's density requirements (20-25 homes per mile) to expand without any public subsidy. Knowing the pathway and cost for Spectrum expansion would help the community understand more fully what is possible. Axiom stands ready to work with the community to facilitate communication with the town and Spectrum.

FirstLight has not shown any interest in expanded DSL service in the community. Its efforts are on monetizing its fiber network in the region by focusing on businesses that need high-capacity connections.

HotSpots

Having a HotSpot that is a free service provided around the town office is a good way to help community members who currently don't have service or cannot afford it have public access to the internet. As a bonus, this type of investment is relatively low cost.



Town Office HotSpot

Costs:

- One time install fee- $3000
  - Includes one year of technical support and equipment maintenance as needed
  - Monthly usage reports

- Annual maintenance cost of $1000/year, starts in year 2
  - Includes technical support
  - Equipment maintenance/replacement
  - Monthly usage reports

The cost above does not include the monthly fee for internet service which can be $49.99- $99.99 a month and the nominal cost for electricity, which is typically covered by the building owner as a courtesy.

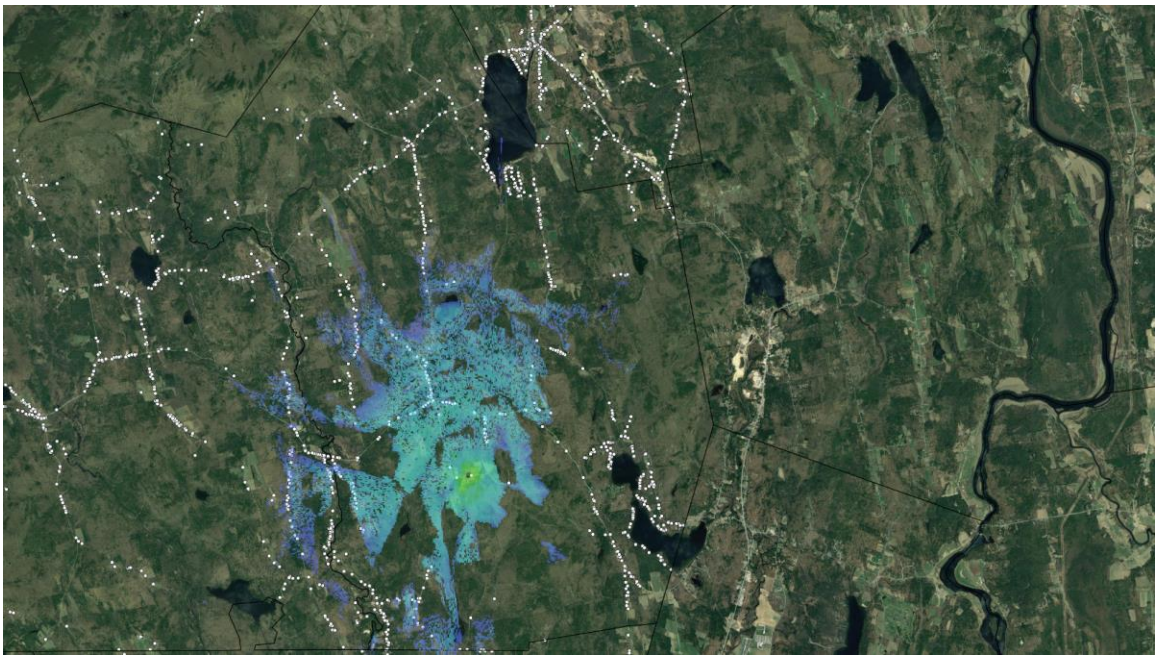
There are a variety of ways that towns use to pay for HotSpots:

- Directly from town budget (South Portland)
- Sponsorship from local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Axiom would be happy to discuss all options and help facilitate an installation.

Wireless

An alternative to a Spectrum or FirstLight expansion could be a wireless solution. Hartford does not have a telecommunications tower, but a location has been suggested where a tower could potentially be erected to serve the surrounding area. Conversations with the landowner are needed to determine if this is a viable location. The coverage and cost are should be considered, too.



Hartford Coverage Area

According to the 2010 Census, the town of Hartford has 479 households. Using the potential site for a tower, the above radiation map has been generated and overlaid with 911 address location data. Based on this map it is estimated that 50% of Hartford can be reached from a tower at this location.

Taking the household numbers listed above and the approximate percentage of coverage for the town, it is estimated that a total of 240 households can be reached. Using the standard wireless take rate of 30%, the total households served is estimated to be 72.

The costs listed below use the above numbers to figure an approximate cost to install service including a new tower build.

Materials Cost	
Turnkey Tower Construction	$60,000.00
Access Point Hardware	$33,000.00
Installation Hardware	$6,500.00
CPE Hardware	$36,000.00
Material Total	**$135,500.00**

Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$14,400.00
Labor Total	**$30,600.00**
Total Non-Recurring Cost	**$166,100.00**

Hebron

Hebron Goals:

- Work with current providers to expand coverage (Spectrum and FirstLight)
- Improve cellular coverage

Axiom's recommendations:

- Work with regional entities such as Community Concepts Finance Corporation to help attract additional investments by the cellular carriers
- Set up meeting with FirstLight to discuss options with fiber

While not identified as a goal, Axiom could provide a fixed wireless solution for the town at an approximate cost of $100,000-$180,000. This would be something to consider once all options with Spectrum and FirstLight are exhausted.

Cellular Phone coverage

Cellular phone coverage in rural Maine is a difficult problem to solve and one that is beyond the scope of this report. Very much like rural Broadband, better cellular coverage relies on the number of potential subscribers and the ability for the cellular carrier to recover the costs of equipment that would offer better coverage and reliability. In Oxford County, several attempts have been made to attract a carrier to build additional towers and increase service area coverage to no avail.

Axiom recommends taking a regional approach with the surrounding communities and working exclusively with one carrier (typically US Cellular). Either AT&T or Verizon could be considered, too, to quantify demand. For example, if the number of current customers for any of the carriers is known communities could find out from that carrier how many additional customers would be needed to induce additional build out.

AT&T may be entering the market in western Maine with some new offerings and Axiom has spoken to the bidder for those services about partnering to offer fixed wireless Broadband from towers that are under consideration. There is hope for better cellular phone coverage, but it requires a significant effort and regional approach.

It is not uncommon for people to equate Broadband to cellular coverage, as both allow you to use the internet. However, cellular services are much different than fixed wireless and are not addressed in this report. Also, they are not an area of expertise for Axiom. However, working regionally to identify and aggregate demand would be a good first step to having a conversation with one or more of the cellular carriers.

Spectrum

Spectrum is the cable company that covers most of the denser areas of Hebron. Spectrum is open to engaging the community and open to working to expand service coverage. Typically, it works with communities to identify either 20-25 homes per mile to build out service with its capital, or it can partner with a community to use existing franchise fees or state grants to expand service to areas that do not meet its investment threshold.

Axiom has been working with Spectrum to obtain maps of coverage areas and to have Spectrum representatives explain to communities like Hebron how to partner together on projects. If Hebron would like a Spectrum coverage map, Axiom would be happy to request it.

Axiom would be pleased to help facilitate a meeting with Spectrum and the community.

FirstLight

Since being acquired by FirstLight, the former Oxford Networks has focused on obtaining business customers. Axiom has asked FirstLight to meet with some of the communities interested in expanded service and has not received a clear response on the possibility, nor has Axiom been able to obtain maps that can help communities understand DSL coverage area that FirstLight provides. However, while not able to obtain DSL coverage maps, Axiom has a fiber map from FirstLight that shows fiber on Route 119. This is potentially an asset that could be utilized and discussions with FirstLight would help better understand what the possibilities would be to tap that fiber line.

FirstLight offers DSL to the home for internet and phone service. Typically, in a community like Hebron, FirstLight would offer service almost everywhere in the community and expansion and enhancement questions usually are centered on quality of service and service speeds. Because of the nature of DSL, and the use of copper wiring that can be unreliable. Customers that find themselves farthest away from the DSL equipment can experience service speeds and reliability issues that get users demanding better service.

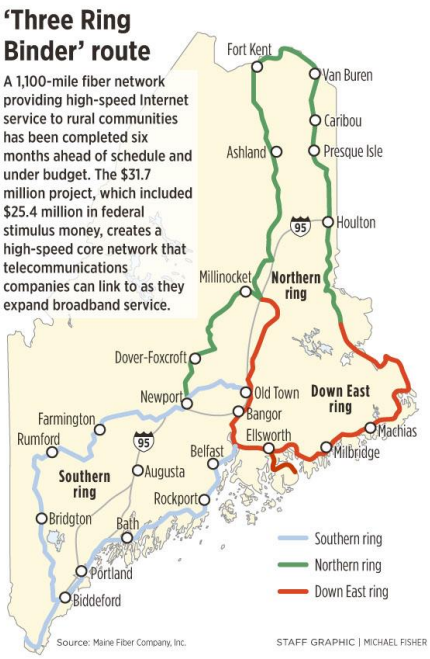
Mexico

Mexico goals:

- Learn how to use Broadband to attract businesses to the area
- Connect the Three Ring Binder to the community

Axiom Recommendations:

- Continue surveying businesses to assess internet connectivity needs
- Create a "Fiber 101" flyer to start talking about the benefits of fiber to the community
  - Host a workshop for residents about fiber connectivity
  - A *Why Fiber?* Section is included in this report that can help the community understand the benefits of fiber vs other types of technology
- Work with Axiom to price a defined area for a high capacity fiber corridor



The Three Ring Binder is an 1100-mile loop (actually three loops) of open access, middle mile dark fiber. This fiber line can be "lit up" with internet traffic and can provide the internet off ramp for increased service and reliability in a community, such as Mexico. The 3RB is important because it allows access to very high capacity and high speeds of internet that were out of reach for most providers (especially the more rural and smaller companies) who hope to serve last mile customers in rural Maine. When it was installed, it was exciting for rural areas that did not have access to the level of speed, capacity or reliability that this project promised.

Because the 3RB runs through Mexico, utilizing this fiber would be a cost-effective way to bring a new level of service to the community that can far surpass current provider speeds and reliability.

However, there are some realities that need to be understood when considering this approach.

- Need a provider

The 3RB in and of itself does not give a community better service. It's a vehicle to transport the internet, through fiber optics, across the state. In order to take advantage, it needs an off ramp, much like the interstate exit, to get the internet where it is wanted. That offramp would involve an internet service provider.

The Internet Service Provider (ISP) would enter into an agreement with the 3RB to access the internet and build a "drop" of fiber that would be delivered to a location of the provider's choosing.

- Need a plan

Any provider would want to know how many customers it might serve and how it would re-coop its capital investment. Fiber is built for the future, so while more expensive up front, it can be the lower cost option over the life of the technology (20 years or more). Wireless is also an option, it is less expensive (often 4X to 5X less) but would require upgrades within 10 years. Fiber optics in a business district or industrial park, along Main Street and potentially dense neighborhoods with wireless service covering the more rural parts of the community, is a reasonable approach, with build out of fiber to the whole community over time.

- Subsidy

Building a new network to compete with existing providers will require a substantial investment of resources that will be borne almost entirely by the community, grant programs or other outside money. Many providers insist on owning the asset, and this can be difficult if public money is being used to build out the internet. Some providers, like Axiom and GWI, are more willing to enter into agreements that can create unique public-private partnerships and negotiate power back to the community.

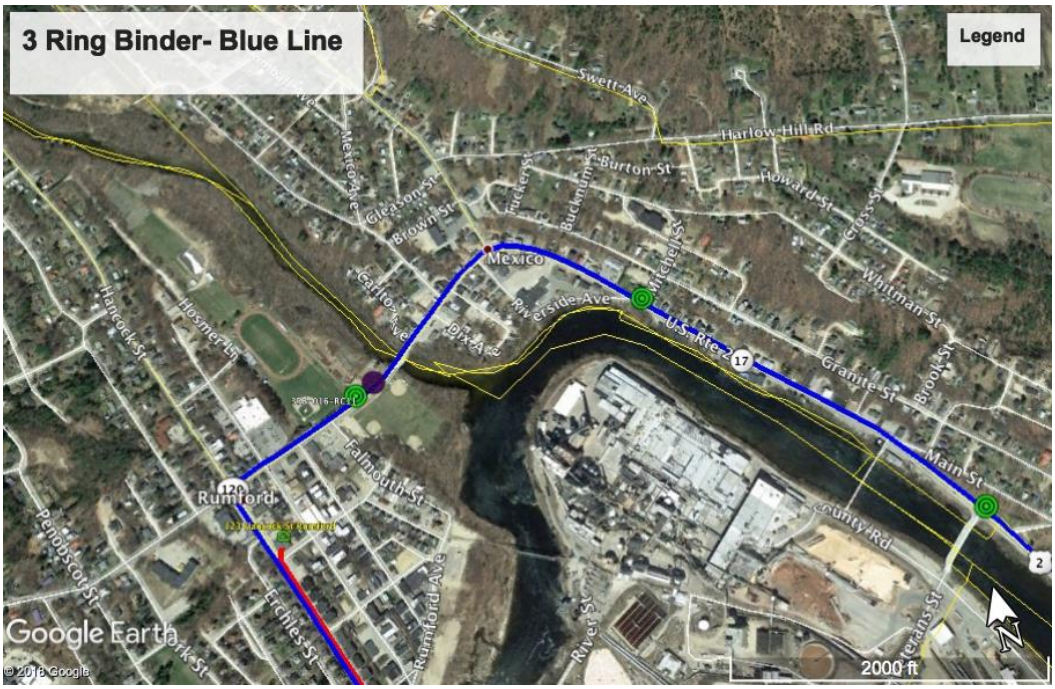
Benefits of Broadband

Broadband is a term that is really undefined and used by providers to describe their service. However, what we are really talking about in this case is a level of service that can only be achieved by using fiber. Fiber allows for connections of up to a Gigabyte (1000Mbps) or more per subscriber. That level of connectivity is almost unheard of in Maine, but these are the types of networks that are being built in places like Austin, Texas and Chattanooga, Tennessee and creating a renaissance of entrepreneurial spirit and attracting new businesses and people to live and work in these places.

This level of connectivity can attract the types of businesses that rely on super-fast speed, large capacity to move big files and a level of reliability that minimizes service interruptions. E-Commerce businesses, architects, financial institutions and other secure, transaction-based businesses and entrepreneurs whose business model relies on this type of internet connection are examples of the kinds of businesses that fiber connectivity can attract.

Next door, in Rumford, a downtown natural gas installation project will also lay fiber simultaneously, giving the community a double attraction of natural gas connectivity and high-speed broadband. Mexico could consider the same type of investment in fiber, perhaps in a potential high growth area or a business park.

Some communities have been marketing Gigabit Business Parks and this should be something to explore as an investment in Mexico's future. An alternative is to create an attractive downtown to revitalize and create a mixed-use, high capacity area that could be accessed by small businesses and citizens. Axiom is ready to work with Mexico to develop a budget for such an investment.

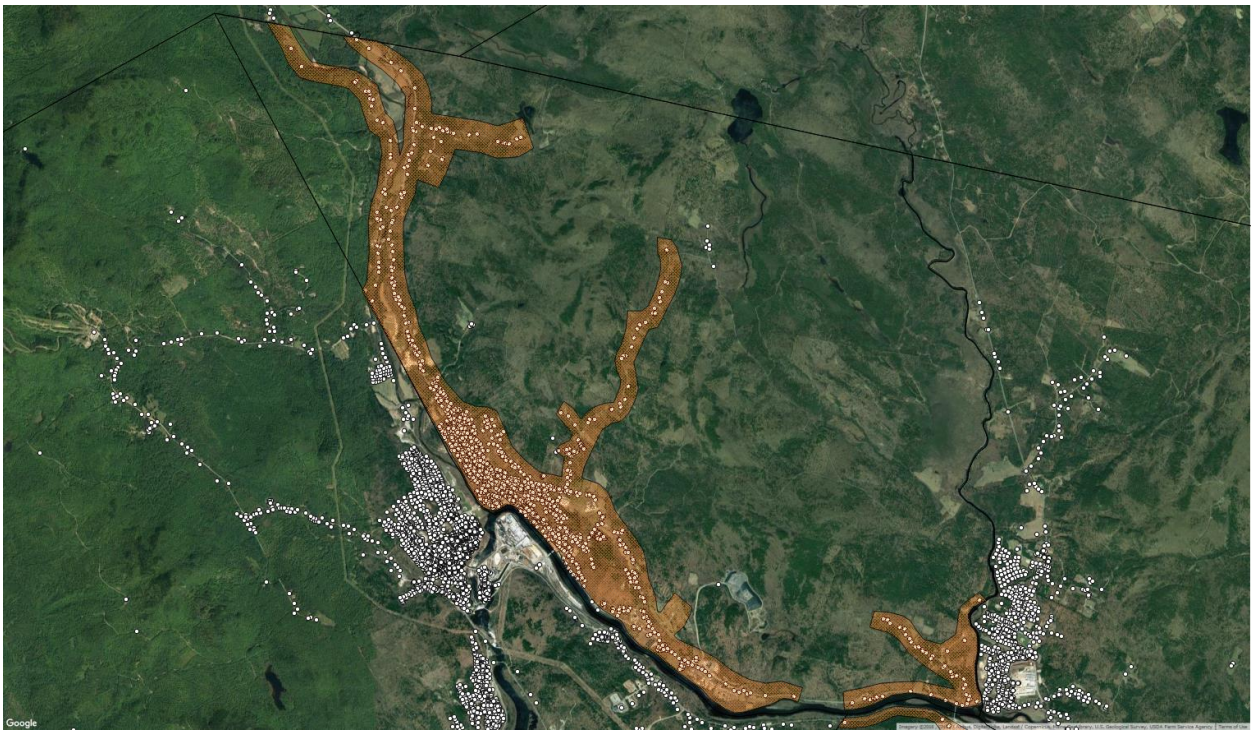


Because of the path of the 3RB it would make economic sense (the cost is less, the closer you are to the connection) to have one off ramp built to serve a downtown district. Every mile of fiber is approximately $30,000, so as you bring fiber to other locations beyond the downtown, it will expand costs.

Spectrum

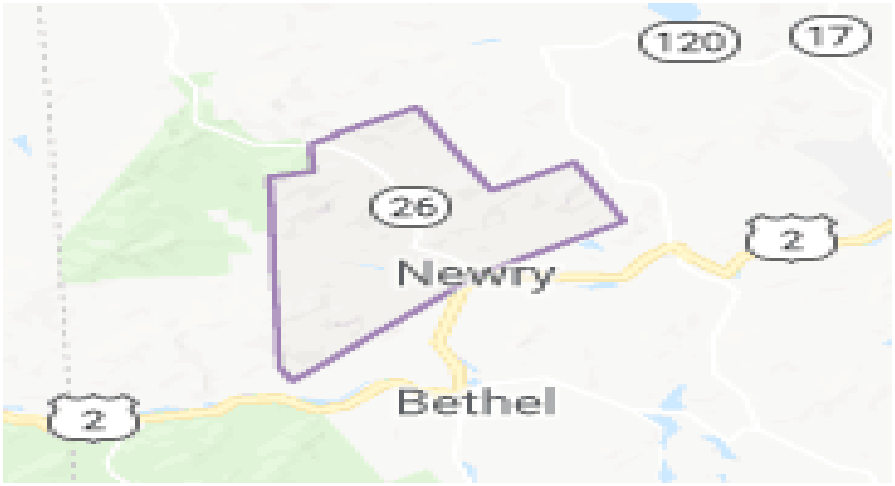
As a comparison, Spectrum offers service to more than 90% of Mexico. Its internet packages of 100Mbps and up to 120Mbps and triple play packages allow a subscriber to buy phone, internet and TV service from one provider. Co-ax cable, which is what the company uses for technology to hook up homes, has several advantages and some significant disadvantages. Currently, there is no cost to the community to expand service, as Spectrum covers almost all of Mexico. While Spectrum's service can be expensive, it is reliable and allows for bundling of multiple services using one provider, providing convenience for the consumer.

The system is shared and internet speeds to the home can vary widely, depending on the number of users on the system at any one time.



Spectrum Coverage Area

Newry



Newry is the home to Sunday River, a destination ski resort that is an economic powerhouse in the community and the surrounding area. As such, much of the area caters to outdoor enthusiasts, not just in the winter months, but also throughout the year, as the region has begun to successfully market itself as a four-season destination. Axiom's discussion of goals involved better understanding connectivity in the many condo associations and homes that surround the Sunday River resort area. An initial outreach to condo associations seemed to indicate that Spectrum service was good, and there is little desire for alternative connectivity.

Second, there are some areas in the less populated areas of the town that suffer from a lack of good quality service. This is particularly true outside of the Spectrum service footprint, where service reliability and speeds can be problematic with DSL service provided by FirstLight.

Goals:

- Bring interested associations, businesses and citizens together to discuss their current experience with internet connectivity
  - Discuss a fiber optic plan that could attract more people to the region and help extend their stay
  - Emphasize local residents who make their living here and need good connectivity to create their own economy
- Work toward better coverage in areas that are poorly served or unserved

Axiom Recommendations:

- Discuss with Bethel the feasibility of a partnership:
  - Fiber or wireless build out
- Hold informational meetings in community about the benefits of fiber
  - Gauge community interest
  - *"WHY FIBER?"* section of report is a good starting place to describe the benefits of fiber
- Work with Axiom to develop a high level, cost analysis of fiber

Spectrum

Spectrum shared information about its coverage area in Newry and the roads it serves. Spectrum's criteria for expanded coverage is 20+ homes per mile. If there are roads in Newry that are not served by Spectrum and there are 20 homes per mile on any of those roads, Axiom can certainly bring those to Spectrum's attention.

Spectrum is open to working with communities, and Axiom can facilitate engaging them, if the community desires to explore this option. Below is Spectrum's coverage area map.

Spectrum coverage area in Newry

FirstLight

FirstLight is the telephone provider in Newry and it offers DSL internet connections as well. In the parts of Newry not covered by Spectrum, typically First Light is the only other choice for internet service. Because of the way DSL technology works, the further away from the equipment, the more likely reliability becomes an issue. In addition, speed levels are also dependent on the home location in relationship to the provider's equipment, often giving those located in more remote areas poor service levels and quality.

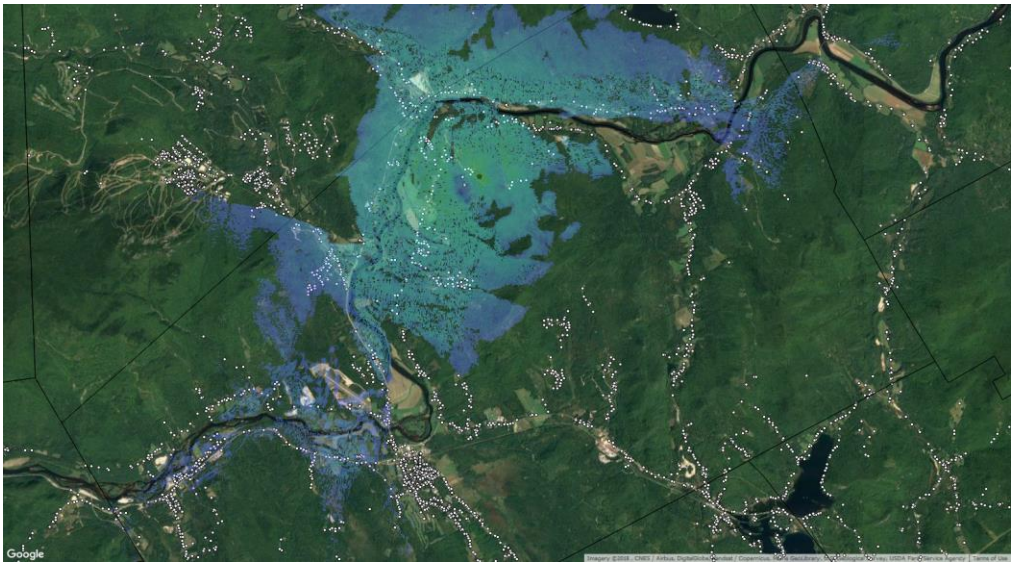
In the case of FirstLight, it is not interested in enhancing or expanding DSL service. Rather, it provides fiber to Sunday River and is interested in expanding fiber service to other areas across the community. A discussion with FirstLight to determine if it would expand its current fiber footprint to serve the community is a reasonable first conversation, given its emphasis on optimizing its fiber infrastructure.

Fiber

With a regional plan in this document that includes a fiber ring, the Three Ring Binder (open access, middle mile fiber) running through Bethel and FirstLight fiber in Newry now, Axiom recommends a more through engagement of the community on a fiber plan that would serve residential customers, as well as the businesses, by building understanding and momentum.

Axiom recommends a fiber plan for Bethel and also recommends that Newry partner with Bethel to bring a Fiber To The Home (FTTH) solution to Newry residents and businesses, as a mini-regional project. There are many benefits to working together and Axiom believes grant opportunities would be greatly enhanced if the two communities worked together. Axiom did not build a fiber plan for Newry because initial discussions with the town were focused on beginning to build community support for such a project. That remains the case. Axiom can build an approximate cost model upon request and would be happy to work with Newry. Initial cost of a trunk fiber route is located in the regional section of this report.

Wireless



As an alternative strategy to build infrastructure that will serve unserved or underserved areas of the community is fixed wireless technology. It is less expensive and can reach those harder to serve locations. An existing tower in the region is the basis of analysis for a Newry/Bethel wireless option.

According to the 2010 Census the following household numbers have been recorded for the following two towns: Newry – 157 and Bethel – 1121.

The towns of Newry and Bethel have a tower that is centrally located and can serve portions of both towns. Based on the coverage map above, it is estimated that 30% of Newry and 80% of Bethel can be reached from this tower.

Taking the household numbers listed above and the approximate percentage of coverage for each town, it is estimated that a total of 463 households can be reached. Using the standard wireless take rate of 30%, the total number of households served would be 139.

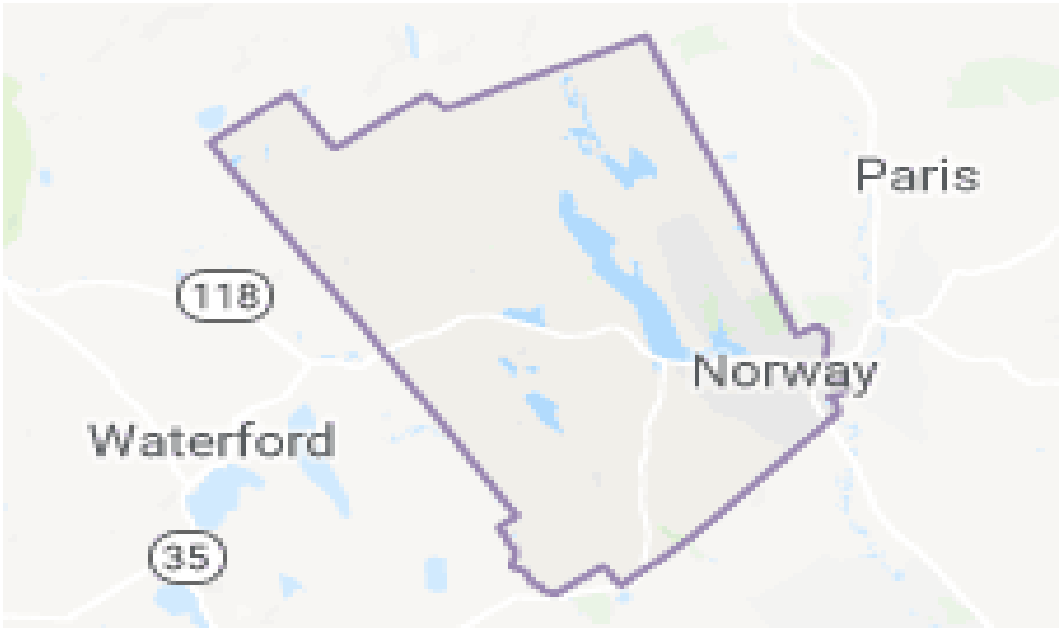
The costs listed below use the above numbers to figure an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$69,500.00
Material Total	**$138,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$27,800.00
Labor Total	**$44,000.00**
Total Non-Recurring Cost	**$182,000.00**

The propagation map that was produced shows that parts of the eastern side of Newry would be covered. This is the area that does not have Spectrum service, making this project something to seriously consider. This project would not extend service on the western side of the community, beyond Sunday River.

Given that most of the coverage would come on the Bethel side, a cost allocation would be important, and that can only occur if the two communities came together to discuss options.

Norway



Norway Goals:

- Attract and retain families and retirees to live and work in community
- Ensure that people can access health services from their home, including those that enable them to stay in their home longer
- Enable a thriving destination recreation economy by improving connectivity and bandwidth

Axiom Recommendations:

- Invest in Community HotSpots to attract and enhance interest and desirability in the downtown
- Insist that Spectrum keep its promise through the current franchise agreement to serve all homes
- Begin community conversation around fiber optics

HotSpots

Community Hotspots are open access networks that allow citizens in the downtown or other public spaces access to the internet. This is a simple, straightforward way to help the community get more connected.

Downtown Hotspots offer several advantages over traditional cellular networks. First, a Hotspot allows for faster downloads, which makes surfing the web easier and helps with accessing the internet more efficiently, while using other devices, like a laptop or tablet. Second, a Hotspot allows the community to create a landing page, which can direct people to community assets or amenities. And last, it allows the community to work with a local sponsor to cover the cost of deployment.

These advantages make community hotspots a low-cost, smart first step for getting the community better connected and helping elected officials and other influencers in the community better understand the demand for good internet connections. A growing number of communities in Maine have installed HotSpots, including Millinocket, Greenville, South Portland, Biddeford, Eastport, Machias and Waterville.

Below is a map representing a possible downtown deployment of three HotSpots. By overlaying the coverage area, it helps people stay connected as they move through each of the three HotSpots.

This is only a depiction of a possible deployment scenario and specific building locations and coverage areas would be determined with the town.

There are a variety of ways that towns pay for HotSpots:

- Directly from town budget (South Portland)
- Sponsorship from a local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Cost:

- One time install fee – $3000x3 HotSpots = $9000

- Includes one year of technical support and equipment maintenance as needed
- Monthly usage reports

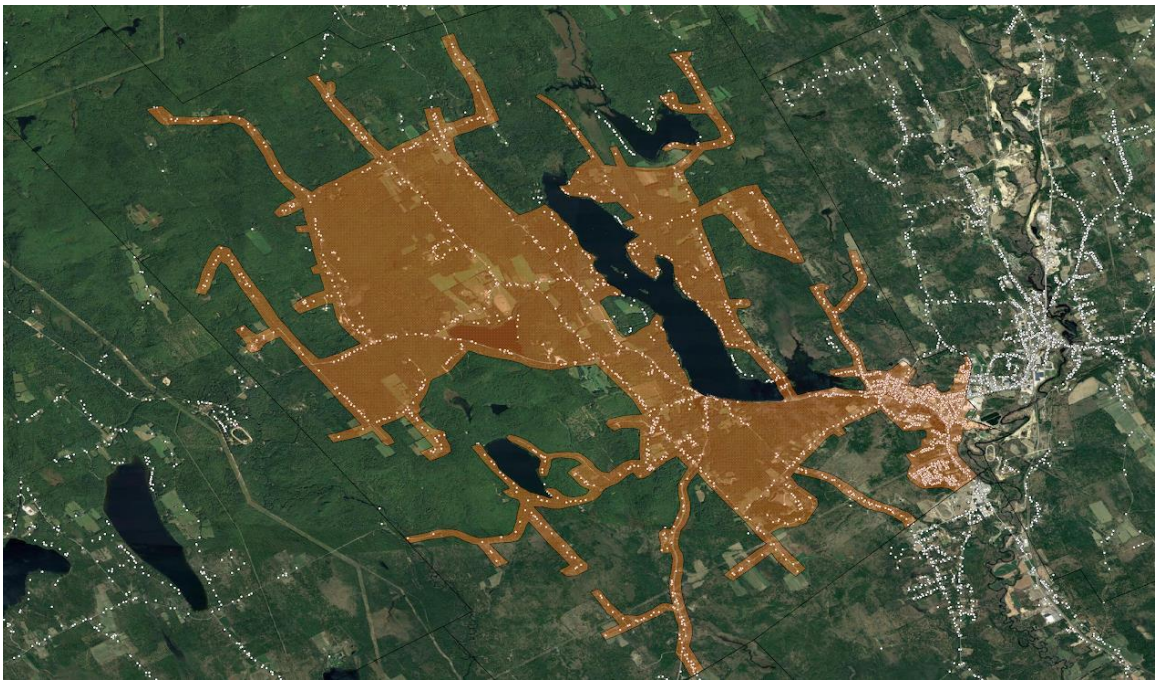
- Annual maintenance – $1500/year, starts in year 2
  - Includes technical support
  - Equipment maintenance/replacement
  - Monthly usage reports

Spectrum

A Spectrum map shows that most of Norway is served by Spectrum. Spectrum's recent upgrades to 100Mbps service are helpful in meeting some of the community's goals and means that over 90% of Norway has access to those speeds. Given this information, Axiom recommends a community conversation to discuss connectivity options.

Norway is currently working on a new Spectrum Franchise Agreement. The current outdated agreement calls for extending cable to every home. Norway has hired the James Sewell Company (as part of a 6 or 7 town consortium) to update its agreement.

A new Spectrum agreement that commits to extending cable service to areas of the community currently only served with DSL would be a significant upgrade to those homes with DSL service that are only able to receive between 3- 25Mbps or are not served at all.

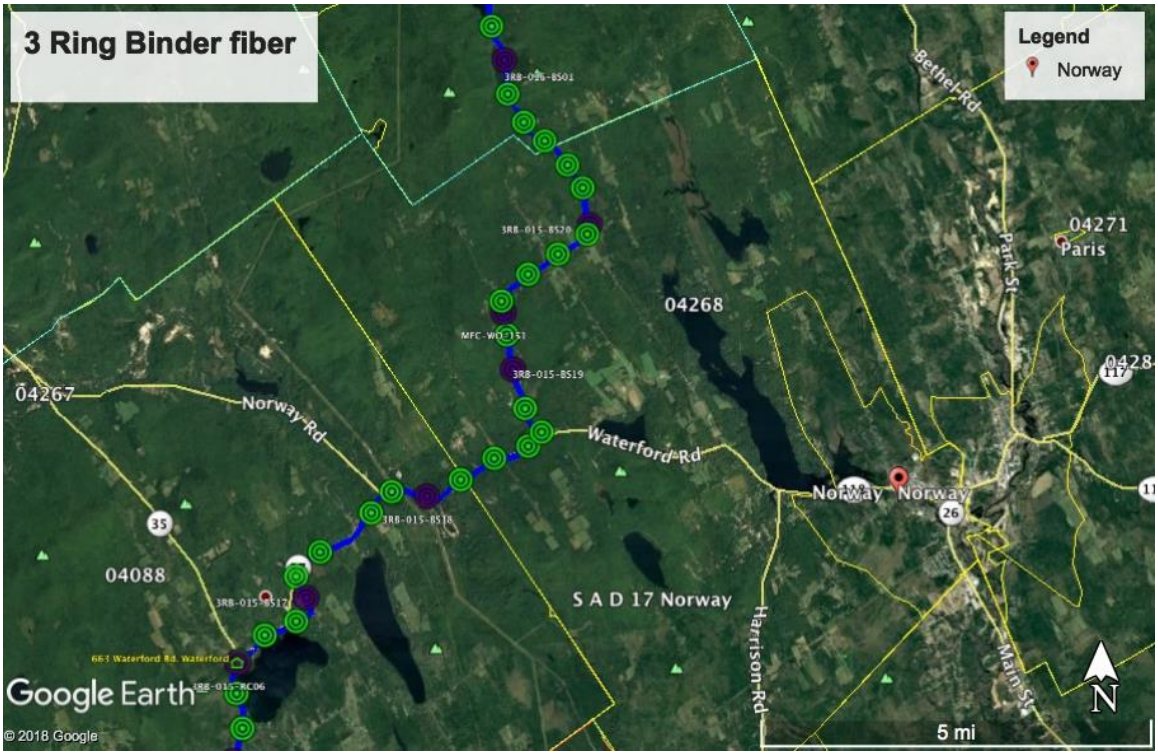


Spectrum coverage map

Fiber

Axiom recommends that Norway consider a fiber plan for the community. Fiber has several advantages over cable and DSL, having the capability to deliver super-fast and extremely reliable service. With the ability to scale, as demand increases, fiber can accommodate faster speeds up to a Gigabyte of service with the technology we would recommend. A *"Why Fiber?"* section of the report can help understand the full benefits of fiber versus DSL/Cable/Wireless.

However, given the current coverage in the community, Axiom expects that extensive community outreach and education will be needed to persuade Norway citizens to invest in a fiber system. Axiom can work with the town when the time is right to put a plan together, if this is a direction the town would want to go in. As a first step to a fiber plan, Norway already has middle-mile, open access fiber, commonly called the Three Ring Binder.



This asset can be accessed, in partnership with a provider, to build an off-ramp of fiber that could bring ubiquitous fiber optic service to residents in the community. Axiom's regional plan proposal contemplates a larger loop of fiber that could benefit Norway. Axiom stands ready to assist the community as a resource and answer questions about the possibilities, as they arise. The regional fiber plan can be viewed in the Regional Plan section of this report. Axiom strongly suggests engaging the community in discussions about fiber and why better connectivity will be a cornerstone to future growth and livability in small, rural towns.

Otisfield

Otisfield is part of the Maine West project scope area. However, they are working with Spectrum to bring service to their community and understandably were not interested in any additional goal setting until this project was completed this year.

Oxford

Oxford Goals:

- Provide 100/20Mbps minimum speed for businesses along the Route 26/Route 121 corridor
- Keep Oxford competitive by putting broadband in the forefront of economic development
- Provide affordable internet in rural areas with speeds of 30/7Mbps

Oxford is growing and would like to enhance business attraction and retention. The Route 26 corridor is an area where high capacity fiber connections could be an important enhancement to businesses that are located there and to future growth.

Axiom Recommendations:

Axiom believes that a first step in expanding internet access to meet Oxford's speed requirements is a fiber build out along the Route 26 business corrido. Currently individual businesses on the corridor can purchase fiber service from providers. However, this fails to capture the economic development opportunities associated with fiber. When fiber connections are only available to businesses that have the capital to connect, it leaves behind businesses that would benefit but cannot, creating an economic lag. In addition, the current situation does not differentiate Oxford in any measurable way. A high capacity business corridor, already built and marketed, could be a differentiator, build on the growing Oxford brand, and potentially diversify the types of businesses that would locate on the corridor.

- Meet with the Oxford Economic Development Committee
  - Discuss a fiber corridor and fiber to the business park to gauge opportunity
  - Explore TIF funding possibilities

This is a project worth exploring for federal funding and can serve as a catalyst to extend fiber into other parts of the community in future years.

- Collaborate with Norway on the wireless plan for the region to help with underserved areas of the community

Fiber

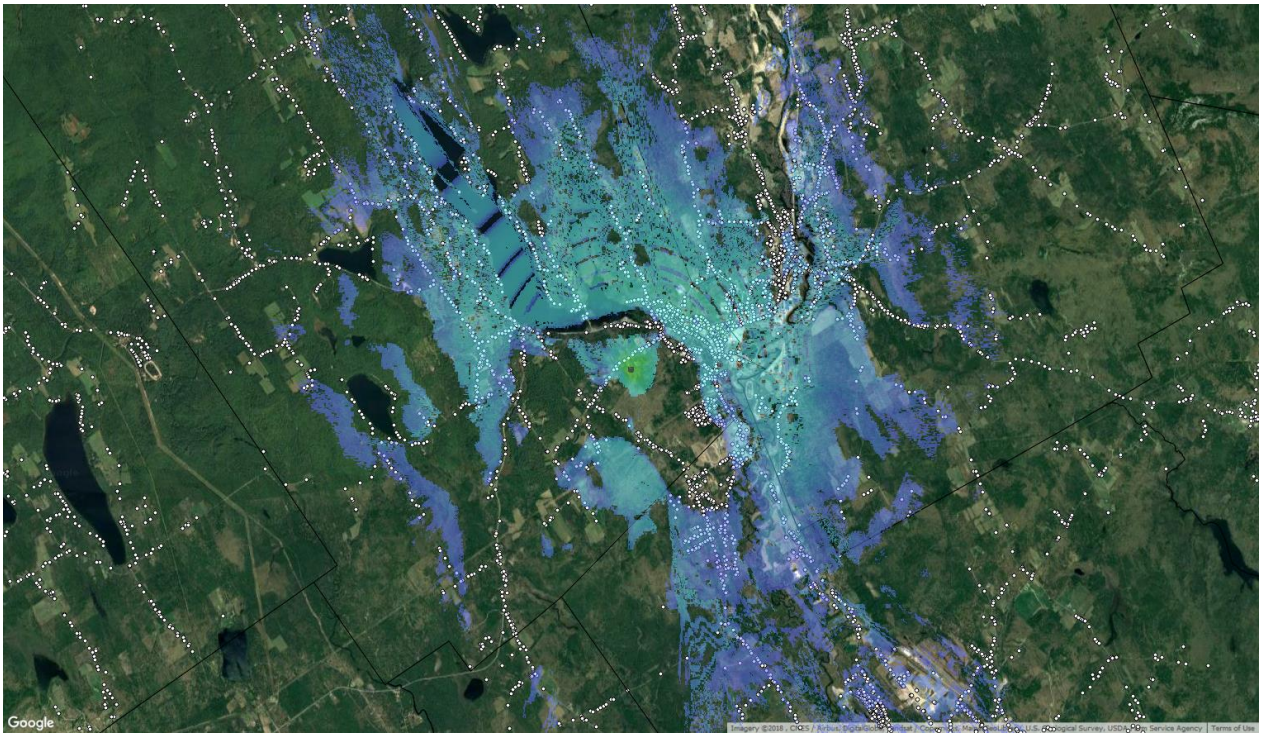
Creating a high capacity, fiber-optic corridor along Route 26 is a serious attempt to attract certain types of businesses. Oxford is already home to Oxford Casino, which anchors the town's business district to the south, and New Balance Show Factory Outlet, approximately 4 miles away to the north.

FirstLight (Oxford Networks) has fiber along Route 26, and Axiom believes Consolidated Communications (FairPoint) has fiber there, too.

FirstLight or Consolidated could provide a wholesale connection to its fiber that would bring speeds of up to a Gigabyte (1000Mbps) by an operator, in partnership with the community to build fiber connection drops to individual businesses and/or to serve the industrial park. Ongoing discussions around TIF District monies that might be available to help finance this project are still unclear but should be resolved, as well as exploring grant funding opportunities.

Wireless

A wireless solution for areas that are underserved was discussed. There is an existing tower that can serve Oxford and Norway.



Oxford/Norway Wireless Coverage Map

According to the 2010 Census, the following household numbers have been recorded for Norway – 2163 and Oxford – 1657.

Both towns have a tower that is centrally located and can serve portions of each town. Based on the coverage map above it has been estimated that 60% of Norway and 30% of Oxford can be reached from this tower.

Taking the household numbers listed above and the approximate percentage of coverage for each town, it is estimated that a total of 2890 households can be reached. Using the standard wireless take rate of 30% the total households served would be 867.

Below is an approximate cost to install service onto the existing tower using the household numbers outlined above.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$269,500.00
Material Total	**$338,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$107,800.00
Labor Total	**$124,000.00**
Total Non-Recurring Cost	**$462,000.00**

Paris

Paris Goals:

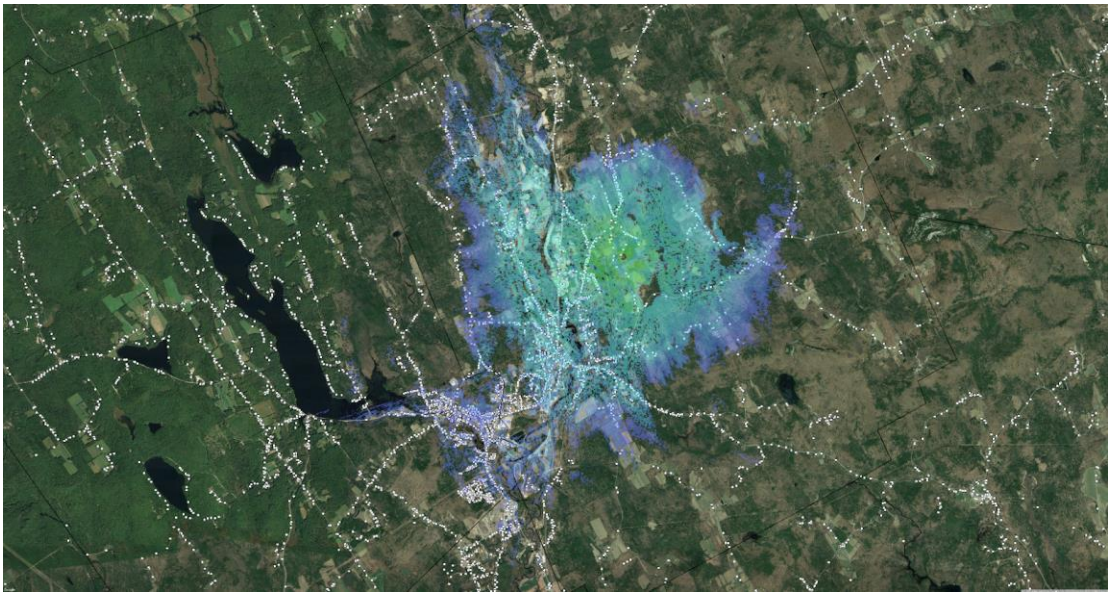
- Provide coverage to residents on the outskirts of town in the areas of Brett Hill Rd, Parsons Rd., Mountain View Rd. and Stearns Hill Rd.
- Create Wi-Fi hotspots at Moore Park, the Town Office and SAD17
- Use broadband expansion and strategic hotspot placement as a marketing tool to brand Paris as business friendly, up and coming, as well as a great place to live

Axiom Recommendations:

- Investigate grant funding for a wireless system
- Engage Spectrum to fill in gaps in service
- Implement HotSpots in the downtown

Cover unserved or poorly served areas

To address the need for internet service in several areas where it is less than satisfactory, Axiom utilized an existing tower to create a coverage map for Paris. The map, which is computer generated, shows the potential service area in green or blue. Because there are dense tree cover and hills, not all of the area in green or blue will have coverage. Individual homes will need to be surveyed to determine the signal strength to that location. However, it is a good representation of what could be expected for wireless coverage.



Paris Wireless Coverage Map

According to the 2010 census, Paris had 2187 households. There is a tower centrally located in the town that could provide very good coverage and, based on the radiation map provided above, there is a strong possibility of reaching 70% of the town, 1531 homes.

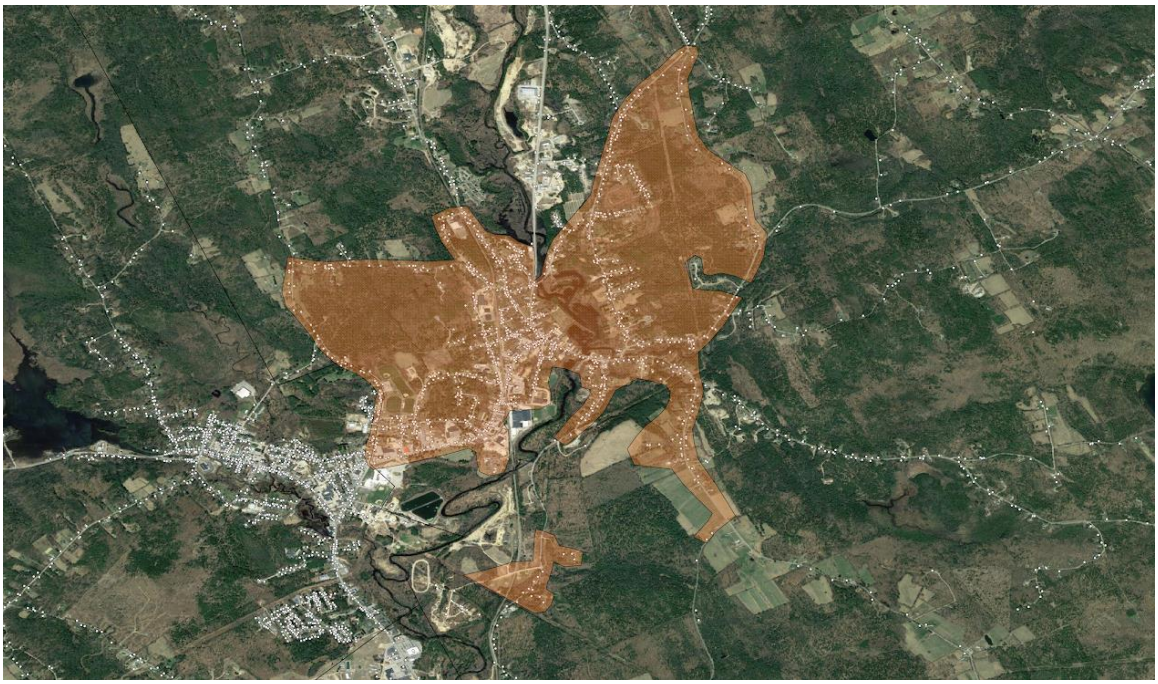
Typical take rate for wireless service in a competitive environment is 30%, so our calculations of equipment cost are based on 460 homes taking service, with the potential for 1531 homes that could receive the service.

The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower in Paris.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$230,000.00
Material Total	**$298,500.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$92,000.00
Labor Total	**$108,200.00**
Total Non-Recurring Cost	**$406,700.00**

Spectrum

Spectrum is aggressively updating its Franchise Agreements with communities across the state. Axiom recommends that Paris work with Spectrum to expand service, as the town negotiates its Franchise Agreement.



Spectrum Coverage Map

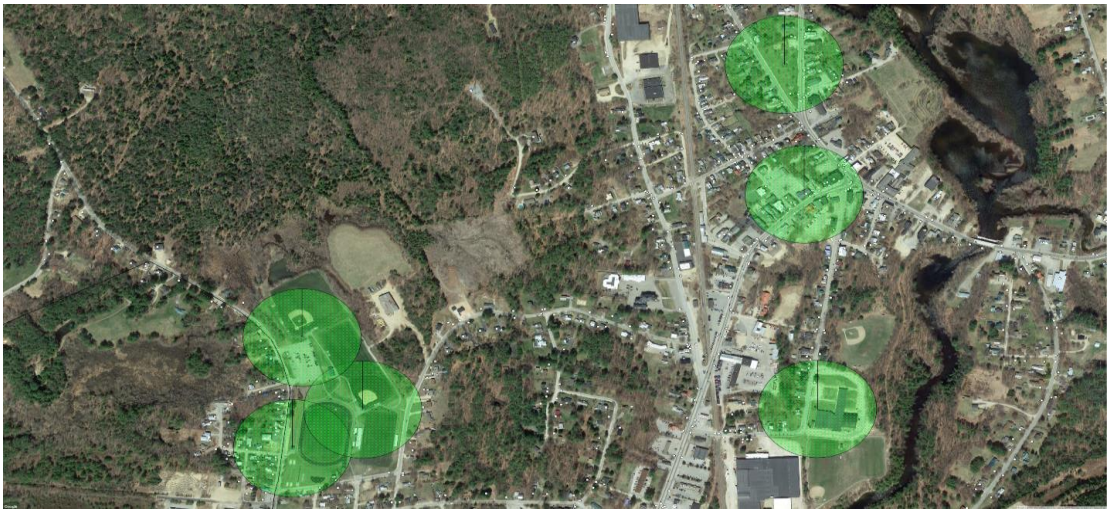
The community has gaps in service that would be covered by a wireless solution. However, a step toward better coverage without the expense of a wireless buildout would be to work closely with Spectrum through the Franchise Agreement renewal process to expand Spectrum service to areas they do not currently serve. Currently, those areas do not meet Spectrum's criteria for build out without a subsidy. A first step would be to identify areas that Spectrum could price out and for the town to work with Spectrum in applying for a ConnectME Authority infrastructure grant. Other funding options would include self-funding the build out, or forgoing franchise fees to help contribute to a build out of Spectrum service.

This approach would certainly not get additional coverage to the number of homes covered by a wireless solution, but represents an alternative to the wireless plan and the ability to focus in on very specific areas of need just beyond Spectrum's current coverage footprint.

Consolidated Communications (formerly FairPoint)

Previous to this planning process Consolidated was contacted to better understand the potential for enhanced and expanded coverage. Consolidated has been using federal funding through a program called Connect America Fund II or CAF II (it was the second round of funding) to expand and enhance coverage. Currently, Consolidated has no plans to expend CAF II funds in Oxford County communities in 2018. So, any expansion of Consolidated coverage would come from local funds to pay for upgrades in Paris. Axiom does not recommend exploring expansion opportunities with Consolidated at this time.

HotSpots



HotSpots at Moore Park, SAD 17 and town office

HotSpots are increasingly a way for communities to better serve citizens who cannot afford or do not currently have a Broadband connection. In addition, if placed in strategic locations, HotSpots enhance a downtown experience for visitors.

Typical coverage area of a HotSpot is 400'-600'. The map above provides a good approximation of the coverage area that could be expected from HotSpots at locations identified by the town. The three HotSpots on the right are cover Moore Park, the town office and the high school building. The HotSpots to the left are added for consideration to cover the ball fields and track.

There are a variety of ways that towns can pay for HotSpots:

- Directly from town budget (South Portland)
- Sponsorship from a local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Axiom would be happy to discuss all options to help facilitate an installation.

HotSpot Cost:

- One time install fee of $3000 per HotSpot
  - Includes one year of technical support and equipment maintenance as needed
  - Monthly usage reports

- Annual maintenance cost of $1000/year per HotSpot, starts in year 2
  - Includes technical support
  - Equipment maintenance/replacement

- Monthly usage reports

The cost above does not include the monthly fee for internet service which can be anywhere from $49.99- $99.99 a month and the nominal cost for electricity, which is typically covered by the building owner as a courtesy.

‘HotSpot Plan for Paris:

Installation of 3 HotSpots (Moore Park, Town Office, Oxford Hills High School) = $9000
Does not include the monthly cost of internet to each site ($49.99- $99.99) or the cost of electricity, which is nominal and usually absorbed by the owner of the building.

Annual maintenance, starting in year 2= $2500

If the other three HotSpots are included the upfront cost would be $18,000 and the annual maintenance cost would increase to $3500.

Axiom would be happy to discuss this project further. Axiom has extensive experience installing and servicing HotSpots around the state and can explain the opportunities and challenges with this type of project.

Peru

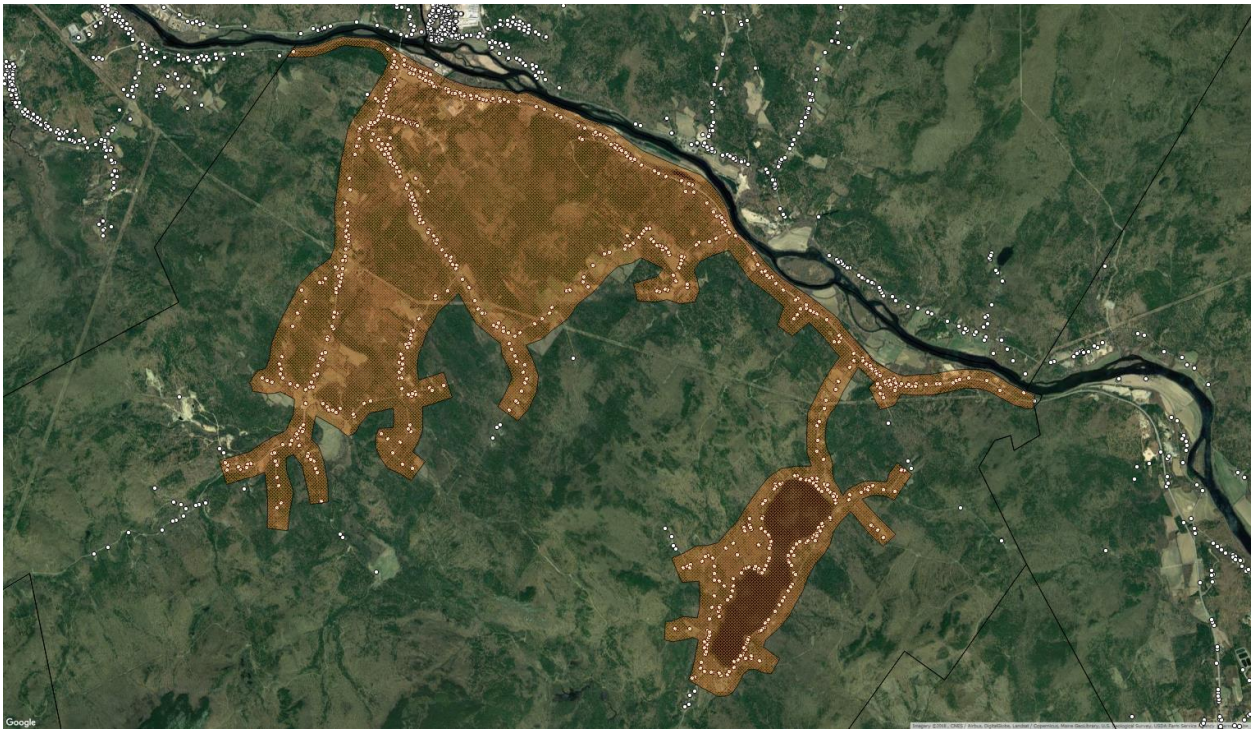
Peru Goals:

- Every resident has access to high speed internet
- Residents clearly understand the benefits of broadband
- Improve access to the internet for the village and businesses at an affordable rate
- Provide service to unserved homes at an affordable rate

Axiom Recommendations:

- Explore a partnership with Dixfield to gauge interest in a wireless solution for both communities that would provide service to unserved and underserved areas. Based on mapping, a wireless solution can cover a good portion of the community, but introducing another provider to compete with existing service would require a substantial subsidy, either by the town or another funding source through grants
- Spectrum coverage in Peru is very good and overlaying another solution would need careful thought
- A section of *"Why Fiber?"* in this report will help the community begin to understand the benefits of fiber and better connectivity

Peru is served by Spectrum; the map below shows Spectrum's coverage area in the community.



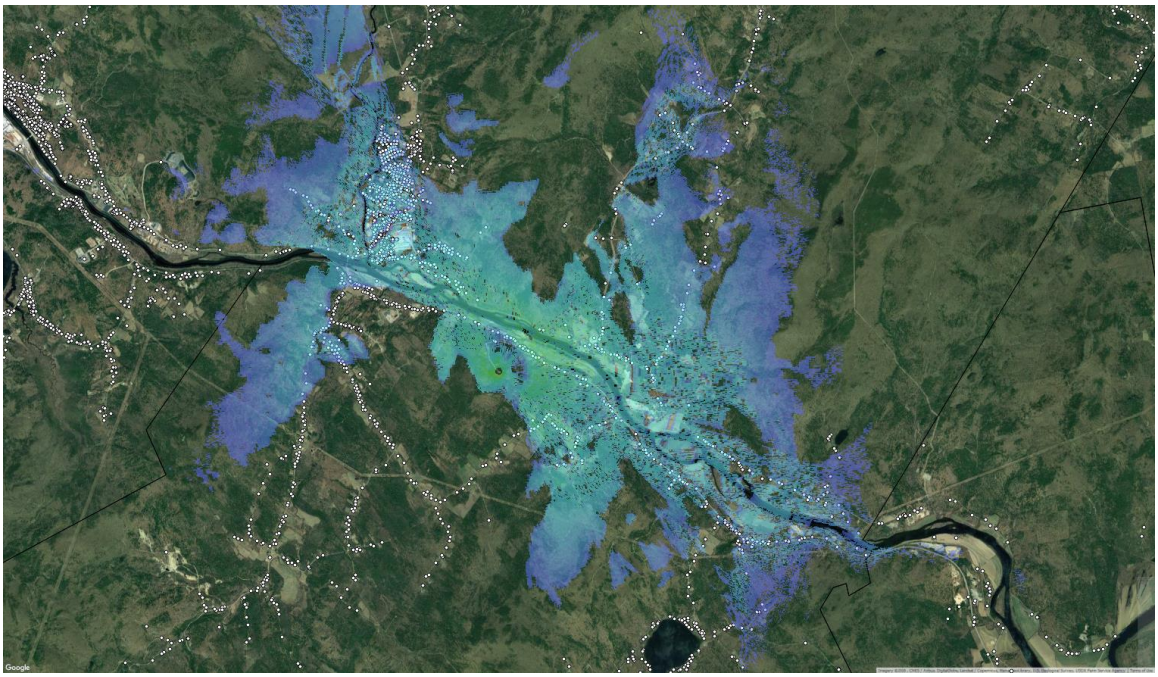
Spectrum Coverage Map

Peru is also served by Consolidated, formerly FairPoint Communications. Consolidated offers DSL service to homes and businesses across Peru. Consolidated did not provide Axiom with a map of its service in the town. Typically, DSL service and reliability are dependent on the distance from the provider's equipment. As the service extends to the maximum of 3 miles from the equipment that powers the internet service, the internet speeds decrease, and the service becomes less reliable.

Consolidated has undergone a significant upgrade in its network over the past few years. Peru may have benefited from the upgrade, allowing some customers to double the speeds they were experiencing previously, if they chose to upgrade. Maximum speeds reach close to 25Mbps. Those who have not taken advantage of higher speeds should be encouraged to contact Consolidated to determine if those upgrades are available at their home.

Wireless

Wireless broadband offers an affordable solution for hard to reach homes and is especially effective in rural environments where other types of technology would be cost prohibitive. Because Peru and Dixfield share an extended border, it could offer an opportunity to work together to implement a wireless solution that could benefit both communities. Below is a coverage map that can give the community a good idea of the coverage area of a wireless solution. However, while a cost effective way to fill in gaps in areas that are unserved, much of the coverage map would overlay Spectrum service. This would be a lower cost solution to the homeowner, so it remains a viable option, additional engineering work and refinement of cost and coverage would need to be conducted to ensure that a wireless solution would reach those areas of concern affectively.



Expected Coverage area for Peru/Dixfield

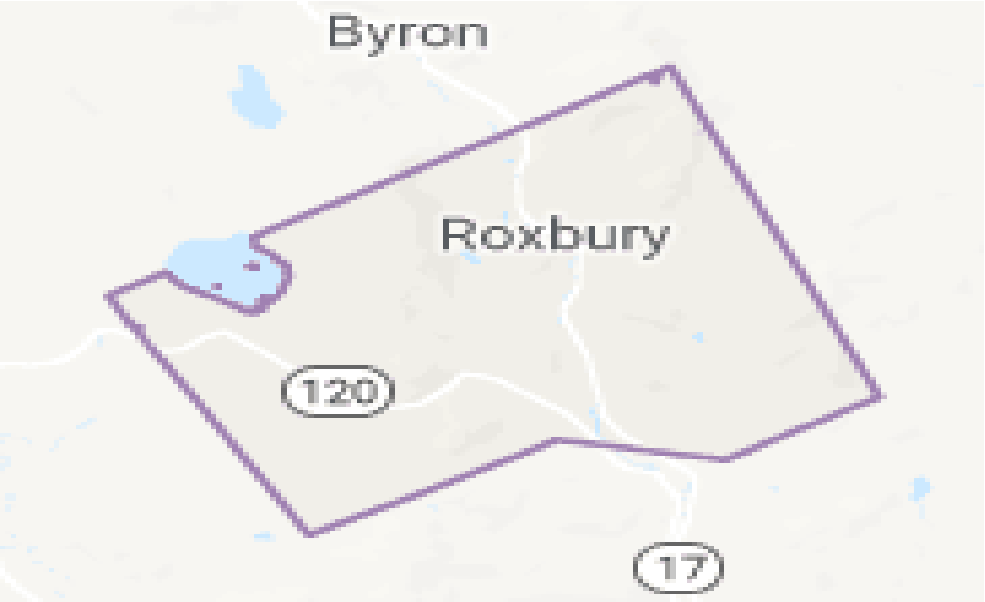
According to the 2010 Census, Peru has 629 homes and Dixfield 1044 homes. There is a tower that is centrally located that can serve portions of both towns. Based on the coverage map above it has been estimated that 50% of Dixfield and 70% of Peru can be reached from this tower.

Using the household numbers listed above and the approximate percentage of coverage for each town, it is estimated that a total of 963 households can be reached. Applying the standard wireless take rate of 30%, an estimate of the total households that would be served is 289.

The costs listed below use the above numbers to figure an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$144,500.00
Material Total	**$213,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$57,800.00
Labor Total	**$74,000.00**
Total Non-Recurring Cost	**$287,000.00**

Roxbury



Roxbury Goals:

- Install HotSpots across the community to improve cellular data coverage
  - Possible HotSpot at Ellis Pond (boat launch, campground)
- Expand Spectrum service
- Utilize wind farm fiber if the wind farm is served by fiber
- Provide guidance in negotiating an updated Franchise Agreement with Spectrum

Axiom Recommendations:

- Apply for funding to install HotSpots at locations identified by the town and consider prioritizing the Town Office and Ellis Pond
- Work with Maine West to explore funding a potential Ellis Pond FTTH project
- Meet with Rumford and Hanover to assess interest in wireless project partnership

Spectrum

Spectrum coverage map

Currently Spectrum is the cable provider in Roxbury, and the map above shows that does not cover a significant portion of the town, essentially every road east of Route 17.

There appears to be gaps in service along Route 17 and Route 120. These gaps in service should be part of the discussion the town has with Spectrum in negotiating a new Franchise Agreement. Axiom sent Roxbury a memorandum with strategies for negotiating the various components of a new agreement. As part of the negotiation, Axiom recommends highlighting the gaps in service and possibly leveraging the agreement negotiation to expand service.

Spectrum must have 20 homes per mile to expand service without additional commitments from the town or other monies. It is wants to update out of date Franchise Agreements and is open to submitting a ConnectME state infrastructure grant, if its requirement of 20 homes per mile can be met and the community will be a partner.

If Roxbury would like to discuss this further with Spectrum, Axiom recommends that Roxbury contact Melinda Kinney.

Melinda Kinney, Director of Government Relations, Melinda.Kinney@charter.com

Wind Farm Fiber

Axiom has confirmed that the wind farm in Roxbury is not served by fiber. However, there is fiber in Roxbury on Route 120, Roxbury Notch Road toward Ellis Pond.

Ellis Pond

Following up on the town's interest in installing a HotSpot at Ellis Pond, Axiom created the map below to show the service area for a potential HotSpot.

Proposed Ellis Pond HotSpot

With the potential to run fiber down Shore Road or around the lake, Axiom recommends that the community explore a Fiber to the Home project around the lake. A fiber connection with FirstLight is approximately a mile from this HotSpot site.

Running fiber for a mile would cost approximately $25,000- $30,000, plus the licensing fees to be on the poles (estimated at $450 per pole, 21 poles per mile on average), equipment to power the system ($80,000) and drops to each home ($1000/per home). A rough estimate of the cost for this project is $200,000. That is worth considering for grant funding through ConnectME or possibly some USDA grants that will be coming on line in the near future.

Following are computer generated maps for several other HotSpots that the town expressed an interest in installing to expand cellular data coverage.

Town Office HotSpot

Three Pool HotSpot

Walker Brook

Rt 17 and Canwell Hill

Costs:

A town HotSpot is a reasonable investment to give community members a location where they can access the internet for free. It would be especially important to residents whose homes do not have a connection or who cannot afford internet.

There are a variety of ways that towns pay for HotSpots:

- Directly from town budget (South Portland)
- Sponsorship from local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Axiom would be happy to discuss all options to help facilitate an installation.

Cost per HotSpot

- One time install fee of $3000 (per HotSpot)
  - Includes one year of technical support and equipment maintenance as needed
  - Monthly usage reports

- Annual maintenance cost of $1000/year, starts in year 2 (per HotSpot)
  - Includes technical support
  - Equipment maintenance/replacement
  - Monthly usage reports

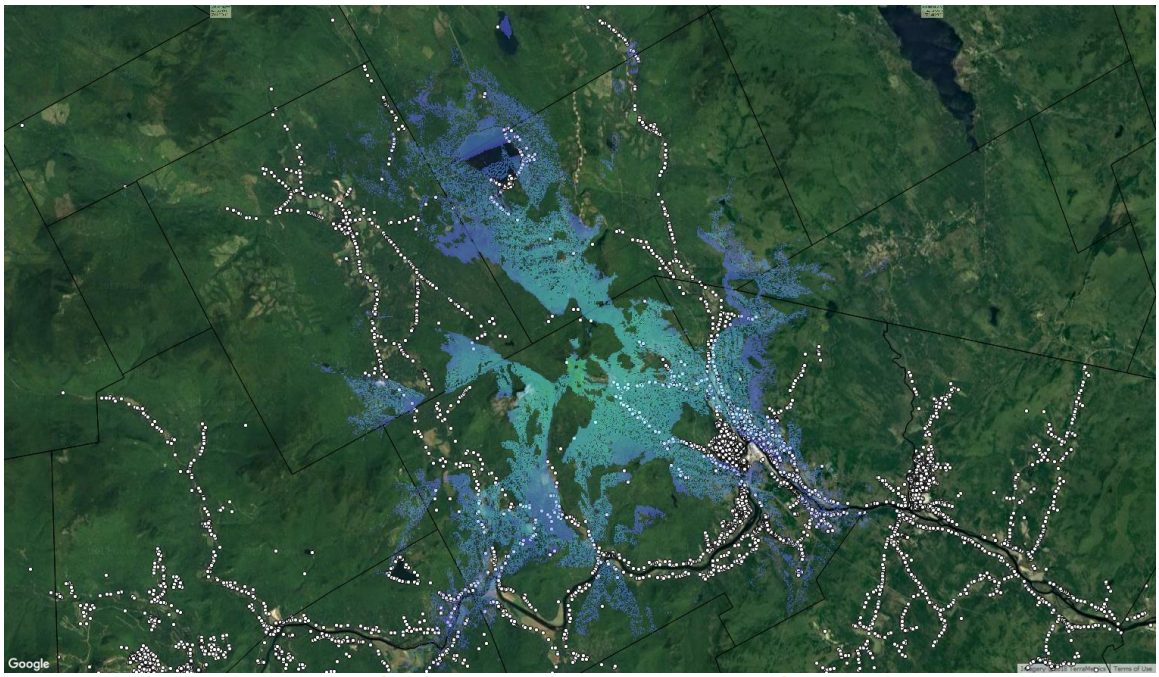
Total Cost for all 6 HotSpots:

$18,000	Installation Cost
$ 3,500	Annual Maintenance

The cost above does not include the monthly fee for internet service to each site, which can be $49.99- $99.99 a month per HotSpot, and the nominal cost for electricity, which is typically covered by the building owner as a courtesy.

Wireless

Another possible project could be to partner with Rumford and Hanover on a wireless project that could bring service to some parts of Roxbury. There is a tower that could potentially be used to bring a wireless service to approximately 40% of Roxbury.



Rumford/Hanover/Roxbury Wireless Coverage

According to the 2010 Census, Rumford had 2674 households, Hanover had 116 households, and Roxbury had 181 households.

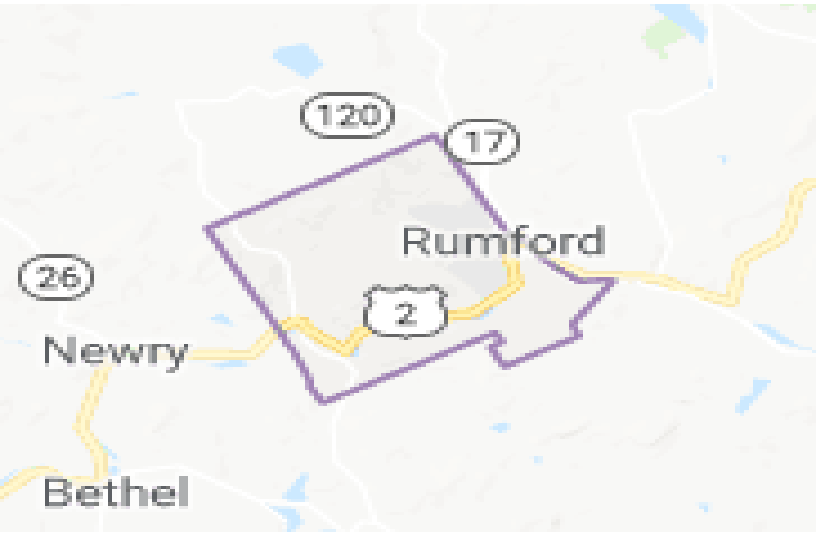
The towns of Rumford, Hanover and Roxbury have a tower that is centrally located that can serve portions of all three towns. Based on the coverage map above it has been estimated that 30% of Rumford, 40% of Hanover and 40% of Roxbury can be reached from this tower.

Taking the household numbers listed above and the approximate percentage of coverage for each town it is estimated that a total of 923 households can be reached. Using the standard wireless take rate of 30% the total households served would be 277.

The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$138,500.00
Material Total	**$207,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$55,400.00
Labor Total	**$71,600.00**
Total Non-Recurring Cost	**$278,600.00**

Rumford



Background:

Rumford is in the midst of a transformational project that will bring natural gas service to the downtown. The developer of that project has pledged to also include fiber optic cabling that will offer high-speed internet to the buildings that are to be connected to natural gas. The project will also include replacing poles and constructing new sidewalks.

Rumford Goal:

Rumford asked that Axiom produce a Fiber to the Premise (FTTP) analysis to determine the cost of putting the fiber on the new utility pole structure. This information was used to determine the cost of including fiber in the installation of natural gas lines. Initial thoughts were that installation of fiber on poles would be less expensive than including it in the initial buried cost of the natural gas line. An extensive conversation with the gas line developer indicated that the additional cost of burying the fiber optic cable with the gas line was a minimal additional expense to the overall project.

The cost of the plan below includes make ready cost to run fiber on the utility poles. But either way, in the ground or on the poles, the technology would essentially be the same. Stringing fiber cable on existing utility poles (if town negotiated a space on the new poles free of charge) would eliminate make ready costs; however, the gas developer calculations indicate an additional $5/foot charge to lay the fiber in the ground simultaneously with the gas project, and that those costs would be minimal and covered by grant monies, saving approximately $80,000 in make ready and drop fiber costs.

Axiom Recommendations:

- From Axiom's understanding of the pricing of the two approaches to installing the fiber, in the ground or on poles, placing fiber in the ground is the best option
    - Lower cost
    - Greater reliability

- Less likely to break
- Less maintenance

- Once the project is completed:
  - Consider extending fiber across the river to serve Mexico and Route 17
  - Consider extending fiber to neighborhoods on the fiber line that extends to the hospital

Rumford Fiber Project
Pink line is fiber trunk on island and to hospital
Yellow line is proposed bridge crossing

Total estimated cost of project = $279,291

Cost Breakdown:

Fiber Materials $82,198
Fiber materials are the cost of the trunk fiber and the other materials and equipment necessary to install fiber on the poles. According to Axiom's our rough estimation, the trunk fiber would be approximately 9500'. The natural gas developer has a quote for laying fiber in the ground of less than $5/foot. At a cost of $47,500 (9500' x $5= $47,500) there appears to be a savings of almost $35,000 compared with aerial fiber.

Fiber Labor $48,846
Fiber labor refers to the labor cost to hang the trunk fiber on the poles. It is unclear whether the labor for the fiber put it in the ground would change. It is assumed the $5 per foot includes the labor of installing the fiber, so this labor cost may be reduced.

Licensing & Make Ready $22,245
Licensing and Make Ready is the cost associated with applying for the rights to hang the fiber on the utility poles. This is the cost of the engineering analysis of each pole and the labor of moving lines already on the poles to accommodate the new fiber line. As stated above, this cost would be eliminated if the fiber were buried.

Replacement Poles (10%) $24,000

The Licensing and Make Ready part of the analysis also determines if any existing poles need to be replaced. Not knowing the gas line installation path it is hard to determine if this budget item would be eliminated. However, it is likely that it would be greatly reduced, if not totally eliminated, if the fiber is placed in the ground.

Customer Serving Hardware $75,000
This line item refers to the equipment that is needed to power and distribute the internet over the system. This cost would remain in either scenario. A cost savings of $25,000 has already been planned for by placing the equipment in an existing building vs. building a utility shack to hold the equipment.

Customer Premises Hardware & Installation $27,000
This budget item refers to the cost of the equipment that needs to be located at each "drop" or each connection to a subscriber and the cost of labor to install at each subscriber's location. This item would not change but has the potential to increase if downtown buildings require extensive wiring to distribute the fiber to reach every office suite or apartment in the downtown. The cost of hooking up individual homes or properties is much more predictable.

Cost estimate (licensed pole attachment): $279,291

Estimated savings for buried fiber when gas lines are installed: $81,245

Cost of Each Segment – See Appendix 1 Fiber Budgets

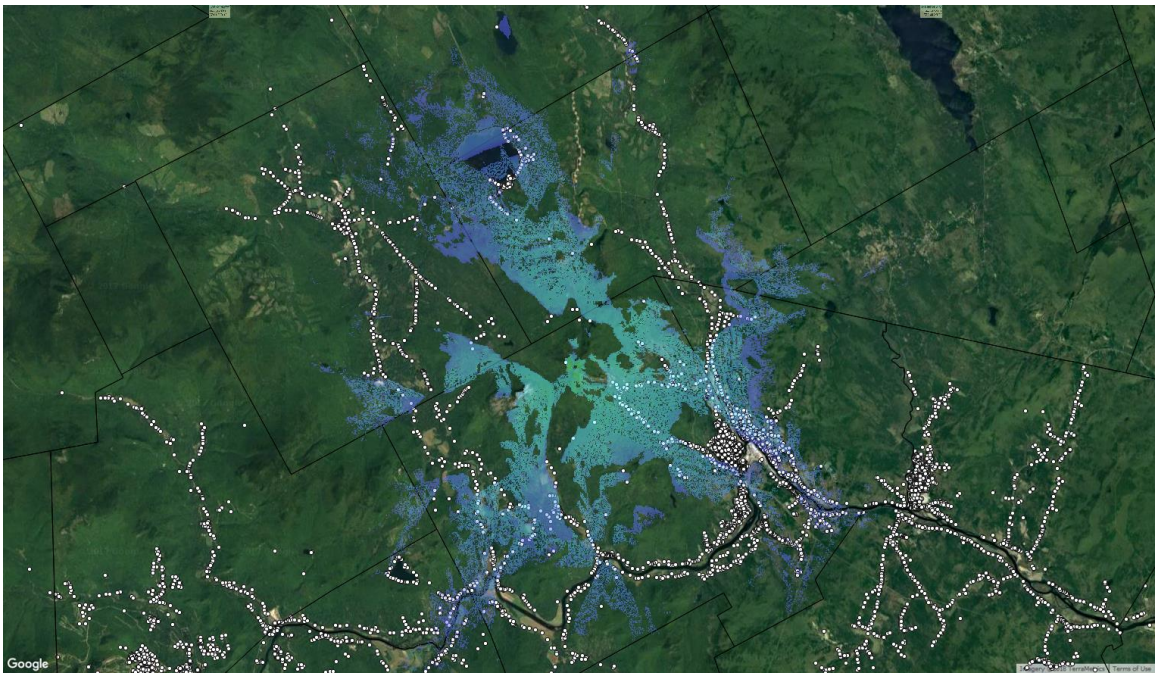
Other Thoughts:

From a regional standpoint, this is an exciting project because it has the potential to extend a fiber trunk into Mexico or beyond. For Mexico, this project will offer lessons learned in bringing fiber service to the community, and creates the potential for a partnership with Rumford to extend fiber or gas into the community. It will also put active fiber close to Route 17, which could add to a regional plan to extend fiber to Roxbury or Byron.

Wireless

Rumford did not ask for a wireless plan to help support the outskirts of town. However, there is an existing tower that could potentially serve Rumford, so it is included here as a potential connectivity project in the future. This project would not only serve Rumford, but also Roxbury and Hanover.

Below is a computer-generated map that shows the coverage area for this project.



Wireless Coverage Map for Rumford/Roxbury/Hanover

According to the 2010 Census, the following household numbers have been recorded for the following Rumford (2674), Hanover (116), and Roxbury (181).

The towns of Rumford, Hanover and Roxbury have a tower that is centrally located to serve portions of all three towns. Based on the coverage map above it has been estimated that 30% of Rumford, 40% of Hanover, and 40% of Roxbury can be reached from this tower.

Taking the household numbers listed above and the approximate percentage of coverage for each town, it is estimated that a total of 923 household can be reached. Using the standard wireless take rate of 30%, the total households served is estimated to be 277.

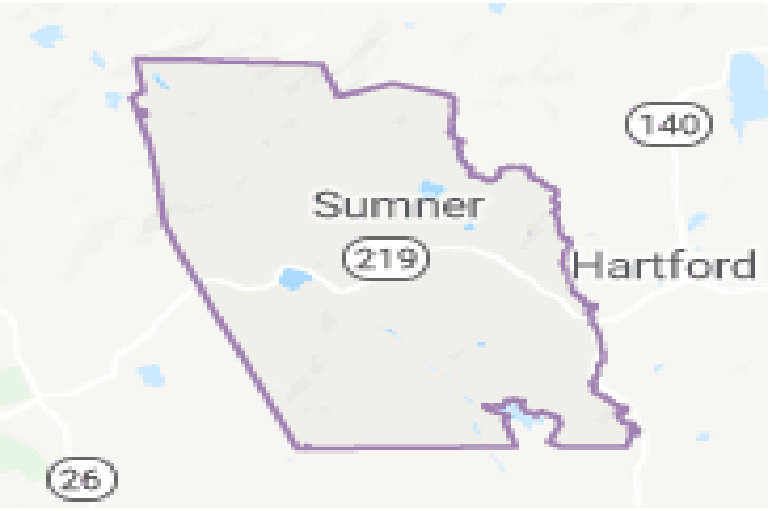
The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$138,500.00
Material Total	**$207,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$55,400.00

Labor Total	**$71,600.00**
Total Non-Recurring Cost	**$278,600.00**

Because of the distribution of coverage, a regional collaboration among the three communities sharing costs would be the preferred strategy for implementing this project.

Sumner



Sumner Goals:

- Schedule a meeting with FirstLight to discuss possible expansion/enhancement of current service (possibly with Buckfield and Hartford)
- Extend internet service in the community with a Sumner Hill wireless plan
- Explore options for bringing fiber to community

Axiom Recommendations:

- Schedule a meeting with FirstLight to talk about leveraging its fiber
- Create a series of workshops in the community to discuss the benefits of fiber (A *"Why Fiber?"* section is included that can help with those discussions
- Work with Maine West to explore grant and other funding opportunities

If fiber is cost prohibitive then explore wireless option as alternative.

FirstLight

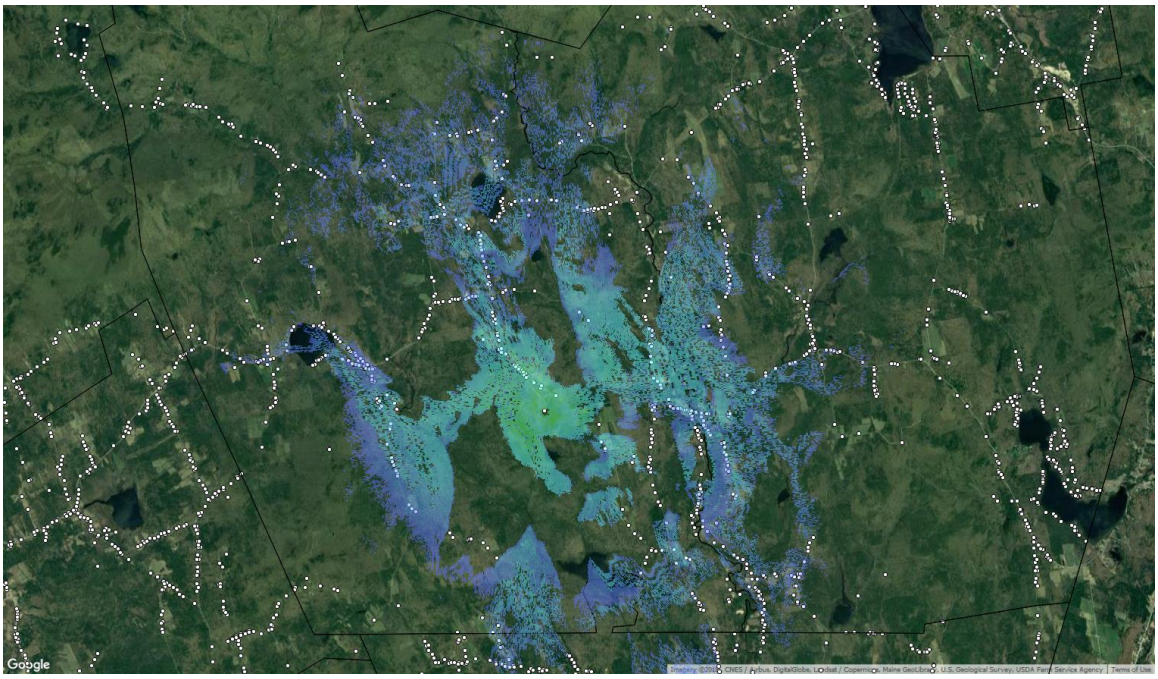
FirstLight (formerly Oxford Networks) is not interested in meeting with individual communities about enhancing or expanding its DSL service. FirstLight is the telephone provider in Sumner and offers DSL internet connections as well. Because of the way DSL technology works, the further away a customer is from the provider's equipment, the less reliable the internet connection is. In addition, speed levels are also dependent on the customer's location in relationship to the provider's equipment, often giving those located in more remote locations poor service levels and quality.

FirstLight is focused on utilizing its fiber network in Oxford County, including in Sumner. A first step would be to discuss with FirstLight if it would consider expanding its current fiber footprint to serve the community. We have not explored if FirstLight would be willing to work with the community to expand fiber through the community. This would be one option, work with FirstLight and cost share a fiber network expansion in partnership. One additional option, to working with FirstLight would be for

another provider to provision a wholesale connection from FirstLight and have the provider expand fiber in partnership with the town. Either of these options ae viable, if FirstLight were a willing partner. If FirstLight was not willing to build out or provide a connection to another internet service provider, the Three Ring Binder (an open access fiber trunk that a provider could tap into for bulk internet service on fiber is available in Greenwood. There are benefits to hooking up to the 3RB, but it also comes with increased cost to bring a new fiber build from the 3RB into Sumner. Our recommendation is to start with a meeting with FirstLight to discuss willingness to partner and options.

Sumner Wireless Plan

The computer generated map below provides a snapshot of the coverage area with a wireless microwave system that would deliver a signal from a tower located on Sumner Hill. A new tower could be sited and built; it would need a power supply that is fed by a fiber connection. FirstLight has fiber approximately a half mile away on Upper Sumner Hill Road that could be used to extend service to the tower that would then distribute internet service through a wireless microwave system to the home.



Sumner Hill Wireless Coverage Map

According to the 2010 census, Sumner had 383 households. The existing tower on Sumner Hill could provide good coverage to the area and, based on the radiation map provided above, there is a possibility of reaching approximately 80% of the town. From these numbers it is estimated that 307 households can be reached. Using the 30% coverage figure and taking into consideration a typical take rate for wireless service of 30%, the total number of homes taking service is estimated at 93.

The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$46,500.00
Material Total	**$115,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$18,600.00
Labor Total	**$34,800.00**
Total Non-Recurring Cost	**$149,800.00**

Fiber Costs

FirstLight fiber currently runs down Route 219, Main Street in Sumner, and also down Lower Sumner Hill Drive and part of the way up Upper Sumner Hill Drive. This is an opportunity to work with a provider to expand coverage. FirstLight will work with local businesses to determine a cost to hook up that will most likely be shouldered by the business. This makes fiber connections unaffordable for many small businesses.

Another option would be to connect to the Three Ring Binder, an open access middle mile fiber that runs through Greenwood. A connection could be made to the Three Ring Binder, and at $30,000 per mile, could be brought to Sumner from a couple of directions.

Axiom recommends working with FirstLight to understand if it would expand fiber into the community, or what the options and cost of another provider working with FirstLight are to provision a bulk internet, wholesale connection that could then distribute internet to a new fiber system that would be built to parts of the community.

If the community is interested in exploring this option, Axiom would be willing to put together a plan for fiber in the community. Below is a rough assessment of the cost:

$30,000 per mile for fiber trunk line
$1000 per home to connect them to trunk line (100 homes = $100,000)
$100,000 in equipment to power the system

While expensive on the surface, this technology would be an investment in the future of the community and operational for over 20 years with little to no upgrades needed. When compared to a new fire truck or a mile of road resurfacing or a replacement project, this is not something out of reach for even small communities, like Sumner.

Unorganized Territories of Oxford County

The Unorganized Territories in Oxford County are governed by the State of Maine and have no formal government, although two territories we spoke with meet at least once a year to discuss issues and concerns. Axiom spoke with Milton and Mason Townships about their internet connectivity.

Milton Township

Discussion:

Milton is a divided by a mountain. On one side there are 8-10 homes spread across a few miles. Fiber is available to these homes from the Three Ring Binder on Route 232. This may be the best option for so few homes, even though it is more expensive than wireless. Axiom recommends discussing this potential project with the homeowners to find out if they would accept the new service if it was provided and then exploring with GWI the feasibility of connecting to the Three Ring Binder.

On the other side of the mountain, access to Milton is from Rumford. With Rumford building a downtown fiber network and Three Ring Binder running along Route 2, there may be an option to bring fiber to the 50-60 homes on that side of the mountain. It is also possible that a wireless

system might be an option. A community meeting to discuss the various choices might be an important first step.

Axiom Recommendation:

- Town should work with Community Concepts Finance Corporation to convene a community informational meeting about internet connectivity to gauge the level of interest in finding a solution for improving and expanding internet service
- Seek grant funding for Fiber To The Home project(s)

Mason Township

Discussion:

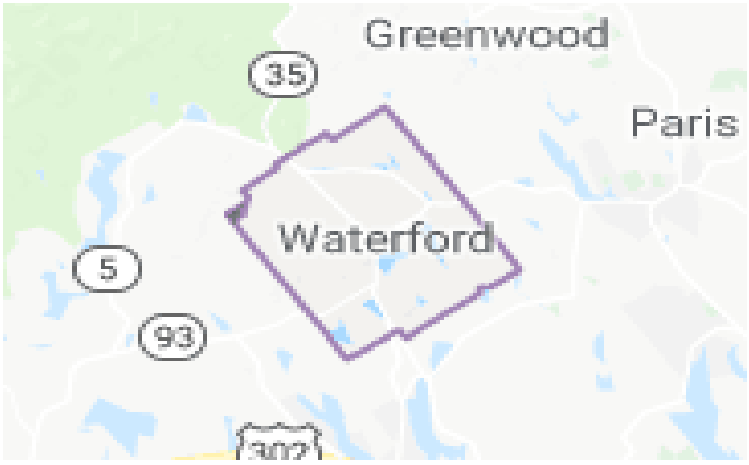
Mason Township is connected to Bethel in many ways, including internet service. Most residents have DSL service, which is inadequate, and many would like fiber.

There is fiber on Route 2 and on Route 5, both operated by FirstLight, so it is conceivable that a FTTH plan could be built out. However it would be difficult to justify a fiber project without significant buy-in from the community and 100% subsidy of the cost.

Axiom Recommendations:

- Confirm with FirstLight if its fiber can be accessed
- Convene a town meeting to gauge the need for better connectivity
- Consider including Albany Township which is adjacent to Mason Township and Bethel

Waterford



Waterford Goals:

- Serve the seasonal population around the lakes with wireless service
- Update town's Franchise Agreement with Spectrum

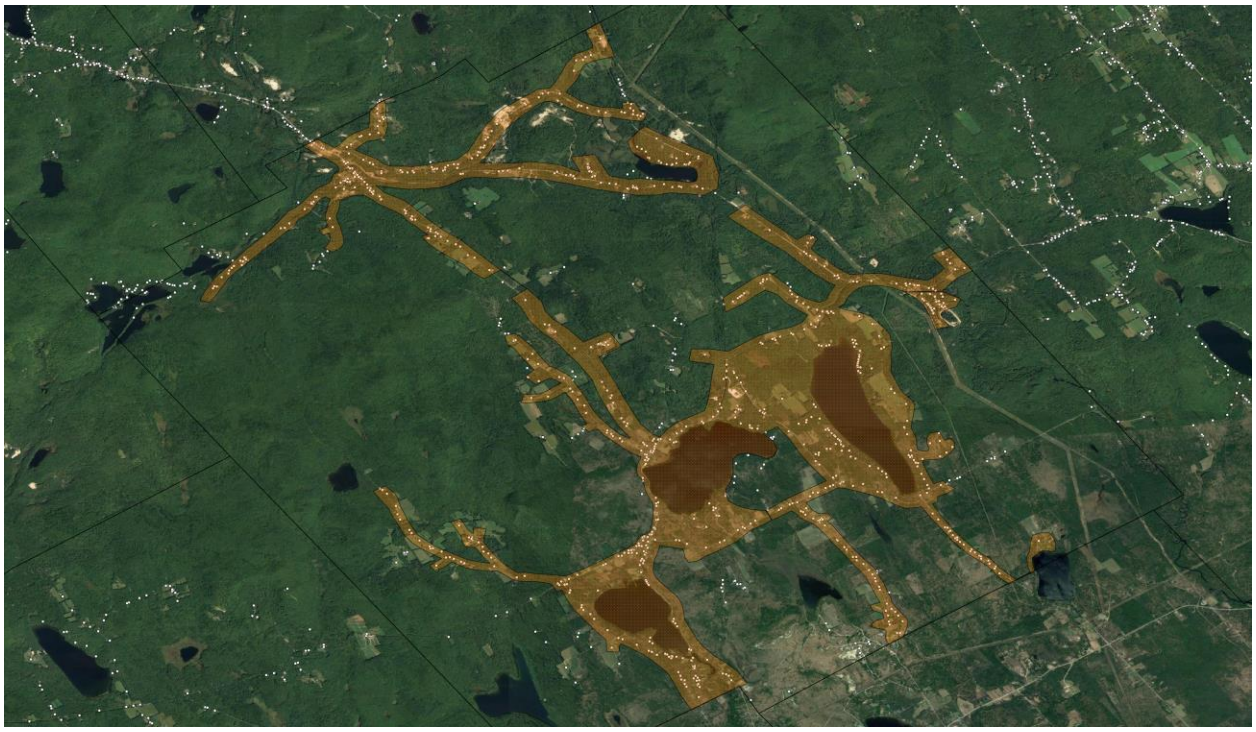
Axiom Recommendations:

- Given Spectrum's extensive coverage of the town, Axiom recommends exploring with Spectrum what the cost would be of building out the whole town with Spectrum service through an updated Franchise Agreement
- Consider a tiered fiber infrastructure project to meet a specific objective (i.e., serving summer residents who live on the lakes)
- Consider wireless is an alternative to fiber at a lower cost point

Spectrum

Spectrum has upgraded its internet service across Maine to 100Mbps/120Mbps speeds. Spectrum's criteria for targeting areas for expanding service includes 20-25 homes per mile.

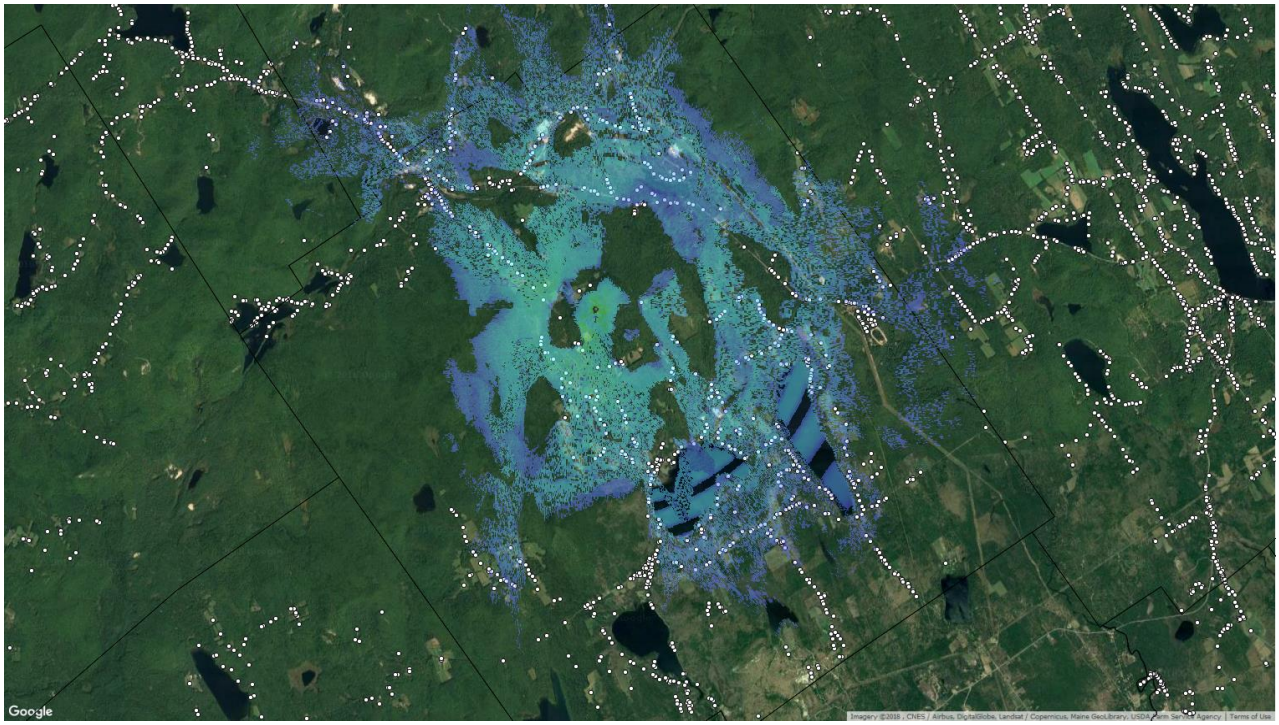
At Waterford's request, Axiom provided the town with a copy of its Franchise Agreement with Spectrum which was signed in 2002. Axiom recommends that Waterford begin negotiations on a new agreement with an eye on expanded service. The map below shows that there are several gaps in Spectrum service that should be considered for a service expansion. This might be accomplished in lieu of franchise fees, or in coordination with Spectrum on a ConnectME state infrastructure grant, if some of these areas are unserved.



Spectrum coverage map

Wireless Plan

A wireless plan was developed using a tower on Rice Hill that would serve the three-lake region.



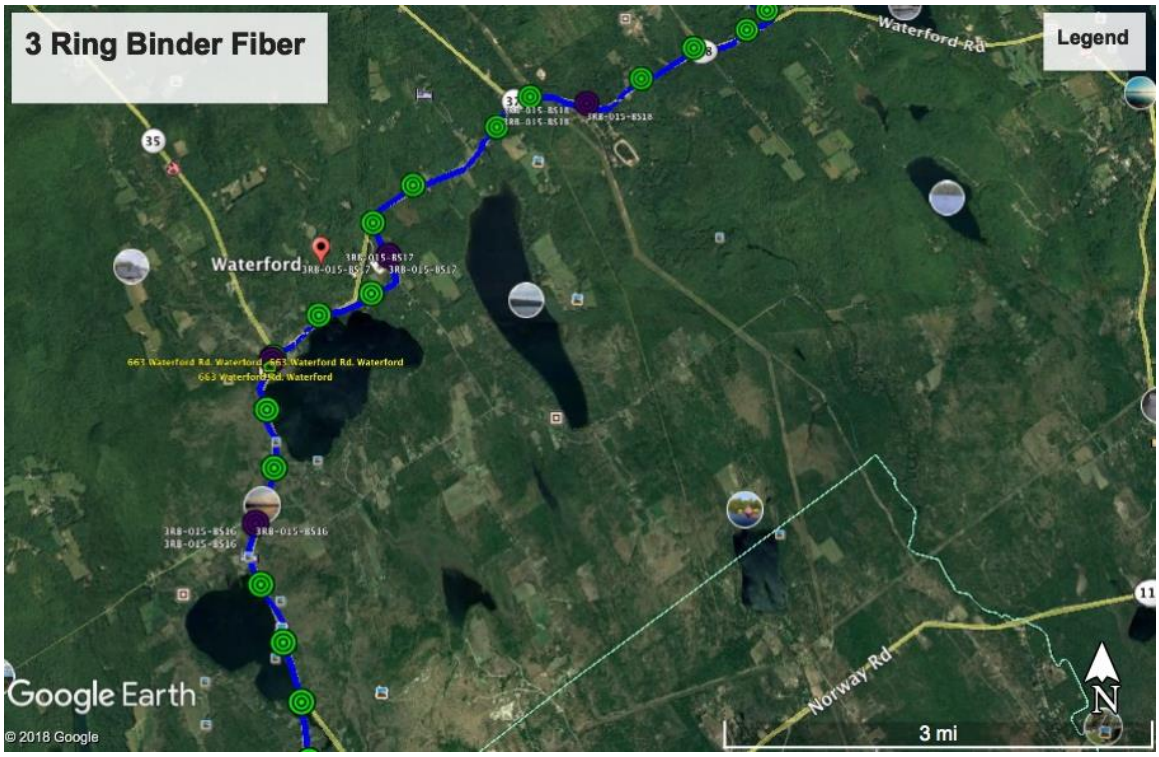
Wireless Coverage Map

Waterford, according to the 2010 census, had a recorded 667 households residing within the town. A tower currently located near the center on Rice Hill Road could provide good coverage to the area. Based on the radiation map provided above, there is a possibility of reaching approximately 80% of the town. From these numbers it is estimated that 534 households can be reached. Using the coverage figure above and taking into consideration a typical take rate for wireless service of 30%, the total number of homes taking service is estimated at 161.

The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$58,000.00
Installation Hardware	$10,500.00
CPE Hardware	$80,500.00
Material Total	**$149,000.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00
CPE Installation	$32,2600.00
Labor Total	**$48,400.00**
Total Non-Recurring Cost	**$197,400.00**

Fiber



In addition to considering wireless service and expanding Spectrum's service to the town, Waterford could build fiber off of the Three Ring Binder. Fiber would allow much higher speeds than cable or DSL and creating a corridor of fiber might attract businesses or at least begin to build out the town with a technology that is likely future proof.

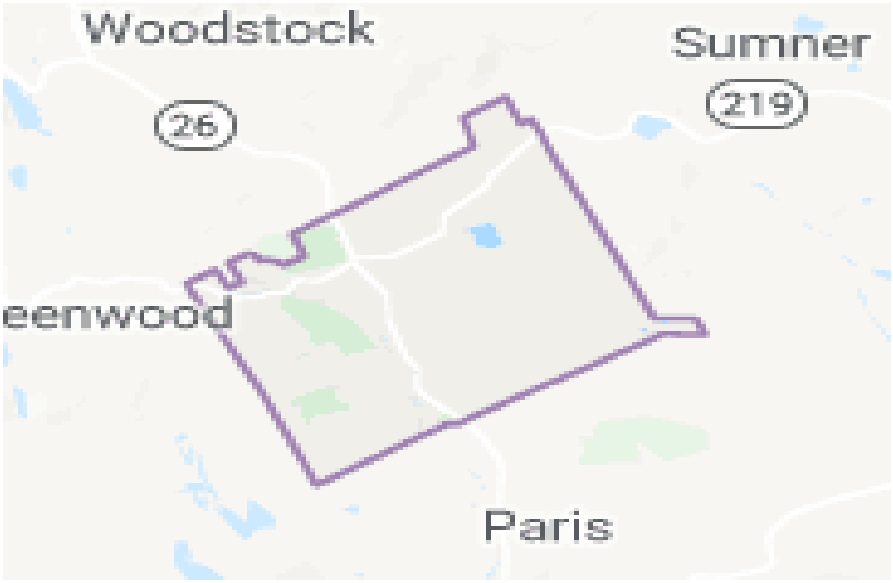
Here is a rough estimate of fiber costs for Waterford to consider:

$100,000 for electronics to power the internet through the fiber
$30,000 per mile for fiber trunk line
$1000/per home connection from the trunk fiber
$450/per pole for licensing and pole "make ready"

This type of project is within range of a new fire truck or a mile of resurfaced road reconstruction. It is affordable for an internet system that will last well over 20 years.

Waterford did not request a fiber plan, so Axiom did not create a detailed engineered map and budget. However, Axiom would be glad to develop a budget and plan for extending fiber into the community.

West Paris



West Paris Goals:

- Every resident and business has access to affordable, high-speed internet, including those with no service

Axiom Recommendations:

- Discuss leveraging fiber with FirstLight
- Fund a HotSpot at the town office
- Locate a local tower to cover more of the community with a wireless system

Spectrum

Spectrum's service area in West Paris is small and located primarily in the northwest and a very small area in the southeast. Below is the map of Spectrum's service area in West Paris. Given the limited area of service, Axiom does not recommend engaging Spectrum to expand service, as it would not meet its expansion criteria of 20 homes per mile.

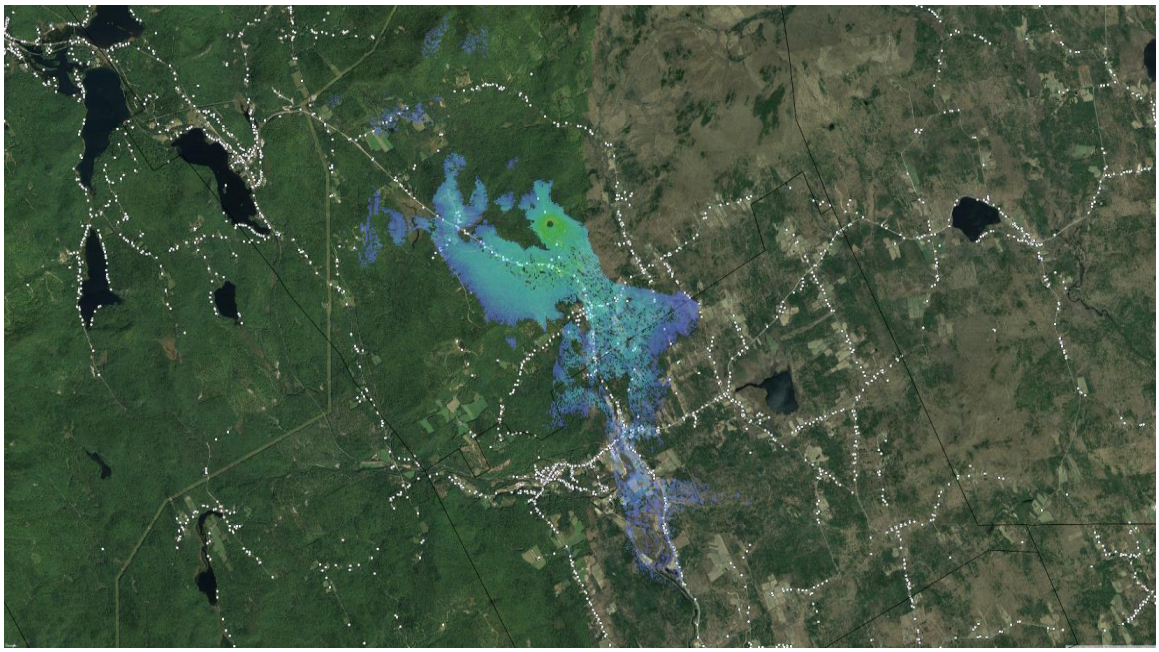
Spectrum coverage map

FirstLight

The rest of West Paris that has internet service is covered by FirstLight which is the telephone provider in West Paris and it offers DSL internet connections as well. Because of the way DSL technology works, the further away a customer is from the provider's equipment, the less reliable the service is. In addition, speed levels are also dependent on the customer's location in relationship to the provider's equipment, often giving those customers in more remote locations poor service levels.

FirstLight is not interested in enhancing or expanding its DSL service and is much more willing to discuss utilizing its fiber network in Oxford County. FirstLight has fiber in West Paris and Axiom recommends exploring with FirstLight its willingness to expand its current fiber footprint as a first step to determining FirstLight's interest in an expanded fiber network. Partnering with a provider who could utilize a wholesale connection to FirstLight fiber could bring fiber connections to parts or all of the community, as an alternative to FirstLight DSL expansion. Our approach to attracting another Internet Service Provider would be to create an RFI to attract responses from providers that might be interested in partnering. Typically, GWI, Pioneer and Axiom are typical respondents to these types of request. There may be others, and Consolidated Communications and Spectrum also sporadically respond to these types of requests. This type of investment would require funding, but many communities are beginning to invest in fiber infrastructure.

Wireless



Wireless Coverage map for parts of West Paris

The town of West Paris does not appear to have any registered towers located within its borders, but there is one located to the north in Woodstock that can extend coverage partially into West Paris and reach approximately 30% of the homes along the northern border of the town. According to the 2010 census, West Paris has an estimated 700 households in its boundaries and this tower can reach roughly 210 homes. Using a standard take rate for wireless deployment of 30%, the estimated total number of served households would be 63.

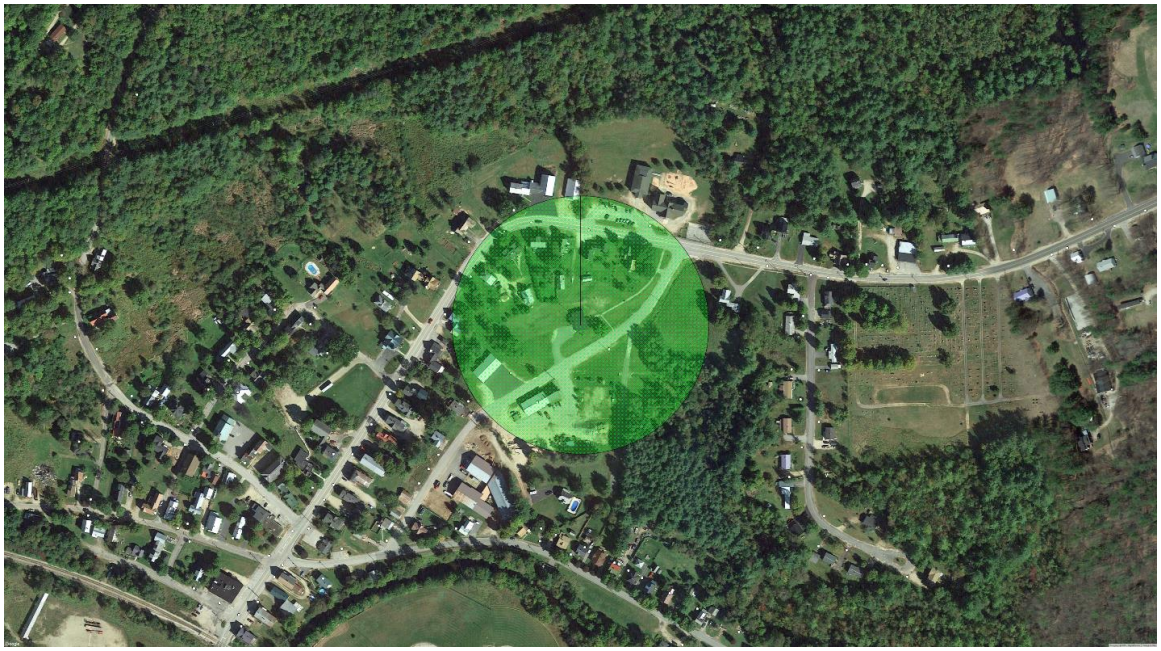
The costs listed below use the above numbers to calculate an approximate cost to install service onto the existing tower.

Materials Cost	
Access Point Hardware	$45,500.00
Installation Hardware	$10,500.00
CPE Hardware	$31,500.00
Material Total	**$87,500.00**
Labor Costs	
Site Prep & Installation	$7,200.00
Engineering	$9,000.00

CPE Installation	$12,600.00
Labor Total	**$28,800.00**
Total	**$116,300.00**

HotSpot

HotSpots are inexpensive ways to help community members and visitors have a place to use their computer, tablet or phone, without incurring data charges. Typically, HotSpots cover a radius of approximately 400-600'. Below is a HotSpot map located at the Town Office.



The nature of the propagation would extend the signal around the Town Office as long as there were no obstructions. This type of equipment does not have enough broadcast power to penetrate building walls.

There are a variety of ways that towns pay for HotSpots:

- Directly from town budget (South Portland)
- Sponsorship from local business or bank (Machias, Eastport, Biddeford)
- Local economic development entity (Greenville)
- Individual donor (Millinocket)

Axiom would be happy to discuss all options to help facilitate a HotSpot installation.

HotSpot Cost:

- One time install fee of $3000
  - Includes one year of technical support and equipment maintenance as needed
  - Monthly usage reports

- Annual maintenance of $1000/year, starts in year 2

- Includes technical support
- Equipment maintenance/replacement
- Monthly usage reports

The cost does not include the monthly fee for internet service, which can be $49.99- $99.99 a month, and the nominal cost for electricity, which is typically covered by the building owner as a courtesy.

Woodstock

Woodstock Goals:

- Develop a wireless solution to serve the Shagg Pond area, which is difficult to cover
- Explore with FirstLight leveraging its service
- Explore with Spectrum expanding its service, if the town contracted with Spectrum's service at town office

Axiom Recommendations:

- Meet with FirstLight to discuss options for leveraging fiber to serve the Shagg Pond area
- Discuss feasibility of a wireless solution

FirstLight

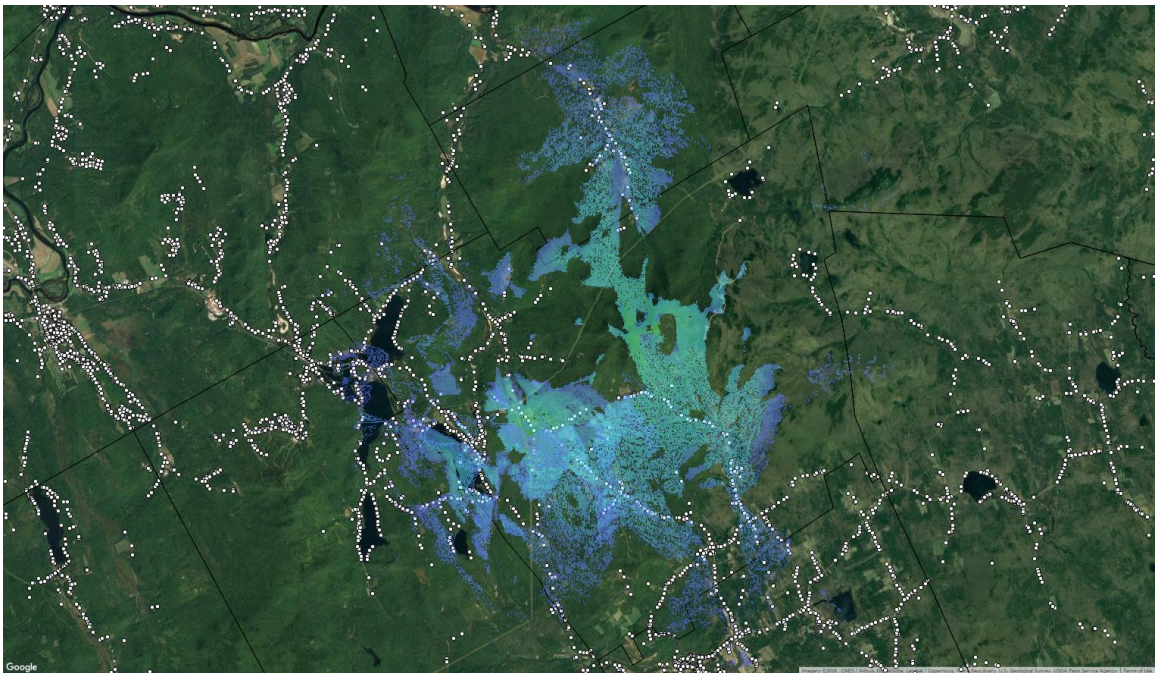
FirstLight is interested in expanding its fiber footprint. It has fiber that runs down Main Street by the town office and continues north on Route 26 and Rumford Avenue. It also has fiber from a tower off of Route 26. And, its fiber extends along Shagg Pond Road in the area the town would like to serve. Axiom recommends meeting with FirstLight to discuss options for leveraging fiber to serve the Shagg Pond area.

Spectrum

Spectrum service is not extensive in Woodstock, mostly serving the more populated areas around the town office. Woodstock renewed its Franchise Agreement with Spectrum last year, which may limit the town's ability to negotiate expansion of service with Spectrum.

Spectrum coverage map

Wireless



Wireless Coverage Map for Woodstock

According to the 2010 census, Woodstock had 546 households. There are two tower locations in the town that could provide good coverage. Based on the radiation map provided above, there is a possibility of reaching approximately 80% of the town, by using either tower. It is estimated that 437 households can be reached using the 80% coverage figure. Taking into consideration a typical take rate for wireless service of 30%, the total number of homes taking service is estimated at 132.

The costs listed below use the above numbers to calculate an approximate cost to install service onto one of the existing towers in Woodstock.

Materials Cost	
Access Point Hardware	$91,000.00
Installation Hardware	$13,000.00
CPE Hardware	$66,000.00
Material Total	**$170,000.00**
Labor Costs	
Site Prep & Installation	$14,400.00
Engineering	$18,000.00
CPE Installation	$26,400.00
Labor Total	**$58,800.00**
Total Non-Recurring Cost	**$228,800.00**

While the wireless solution offers good coverage, it does not cover the Shagg Pond area. Careful consideration and further investigation in partnership with the town is required to make a final decision on this recommendation. Axiom recommends engaging FirstLight on expanding its fiber on Shagg Pond Road.