

# Northeast Kingdom of Vermont Preliminary Feasibility Study

April 8, 2020

**TILSON**

Prepared for the Northeastern Vermont  
Development Association



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# 1. Introduction and Background

On March 3, 2020, 27 towns in Caledonia, Essex, and Orleans Counties, Vermont, voted at Town Meeting to form a Communications Union District (CUD), Northeast Kingdom Broadband. CUDs are a specialized form of municipality in Vermont that allow multiple towns and cities to join together to deliver communications services and operate a communications plant. The Northeastern Vermont Development Association (NVDA) engaged Tilson in a “pre-feasibility study” to assess the potential boundaries for one or more CUDs in the Northeast Kingdom region, including all of Caledonia, Essex and Orleans counties as well as parts of Lamoille county prior to the vote, and Tilson recommended formation of a single CUD in the region, starting with the towns in the region ready to vote on the CUD formation at Town Meeting 2020, and expanding it to other interested towns in the region subsequently.

NVDA subsequently authorized this follow-on study, which provides a preliminary feasibility analysis of a Fiber-to-the-Premise network across the entirety of the towns which authorized formation of the CUD in March 2020. This study included: a high-level network design; capital and operating cost estimates; and revenue and take-rate scenarios. It includes an analysis of the impact of major financing and subsidy opportunities, especially the upcoming Rural Digital Opportunity Fund (RDOF) reverse auction from the Federal Communications Commission, but also financing through New Market Tax Credits or Opportunity Zone Investments.

This study is not designed to be the final word on the feasibility of Northeast Kingdom Broadband. It provides an initial look at what all-at-once, entire CUD network costs and business cases might look like. It is intended to provide a baseline of information and analysis that the CUD can use to further refine its approach. As such, the report provides conclusions drawn from the present analysis and recommendations for more targeted study.

## 2. Overview of the Operating Model

The principal operating model studied here assumes a public-private partnership between the CUD and private investors, network developers, and network operators. Public-private partnerships are an important path for a CUD to consider. The CUD itself does not start with the organizational experience to operate a broadband network and faces financial hurdles in the initial stage of its existence, the most important of which is its initial lack of a financial track record it can use when seeking debt financing of new infrastructure. Forming partnerships with private entities that can assist with operational expertise and financing is a common way that municipalities overcome these challenges to enter the broadband market. Furthermore, Northeast Kingdom Broadband will not be able to compete directly for subsidies in the FCC's Rural Digital Opportunity Fund (RDOF) reverse auction because it will likely not qualify as a bidder due to a lack of history as an ISP and a lack of financial resources at the time the auction takes place. It will require forming partnerships with entities that would qualify. (This subsidy opportunity is covered in Section 6.2 of this report.)

Therefore, the prime operating model studied here is a Wholesale Network Owner Public-Private Partnership. In this model, Northeast Kingdom Broadband would form a partnership with a "Project Developer" who would be responsible for most of the project in its initial phases. The Project Developer would design, build, hold, maintain, and manage the fiber network and associated network electronics, and provide local network operations. It would negotiate access to existing fiber where useful, such as fiber already developed in the region by utilities or the State of Vermont. It would seek out and obtain capital partners to fund the capital expenses to build the network (and any initial operating losses). It would provide wholesale access to an Internet service provider partner who would provide Internet bandwidth, customer service and first-level support, sales, marketing, billing and collection service, as well as seek financial support from RDOF that it would pass through to support construction of the underlying infrastructure it would use. Tilson also assumed that the CUD would negotiate rights to existing fiber assets such as those held by the economic development non-profit corporation, Northern Enterprises. Finally, we sought to explore the feasibility of a buy-out by the CUD of the underlying infrastructure and/or the ISP layer at the end of the RDOF support from the private partners.

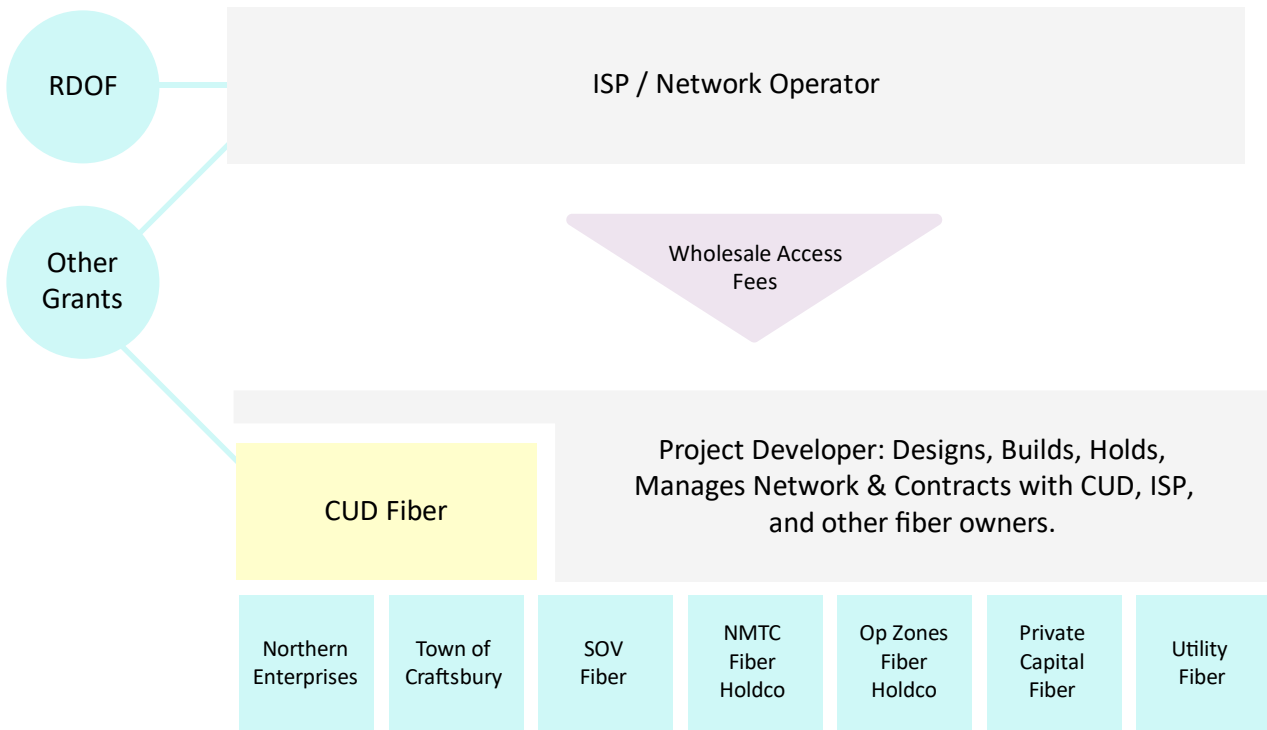


Figure 1: Wholesale Model

### 3. High-Level Design

A high-level design creates an approximate network lay-out and can be used to calculate estimated quantities of network elements that can support a cost estimate. To generate a high-level design, Tilson divided the CUD towns into eight study areas, based on one or more Census Block Groups each. These study areas also corresponded with town boundaries, with the exception of Lyndon, which was allocated to two study areas east and west of I-91. Seven groups were created based largely on differences in eligibility for New Market Tax Credit and Opportunity Zone funding, as well as practical considerations for town groupings constrained by feasible network routes (i.e. some parts of some towns were only accessible through routes transiting neighboring towns). In addition, premises passed by State of Vermont, Northern Enterprises or Town of Craftsbury fiber were removed from the other study areas and placed in a separate study area called the Northeast Kingdom Fiber Network premises.<sup>1</sup> Therefore, the eight study area groups were:

- NEK Fiber Network Premises
- Coventry
- Western Lyndon, Wheelock, Sutton, Sheffield, Newark, East Haven, Brighton
- St. Johnsbury, Kirby, Burke, eastern Lyndon, Concord
- Barton, Albany, Craftsbury, Hardwick
- Greensboro, Glover
- Lowell, Westfield
- Danville, Waterford, Barnet, Ryegate, Groton, Peacham

Tilson selected for the design a common Gigabit Passive Optical Network (GPON) network architecture, with a limited number (less than 3%) of sites served with Active Ethernet connections, representing enterprise, institutional and higher-demand commercial locations. Tilson assumed a primary network headend plus 18 other

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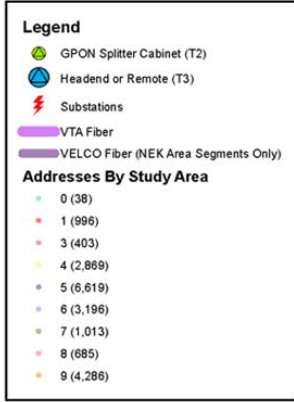
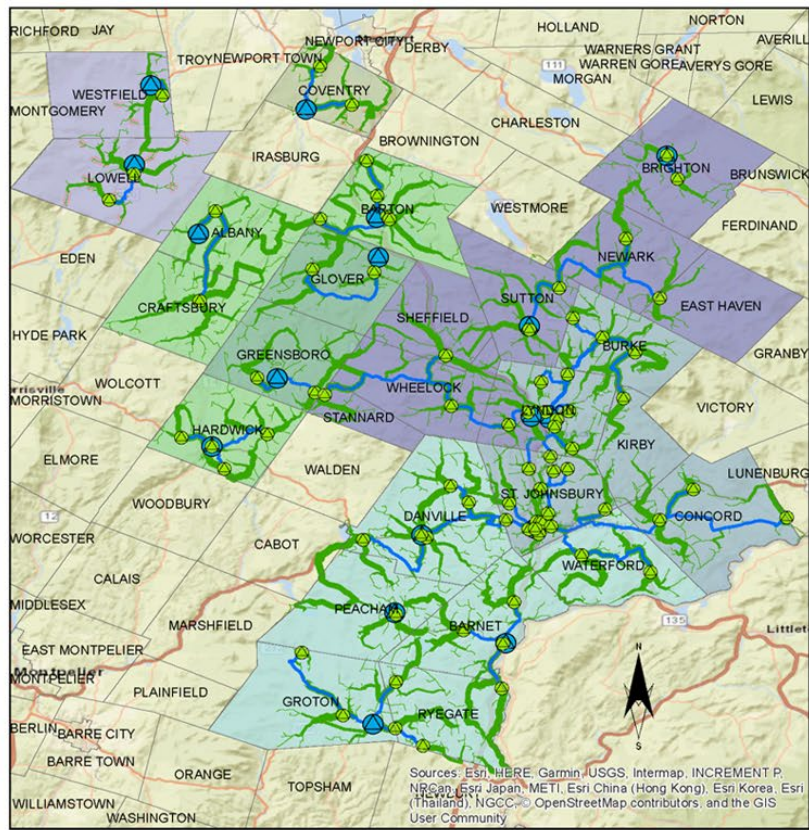
<sup>1</sup> The Northern Enterprises fiber network overlaps with fiber assets held in the Northeast Kingdom by the State of Vermont (see <https://publicservice.vermont.gov/content/map-fiber-owned-department-public-service>), and fiber held by the Town of Craftsbury interconnects with it. Existing service over State of Vermont and Town of Craftsbury fiber is provided by the local Internet Service Provider Kingdom Fiber. These existing assets are a small fraction of the overall fiber construction necessary to serve all towns in the CUD. To simplify the analysis at this phase, routes in the high-level fiber design overlapping the existing Northern Enterprises/ State of Vermont fiber routes were presumed to use that existing fiber, and routes already served by the Town of Craftsbury fiber were excluded from the design. None of these assumptions, made for the purposes of generating a high-level assessment of the cost and business case for a CUD-wide network, are intended to pre-judge or forecast potential future negotiations between Northeast Kingdom Broadband, Northern Enterprises, the State of Vermont, the Town of Craftsbury, and/or Kingdom Fiber about the use of existing fiber assets and/or any potential future relationship between Kingdom Fiber and the wider Northeast Kingdom CUD.

shelters with active network equipment distributed throughout the study areas.<sup>2</sup> Tilson's design assumed a 1:32 split ratio using GPON splits centralized at 74 passive (unpowered) concentration points, some of which were located at the 19 powered sites, and others at field locations.<sup>3</sup> Tilson's design used utility pole locations and lines where GIS layers were available and estimated them where they were not available. Routes requiring underground construction were inferred from the absence of utility poles, telephone exchange boundaries, and to a limited extent, stretches of road without premises to serve. The high-level design exercise did not include field survey work. Tilson performed a limited amount of fiber route optimization, but further optimization would be appropriate for a mid-level or detailed design. The resulting network layout, with and without premise locations overlaid, appears in Figure 2 below.

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<sup>2</sup> Powered sites generally had sufficient fiber routes between them to create transport links between them, and no new fiber routes were created explicitly for this purpose. The exception is the GPON network in the towns of Westfield and Lowell, which is non-contiguous from the rest of the network. However, utility owned by Vermont utility VELCO does run between these towns and the rest of the CUD. It may be possible to negotiate for access to this fiber, perhaps by providing utilities access to substations or similar locations not currently connected to utility fiber. Therefore, the design contains no dedicated fiber transport segments solely for the purposes of connecting these towns to the rest of the network.

<sup>3</sup> In a GPON network, optical signal from each fiber originating at a Optical Line Terminal (OLT) is split passively to deliver signal to multiple end users. A 1:32 ratio means that each fiber signal originating from the OLT may be split to reach as many as 32 user locations. A centralized split provides an individual cable from centralized points where 1:32 splits are made.



0 5 10 15 20 Miles

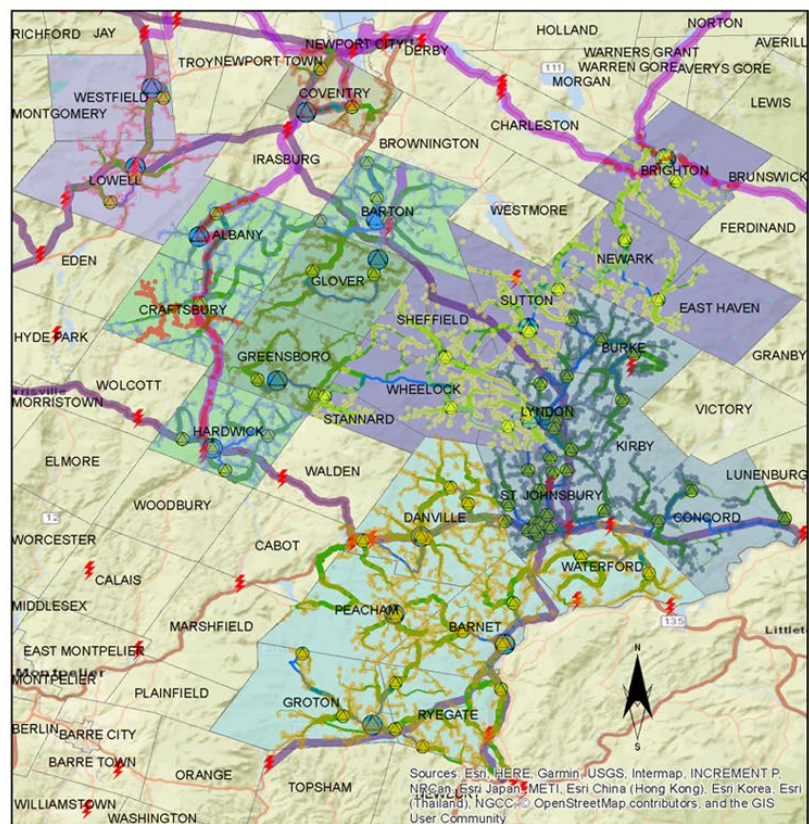


Figure 2: High Level Network Design



## 4. Capital Cost Estimate

Tilson identified cost factors for the high-level design it generated, resulting in an estimate of the network’s initial cost, \$77.0M. Initial capital costs included:

- labor and materials required to build or install the outside plant for the network
- the network equipment to light up the network and interconnect with the larger Internet, both the centralized equipment and subscriber-location equipment
- permitting and pole make-ready
- equipment for network monitoring
- professional services such as engineering, project management, and consulting services
- vehicles to maintain the network and service users
- concrete buildings to house active network electronics
- outreach for a pre-launch marketing/presubscription campaign.

The estimate does not include a contingency, which may be appropriate in some circumstances, such as budgeting in advance of a Request-for-Proposals bid process.

Table 1: Network Initial Capital Cost Estimate--By Study Area

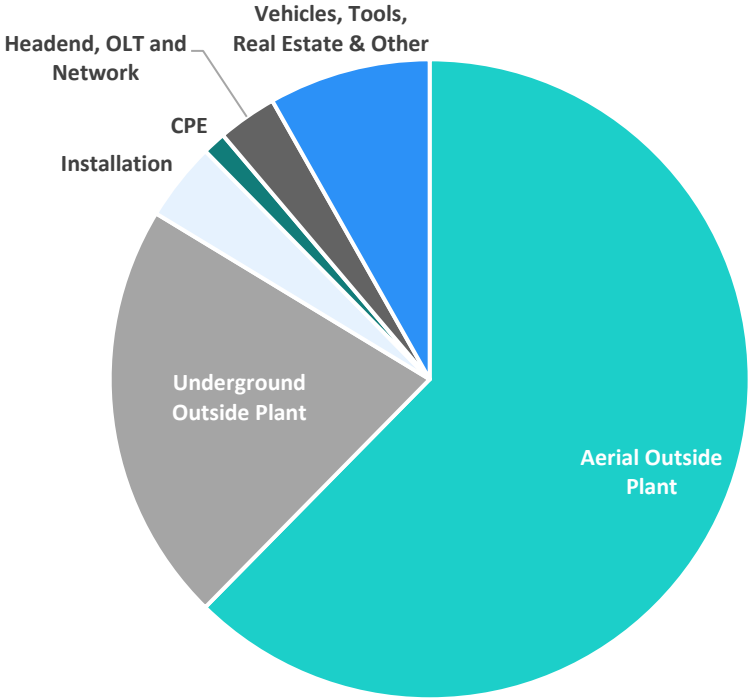
	Total	NEK Fiber Premis	Coventry	W. Lyndon Wheelock Sutton Sheffield Newark E. Haven Brighton	St. J Kirby Burke E. Lyndon Concord	Barton Albany Craftsbury Hardwick	Greensboro Glover	Lowell Westfield	Danville Waterford Barnet Ryegate Groton Peacham
Fiber Route Miles	1,689.80	63.5	42.8	303.5	360.8	240.8	119.4	82.6	476.5
Premises passed	20,399	993	426	2,866	6,882	3,291	1,009	680	4,252
Premises passed/mile	12.1	15.6	9.9	9.4	19.1	13.7	8.5	8.2	8.9
<b>Total Initial Capital Costs</b>	<b>\$77,034,861</b>	<b>\$395,158</b>	<b>\$2,170,551</b>	<b>\$14,601,414</b>	<b>\$18,187,318</b>	<b>\$10,990,827</b>	<b>\$4,668,679</b>	<b>\$4,439,728</b>	<b>\$21,581,188</b>
<b>\$/Premises Passed (all costs, not just per premise costs)</b>	<b>\$3,776</b>	<b>\$398</b>	<b>\$5,095</b>	<b>\$5,095</b>	<b>\$2,643</b>	<b>\$3,340</b>	<b>\$4,627</b>	<b>\$6,529</b>	<b>\$5,076</b>

The largest share of costs is attributable to design, permitting, and construction of the outside plant. While underground routes represented only about 7% of the miles in the design, they represented about ¼ of outside plant construction costs. To a certain degree, this is unavoidable (underground construction is usually more

expensive than aerial), but a more detailed design exercise may be able to narrow the number of underground miles required.

Table 2: Network Initial Capital Cost Estimate-- By Major Cost Category

	Total \$	Units	Estimated per Unit Cost
<b>Aerial Outside Plant</b>	\$48,050,249	\$ per aerial mile	\$31,725
<b>Underground Outside Plant</b>	\$16,407,215	\$ per underground mile	\$146,861
<b>Installation</b>	\$3,051,916	\$ per sub.	\$473
<b>CPE</b>	\$909,321	\$ per sub.	\$141
<b>Headend, OLT and Network</b>	\$2,310,810	Fixed \$	
<b>Vehicles, Tools, Real Estate &amp; Other</b>	\$6,305,350	Fixed \$	



The capital cost per premise passed for the project is substantial--\$3,776 per premise passed. While substantial, this cost is not unexpectedly high for a network in a relatively low-density area. Not surprisingly, the higher-density study areas generally tended to be lower cost per premise to serve.

Due to the size of the network (almost 1,700 miles), Tilson assumed that it would be built out in phases over a 42-month period, and as a result capital costs would be incurred stretched out over this period.

After the initial period Tilson has included in the model capital re-investment in the network. Tilson's model assumes that money is set aside each month for current or eventual capital replacement/reinvestment.<sup>4</sup> The model assumes that outside plant and buildings have a 30-year capital cycle, network equipment a seven-year capital cycle, tools and test equipment a 15-year cycle, and other capital items a 10-year cycle. It also assumes that most capital costs ramp up gradually through year 10, except network equipment expenses (which do not have a ramp-up after the completion of initial construction) and buildings and tools and test equipment (which have a 15-year ramp-up).

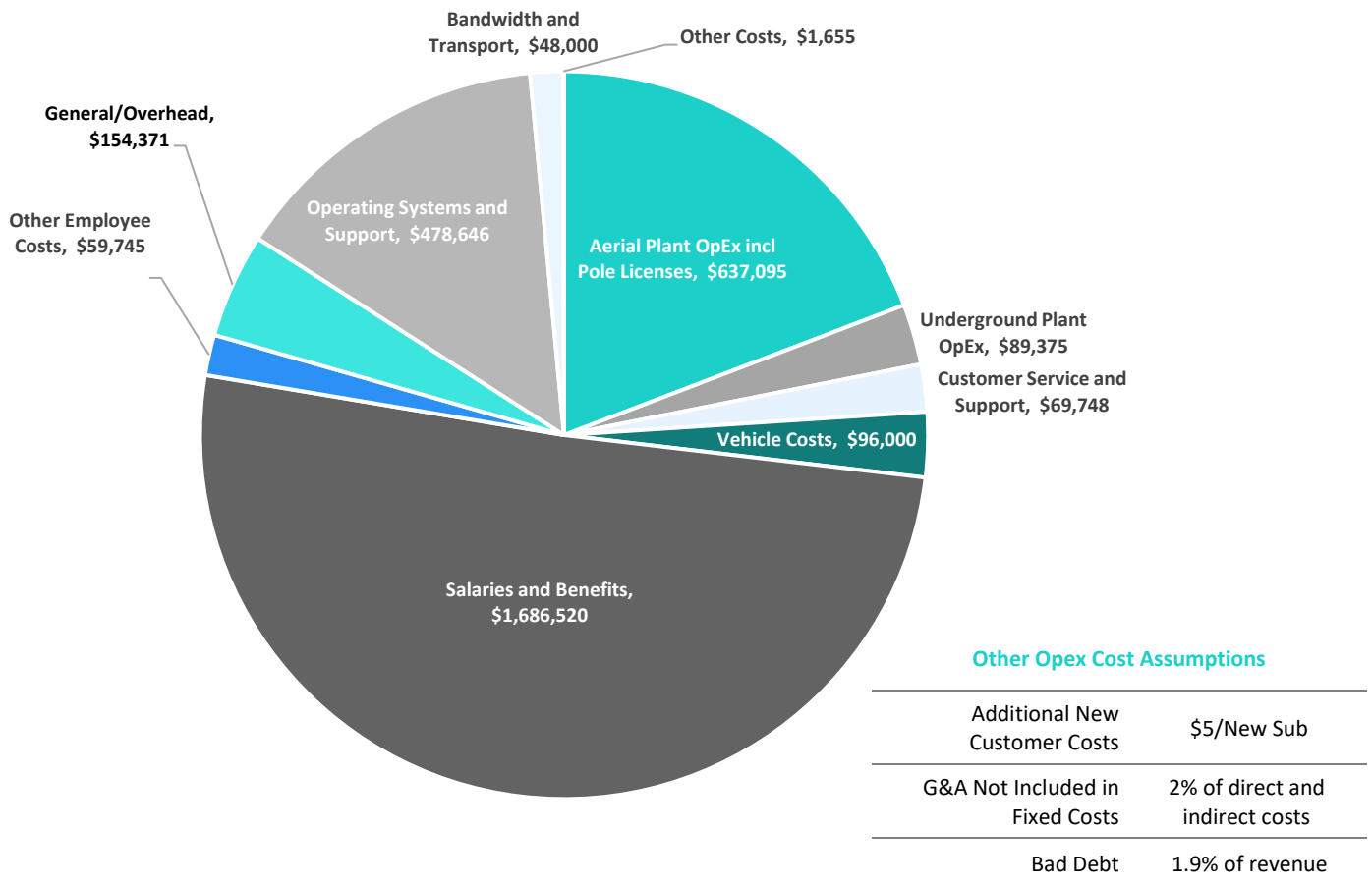
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<sup>4</sup> Unlike the reinvestment expenditures in the model, real-world capital reinvestment and replacement expenditures would likely be "lumpy," but it is difficult to determine the exact timing of such "lumpy" costs.

## 5. Operating Cost Estimate

To analyze the overall business case, Tilson also prepared an estimate of operating costs for the network for the Wholesale Network Owner model. Figure 3 shows a summary of these costs.

Figure 3: Operating Expense Assumptions--Wholesale Model



Costs shown represent annual costs at “year 1” levels, with an assumption that most cost categories increase by an annual inflation rate of 2.5%.<sup>5</sup> The figure does not have a total because some cost elements vary by the number of total subscribers in a year, the number of new subscribers, and the level of revenue.

<sup>5</sup> The major exception is that Tilson used an average annual inflation rate of 21.5% for Bandwidth and Transport costs, which reflects the combined effect of assumed growth in total subscribers and per-subscriber bandwidth consumption, somewhat offset by a decrease in per-MB bandwidth costs. In the wholesale model, the network has no bulk Internet bandwidth costs, as this is assumed to be provided by the retail ISP, but it is assumed to have leased transport costs to connect the network to the ISP’s network.

Salary and benefits costs dominated operating expenses, supporting employment of 23.5 positions. Tilson assumed most required functions would be provided by employees dedicated to the network and employed in the local networking operations, except those functions supported by the network's ISP, such as customer service, level 1 technical support, sales, and billing operations.<sup>6</sup> The Operating Cost estimate did assume a local general manager, local technical network operations and field and warehouse staff to service customer installations, on-site troubleshooting and maintenance of the outside plant. There may be some opportunity for savings by changing assumptions. While the model prepared did not use a gradual phase-in of employees, it is likely that this could be done to some degree. However, this will not scale linearly due to the need for training, operational system development, and the fact that some systems require minimum levels of staffing to support. In addition, some network operations may be more cost-effectively handled remotely on a contract basis. These options could be explored as refinements to the model. However, it is desirable to have at least a couple of network operations staff who can easily be physically present at network equipment locations when necessary, and in a similar way, it is desirable to have field staff who are based nearby the network they service.

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<sup>6</sup> This does not necessarily mean that the ISP employees might not also be local, simply that they are not part of the operating cost in the wholesale model.

## 6. Revenue Assumptions

### 6.1. Wholesale Revenue and Take-Rate Assumptions

In the Wholesale Network Owner model, the revenue in the model reflects payments from the retail ISP to the underlying network owner. In this model, Tilson assumed three classes of users, residential, commercial, and enterprise/institutional, with average revenue to the network owner of \$35, \$50, and \$250/month, respectively<sup>7</sup>. These amounts would be subject to negotiation between the ISP and network owner, and alternative amounts or revenue-share arrangements may be negotiated. However, based on Tilson's experience, it is likely that these per subscriber revenue levels are achievable in a wholesale arrangement. It is important to stress that this is not the assumed retail price to the end user, which would be higher. The model reflects a mix of customer types that is 90.9% residential, 8.6% commercial, and 0.5% enterprise/institutional. This distribution is based on the distribution of site type classes in the state E-911 address point GIS layer within in the CUD towns.

For this analysis, detailed market research on potential demand for services delivered over the CUD infrastructure is not available, and actual take rates on actual fiber-to-the-premise networks can vary substantially. In the absence of such research, Tilson's approach to modeling demand was to make some reasonable assumptions and then examine the sensitivity of financial outputs to changes in those take-rate assumptions. The sensitivity analysis will be presented in a subsequent section. In a market where there is a single all-fiber network offering broadband service to mass-market consumers, the principal competition for fixed broadband service is cable modem services. In a market with an FTTP network and a cable network where FTTP services are competitively priced with cable, a preliminary reasonable assumption is that a minority of mostly price-sensitive consumers will choose a low-price DSL service or forgo fixed broadband service altogether, and that the FTTP and cable competitors will split the market. In areas with no cable competitor, it is reasonable to assume that the fiber network also takes the share that would otherwise go to cable.<sup>8</sup> Overall, the CUD towns have approximately 50% cable service availability.

Take rates should climb most rapidly after a new network is available, quickly winning those most dissatisfied with existing options, and then grow more slowly long-term. Longer-term trends should generally favor the network with the highest potential for the best performance, which should be the all-fiber network if well-run. For this

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<sup>7</sup> Tilson also used an assumption that prices would increase 2% annually on average.

<sup>8</sup> Although a reasonable assumption for a high-level model, these outcomes are not assured. Execution plays an important role.

analysis, Tilson assigned an assumed take rate at the sixty-month mark of 40%, 45%, or 50% of premises passed in each of the study areas depending on the mix of competing service options. We assumed that 60% of these customers would come on within 18 months of service becoming available. We also assumed that subscriber numbers would continue to creep upward in years 6-10 another 10% (not 10 percentage points) of their year-five levels. These assumptions produce the following take-rate curve (Figure 4) across all the study areas combined:<sup>9</sup>

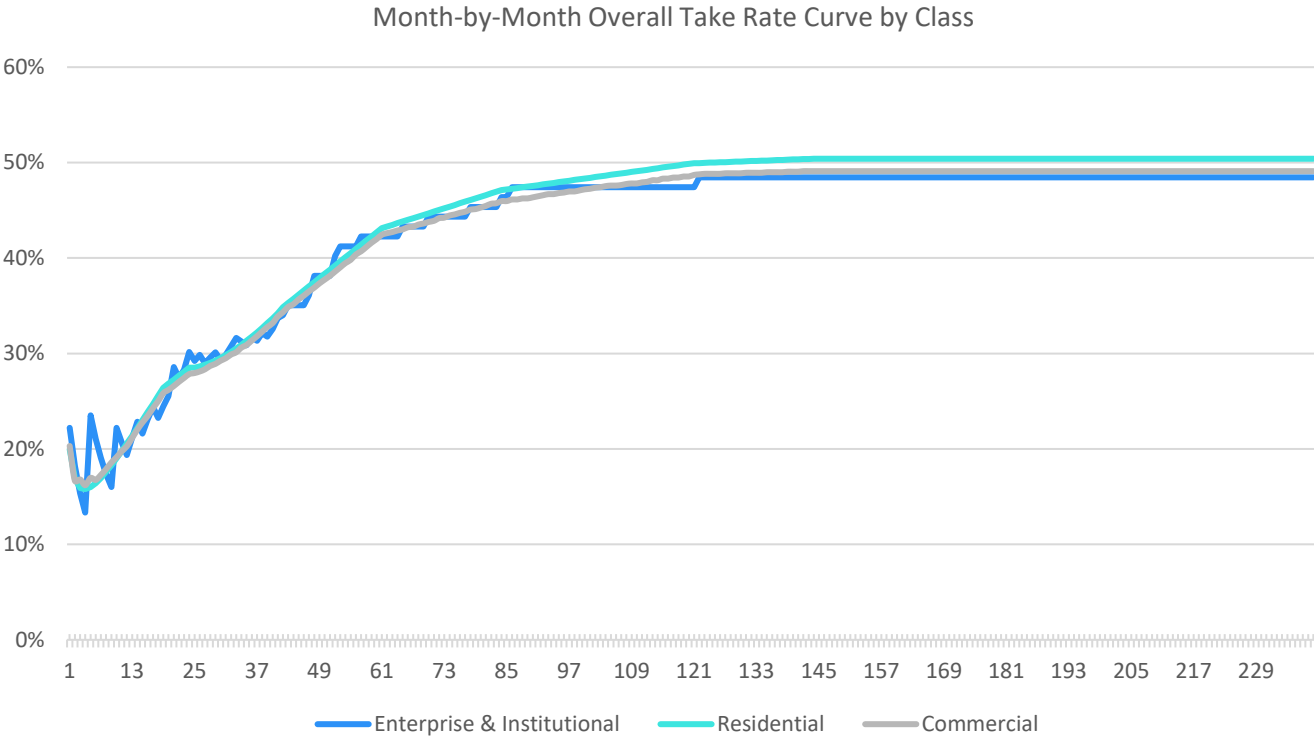


Figure 4: Take Rate Curve

### 6.2. Rural Digital Opportunity Fund Subsidy Estimates

In August 2019 the Federal Communications Commission (FCC) proposed establishing the Rural Digital Opportunity Fund, which would direct up to \$20.4 billion to expand broadband in unserved rural areas.<sup>10</sup> Recent versions of this program were known as the “Connect America Fund (CAF).” In January 2020, the FCC announced its intention

<sup>9</sup> In early years, take-rates appear to dip as an artifact of variable assumptions about when different study areas would begin to come on line in a phased construction schedule. The model tracks rises in take rate from the first month that services begin to become available for a particular phase, not for the project as a whole. Therefore, adding a phase with a later start date can temporarily “set back” the take rate, not because there are fewer total customers, but because there are now more total premises passed, and the later phases have not yet progressed as far along the take rate curve.

<sup>10</sup> <https://docs.fcc.gov/public/attachments/FCC-19-77A1.pdf>

to hold the auction starting on October 22, 2020.<sup>11</sup> This is the primary program the FCC offers to support broadband service in unserved areas with a high cost to serve. RDOF funding will be available as a Universal Service Fund subsidy to the winners of a reverse auction open to Internet service providers and electric utilities, where bidders compete nationally for the obligation to serve, with broadband and voice, unserved census blocks, an obligation that would come with a stream of subsidy payments paid out over a 10-year period. Bidders would bid against an expected or “model” support amount, with awards going to bidders willing to accept a lower amount of support. However, the FCC has stated its intention to continue the practice from the CAF-II auction in which bidders offering to build higher-performance networks (such as gigabit-capable networks) received higher subsidy amounts for the same bids. In March 2020, the FCC released a preliminary list of eligible areas and model support amounts.<sup>12</sup>

	Coventry	W. Lyndon Wheelock Sutton Sheffield Newark E. Haven Brighton	St. J Kirby Burke E. Lyndon Concord	Barton Albany Craftsbury Hardwick	Greensboro Glover	Lowell Westfield	Danville Waterford Barnet Ryegate Groton Peacham	Total
<b>Annual Model Support</b>	\$56,281	\$591,384	\$231,868	\$419,522	\$143,981	\$71,651	\$635,115	<b>\$2,149,802</b>
<b>70% of Annual Model Support</b>	\$39,397	\$413,969	\$162,308	\$293,665	\$100,787	\$50,156	\$444,581	<b>\$1,504,861</b>
<b>Locations in Eligible Census Blocks*</b>	146	1,077	696	1,168	509	217	1,397	<b>5,210</b>
<b>Estimated premises passed</b>	426	2,866	6,882	3,291	1,009	680	4,252	<b>20,399*</b>
<b>Estimated % of subsidized premises</b>	34%	38%	10%	35%	50%	32%	33%	<b>26%*</b>

*\*Locations along NEK Fiber Network folded into surrounding study areas.*

Table 3: RDOF Estimated Subsidy Amount by Study Area

In addition to revenue from wholesale per-line charges, Tilson assumed that RDOF subsidies flowed through the ISP to the underlying network owner. Based on the published preliminary map and support amount, Tilson estimated potential support amounts shown in Table 3 above.

This table shows preliminary annual model support amounts in the census blocks within the various study areas, and 70% of these amounts, for a network offering gigabit services. This reflects the assumption, used in the model,

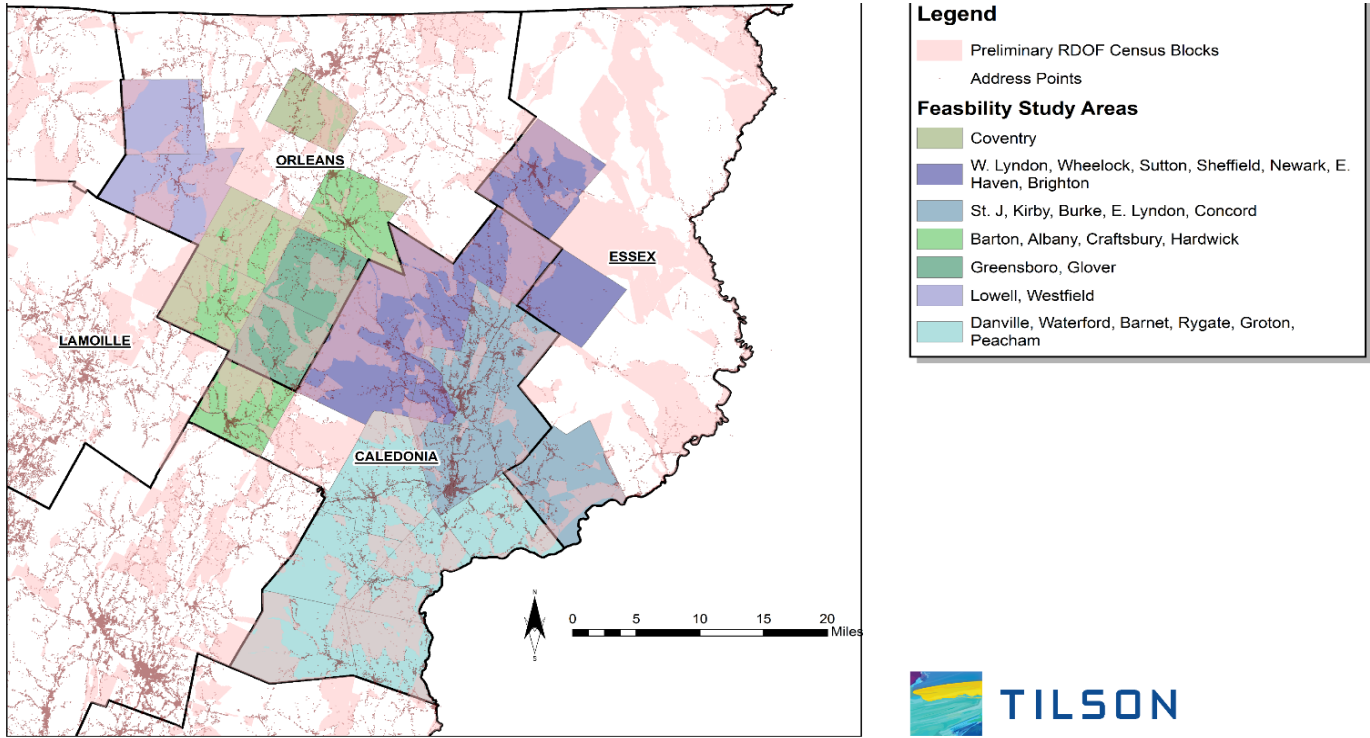
<sup>11</sup> <https://docs.fcc.gov/public/attachments/FCC-20-5A1.pdf>

<sup>12</sup> <https://www.fcc.gov/document/wcb-releases-preliminary-list-and-map-rdof-phase-i-eligible-areas>

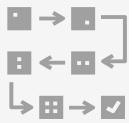


that 70% of model support is a reasonable estimate of the support that might be available in the auction.<sup>13</sup> At the 70% of model support level, approximately \$15M in support would be available across the CUD towns over 10 years. However, this support only requires serving census blocks containing about ¼ of the addresses within the CUD towns.

Figure 5: Study Areas and Preliminary RDOF Eligible Blocks



**RDOF Pre-Auction**



- Initial Eligible Areas map and list released March 17, 2020
- Final Eligible Areas map and list expected in April
- Short Form application window will be open “Summer 2020”
- Auction bidding starts October 22, 2020

**RDOF Post-Auction**



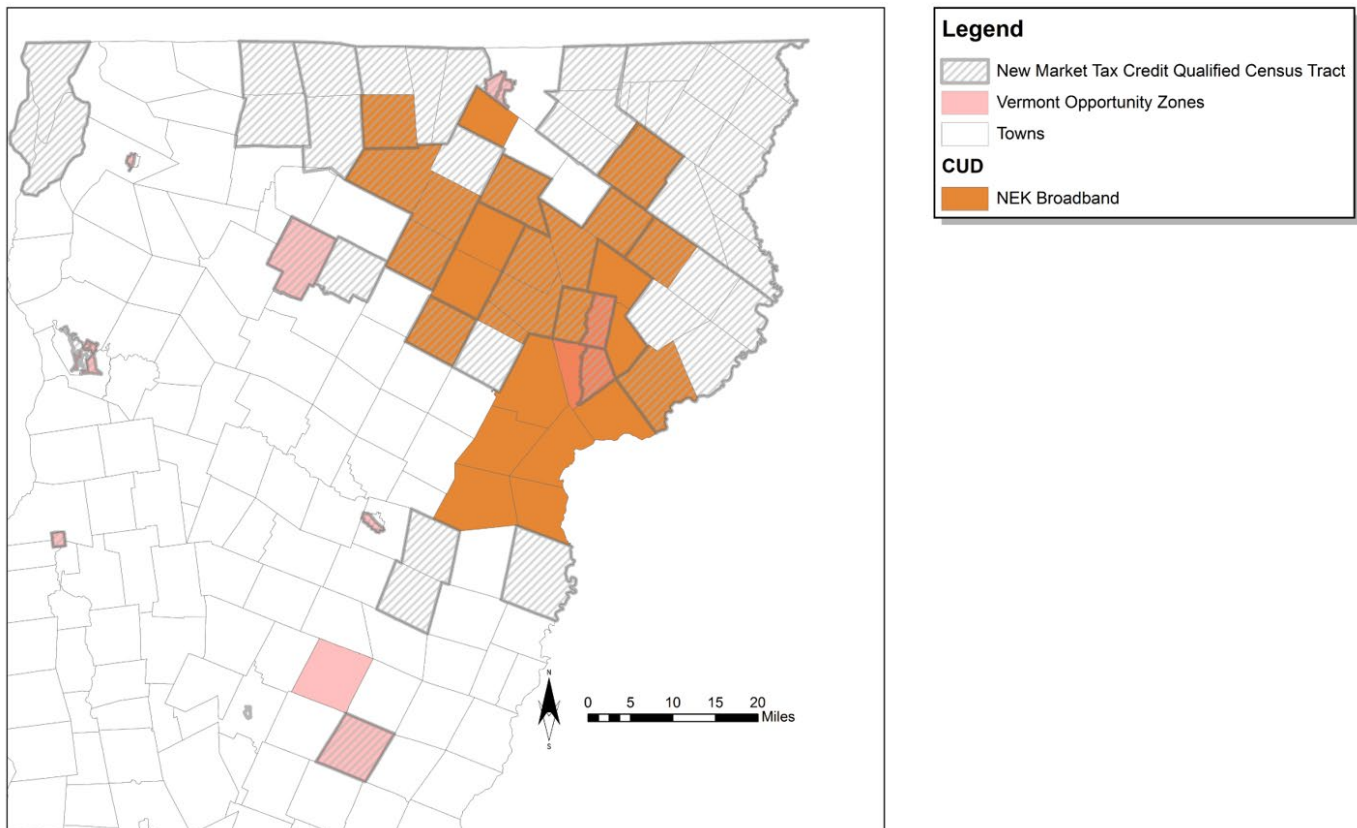
- Letter of credit commitment letter within 60 days
- Audited financials in 180 days
- ETC designation in 180 days
- Letter of credit 10 days after authorization to receive support

<sup>13</sup> In the CAF-II Auction, the auction budget “cleared” and awards started to be made once bids came down to 78.35% or below. See [https://auctiondata.fcc.gov/public/projects/auction903/reports/round\\_summary](https://auctiondata.fcc.gov/public/projects/auction903/reports/round_summary).

## 7. Special Financing Options

As part of its analysis, Tilson examined whether including financing using Opportunity Zone investment or New-Market Tax Credit loans would improve the business case. Generally, each of these vehicles can help improve a marginal business case for a project, but neither have the impact of a large outright subsidy.

Figure 6: New Market Tax Credits and Opportunity Zones



### 7.1. Opportunity Zones

The Opportunity Zone designation encourages investment in communities by granting investors federal tax advantages for using their capital gains to finance new projects and enterprises. Opportunity Zone investments are equity investments and must therefore have a good equity investment business case, although a somewhat reduced one because of the tax advantages to the investor.

Qualified Opportunity Zones were created by the 2017 Tax Cuts and Jobs Act. These zones are designed to spur economic development and job creation in distressed communities throughout the country by providing tax

benefits to investors who invest eligible capital into these communities. Taxpayers may defer tax on eligible capital gains by making an appropriate investment in a Qualified Opportunity Fund and meeting other requirements.

For investments made for two years after January 1, 2020, investors won't pay tax on 10% of their deferred capital gains, and their remaining federal tax obligation is deferred for seven years. For example, if an investor realizes a \$1M capital gain on the sale of an asset, the investor has 180 days to put that amount in a qualified Opportunity Zone investment. In that scenario, at the end of seven years, the investor would pay tax on \$900K. After holding an investment in a Qualified Opportunity Fund for a total of ten years, the investor may sell the investment and exclude all or most of the gain resulting from the sale.<sup>14</sup> Based on conversations with Opportunity Zone Investors, Tilson believes an investment on the scale of \$10M-\$15M, focused largely but not exclusively within the St. Johnsbury/Lyndon Opportunity Zone would be achievable, if it were possible to show a sufficient return on the investment.

## 7.2. New Market Tax Credits

The New Markets Tax Credit (NMTC) Program incentivizes business and real estate investment in low-income communities via a federal tax credit. The program is administered by the US Treasury Department's Community Development Financial Institutions (CDFI) Fund and allocated by local Community Development Entities (CDEs) across the United States.

The NMTC Program attracts private capital into low-income communities by permitting individual and corporate investors to receive a tax credit against their federal income tax in exchange for making equity investments in specialized financial intermediaries called Community Development Entities (CDEs).

A CDE is a domestic corporation or partnership that is an intermediary vehicle for the provision of loans, investments, or financial counseling in Low-Income Communities (LICs). Benefits of being certified as a CDE include being able to apply to the CDFI Fund to receive a New Markets Tax Credit (NMTC) allocation to offer its investors in exchange for equity investments in the CDE and/or its subsidiaries; or to receive loans or investments from other CDEs that have received NMTC allocations.<sup>15</sup> Allocations are made to CDEs by the U.S. Treasury Department. Examples of regional CDEs include Vermont Rural Ventures and Coastal Enterprises, Inc. Based on Tilson's conversations with these CDEs, at the present time no unused allocations remain, but new allocations from the

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<sup>14</sup>For information, see <https://www.irs.gov/newsroom/opportunity-zones-frequently-asked-questions> and <https://www.forbes.com/sites/anthonyнити/2019/12/23/irs-publishes-final-opportunity-zone-regulations-putting-it-all-together/#61263a912551>.

<sup>15</sup> For more information, see <https://www.cdfifund.gov/programs-training/Programs/new-markets-tax-credit/Pages/default.aspx> and <https://www.cdfifund.gov/programs-training/certification/cde/Pages/default.aspx>

Treasury are expected in summer 2020.<sup>16</sup> An important part of successfully seeking funding for a NMTC project is to demonstrate positive impacts on employment and low-income populations in the qualified areas. NMTC loans generally are limited on the low end by deal costs associated with the program that make small loans not worthwhile, and on the high end by the amount of NMTCs that an allocatee receives. Based on its conversations with allocatees, Tilson believes that if a project can demonstrate that it is a good candidate for NMTC support, a \$10M-\$15M loan may be a reasonable target for a single allocatee, or more if there is more than one allocatee participating.

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<sup>16</sup> <https://www.cdfifund.gov/programs-training/Programs/new-markets-tax-credit/Pages/apply-step.aspx>

## 8. Pro Forma Analysis, Alternative Assumptions, and Financing

Using the assumptions detailed above, Tilson prepared a 20-year pro forma analysis for the Wholesale Network Owner model assuming initial funding through a private equity investment in a public-private partnership. The outputs of this model did not indicate such an investment was viable under the assumptions given. Therefore, Tilson created alternative models based on an integrated Retail Owner-Operator and used this to explore different alternative financing assumptions. While none of these alternatives should be seen as an option to implement “as-is,” they generated information that Northeast Kingdom Broadband can use to further refine the alternatives it can consider to move its project forward

### 8.1. Wholesale Network Owner Public-Private Partnership

In the Wholesale Network Owner model, presented in Table 4, key metrics are net operating revenue (EBITDA), free cash flow, and the equity investor’s Internal Rate of Return (IRR). Under this model, both net operating revenue and free cash flow are negative until year 5, reflecting two factors:

1. Initially, operating expenditures are higher than revenues until network phases come on-line and areas constructed begin to climb the take-rate curve, bringing paying customers on-line.
2. Capital expenditures are high during the period of initial construction.

Net Operating revenue, once it becomes positive in Year 5, remains positive through year 20. It is important to note that this is so even at the wholesale revenue levels, and before the impact of subsidy. Challenges in the model reflect the relatively high capital cost to build the network, and insufficient net revenue to cover those costs.

Free cash flow, which reflects net operating revenue, capital expenditures, and RDOF subsidy levels, becomes positive in year 5, but negative again in years 11-20. There are two reasons for this:

1. The model assumes that RDOF subsidies cease after year 10. While it is not certain that there would be no further opportunity for FCC subsidy on an ongoing basis, there is no specific reason to believe that the FCC will provide a similar subsidy after year 10.
2. Capital re-investment requirements are low when the network is new but grow over time.

Capital expenditures and initial losses require \$78M in equity investment, slightly more than the initial capital costs. Due to the limited window of positive free cash flow, this investment has a negative return under this

model. Furthermore, due to negative free cash flow after year 10, this model does not present a viable opportunity for the CUD to recapitalize the network and buy out the equity investor.

Table 4: Pro Forma: Underlying Infrastructure Owner Wholesale Model

Years	Initial	1	2	3	4	5	6	7	8	9	10
Average Subscribers	-	742	2,786	4,939	7,001	8,209	8,978	9,397	9,690	9,877	10,061
Revenue	\$0	\$335,035	\$1,271,843	\$2,302,868	\$3,322,966	\$3,980,460	\$4,435,948	\$4,734,668	\$4,982,637	\$5,177,832	\$5,377,247
Operating Expenses	\$0	\$2,550,808	\$2,714,485	\$3,572,468	\$3,703,792	\$3,829,205	\$3,948,846	\$4,064,943	\$4,182,096	\$4,300,089	\$4,421,078
EBITDA	\$0	(\$2,215,773)	(\$1,442,642)	(\$1,269,600)	(\$380,826)	\$151,255	\$487,103	\$669,726	\$800,541	\$877,743	\$956,170
Debt Service	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
ARPU (Monthly)	\$0.00	\$37.65	\$38.04	\$38.86	\$39.55	\$40.41	\$41.18	\$41.99	\$42.85	\$43.69	\$44.54
Opex Per Subscriber (Monthly)	\$0.00	\$286.64	\$81.19	\$60.28	\$44.08	\$38.87	\$36.66	\$36.05	\$35.96	\$36.28	\$36.62
Operating Subsidy	\$0	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861
Net Income before Tax, Depreciation, Amortization (with operating subsidy)	\$0	(\$710,912)	\$62,219	\$235,261	\$1,124,036	\$1,656,117	\$1,991,964	\$2,174,587	\$2,305,402	\$2,382,604	\$2,461,031
Capital Expenditures	\$15,246,803	\$16,645,152	\$20,653,459	\$13,546,807	\$12,378,661	\$583,787	\$554,327	\$650,466	\$812,568	\$1,152,612	\$1,537,266
Cumulative	\$15,246,803	\$31,891,955	\$52,545,414	\$66,092,221	\$78,470,882	\$79,054,669	\$79,608,996	\$80,259,462	\$81,072,030	\$82,224,642	\$83,761,908
Free Cash Flow	(\$15,246,803)	(\$17,356,063)	(\$20,591,240)	(\$13,311,546)	(\$11,254,625)	\$1,072,330	\$1,437,637	\$1,524,121	\$1,492,834	\$1,229,992	\$923,765
Cumulative Free Cash Flow	(\$15,246,803)	(\$32,602,866)	(\$53,194,106)	(\$66,505,653)	(\$77,760,278)	(\$76,687,948)	(\$75,250,311)	(\$73,726,190)	(\$72,233,356)	(\$71,003,363)	(\$70,079,598)
Capital Sources	\$33,000,000	\$0	\$21,000,000	\$24,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative	\$33,000,000	\$33,000,000	\$54,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000
Interest on Cash	\$0	\$86,972	\$1,451	\$21,850	\$29,603	\$4,172	\$10,515	\$18,039	\$25,776	\$32,828	\$38,459
Net Cash	\$17,753,197	\$484,106	\$894,317	\$11,604,620	\$379,598	\$1,456,099	\$2,904,251	\$4,446,411	\$5,965,021	\$7,227,842	\$8,190,066
Project IRR at Year End		CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	-68.88%	-54.59%	-44.76%	-38.36%	-34.09%
Equity Investment IRR at Year End		CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	-74.00%	-61.02%	-51.55%	CAN'T CALC	CAN'T CALC

Years	11	12	13	14	15	16	17	18	19	20
<b>Average Subscribers</b>	10,186	10,234	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257
<b>Revenue</b>	\$5,553,854	\$5,691,279	\$5,817,501	\$5,933,851	\$6,052,528	\$6,173,579	\$6,297,050	\$6,422,991	\$6,551,451	\$6,682,480
<b>Operating Expenses</b>	\$4,544,734	\$4,670,180	\$4,798,510	\$4,929,813	\$5,064,668	\$5,203,228	\$5,345,594	\$5,491,872	\$5,642,169	\$5,796,595
<b>EBITDA</b>	\$1,009,120	\$1,021,098	\$1,018,991	\$1,004,038	\$987,860	\$970,351	\$951,456	\$931,119	\$909,283	\$885,885
<b>Debt Service</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>ARPU (Monthly)</b>	\$45.44	\$46.34	\$47.26	\$48.21	\$49.17	\$50.16	\$51.16	\$52.18	\$53.23	\$54.29
<b>Opex Per Subscriber (Monthly)</b>	\$37.18	\$38.03	\$38.99	\$40.05	\$41.15	\$42.27	\$43.43	\$44.62	\$45.84	\$47.09
<b>Operating Subsidy</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Net Income before Tax, Depreciation, Amortization (with operating subsidy)</b>	\$1,009,120	\$1,021,098	\$1,018,991	\$1,004,038	\$987,860	\$970,351	\$951,456	\$931,119	\$909,283	\$885,885
<b>Capital Expenditures</b>	\$1,924,117	\$2,330,551	\$2,659,844	\$2,907,999	\$3,015,023	\$3,102,350	\$3,180,052	\$3,257,381	\$3,339,435	\$3,417,446
<b>Cumulative</b>	\$85,686,025	\$88,016,576	\$90,676,420	\$93,584,419	\$96,599,442	\$99,701,792	\$102,881,844	\$106,139,225	\$109,478,660	\$112,896,106
<b>Free Cash Flow</b>	(\$914,997)	(\$1,309,453)	(\$1,640,853)	(\$1,903,961)	(\$2,027,163)	(\$2,131,999)	(\$2,228,596)	(\$2,326,262)	(\$2,430,152)	(\$2,531,561)
<b>Cumulative Free Cash Flow</b>	(\$70,994,595)	(\$72,304,048)	(\$73,944,901)	(\$75,848,862)	(\$77,876,025)	(\$80,008,024)	(\$82,236,620)	(\$84,562,882)	(\$86,993,034)	(\$89,524,596)
<b>Capital Sources</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Cumulative</b>	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000	\$78,000,000
<b>Interest on Cash</b>	\$39,089	\$33,798	\$26,594	\$17,859	\$8,085	(\$2,271)	(\$13,196)	(\$24,651)	(\$36,672)	(\$49,269)
<b>Net Cash</b>	\$7,314,157	\$6,038,503	\$4,424,243	\$2,538,141	\$519,063	(\$1,615,207)	(\$3,856,999)	(\$6,207,911)	(\$8,674,736)	(\$11,255,566)
<b>Project IRR at Year End</b>	-50.90%	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC
<b>Equity Investment IRR at Year End</b>	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC	CAN'T CALC



## 8.2. Alternative: Integrated Retail Network Owner-Operator

The financial performance of the Wholesale Network Owner model suggests that an FTTP network in the Northeast Kingdom requires more revenue than would be provided under the assumptions used. Capturing the retail revenue paid by the end user is a way to do so. This would require additional capital and operating costs, but a relatively small amount relative to the costs over and above the Wholesale Network Owner model. Tilson prepared an alternative analysis with increased revenue and expenses reflecting this operating model, shown in Table 5. Tilson estimated the initial increase in initial capital expenditure to be less than \$150,000, and an increase in free cash flow of approximately \$6.5M/year in year 5 and growing over time. These results depend on a substantial increase in average revenue per premise. In this version of the model, Tilson assumed an average retail revenue from internet and phone services of \$100.50 for residential users, \$196.30 for commercial users, and \$723.75 for Enterprise/Institutional users, and the same take rate projections. While these average revenue assumptions are somewhat high, especially for residential and small business users who would make up the bulk of users, they are not without precedent in a similar territory. The most established Communications Union District in Vermont, EC Fiber, charges residential rates for internet service starting at \$72/mo. for 25Mbps service up to \$164/mo. for 800 Mbps service, and \$25/mo. for telephone service. Its business rates range from \$107/mo. for 30 Mbps service to \$242/mo. for 800 Mbps service, and \$35/mo. for phone service.<sup>17</sup> Further analysis below explores the sensitivity of this model's financial performance to variations in these revenue levels and take rates.

Key differences in operating expenses under this model include adding bulk internet bandwidth costs, additional marketing costs, maintenance and licensing costs for additional operating systems to service retail customers, VoIP service costs, and customer service and sales employees.

In this model, financial performance was sufficiently positive to include some debt in the model. Included in this scenario was a \$14.6M New Market Tax Credits loan for a 20-year term at 4% interest, with approximately 25% of the loan forgiven at the end of year 7. In addition, this model required \$73.6M in equity investment in the first three years of the project. Project cash flow, including in years 11-20, would support a \$95M 20-year municipal bond at 4% interest and a 5% cost to issue the bond in year 11 to buy out the equity investors. However, even with this money to support a buy-out, the equity IRR was less than 3.5%, too low to be investable by a conventional equity investor or an Opportunity Zone investment.

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<sup>17</sup> See <https://www.ecfiber.net/home-page/pricing/>. (Rates as of last page access April 7, 2020.) Rates presented here include EC Fiber's \$8 charge for an Optical Network Termination Device.

Table 5: Pro Forma: Integrated Retail Owner-Operator Model

Years	Initial	1	2	3	4	5	6	7	8	9	10
<b>Average Subscribers</b>		742	2,786	4,939	7,001	8,209	8,978	9,397	9,690	9,877	10,061
<b>Revenue</b>	\$0	\$1,010,389	\$3,822,408	\$6,909,549	\$9,951,613	\$11,917,769	\$13,280,566	\$14,172,716	\$14,913,793	\$15,498,777	\$16,095,282
<b>Operating Expenses</b>	\$0	\$3,095,624	\$3,457,344	\$4,547,806	\$4,893,841	\$5,180,532	\$5,423,086	\$5,629,774	\$5,829,457	\$6,021,691	\$6,218,924
<b>EBITDA</b>	\$0	(\$2,085,235)	\$365,064	\$2,361,743	\$5,057,771	\$6,737,238	\$7,857,480	\$8,542,941	\$9,084,336	\$9,477,086	\$9,876,358
<b>Debt Service</b>	\$0	\$943,476	\$943,476	\$943,476	\$943,476	\$943,476	\$943,476	\$943,476	\$797,288	\$797,288	\$797,288
<b>ARPU (Monthly)</b>	\$0.00	\$113.54	\$114.33	\$116.59	\$118.45	\$120.98	\$123.28	\$125.69	\$128.25	\$130.77	\$133.31
<b>Opex Per Subscriber (Monthly)</b>	\$0.00	\$347.86	\$103.41	\$76.74	\$58.25	\$52.59	\$50.34	\$49.93	\$50.13	\$50.81	\$51.51
<b>Operating Subsidy</b>	\$0	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861	\$1,504,861
<b>Net Income before Tax, Depreciation, Amortization (with operating subsidy)</b>	\$0	(\$1,523,850)	\$926,449	\$2,923,128	\$5,619,156	\$7,298,622	\$8,418,865	\$9,104,326	\$9,791,910	\$10,184,660	\$10,583,932
<b>Capital Expenditures</b>	\$15,295,439	\$16,698,196	\$20,686,728	\$13,580,532	\$12,397,817	\$603,424	\$574,457	\$671,101	\$833,720	\$1,174,293	\$1,559,488
<b>Cumulative</b>	\$15,295,439	\$31,993,635	\$52,680,362	\$66,260,894	\$78,658,711	\$79,262,135	\$79,836,592	\$80,507,693	\$81,341,413	\$82,515,706	\$84,075,194
<b>Free Cash Flow</b>	(\$15,295,439)	(\$18,222,046)	(\$19,760,278)	(\$10,657,404)	(\$6,778,661)	\$6,695,198	\$7,844,408	\$8,433,225	\$8,958,190	\$9,010,367	\$9,024,444
<b>Cumulative Free Cash Flow</b>	(\$15,295,439)	(\$33,517,485)	(\$53,277,763)	(\$63,935,167)	(\$70,713,828)	(\$64,018,629)	(\$56,174,222)	(\$47,740,997)	(\$38,782,807)	(\$29,772,441)	(\$20,747,997)
<b>Capital Sources</b>	\$33,618,878	\$0	\$20,000,000	\$20,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Cumulative</b>	\$33,618,878	\$33,618,878	\$53,618,878	\$73,618,878	\$73,618,878	\$73,618,878	\$73,618,878	\$73,618,878	\$73,618,878	\$73,618,878	\$73,618,878
<b>Interest on Cash</b>	\$0	\$87,491	\$1,046	\$18,305	\$30,188	\$30,034	\$66,719	\$107,781	\$151,954	\$197,775	\$243,957
<b>Net Cash</b>	\$18,323,438	\$188,884	\$429,651	\$9,790,552	\$3,042,079	\$9,767,311	\$17,678,438	\$26,219,443	\$35,329,587	\$44,537,729	\$53,806,129

Years	11	12	13	14	15	16	17	18	19	20
Average Subscribers	10,186	10,234	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257
Revenue	\$16,624,444	\$17,035,085	\$17,412,521	\$17,760,772	\$18,115,987	\$18,478,307	\$18,847,873	\$19,224,830	\$19,609,327	\$20,001,514
Operating Expenses	\$6,415,973	\$6,608,436	\$6,803,259	\$7,000,609	\$7,203,610	\$7,412,585	\$7,627,712	\$7,849,173	\$8,077,158	\$8,311,862
EBITDA	\$10,208,471	\$10,426,649	\$10,609,262	\$10,760,163	\$10,912,377	\$11,065,722	\$11,220,161	\$11,375,657	\$11,532,169	\$11,689,652
Debt Service	\$6,841,941 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *	\$8,050,872 *
ARPU (Monthly)	\$136.01	\$138.71	\$141.47	\$144.30	\$147.18	\$150.13	\$153.13	\$156.19	\$159.32	\$162.50
Opex Per Subscriber (Monthly)	\$52.49	\$53.81	\$55.27	\$56.88	\$58.53	\$60.22	\$61.97	\$63.77	\$65.62	\$67.53
Operating Subsidy	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Net Income before Tax, Depreciation, Amortization (with operating subsidy)	\$3,366,530	\$2,375,777	\$2,558,390	\$2,709,290	\$2,861,505	\$3,014,849	\$3,169,289	\$3,324,785	\$3,481,297	\$3,638,780
Capital Expenditures	\$1,946,893	\$2,353,904	\$2,683,785	\$2,932,530	\$3,040,167	\$3,128,120	\$3,206,471	\$3,284,461	\$3,367,189	\$3,445,897
Cumulative	\$86,022,087	\$88,375,991	\$91,059,776	\$93,992,306	\$97,032,473	\$100,160,593	\$103,367,064	\$106,651,525	\$110,018,714	\$113,464,611
Free Cash Flow	(\$147,580,363)	\$21,873	(\$125,395)	(\$223,240)	(\$178,662)	(\$113,271)	(\$37,182)	\$40,324	\$114,108	\$192,883
Cumulative Free Cash Flow	(\$168,328,360)	(\$168,306,487)	(\$168,431,882)	(\$168,655,122)	(\$168,833,784)	(\$168,947,055)	(\$168,984,237)	(\$168,943,913)	(\$168,829,805)	(\$168,636,922)
Capital Sources	\$95,000,000 *	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878	\$168,618,878
Interest on Cash	\$50,135	\$6,576	\$6,349	\$5,487	\$4,459	\$3,739	\$3,357	\$3,370	\$3,757	\$4,527
Net Cash	\$1,275,901 *	\$1,304,351	\$1,185,305	\$967,552	\$793,349	\$683,817	\$649,993	\$693,687	\$811,551	\$1,008,960

\* Reflects Buy-Out of Equity Investors Equity Investor IRR with Terminal Value from Buy-out: 3.37%

### 8.3. Municipal Bonding

Tilson also explored the impact on the pro forma if the Retail Network Owner-Operator model were financed entirely by the CUD using municipal revenue bonding. It is important to stress that this is an entirely hypothetical scenario, as the CUD has no track record initially to support such revenue bonding, including financing early year operating losses in addition to direct costs to develop assets. Nevertheless, this scenario is presented in Table 6 as a way to assess the desirability of using revenue bonding earlier in the project and directly, and not only as a way of buying out an equity investor. This is not a scenario that could be implemented “as-is” but can inform the direction for subsequent analysis by the CUD.

This scenario is identical to the prior Retail Network Owner-Operator, with two differences: equity investment is replaced by a \$99M 20-year municipal bond at 4% interest with a 5% cost to issue the bond, and the RDOF subsidy is eliminated (because the CUD would not qualify as an eligible ISP). This scenario, under the other expense and revenue assumptions, shows sufficient cash flow to service the bond, although with minimal buffer.

Table 6: Pro Forma: Retail Model, All Muni Bond Financing

Years	Initial	1	2	3	4	5	6	7	8	9	10
Average Subscribers	-	742	2,786	4,939	7,001	8,209	8,978	9,397	9,690	9,877	10,061
Revenue	\$0	\$1,010,389	\$3,822,408	\$6,909,549	\$9,951,613	\$11,917,769	\$13,280,566	\$14,172,716	\$14,913,793	\$15,498,777	\$16,095,282
Operating Expenses	\$0	\$3,095,624	\$3,457,344	\$4,547,806	\$4,893,841	\$5,180,532	\$5,423,086	\$5,629,774	\$5,829,457	\$6,021,691	\$6,218,924
EBITDA	\$0	(\$2,085,235)	\$365,064	\$2,361,743	\$5,057,771	\$6,737,238	\$7,857,480	\$8,542,941	\$9,084,336	\$9,477,086	\$9,876,358
Debt Service	\$0	\$4,158,000	\$5,858,499	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999
ARPU (Monthly)	\$0.00	\$113.54	\$114.33	\$116.59	\$118.45	\$120.98	\$123.28	\$125.69	\$128.25	\$130.77	\$133.31
Opex Per Subscriber (Monthly)	\$0.00	\$347.86	\$103.41	\$76.74	\$58.25	\$52.59	\$50.34	\$49.93	\$50.13	\$50.81	\$51.51
Operating Subsidy	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Net Income before Tax, Depreciation, Amortization (with operating subsidy)	\$0	(\$6,243,235)	(\$5,493,435)	(\$5,197,256)	(\$2,501,227)	(\$821,761)	\$298,481	\$983,942	\$1,525,337	\$1,918,087	\$2,317,359
Capital Expenditures	\$15,295,439	\$16,698,196	\$20,686,728	\$13,580,532	\$12,397,817	\$603,424	\$574,457	\$671,101	\$833,720	\$1,174,293	\$1,559,488
Cumulative	\$15,295,439	\$31,993,635	\$52,680,362	\$66,260,894	\$78,658,711	\$79,262,135	\$79,836,592	\$80,507,693	\$81,341,413	\$82,515,706	\$84,075,194
Free Cash Flow	(\$15,295,439)	(\$22,941,431)	(\$26,180,163)	(\$18,777,787)	(\$14,899,044)	(\$1,425,185)	(\$275,976)	\$312,841	\$691,617	\$743,794	\$757,871
Cumulative Free Cash Flow	(\$15,295,439)	(\$38,236,870)	(\$64,417,033)	(\$83,194,820)	(\$98,093,864)	(\$99,519,049)	(\$99,795,025)	(\$99,482,184)	(\$98,790,566)	(\$98,046,772)	(\$97,288,901)
Capital Sources	\$99,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000
Interest on Cash	\$0	\$404,317	\$294,036	\$140,974	\$45,901	\$5,131	\$996	\$1,033	\$3,642	\$7,291	\$11,090
Net Cash	\$83,704,561	\$61,167,447	\$35,281,320	\$16,644,506	\$1,791,363	\$371,309	\$96,328	\$410,203	\$1,105,462	\$1,856,547	\$2,625,509

Years	11	12	13	14	15	16	17	18	19	20
<b>Average Subscribers</b>	10,186	10,234	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257
<b>Revenue</b>	\$16,624,444	\$17,035,085	\$17,412,521	\$17,760,772	\$18,115,987	\$18,478,307	\$18,847,873	\$19,224,830	\$19,609,327	\$20,001,514
<b>Operating Expenses</b>	\$6,415,973	\$6,608,436	\$6,803,259	\$7,000,609	\$7,203,610	\$7,412,585	\$7,627,712	\$7,849,173	\$8,077,158	\$8,311,862
<b>EBITDA</b>	\$10,208,471	\$10,426,649	\$10,609,262	\$10,760,163	\$10,912,377	\$11,065,722	\$11,220,161	\$11,375,657	\$11,532,169	\$11,689,652
<b>Debt Service</b>	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999	\$7,558,999
<b>ARPU (Monthly)</b>	\$136.01	\$138.71	\$141.47	\$144.30	\$147.18	\$150.13	\$153.13	\$156.19	\$159.32	\$162.50
<b>Opex Per Subscriber (Monthly)</b>	\$52.49	\$53.81	\$55.27	\$56.88	\$58.53	\$60.22	\$61.97	\$63.77	\$65.62	\$67.53
<b>Operating Subsidy</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Net Income before Tax, Depreciation, Amortization (with operating subsidy)</b>	\$2,649,473	\$2,867,651	\$3,050,264	\$3,201,164	\$3,353,378	\$3,506,723	\$3,661,163	\$3,816,659	\$3,973,170	\$4,130,653
<b>Capital Expenditures</b>	\$1,946,893	\$2,353,904	\$2,683,785	\$2,932,530	\$3,040,167	\$3,128,120	\$3,206,471	\$3,284,461	\$3,367,189	\$3,445,897
<b>Cumulative</b>	\$86,022,087	\$88,375,991	\$91,059,776	\$93,992,306	\$97,032,473	\$100,160,593	\$103,367,064	\$106,651,525	\$110,018,714	\$113,464,611
<b>Free Cash Flow</b>	\$702,580	\$513,747	\$366,479	\$268,634	\$313,211	\$378,603	\$454,692	\$532,198	\$605,981	\$684,756
<b>Cumulative Free Cash Flow</b>	(\$96,586,321)	(\$96,072,574)	(\$95,706,096)	(\$95,437,462)	(\$95,124,251)	(\$94,745,648)	(\$94,290,956)	(\$93,758,758)	(\$93,152,777)	(\$92,468,021)
<b>Capital Sources</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Cumulative</b>	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000	\$99,000,000
<b>Interest on Cash</b>	\$14,897	\$18,064	\$20,360	\$22,032	\$23,553	\$25,394	\$27,585	\$30,184	\$33,170	\$36,553
<b>Net Cash</b>	\$3,342,985	\$3,874,796	\$4,261,634	\$4,552,301	\$4,889,065	\$5,293,061	\$5,775,338	\$6,337,720	\$6,976,872	\$7,698,181

## 8.4. Sensitivity Analysis

Tilson examined the sensitivity of financial performance on the assumptions for average revenue per location served (ARPU) and the percentage of premises passed that subscribe (take rate).<sup>18</sup> Table 7 and Table 8 present these sensitivity analyses varying ARPU and take rates for residential customers and commercial customers in the Retail Network Owner-Operator model.

		<b>Take Rate vs. ARPU</b>										
		<i>Showing Equity IRR with Terminal Value</i>										
		Blended Monthly Residential ARPU										
		60	65	70	75	80	85	90	95	100	105	110
Residential Take Rate	30.0%	-2.03%	-1.71%	-1.39%	-1.07%	-0.75%	-0.43%	-0.11%	0.21%	0.52%	0.84%	1.16%
	35.0%	-1.53%	-1.16%	-0.79%	-0.42%	-0.05%	0.32%	0.69%	1.06%	1.43%	1.80%	2.17%
	40.0%	-1.03%	-0.61%	-0.19%	0.23%	0.65%	1.08%	1.50%	1.92%	2.34%	2.75%	3.17%
	45.0%	-0.54%	-0.07%	0.41%	0.88%	1.35%	1.82%	2.29%	2.76%	3.23%	3.70%	4.16%
	50.0%	-0.04%	0.48%	1.00%	1.52%	2.05%	2.57%	3.08%	3.60%	4.12%	4.64%	5.15%
	55.0%	0.44%	1.01%	1.58%	2.16%	2.73%	3.29%	3.86%	4.43%	4.99%	5.56%	6.12%
	60.0%	0.93%	1.55%	2.17%	2.79%	3.41%	4.03%	4.64%	5.26%	5.87%	6.48%	7.09%

		Blended Monthly Commercial ARPU										
		\$160	\$165	\$170	\$175	\$180	\$185	\$190	\$195	\$200	\$205	\$210
Commercial Take Rate	30.0%	2.62%	2.65%	2.68%	2.71%	2.74%	2.77%	2.80%	2.83%	2.86%	2.89%	2.93%
	35.0%	2.77%	2.80%	2.84%	2.87%	2.91%	2.95%	2.98%	3.02%	3.05%	3.09%	3.12%
	40.0%	2.91%	2.95%	2.99%	3.04%	3.08%	3.12%	3.16%	3.20%	3.24%	3.28%	3.32%
	45.0%	3.06%	3.11%	3.15%	3.20%	3.24%	3.29%	3.34%	3.38%	3.43%	3.47%	3.52%
	50.0%	3.21%	3.26%	3.31%	3.36%	3.41%	3.46%	3.51%	3.57%	3.62%	3.67%	3.72%
	55.0%	3.36%	3.41%	3.47%	3.53%	3.58%	3.64%	3.69%	3.75%	3.81%	3.86%	3.92%
	60.0%	3.50%	3.57%	3.63%	3.69%	3.75%	3.81%	3.87%	3.93%	3.99%	4.05%	4.11%

Table 7: Residential and Commercial Take Rate vs. ARPU - Equity IRR with Terminal Value - Equity/NMTC Financed Scenario

<sup>18</sup> Take rate is keyed to the 60-month mark after service becomes available in the area. The sensitivity analysis continues to assume that take rates will climb an additional 10% (not 10 percentage points) in months 61-120 over whatever level is achieved by month 60. Example: If the Month 60 take rate is 40%, the month 120 take rate would be 44%.

**Take Rate vs. ARPU**

*Showing Net Cash in after 20 Years*

		Blended Monthly Residential ARPU										
		60	65	70	75	80	85	90	95	100	105	110
Residential Take Rate	30.0%	-\$132,307,382	-\$124,343,598	-\$116,379,815	-\$108,416,031	-\$100,452,247	-\$92,488,464	-\$84,524,680	-\$76,560,896	-\$68,597,112	-\$60,633,329	-\$52,669,545
	35.0%	-\$119,057,317	-\$109,770,855	-\$100,484,394	-\$91,197,933	-\$81,911,471	-\$72,625,010	-\$63,338,549	-\$54,052,088	-\$44,765,626	-\$35,479,165	-\$26,192,704
	40.0%	-\$105,755,084	-\$95,146,961	-\$84,538,839	-\$73,930,716	-\$63,322,594	-\$52,714,471	-\$42,106,349	-\$31,498,226	-\$20,890,103	-\$10,281,981	\$326,142
	45.0%	-\$92,489,914	-\$80,560,844	-\$68,631,774	-\$56,702,704	-\$44,773,633	-\$32,844,563	-\$20,915,493	-\$8,986,423	\$2,942,647	\$14,871,717	\$26,800,787
	50.0%	-\$79,111,559	-\$65,859,099	-\$52,606,639	-\$39,354,180	-\$26,101,720	-\$12,849,260	\$403,199	\$13,655,659	\$26,908,119	\$40,160,579	\$53,413,038
	55.0%	-\$65,881,205	-\$51,306,345	-\$36,731,485	-\$22,156,625	-\$7,581,765	\$6,993,095	\$21,567,955	\$36,142,815	\$50,717,676	\$65,292,536	\$79,867,396
	60.0%	-\$52,461,732	-\$36,565,838	-\$20,669,943	-\$4,774,048	\$11,121,847	\$27,017,742	\$42,913,637	\$58,809,531	\$74,705,426	\$90,601,321	\$106,497,216

		Blended Monthly Commercial ARPU										
		160	165	170	175	180	185	190	195	200	205	210
Commercial Take Rate	30.0%	-\$11,756,741	-\$10,983,336	-\$10,209,931	-\$9,436,527	-\$8,663,122	-\$7,889,717	-\$7,116,312	-\$6,342,908	-\$5,569,503	-\$4,796,098	-\$4,022,693
	35.0%	-\$7,950,745	-\$7,050,076	-\$6,149,407	-\$5,248,738	-\$4,348,069	-\$3,447,401	-\$2,546,732	-\$1,646,063	-\$745,394	\$155,275	\$1,055,944
	40.0%	-\$4,146,422	-\$3,117,661	-\$2,088,899	-\$1,060,137	-\$31,376	\$997,386	\$2,026,147	\$3,054,909	\$4,083,670	\$5,112,432	\$6,141,193
	45.0%	-\$242,888	\$915,469	\$2,073,826	\$3,232,183	\$4,390,540	\$5,548,897	\$6,707,253	\$7,865,610	\$9,023,967	\$10,182,324	\$11,340,681
	50.0%	\$3,598,354	\$4,883,961	\$6,169,568	\$7,455,175	\$8,740,782	\$10,026,389	\$11,311,997	\$12,597,604	\$13,883,211	\$15,168,818	\$16,454,425
	55.0%	\$7,466,699	\$8,880,396	\$10,294,093	\$11,707,789	\$13,121,486	\$14,535,183	\$15,948,880	\$17,362,576	\$18,776,273	\$20,189,970	\$21,603,667
	60.0%	\$11,323,904	\$12,866,402	\$14,408,900	\$15,951,398	\$17,493,896	\$19,036,393	\$20,578,891	\$22,121,389	\$23,663,887	\$25,206,385	\$26,748,882

Table 8: Residential and Commercial Take Rate vs. ARPU - Net Cash in After 20 Years – Municipal Bonding Scenario



Two sets of these two tables are shown. One set displays the impact of different ARPU and take-rate assumptions on the Equity/NMTC financed scenario, using the key financial output for that scenario, Equity IRR with Terminal Value.<sup>19</sup> The other set displays the impact in the Municipal Bonding scenario, using its key financial output, Net Cash (at the 20-year mark). This is helpful to understand how robust the network is under adverse assumptions (and to understand potential upside scenarios). So, for example, at a residential ARPU of \$100/mo. and a residential take rate of 45%, the Equity IRR with Terminal Value would be 3.23%. However, if an ARPU of \$100/mo. only yields a take rate of 30%, the IRR is barely positive. There is a similar outcome if it is necessary to reduce prices to a point where ARPU is only \$70/mo. to achieve the 45% take rate.

The impact of variations in these variables is more starkly illustrated by tables showing Net Cash from the Municipal Bonding scenario. In these tables a \$100/mo. residential ARPU and 45% residential take rate produce a small positive net cash position. However, decreases in either ARPU or take rate can result in negative net cash positions. This sensitivity is especially important in scenarios with substantial debt, as a cash crunch can lead to default and loss of control of the network.

Sensitivity analysis is also useful to understand the impact of different levels of subsidy, either an up-front, one-time capital subsidy or a recurring subsidy. This can reflect, for example, the impact of receiving other one-time grants, or alternative assumptions about the amount of RDOF subsidy. Also, this can simulate the impact of reductions or increases in the project’s initial capital costs or recurring operating costs, as these changes are functionally similar in the model to variations in a subsidy amount.

**Capital Subsidy vs. Monthly Subsidy**  
*Showing Equity IRR with Terminal Value*

		Monthly Subsidy										
		\$0	\$50,000	\$100,000	\$150,000	\$200,000	\$250,000	\$300,000	\$350,000	\$400,000	\$450,000	\$500,000
<b>Capital Subsidy</b>	\$0	1.68%	2.35%	3.02%	3.71%	4.40%	5.11%	5.83%	6.56%	7.30%	8.06%	8.84%
	\$3,000,000	2.06%	2.74%	3.43%	4.14%	4.85%	5.58%	6.32%	7.08%	7.85%	8.64%	9.44%
	\$6,000,000	2.45%	3.15%	3.86%	4.59%	5.33%	6.08%	6.85%	7.63%	8.43%	9.25%	10.09%
	\$9,000,000	2.86%	3.58%	4.31%	5.06%	5.83%	6.61%	7.41%	8.22%	9.05%	9.91%	10.78%
	\$12,000,000	3.29%	4.03%	4.79%	5.57%	6.36%	7.17%	8.00%	8.85%	9.72%	10.61%	11.53%
	\$15,000,000	3.74%	4.51%	5.29%	6.10%	6.92%	7.77%	8.63%	9.52%	10.43%	11.37%	12.34%
	\$18,000,000	4.22%	5.01%	5.83%	6.66%	7.52%	8.40%	9.31%	10.24%	11.20%	12.19%	13.22%

*Table 9: Capital Subsidy vs. Monthly Subsidy - Equity/NMTC Financed Scenario*

<sup>19</sup> As discussed above, as the Equity/NMTC financed scenario assumes a buy-out in year 11, this is measured at the point of the buy-out.

Table 9 shows the impact of different subsidy amounts on the Equity/NMTC financed scenario of the Retail Network Owner-Operator model.<sup>20</sup> Note that the recurring subsidy level included in the pro forma for this scenario is approximately \$125,000 per month, with no one-time subsidy; the table here shows variations in outcomes from that scenario.

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<sup>20</sup> The Municipal Bonding scenario is not shown because changes in subsidy amounts would likely result in a need for a different bond amount, which produces a more complex set of model interactions than is readily captured in this table.

## 9. Key Conclusions and Recommendations for Further Study

It is not surprising that the business case for a Fiber-to-the-Premise network across a rural, low-density 27-town region presents some challenges. Even though none of the financial models presented in this report show feasibility “as-is,” the study work at this stage points to important information that Northeast Kingdom Broadband can use to refine its approach. This study suggests four objectives for the next phase of planning and investigation:

**Focus on a higher-revenue model.** This will mean focusing on a model where the network owner can capture most of the revenue from the end user. An integrated retail owner-operator is one way to approach this, or merely a wholesale model with a retail partner willing to share a large amount of total revenue with the underlying network owner. An “integrated” retail network owner-operator also does not exclude the possibility of hiring an ISP as a network operator, provided that it can be done more economically than under an insourced model.

The analysis in this study points to the possible importance of achieving a relatively high average revenue per user. There will obviously be some tension between this and an understandable desire to make services as affordable as possible for as many people as possible. There may also be adverse impacts to take rates from higher prices. To the extent possible, collection of survey or similar data that explores willingness and ability to pay for services in the CUD towns can inform the degree of trade-off here.

**Improve the subsidy-to-cost ratio.** The estimated amount of RDOF funding available used in these models, approximately \$15M over ten years, is significant, but still substantially less than the estimated \$77M capital costs of building out a network across the 27 CUD towns. However, the RDOF funding does not require building out all of the CUD footprint, only those census blocks associated with RDOF funding. This raises the possibility of a more targeted Phase I project that builds out to as much of the RDOF blocks as possible, while deferring non-subsidized areas to a subsequent phase. Of course, it will not be possible to construct a build-out plan limited to only the RDOF blocks; they are not a contiguous mass, so such a Phase I Project would need to incorporate connecting routes. Also, only about ¼ of the premises in the CUD footprint are located within these blocks, so there will also be less non-subsidy revenue in this approach. Nevertheless, it is worth exploring how much cost can be reduced while losing no or little of the subsidy available. Under this approach, additional grant opportunities could be pursued in a more incremental fashion without the timeline pressure of the RDOF auction.

**Retain as much operating economies of scale as possible.** A potential pitfall of scaling down the project is that costs will not necessarily shrink proportionally with the number of premises passed. On the capital side, headend and network electronics have some components that do not shrink proportionally when the number users serve

shrink. Many RDOF-eligible census blocks are in lower-density areas and may require greater lengths of cable between premises. On the operating cost side, certain costs do not shrink directly in proportion to network size. Network operations require some minimum number of employees to provide coverage of key tasks. (This may be somewhat mitigated by outsourcing some functions.) Bandwidth and transport services are more expensive per user with fewer users, and the ability to offer gigabit services requires certain minimum levels of bandwidth available to the network.

A next phase of investigation could also look at the business case to include the denser Opportunity Zone (St. Johnsbury and eastern Lyndon) in Phase I. Although none of the business cases developed for the entire CUD demonstrated a sufficient business case for an equity Opportunity Zone investment, a higher-density area may, and this may provide an opportunity to retain at least some of the economies of scale for the project.

**Explore bringing revenue bonding into play sooner, and with a different focus.** This study sought to identify a viable business case to fund the entire CUD network at once through private investment, assisted by a CUD buy-out funded through municipal revenue bonding by the CUD once the network was well-established. This report's analysis did not conclude that this all-at-once path would work with the cost and revenue assumptions examined. Similarly, while a scenario where an integrated retail owner-operator initially capitalized entirely through revenue bonding could *hypothetically* generate enough cash flow to sustain its operations and repay debt, this scenario requires overlooking the real barriers to large amounts of borrowing by a new entity with no operational track record.

Despite these limitations, the analysis presented here suggests investigation of an alternative way to deploy municipal revenue bonding by the CUD. Instead of focusing the bonding on funding a buy-out of the network built by equity investors, it may be worthwhile to examine the deployment of municipal revenue bonding by the CUD to directly fund Phase II expansions once the potential Phase I project establishes a track record for the CUD in conjunction with its private partners.

This analysis confirms that the financial model across the Northeast Kingdom Broadband towns is not easy and that immediately available subsidies, while helpful, do not completely transform that business case. These statements do not, however, change how important this fundamental infrastructure is to the region. Success will require a tuned strategy and perseverance, and these efforts are worth the value of the investment needed to serve the region's residents, businesses, and institutions.

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