

# Application to DHCD Submitted through CAMS

Montgomery County, VA

Montgomery Co\_VATI2021

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**Application ID:** 75708102020162636  
**Application Status:** In Progress - DHCD  
**Program Name:** Virginia Telecommunications Initiative 2021  
**Organization Name:** Montgomery County, VA  
**Organization Address:** 755 Roanoke Street  
Christiansburg, VA 24073-3179  
**Profile Manager Name:** Angela Hill  
**Profile Manager Phone:** (540) 382-6960  
**Profile Manager Email:** hillam@montgomerycountyva.gov

**Project Name:** Montgomery Co\_VATI2021  
**Project Contact Name:** Brian Hamilton  
**Project Contact Phone:** (540) 382-5732  
**Project Contact Email:** hamiltonbt@montgomerycountyva.gov  
**Project Location:** 755 Roanoke Street, Suite 2H  
Christiansburg, VA 24073-3169  
**Project Service Area:** Montgomery County

**Total Requested Amount:** \$919,569.00

**Required Annual Audit Status:** Pending Review

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## Budget Information:

Cost/Activity Category	DHCD Request	Other Funding	Total
<b>Telecommunications</b>	<b>\$919,569.00</b>	<b>\$488,068.00</b>	<b>\$1,407,637.00</b>
Construction	\$894,569.00	\$478,068.00	\$1,372,637.00
Other: Grant Administration	\$25,000.00	\$10,000.00	\$35,000.00
<b>Total:</b>	<b>\$919,569.00</b>	<b>\$488,068.00</b>	<b>\$1,407,637.00</b>

### Budget Narrative:

A detailed budget includes up to 73 sites and breaks down cost per site along with wireless construction costs, grant administration, and wireless client installation costs. Because Montgomery County has procured Gigabeam's partnership through a RFP, there are no additional procurement or bidding costs associated with this project. A detailed breakdown of site costs and customer equipment and installation are attached to this application.

## Questions and Responses:

### 1. Project Description and Need

Describe why and how the project area(s) was selected. Describe the proposed geographic area including specific boundaries of the project area (e.g. street names, local and regional boundaries, etc.). Attach a copy of the map of your project area(s). Label map: Attachment 1 – Project Area Map.

#### Answer:

The project areas were selected based on the findings from the Montgomery County Broadband Assessment, completed in May of 2020. The communities in the project area were all determined to be areas of prioritized broadband need, based on the assessment, and are considered un-served areas (less than or equal to 25/3mbps). More specifically, the portion of the Allegheny Springs/Shawsville area identified in the project area map is lacking broadband speeds of 10 Megabits per second download and 1 Megabits per second upload capacity, according to the assessment.

The project areas include the communities of Allegheny Springs, Elliston, Lafayette, and Shawsville. The project areas are located on the eastern portion of Montgomery County and begins east of the town of Christiansburg and extends towards the border of Roanoke County. Most of the communities in the project area are located along Route 460, while Allegheny Springs is situated south of Route 460.

### 2. List existing providers in the proposed project area and the speeds offered. Please do not include satellite. Describe your outreach efforts to identify existing providers and how this information was compiled with source(s).

#### Answer:

According to the Federal Communications Commission's (FCC) "Provider Coverage Overlap and Population Coverage" database, there are four existing providers in the proposed project areas. However, when entering an address from the project area to check availability with these providers only DSL is available for Verizon and

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Comcast states, they do not provide coverage (or only offer to commercial sites). Furthermore, Citizens Telephone Cooperative has open access fiber that runs along Route 460 but does not extend further into residential areas located within the project areas. Lastly, Segra is another internet service provider within the project area, however they only offer commercial service and not residential service. So, while there technically are existing service providers within the project area, residential areas still do not have access to them or are only offered insufficient speeds, e.g. 10/1mbps.

Existing providers include:

Verizon Communications DSL at estimated speed of 10/1 mbps

Comcast Corporations Cable Wireline starting at 25/3 mbps or higher

Citizens Telephone Cooperative, Inc. Fiber Optic starting at 10/1 mbps and going up to 1 gbps

Segra Fiber at estimated speed of 1 gbps (commercial only)

Following the Montgomery County Broadband Assessment, the County took the next step toward expanding broadband services. The County issued a request for proposals (RFP) on May 26, 2020 to procure a private broadband service partner. Four proposals were received and through this process one provider was identified as most suitable for addressing the priority areas of need identified in the assessment.

The County submitted their VATI 2021 Notice of Application to the Department of Housing and Community Development (DHCD) on July 6, 2020. A copy of this notice of application will be included in the additional attachments area.

3. Describe if any areas near the project have received funding from federal grant programs, including but not limited to Connect America Funds II (CAF II), ACAM, ReConnect, and Community Connect. If there have been federal funds awarded near the project, provide a map verifying the proposed project area does not conflict with these areas. Describe if there are Rural Digital Opportunity Fund (RDOF) eligible census blocks located in the proposed project area. Label Map: Attachment 2 – Documentation on Federal Funding Area.

**Answer:**

According to data compiled from the Connect American Fund Broadband Map (CAF Map), there has been no previous federal funding near the project areas. See Attachment 2 for more details.

There are Rural Digital Opportunity Fund (RDOF) eligible census blocks located in the project areas, according to the Auction 904 Updated Eligible Areas map on the FCC's database. In comparing what the FCC listed as eligible locations with the address data the County has available, it was determined that there are approximately 17 serviceable units within the RDOF eligible areas located within the project area.

4. Overlap: To be eligible for VATI, applicants must demonstrate that the proposed project area(s) is unserved. An unserved area is defined as an area with speeds of 25/3 mbps or less and with less than 10% service overlap within the project area. Describe any anticipated service overlap with current providers within the project area. Provide a detailed explanation as to how you determined the percentage overlap. Label Attachment: Attachment 3 – Documentation Unserved Area VATI Criteria.

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## Answer:

The project areas are unserved according to the Montgomery County Broadband Assessment, as well as the Virginia Broadband Availability Map. Although the FCC does indicate that there are existing providers in the proposed project area, based on the survey responses in the assessment speeds are not adequate, nor does the data seem entirely comprehensive, or only commercial sites are offered service.

Per the FCC's "Provider Coverage Overlap and Population Coverage" map, it would appear as though there is over a 10% service overlap. However, when adding physical addresses to these various providers websites to check for availability, they state they do not offer service, or they only offer DSL. The FCC's coverage map is somewhat misleading in its representation of coverage. This determination of service overlap was made by comparing the FCC's "Provider Coverage Overlap and Population Coverage" map with the project area map.

Through the extensive process of the Montgomery County Broadband Assessment, it was determined that the communities in the project areas were un-served. This determination was based on extensive research, survey responses from County residents, interviews with regional service providers, and interviews with key stakeholders in the region.

5. Total Passings: Provide the number of total serviceable units in the project area. Applicants are encouraged to prioritize areas lacking 10 Megabits per second download and 1 Megabits per second upload speeds, as they will receive priority in application scoring. For projects with more than one service area, each service area must have delineated passing information. Label Attachment: Attachment 4 – Passings Form
  - a. Of the total number of passings, provide the number of residential, business, non-residential, and community anchors in the proposed project area. Describe the methodology used for these projections.
  - b. Provide the number of serviceable units in the project area that have 10/1 mbps or less. Describe the methodology used for these projections.

## Answer:

The total number of passings from both project areas is 1,292. When breaking the project areas out, the totals are:

Allegheny Springs/Shawsville Project Area = 229

Elliston/Lafayette Project Area = 1063

A.) Allegheny Springs/Shawsville Project Area:

Total number of passings = 229

Residential passings = 209

Business passings = 11

Community anchors = 0

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Non-residential passings = 9

Elliston/Lafayette Project Area:

Total number of passings = 1063

Residential passings = 1006

Business passings = 33

Community anchors = 4

Non-residential passings = 20

The Montgomery County's G.I.S. data was used to determine these projections, in conjunction with the Montgomery County Broadband Assessment.

B.) The Allegheny Springs/Shawsville project area was determined to be lacking 10 Megabits per second download and 1 Megabits per second upload speeds, according to the Montgomery County Broadband Assessment. According to the County's database, the Allegheny Springs/Shawsville project area contains:

Total number of passings = 229

Residential passings = 209

Businesses = 11

Community anchors = 0

Non-residential = 9

The Montgomery County's G.I.S. data was used to determine these projections, in conjunction with the Montgomery County Broadband Assessment.

6. For wireless projects only: Please explain the ownership of the proposed wireless infrastructure. Please describe if the private co-applicant will own or lease the radio mast, tower, or other vertical structure onto which the wireless infrastructure will be installed.

**Answer:**

Vertical assets will entirely be owned by the private applicant (GigaBeam Networks) apart from water tank locations which are owned by the public applicant (Montgomery County).

7. Speeds: Describe the internet service offerings, including download and upload speeds, to be provided after completion of the proposed project. Detail whether that speed is based on dedicated or shared bandwidth, and

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detail the technology that will be used. This description can be illustrated by a map or schematic diagram, as appropriate. List the private co-applicant's tiered price structure for all speed offerings in the proposed project area, including the lowest tiered speed offering at or above 25/3 mbps.

**Answer:**

The project will provide broadband services through a mixture of fixed wireless technologies. All the coverage area with the exception of areas around Brake Rd will be connected utilize modern milometer wave 60ghz fixed "5g" equipment capable of gigabit + speeds to the user. V1000 client nodes are capable of up to 1Gbps to the end user, while the V3000 node can provide over 7Gbps to the end user.

Exception areas have denser tree coverage making mmw 60ghz unusable and traditional 5.8ghz / 3.6 ghz cbrs equipment will be utilized to provide service up to 200Mbps.

Being a fixed wireless network in a ptmp configuration, the network will be a shared bandwidth network. Two fiber pop's will be used to provide connectivity to the network with capacities up to 10Gbps each giving more than adequate bandwidth capabilities to the network.

Initial residential offerings will include:

10Mbps x 1Mbps - \$45

25Mbps x 5Mbps - \$65

50Mbps x 5Mbps - \$85

100Mbps x 10Mbps - \$99

250Mbps x 25Mbps - \$139

500Mbps x 50Mbps - \$169

1Gbps x 100Mbps - \$199

Standard Business Pricing:

25x5 Mbps - \$89

50x5 Mbps - \$109

100x10 Mbps - \$139

250 x 25Mbps - \$169

500Mbps x 50Mbps - \$199

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1Gbps x 100Mbps - \$249

Customer Business plans will also be offered to fit the needs of specific businesses.

All plans include a managed Wi-Fi router and no additional cost. All plans have no data caps.

8. Network Design: Provide a description of the network system design used to deliver broadband service from the network's primary internet point(s) of presence to end users, including the network components that already exist and the ones that would be added by the proposed project. Provide a detailed explanation of how this information was determined with sources. If using a technology with shared bandwidth, describe how the equipment will handle capacity during peak intervals. For wireless projects, provide a propagation map for the proposed project area with a clearly defined legend for scale of map. Label Map: Attachment 5 – Propagation Map Wireless Project.

**Answer:**

The project will utilize next generation fixed “5g” wireless equipment in the 60ghz band to deliver gigabit speeds to end users throughout the bulk of the coverage area. Outer areas that are denser in tree coverage will utilize CBRS and unlicensed 5.8ghz equipment for speeds up to 200Mbps.

The project will utilize middle mile fiber sourced from Citizen's Telephone and/or Segra that is located near the project areas to provide the primary internet connections. These fiber points will provide 1 to 10Gbps bandwidth capabilities to the project and be distributed to the initial Cambium Networks V5000 CnWave Distribution Nodes via 60 and 80ghz ptp microwave links capable of 10Gbps. Each Distribution node will then interconnect to nearby distribution nodes in a “mesh” style network based off of Facebook's Terragraph technology. Mesh connections will also be at 10Gbps with each distribution node capable of communicating with other nearby nodes. This will provide a backhaul capability of 10Gbps throughout the core of the network.

End users will be connected using CnWave V1000 or V3000 client nodes capable of 1Gbps to approximately 7Gbps of connection speeds. These client nodes will connect the nearest distribution node. Each distribution node is capable of a total of 30 devices connected either being other distribution nodes or client nodes.

Subscribers in the outer parts of the project area that are utilizing traditional fixed wireless equipment due to tree coverage will connect using Cambium Networks epmp 3000 AP's and Force 300 radios. These radios can deliver up to 200Mbps speeds to end users in a single 40mhz channel (over 400Mbps in an 80Mhz channel). In extreme hard to reach areas, CBRS LTE equipment from Baicells will be utilized that will provide up to 100Mbps speeds to nLOS condition areas. We expect fewer than 20 homes needing this type of equipment and fewer than 100 needing the epmp gear. This design ensures every subscriber in the project area has access to up to 100Mbps service with the bulk offered up to 1Gbps.

All hardware specification sheets from the manufacturers are attached to verify performance claims. CnWave is a new technology that will be available in September 2020. It is designed and will be approved to provide verified wireless gigabit performance per RDOF specifications. A whitepaper from Cambium Networks is attached verifying the capacity and capabilities of this hardware. GigaBeam Networks currently deploys both Baicells ENB's and Cambium Epmp 3000 equipment and can verify speeds from actual users of 100Mbps on Baicells LTE, and 200-400Mbps on Epmp 3000 depending on channel width configurations.

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The project network is designed to support large bandwidth amounts with 2 10Gbps connections and multiple path meshed wireless networking also at 10Gbps. Each node can only connect a maximum of 30 devices and with house layout and node placement most nodes will have less than 20 units connected to them. This will prevent over utilization at peak times on the hardware directly. Monitoring of usage from the fiber pops to prevent max capacity consumption will also prevent slowness and overloading of the network. Once a fiber capacity has reached 70%, GigaBeam's standard practice is to upgrade the circuit or add circuits for more capacity.

## 9. Project Readiness

Describe the current state of project development, including but not limited to: planning, preliminary engineering, identifying easements/permits, status of MOU or MOA, and final design. Prepare a detailed project timeline or construction schedule, identifying specific tasks, staff, contractor(s) responsible, collection of data, etc., and estimated start and completion dates. Applicants must include Memorandums of Understanding (MOUs) or Memorandums of Agreement (MOAs) between applicants (drafts are allowable). Label Attachments: Attachment 6 – Timeline/Project Management Plan; Attachment 7 – MOU/MOA between Applicant/Co-Applicant.

### Answer:

The current MOU is in draft form. The initial design of the network improvements has been completed. This project is requesting construction funds to acquire equipment and install it with service available in the project area by project completion.

Permitting is estimated to take up to six months, with sites being permitted concurrently. Construction can be done within six months. Gigabeam keeps much of the required equipment and construction materials in stock, what is not available in their inventory can be ordered and delivered quickly.

Customer equipment installation will be completed as customers sign up for service, with work to be completed within six months after construction is complete. Project closeout would then be conducted during the last two months of the project timeline.

10. Matching funds: Complete the funding sources table indicating the cash match and in-kind resources from the applicant, co-applicant, and any other partners investing in the proposed project (VATI funding cannot exceed 80 percent of total project cost). In-kind resources include, but are not limited to: grant management, acquisition of rights of way or easements, waiving permit fees, force account labor, etc. Please note the a minimum 20% match is required to be eligible for VATI, the private sector provider must provide 10% of the required match. If the private co-applicant's cash match is below 10% of total project cost, applicants must provide financial details demonstrating appropriate private investment. Label Attachments: Attachment 8 - Funding Sources Table; Attachment 9 – Documentation of Match Funding.

### Answer:

Montgomery County is requesting \$919,569 in VATI funding. The majority of this request includes equipment costs such as utility poles, towers, access points, back hauls, and client premise equipment. Montgomery County has pledged to match \$140,763.70, or 10%, in cash towards the effort. This cash match would be utilized towards the customer installation supplies and labor, which totals \$155,100. Gigabeam has pledged to match \$140,763.70, or 10%, cash towards this project. This cash match would go towards supplies, shipping and sales tax, grant

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administration, cabling, etc. Additionally, Gigabeam has pledged to match \$206,540.60, or 15%, as in-kind matching funds. These in-kind resources include labor and equipment use, design, and fiber connections/routers. A detailed breakdown of the matching funds can be found on Attachment 10 – Documentation of Matching Funds. The Funding Sources Table also shows the breakdown.

11. Leverage: Describe any leverage being provided by the applicant, co-applicant, and partner(s) in support of the proposed project.

**Answer:**

There could be an opportunity to leverage Rural Digital Opportunity Funds (RDOF) depending on the award announcements in late October, given the fact that there are RDOF eligible areas within the project area. However, because of FCC regulations it is unknown as to whether RDOF funding was applied for regarding these eligible locations.

12. Marketing: Describe the broadband adoption plan.

- a. Explain how you plan to promote customer take rate, including marketing activities, outreach plan, and other actions to reach the identified serviceable units within the project area. Provide the anticipated take rate and describe the basis for the estimate.
- b. Describe any digital literacy efforts to ensure residents and businesses in the proposed project area sufficiently utilize broadband. Please list any partnering organizations for digital literacy, such as the local library or cooperative extension office.

**Answer:**

A.) Gigabeam would market the service in the project area in conformity to current marketing plans including:

- Door hangers
- Radio Ads
- Social Media
- TV Ads
- Newspaper Ads
- Community Events

Based on conversations with other areas where new service has been introduced and confirmed in Gigabeam's experience, residents see the company doing the preliminary field work and construction near their homes and inquire about the coming service - even asking if they can be connected right there and then. While this is a passive marketing role for the provider, it will also serve as a marketing piece for launching the service and

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acquiring new customers.

- B.) As part of this proposed project, one of the efforts to ensure residents and businesses are sufficiently utilizing broadband will be to partner with Meadowbrook Public Library located in Shawsville. Information on utilizing broadband will be available at the Meadowbrook Public Library, in forms such as informational pamphlets, posters, and other related promotional material.
13. Project Management: Identify key individuals who will be responsible for the management of the project and provide a brief description of their role and responsibilities for the project. Present this information in table format. Provide a brief description of the applicant and co-applicant's history and experience with managing grants and constructing broadband communication facilities. Please attach any letters of support from stakeholders. If applicant is not a locality(s) in which the project will occur, please provide a letter of support from that locality. Attachment 10 – Letters of Support.

## Answer:

Montgomery County, VA - project administration

Montgomery County and has provided grant administration and project management on DHCD grants in projects such as prices fork elementary school and delivering services aligned to DHCD goals to Montgomery County. Craig Meadows, County Administrator has managed projects in Montgomery County such as construction of a new Courthouse and Emergency Services center including 911. years.

Brian Hamilton, Economic Development Director, with Montgomery County, will manage the project for the County. Mr. Hamilton has 27 years in experience in local government including Roanoke City, Roanoke County, Austin Tx, and Montgomery County VA. Mr. Hamilton has managed grants from the DEQ, VEDP, DHCD, and Economic Development Administration. In addition to grant management, Mr. Hamilton has managed construction for approximately \$20 million of new building construction, building renovation, road construction, and corporate park development.

. His most relevant experience in this capacity includes:

- DHCD grant for Broadband Planning Services in Montgomery County, VA for \$61,100 (50% funding), closed out
- VEDP planning grant for Falling Branch Phase II Grading for \$110,934 (50% funding), closed 2020

Gigabeam Networks – System construction and operation

GigaBeam Networks, LLC is a locally owned and operated WISP (wireless internet service provider) with offices in Rich Creek and Bluefield, VA. GigaBeam Networks started as WVVA.net, a dialup provider in the late 90's and expanded to offering fixed wireless broadband access in 2004. Currently, GigaBeam Networks offers service in 8 regional counties over 3 states (Virginia, West Virginia, and Kentucky). As shown in the attached maps, GigaBeam Networks has invested heavily in Giles County this summer to extend their Fixed LTE network. This work will continue those efforts.

Currently, residential speeds up to 50Mbps are offered throughout the network footprint and up to 100Mbps coming soon. Also being deployed is one of the first "5G" wireless networks in Bluefield that will offer speeds up to 1Gbps. Slated for this fall is the addition of GigaStream TV, an affordable alternative to traditional television followed by GigaVoice Phone services. WVVA.net Inc. is the parent company of GigaBeam Networks, LLC and has 100% ownership. WVVA.net Inc. is 100% owned by Michael Clemons, President and founder.

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GigaBeam Networks has been in the ISP business for over 21 years. A full staff of qualified personnel provides every aspect of operating the business as well as constructing new sites. All climbers are Comtrain certified and GigaBeam Networks is an approved American Tower Company contractor. Staff also has extensive knowledge in designing, engineering, and maintaining large scale networks. GigaBeam Networks' primary focus is local, friendly customer support.

Michael Clemons – Project Management – Founder of GigaBeam Networks with 23 years experience in IT and 21 years experience as an ISP. Designed and developed multiple projects to extend broadband throughout the area including several that were grant funded.

Adam Blankenship – Field Management – 10 years with GigaBeam Networks primarily as Operations Manager. Very familiar with deployment projects and employee management.

Regional Commission – project administration

The Regional Commission has provided grant administration and project management on DHCD grants and delivering services aligned to DHCD goals to our local governments as a planning district commission for more than 40 years. Mr. Kevin Byrd, executive director, has been involved in DHCD projects in a management and participatory capacity for the last ten years and will provide oversight of the project.

James Jones, Regional Planner with the Regional Commission will provide the day-to-day project management and grant administration. He has been a planner with the Commission for four years. In that time, he has helped with grant administration for a number of federally-funded projects as well as state-funded projects. His most relevant experience in this capacity includes:

- DHCD grant for Western Giles County Fixed Wireless Coverage, total project \$855,700 (100% funding), current
- ARC grant for Town of Christiansburg Planning grant, total project \$70,000 (100% funding), closed 2020

## 14. Project Budget and Cost Appropriateness

Budget: Applicants must provide a detailed budget that outlines how the grant funds will be utilized, including an itemization of equipment, construction costs, and a justification of proposed expenses. If designating more than one service area in a single application, each service area must have delineated budget information. For wireless projects, please include delineated budget information by each tower. Expenses should be substantiated by clear cost estimates. Include copies of vendor quotes or documented cost estimates supporting the proposed budget. Label Attachments: Attachment 11 – Derivation of Costs; Attachment 12 - Documentation of Supporting Cost Estimates.

### Answer:

The total funding for this project is \$1,407,637.00 and requests \$919,569.00, or 65%, in VATI funding. Montgomery County has pledged \$140,763.70, or 10%, towards the project as a cash match. This cash match would go towards customer installation supplies and labor. Gigabeam has pledged \$140,763.70, or 10%, as cash match along with \$206,540.60, or 15%, as in-kind match towards this effort. Gigabeam's contributions would go towards design, supplies, fiber connections, routers, cabling, labor and equipment use, etc. A full breakdown of costs can be found in Attachment 11 – Derivation of Cost and Attachment 12 – Documentation of Supporting Project Costs.

15. The cost benefit index is comprised of three factors: (i) state share for the total project cost, (ii) state cost per unit passed, and (iii) the internet speed. From these statistics, individual cost benefit scores are calculated and averaged

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together to create a point scale for a composite score. Provide the following:

- a. Total VATI funding request
- b. Number of serviceable units
- c. Highest residential speed available in proposed project area

**Answer:**

- a. Total VATI funding request = \$919,569.00
- b. Number of serviceable units = 1,262
- c. Highest residential speed available in proposed project area = 1Gbps/100Mbps

16. Commonwealth Priorities

Additional points will be awarded to proposed projects that reflect Commonwealth priorities. If applicable, describe the following:

- a. How the proposed project fits into a larger plan to achieve universal broadband coverage for the locality. Explain the remaining areas of need in the locality and a brief description of the plan to achieve universal broadband coverage.
- b. Businesses, community anchors, or other passings in the proposed project area that will have a significant impact on the locality or region because of access to broadband.
- c. Unique partnerships involved in the proposed project. Examples include electric utilities, universities, and federal/state agencies.
- d. Digital equity efforts to ensure low to moderate income households in the proposed project area will have affordable access to speeds at or above 25/3 mbps.

**Answer:**

A.) Montgomery County invested into the Broadband Assessment study to determine where the priority areas are located within the County. With this framework in place, the County is now looking to move forward with addressing these unserved areas. This project is part of an on-going effort by Montgomery County to achieve four critical objectives:

1. Every citizen of Montgomery County have access to high-speed internet
2. Families with school-aged children must be a priority
3. Knowledge workers must have ubiquitous access to high-speed internet
4. County leadership desires a market-based solution

Through the process of the Montgomery County Broadband Assessment, several areas in the County were determined to be in need of broadband services. The plan for these remaining areas would be to continue to look for additional funding opportunities, such as US Department of Agriculture's Re Connect Program, or

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other related programs.

Montgomery County also outlined in their Comprehensive Plan specific broadband/fiber optic goals. Specifically, the County wants to “provide greater access to broadband capabilities to the Urban and Village Expansion Areas and Villages in Montgomery County.”

- B.) Because the Allegheny Springs/Shawsville project area was determined to be lacking speeds of 10/1 mbps, it is the passings within this area that will be greatly impacted because of access to broadband. Now, more than ever, families are depending on having reliable internet to accomplish day-to-day tasks. Not to mention the need for reliable service so kids can successfully practice distanced learning. While all the passings in both project areas will be positively impacted by this grant opportunity, the Allegheny Springs/Shawsville will see a critical impact.
- C.) With the support from Mountain Valley Charitable Foundation, there may be an opportunity to partner on various digital literacy efforts. As mentioned previously, information on utilizing broadband could be available at the Meadowbrook Community Center, which Mountain Valley Charitable Foundation operates.
- D.) Efforts to ensure digital equity could be addressed by partnering with the schools located within the project area and developing a digital equity model. Learning.com provides the framework for building a digital literacy program, which includes ensuring digital equity. Implementation models from this framework could be pursued.

## 17. Additional Information

17. Provide any other information that the applicant desires to include. Applicants are limited to four additional attachments.

Label Additional Attachments as:

- a. Attachment 13 – Two most recent Form 477 submitted to the FCC or equivalent
- b. Attachment 14 – XXXXXXXX
- c. Attachment 15 – XXXXXXXX
- d. Attachment 16 – XXXXXXXX
- e. Attachment 17 – XXXXXXXX

### Answer:

Additional attachments include the Montgomery County Broadband Assessment and a Cambium White Paper on network performance.

### Attachments:

Map(s) of project area, including proposed infrastructure

Attachment1ProjectAreaMap817202041343.pdf

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Documentation of Federal Funding (CAF/ACAM/USDA, etc...) in and/or near proposed project area.

Attachment2DocumentationonFederalFundingArea8142020124536.pdf

Documentation that proposed project area is unserved based on VATI criteria

Attachment3DocumentationUnservedVATICriteria814202020023.pdf

Passings Form (Please use template provided)

Attachment4PassingsForm814202011119.pdf

Propagation Map if Wireless Project

Attachment5PropagationMapWirelessProject817202042214.pdf

Timeline/Project Management Plan

Attachment6TimelineProjectManagementPlan8142020124449.pdf

MOU/MOA between applicant/co-applicant (can be in draft form)

Attachment7MOUbetweencoapplicantandapplicant817202042455.pdf

Funding Sources Table

Attachment8FundingSourcesTable817202034035.pdf

Documentation for match funding

Attachment9DocumentationofMatchingFunds817202034043.pdf

Letters of Support

Attachment10LettersofSupport817202023708.pdf

Derivation of Cost (Project Budget)

Attachment11DerivationofCost817202025104.pdf

Documentation supporting project costs (e.g. vendor quotes)

Attachment12Documentationofsupportingprojectcosts817202025404.pdf

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Two most recent Form 477 submitted to FCC

Attachment13TwoMostRecentForm477SubmittedtoFCC817202023823.pdf

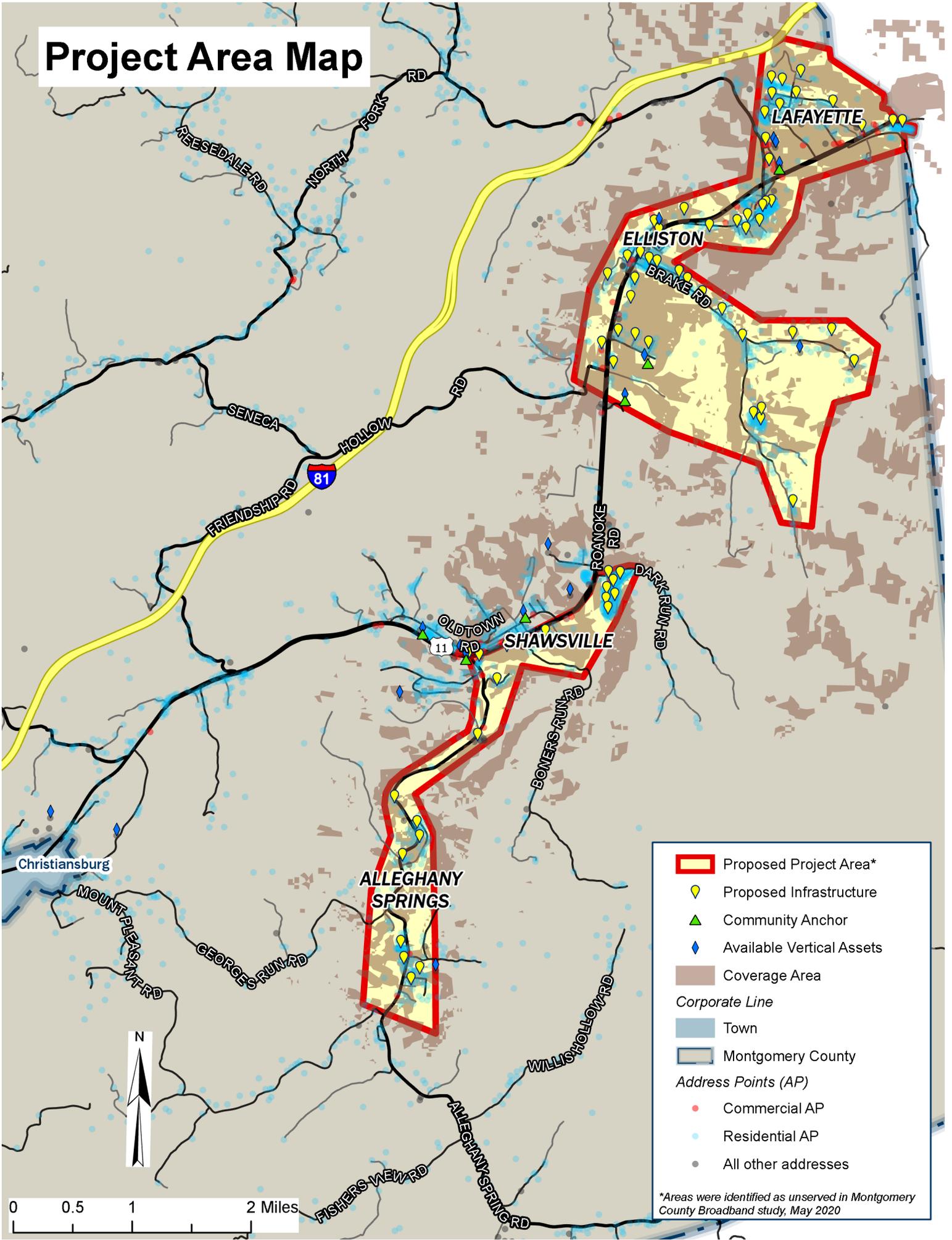
Optional

Attachment14MontgomeryCountyBroadbandAssessment8142020124739.pdf

Optional

Attachment15CambiumNetworksWhitepaper817202023232.pdf

# Project Area Map

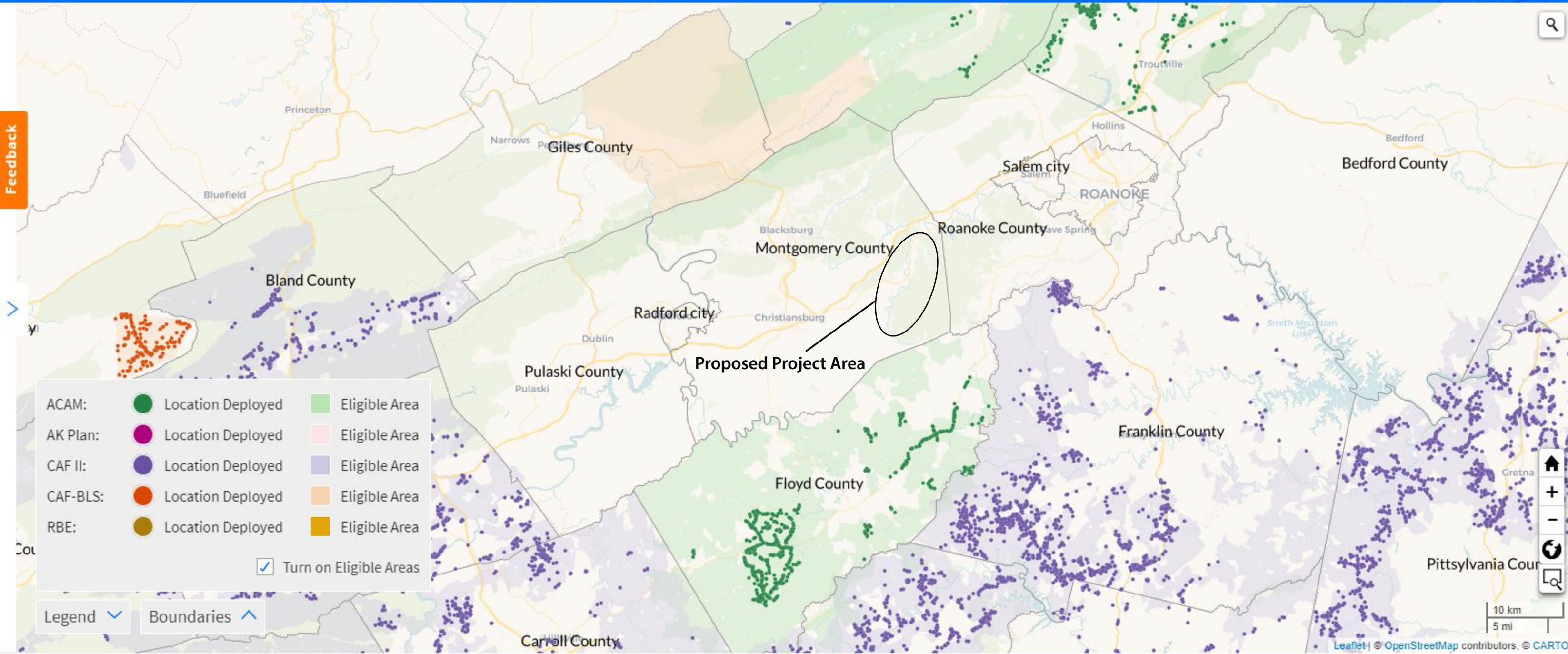


	Proposed Project Area*
	Proposed Infrastructure
	Community Anchor
	Available Vertical Assets
	Coverage Area
<i>Corporate Line</i>	
	Town
	Montgomery County
<i>Address Points (AP)</i>	
	Commercial AP
	Residential AP
	All other addresses

\*Areas were identified as unserved in Montgomery County Broadband study, May 2020



Feedback



Fund

All Funds

State

VA

Company Name

Search Company Name

Speed (Applicable only to Local Data)

All Speeds

Deployment Year

All Years

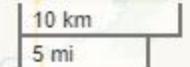
Clear All Filters

\*CAF Map is based on data certified in the HUBB as of 3/6/2019. Access the [data source](#)

- ACAM: ● Location Deployed  Eligible Area
- AK Plan: ● Location Deployed  Eligible Area
- CAF II: ● Location Deployed  Eligible Area
- CAF-BLS: ● Location Deployed  Eligible Area
- RBE: ● Location Deployed  Eligible Area

Turn on Eligible Areas

Legend  Boundaries



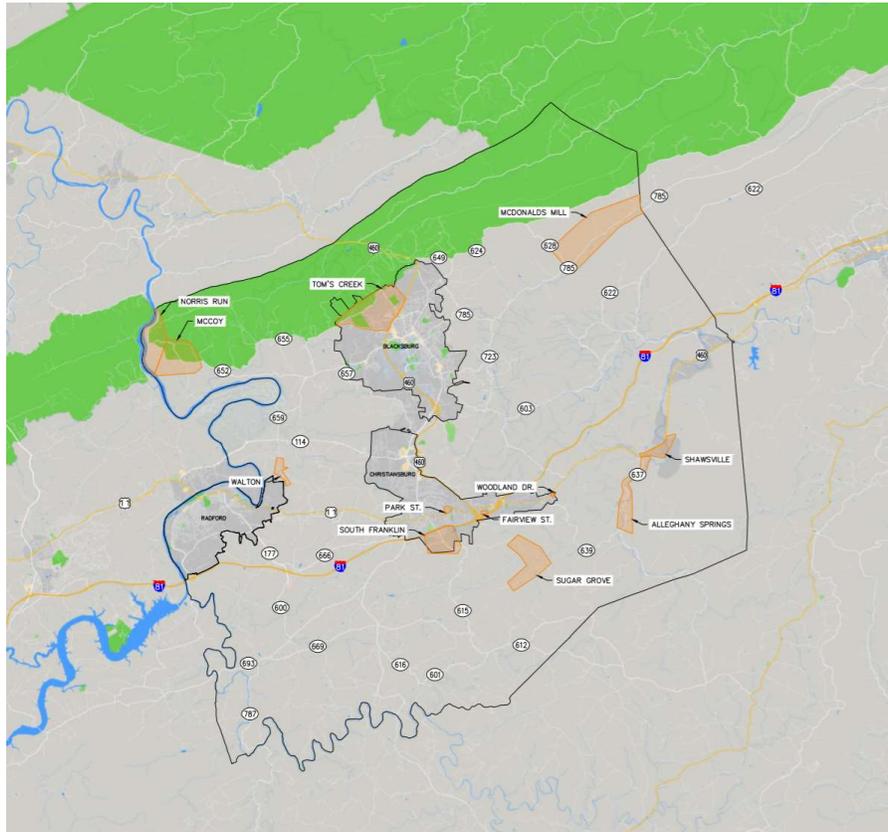
## 8 Attachments and Appendices

### 8.1 Regional Maps with Needs Appendix

#### Un-served Communities:

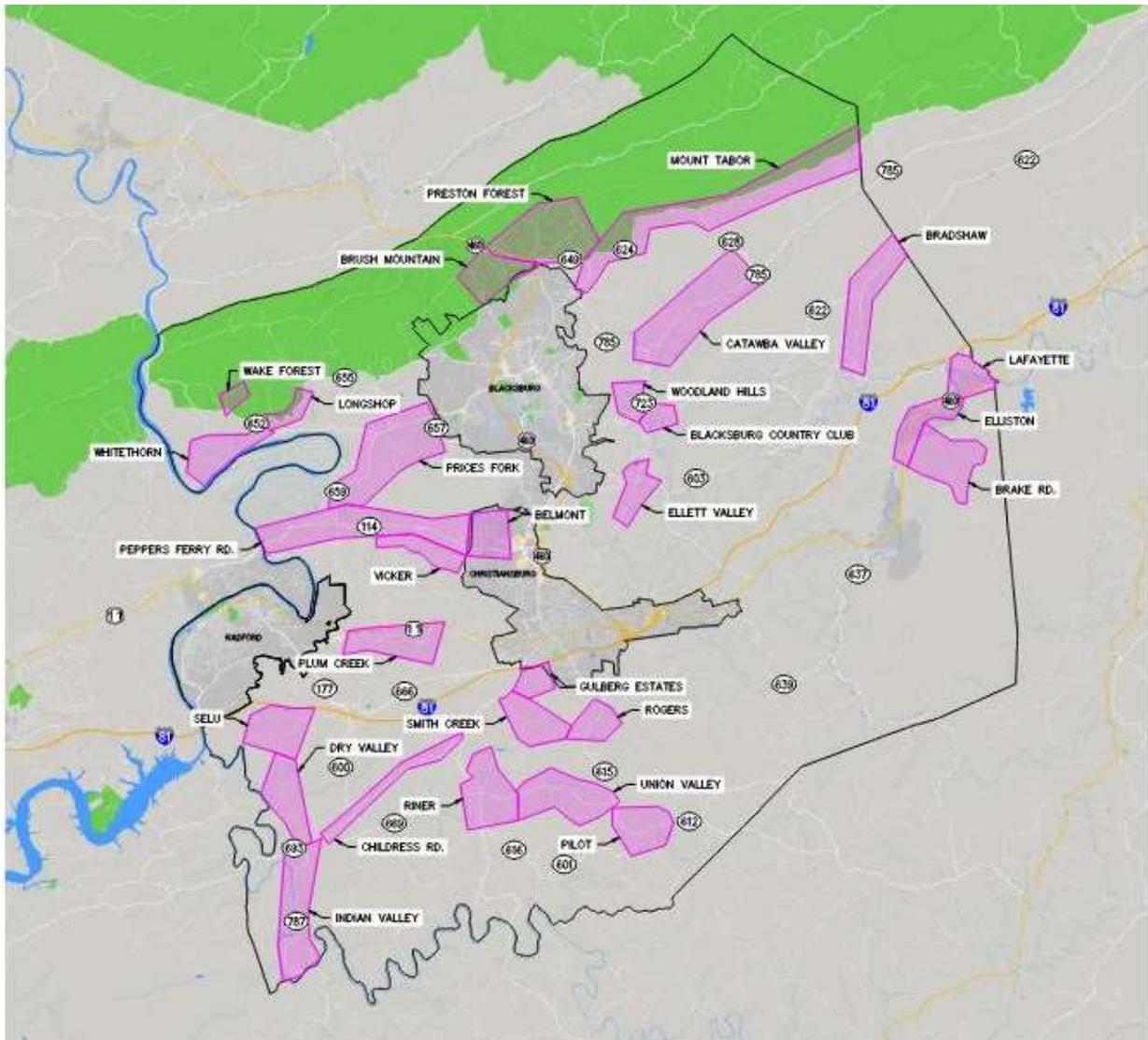
The following table and corresponding map identify the un-served communities in the Study Area:

Un-Served Communities	Number of Households
Alleghany Springs	183
Christiansburg -- Eastern edge. Woodland Dr.	20
Christiansburg -- Park Dist (S. Franklin south of 8	584
Christiansburg -- Park Street	157
Christiansburg --Trailers off Fairview St at 81	126
McCoy	250
McDonalds Mill	59
Norris Run	111
Shawsville (CDP)	550
Sugar Grove	49
Tom's Creek	656
Walton	360
Total	3,105



**Under-served Communities:**

<b>Under-Served Communities</b>	<b>Number of Households</b>
Belmont	650
Blacksburg Country Club Area	174
Bradshaw	179
Brake Road	174
Brush Mountain	217
Catawba Valley	129
Childress Road (Radford)	202
Dry Valley	56
Ellett Valley	119
Elliston (CDP)	345
Gulberg Estates	55
Indian Valley	65
Lafayette (CDP)	194
Longshop	78
Mt. Tabor	274
Peppers Ferry Road	540
Pilot	168
Plum Creek (CDP)	627
Preston Forest	310
Prices Fork	498
Riner (CDP)	317
Rogers (South of Christiansburg, along Rt. 615)	65
Selu	50
Smith Creek	82
Union Valley	132
Vicker	82
Wake Forest	48
Whitethorn	42
Woodland Hills	61
<b>Total</b>	<b>5,933</b>





Va. Funding Query Results

County	Partner	Year	Award Amount	Units Contracted to Pass	Funding Program
No results found					

Choose Some Layers

- Cities/Counties
- Cable Wireline Coverage (Dec. 2018)
- DSL/Copper Coverage (Dec. 2018)
- Fiber Optic Coverage (Dec. 2018)
- Fixed Wireless Coverage (Dec. 2018)
- Mobile Wireless Coverage (Dec. 2018)
- 4G/LTE Wireless Coverage (Dec. 2018)
- Satellite Coverage (Dec. 2018)
- Virginia Telecommunication Initiative (VATI) Funding
- Tobacco Region Revitalization Commission (TRRC) Funding
- Underserved Areas  
[greater than 10 Mbps download and 1 Mbps upload and less than 25 Mbps download and 3 Mbps upload] (Dec. 2018)
- Unserved Areas  
[below or equal to 10 Mbps download and 1 Mbps upload] (Dec. 2018)
- No Residential Broadband (25/3) reported (Dec. 2018)
- Vertical Assets (updated daily)
- Community Anchor Institutions (Dec. 2017)
  - School
  - Library
  - Hospital
  - Public Safety Entity
  - Government Building



Approximate Project Area

# 2021 Virginia Telecommunication Initiative (VATI) Passing Form

## Allegheny Springs – Shawsville Area

Type of Passings	Total Number in Project Area	Number with Speeds at 10/1 or below in Project Area
Residential	209	209
Businesses (non-home based)	11	11
Businesses (home-based)	0	0
Community Anchors	0	0
Non-residential	9	9
Total Number of Passings	229	229

*Note: The Total Number of Passings **MUST** be equal to the Residential, Business (non-home based), Non-residential and Community Anchors sum.*

### Definitions

**Passing** – any structure that can receive service.

**Business** – An organization or entity that provides goods or services in order to generate profit. Businesses based in residential homes can count if they are a registered business (BPOL, LLC, etc.).

**Community Anchor** - schools, libraries, medical and health care providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband service by vulnerable populations, including low-income, unemployed, and the aged.

**Non-Residential Passing** – places of worship, federal, state, or local facilities or other potential customers that are neither a residence, business or a community anchor as defined above.

# 2021 Virginia Telecommunication Initiative (VATI) Passing Form

## Elliston - Lafayette Area

Type of Passings	Total Number in Project Area	Number with Speeds at 10/1 or below in Project Area
Residential	1006	
Businesses (non-home based)	33	
Businesses (home-based)	0	
Community Anchors	4	
Non-residential	20	
Total Number of Passings	1063	

*Note: The Total Number of Passings **MUST** be equal to the Residential, Business (non-home based), Non-residential and Community Anchors sum.*

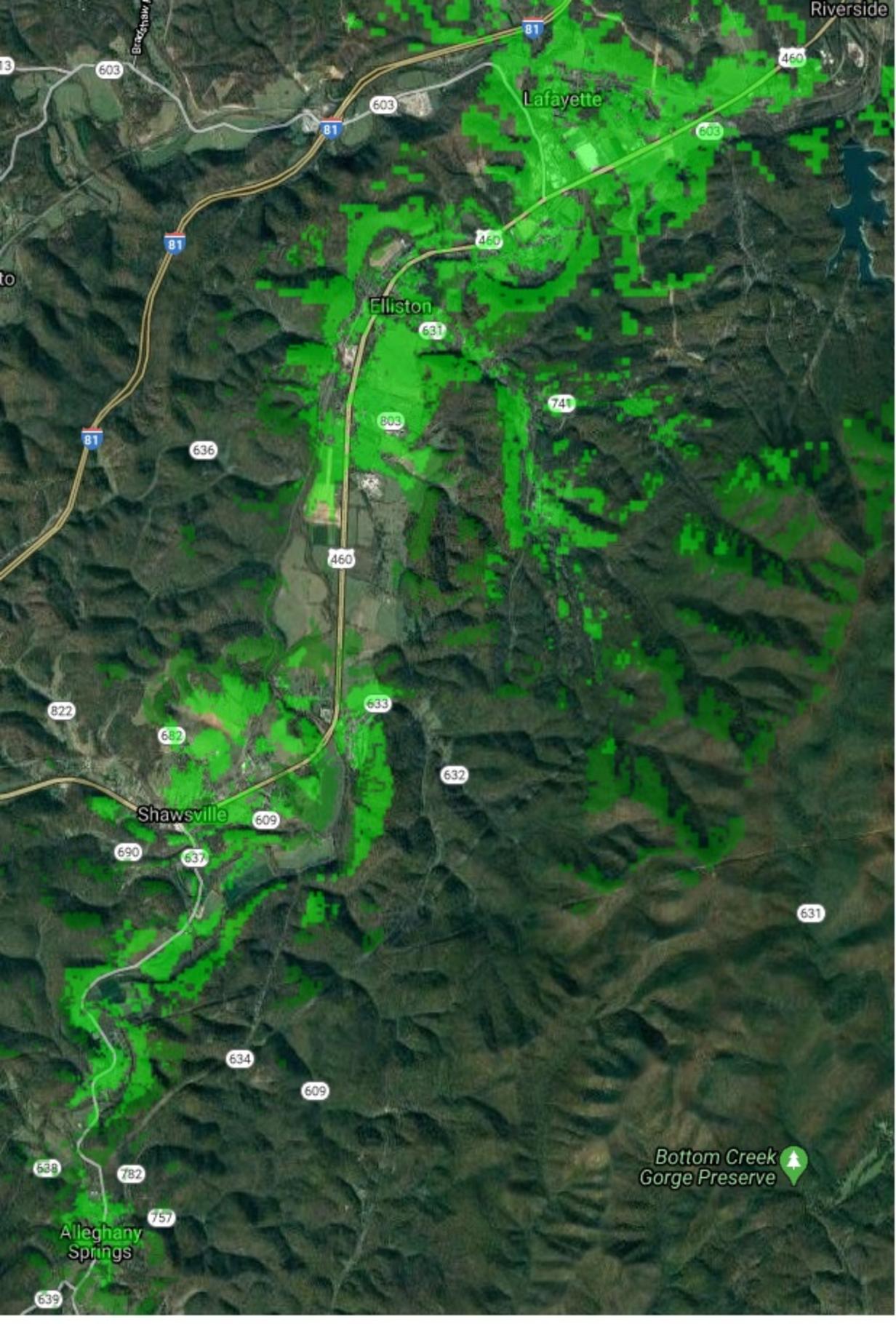
### Definitions

**Passing** – any structure that can receive service.

**Business** – An organization or entity that provides goods or services in order to generate profit. Businesses based in residential homes can count if they are a registered business (BPOL, LLC, etc.).

**Community Anchor** - schools, libraries, medical and health care providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband service by vulnerable populations, including low-income, unemployed, and the aged.

**Non-Residential Passing** – places of worship, federal, state, or local facilities or other potential customers that are neither a residence, business or a community anchor as defined above.





## MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (this “Memorandum”) is made effective as of August 17, 2020 (the “Effective Date”), between and among Gigabeam Networks, LLC, a Virginia limited liability company (“Gigabeam”), and Montgomery County, Virginia, a political subdivision of the Commonwealth of Virginia (the “County”).

### RECITALS

- A. WHEREAS, the Commonwealth of Virginia is seeking to expand broadband service into unserved areas of the Commonwealth and the County desires to expand broadband in unserved and underserved areas of Montgomery County; and
- B. WHEREAS, the County completed a study to explore the feasibility of deploying last mile broadband service to unserved populations in the County; and
- C. WHEREAS, Gigabeam is a Virginia limited liability company that provides fiber and wireless internet services; and
- D. WHEREAS, after issuance of a request for proposal and a review of potential broadband providers, the County has identified and selected Gigabeam as the most suitable Internet Service Provider to partner with the County in expanding broadband services in the County; and
- E. WHEREAS, the County has identified portions of the Allegheny Springs, Shawsville, Elliston and Lafayette communities in the eastern area of the County (as shown on the attached “Project Map”) as unserved or underserved lacking in broadband speeds of 10 Megabits per second download and 1 Megabit per second upload capacity, (“the Project”); and
- F. WHEREAS, the parties desire to develop a relationship and enter into agreements with the purpose of Gigabeam deploying infrastructure and providing improved broadband service within the Project area in the County; and
- G. WHEREAS, The County supports the Project and seeks to facilitate all permitting and use of public rights of way when available including facilitating the possible use of the Montgomery County Public Service Authority facilities if necessary and available;

NOW, THEREFORE, the parties hereby agree as follows:

**1. NEGOTIATION OF DEFINITIVE AGREEMENTS**

Once funding is established and finalized, the parties intend to negotiate an Agreement(s) whereby the parties develop the means to provide broadband services to the Project Area in Montgomery County including the use of public rights of way and Public Service Authority facilities when needed and available.

**2. DUE DILIGENCE**

The parties shall cooperate with each other with all due diligence efforts necessary to determine the viability and implementation of the Project.

**3. DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT**

Montgomery County shall prepare the application to be submitted to the Department of Housing and Community Development (DHCD) VATI Program, seeking approval and funding for the Project. All parties herein shall cooperate with the preparation of such application. Implementation of the Project shall be contingent upon VATI approval and funding and execution of the definitive agreements mentioned in Section 1 above.

**4. EXPENSES**

The parties understand that various costs will be incurred in relation to activities contemplated herein. The parties understand that regardless of which party incurs such costs, none of the parties herein shall be responsible for reimbursement of expenses to another unless such reimbursement is agreed to in writing.

**5. CONFIDENTIALITY**

The parties agree that negotiations between the parties and any information shared shall remain confidential and not shared by the parties without consent of the other party, subject to the requirements of open government, and the providing of public records when requested, as provided in the Virginia Freedom of Information Act and the Virginia Public Procurement Act.

**6. PARTIALLY BINDING NATURE**

The parties understand and agree that, except for Paragraph 5 and 6, this Memorandum constitutes only a statement of the parties' future intentions and does not reflect all matters upon which a later definitive agreement(s) must be reached. This Memorandum does not obligate the parties to enter into any binding definitive agreement relating to the Project. The parties hereto expressly agree that binding obligations with respect to the Project will result only from the execution of the definitive agreements, subject to the terms and conditions stated therein. No course of negotiation or course of dealing under this Memorandum shall create an obligation to enter into any definitive agreements.

**7. TERMINATION**

Either party may terminate this Memorandum at any time, with or without cause, upon written notice to the other parties. In addition, this Memorandum shall terminate and be of no further force and effect if the Project is not approved by DHCD VATI and no funding is provided.

**8. LIMITATION OF LIABILITY**

To the extent permitted by law, neither party shall be liable to the other in contract, tort, or otherwise, for any claims, liabilities or losses arising out of this Memorandum or alleged to result from the failure of the other party to enter into any definitive agreements. The parties hereby waive, in advance, any claims (whether such claims are based on breach of contract, tort, equity or any other theory) for the failure for any reason to enter into the definitive agreements. In no event shall either party be liable to the other for any incidental, indirect, special, punitive or consequential damages (including without limitation damages for lost profits).

**9. GENERAL**

This Memorandum shall be governed in all respects by the laws of the Commonwealth of Virginia. No modification, amendment or waiver of any of the provisions of this Memorandum shall be binding on the parties without the written consent of all parties.

This Memorandum shall inure to the benefit of and be binding upon each of the parties hereto and their respective successors and permitted assigns to the extent provided in Section 6, but in no respect shall give rise to any third party beneficiary rights or claims. No party may assign any of its rights, interests, or obligations hereunder without the prior written consent of the other parties, except that a party may assign this Memorandum to an affiliated entity upon written notice to the other parties.

No failure or delay in exercising any right, power or privilege hereunder will operate as a waiver thereof, nor will any single or partial exercise thereof preclude any other or further exercise thereof or the exercise of any other right, power or privilege hereunder.

Nothing in this Memorandum shall be deemed to constitute, create, give effect to, or otherwise recognize a joint venture, partnership, or formal business entity of any kind.

**10. NOTICE**

All demands, notices, consents, approvals, reports, requests, and other communications hereunder that must be in writing, shall be deemed to have been duly given only if delivered personally or by an internationally-recognized express courier service or by mail (first class, postage prepaid) to the parties hereto at the following addresses and will be deemed effective upon delivery. Any party may change its address at any time upon notice to the other party.

If to Gigabeam:

If to the County:

IN WITNESS WHEREOF, the parties have executed this Memorandum as of the Effective Date.

**Montgomery County, VIRGINIA**

---

**F. Craig Meadows County Administrator**

**GIGABEAM NETWORKS, LLC**

---

**Michael Clemons, President**

Attachment 8 VATI FUNDING SOURCES TABLE

Please fill in the chart below with a description of the project funding source (local, federal, state, private, other), the amount from that source, the percentage of total project funding that source represents, and a description of the current status of the funds (pending, secured, etc.).

Source	Amount	%	Status
REQUESTED VATI	\$ 919,569.00	65%	Pending
Private ISP -Gigabeam (Cash Match)	\$140,763.70	10%	SECURED
Private ISP -Gigabeam (In-kind match)	\$ 206,540.60	15%	SECURED
Local – Montgomery county (Cash Match)	\$ 140,763.70	10%	SECURED
	\$		
	\$		
	\$		
<b>TOTAL</b>	<b>\$ 1,407,637.00</b>	<b>100 %</b>	

**TOTAL PROJECT COSTS**

**\$ 1,407,637.00**

Source	Amount	Percent	Status
Requested VATI	\$ 919,569.00	65.33%	Pending
Private ISP - Gigabeam (Cash match)	\$ 140,763.70	10.00%	Secured
Private ISP - Gigabeam (In-kind; labor, supplies, equipment use)	\$ 206,540.60	14.67%	Secured
Local - Montgomery County (Cash match)	\$ 140,763.70	10.00%	Secured
<b>Total</b>	<b>\$ 1,407,637.00</b>	<b>100.00%</b>	

**Documentation of Matching Funds**

Product	Total	VATI	Non-VATI	Proposed Source/Type	Notes
<b>Wireless Construction</b>					
Design / Site Acquisition/Permitting	\$ 75,000.00		\$ 75,000.00	Gigabeam (In-kind Match)	
Utility poles / Towers	\$ 45,600.00	\$ 45,600.00			
Power	\$ 121,000.00	\$ 121,000.00			
Enclosures	\$ 26,600.00	\$ 26,600.00			
Backhauls	\$ 60,000.00	\$ 60,000.00			
Access Points	\$ 91,521.00	\$ 91,521.00			
Labor and equipment use	\$ 114,000.00		\$ 114,000.00	Gigabeam (In-kind Match)	
Misc Supplies, cabling, POE	\$ 57,000.00		\$ 57,000.00	Gigabeam (Cash Match)	
Fiber Connections/routers	\$ 11,050.00		\$ 11,050.00	Gigabeam (In-kind Match)	
Shipping/Sales Tax	\$ 65,918.00		\$ 65,918.00	Gigabeam (Cash Match)	
<b>Grant Administration</b>	\$ 35,000.00	\$ 25,000.00	\$ 10,000.00	Gigabeam (Cash Match)	
<b>Wireless Client Installation</b>					
Client Premise Equipment	\$ 549,848.00	\$ 549,848.00			
Customer Installation Labor/supplies	\$ 155,100.00		\$ 155,100.00	Montgomery County (Cash Match up to \$140,763.70)	Gigabeam to provide remaining \$14,336.30
<b>Total</b>	<b>\$ 1,407,637.00</b>	<b>\$ 919,569.00</b>	<b>\$ 488,068.00</b>		



Montgomery County Board of Supervisors  
755 Roanoke Street, Suite 2E  
Christiansburg, Va 24073  
540-382-6954 Fax 540-382-6943  
[www.MONTGOMERYCOUNTYVA.gov](http://www.MONTGOMERYCOUNTYVA.gov)

August 17, 2020

Tamarah Holmes, Ph.D  
Director  
Office of Broadband  
Department of Housing and Community Development  
600 East Main Street, Ste. 300  
Richmond, VA 23219

**RE: Letter of Support for Virginia Telecommunications Initiative (VATI) Broadband project proposal for Eastern Montgomery County**

Dear Dr. Holmes:

We are excited to pledge our support to the Virginia Telecommunication Initiative Broadband project to deploy broadband services to our citizens and strongly support the Virginia Department of Housing and Community Development's (DHCD) goal of achieving universal broadband coverage. As broadband becomes more widely understood as a service as necessary as electricity and running water, those without access to it will face considerable challenges in maintaining and building economic resiliency. Without widely available internet access, our community will not simply stagnate, it will fall behind in pursuing economic opportunity.

The proposed broadband deployment project to expand internet access in Eastern Montgomery County addresses these issues by reaching into communities without broadband speed internet service and builds on the incredible amount of work done in the Montgomery County Broadband Assessment. This assessment, with funding from DHCD, helped Montgomery County determine prioritized areas of need for broadband services. With this knowledge and determination, our citizens will be able to ready themselves to participate in the workforce, create their own business endeavors, access community services, and even conduct basic banking, shopping and communication activities online.

We look forward to working with DHCD and the other project partners, including local private wireless internet providers, to facilitate the deployment of broadband in our locality, offering assistance in the acquisition of sites and access to locality-owned properties where feasible. Please contact me if you need any further information about our support for this effort.

Sincerely,

Sara R. Bohn, Vice-Chair  
Montgomery County Board of Supervisors

District A  
Sara Bohn, Vice Chair

District C  
Steve R. Fijalkowski, Chair

District E  
Darrell O. Sheppard

District G  
April N. Demotts

District B  
Sherri M. Blevins

District D  
M. Todd King

District F  
Mary W. Biggs

County Administrator  
F. Craig Meadows

# MONTGOMERY COUNTY

F. CRAIG MEADOWS, COUNTY ADMINISTRATOR  
OFFICE OF COUNTY ADMINISTRATION  
MONTGOMERY COUNTY • VIRGINIA



755 ROANOKE ST., SUITE 2E • CHRISTIANSBURG, VA 24073  
PHONE: 540.382.6954 • FAX: 540.382.6943  
WWW.MONTGOMERYCOUNTYVA.GOV

August 12, 2020

Tamarah Holmes, Ph.D  
Director  
Office of Broadband  
Department of Housing and Community Development  
600 East Main Street, Ste. 300  
Richmond, VA 23219

RE: Letter of Support for Virginia Telecommunications Initiative (VATI) Broadband project proposal for Eastern Montgomery County

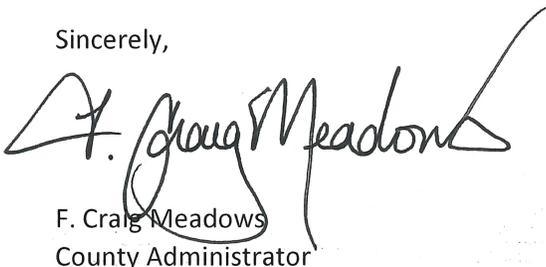
Dear Dr. Holmes:

We are excited to pledge our support to this project to deploy broadband services to our citizens and strongly support the Virginia Department of Housing and Community Development's (DHCD) goal of achieving universal broadband coverage. As broadband becomes more widely understood as a service as necessary as electricity and running water, those without access to it will face considerable challenges in maintaining and building economic resiliency. Without widely available internet access, our community will not simply stagnate, it will fall behind in pursuing economic opportunity.

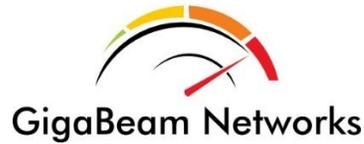
The proposed broadband deployment project to expand internet access in Eastern Montgomery County addresses these issues by reaching into communities without broadband speed internet service and builds on the incredible amount of work done in the Montgomery County Broadband Assessment. This assessment, with funding from DHCD, helped Montgomery County determine prioritized areas of need for broadband services. With this knowledge and determination, our citizens will be able to ready themselves to participate in the workforce, create their own business endeavors, access community services, and even conduct basic banking, shopping and communication activities online.

We look forward to working with DHCD and the other project partners, including local private wireless internet providers, to facilitate the deployment of broadband in our locality, offering assistance in the acquisition of sites and access to locality-owned properties where feasible. Please contact me if you need any further information about our support for this effort.

Sincerely,



F. Craig Meadows  
County Administrator



387 Old Virginia Avenue  
Rich Creek, VA 24147  
540-726-2317

601 Virginia Avenue  
Bluefield, VA 24605  
866-988-2638

August 17, 2020

Erik Johnston, Director  
Department of Housing and Community Development  
600 E. Main Street, Suite 300  
Richmond, VA 23219

RE: VATI Telecommunication Initiative Grant Letter of Support

Dear Mr. Johnston:

We are pleased to pledge our support to this project to deploy broadband service for Montgomery County's citizens. As the internet provider constructing the project, delivering the service when the network goes live, and continuing the operations and maintenance of that network, we commit to providing a match both in-kind and in cash for this grant.

As broadband becomes more widely understood as a service as necessary as electricity and running water, those without access to it will face considerable challenges in maintaining and building economic resiliency. Without widely available internet access, our community will not simply stagnate, it will fall behind in pursuing economic opportunity.

The proposed broadband deployment project to expand internet access in Montgomery County addresses these issues by reaching into communities without broadband speed internet service. Our citizens will be able to ready themselves to participate in the workforce, create their own business endeavors, access community services, and even conduct basic banking, shopping and communication activities online.

We look forward to working with DHCD and the other project partners to facilitate the deployment of broadband. Please contact me if you need any further information about our support for this regional effort.

Sincerely,

A handwritten signature in blue ink that reads "Michael Clemons".

Michael Clemons  
President  
GigaBeam Networks, LLC

# Mountain Valley Charitable Foundation

267 Allegheny Spring Road ~ Shawsville, VA 24162 ~ 540.268.1086 ~ cmhawes@verizon.net



August 13, 2020

Tamarah Holmes, Ph.D  
Director  
Office of Broadband  
Department of Housing and Community Development  
600 East Main Street, Ste. 300  
Richmond, VA 23219

RE: Letter of Support for Virginia Telecommunications Initiative (VATI) Broadband project proposal for Eastern Montgomery County

Dear Dr. Holmes:

The Mountain Valley Charitable Foundation is a non-profit 501(c)(3) organization that has as its mission improving the quality of life in Eastern Montgomery County. Toward this end we operate a community center, a fitness center, a thrift store and an athletic and concert venue. We work closely with our local schools to provide scholarships and educational opportunities and equipment. If the broadband deployment project were implemented, it would enhance our community's prospects and our organization's ability to provide improved services.

We are excited to pledge our support to this project to deploy broadband services to our citizens and strongly support the Virginia Department of Housing and Community Development's (DHCD) goal of achieving universal broadband coverage. As broadband becomes more widely understood as a service as necessary as electricity and running water, those without access to it will face considerable challenges in maintaining and building economic resiliency. Without widely available internet access, our community will not simply stagnate, it will fall behind in pursuing economic opportunity.

The proposed broadband deployment project to expand internet access in Eastern Montgomery County addresses these issues by reaching into communities without broadband speed internet service and builds on the incredible amount of work done in the Montgomery County Broadband Assessment. This assessment, with funding from DHCD, helped Montgomery County determine prioritized areas of need for broadband services. With this knowledge and determination, our citizens will be able to ready themselves to participate in the workforce, create their own business endeavors, access community services, and even conduct basic banking, shopping and communication activities online.

We look forward to working with DHCD and the other project partners, including local private wireless internet providers, to facilitate the deployment of broadband in our locality, offering assistance in the acquisition of sites and access to locality-owned properties where feasible. Please contact me if you need any further information about our support for this effort.

Sincerely,

A handwritten signature in cursive script that reads "Charlotte M. Hawes".

Charlotte M. Hawes  
Executive Director

## Attachment 11: Derivation of Cost

Product	Total	VATI	Non-VATI	Source of Estimate	Date
<b>Wireless Construction</b>					
Design / Site Acquisition/Permitting	\$ 75,000.00		\$ 75,000.00		
Utility poles / Towers	\$ 45,600.00	\$ 45,600.00		GigaBeam	8/17/2020
Power	\$ 121,000.00	\$ 121,000.00		GigaBeam	8/17/2020
Enclosures	\$ 26,600.00	\$ 26,600.00		GigaBeam	8/17/2020
Backhauls	\$ 60,000.00	\$ 60,000.00		GigaBeam	8/17/2020
Access Points	\$ 91,521.00	\$ 91,521.00		GigaBeam	8/17/2020
Labor and equipment use	\$ 114,000.00		\$ 114,000.00	GigaBeam	8/17/2020
Misc Supplies, cabling, POE	\$ 57,000.00		\$ 57,000.00	GigaBeam	8/17/2020
Fiber Connections/routers	\$ 11,050.00		\$ 11,050.00	GigaBeam	8/17/2020
Shipping/Sales Tax	\$ 65,918.00		\$ 65,918.00	GigaBeam	8/17/2020
<b>Grant Administration</b>	\$ 35,000.00	\$ 25,000.00	\$ 10,000.00	NRVRC	8/17/2020
<b>Wireless Client Installation</b>					
Client Premise Equipment	\$ 549,848.00	\$ 549,848.00		GigaBeam	8/17/2020
Customer Installation Labor/supplies	\$ 155,100.00		\$ 155,100.00	GigaBeam	8/17/2020

**Total** \$ 1,407,637.00 \$ 919,569.00 \$ 488,068.00

**Budget per Site**

Lafayette/Elliston Area	MS-1	MS-2	MS-3	MS-4	MS-5	Lafayette WT	MS-6	MS-7	MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16	MS-17	MS-18	MS-19	MS-20	MS-21	MS-22	MS-23	MS-24	Total	
Utility Pole/Tower	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$15,000
Power (UPS, breakerbox, utility setup)	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$37,500
Enclosure	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$8,750
Backhauls	\$0	\$0	\$0	\$0	\$5,000	\$5,000	\$5,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$15,000
CnWave V5000 DN (\$1199 each)	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$29,975
Emp 3000 AP (\$1180 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Baiccels 227 LTE Enb (\$1,750 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Misc Supplies - Cable, conduit, POE	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$18,750
Site construction	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$37,500
Router - Mikrotik CCR 2004																											\$0
Middle Mile Fiber connection																											\$0
<b>Total</b>	\$5,899	\$5,899	\$5,899	\$5,899	\$10,899	\$10,899	\$10,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$162,475
Shipping and sales taxes.	\$813	\$813	\$813	\$813	\$1,078	\$1,078	\$1,078	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$21,111
<b>Grand Total</b>	\$6,712	\$6,712	\$6,712	\$6,712	\$11,977	\$11,977	\$11,977	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$183,586

Brake Road / High School area	MS-25	MS-26	MS-27	MS-28	MS-29	MS-30	MS-31	MS-32	MS-33	MS-34	MS-35	MS-36	MS-37	MS-38	MS-39	MS-40	MS-41	MS-42	MS-43	MS-44	MS-45	MS-46	MS-47	MS48	MS49	MS-50	MS-51	HS-Fiber POP 1	Total		
Utility Pole/Tower	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$16,800	
Power (UPS, breakerbox, utility setup)	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$5,000	\$45,500	
Enclosure	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$9,800	
Backhauls	\$0	\$0	\$0	\$0	\$0	\$5,000	\$5,000	\$0	\$0	\$0	\$5,000	\$0	\$0	\$0	\$5,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$5,000	\$20,000	
CnWave V5000 DN (\$1199 each)	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$0	\$1,199	\$0	\$0	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$0	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$25,179	
Emp 3000 AP (\$1180 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,180	\$0	\$1,180	\$1,180	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,540	
Baiccels 227 LTE Enb (\$1,750 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,750	\$0	\$0	\$0	\$0	\$0	\$1,750	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$5,250	
Misc Supplies - Cable, conduit, switch gear	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$21,000	
Site construction	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$42,000	
Router - Mikrotik CCR 2004																												\$0	\$525		
Middle Mile Fiber connection																												\$5,000	\$5,000		
<b>Total</b>	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$10,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$10,899	\$5,880	\$5,899	\$5,880	\$10,880	\$6,450	\$5,899	\$5,899	\$5,899	\$5,899	\$6,450	\$5,899	\$5,899	\$5,899	\$5,899	\$6,450	\$5,899	\$5,899	\$18,725	\$194,594
Shipping and sales tax	\$813	\$813	\$813	\$813	\$813	\$1,078	\$813	\$813	\$813	\$813	\$813	\$1,078	\$812	\$813	\$812	\$1,077	\$842	\$813	\$813	\$813	\$813	\$842	\$813	\$813	\$813	\$813	\$842	\$813	\$813	\$1,492	\$24,313
<b>Grand Total</b>	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$11,977	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$11,977	\$6,692	\$6,712	\$6,692	\$11,957	\$7,292	\$6,712	\$6,712	\$6,712	\$6,712	\$7,292	\$6,712	\$6,712	\$6,712	\$6,712	\$7,292	\$6,712	\$6,712	\$20,217	\$218,907

Alleghany Springs	MS-52	MS-53	MS-54	MS-55	MS-56	MS-57	MS-58	MS-59	MS-60	MS-61	MS-62	MS-63	MS-64	MS-65	MS-66	MS-67	MS-68	MS-69	MS-70	MS-71	MS-72	MS-73	FIBER POP 2	Total	
Utility Pole/Tower	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$600	\$13,800
Power (UPS, breakerbox, utility setup)	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$5,000	\$38,000
Enclosure	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$8,050
Backhauls	\$0	\$0	\$0	\$0	\$0	\$5,000	\$5,000	\$0	\$5,000	\$5,000	\$0	\$5,000	\$0	\$0	\$5,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$25,000
CnWave V5000 DN (\$1199 each)	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$1,199	\$27,577
Emp 3000 AP (\$1180 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Baiccels 227 LTE Enb (\$1,750 each)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Misc Supplies - Cable, conduit, switch gear	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$750	\$17,250
Site construction	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$34,500
Router - Mikrotik CCR 2004																									\$525
Middle Mile Fiber connection																									\$5,000
<b>Total</b>	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$10,899	\$5,899	\$10,899	\$10,899	\$5,899	\$10,899	\$5,899	\$5,899	\$5,899	\$10,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$5,899	\$14,924	\$169,702
Shipping and sales tax	\$813	\$813	\$813	\$813	\$813	\$1,078	\$813	\$1,078	\$1,078	\$813	\$1,078	\$813	\$813	\$813	\$1,078	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$813	\$1,291	\$20,494
<b>Grand Total</b>	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$11,977	\$6,712	\$11,977	\$11,977	\$6,712	\$11,977	\$6,712	\$6,712	\$6,712	\$11,977	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$6,712	\$16,215	\$190,196

Wireless Client Installation	V1000 CnWave	V3000 CnWave	Force 300-19	Baiccels LTE
CPE	\$249	\$599	\$175	\$260
Surge	\$15	\$15	\$15	\$15
Router	\$85	\$85	\$85	\$85

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Form 477 Filing Summary

FRN: 0018473223 | Data as of: Dec 31, 2019 | Operations: Non-ILEC | Submission Status: Original - Submitted | Last Updated: Apr 21, 2020 16:47:26

**Filer Identification**

Section	Question	Response
<b>Filer Information</b>	Company Name	GigaBeam Networks LLC
	Holding Company Name	WVVA.net Inc.
	SAC ID	
	499 ID	
<b>Data Contact Information</b>	Data Contact Name	Michael Clemons
	Data Contact Phone Number	(540) 726-2317 ext: 103
	Data Contact E-mail	mclemons@gigabeam.net
<b>Emergency Operations Contact Information</b>	Emergency Operations Name	Michael Clemons
	Emergency Operations Phone Number	(540) 726-2317 ext: 103
	Emergency Operations E-mail	mclemons@gigabeam.net
<b>Certifying Official Contact Information</b>	Certifying Official Name	Michael Clemons
	Certifying Official Phone Number	(540) 726-2317 ext: 103
	Certifying Official E-mail	mclemons@gigabeam.net

**Data Submitted**

Form Section	File Name	Date & Time	Number of Rows
Fixed Broadband Deployment	CENSUS_BLOCKS_ALL_DEC_2019.csv	Apr 21, 2020 16:41:54	7624
Fixed Broadband Subscription	Form 477 Customers Dec 2019.csv	Apr 21, 2020 16:46:02	104

**Fixed Broadband Deployment**

**Census Block Counts by State, DBA Name and Technology**

State	DBA Name	Technology	Blocks
Kentucky	GigaBeam Networks LLC	Terrestrial Fixed Wireless	526
Virginia	GigaBeam Networks LLC	Terrestrial Fixed Wireless	4360
West Virginia	GigaBeam Networks LLC	Terrestrial Fixed Wireless	2738
<b>Total</b>			<b>7624</b>

**Fixed Broadband Subscription**

**Fixed Broadband Subscriptions by State, Technology and End-user Type**

State	Technology	Census Tracts	Subscriptions		
			Consumer	Business / Govt	Total
Kentucky	Terrestrial Fixed Wireless	9	49	13	62
Virginia	Terrestrial Fixed Wireless	52	553	94	647
West Virginia	Terrestrial Fixed Wireless	43	529	58	587
<b>Total</b>		<b>104</b>	<b>1131</b>	<b>165</b>	<b>1296</b>

**Fixed Broadband Subscriptions by Bandwidths and End-user Type**

Downstream Bandwidth (in Mbps)	Upstream Bandwidth (in Mbps)	Consumer	Business / Govt	Total
5.000	1.000	18	0	18
10.000	1.000	748	60	808
10.000	2.000	3	0	3
25.000	2.000	290	69	359

Downstream Bandwidth (in Mbps)	Upstream Bandwidth (in Mbps)	Consumer	Business / Govt	Total
50.000	3.000	72	32	104
100.000	10.000	0	2	2
200.000	200.000	0	1	1
1000.000	100.000	0	1	1
<b>Total</b>		<b>1131</b>	<b>165</b>	<b>1296</b>

**Fixed Broadband Subscriptions by Technology, Bandwidths and End-user Type**

Technology	Downstream Bandwidth (in Mbps)	Upstream Bandwidth (in Mbps)	Consumer	Business / Govt	Total
Terrestrial Fixed Wireless	5.000	1.000	18	0	18
	10.000	1.000	748	60	808
	10.000	2.000	3	0	3
	25.000	2.000	290	69	359
	50.000	3.000	72	32	104
	100.000	10.000	0	2	2
	200.000	200.000	0	1	1
	1000.000	100.000	0	1	1
<b>Total</b>			<b>1131</b>	<b>165</b>	<b>1296</b>

(RETAIN FOR YOUR RECORDS)  
Form 477 Filing Summary

FRN: 0018473223 | Data as of: Dec 31, 2018 | Operations: Non-ILEC | Submission Status: Original - Submitted | Last Updated: Mar 23, 2019 10:14:13

**Filer Identification**

Section	Question	Response
<b>Filer Information</b>	Company Name	GigaBeam Networks LLC
	Holding Company Name	WVVA.net Inc.
	SAC ID	
	499 ID	
<b>Data Contact Information</b>	Data Contact Name	Michael Clemons
	Data Contact Phone Number	(540) 726-2317
	Data Contact E-mail	mclemons@gigabeam.net
<b>Emergency Operations Contact Information</b>	Emergency Operations Name	Michael Clemons
	Emergency Operations Phone Number	(540) 726-2317
	Emergency Operations E-mail	mclemons@gigabeam.net
<b>Certifying Official Contact Information</b>	Certifying Official Name	Michael Clemons
	Certifying Official Phone Number	(540) 726-2317
	Certifying Official E-mail	mclemons@gigabeam.net

**Data Submitted**

Form Section	File Name	Date & Time	Number of Rows
Fixed Broadband Deployment	CENSUS_BLOCKS_ALL_Dec_2018.csv	Mar 23, 2019 10:08:20	7624
Fixed Broadband Subscription	form_477_customers_Dec_2018.csv	Mar 23, 2019 10:13:21	77

**Fixed Broadband Deployment**

**Census Block Counts by State, DBA Name and Technology**

State	DBA Name	Technology	Blocks
Kentucky	GigaBeam Networks LLC	Terrestrial Fixed Wireless	526
Virginia	GigaBeam Networks LLC	Terrestrial Fixed Wireless	4360
West Virginia	GigaBeam Networks LLC	Terrestrial Fixed Wireless	2738
<b>Total</b>			<b>7624</b>

**Fixed Broadband Subscriptions by State, Technology and End-user Type**

State	Technology	Census Tracts	Subscriptions
-------	------------	---------------	---------------

**Fixed  
Broadband  
Subscription**

State	Technology	Census Tracts	Subscriptions		Total
			Consumer	Business / Govt	
Kentucky	Terrestrial Fixed Wireless	6	53	12	65
Virginia	Terrestrial Fixed Wireless	42	516	112	628
West Virginia	Terrestrial Fixed Wireless	29	486	56	542
<b>Total</b>		<b>77</b>	<b>1055</b>	<b>180</b>	<b>1235</b>

**Fixed Broadband Subscriptions by Bandwidths and End-user Type**

Downstream Bandwidth (in Mbps)	Upstream Bandwidth (in Mbps)	Consumer	Business / Govt	Total
10.000	1.000	781	89	870
25.000	2.000	226	70	296
50.000	3.000	48	19	67
50.000	50.000	0	1	1
100.000	100.000	0	1	1
<b>Total</b>		<b>1055</b>	<b>180</b>	<b>1235</b>

**Fixed Broadband Subscriptions by Technology, Bandwidths and End-user Type**

Technology	Downstream Bandwidth (in Mbps)	Upstream Bandwidth (in Mbps)	Consumer	Business / Govt	Total
Terrestrial Fixed Wireless	10.000	1.000	781	89	870
	25.000	2.000	226	70	296
	50.000	3.000	48	19	67
	50.000	50.000	0	1	1
	100.000	100.000	0	1	1
<b>Total</b>			<b>1055</b>	<b>180</b>	<b>1235</b>

# **Broadband Assessment Montgomery County, Virginia**

**Includes City of Radford and Towns of Christiansburg and  
Blacksburg**

**Final Report**

May 11, 2020

Prepared by



*and*



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## 2 Executive Summary

This report documents a comprehensive needs assessment of high-speed Internet services in Montgomery County, Virginia including the City of Radford and the Towns of Christiansburg and Blacksburg. The study was conducted in the fall of 2019.

This report identifies forty-one communities in the County, City, and Towns that need assistance in either attaining high-speed internet service or improving the existing service. It would be natural to assume these 41 communities encompass all households to be remediated; it does not. There are certainly households in the study area that are not included in this report. We are confident that we have identified the preponderance of communities in need, but there are certainly outlying households not included in this report. Our recommendations address this and provide a path forward to identify all households in need of service improvement.

Montgomery County is an exception in Southwest Virginia. It is a hub of innovation, economic development, growth, and prosperity. Yet, despite its demographics and the presence of world-class research and education institutions, there is a surprisingly large population of un-served and under-served communities in the Study Area. Nationally, the un-served population is approximately 6% of households. In Montgomery County and Radford, the un-served population is about 7.6% of households. In total, just over 9,000 households are un-served or under-served.

Un-Served Communities	Number of Households
Alleghany Springs	183
Christiansburg -- Eastern edge. Woodland Dr.	20
Christiansburg -- Park Dist (S. Franklin south of 8'	584
Christiansburg -- Park Street	157
Christiansburg --Trailers off Fairview St at 81	126
McCoy	250
McDonalds Mill	59
Norris Run	111
Shawsville (CDP)	550
Sugar Grove	49
Tom's Creek	656
Walton	360
<b>Total</b>	<b>3,105</b>

Our estimate of the Capital Cost to solve this situation is between \$7.3 Million and \$31 Million. The variance is because of network deployment – wireless, or an all-fiber-optic deployment. Wireless is significantly less capital intensive to deploy but has much lower network reliability, network performance, and higher network operations cost.

Under-Served Communities	Number of Households
Belmont	650
Blacksburg Country Club Area	174
Bradshaw	179
Brake Road	174
Brush Mountain	217
Catawba Valley	129
Childress Road (Radford)	202
Dry Valley	56
Ellett Valley	119
Elliston (CDP)	345
Gulberg Estates	55
Indian Valley	65
Lafayette (CDP)	194
Longshop	78
Mt. Tabor	274
Peppers Ferry Road	540
Pilot	168
Plum Creek (CDP)	627
Preston Forest	310
Prices Fork	498
Riner (CDP)	317
Rogers (South of Christiansburg, along Rt. 615)	65
Selu	50
Smith Creek	82
Union Valley	132
Vicker	82
Wake Forest	48
Whitethorn	42
Woodland Hills	61
<b>Total</b>	<b>5,933</b>

In reality, the low-density of some communities will dictate a wireless deployment, and we expect the most likely Capital Expenditure (CAPEX) requirement to fully address the un-served and under-served communities will be in the \$18 Million range.

The County leadership articulated four objectives for the project team:

1. Every citizen of Montgomery County have access to high-speed Internet.
2. Families with school-aged children must be a priority.
3. Knowledge workers must have ubiquitous access to high-speed Internet.
4. County leadership desires a market-based solution.

Montgomery County is rich in fiber optic deployments. At least five companies have fiber optic backbones that traverse the County. The County has expressed a strong preference for finding a market-based solution to address this problem. There are a number of service providers who have expressed a strong interest in partnering with the County to achieve grant funding to address the un-served and under-served communities. We believe there are at least six companies who are high-potential partners to collaborate with the County to address the needs. There is probably not a single solution for the County. The matter will have to be addressed on a community-by-community basis, cobbling together a number of different solution sets to fully resolve the matter.

It is recommended the County take the following actions to ameliorate the lack of high-speed Internet. These recommendations are explained more fully in section 7 of this report:

- **Immediate Action:** Allocate a resource – a *broadband czar* – to address the situation and find solutions for each community. Task this individual with identify the outlying households that need service but have not been identified. Consider forming/joining a broadband authority.
- **Intermediate Action:** Require new major subdivisions to build Fiber to the Home (FTTH) conduit systems. Install telecom conduit whenever a trench is opened. Revise local franchise requirements to foment more competition.
- **Long-Term Action:** Plan for and encourage FTTH deployment. Improve competition in the County.

## What is Broadband and High-Speed Internet?

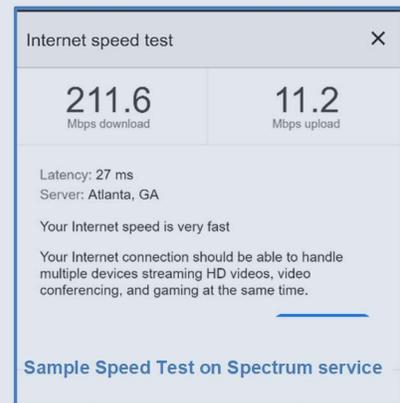
The definition of Broadband has been a constantly changing value as services and applications have become more sophisticated and feature-rich, requiring more and more bandwidth to deliver a satisfactory user experience.

In 1994, when the internet was generally considered to be “born,” a 56 kilobit dial-up line and phone modem were sufficient for email messages, chat rooms, message boards, and fee-based services like Prodigy and America online. At the time, 1.5 megabits per second (Mbps) was considered the threshold for broadband services. This was a business-class service and was synchronous, meaning 1.5 Mbps up and down.

The Federal Communications Commission (FCC), today considers residential broadband service to be a minimum of 23 Mbps down X 3 Mbps up.

It is quite common today to find Cable TV service offering 100 to 400 Mbps down, and 10 to 15 Mbps up. This service costs between \$50 and \$65 per month depending upon the local market.

Services like Netflix state they need at least a 25 Mbps down connection for users to have a quality experience with HD TV. From first-hand experience, this is an understatement; much more bandwidth is required for a satisfactory experience.



### Business Class Service and Residential Service.

Business Class Service is a dedicated service, meaning no other users are sharing that pipe or bandwidth. If a business subscribes to 100 MBPS, they are getting precisely that much bandwidth up and down. Dedicated service is significantly more expensive than residential service. A dedicated 100 Mbps service will cost between \$600 and \$1,200 per month depending upon market conditions. Residential service is “over-subscribed,” meaning many people are sharing the same pipe. Depending upon network architecture, several hundred to 1,000 end users can be on the same 100 Mbps service.

### Minimum Recommended Speeds for Residential Use:

10 Mbps	20 Mbps	50 Mbps	100 Mbps
<ul style="list-style-type: none"><li>• Email</li><li>• IP Telephone</li><li>• Few devices connected</li><li>• One or two users</li></ul>	<ul style="list-style-type: none"><li>• All 10 Mbps services, plus:</li><li>• Occasional Streaming video service on one device</li><li>• ~ 10 internet connected devices</li></ul>	<ul style="list-style-type: none"><li>• All 20 Mbps services, plus:</li><li>• Daily audio streaming</li><li>• ~ 20 internet connected devices</li><li>• 4k HD video stream</li></ul>	<ul style="list-style-type: none"><li>• All 50 Mbps services, plus:</li><li>• Multi-user on-line gaming</li><li>• 30 or more internet connected devices</li><li>• Four people in household watching multiple HD streams</li></ul>

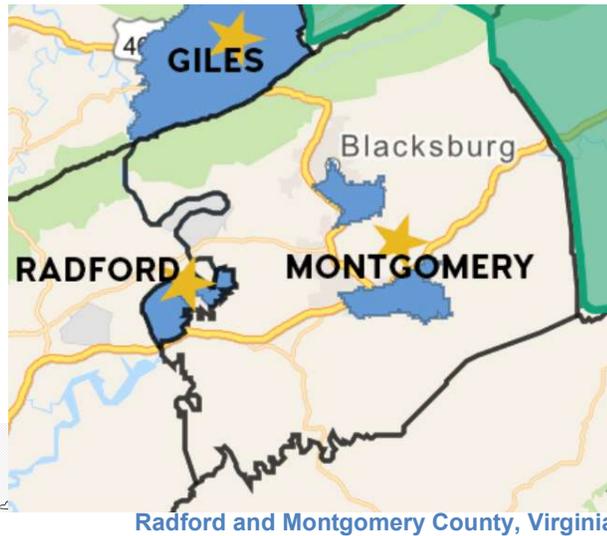
## 3 Introduction

This report documents a comprehensive needs assessment of broadband services in Montgomery County, Virginia and the City of Radford. The assessment includes the Towns of Blacksburg and Christiansburg (the Study Area).

This report identifies forty-one communities in the County, City, and Towns that need assistance in either attaining high-speed internet service or improving the existing service. It would be natural to assume these 41 communities encompass all households to be remediated; it does not. There are certainly households in the study area that are not included in this report. We are confident that we have identified the preponderance of communities in need, but there are certainly outlying households not included in this report. Our recommendations address this and provide a path forward to identify all households in need of service improvement.

### 3.1 Project Area

Montgomery County and the City of Radford are unique among communities in Southwest Virginia. The Study Area has a total population of just under 100,000 and has been experiencing growth – possibly the only region in Southwest Virginia to have a growth story. The Study Area is home to Virginia Tech and Radford University. The student population is estimated at 40,000, which is included in the census population count.



The citizens of the Study Area are on average, younger, more highly educated, and have higher earnings than their peers in Southwest Virginia.

Much of this growth and development is driven by Virginia Tech, a tier-1 technical research and teaching university with a forward-thinking, if not aggressive, approach to the commercialization of technology developed at the University. Virginia Tech is a thought leader in several technology areas that are engines of economic growth including wireless, robotics, advanced manufacturing, and drone aviation. In addition to being a juggernaut of economic development, Virginia Tech was a leader in the development of high-speed Internet and foresaw the disruption the Internet would drive in commerce and social change.

The Blacksburg Electronic Village (BEV) was conceived in 1991 in an effort by the University to expand Internet access to all citizens of Blacksburg. At the time, Virginia Tech had a sophisticated campus-wide voice/data network and was exploring ways to

extend network access to faculty, staff, and students living in Blacksburg. Today, BEV has largely turned over the residential Ethernet operations to the private sector; the job essentially completed. Every data port on the campus, the Corporate Research Center, and in student housing delivers 1 gigabit per second of Internet speeds. Given the early start, the leadership of Tech, and the demographics of Montgomery County, we expected to find a County substantially ahead of the region and nation in broadband availability; however, we were incorrect.

The areas studied are outlined in the following table. The large student population skews the average data, so we attempted to net-out or eliminate the student population from the demographic statistics.

US Census Bureau People Quick Facts	Montgomery County	Radford	Student Pop. Radford and VA Tech	Total - Area of Interest (net of student pop.)	Virginia	United States
Population estimates, July 1, 2018, (V2018)	98,985	18,339	39,900	<b>77,424</b>	8,517,685	327,167,434
Households, 2013-2017	35,577	5,503		<b>41,080</b>	3,105,636	118,825,921
Households with a computer, percent, 2013-2017	91%	85%		<b>90%</b>	89%	87%
Households with a broadband Internet subscription, percent, 2013-2017	84%	76%		<b>83%</b>	80%	78%
High school graduate or higher, percent of persons age 25 years+, 2013-2017	92%	88%		<b>91%</b>	89%	87%
Bachelor's degree or higher, percent of persons age 25 years+, 2013-2017	46%	34%		<b>45%</b>	38%	31%
Median household income (in 2017 dollars), 2013-2017	\$53,424	\$36,082		<b>\$51,101</b>	\$68,766	\$57,652
Per capita income in past 12 months (in 2017 dollars), 2013-2017	\$28,277	\$19,539	\$ 40,780	<b>\$27,106</b>	\$36,268	\$31,177

As noted earlier, there is a large student body component in the population -- nearly 40,000 -- which is included in the census data. Adjusting the per-capita income to exclude the student population and distributing income over the non-student population, the per capita income could be as high as \$40,700, 12% higher than the Commonwealth's per capita income and 31% higher than the national average.

### 3.2 Deliverables

The final deliverables of this study include this written report, as well as two presentations to the broadband management team and County leadership. The first presentation was made in October 15<sup>th</sup>, 2019 and was followed by presentation to the full Board of Supervisors in a public meeting that same day. A second presentation was made on December 11<sup>th</sup>, 2019. A draft final report was prepared for review and comment in January 2020, resulting in this final report. Two separate supplemental deliverables were prepared: 1) an inventory of vertical assets, and 2) a report on public-private-partnerships. A presentation is being coordinated for the City of Radford. All work products are the property of Montgomery County.

### 3.3 Methodology

T&L and Blue Ridge worked with a cross-functional management team of regional leaders to define:

- Community Needs,
- Prioritized List of Communities in Greatest Need,
- Potential Service Providers,
- Remedial Strategies and Associated Costs, and

- Potential Funding Sources and Strategies.

To identify the specific needs of each community, Blue Ridge conducted 32 diagnostic interviews with key stakeholders in the region including City and Town Managers, IT directors, Economic Developers, Educators, and County Leadership, including all members of the Board of Supervisors.

At the time we undertook this project, the New River Valley Regional Commission was in the process of compiling a Community Broadband Survey gauging the citizens service levels, availability, and attitudes about service providers. The survey was very well designed, had geographic identifiers, and had over 1,600 records. The survey was extremely valuable in fleshing out specifics about un-served communities, network reliability, quality of service, and attitudes about price and service providers.

Finally, we interviewed six of the regional service providers to understand their network architecture, coverage areas, concerns, and issues with network deployment in Montgomery County.

## 4 County Needs

To understand the Study Area's preparedness to support technology-enabled, quality-of-life-improving applications, we interviewed key stakeholders throughout the County, the City, and two towns. Regional leaders view broadband as a necessity - a "4th utility." County leaders were consistent in their message to the consulting team:

- Leadership would like every citizen of Montgomery County to have access to high-speed Internet. It is not viewed as a luxury item or a discretionary service. High-speed Internet service is a "must have" to sustain a basic quality of life. Solve the un-served problem first, and then address the under-served communities.
- Families with school-aged children must be a priority. The school systems are moving toward all-digital curricula. Children without access to high-speed Internet at home are being significantly disadvantaged. Make fixing the un-served and under-served communities with school-aged children a priority.
- The workforce in Montgomery County is increasingly becoming a "knowledge-worker" community. As employees who deal with the handling and processing of information, there is an expectation that they will always have access to high-speed Internet. Economic developers' biggest obstacle is ensuring that the workforce has continuous connectivity.
- Finally, the County leadership desires for the solution to this problem be a market-based solution. There are a number of service providers in the region. There is a rich fiber optic backbone infrastructure widely deployed in the County, but not everywhere. There are multiple incumbent providers and competitive start-ups using many different technologies. The Board of Supervisors and the County leaders agree that there is no need for the County or City to take an active investment role in becoming a provider of high-speed Internet services.

These four guiding principles became the mission for the project.

## 5 Identification of Communities

Forty-one (41) communities were identified as needing remediation. Twelve (12) communities are unserved by high-speed Internet service. These twelve communities represent an estimated 3,105 homes in the County and City. Nationally, about 6% of households are un-served with high-speed Internet. This level of unserved homes represents about 7.6% of the housing units in Radford and Montgomery County – a much higher percentage than we would have thought -- given the early actions of Radford University and Virginia Tech to expand the reach of broadband. To validate these findings, we visited several communities and conducted person-on-the-street discussions to validate the finding. Additionally, the Thompson & Litton office this project was worked out of is located in Radford. Several employees validated these finding based upon first-hand experience.

The balance of the 41 communities identified for remediation have some level of [High Speed Internet](#); however, it is either too slow to meet current and emerging bandwidth demands or is unreliable in its system availability. Typically, this might be a DSL (digital subscriber loop) service with a 3 mbps downstream speed and .5 mbps up. These 29 communities are identified in the table to the right. There are an estimated 5,933 households in this group.

Un-Served Communities	Number of Households
Alleghany Springs	183
Christiansburg -- Eastern edge. Woodland Dr.	20
Christiansburg -- Park Dist (S. Franklin south of 8'	584
Christiansburg -- Park Street	157
Christiansburg --Trailers off Fairview St at 81	126
McCoy	250
McDonalds Mill	59
Norris Run	111
Shawsville (CDP)	550
Sugar Grove	49
Tom's Creek	656
Walton	360
Total	<b>3,105</b>

Under-Served Communities	Number of Households
Belmont	650
Blacksburg Country Club Area	174
Bradshaw	179
Brake Road	174
Brush Mountain	217
Catawba Valley	129
Childress Road (Radford)	202
Dry Valley	56
Ellett Valley	119
Elliston (CDP)	345
Gulberg Estates	55
Indian Valley	65
Lafayette (CDP)	194
Longshop	78
Mt. Tabor	274
Peppers Ferry Road	540
Pilot	168
Plum Creek (CDP)	627
Preston Forest	310
Prices Fork	498
Riner (CDP)	317
Rogers (South of Christiansburg, along Rt. 615)	65
Selu	50
Smith Creek	82
Union Valley	132
Vicker	82
Wake Forest	48
Whitethorn	42
Woodland Hills	61
Total	<b>5,933</b>

## 5.1 Prioritization of Communities

### Methodology

Using the driving principles indentified throughout the project:

- Everyone connected, with completely un-served addressed first,
- School-aged children a priority, and
- Serve the knowledge workers.

As well as some factors the consulting team knows to be important in network deployment:

- Economies of scale - the more dense the housing units and the greater the number of house units, the bigger the impact for the fixed cost of developing a fiber-optic lateral.
- The captial expense (CAPEX) estimate per household to serve a community is driven by the length of the fiber drop from the street to the home.

We developed the following ranking model:

Criteria	Weighting	Maximum Value	Minimum Value
Un-served or Under-served	40 points	Un-served = 40	Under-served = 20
Number of Households (HH)	20 points	656 HH is the largest = 20 pts	20 HH is the smallest = 1 pt
% of HH with Children	20 points	32% = 20 pts	14% = 1 pt
Income per HH (as a proxy for knowledge workers)	10 points	\$106,161 = 10 pts	\$33,425 = 1 pt
CAPEX est per HH (note lower cost per HH is a better value than higher cost)	10 points	\$2,500 = 10 pts	\$8,000 = 1 pt

Based upon this ranking methodology, we developed a model that rates and ranks all 41 communitites of interest. The community that generates the highest score should, theoretically, be the one that is addressed first. Of course, in network deployments there are always additional circumstances to consider – a new trench may be opening for a water project that would provide more cost-effective network deployment, or a unique

grant may become available for a certain condition that changes the order of communities. This prioritization is a guideline only to be used to prioritize focus.

Rank	Community	Total Score
1	Christiansburg -- Park Dist (S. Franklin south of 81)	86.7
2	Shawsville (CDP)	82.3
3	Walton	76.0
4	Tom's Creek	72.6
5	Christiansburg --Mobile Homes off Fairview St at 81	72.3
6	McCoy	71.9
7	Christiansburg -- Park Street	71.6
8	Belmont	70.5
9	Christiansburg -- Eastern edge. Woodland Dr.	69.0
10	Alleghany Springs	68.5
11	Norris Run	67.5
12	Riner (CDP)	67.2
13	Plum Creek (CDP)	64.4
14	Sugar Grove	64.3
15	McDonalds Mill	62.1
16	Peppers Ferry Road	61.0
17	Prices Fork	59.7
18	Elliston (CDP)	57.6
19	Mt. Tabor	56.1
20	Bradshaw	53.1
21	Childress Road (Radford)	51.9
22	Catawba Valley	51.5
23	Pilot	50.8
24	Union Valley	49.7
25	Lafayette (CDP)	48.3
26	Brake Road	48.2
27	Indian Valley	47.6
28	Dry Valley	47.3
29	Selu	47.1
30	Vicker	46.6
31	Longshop	46.5
32	Wake Forest	45.6
33	Whitethorn	45.4
34	Preston Forest	44.9
35	Smith Creek	44.5
36	Rogers (South of Christiansburg, along Rt. 615)	43.9
37	Gulberg Estates	43.6
38	Brush Mountain	39.5
39	Blacksburg Country Club Area	37.9
40	Ellett Valley	34.6
41	Woodland Hills	31.7

## 6 Capital Cost Estimate

It is impossible to precisely forecast the Capital Expenditure (CAPEX) to solve the problem without a network design basis to use for cost estimating. However, we have a sufficiently large frame-of-reference with other projects that can be used to develop a credible cost estimate. A general cost estimate will be a useful tool for regional planners.

### Cost Estimating Assumptions:

The following assumptions were used for developing the frame-of-reference for both a Fiber to the Home (FTTH) and a wireless deployment:

<b>Base-case Planning assumptions for Montgomery County projects:</b>	
<b>Backbone Aerial:</b>	
Cost per mile to Engineer, Design, and Permit a BACKBONE network	\$ 3,000
Cost per mile for Aerial backbone build	\$ 20,000
Cost per mile for make-ready on existing poles	\$ 3,000
<b>Fiber Drop:</b>	
Cost per foot for aerial drop to premises	\$ 2.30
Cost per foot for UG drop to premises	\$ 4.00
Survey	\$ 75
NID	\$ 165
ONT	\$ 176
Cables	\$ 6
Inside installation	\$ 300
<b>Wireless:</b>	
Cost to turn up a Wireless backbone site	\$ 2,000
Cost to turn up a Wireless customer	\$ 300
<b>Shelter and Electronics if needed</b>	
Cost of electronics set for POP	\$ 25,000
POP shelter building without generator	\$ 20,000

Housing density is a major driving factor for FTTH deployments. The length of the fiber drop from the backbone to the residence is the single largest variable cost in the overall deployment. The length of fiber extension from the existing backbone to the community to be served is the also a density-driven variable. All other costs are fixed costs and do not vary with density: The Optical Network (ONT) terminating device, the Network Interface Device (NID), etc., are all fixed costs.

Density is also a factor in wireless deployments; the greater the density, the lower the cost-per-home.

To develop a CAPEX estimate, we used ranges of CAPEX based upon density, then applied the appropriate CAPEX for each community based upon the housing density in that census tract.

<b>Estimating CAPEX Values</b>		
<b>Housing Density</b>	<b>Estimated Wireless CAPEX per Home</b>	<b>Estimated FTTH CAPEX per home</b>
Less than 20 Housing Units per Sq. Mile	\$ 2,500	\$ 8,000
Greater than 20 and less than 250	\$ 1,000	\$ 4,000
Greater than 250 Housing Units per Sq. Mile	\$ 500	\$ 2,500

Thompson & Litton selected six communities from the 41 and designed an actual FTTH network. We compared our frame-of-reference estimate with the six designs and found the frame of reference to be about 20% higher than the actual design-cost estimate. So, we can realistically expect this CAPEX estimate to be credible.

**CAPEX:**

Using the methodology described above, we formulated the CAPEX estimates for both an FTTH and a wireless deployment. The County can expect to spend between \$7 Million and \$31 Million to solve the un-served and under-served problem in the entire Study Area. \$7 Million represents a complete wireless solution; \$31 Million represents a complete Fiber to the Home network solution.

While Fiber-to-the-Home is the gold standard for network deployment, in actual practice, the County can expect some hybrid solution of FTTH and wireless, depending upon the community’s distance from the backbone, the community density, and the geography (topography) of each community. If we applied a density factor of 200 homes-per-square-mile as the cutoff for FTTH, the resulting solution will be a hybrid CAPEX estimate of about \$16.4 Million.

**Estimate of CAPEX by Community:**

Community	CAPEX Estimate	
	FTTH	Wireless
Alleghany Springs	\$ 732,000	\$ 183,000
Belmont	\$ 1,625,000	\$ 325,000
Blacksburg Country Club Area	\$ 435,000	\$ 87,000
Bradshaw	\$ 716,000	\$ 179,000
Brake Road	\$ 696,000	\$ 174,000
Brush Mountain	\$ 868,000	\$ 217,000
Catawba Valley	\$ 516,000	\$ 129,000
Childress Road (Radford)	\$ 808,000	\$ 202,000
Christiansburg -- Eastern edge. Woodland Dr.	\$ 50,000	\$ 10,000
Christiansburg -- Park Street	\$ 392,500	\$ 78,500
Christiansburg -- Parke Dist (S. Franklin south of 81)	\$ 1,460,000	\$ 292,000
Christiansburg --Mobile Homes off Fairview St at 81	\$ 315,000	\$ 63,000
Dry Valley	\$ 224,000	\$ 56,000
Ellett Valley	\$ 476,000	\$ 119,000
Elliston (CDP)	\$ 862,500	\$ 172,500
Gulberg Estates	\$ 220,000	\$ 55,000
Indian Valley	\$ 260,000	\$ 65,000
Lafayette (CDP)	\$ 776,000	\$ 194,000
Longshop	\$ 312,000	\$ 78,000
McCoy	\$ 1,000,000	\$ 250,000
McDonalds Mill	\$ 472,000	\$ 147,500
Mt. Tabor	\$ 1,096,000	\$ 274,000
Norris Run	\$ 444,000	\$ 111,000
Peppers Ferry Road	\$ 2,160,000	\$ 540,000
Pilot	\$ 672,000	\$ 168,000
Plum Creek (CDP)	\$ 1,567,500	\$ 313,500
Preston Forest	\$ 1,240,000	\$ 310,000
Prices Fork	\$ 1,992,000	\$ 498,000
Riner (CDP)	\$ 1,268,000	\$ 317,000
Rogers (South of Christiansburg, along Rt. 615)	\$ 260,000	\$ 65,000
Selu	\$ 200,000	\$ 50,000
Shawsville (CDP)	\$ 1,375,000	\$ 275,000
Smith Creek	\$ 328,000	\$ 82,000
Sugar Grove	\$ 196,000	\$ 49,000
Tom's Creek	\$ 2,624,000	\$ 656,000
Union Valley	\$ 528,000	\$ 132,000
Vicker	\$ 328,000	\$ 82,000
Wake Forest	\$ 192,000	\$ 48,000
Walton	\$ 900,000	\$ 180,000
Whitethorn	\$ 168,000	\$ 42,000
Woodland Hills	\$ 244,000	\$ 61,000
<b>TOTAL ESTIMATE</b>	<b>\$ 30,998,500</b>	<b>\$ 7,330,000</b>

## 7 Recommendations and Next Steps

Beyond creating an inventory of communities-in-need of high-speed Internet service, there are several recommendations the consulting team formulated, stemming from our interaction with community leaders, stakeholders, and service providers. These recommendations are presented in descending order of importance, or urgency, and are presented in a general timeframe for implementation.

### Immediate Action:

1. We recommend the County **allocate a resource** to manage addressing the communities in need and pursue both funding and partnerships with service providers to solve the problem of un-served and under-served communities. Addressing the problem will be neither easy nor quick. An individual must be identified and tasked with a single purpose – to reduce the number of unserved and under-served households in the service area. While there are several functional areas in County government where this position could reside – Public Service Authority, Information Technology, Economic Development, etc. -- we recommend this be a direct report to the County Administrator to increase the visibility and authority of the individual. As a direct report to the Administrator, this position will enjoy much greater traction when negotiating with carriers and service providers. An additional benefit of creating this position is the carriers will have a single-point-of-contact to discuss network deployments. To this point, some of the service providers have been frustrated by the lack of engagement and difficulty in understanding whom to petition regarding their outside-plant requirements. This position will also be a focal point for compiling a comprehensive inventory of all households in need of service improvement (there are certainly outlying households without service who were not identified in this study). Finally, we recommend this person be tasked with solving a specific number of the 9,000 households with no or insufficient high-speed Internet service. While it is not a widespread practice in County government, we recommend this individual's compensation be directly linked to the number of households solved and that number be tracked and reported on a regular basis. The goals established for this position must be measurable and time specific. We estimate that solving the entire problem is most likely a 10-year process. We know there will be some "low-hanging fruit" that can be addressed easily, but some communities will present great challenge.
2. **Consider forming/joining a Broadband Authority**, under the agency conveyed in the *Virginia Wireless Service Authorities Act*. This should be one of the first considerations of the new position created to address the broadband availability issue. Forming an Authority will provide access to funds through the Virginia Resources Authority (VRA) who provides innovative, and cost-effective financing to build infrastructure projects. Broadband has become an

area of interest for VRA investment. There is an existing Authority in the region – The New River Valley Network Wireless Authority – which includes Giles County, Pulaski County, and Radford. The only hesitation in recommending joining an existing Authority is that it could distract attention from Montgomery County and Radford. Forming the Authority will also send a powerful signal to the service-provider community that the County is serious about addressing the problem and if necessary willing to take an active role.

**Intermediate Action:**

1. Consider conditioning the permitting of new housing developments with a requirement for a Fiber to the Home (FTTH) conduit system. While a new subdivision is under construction, the incremental cost of installing an FTTH conduit system is very low. Trenches are open, crafts people are on site, and traffic control is in place. The cost of installing an FTTH network after the homes are complete is significantly more complicated, costly, and disruptive. This has been done successfully in a number of California major subdivisions with much success. The County attorney was going to conduct research to see if the California best practices can be applied in Virginia.
2. When opening a trench for any reason, consider installing telecommunications conduit in the trench for future use. The Public Service Authority (PSA) is aware of the potential for such an initiative and has had some discussions with service providers about specifying materials and construction practices, but nothing has occurred. The truth of the matter is that telecommunications is not core to the mission of the PSA. They are focused on the delivery of reliable and safe water and wastewater. The coordination of additional utility lines is simply not in their current mission. The PSA has recommended that the service providers keep a watchful eye on upcoming PSA projects; that has had a similar unsuccessful outcome for precisely the same reason.
3. Review the local franchise requirements for service providers and consider exceptions. Some service providers expressed that the franchise obligations prevent them from offering residential service in some markets. The franchise agreements typically come with an affirmative obligation to build network where certain density thresholds are met. The service providers readily admit they are “cherry picking” select neighborhoods that are near their backbone and have favorable demographics. If service providers could be exempted, selectively, from executing the franchise agreements there would be less unserved residents in Montgomery County.

**Long-Term Action:**

1. As mentioned throughout this report, Fiber to the Home (FTTH) is the gold standard for network deployment. With the University delivering 1 GBPS speeds to all student housing, campus facilities, and the Corporate Research

Center, the bar has been set. Community leaders have already heard complaints from new residents moving to the area from other markets where FTTH is widely deployed, and express dissatisfaction / surprise that it's not available in Blacksburg. The County must adopt policies, procedures, and permitting practices that encourage FTTH deployments by the service providers for the long-term. This recommendation is out of the current scope of work for the consulting team. We were tasked with identifying the un-served and under-served markets and propose cost estimates for addressing those projects. However, we would be doing the County a disservice if we did not mention where the future of this marketplace is most certainly headed.

2. Finally, the County must take action to improve the competition in the County. Competition drives price reduction and improves service levels. We have seen this first-hand in a number of different markets. There are at least eight facilities-based providers in the County. The County needs to eliminate policies and practices that hinder competition and adopt those that encourage new entrants and fosters competition.

In summary our recommendations are presented in descending order of urgency for action:

- **Immediate Action:** Allocate a resource to solve the problem. Consider forming/joining a broadband authority.
- **Intermediate Action:** Require new major subdivisions to build FTTH conduit systems. Install telecom conduit whenever a trench is opened. Revise local franchise requirements to foment more competition.
- **Long-Term Action:** Plan for and encourage FTTH deployment. Improve competition in the County.

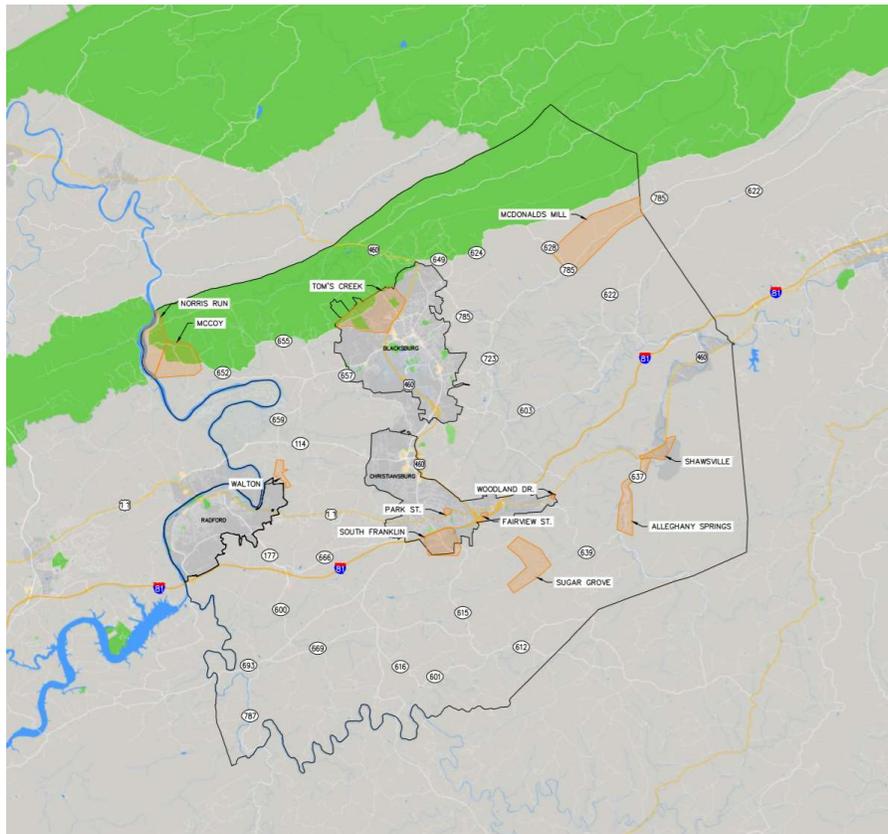
## 8 Attachments and Appendices

### 8.1 Regional Maps with Needs Appendix

#### Un-served Communities:

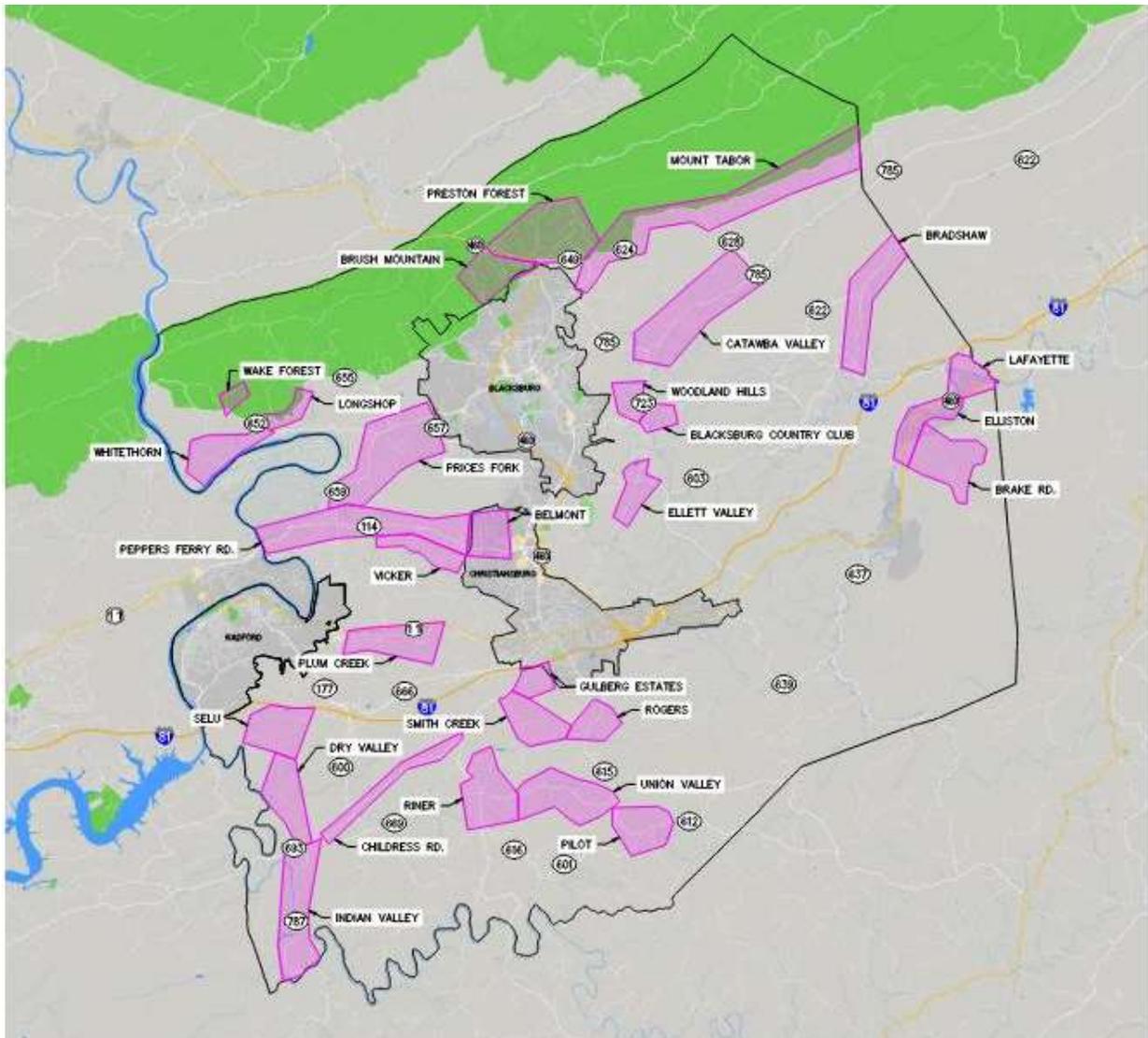
The following table and corresponding map identify the un-served communities in the Study Area:

Un-Served Communities	Number of Households
Alleghany Springs	183
Christiansburg -- Eastern edge. Woodland Dr.	20
Christiansburg -- Park Dist (S. Franklin south of 8	584
Christiansburg -- Park Street	157
Christiansburg --Trailers off Fairview St at 81	126
McCoy	250
McDonalds Mill	59
Norris Run	111
Shawsville (CDP)	550
Sugar Grove	49
Tom's Creek	656
Walton	360
Total	3,105



**Under-served Communities:**

<b>Under-Served Communities</b>	<b>Number of Households</b>
Belmont	650
Blacksburg Country Club Area	174
Bradshaw	179
Brake Road	174
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Catawba Valley	129
Childress Road (Radford)	202
Dry Valley	56
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Elliston (CDP)	345
Gulberg Estates	55
Indian Valley	65
Lafayette (CDP)	194
Longshop	78
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Peppers Ferry Road	540
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Plum Creek (CDP)	627
Preston Forest	310
Prices Fork	498
Riner (CDP)	317
Rogers (South of Christiansburg, along Rt. 615)	65
Selu	50
Smith Creek	82
Union Valley	132
Vicker	82
Wake Forest	48
Whitethorn	42
Woodland Hills	61
<b>Total</b>	<b>5,933</b>



## **8.2 Sources of Funding Appendix**

### **National Funding**

In December 2019, US Department of Agriculture (through RUS) announced a second round of \$600 million grant and loan Broadband Program availability through the ReConnect Program to assist with building rural broadband infrastructure. Telecommunications companies, rural electric cooperatives, utilities, Internet service providers, and municipalities may apply for funding. To be eligible, communities must have populations smaller than 20,000 people with no broadband service or where service is slower than 10x1 MBPS. Loan applications are due late January through March 16, 2020.

### **State Level Awards Granted**

The Commonwealth of Virginia, through Governor Northam, is heavily invested in the vision of equitable broadband coverage throughout the state. The Governor's vision is statewide broadband coverage within 10 years. The two agencies that have deployed the most capital to support broadband connectivity are the Virginia Tobacco Region Revitalization Commission (Tobacco Commission) and the Virginia Department of Housing and Community Development (DHCD). Part of receiving funding is a requirement that communities/localities have a "granular plan" for ensuring coverage. The Governor, through his FY2020-2022 budget proposal to the money committees of the Virginia General Assembly, has recommended increasing funding for broadband to \$35 Million for each year of the biennium budget.

There will be numerous grant opportunities for Montgomery County over the life of this initiative. The individual tasked with managing the effort to close the digital gap will have to become familiar with the funding programs, determine where the high-potential communities are in Montgomery County that fit the many differing criteria of each program and vigilantly go after funding with an operating partner.

### 8.3 Addressable Market Appendix

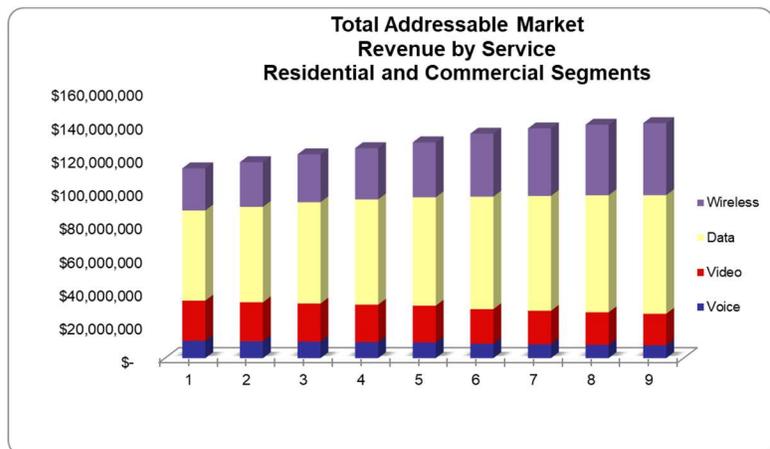
#### Market Overview

The telecommunications market in the Study Area is estimated at roughly a \$114 Million annually for voice, video, data, and wireless services. This excludes the Universities and the student population and student housing.

Total Addressable Market for Retail Telecom Services for Montgomery County, Virginia				
Includes City of Radford and Towns of Christiansburg and Blacksburg				
Telecom Service	Annual Revenue at Year 1	Annual Revenue at Year 5	Annual Revenue at Year 10	Cumulative 10 Year Revenue
Voice	\$10,408,095	\$9,372,255	\$8,011,459	\$91,079,870
Video	\$24,073,205	\$22,079,075	\$19,465,230	\$215,338,374
Data	\$54,021,652	\$64,988,686	\$70,150,086	\$643,787,662
Wireless	\$25,265,924	\$32,926,229	\$42,358,055	\$343,498,071
<b>Total</b>	<b>\$113,768,876</b>	<b>\$129,366,245</b>	<b>\$139,984,830</b>	<b>\$1,293,703,978</b>

Most of the growth will be occurring in the high-speed Internet service and wireless services (commonly called cellular). Both traditional voice services (circuit switched telephony) and multi-channel video services (CATV) are in rapid decline as customers migrate to wireless voice services (so-called cord cutters) and streaming video services (so-called cable cutters).

The market of interest for Montgomery County is the high-speed Internet service. That market is currently about a \$54 million annual market, with about 37% coming from the residential segment and 63% from the commercial segment. The residential high-speed Internet market has about a 4% compound annual growth rate.



## **8.4 Service Provider Appendix**

Following is a brief description of the regional service providers and their capabilities:

### **All Points Broadband**

All Points Broadband (APB) is a fixed wireless service provider that offers services throughout the New River Valley. Based in Northern Virginia, APB has an office in Christiansburg with customer service and field technicians in the immediate area. APB expressed a strong interest in partnering with the County to address the un-served and under-served communities. In fact, the senior management team suggested that if Montgomery County partnered with APB exclusively, they would solve all of the un-served and under-served problems. In our experience (and we have such exclusive arrangements in practice), competition drives lower prices and improved services. Nonetheless, APB is willing and anxious to work in collaboration with the County to address the issue.

### **Citizens Telephone Cooperative**

Citizens is a regional Incumbent Local Exchange Carrier (ILEC) with full-service communications offerings, including land-line telephone, VoIP, IPTV Video, web and e-mail hosting, DSL, FTTP (Fiber to the Premises), and Business Ethernet. Citizens serves portions of 7 counties in Southwest Virginia. Based in Floyd, Virginia, Citizens' network is still 90% copper based, but they are rolling out gigabit FTTP.

There is some overlap of their services in several counties within PDC's 1, 2, & 3, including Carroll County, Grayson County, and Wythe County. Citizens' network stops at the Smyth County line. Their fiber runs from Route 58 to Route 16 (BVU/Sunset) and U.S. Route 221 to Sparta. They just completed a build on U.S. Route 221 (North) to Roanoke Co., passing over 1,000 homes with FTTH.

### **Comcast**

Comcast is the largest cable provider in the United States (second largest multi-channel video service provider when AT&T / DirecTV are considered). Comcast operates a hybrid-fiber-coaxial system principally in Radford and Blacksburg. Comcast is respected as a solid operator. We were unable to speak to a local executive about a public-private partnership to pursue a publicly-funded opportunity. We are unaware of any public-private collaboration involving Comcast.

### **Gigabeam Networks**

Gigabeam Networks, a wireless Internet service provider, or WISP, provides service in Southwest Virginia, West Virginia and southeastern Kentucky. Their network was, until recently, completely wireless, including the backhaul. Gigabeam has recently begun to integrate fiber backhaul into their network and is piloting a large program with an investor owned electric utility in Giles County to expand the reach of broadband using the utilities' middle-mile network. Gigabeam is a small, highly entrepreneurial venture that has

experienced some impressive successes. Gigabeam expressed a strong interest in partnering with Montgomery County to address the broadband issue.

### **GoGig**

GoGig is a fiber and wireless provider in the town of Blacksburg. Little is known about GoGig and their corporate structure. It is believed they utilize the Town of Blacksburg's municipal fiber network and serve a handful of commercial customers. We interviewed one technology company who uses GoGig service and their CIO was very upbeat about quality, price, and service. At this point it is premature to say if GoGig will be an influence in addressing the un-served and under-served communities in Montgomery County.

### **LIT Networks**

LIT is a facilities-based long-haul network that spans the Commonwealth. LIT has facilities in Equinix Ashburn, 56 Marietta in Atlanta, and the transatlantic cable landing in Virginia Beach. LIT operates extremely high-capacity circuits typically connecting carriers to carriers and data centers. Their network travels through Montgomery County and their POP is on Prices Fork Rd. LIT is not a retail service provider, but they are worth noting because of their ability to facilitate any local carriers' access to Tier 1 Network Access Points for wholesale Internet.

### **SEGRA**

Segra is the recently acquired LUMOS Networks, a large facilities-based service provider with network from Pittsburgh to Atlanta. Segra is headquartered in Waynesboro, Virginia and has significant network in Montgomery County. Segra is both a residential and commercial service provider with FTTH experience. We believe Segra has high potential to be a partner for Montgomery County. We reached out to a regional executive but were unable to schedule a meeting prior to completion of the project.

### **Shentel**

Shentel, or Shenandoah Telecommunications Company, is a publicly traded telecommunications company headquartered in Edinburg, Virginia. Shentel has digital wireless and wireline network in rural Virginia, West Virginia, Maryland and Pennsylvania. Shentel is also an affiliate of Sprint with wireless coverage in Pennsylvania, Maryland, Virginia, West Virginia, Kentucky and Ohio. It owns its own cell site towers built on leased land and leases space on these towers to both affiliates and non-affiliated service providers. Shentel has invested over \$200 million in the past two years upgrading and expanding its wireless networks, primarily in rural markets. Shentel also provides fiber services to commercial and wholesale customers along its 5,641-mile fiber network across four states.

Shentel has significant network in Montgomery County, is the franchised CATV operator in Christiansburg, and offers multi-channel video, Internet, and voice services. Shentel has recently filed for franchises in several Comcast markets in Virginia and appears to be becoming aggressive in their competitive threat to other operators. Shentel is developing

a FTTH offering. Senior managers at Shentel said they would welcome an opportunity to partner with Montgomery County to pursue grant funding to solve the broadband issues in the County.

### **Verizon**

Verizon is the Incumbent Local Exchange Carrier (ILEC) in most of Montgomery County. Verizon has DSL service in much of Montgomery County and it is generally considered to be unreliable and of insufficient speeds to meet future demands. We did not speak to a Verizon Executive. However, our dealings with Verizon in other Virginia markets as well as other parts of the country have led us to the following conclusions:

- Verizon is re-inventing itself as a wireless company.
  - Verizon Wireless recently bought out its minority partner – Vodafone – for \$130 Billion.
- Verizon is divesting of many rural markets to others.
  - Verizon sold its Texas, California, Florida, and West Virginia markets to Frontier,
  - Maine, New Hampshire, and other New England markets to Fair Point Communications; and
  - Hawaii to the Carlyle Group.
- Verizon has not deployed any significant FIOS (their FTTH network) since 2010.

We have concluded that Verizon is not a high-potential partner for Montgomery County.

### **WideOpen Networks**

WideOpen Networks (WON), based in Blacksburg, describes itself as a “transport provider” of layer 1 and layer 2 services. The actual consumer services are provided by any number of service providers who ride the WON network. For example, in Blacksburg, ISP services are provided by Biz Net Technologies. According to its founder, Andrew Cohill, WON is presently available in two Blacksburg area neighborhoods providing gigabit speeds over fiber-optic connections. WON has plans to extend to other parts of Blacksburg and throughout the New River Valley.

Design Nine, a related consulting firm, asserts it “*helps communities build their own networks*” and specializes in assisting communities such as a master-planned subdivision or a property-owners association with a self-help business model.

Based upon its size and technology, WON might be a high-potential partner for Montgomery County.



## Delivering Gigabit tier service with wireless using 60 Ghz or 6 Ghz band

In the recent order regarding the RDOF auction the FCC said "While an applicant will be permitted to select the Gigabit performance tier in its application if it intends to use fixed wireless or DSL technologies for meeting its Auction 904 public interest obligations, such applicants face a high burden to persuade Commission staff that they are reasonably capable of meeting the public interest obligations in rural areas and thus qualified to bid for the Gigabit performance tier.

This paper from Cambium Networks is designed to assist prospective bidders to persuade the Commission staff that the Gigabit tier is most certainly capable and that many of our customers are qualified and currently delivering a Gigabit service.

### 60 GHz millimeter wave

(V-Band) fixed wireless technology that makes it easy to meet the surging demand for bandwidth in urban locations. Service providers now have access to multi-gigabit speeds in multiple configurations, including business and residential last mile access and backhaul for wireless MicroPoP access. Certified for Facebook Terragraph mesh technology, these 60 GHz solutions make it easy to provide efficient multi-gigabit speeds in the heart of any city.

The multi-mode 802.11ay standard system can be configured for Point-to-Point (PTP), Point-to-Multipoint (PMP), or efficient mesh modes. The solution provides last mile access to subscriber homes, enterprises, and multi-dwelling buildings as well as transport for video surveillance and public Wi-Fi networks.

### Performance

The solution operates in the 57 to 66 GHz bands with channel bandwidth of 2.16 GHz and delivers up to 10 Gbps (L1) total throughput. Modules include smart beamforming for noise isolation, a GPS receiver to reduce self-interference and are designed for easy installation.

- V5000 Distribution Node (DN) forms the mesh network and provides coverage. Each V5000 has two sectors and can provide up to 20 Gbps.
- Client Nodes (CN) available in two options for range and capacity:
  - V3000 - 10 Gbps throughput at a range of up to 800m in point-to-point mode and to 500m in multipoint mode
  - V1000 - 1 Gbps throughput at a range of up to 200m



V5000



V3000



V1000

Contact

In a recent global survey of 800 service providers conducted by Cambium Networks, the top three applications for 60 GHz technology are business connectivity, residential access and Wi-Fi backhaul. To deliver the best quality of experience in these and other applications, the Cambium solution is architected using the 802.11ay standard for higher capacity, better channel access, mesh support and more subscribers supported.

Cambium can achieve +1Gbps downlink speeds utilizing the unlicensed 60 GHz band spectrum. Our solution supports CH1 to CH4 with a channel size of 2.16 GHz. With modulation from BPSK to 16 QAM, the radio supports downlink throughput up to 1.92 Gbps. With channel bonding enabled. The radio can support downlink throughput up to 3.84 Gbps.

TDD structure with DL/UL ratio: 50:50

MCS	Modulation	Coding Rate	L2 Throughput (Mbps)						
			64	128	256	512	1024	2048	4096
2	$\pi/2$ -BPSK	1/2	718	729	734	737	733	740	732
3	$\pi/2$ -BPSK	5/8	892	904	907	915	914	918	910
4	$\pi/2$ -BPSK	3/4	1057	1072	1084	1084	1085	1093	1071
5	$\pi/2$ -BPSK	4/5	1146	1155	1162	1175	1175	1174	1159
6	$\pi/2$ -QPSK	1/2	1394	1415	1420	1429	1421	1435	1411
7	$\pi/2$ -QPSK	5/8	1720	1734	1749	1764	1748	1767	1728
8	$\pi/2$ -QPSK	3/4	2024	2041	2076	2076	2059	2089	2017
9	$\pi/2$ -QPSK	4/5	2173	2192	2206	2229	2221	2224	2173
10	$\pi/2$ -16-QAM	1/2	2615	2671	2682	2682	2673	2687	2609
11	$\pi/2$ -16-QAM	5/8	3180	3207	3262	3262	3245	3287	3143
12	$\pi/2$ -16-QAM	3/4	3694	3725	3788	3788	3737	3837	3614

## 6 GHz millimeter wav

The recently available 6GHz of spectrum in standard power mode has opened up the possibility to offer Gigabit speeds via fixed outdoor wireless broadband equipment and in fact to some extent in the current 5GHz spectrum. Cambium Networks is currently developing both a 5GHz and 6GHz range of fixed wireless broadband equipment capable of offering greater than 1Gbps service to customers throughout the fixed wireless community. This new technology leveraging the 6GHz spectrum is based on chipsets and capabilities derived from the 802.11ax technology.

The ability to perform in channel widths as wide as 160MHz, achieving maximum modulations of 1024QAM or 4096 QAM allows the fixed wireless equipment to confidently offer gigabit speeds to a wide swath of rural customers. Based on Cambium Network's tests and analysis the following performance numbers can be achieved confidently via the use of 160MHz spectrum in the 6GHz spectrum in conjunction with the hardware based on AX technology.

Following an EIRP of 36dBm at the AP and SM antenna of 25dBi in low interference scenarios, an operator can provide

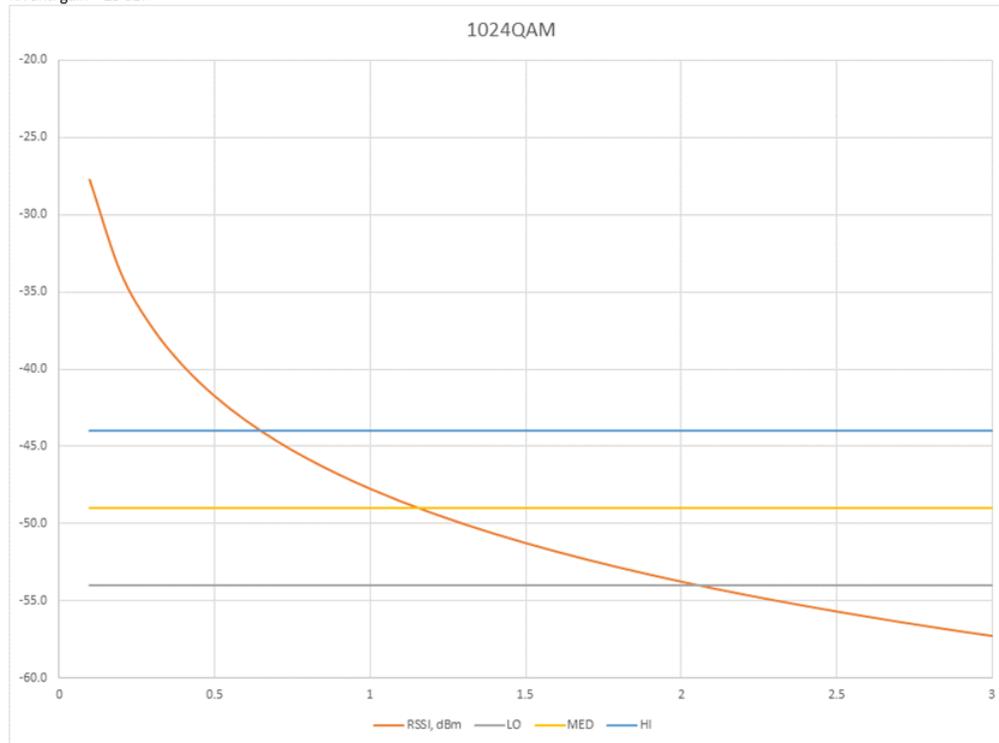
1.6Gbps of DL speeds leveraging 1024 QAM modulation at a distance of 1.3miles.

In the same distance, uplink of approximately 500Mbps can be achieved. Furthermore, assuming rural deployment and very low interference that do not necessarily require synchronization and a fixed DL/UL ratio, the DL and UL performance can be both 1.6Gbps.

Cambium Networks is also planning to offer a platform that can achieve 4096 QAM. With the use of this platform, in low interference environments, at .6 mile distances, DL speeds of 2Mbps can be achieved and uplink speeds of 576Mbps.

Below chart offers a visual on distances that can be achieved against interference levels.

EIRP = 36 dBm  
 F = 6500 MHz  
 RX ant. gain = 25 dBi



For 160 MHz, 2SS, MCS11  
 RX sensitivity levels and corresponding distances are  
 LO = -54 dBm => 2.1 km  
 MED = -49 dBm => 1.2 km  
 HI = -44 dBm => 0.7 km

The table below highlights the key technology attributes that allows for the 802.11ax based solutions to achieve Gbps performance in fixed wireless deployments.

Feature	Options	Comments
Band	4910 – 5970 MHz 5925 – 7125 MHz	Support for the 6GHz standard power band.
Channel width	5/10/20/40 MHz 80 MHz 160 MHz	Support in 5Ghz Support of 160MHz wide channels in the new 6GHz band.
Spatial streams	2 4 8	Grouping of two SMs. In 6GHz, 4X4 mode at the AP the capacity with 160MHz, 1024 QAM is estimated to be 3.3Gbps in the DL and 961Mbps in the UL based on a 75/25 TDD ratio. Grouping of four SMs in 8X8 mode at the AP with 80MHz operation and 1024 QAM, the capacity at the AP is estimated to be 3.3 Gbps and 961Mbps in the UL in a 75/25 ratio in TDD mode. Note that, with higher number of MUMIMO streams the 5GHz AP can have higher input.
Modulation	1024QAM	Higher modulation as compared to

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		current 11AC Wave2 products
	4096QAM	Higher modulation as compared to current 11AC Wave2 products. Combined with 160MHz wide channels, 2Gbps DL speeds can easily be achieved with 4096QAM.
Long OFDM Symbol	12.8 us OFDM symbol	Reduced over the air overhead for wireless transmission.
	0.8/1.6/3.2 us Guard Interval	Flexibility in guard interval allows for further optimization of fixed deployments and thus achieving higher efficiency.
MU-OFDMA	DL	OFDMA allows flexibility in allocating over the air bandwidth in much smaller granularity and thus reduce over the air overhead during transmissions. This in turn results in higher efficiency in the wireless transmission.
	UL	OFDMA allows flexibility in allocating over the air bandwidth in much smaller granularity and thus reduce over the air overhead during transmissions. This in turn results in higher efficiency in the wireless transmission.
MU-MIMO	DL	MUMIMO allows for grouping of SMs and the ability to Tx to multiple SMs at the same time. This is more of an impact to a base station overall capacity but certainly allows servicing of multiple SMs with 1Gbps DL speeds Please see sections on spatial streams.
	UL	MUMIMO allows for grouping of SMs and the ability to Tx to multiple SMs at the same time. This is more of an impact to a base station overall capacity but certainly allows servicing of multiple SMs with 1Gbps DL speeds Please see sections on spatial streams.
Maximum likelihood (ML) decoding	Yes	Coding techniques to improve reliability of wireless transmissions.
Maximal ratio combining (MRC)	Yes	Coding techniques to improve reliability of wireless transmissions.
Space Time Block Code (STBC)	Yes	Coding techniques to improve reliability of wireless transmissions.
Low-Density Parity Check (LDPC)	Yes	Coding techniques to improve reliability of wireless transmissions.
AMSDU frame aggregation	No limit on the number of MSDUs aggregated	Techniques to allow lower overhead in wireless transmission and thus allow for faster speeds.
AMPDU frame aggregation	Maximum of 256 MPDU per PPDU	Techniques to allow lower overhead in wireless transmission and thus allow for faster speeds.

Additionally, the below table for 6 GHz rates highlights the various configurations under 802.11ax based solutions for fixed wireless where greater than 1Gbps DL and 500Mbps UL performance can be offered.

BW, MHz	80								
Nss	2						Data Rate, Mb/s	DL TDD	UL TDD
MCS	Modulation	R	Nbpscs	Nsd	Ncbps	Ndbps	0.8us GI	0.7	0.2
8	256QAM	3/4	8	980	15680	11760	864.7	605.3	172.9
9		5/6				13066	960.7	672.5	192.1
10	1024QAM	3/4	10		19600	14700	1080.9	756.6	216.2
11		5/6				16333	1201.0	840.7	240.2
12	4096QAM	3/4	12		23520	17640	1297.1	907.9	259.4
13		5/6				19600	1441.2	1008.8	288.2
BW, MHz	160								
Nss	2						Data Rate, Mb/s	DL TDD	UL TDD
MCS	Modulation	R	Nbpscs	Nsd	Ncbps	Ndbps	0.8us GI	0.7	0.2
8	256QAM	3/4	8	1960	31360	23520	1729.4	1210.6	345.9
9		5/6				26133	1921.5	1345.1	384.3
10	1024QAM	3/4	10		39200	29400	2161.8	1513.2	432.4
11		5/6				32666	2401.9	1681.3	480.4
12	4096QAM	3/4	12		47040	35280	2594.1	1815.9	518.8
13		5/6				39200	2882.4	2017.6	576.5

In the above table –  
 MCS – represents the “Modulation and coding scheme”  
 R – Coding Rate  
 Nbpscs – Number of coded bits per single carrier  
 Nsd – Number of data sub-carriers  
 Ncbps – Number of coded bits per OFDM symbol  
 Ndbps – Number of data bits per OFDM symbol

Note: For UL TDD, the estimations here are based on a pure GPS sync'd TDD frame structure. For scenarios requiring no GPS sync such as a low interference, low density deployment, a flexible scheduler can achieve ~2Mbps both in the DL and UL.

In summary, the 6GHz spectrum combined with Cambium Networks solution leveraging operation in contiguous 160MHz spectrum, support of 1024/4096QAM, OFDMA efficiencies of the 11AX standard, operators can confidently offer greater than 1 Gbps service in the DL and 500Mbps of service in the uplink.

[Meet RDOF with Cambium Networks PMP Solutions](#)

Auction 903 and 904 Resources

[Download FCC Application Instructions](#)

- [Auction 903 application Tutorial Video](#)
- [Checklist for application](#)
- [Auction 904 Website](#)

**Please note that short-form applications must be electronically submitted on Form 183 before 6 PM Eastern Time on July 15, 2020.** The application should be available online on July 1, 2020. For more information about RDOF, see the materials available on the [FCC Website](#), especially the Auction Procedures Public Notice and the Application Tutorial.

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