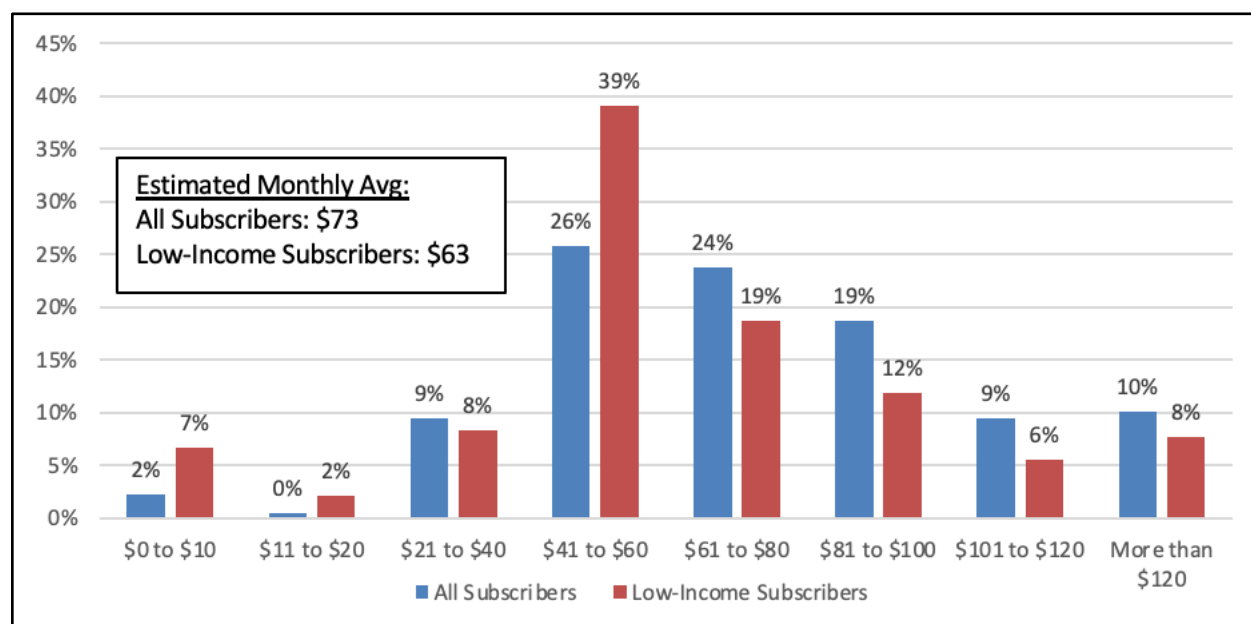


**Figure 16: Monthly Fees for Low-Income Subscribers Compared to All Subscribers**



These survey results also clearly indicate a lack of usage of existing low-income programs. Providers’ prices for service in Vermont, as well as a comparison to prices in other states, are in Appendix G.

#### 4.1.1 Overview of Service Based on State Broadband Mapping and Testing

The State Department of Public Service has compiled a rich set of data providing the level of wired broadband service available at each address in the State, as well as wireless service areas based on drive tests on major State roads. The map and the accompanying drive tests and resources are among the most comprehensive sets of information compiled by any state and provide a starting point to assessing and addressing the State’s broadband challenges. Unlike databases produced by the Federal Communications Commission and others that work on the Census Block level, and erroneously describe entire areas as “served,” when only one or a few addresses are claimed to be served by a service provider, the State’s data and accompanying materials provide the wired broadband service at each address from the State’s E-911 database. The data fit the existing service into categories of 100/100 Mbps service, 25/3 Mbps service, 10/1 Mbps, 4/1 Mbps and underserved. The broadband map also provides the opportunity to comment on the service at each address, to correct information and to provide more background about other aspects of the broadband service or needs at the address.

Because the wireless drive test data was taken in 2018 and was measured only on major roads, the information from those tests is more impressionistic. Yet it is still a useful complement to the wired data and, accompanied by further information from subsequent drive tests in various parts

of the State as well as further analysis based on tower locations, provides a starting point for understanding both wired and wireless coverage.

Based on the State's data, approximately 70,000 premises, or about 20 percent of the total, do not receive at least 25 Mbps download and 3 Mbps upload speeds—the current definition of broadband by the FCC.

Households and businesses not receiving 25/3 service will likely have challenges with stable and consistent access to the following applications, especially when a home's broadband connection is used by more than one person at a time:

- Interactive video as part of Zoom, Teams, or other tools commonly used for distance learning
- Access to data resources such as maps and stored videos (YouTube, etc.)
- Access to resources in a work or learning environment based in the cloud
- Sharing and backup of files in a storage and application environment such as Google Docs, Dropbox or OneDrive
- Medical appointments including video, medical charts, and rudimentary testing

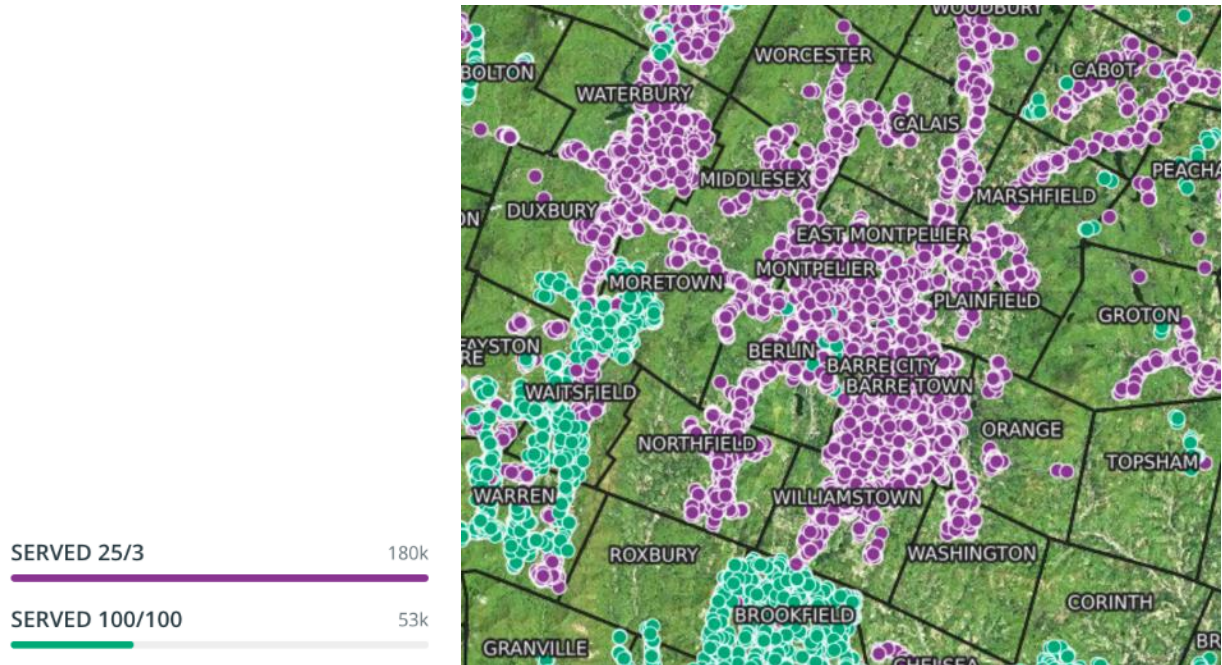
Moreover, households and businesses who have bandwidth-limited or metered services (e.g. “up to 20 GB per month”), even if their service is adequate for these applications, will need to be extremely sparing in their use, needing to ration bandwidth between work needs, classroom learning by children, and entertainment. Even wireless and satellite services which claim to be unlimited often have fine print terms enabling the provider to “deprioritize” users who hit their bandwidth caps, resulting in inability to effectively use video resources until the following month billing period, and/or may pay significant overage charges.

Since the State's broadband data were compiled in 2019, there have been expansions of service by some providers (e.g., ECFiber, Waitsfield Champlain Valley Telecom, and others) and the funding of deployment to approximately 8,700 addresses via the Emergency Connectivity Initiative. Though we do not have data on where providers have built in planned expansions, we have subtracted the premises served by the Emergency Connectivity Initiative to identify 62,000 premises without access to wireline broadband over 25/3 to be at immediate connectivity risk during the pandemic, and we identify strategies targeted at these homes and businesses.

The 62,000 premises that do not receive 25/3 are distributed throughout the State, which poses significant and varied challenges for both short-term and long-term connectivity goals. However, there are some clear trends. Those served by 25/3 or 100/100 tend to be in the cities and towns.

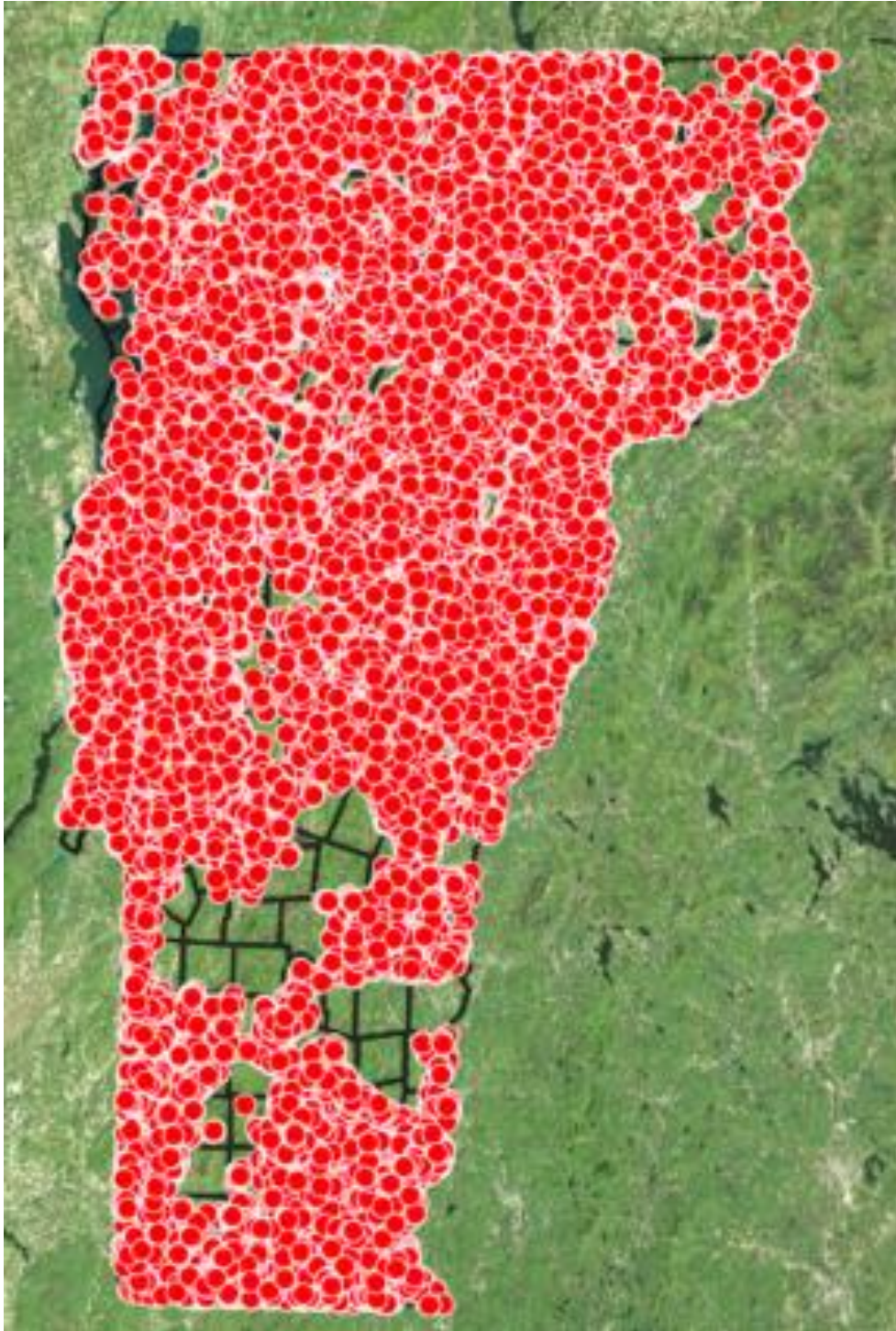
Those without the service are often in a perimeter area around a town or in an outlying area. The following figure provides a typical example.

Figure 17: Sample Coverage Map



Because most of the 25/3 service is provided by cable broadband companies (Comcast, Charter) the distribution is mostly historical, due to the fact that cable operators were only required to build to areas up to a particular density in their franchise agreements. The following is a map of unserved premises in Vermont. This data was collected by the State in 2019 and is current as of that date, however, premises funded by the Emergency Connectivity Initiative have been removed.

**Figure 18: Unserved Premises (State Data)**



Vermont's mobile broadband coverage is strongly influenced by the topography and geography of the State; due to the hills, mountains, and trees, almost no town is completely covered by

service, though very few towns are also wholly unserved. The following is a map of drive-test data performed on major roads in 2018, with additional data collected by volunteers in 2020.

**Figure 19: Drive Test Routes**



In addition to the drive-test data, we have mapped locations of cell provider antenna sites in Vermont used by one or more providers. The infrastructure ranges from latticed towers to monopoles or “stealth trees” to radios on siloes, steeples, or water towers. Naturally, the height of the infrastructure and surrounding topography will dictate how far service reaches; however due to time constraints, we have estimated that good service can be provided to premises up to three miles away from the radios. This is a crude estimate that is an average; with good height

and lines of sight, service could potentially extend for five or more miles. Installed low and in a valley or obstructed by trees, service might be limited to a mile.

Even advanced RF propagation estimates may not be able to predict how strong a signal is at a particular premises. Any first responder who knows the back roads of the State would tell you that propagation maps published by providers themselves largely overstate the range of their signal.

However, our high-level analysis based on the drive test maps and the tower sites, indicates that there may sufficient coverage over many parts not served by 25/3 with wired services, to provide broadband using mobile service to many underserved Vermonters—and that because provide them with mobile service does not require new construction or new towers, they can receive service in time to address their needs during the pandemic.

An even larger number of the remaining unserved and underserved premises in the State could be served if the signal were augmented by a rooftop signal booster. We note again the difficulty in precisely predicting the signal levels and capacity of wireless networks, and emphasize that it will need to examine individual cases more closely, which may be the responsibility of the proposed Broadband Corps discussed in more detail below.

#### **4.1.2 Status Reported by Providers**

In interviews, internet service providers across the State reported increases in bandwidth usage over the course of the epidemic, with a larger increase in upstream utilization. For example, Waitsfield and Champlain Valley Telecom reported a 30 percent increase in bandwidth usage; AT&T reported that core network traffic increased 22 percent and that video conferencing increased 400 percent. ISPs also reported changes in peak utilization times: Peak internet usage used to be around 8pm; providers are finding now that peak usage occurs throughout the day as well as in the evening, as people are working and learning from home.

Internet service providers reported that their networks were able to handle increased utilization, although in practice, certain types of networks become much more constrained with more usage. In particular, wireless technology and DSL based technology, have greater capacity constraints and are more likely to provide slow performance with many users on the network. In contrast to wireless and DSL, operators of fiber networks and cable networks reported no bandwidth constraints during the pandemic, despite increased bandwidth needs.<sup>23</sup>

Wireless providers face similar constraints due to limitations of their technology and the spectrum. VTel reports that they manage capacity by limiting service to customers with adequate

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<sup>23</sup> Sutich, John, and Matthews, Alicia, “Comcast Covid Response Interview,” October 22, 2020; Gruending, Kurt, “Waitsfield Champlain Valley Telecom Covid Response Interview,” October 30, 2020.

line of sight from the antenna to their home or business. They report that they do not like to hook up customers on their wireless 4G LTE network unless they are confident the customer can get at least 10 Mbps download, because customer satisfaction drops significantly at lower speeds.

Several internet service providers interviewed said they saw an increase in requests for customer installations, and in some cases did not have enough technicians to meet the demand; for example, ECFiber, FirstLight, and Waitsfield and Champlain Valley Telecom all expressed the need for more trained technicians.

Prices for service in Vermont range by provider, but are not out of step with service costs in other areas (see Appendix G for comparison to other states). Providers have also launched a range of programs to assist Vermonters who may be struggling financially due to the Covid-19 pandemic, many focused on ensuring children in school have access to the internet. The Department of Public Service has aggregated a list of ISP programs on their website:<sup>24</sup>

- CenturyLink, Comcast, Consolidated Communications, FirstLight, Sprint, AT&T, Burlington Telecom/Schurz Communications, TDS Telecom, US Cellular, Verizon, Waitsfield and Champlain Valley Telecom signed the FCC Keep America Connected Pledge,<sup>25</sup> which was in effect through June 30th
- AT&T, Burlington Telecom, Charter, Comcast, Franklin Telephone, Stowe, T-Mobile, VTel, and Waitsfield and Champlain Valley Telecom, opened up public Wi-Fi hotspots.
- Comcast, Charter, and others introduced programs to assist customers with overdue bills.
- Waitsfield Champlain Telecom and Burlington Telecom have not been disconnecting customers during the Covid-19 pandemic, and ECFiber has announced they are not disconnecting any customers until further notice. Duncan Cable has extended all disconnections for non-pay from the normal 30 days past due to 60.
- Charter and Comcast have existing low-cost options for qualifying low-income customers. Comcast has given 60 days free to new Internet Essentials customers. Comcast expressed that while about 14-15,000 Vermonters are currently enrolled in Internet Essentials, there

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<sup>24</sup><https://publicservice.vermont.gov/content/new-connectivity-resources-support-you-during-covid-19-state-emergency-vermont>

<sup>25</sup> The pledge is “to not terminate internet/data service to any residential or small business customers because of their inability to pay their bills due to the disruptions caused by the coronavirus pandemic; waive any late fees that any residential or small business customers incur because of their economic circumstances related to the coronavirus pandemic; and open its Wi-Fi hotspots to any American who needs them.”

are many eligible Vermonters who have not enrolled. Charter offers Spectrum Internet Assist as an option for low income customers.

- Burlington Telecom, Charter, Consolidated Communications, ECFiber, Otelco, TDS, Waitsfield and Champlain Telecom have introduced programs to connect K-12 students. These programs vary, but the most common program is providing 60 days of free service.
  - Some programs are for low-income students, while others are designed for all students.
  - Some have been funded by private philanthropists, and some by providers themselves.
- Charter instituted a program that provided one month of free service for new small business customers.
- Comcast and CenturyLink suspended data caps; AT&T suspended data caps for fixed internet service. T-Mobile and Sprint gave their customers 60 days of unlimited data, and Verizon added 15GB of free data for residential and small business customers free of charge. Charter continues to impose no data caps or hidden fees.

Our study did not determine whether the quality of infrastructure provided to low-income Vermonters is significantly worse than that available to wealthier Vermonters. It has been documented in other states that some providers charge similar amounts in wealthier and lower-income areas, but only upgrade infrastructure in higher income areas. This investigation was not able to be done within the confines of this work; however, it is important to understand whether low-income Vermonters are paying similar rates for similar quality infrastructure, or if they are more likely to have only less capable infrastructure available to them.

## 4.2 State-Owned and Operated Systems

Operators of State telecommunications systems report their networks have functioned well during the Covid-19 pandemic, and alterations to operations or resiliency measures put in place have not impacted delivery of services.

Many State agencies successfully changed telecommunications protocols or operational protocols due to the pandemic—increasing the IT and network load to State agencies. The Agency of Natural Resources switched to a contact-free payment system as a Covid-19 safety precaution, which requires an internet connection to use. The Agency of Natural Resources now allows game harvest reporting online. During the height of the pandemic, when thousands of Vermonters were filing new unemployment claims, and the department successfully replaced their aging Unemployment Insurance system.