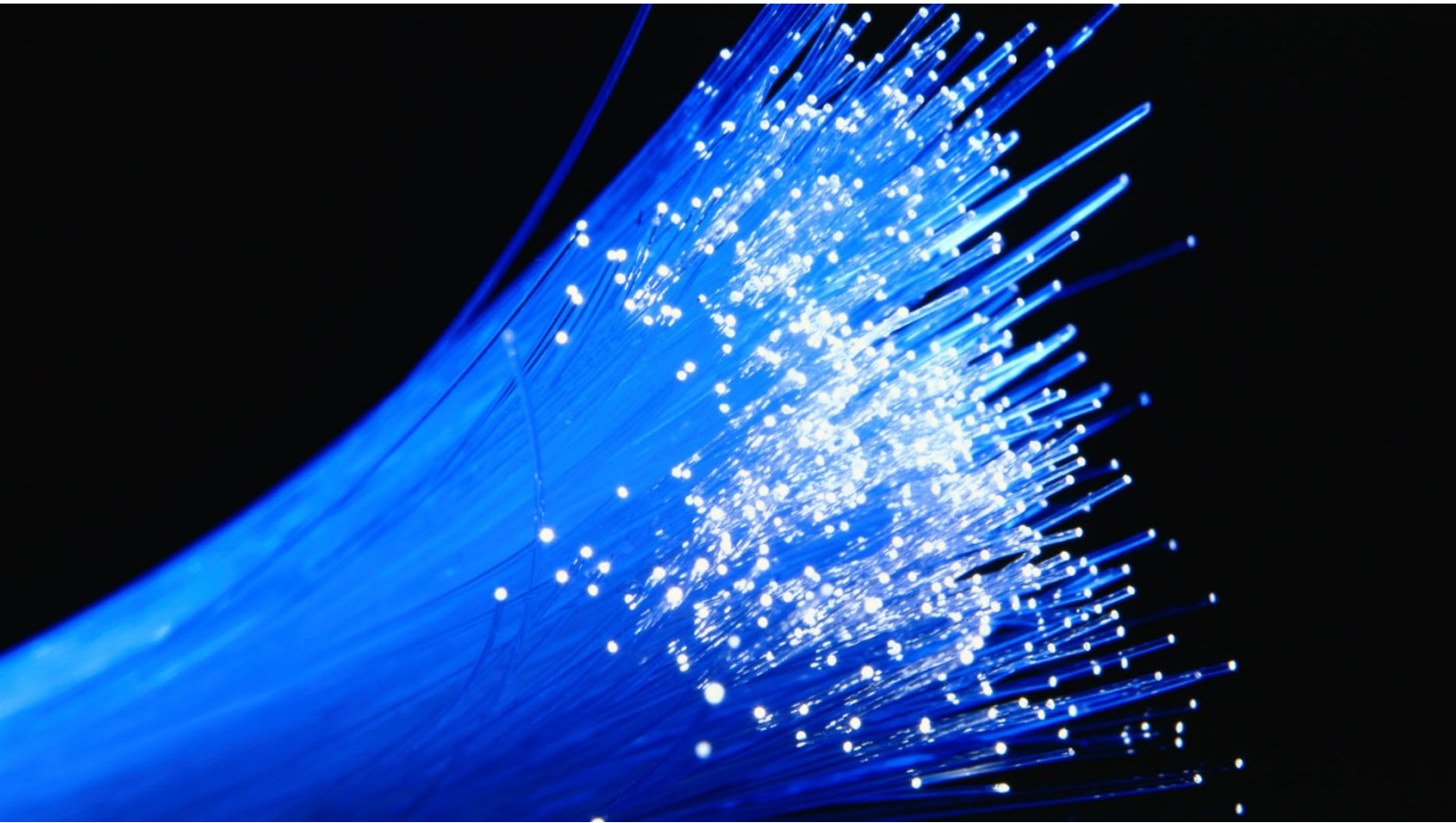**ctc technology & energy**
engineering & business consulting

Rural Innovation Strategies Inc.

Fixed and Mobile Broadband Needs Assessment
Prepared for Barnstable County, Massachusetts
August 2024

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1. Introduction

This report presents the findings of a broadband assessment conducted for Barnstable County through the Cape Cod Commission. The Commission contracted with CTC Technology & Energy (CTC) and Rural Innovation Solutions, Inc. (RISI) to conduct a comprehensive study of commercial broadband internet availability for residential, commercial, and institutional properties within Barnstable County, and to generate recommendations on strategies for pursuing fixed and mobile broadband network upgrades and expansions.

The consultant team also documented challenges Cape Cod residents face in affording and using broadband and computers and developed recommendations to address these challenges.

1.1   Overview of this study

This report includes presentation and analysis of:

- Quantitative and qualitative data on fixed broadband (cable, fiber, DSL, and fixed wireless services) and mobile service availability, as well as gaps or deficiencies in these services;

- Challenges with respect to affordability, digital skills, digital literacy, and device access as determined from a survey conducted as part of this project, plus Commission-generated data and additional data from the U.S. Census Bureau's American Community Survey;

- Information and perspective on recent and evolving market developments—including a recent grant award to Verizon that may result in the company building its Fios fiber optic service in seven Cape Cod towns to compete with Comcast—as well as other efforts by municipalities and OpenCape, the nonprofit middle-mile fiber provider, that may lead to fiber-to-the-premises (FTTP) deployments;

- Information on how Towns can pursue and leverage deployment of FTTP through a variety of approaches that differ regarding the role the Towns or partners play, and the levels of risk and control involved; and

- Recommendations based on the data.

In recent years, the 15 towns of Barnstable County and other entities have taken significant steps toward highlighting broadband needs and achieving certain network and service improvements. These efforts include establishing fiber connectivity in downtown zones through OpenCape, organizing local task forces, obtaining grant monies to upgrade municipal (non-commercial) fiber networks, studying the adequacy of available broadband to serve the needs of local businesses and, the case of Falmouth, setting up a public entity that can allow the Town to enter the broadband business. A spreadsheet summarizing these activities is provided in Appendix E. The Commission's work builds on those efforts.

1.2 Past study efforts by the Cape Cod Commission

Regional plans including the Cape Cod Comprehensive Economic Development Strategy, Cape Cod Regional Policy Plan (RPP), Cape Cod Regional Transportation Plan, and the Cape Cod Climate Action Plan have identified the importance of reliable and affordable broadband connectivity. While the COVID-19 pandemic exposed weaknesses in broadband connectivity and community adoption, understanding and bolstering local infrastructure has been an identified regional priority for much longer.

These plans discuss broadband challenges being an impediment to economic development, accessing health services, and employment. The RPP specifically notes that *"education, government, healthcare, and other service and innovation sectors of the economy rely on effective and reliable access to broadband and telecommunications."*

There have been specific efforts recently to develop a more comprehensive understanding of the broadband challenges unique to Barnstable County including an information technology bond bill (S.2790) that called for a study of internet access and cell phone coverage gaps across the County. Though that project did not materialize, the concept behind it evolved into this study funded with Barnstable County American Rescue Plan Act (ARPA) funds.

Barnstable County received $41.4 million in ARPA funds from the U.S. Treasury. The Barnstable County Commissioners (BCC) and the Barnstable County Assembly of Delegates (AOD) identified broadband as one of the regional priority projects, allocating $400,000 for the completion of a *"Broadband, Internet, and Cellular Network Assessment."*[1]

The importance of the effort was further articulated in a related AOD resolution that detailed the importance of allocating available state and federal grants for broadband to address the unique challenges faced by Barnstable County.[2] This resolution articulated that: *"Massachusetts is on the precipice of a historic influx of broadband funding. This investment acknowledges that reliable Internet is a fundamental necessity for communities seeking to thrive in the modern economy. Yet, as the Internet makes the world smaller, it threatens to make Cape Cod—with its often overlooked, aging broadband infrastructure—more distant than ever before."*

As the regional planning agency for Cape Cod, the Cape Cod Commission ("Commission") was tasked with overseeing the regional needs assessment. The Commission was well-positioned to coordinate this effort given its experience coordinating regional planning projects and ongoing

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[1] "Barnstable County Announces $12,758,514 in ARPA Funding for Critical Regional Projects," CapeCod.gov, https://www.capecod.gov/2023/02/02/barnstable-county-announces-12758514-in-arpa-funding-for-critical-regional-projects/.

[2] "Resolution 23," Barnstable County, https://barnstablecounty.sharepoint.com/:b:/s/Public/EfvqtiOACIVAsy1AEzVd_p4Bg4DUPQlTpfpPwwxiVtfrtw?e=Qr1yjl.

digital equity work. From 2022 to 2024, the Commission participated in digital equity training sessions hosted through the Massachusetts Broadband Institute (MBI) and the National Digital Inclusion Alliance (NDIA).

The Commission is also providing direct planning services to the towns of Bourne, Sandwich, Orleans, Falmouth, and Barnstable for digital equity studies under the Massachusetts Municipal Digital Equity Planning Program and the Municipal Digital Equity Implementation Grant Program. The Commission has also supported MBI's Statewide Digital Equity Planning Process, co-hosting a regional listening session and contributing to the statewide asset mapping process. The Commission was able to bring insights gained about the strengths, challenges, and opportunities related to broadband and digital equity in the region to the assessment.

2. Key findings and recommendations

The key findings of this report are divided into the three major subcategories: fiber/fixed broadband infrastructure (including the current extent and quality of service, plans for new deployment, and public opinion on FTTP deployment questions), mobile service, and digital equity (including residents' use of subsidy programs and their challenges with respect to affordability, skills, and device access).

2.1 Summary of recommendations

The following table summarizes the recommendations presented in this report in relation to the findings. These recommendations describe approaches the County, towns, or other entities may consider. The full text of the recommendations are provided in Sections 3.6 (fiber and other fixed broadband deployment), 4.5 (mobile network improvements), and 5.3 (advancing digital equity).

Table 1: Summary of recommendations

Category	Recommendation
Fiber/fixed broadband infrastructure	• Pursue the development of FTTP deployments through one of four broad categories of business models that differ regarding the role the Towns or partners play • Facilitate construction to encourage and reduce costs of deployment, regardless of model or how the project came about • Seek to leverage deployments to obtain fiber for current and future municipal needs, such as connectivity to municipal buildings, backhaul for public safety radios and traffic or security cameras
Mobile service	• Implement a rigorous and repeatable drive-test data collection process that measures signal strength on all Cape Cod roadways at a granular level • Perform mobile broadband "walk tests" to measure signal strength in critical non-driving areas • Create a vertical asset database for areas surrounding identified coverage gaps • Use data collected and proactive posture to encourage collaborative solutions with mobile wireless carriers
Digital equity	• Form a countywide Digital Equity Coalition and convene annual or biannual meetings to harmonize efforts and support outreach to funders • Consider augmenting state and federal digital equity funds with a regional grant program • Help pursue funding to Community TV stations to support digital

Category	Recommendation
	skills programs
	• Promote [digital navigator programs](#) enhancing telehealth and other digital skills at community health centers across Cape Cod
	• Facilitate the partnership between [device provision](#) entities with interested local community organizations on the Cape
	• Consider establishing a [County call center](#) to assist in connecting residents with technical support resources and supporting enrollment in current or future broadband subsidy or low-cost programs
	• Consider approaches for [connectivity in housing authority buildings](#)—including procuring services from existing providers (a single-payer approach) or state programs to provide potential capital and operating support for Wi-Fi and for affordable housing wiring retrofits

2.2   Summary of infrastructure findings

Following are the findings related to broadband infrastructure on Cape Cod.

- **Comcast provides nearly ubiquitous residential broadband service at speeds above 100/20 Mbps.[3] While competition is absent at most addresses, a small but growing number of addresses have access to a fiber alternative. Comcast has recently made network upgrades with far faster upload speeds, but only in some areas.** Comcast serves most addresses (99.5 percent), but only 23,454 locations of the total of 144,991 (or 16.2 percent) have a second choice of provider offering service at 100/20 or higher. At some addresses this alternative is fiber, such as in Bourne, where 2,018 locations are served by Verizon Fios. For most of the rest, the second option is fixed-wireless 5G Home Internet service from Verizon or T-Mobile, with service levels varying by address. In some parts of the Cape, Comcast has recently made network upgrades resulting in a significant growth in the number of locations receiving 2000/200 Mbps service. This reflects investments by Comcast in a technology standard version known as DOCSIS 4.0, which enables far faster upload speeds. These higher speeds are now available to approximately 40,171 addresses, or 51,604 units, many in Falmouth and Mashpee. The company's investments may show the effect of anticipated competition; the Town of Falmouth has been

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[3] Megabits per second (Mbps) is a unit of measurement for data transfer rates and broadband speeds. 100/20 Mbps refers to service speeds of at least 100 Mbps download and 20 Mbps upload, the federal threshold for a location to be considered "served." Locations able to receive 25/3 or more, but less than 100/20, are considered "underserved" and locations unable to get 25/3 are considered "unserved."

particularly active in pursuing a competing fiber alternative to Comcast, and the Mashpee Wampanoag tribe recently received a federal grant to build 118 miles of fiber.

- **Verizon may now be planning FTTP deployments in seven Cape Cod towns, significantly changing the Cape's broadband landscape.** Verizon was recently awarded grants from MBI to fill broadband service gaps in Brewster, Falmouth, Harwich, Mashpee, Sandwich, Wellfleet, and Yarmouth—plus 19 other communities in other parts of the state.[4] The company plans to use these monies to deploy fiber. It is highly likely that Verizon will now not only build to the relatively few locations without broadband service, but also as a first step to upgrading its copper network to provide ubiquitous fiber service to residences and businesses, which would be a dramatic change to the competitive landscape. This is being made possible under MBI's Gap Networks Grant Program[5] which is funding deployment of broadband infrastructure in areas that currently lack access to 100/20 service.

- **For larger businesses and enterprise customers, competitive fiber providers including OpenCape and Comcast Business are available.** Since it went online in 2013, OpenCape has provided a critical new source of fiber service and competition for municipalities, institutions, and large and small businesses—and now may catalyze potential partnerships for wider FTTP deployment. OpenCape has deployed fiber for business zones in Falmouth, Buzzards Bay, and Hyannis and has been actively pursuing FTTP partners. Applications for Round 2 of the MBI Gap Networks Grant Program were being accepted at the time this report was finalized in early July of 2024.

- **Speed tests show that Cape Cod experiences significant seasonal degradation of fixed and mobile broadband service.** Widespread anecdotal reports of slower speeds in the summer high season, when network usage is highest, were confirmed through analysis of speed test datasets from 2022 and 2023, which showed clear speed declines across the summer months.[6]

- **Significant numbers of residents are very concerned about the speed and quality of available cable broadband service.** The residential survey conducted for this study found that with respect to satisfaction with fixed broadband services (which means either wired or fixed wireless—and thus primarily refers to Comcast), 25 percent of respondents said

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[4] "Healey-Driscoll Administration Awards More Than $45 Million in Grants to Extend High-Speed Internet Coverage Statewide," MBI, press release, July 2, 2024 Healey-Driscoll Administration Awards More Than $45 Million in Grants to Extend High-Speed Internet Coverage Statewide | MBI (masstech.org)

[5] "Gap Networks Grant Program," MBI, https://broadband.masstech.org/gap-networks-grant-program.

[6] For mobile speed tests, "summer months" refers to Memorial Day to Labor Day. For fixed speed tests, "summer months" is inclusive of quarter 2 and quarter 3 (April to September), as fixed speed test data was aggregated by quarter.

they were very dissatisfied. Nineteen percent said they experienced slowdowns in service at least once daily and 20 percent said slowdowns occur at least once per week. Nearly half of renters reported experiencing issues at least weekly or daily; the figure was 37 percent for owner-occupants. Among residents who expressed some dissatisfaction, complaints included that service is too expensive (69 percent), service drops from time to time (57 percent), and service is too slow (51 percent). With respect to the enterprise fiber market—that is, fiber connections and premium services for large business and institutions—stakeholders consulted for this assessment who accessed enterprise level services were generally satisfied with services they receive.

- **Similarly, large numbers of residents report problems with mobile voice and data services.** Thirty-five percent of survey respondents reported they do not experience any connection issues or drops in mobile voice calls, but 20 percent reported that they experience this at least once daily and 20 percent at least weekly. Among those with lower satisfaction levels, respondents cited service drops (76 percent), high cost (60 percent), and slow service (40 percent). Though mobile providers on the Cape cited challenges associated with the approval process of some new tower deployments in Barnstable County, there was not clear indication that permitting processes are a driver of network performance issues in the region.

- **A private fiber provider announced and then canceled plans for a ubiquitous FTTP buildout on Cape Cod.** Boundless is an internet service provider created in 2020 by Tilson, a New England-based broadband consultant and design/builder, to deploy broadband in Vermont. In early 2024 the company said it planned to deploy FTTP across Falmouth in 18 months and to the entire Cape in three years, targeting the residential and small business market, but in late May the company announced it was withdrawing. A Verizon Fios buildout would likely make such an effort infeasible in the seven towns involved.

- **Communities are also driving localized broadband expansion activities.** Appendix E: Broadband activities by Town outlines local activities in recent years; the following two are particularly significant:

  - **The Mashpee Wampanoag Tribe received $9.1 million from the National Telecommunications and Information Administration's (NTIA) Tribal Broadband Connectivity Program to build 118 miles of fiber connecting tribal residences, businesses, and anchor institutions.** While most details of the tribe's network deployment plan are yet to be released, a new fiber network of this scale could, in theory, provide additional services and connections for the region, in addition to meeting the needs of the tribe. At the time this report was delivered in early July of 2024, the tribe was evaluating key strategic decisions, including whether it

will operate the network independently or partner with an existing ISP, or whether the network will provide services to non-tribal residences and businesses.

o **Falmouth has created a Municipal Light Plant (MLP) and is in talks with potential partners.** An MLP entity is required under Massachusetts law if a Town wishes to go directly into the broadband business. While the Falmouth MLP currently has no physical plant or budget, the MLP sought and received approval from the Select Board to enter talks with Boundless before the company withdrew its plan. Other entities also replied to an RFI issued by the MLP. The Town is now exploring these responses in greater depth. Neither the MLP nor the Select Board has voted on recommended paths for FTTP deployment. (From a business perspective, a Verizon Fios buildout would raise significant hurdles to any other potential entrants.) As summarized in Section 3.6, these and other partners and fiber business model variations can be pursued through municipal procurement processes.

- **Overall, there is strong public support for local action to foster fiber broadband competition.** In response to the survey conducted for this report, 64 percent of respondents from across Cape Cod either strongly agreed or agreed that their town should work to bring in a new private broadband provider to compete with existing providers. This reflects strong overall conceptual support for municipal action—albeit without details about what such an effort might cost or the range of ways such a service could be brought about.

- **There is moderate support among residents surveyed for temporary subsidies related to new deployments.** Because building new broadband networks in Cape Cod may in some cases require public resources or subsidies, the survey also gauged support for temporary public subsidies and found moderate support (3.2 on a scale of 1 to 5) at $200 per year per household for five years, dropping to 2.1 at $800 per year for five years. This provides a sense of the public's willingness to shoulder construction subsidies and is not reflective of actual cost estimates or subsidy requirements.

2.3 Summary of digital equity findings

Following are the findings related to digital equity on Cape Cod.

- **Affordable Connectivity Program (ACP) adoption rates among eligible households were lower than state and national averages.** As of December 1, 2023, only 16 percent of the estimated 37,100 eligible low-income households in Barnstable County were enrolled in the federal ACP, which provided a $30 monthly subsidy for broadband service costs but

was defunct at the time this report was submitted.[7] This is significantly lower than the statewide figure of 31 percent and the national figure of 40 percent.

While the ACP is no longer accepting new enrollments, new Congressional funding for the ACP or other subsidy programs may emerge, and existing low-cost ISP programs—notably Comcast's Internet Essentials—remain available. The relatively low enrollment rate in the ACP points to the importance of new or expanded programs to help eligible households on Cape Cod to enroll in available low-cost or subsidy programs, regardless of the ACP's status.

- **Cape Cod exceeds state and nationwide averages of home internet subscription rates, but low-income households experience larger gaps.** According to American Community Survey (ACS) data, 83.7 percent of households in the County subscribe to residential internet services via wireline technology (cable, fiber, or DSL), which is higher than the state figure of 80.4 percent and the national figure of 73.3 percent. However, among households without wired broadband services, 76.2 percent earn less than $75,000 annually. This figure, in addition to the low ACP enrollment rate, points to further need for programs to connect households with programs that provide discounts or subsidies for broadband subscriptions.

- **Most respondents to the survey conducted for this report said they have the skills required to perform basic tasks on the internet, but lower-income households face greater skills gaps—and some would attend classes if available.** Overall, most respondents are 'very confident' in their internet and computer skills, such as sending and receiving emails (80 percent) or accessing medical/telehealth resources (72 percent). These high percentages also pertained to seniors; for example, 75 percent were very confident in their ability to access medical or telehealth services. But lower-income residents express markedly less confidence. For example, those that earn less than $50,000 per year are less likely to feel very confident than all other income brackets in sending and receiving emails (76 percent) or accessing telehealth resources (66 percent).

Regarding demand for digital skills classes, there is moderate interest, with 14 percent of all respondents saying they would be somewhat or very likely to attend such a class. Adult English language learners who participated in focus groups for this assessment also expressed a desire to take digital skills classes. Respondents to the survey mirrored this interest, with 13.5 percent of seniors (approximately 9,800 Barnstable County residents)

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[7] Estimates of eligible households are based on CTC's analysis of 2022 American Community Survey reported data on household income, food stamp recipiency, Medicaid recipiency, supplemental security income, and public assistance income. It is important to note that this estimate does not take into account all qualification mechanisms, such as qualification via tribal assistance programs, and therefore may represent an underestimate of the size of eligible populations throughout the state.

and 21.6 percent of individuals aged 40-49 (approximately 4,500 residents) stating they would be somewhat or extremely likely to attend a digital skills class.

- **Census survey data show that 85.6 percent of households in Barnstable County own a desktop or a laptop; respondents to the survey conducted for this report reported higher percentages, and the survey found that low-income households face challenges in affording replacements.** Desktop/laptop ownership per ACS data (85.6 percent) is higher than the state figure of 82.8 percent and the national figure of 79.3 percent, but still points to gaps that could be addressed through device provision programs, subsidies, and partnerships with nonprofits in this space.

  The residential survey conducted for this report shows higher numbers but still a gap; 97 percent of households earning $100,000-$150,000 report having computers in good working order, while the figure for households earning less than $100,000 (and less than $50,000) is 88 percent.

  Of more concern is device insecurity for low-income households; only 29 percent of those in households earning less than $50,000 annually reported they could replace a lost or broken computer within a day, compared to approximately one-half of those earning $50,000 or more, suggesting that this population will face the biggest need for device provision programs on Cape Cod.

3. Fixed broadband service analysis

This section describes the fixed broadband (mostly Comcast cable, Verizon fiber and fixed wireless) environment in Barnstable County, and options for expanding fiber service availability. Most residential and small business addresses have only the option of Comcast for high-speed broadband service. Significant numbers of residents are very concerned about the speed and quality of available cable broadband service, and speed tests show that Cape Cod experiences seasonal degradation of fixed broadband services. Major ISPs and other entities are actively exploring and seeking funding for fiber buildouts or extensions on Cape Cod.

3.1   Existing conditions

The following analysis of existing broadband availability and usage on Cape Cod is based on publicly available data, including the FCC's National Broadband Map and the U.S. Census Bureau's American Community Survey. The National Broadband Map currently is the most granular and comprehensive national data set regarding broadband services. The FCC has a challenge process to refine the National Broadband Map, which may impact the coverage reported in future iterations of the map. The FCC updates the National Broadband Map's availability data on an ongoing basis as it resolves challenges or receives additional updates, and it issues new versions of the map around June 30 and November 30 each year.[8]

3.1.1 Almost all addresses in Barnstable County are considered served by broadband

The passage of the Infrastructure Investment and Jobs Act (IIJA) by Congress created grant programs that define 100/20 service as the threshold for locations to be considered "served." Any area with service between 25/3 and 100/20 is considered "underserved."[9] Almost all addresses in the County[10] have access to broadband at speeds of at least 100/20 Mbps, mostly from Comcast. In total, 144,374 addresses in the County, or 99.57 percent of all addresses, are considered served, as shown in Table 2.

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[8] Federal Communications Commission, Public Notice DA 23-69, January 25, 2023, https://docs.fcc.gov/public/attachments/DA-23-69A1.pdf (accessed February 20, 2023). The data used in this section were current as of November 14, 2023.

[9] "NTIA's Role in Implementing the Broadband Provisions of the 2021 Infrastructure Investment and Jobs Act," NTIA, https://broadbandusa.ntia.doc.gov/news/latest-news/ntias-role-implementing-broadband-provisions-2021-infrastructure-investment-and.

[10] As noted earlier, while FCC data used in the following analysis provides address-level information, a physical address or location may have more than one household or unit, as is the case with duplexes and apartment buildings. Where an address or location is serviced by a single provider or technology, an assumption can be made that the same is true for all households or units contained therein.

Table 2: Broadband service on Cape Cod by address and unit

Status	Addresses (may include two or more housing units per address)	Percentage of addresses	Unit count	Percentage of units
Served (100/20 or higher available)	144,374	99.57%	180,533	99.57%
Underserved (25/3 to 100/20)	125	0.09%	148	0.08%
Unserved (less than 25/3)	492	0.34%	629	.35%
TOTAL	**144,991**		**181,310**	

3.1.1.1   Fiber broadband availability

Fiber is considered "future-proof" infrastructure—meaning infrastructure that requires little extra cost to increase speeds in the future and lasts for decades. Fiber also readily enables symmetrical speeds (the same upload as download speeds) that can easily scale to multi-gigabit capacity, which will best accommodate future bandwidth needs.

For residential customers, fiber access to homes is relatively limited on the Cape, except for the Verizon Fios deployment in Bourne. As noted above, Verizon has recently received awards under the MBI Gap Networks Grant Program to close broadband gaps in seven Cape Cod towns—Brewster, Falmouth, Harwich, Mashpee, Sandwich, Wellfleet, and Yarmouth. The grant monies are to pay for reaching unserved or underserved locations by the end of 2026. However, the company could then go on to complete ubiquitous fiber buildouts in those towns in the next several years. OpenCape is a middle-mile fiber network (please see Appendix C for a discussion of fiber network types and the broadband market structure) that serves institutions, large businesses, and some business districts on Cape Cod, as well as providing fiber backhaul to some mobile providers. OpenCape only provides residential services under special arrangements. Other providers also offer fiber for large enterprises and institutions in select areas on Cape Cod.

ISPs offering residential fiber service in limited areas of Cape Cod include Comcast and Verizon. Table 3 shows the availability of residential fiber by town. Overall, less than 2 percent of addresses can sign up for fiber internet service. This is far less than is the case statewide or in adjacent Plymouth or Bristol Counties, as shown in Table 4. (OpenCape's limited residential connections are not documented in FCC data.)

Table 3: Fiber access by municipality[11]

Municipalities of Barnstable County	Addresses with fiber	Total addresses	Percent with fiber	Units with fiber	Total units	Percent with fiber
Barnstable	59	24,154	0.244%	224	31,622	0.708%
Bourne	2,018	9,590	21.043%	2,321	11,924	19.465%
Brewster	46	6,767	0.680%	121	8,581	1.410%
Chatham	10	6,903	0.145%	12	8,448	0.142%
Dennis	116	14,061	0.825%	140	17,175	0.815%
Eastham	8	5,803	0.138%	14	6,161	0.227%
Falmouth	47	20,905	0.225%	173	25,999	0.665%
Harwich	6	9,626	0.062%	10	11,267	0.089%
Mashpee	58	8,808	0.658%	354	12,109	2.923%
Orleans	14	4,754	0.294%	41	6,132	0.669%
Provincetown	20	2,311	0.865%	106	4,192	2.529%
Sandwich	189	9,616	1.965%	407	11,695	3.480%
Truro	1	2,805	0.036%	1	3,193	0.031%
Wellfleet	1	3,837	0.026%	1	4,155	0.024%
Yarmouth	128	15,051	0.850%	343	18,657	1.838%
Total	**2,721**	**144,991**	**1.877%**	**4,268**	**181,310**	**2.364%**

Table 4: Fiber access by region

Region	Addresses with fiber	Total addresses	Percent with fiber
Statewide	901,838	1,939,692	46.49%
Barnstable County	2,721	144,991	1.88%
Bristol County	54,328	169,643	32.03%
Plymouth County	109,501	176,284	62.12%

Figure 1 shows current fiber availability in Barnstable County. This map is based on FCC data reflecting reported service as of June 2024. It demonstrates the expansion of fiber availability throughout the Cape.

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11 Source: FCC National Broadband Map, December 31, 2023 (Version 4), BDC data December 31, 2023 (Version 4), updated June 11, 2024.

Figure 1: Fiber availability on Cape Cod
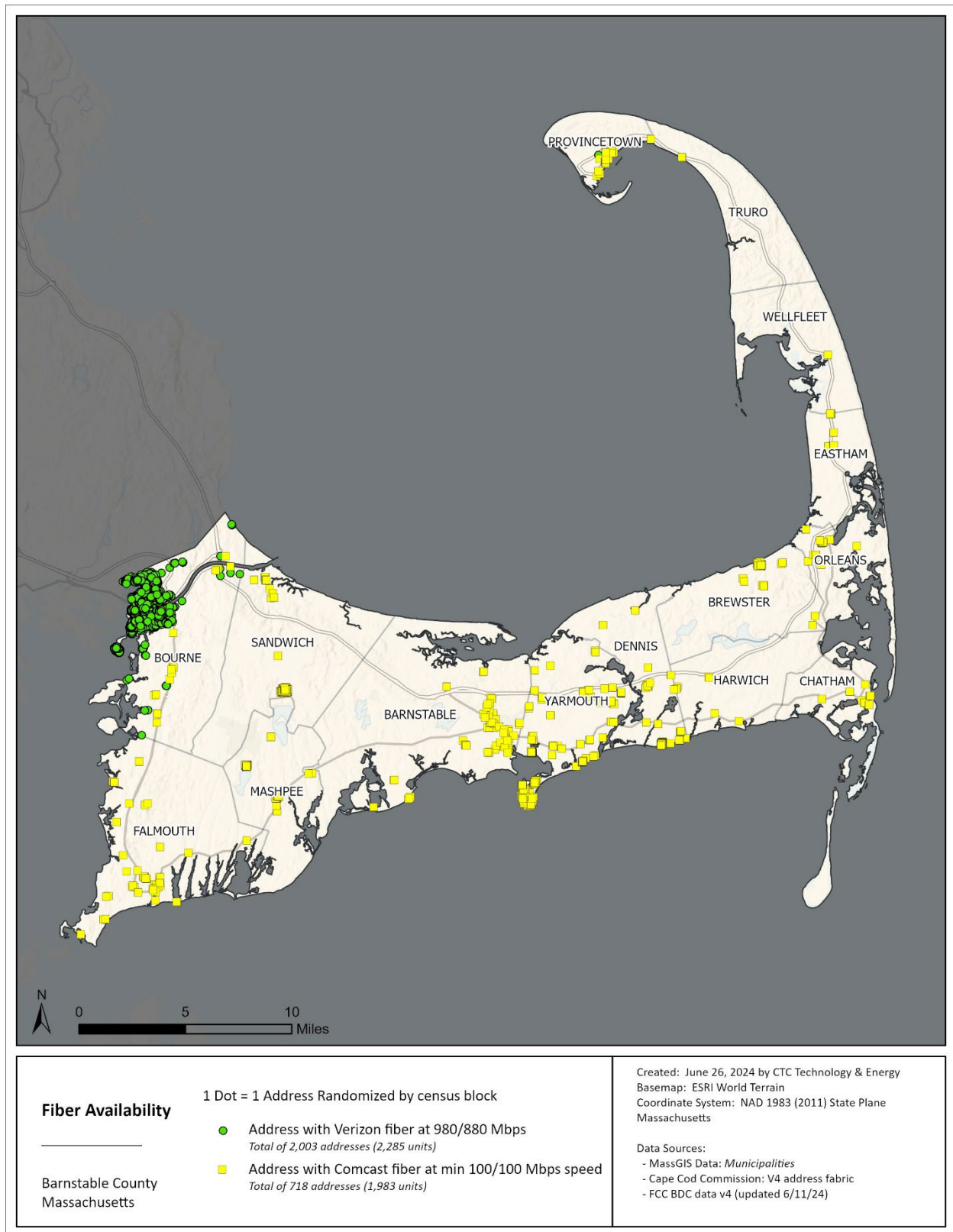
3.1.1.2   *OpenCape fiber availability*

OpenCape is a nonprofit that owns and operates a fiber network built to serve local governments, businesses, and residents of Cape Cod and other parts of southeastern Massachusetts. It provides fiber connectivity to several hundred institutions, including libraries, government buildings, schools, colleges, hospitals, public safety agencies, and research institutions. In addition, it serves larger businesses that rely on high-speed Internet access and data transfers. It has deployed downtown fiber solutions for smaller businesses in Woods Hole, Falmouth, Hyannis, and Buzzards Bay.

OpenCape connects nearly all schools on Cape Cod including in the Bourne, Falmouth, Barnstable, Mashpee, Nauset, Provincetown, and Monomoy Regional school districts. These districts have connected to OpenCape fiber to enable high-speed bandwidth to provide the capacity to support mobile devices and online teaching tools. The Town of Falmouth used OpenCape infrastructure to create a municipal network of 19 town buildings.

For homeowners who need enterprise-grade service, are near the OpenCape network, and are willing to pay for the connection, OpenCape can offer dedicated symmetrical service—but residential service is currently offered only in special cases as the installation and service are expensive when compared to cable. OpenCape said it has applied for an MBI gap grant in the Town of Barnstable but was denied.[12] OpenCape has also said it is in talks with possible partners to perform fiber-to-the-premises buildouts in some towns.

3.1.1.3   *Cable broadband availability*

According to data reported to the FCC by Comcast, Comcast dominates the market in Barnstable County, serving all but 582 of 144,991 addresses.[13] Table 5 shows the numbers of addresses and units by municipality that do not have access to Comcast service. Only 0.4 percent of Cape addresses (0.45 percent of units) lack access to Comcast service.

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[12] "News & Customer Spotlights: OpenCape applies for Mass Broadband GAP Grants," OpenCape, December 19, 2023, https://opencape.org/news/opencape-applies-for-mass-broadband-gap-grants.

[13] The Cape Cod Commission and the Towns have access to address-level data about addresses without Comcast service, but this information cannot be republished here because of a legal arrangement between the FCC and its mapping contractor. In an email exchange, Comcast reported that the number of unserved is just 325, which may reflect more recent data than what appears on the FCC's National Broadband Map.

Table 5: Addresses and units without Comcast service

Municipality	Addresses without Comcast	Total addresses	Percent without Comcast	Units without Comcast	Total units	Percent without Comcast
Barnstable	115	24,154	0.476%	116	31,622	0.367%
Bourne	32	9,590	0.334%	106	11,924	0.889%
Brewster	20	6,767	0.296%	24	8,581	0.280%
Chatham	20	6,903	0.290%	20	8,448	0.237%
Dennis	34	14,061	0.242%	50	17,175	0.291%
Eastham	34	5,803	0.586%	38	6,161	0.617%
Falmouth	34	20,905	0.163%	39	25,999	0.150%
Harwich	29	9,626	0.301%	31	11,267	0.275%
Mashpee	44	8,808	0.500%	45	12,109	0.372%
Orleans	11	4,754	0.231%	12	6,132	0.196%
Provincetown	1	2,311	0.043%	2	4,192	0.048%
Sandwich	29	9616	0.302%	31	11695	0.265%
Truro	83	2805	2.959%	105	3193	3.288%
Wellfleet	67	3837	1.746%	71	4155	1.709%
Yarmouth	29	15051	0.193%	22	18657	0.118%
Total	**582**	**144,991**	**0.401%**	**712**	**181,310**	**0.45%**

3.1.1.4 *Comcast has made significant but selective network upgrades in the past two years*

A review of FCC data releases show that in 2022 and 2023, Comcast made significant investments in network upgrades in some parts of Cape Cod. In June 2022, Comcast did not offer 2000/200 Mbps service at any addresses on Cape Cod. However, in June 2023, 11,316 addresses (or 14,874 units) could receive 2000/200 Mbps service—and that number has increased to 40,171 addresses (or 51,604 units) as of June 2024.[14] These data are shown in Table 6 below. The data are shown on maps in Figure 2 and Figure 3, revealing that the investment was particularly intensive in

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[14] Source: FCC National Broadband Map, December 31, 2023 (Version 4), BDC data December 31, 2023 (Version 4), updated June 11, 2024.

Falmouth and Mashpee. Falmouth has been pursuing options for a fiber alternative to Comcast, and the Mashpee Wampanoag tribe recently received a federal grant to build fiber.

These changes reflect investments by Comcast in the newest Data Over Cable Service Interface Specification (DOCSIS) industry standard, known as DOCSIS 4.0. Most cable companies have implemented DOCSIS 3.1, which allows near or just above gigabit download speeds but offers far slower upload speeds. But the newest generation, DOCSIS 4.0 (previously called DOCSIS 3.1 Full Duplex) has significantly increased upload speeds.

Table 6: Addresses and units with Comcast service at 2000/200 speeds[15]

Town	Addresses June 2022	Units June 2022	Addresses June 2023	Units June 2023	Addresses June 2024	Units June 2024
Barnstable	0	0	707	1,113	6,099	7,872
Bourne	0	0	0	0	277	326
Brewster	0	0	408	455	430	533
Chatham	0	0	205	352	1,281	1,760
Dennis	0	0	0	0	1	4
Eastham	0	0	0	0	1,592	1,641
Falmouth	0	0	4,159	4,672	20,323	25,231
Harwich	0	0	0	0	0	0
Mashpee	0	0	5,829	8,274	8,759	12,059
Orleans	0	0	0	0	402	442
Provincetown	0	0	0	0	873	1,569
Sandwich	0	0	8	8	36	60
Truro	0	0	0	0	93	101
Wellfleet	0	0	0	0	5	6
Yarmouth	0	0	0	0	0	0
Total			**11,316**	**14,874**	**40,171**	**51,604**

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[15] Source: FCC National Broadband Map, December 31, 2023 (Version 4), BDC data December 31, 2023 (Version 4), updated June 11, 2024.

Figure 2: Locations served by Comcast at 2000/200 Mbps as of June 2023

**2000/200 Availability
V3 Fabric**

———————

Barnstable County
Massachusetts

1 Dot = 1 Address Randomized by census block

● Address served by 2000/200 Mbps
   Total of 11,316 addresses (14,8744 units)

Created: June 26, 2024 by CTC Technology & Energy
Basemap: ESRI World Terrain
Coordinate System: NAD 1983 (2011) State Plane
Massachusetts

Data Sources:
 - MassGIS Data: *Municipalities*
 - Cape Cod Commission: v3.2 address fabric
 - FCC BDC data v3 (updated 6/2/2023)

Figure 3: Locations served by Comcast at 2000/200 Mbps speeds as of June 2024

**2000/200 Availability
V4 Fabric**

Barnstable County
Massachusetts

1 Dot = 1 Address Randomized by census block

● Address served by 2000/200 Mbps
Total of 40,171 addresses (51,604 units)

Created: June 26, 2024 by CTC Technology & Energy
Basemap: ESRI World Terrain
Coordinate System: NAD 1983 (2011) State Plane
Massachusetts

Data Sources:
- MassGIS Data: *Municipalities*
- Cape Cod Commission: V4 address fabric
- FCC BDC data v4 (updated 6/11/24)

3.1.1.5   Fixed wireless availability

T-Mobile and Verizon both have a relatively large fixed wireless footprint on Cape Cod (known technically as "licensed fixed wireless" or LFW). This allows residential customers to obtain home broadband services, branded as "5G Home Internet," from wireless networks. T-Mobile reports that its service reaches 120,916 addresses, and Verizon reports reaching 31,965 addresses. Speeds delivered will vary considerably by location, depending on distance from wireless facilities and the level of network usage. The following four figures depict this coverage by the four Cape regions.

Figure 4: T-Mobile and Verizon licensed fixed wireless coverage in the Upper Cape

LFW Providers
_____

Upper Cape
Barnstable County
Massachusetts

☐ Municipal boundaries

LFW Providers
1 Dot = 1 address randomized by census block
🟢 Address served by T-Mobile & Verizon
🟡 Address served by T-Mobile only
🔵 Address served by Verizon only

Created: March 12, 2024 by CTC Technology & Energy
Basemap: ESRI World Terrain
Coordinate System: NAD 1983 (2011) State Plane
Massachusetts
Data Sources:
- MassGIS Data: *Municipalities*
- Cape Cod Commission: v3.2 address fabric
- FCC BDC data v3 (updated Nov 14, 2023)

Figure 5: T-Mobile and Verizon licensed fixed wireless coverage in the Mid Cape
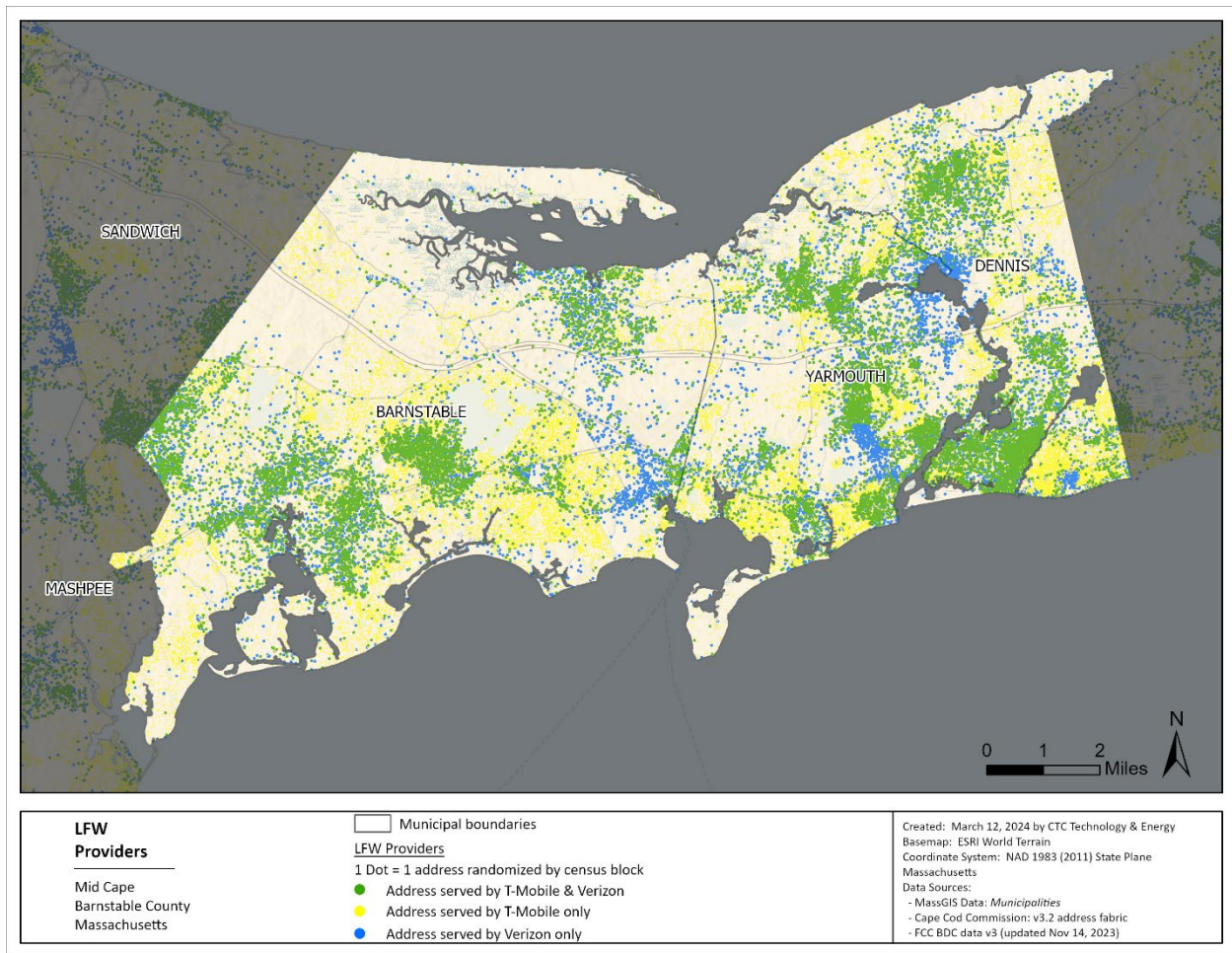
Figure 6: T-Mobile and Verizon licensed fixed wireless coverage in the Lower Cape
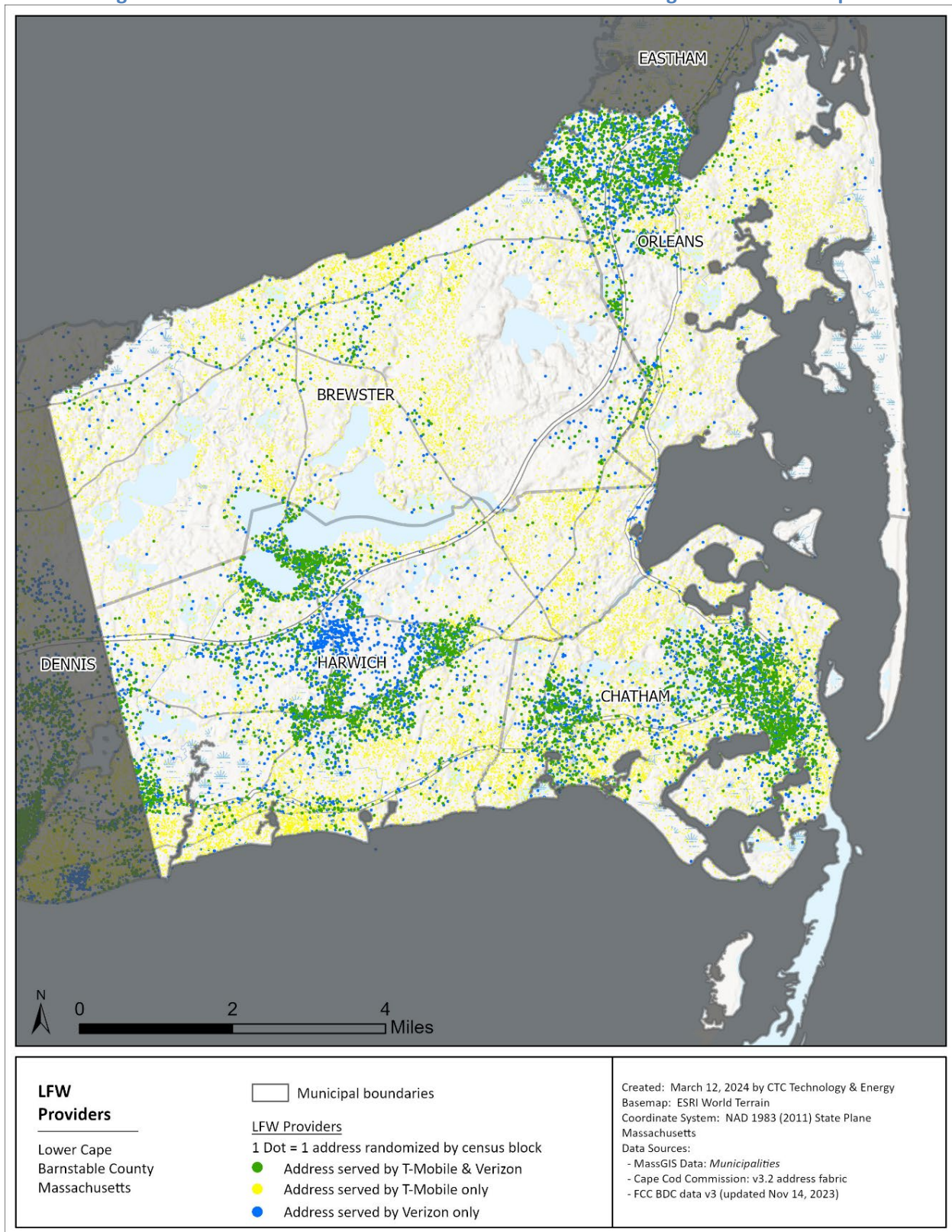
Figure 7: T-Mobile and Verizon licensed fixed wireless coverage in the Outer Cape
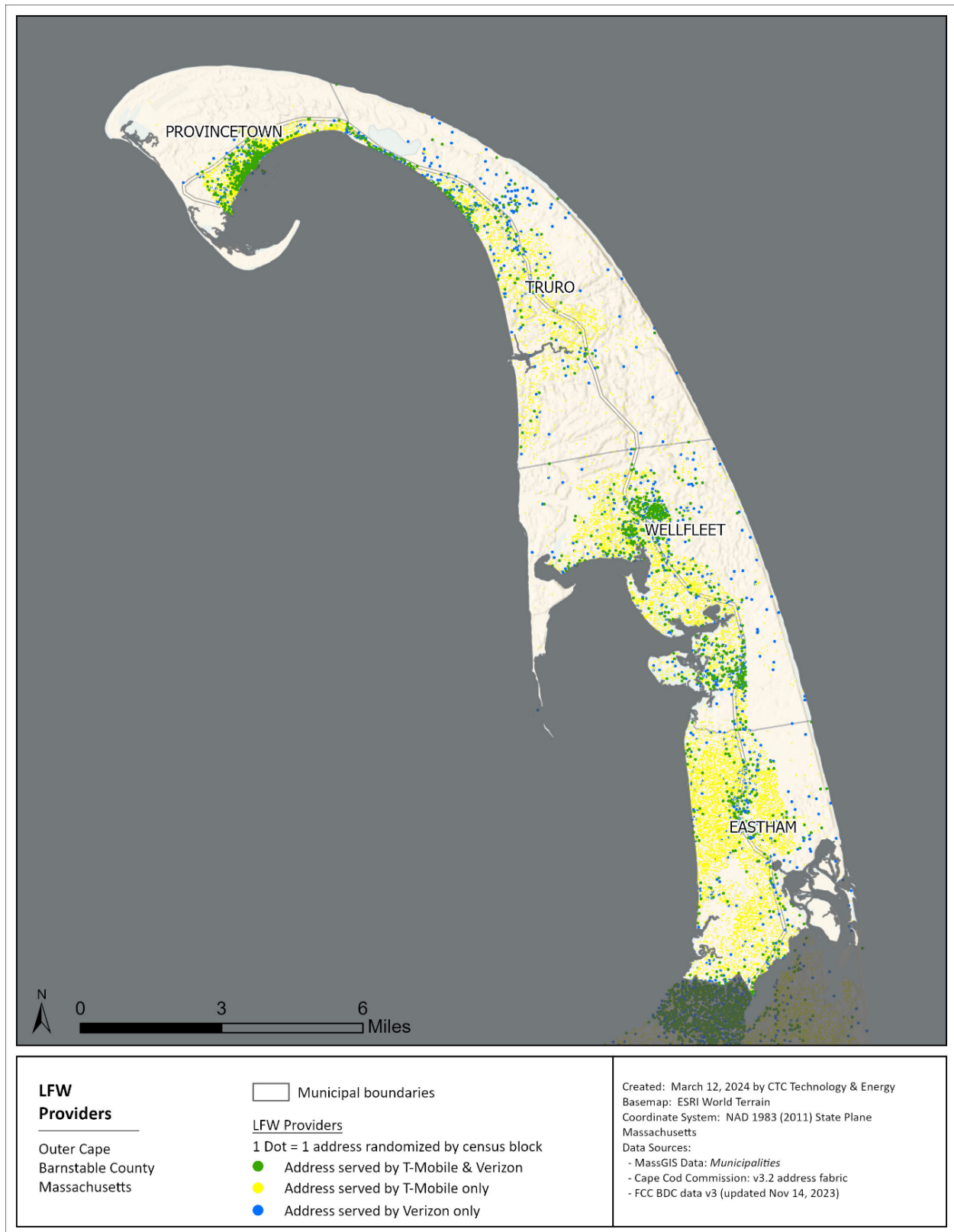
Despite the widespread availability of licensed fixed wireless service on the Cape, a relatively small percentage of these locations can obtain speeds of 100/20 or higher. According to FCC data, such coverage is available to 26,229 addresses, or 18 percent (see Figure 8). But such data should be regarded with caution, because actual speeds available will depend on number of users and their distance from wireless facilities.

Figure 8: Licensed fixed wireless availability by speed
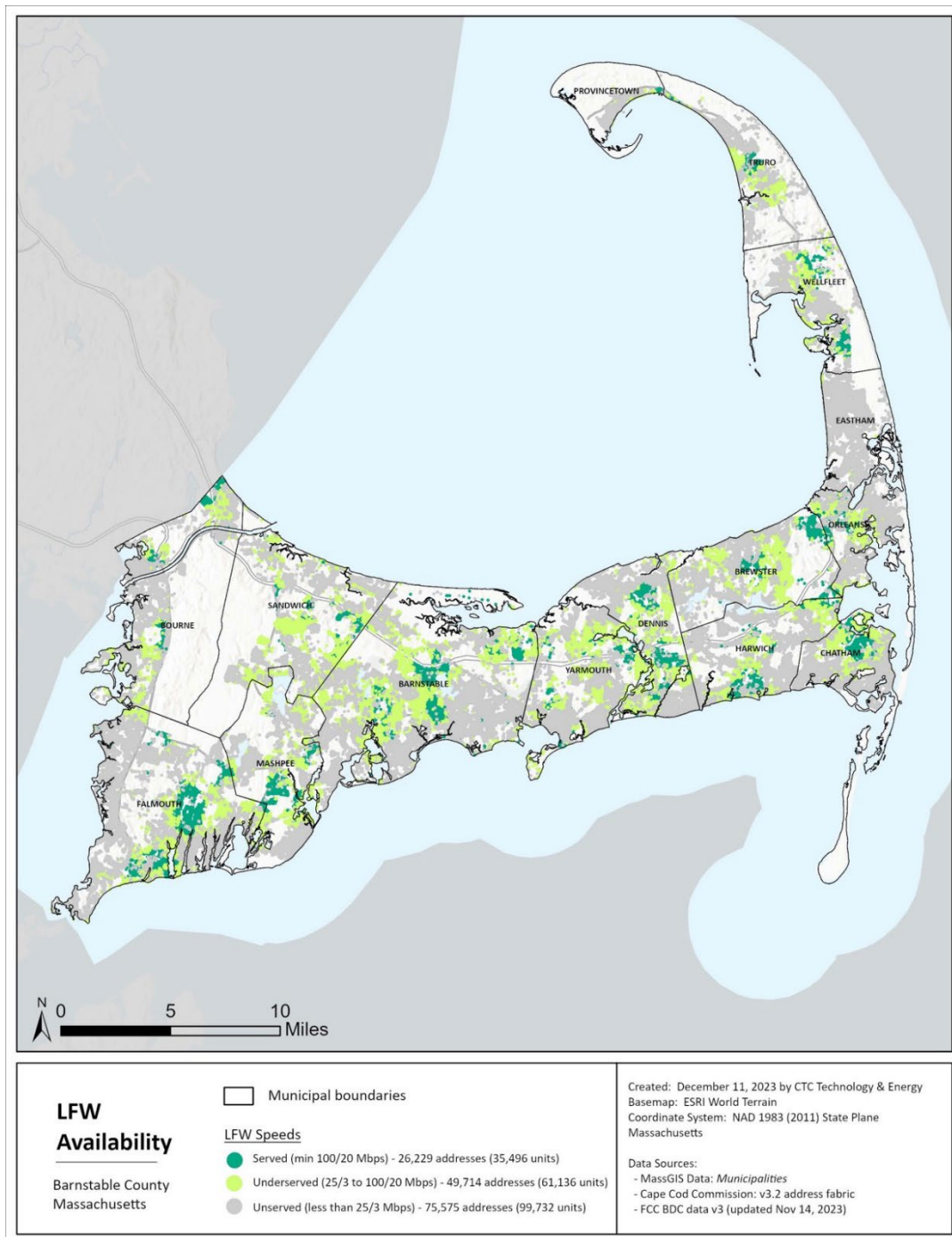
3.1.1.6   *DSL availability*

Digital subscriber line (DSL) technology was developed to carry data over telephone wires in tandem with simultaneous phone calls, and usually with no additional wiring necessary. DSL typically delivers speeds below 25/3 Mbps, and well below the federal standard of 100/20 Mbps. Telecommunications companies are also reluctant to further invest in maintenance of this legacy infrastructure.

Based on the FCC's June 2023 data, 78,056 Cape addresses are served by DSL at speeds of 10/1 Mbps or less, and 8,440 addresses have service of between 10/1 and 25/3 Mbps (Figure 9). The primary service provider for DSL is Verizon.

<p align="center">Figure 9: DSL availability by speed</p>
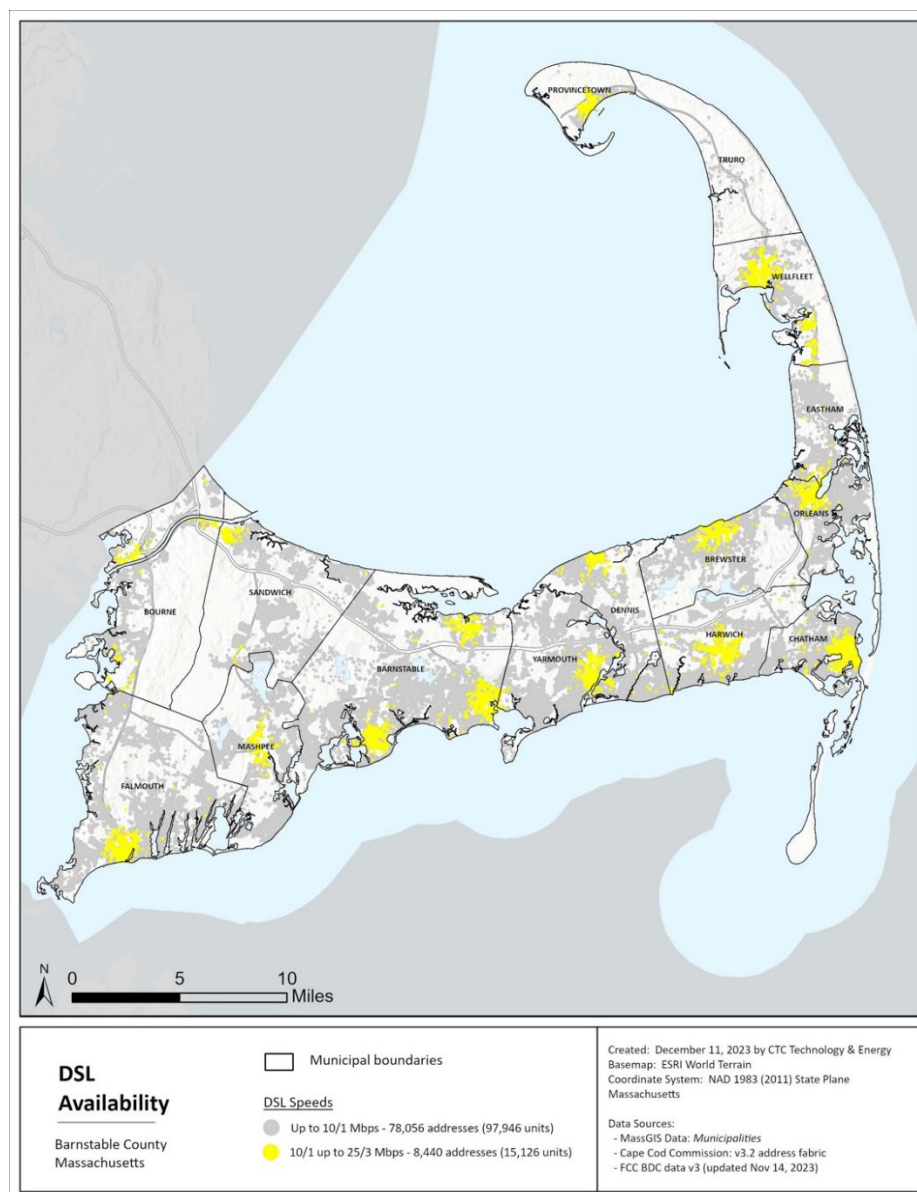
3.1.2 Other than in Bourne, there is at present limited competition for high-speed broadband service on Cape Cod, with most competition coming from fixed wireless services

Other than in Bourne—which has Verizon Fios fiber competition—and isolated fiber builds by OpenCape in downtown areas, there is very little competition on Cape Cod among broadband providers that offer minimum speeds of 100/20 Mbps or greater. Where there is a choice elsewhere at present, it is generally from the fixed wireless services T-Mobile 5G Home Internet and Verizon 5G Home Internet.

Data on fixed wireless services reported by these companies to the FCC should be treated with caution, because availability depends on distance from the premises to the wireless facilities and bandwidth constraints. Figure 10 shows the locations where providers other than Comcast report service at 100/20 or greater. Of the 144,991 serviceable addresses on the Cape, only 23,454 can subscribe to more than one service at 100/20 or higher—and most of these, other than in Bourne, are from T-Mobile 5G Home Internet or Verizon 5G Home Internet and tend to be in downtown areas.

The number of locations served by multiple providers increased substantially in 2024. As shown in Figure 10, there are now pockets of competition throughout the entire Cape.

Figure 10: Locations with service of 100/20 from a provider other than Comcast; most are fixed wireless

Locations Served by Multiple Providers

Barnstable County Massachusetts

1 Dot = 1 Address Randomized by census block

● Address served by 100/20 Mbps
Total of 23,454 addresses (30,259 units)

Created: June 26, 2024 by CTC Technology & Energy
Basemap: ESRI World Terrain
Coordinate System: NAD 1983 (2011) State Plane Massachusetts

Data Sources:
- MassGIS Data: *Municipalities*
- Cape Cod Commission: V4 address fabric
- FCC BDC data v4 (updated 6/11/24)

3.1.3 Speed tests show Cape Cod users experience seasonal degradation of Comcast and other fixed broadband services, but do not reveal gaps in service availability

To investigate stakeholder reports of degraded performance during Cape Cod's summer high season, this study used speed test data[16] to analyze network performance trends.

An individual speed test may not accurately reflect the speeds typically delivered by an ISP to a location. Speed tests measure a user's experience of internet speeds at a moment in time. While instances of slow speeds or service interruptions can be the fault of the ISP because of oversubscription or network outages, they also can be the result of factors that are beyond the ISP's control such as Wi-Fi attenuation, malware on a computer, poorly configured or outdated routers, multiple users sharing bandwidth, loss of power, or degraded wiring in the building. However, when aggregated across a region and over time, speed tests depict trends and user experiences, and can provide a counterpoint to ISPs' advertised speeds.

The analysis confirmed widespread user reports of regional network performance challenges. While speeds remained relatively high across technology types and regions, tests demonstrated seasonal slowdowns.

3.1.3.1 Speed tests confirm near ubiquitous fixed broadband coverage at or above 100 Mbps download speeds

To measure regional network performance, this study first used fixed broadband speed test data gathered in 2022 by Ookla—an online speed testing platform that publishes aggregate data on a quarterly basis—and did not also use data from MBI because it did not add additional value to the analysis.[17] "Fixed broadband" means all common broadband technologies other than mobile service, such as DSL, cable, fiber, and fixed wireless. A total of 61,213 tests were used for this analysis. Most such tests are on Cape Cod with Comcast service.

The analysis showed consistent download speeds greater than 100 Mbps (87 percent across the county), aligned with what is to be expected from Comcast service on Cape Cod. Single tests below 100 Mbps do not necessarily mean that Comcast or another provider is incapable of delivering higher speeds to that location; they simply indicate user-experienced speeds were slow on that occasion for one or more of the reasons described above.

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[16] Data sources included Ookla and the Commission's speed test survey arranged by CTC.

[17] The Massachusetts Broadband Institute (MBI) also aggregated speed test results via Ookla from December 2021 through November 2022. The project team chose to focus on more granular data available from Ookla and not to analyze the MBI results because of two aggregation methods employed in the MBI data. First, all speed tests were bucketed into performance tiers (e.g., < 25/3 Mbps, < 50/10 Mbps) without visibility into individual test results in given geographic units. Second, all tests from December 2021 through November 2022 were combined without visibility into when certain speeds were achieved within the date range.

Geographic speed test distribution showed no clear or consistent service gaps. The absence of a speed test in a particular location does not necessarily mean there is lack of coverage—it just means no tests were taken in that area.

The four regions of Cape Cod did not demonstrate dramatically different speed test results, though the Outer Cape had the lowest share of tests above 100 Mbps download at 83 percent, compared to 86 percent of tests in the Upper Cape, 88 percent in the Mid Cape, and 89 percent in the Lower Cape.

The following figures show average fixed download speeds by census block as well as the distribution of tests at various speed tiers across Barnstable County and its four regions in 2022. Appendix D: Town-level average fixed download speeds by census block includes town-level fixed speed test results.

Figure 11: Average fixed download speeds on Cape Cod by census block in 2022
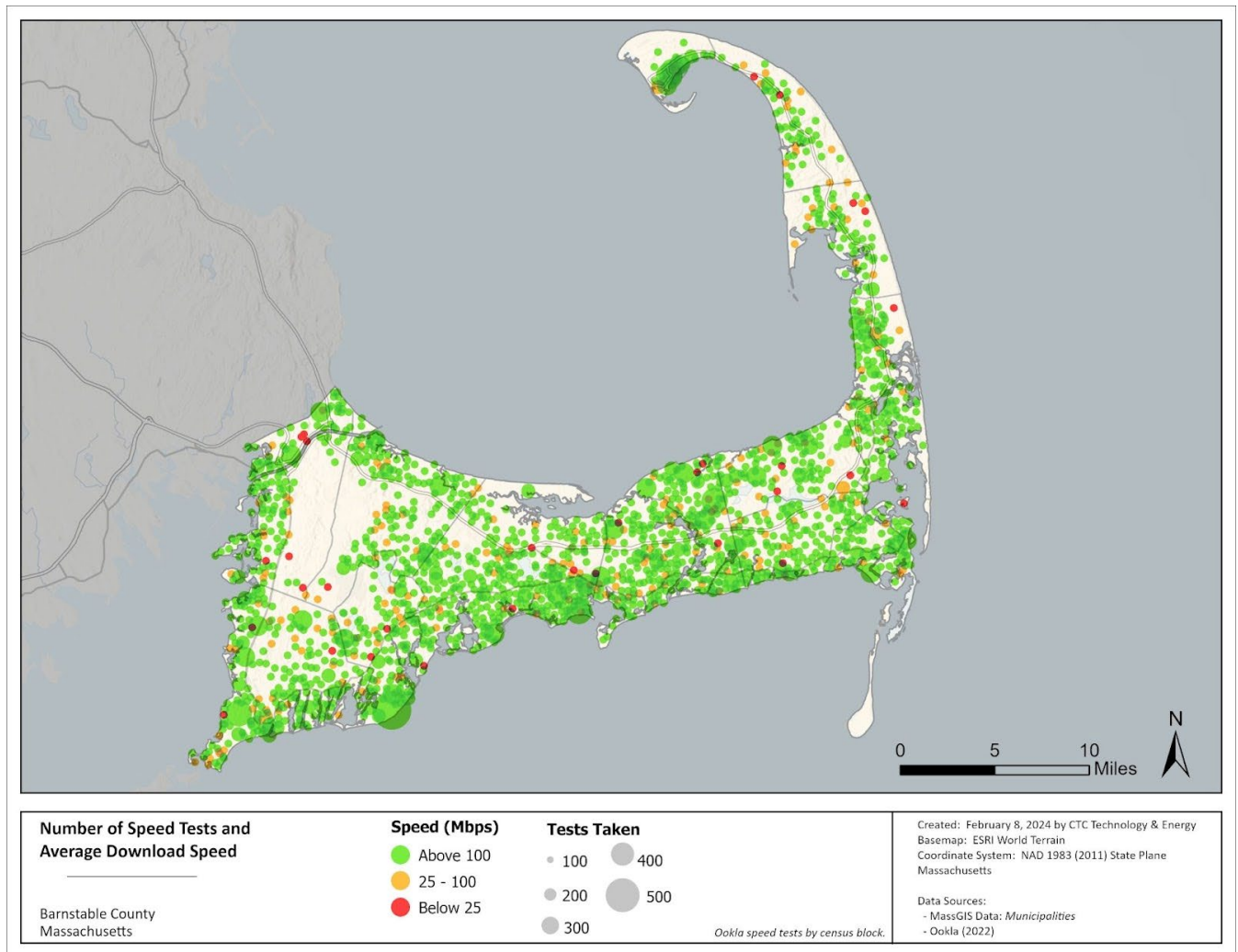
Figure 12: Distribution of average fixed download speed by census block on Cape Cod

Source: Ookla Fixed Speedtest data (2022)

Figure 13: Average fixed download speeds in the Upper Cape by census block in 2022
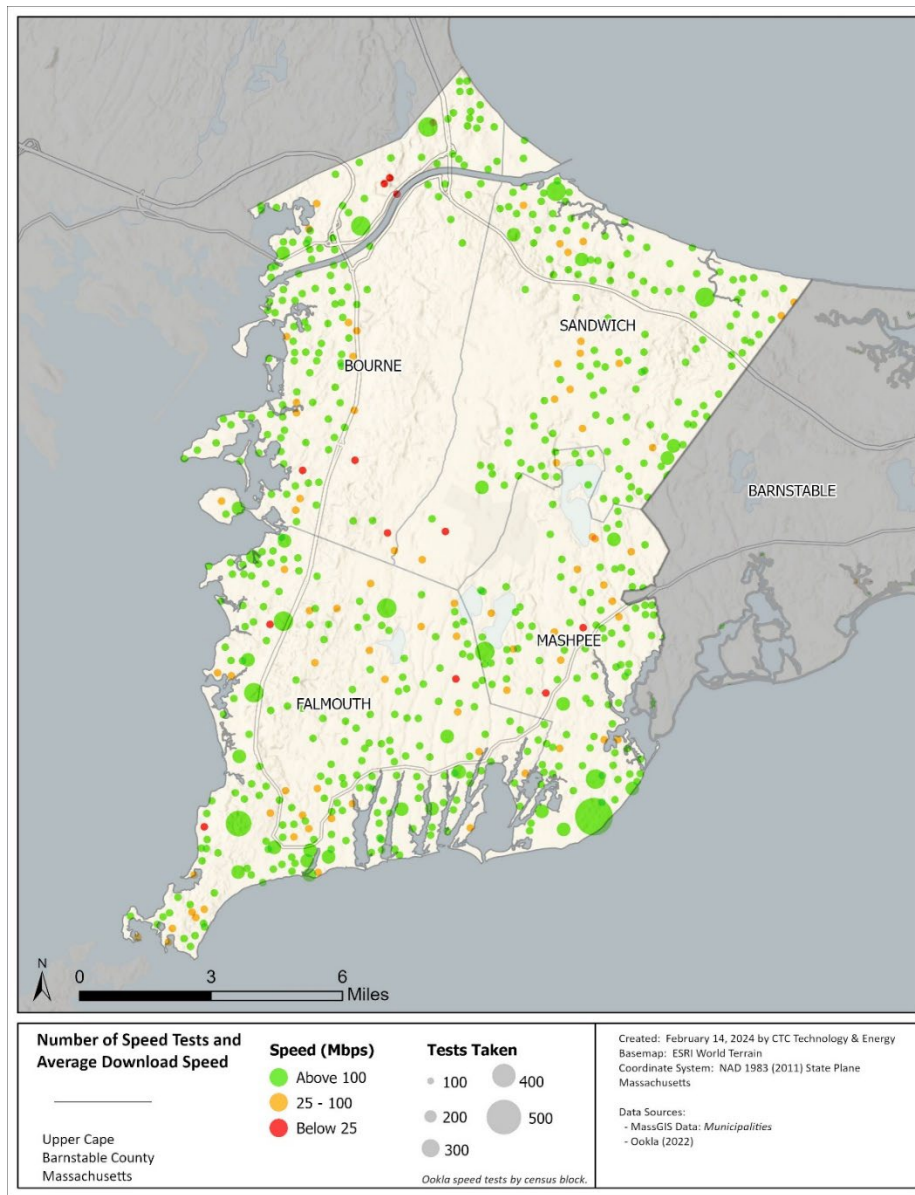
Figure 14: Distribution of average fixed download speed by census block, Upper Cape

Source: Ookla Fixed Speedtest data (2022)
Notes: Upper Cape includes Bourne, Falmouth, Mashpee, and Sandwich

Figure 15: Average fixed download speeds in the Mid Cape by census block in 2022
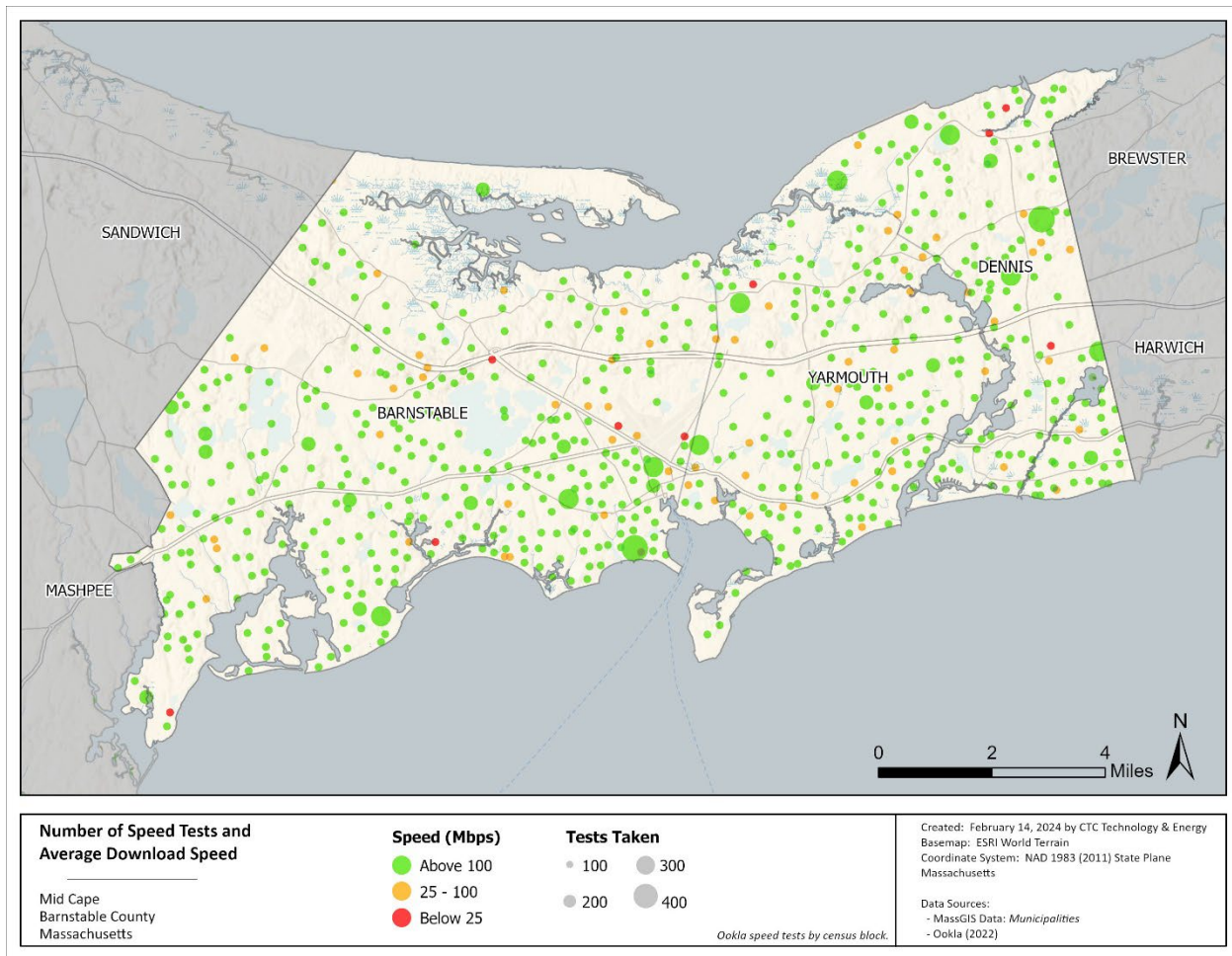
Figure 16: Distribution of average fixed download speed by census block, Mid Cape
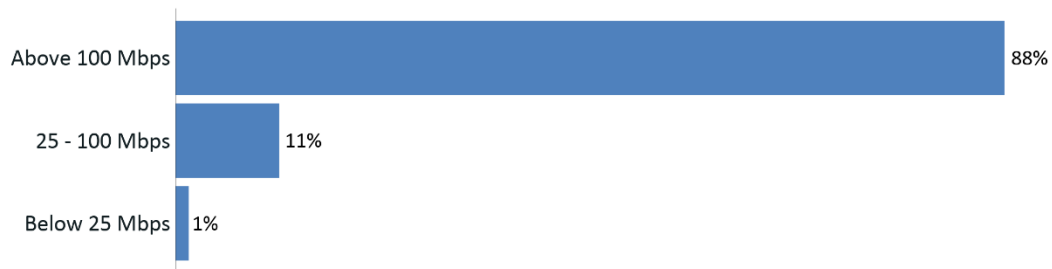
Source: Ookla Fixed Speedtest data (2022)
Notes: Mid Cape includes Barnstable Town, Dennis, and Yarmouth

Figure 17: Average fixed download speeds in the Lower Cape by census block in 2022
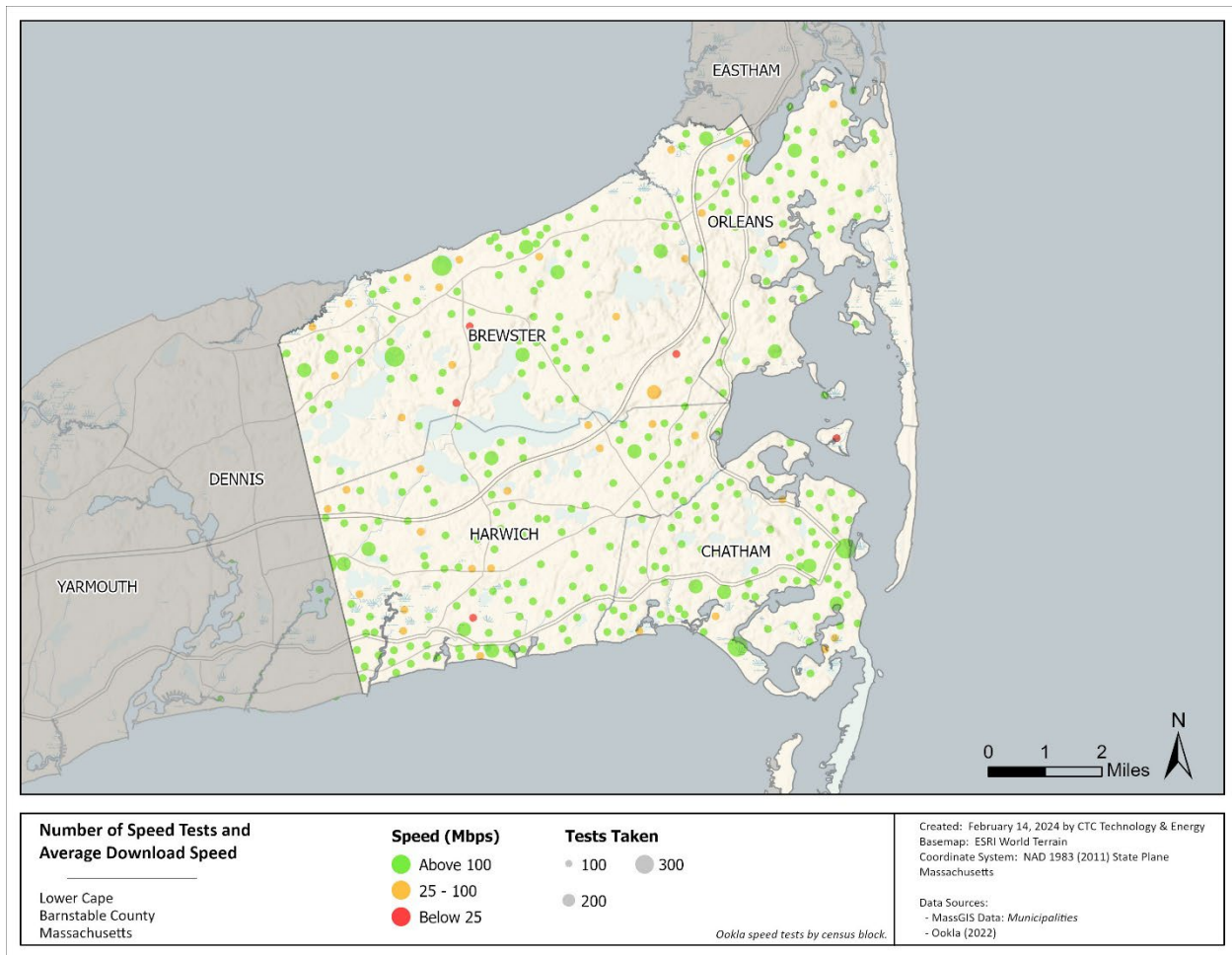
Figure 18: Distribution of average fixed download speed by census block, Lower Cape

Source: Ookla Fixed Speedtest data (2022)
Notes: Lower Cape includes Brewster, Chatham, Harwich, and Orleans

Figure 19: Average fixed download speeds in the Outer Cape by census block in 2022
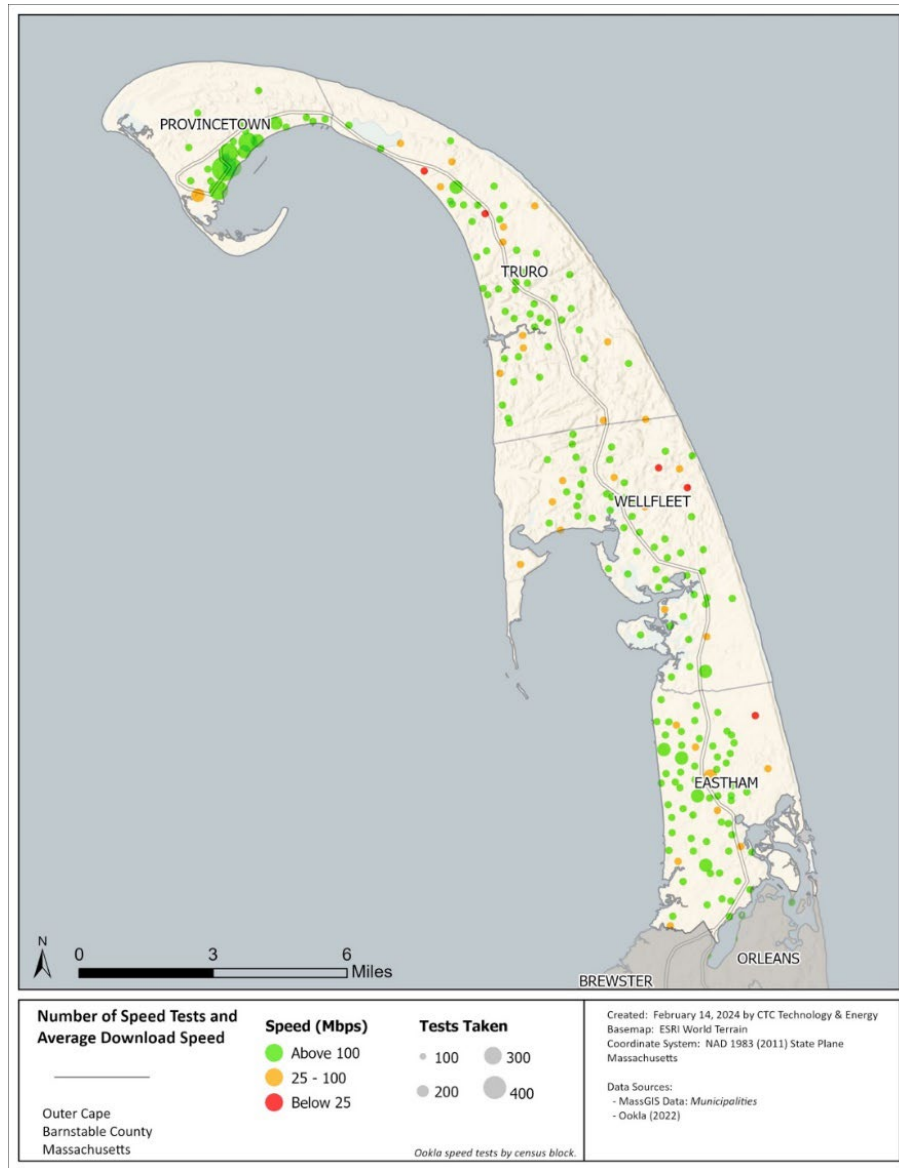
Figure 20: Distribution of average fixed download speed by census block, Outer Cape

Source: Ookla Fixed Speedtest data (2022)
Notes: Outer Cape includes Eastham, Provincetown, Truro, and Wellfleet

3.1.3.2 *Though average speeds are relatively high, Cape Cod experiences degradation of fixed broadband service in the summer high season*

Cape Cod experiences significant population influx during the summer months. Despite widespread fixed broadband availability, there are many anecdotal reports of slower summer speeds. While congestion-based slowdowns can occur on any broadband network, stakeholders consulted for this assessment expressed exasperation with slow summer speeds, and frustration with the lack of publicly available confirmation of their experience. By examining speed test data covering a full year, this analysis demonstrates that Cape Cod faces seasonal network congestion trends that confirm users' anecdotal experience.

The 2022 Ookla fixed speed test data were plotted by Cape Cod region and by quarter. To represent population presence over time, the speed test data were observed alongside population data.[18]

The analysis indicates that, as the Cape's overall population peaks, the average download speed decreases. Decreases in speed occur because there is finite bandwidth provisioned to each node of the Cape's broadband networks, and the bandwidth on the node is shared across more users in summer months, resulting in performance degradation.

This phenomenon is unsurprising in a cable market with limited competition. Provisioning more bandwidth to a network is costly for ISPs, so there is little incentive for any ISP to expand the network to avoid congestion at peak usage times, especially if those peaks only occur for a small portion of the year. There is even less market incentive to take action to decrease congestion in the absence of a competitor.

Figure 21 and Figure 22 show quarterly population change and average download speed for Barnstable County and the four Cape Cod regions in 2022. The data presented under "change in population present" represent the change in average number of cell phones per town, per month. Figure 23 shows the number of speed tests taken per region.

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[18] Source: Placer.ai.

Figure 21: Average fixed download speed and change in population in Barnstable County, 2022
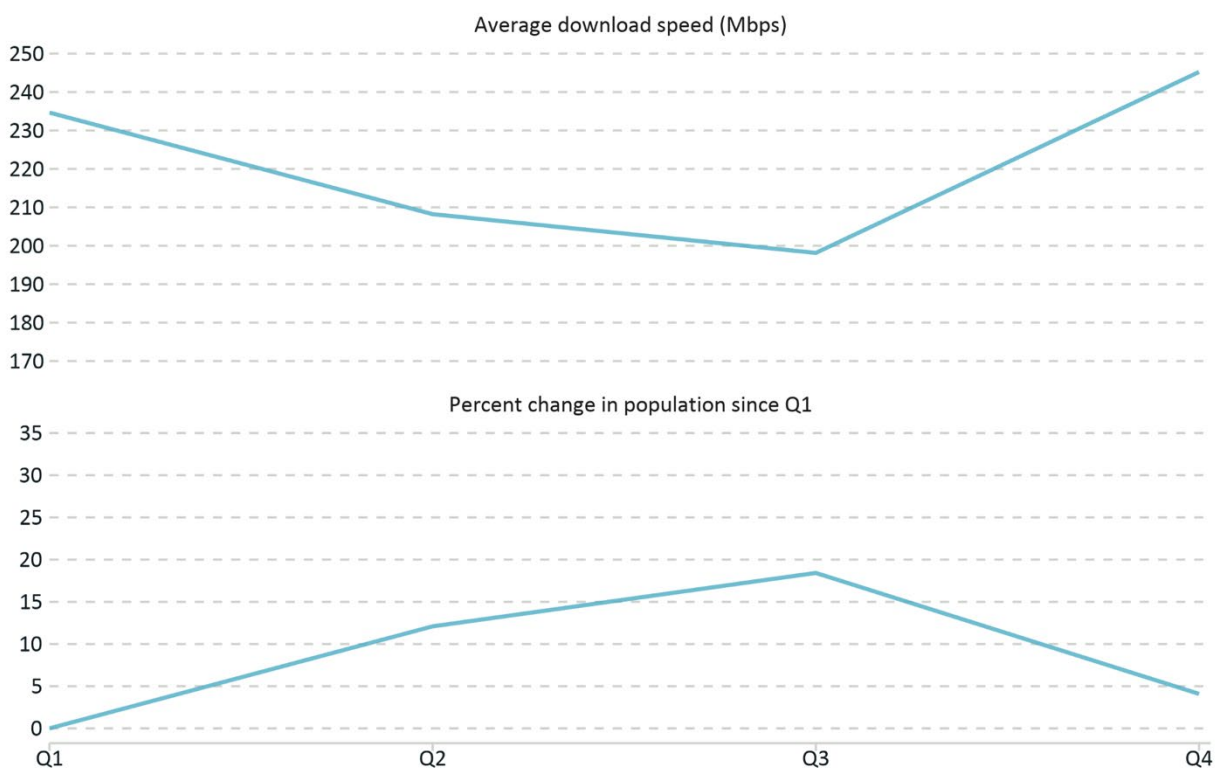
Source: Ookla Fixed Speedtest data (2022), Population estimates extrapolated from cell phone presence data provided by Cape Cod Commission (2022)

Figure 22: Average fixed download speeds and change in population by Cape Cod region, 2022
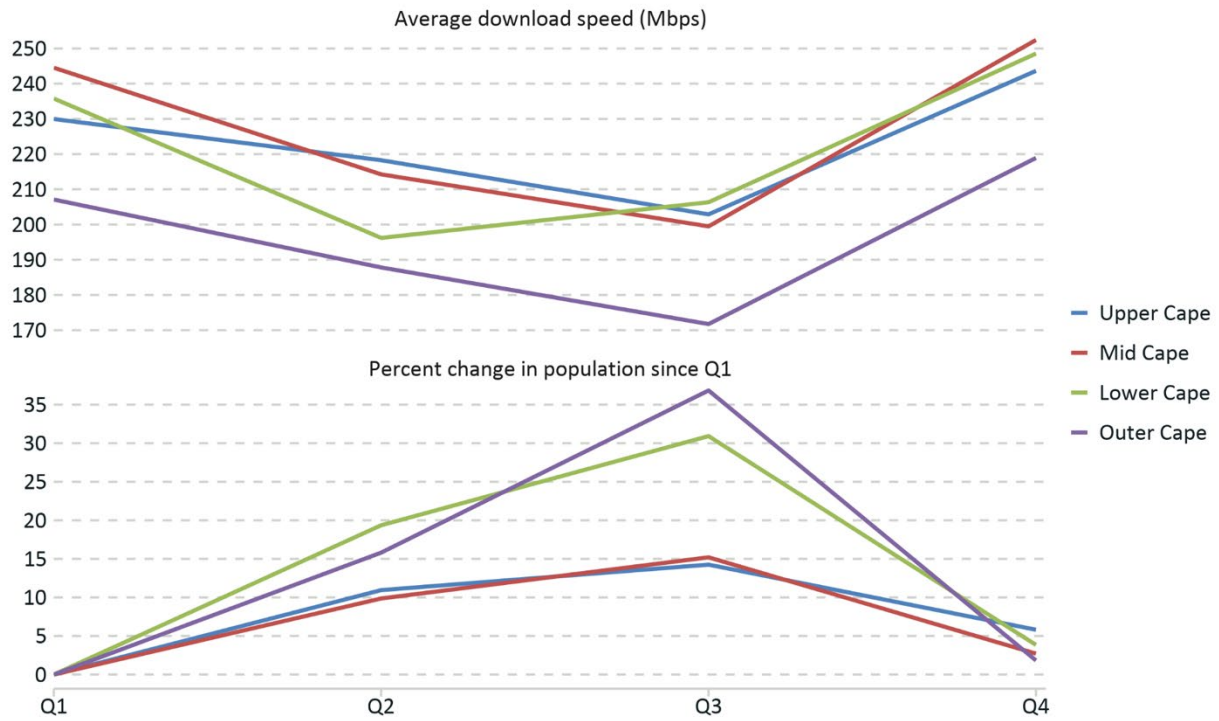
Average download speed (Mbps)

Percent change in population since Q1

Source: Ookla Fixed Speedtest data (2022), Population estimates extrapolated from cell phone presence data provided by Cape Cod Commission (2022)
Notes: Upper Cape includes Bourne, Falmouth, Mashpee, and Sandwich. Mid Cape includes Barnstable Town, Dennis, and Yarmouth. Lower Cape includes Brewster, Chatham, Harwich, and Orleans. Outer Cape includes Eastham, Provincetown, Truro, and Wellfleet.

Figure 23: Number of fixed speed tests taken by region, 2022
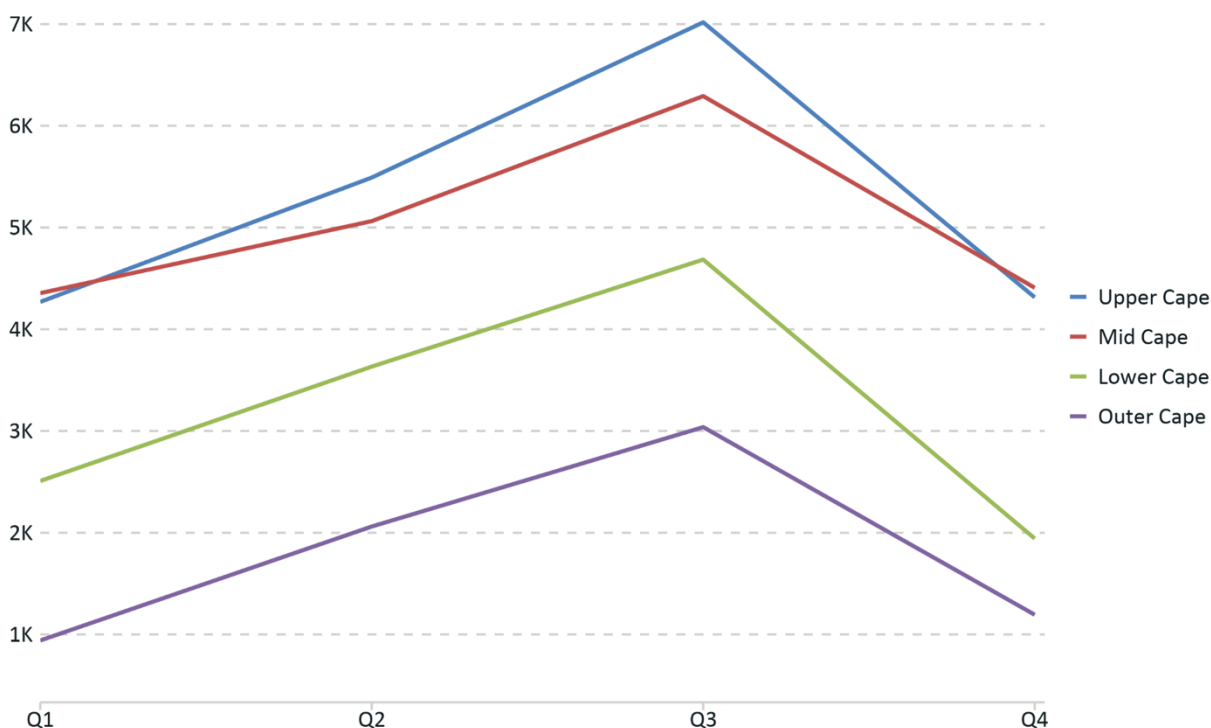
Source: Ookla Fixed Speedtest data (2022)
Notes: Upper Cape includes Bourne, Falmouth, Mashpee, and Sandwich. Mid Cape includes Barnstable Town, Dennis, and Yarmouth.
Lower Cape includes Brewster, Chatham, Harwich, and Orleans. Outer Cape includes Eastham, Provincetown, Truro, and Wellfleet.

While all regions clearly show seasonal slowdowns, the Outer Cape has the highest percentage change in population and the slowest year-round speeds in the analysis. (The Outer Cape also had the fewest number of tests performed, which increases the possible margin of error in the analysis.)

In past decades, cable technology had noticeably worse performance at network edges (i.e., the end of the line), but current technology should not suffer from the same phenomenon, and the Outer Cape's geography is likely not playing a role in these trends. Instead, the portion or portions of the network serving the Outer Cape are in some way likely "sized" smaller than in other regions.

"Sizing" practices could include the relative amount of backhaul provisioned to a portion of a network, the degree to which fiber is physically close to the end user in a hybrid fiber-coaxial network architecture, or the configuration and type of technology in use in the area (i.e., DOCSIS version or type of content caching used on the network).

These ISP-specific factors are not possible to verify externally but are common business practices in areas with fewer customers (lower population). The effects of these practices would be exacerbated by high population influx, resulting in congestion consistent with the trends shown in the speed tests.

3.1.3.3 *Cape Cod Commission speed tests conducted in the late summer of 2023 largely confirmed the patterns shown in the 2022 Ookla dataset*

On behalf of the Commission, CTC launched an online speed survey to collect additional speed test data from broadband users on Cape Cod. The effort was promoted via press release, social media, and the Commission's website, and was shared with partner organizations in the region.

The speed survey gathered speed information and ISP, location, and device information from August to October 2023. Most of the tests (721 of 816) were on the Comcast network and delivered the fastest average speeds. (Providers with fewer than 10 reported tests were excluded from the analysis.) As such, this speed survey allowed the project team to analyze characteristics of Comcast's service specifically, but with fewer samples. It is important to note that individual experiences vary, with some lower and some higher than the averages. (And people unable to obtain a connection cannot perform a speed test to document an outage or other problem.)

The consulting team also had access to a much larger dataset from Ookla, but that data was from 2022. The new dataset, though smaller, enabled a high-level comparison of speeds in the third quarter of 2022 (Ookla dataset) and 2023 (Cape Cod Commission dataset from this speed survey effort) as shown in Table 7. The analysis showed little variation in average speeds.

Table 7: Comparison of average download speeds (Mbps) between 2022 Ookla fixed speed tests and 2023 Cape Cod Commission tests

■ Ookla ■ Cape Cod Commission

Upper Cape	204 Mbps (Ookla)
	184 Mbps (Cape Cod Commission)
Outer Cape	172 Mbps (Ookla)
	169 Mbps (Cape Cod Commission)
Mid Cape	202 Mbps (Ookla)
	188 Mbps (Cape Cod Commission)
Lower Cape	207 Mbps (Ookla)
	192 Mbps (Cape Cod Commission)
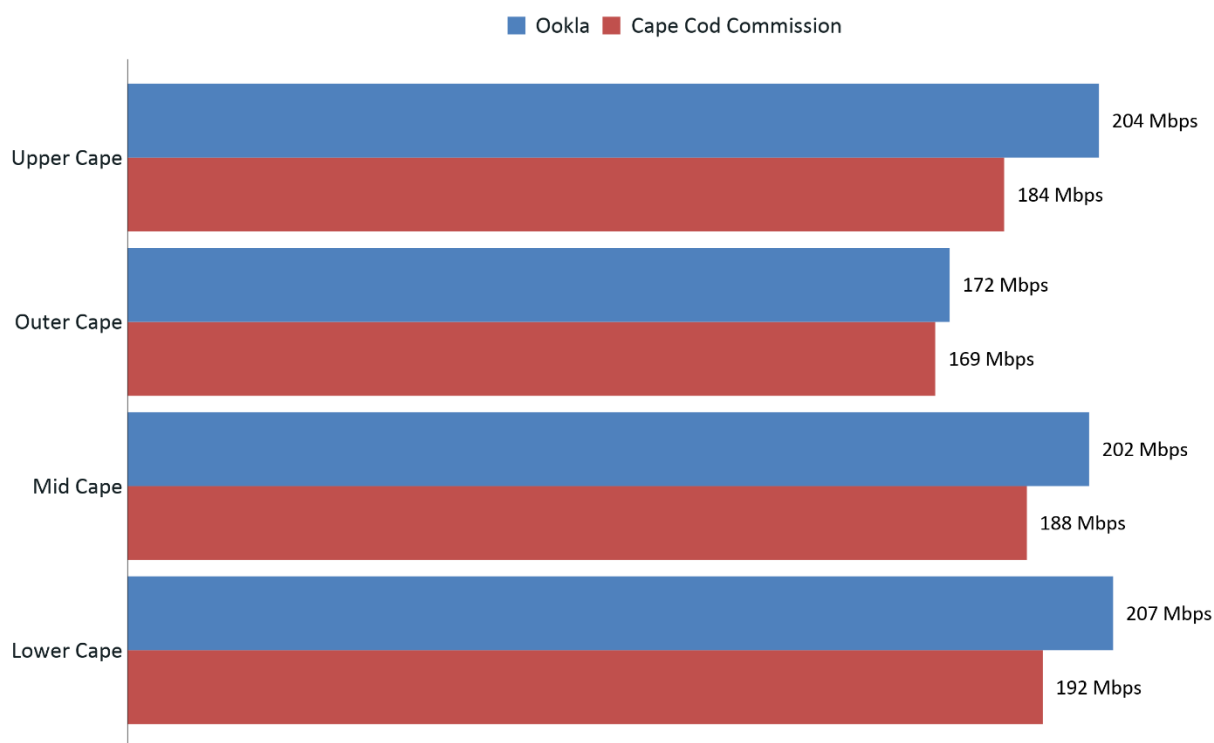
Source: Cape Cod Commission Speed Test Survey (July - Sep. 2023), Ookla Fixed Speedtest data (2022 Q3)
Notes: Upper Cape includes Bourne, Falmouth, Mashpee, and Sandwich. Mid Cape includes Barnstable Town, Dennis, and Yarmouth.
Lower Cape includes Brewster, Chatham, Harwich, and Orleans. Outer Cape includes Eastham, Provincetown, Truro, and Wellfleet.

In many jurisdictions, wireline cable broadband service in multiple-dwelling unit buildings (MDU) can be slower and less reliable than the same service in single-family residences due to in-building factors such as outdated wiring. However, this phenomenon was not apparent in data from this speed survey. Though the Comcast data from MDUs was limited (52 tests), Commission speed survey data did not demonstrate significant differences in speeds between MDUs and single-family households served by Comcast. Table 8 shows these data.

Table 8: Average download speed (Mbps) across multi-family and single-family residences served by Comcast

Source: Cape Cod Commission Speed Test Survey (July - Nov. 2023)
Notes: 52 Comcast Cable speed tests were taken in multi-family residences and 634 were taken in single-family residences.

3.2 Key survey findings: broadband service

As part of this study, CTC conducted a residential survey on behalf of the Commission on a wide range of broadband-related topics (see Appendix A and Appendix B). The survey was intended to gather data about the types of services to which residents subscribe, their use of these services, their perceptions about service quality and slowdowns (such as during the peak summer season), gaps in broadband skills, and residents' level of interest in the County and towns taking steps to address broadband-related gaps. This section documents the survey process and presents results.

3.2.1 Broadband access gaps

The survey found few gaps in acquisition of residential internet services, but significant concerns about the quality of the services. The following are key findings:

- **Almost all respondents have internet access.** Ninety-nine percent of households have either home internet or mobile internet service. Eighty-seven percent of respondents have home internet service (including 67 percent who subscribe to Comcast/Xfinity), and 12 percent only subscribe to mobile. Household internet subscriptions are relatively high across all demographic groups, but seasonal homeowners have a somewhat higher saturation of home internet service.

- **Most respondents bundle their internet service.** Seventy-five percent of households who subscribe to broadband services bundle internet service with television or phone service, including 40 percent with all three (internet, cable, phone). Just 25 percent of respondents have internet-only service.

- **Significant numbers of home internet subscribers have concerns about the quality of their service.** Although 25 percent of subscribers are very satisfied and 38 percent are somewhat satisfied, a sizeable segment of subscribers is either dissatisfied (19 percent) or neither satisfied/ dissatisfied (18 percent) with their service. Primary reasons for lower satisfaction levels include service is too expensive (69 percent), service drops from time to time (57 percent), and service is too slow (51 percent).

- **Many customers experience slowdowns or drops in service weekly or more often.**
  Nineteen percent experience slowdowns in service at least once daily and 20 percent
  experience this at least once per week. More than one-half (55 percent) of those with
  connectivity issues said they occur any time of year with no pattern, and 27 percent were
  unsure if there is a pattern. Nearly one-half (47 percent) of renters reported experiencing
  issues at least weekly or daily. The figure for owners was lower, at 37 percent.

3.2.2   Demand for additional internet service options

Many respondents would like to have a choice of an additional internet service provider on Cape
Cod, but fewer would be willing to pay a temporary construction fee if this were necessary to
make it feasible for a second provider to establish a new best-in-class private or public broadband
service. The following are key findings:

- **Overall, there is support for Town action to foster broadband competition.** Forty-three
  percent of respondents strongly agreed that their Town should work to bring in a new
  private broadband provider to compete with existing providers, and 21 percent agreed.
  Additionally, 39 percent strongly agreed their Town should establish a Town-run
  broadband service to compete with existing providers, and 20 percent agreed. However,
  the survey did not present information about what such an effort might cost or details
  about the range of ways such a service could be brought about and operated.

- **Respondents expressed only moderate support for paying temporary fees to support
  construction of networks.** Starting new broadband services in Cape Cod towns might
  require subsidies to become feasible as businesses. On a scale where 1=Strongly Opposed
  and 5=Strongly Support, the mean level of support for paying household construction
  subsidies (above the cost of service) was 3.2 at $200 per year for five years to 2.1 at $800
  per year for five years.

  Meanwhile, 13 percent of respondents were strongly opposed to paying a temporary
  construction fee of at least $200 per year for five years. The amounts provided were
  round numbers meant to provide a sense of willingness to pay construction subsidies.
  Though they are based on ranges of subsidies seen in some other jurisdictions nationwide,
  they do not reflect an analysis of specific subsidy amounts, if any, that might be required
  for Barnstable County towns.

3.3 Focus groups reported high-quality enterprise services and frustration with Cape Cod's consumer broadband landscape

To augment quantitative data collection and gather qualitative information regarding user experience on Cape Cod, the Cape Cod Commission conducted a series of focus groups with stakeholder groups whose input may not have been as easily captured via the survey.

The Commission identified three user groups to convene for focus group conversations:

1. The Cape Cod business community, with representatives from a wide range of sectors and business sizes

2. Educators and IT professionals from Cape Cod educational institutions, with representatives from primary, secondary, technical postsecondary, and nontechnical postsecondary programs

3. Adult English language learners from multiple Cape Cod towns

Focus group discussion topics ranged from existing internet service and performance to the experience of seasonal connectivity challenges, network management practices, affordability, and device-usage trends. Many sentiments raised in focus groups were also echoed by regional connectivity stakeholders, such as the Barnstable County IT department.

The following sections highlight the key findings from the focus groups.

3.3.1 Cape Cod business community

Business owners and employees generally perceived enterprise-level services favorably, but also expressed a desire for increased competition among internet service providers, better reliability, and improved customer service.

Participants shared that enterprise service competition is somewhat limited, but they viewed the enterprise broadband landscape as better than broadband service for residential customers. Participants felt that providers are not incentivized to upgrade infrastructure or work hard to retain customers. One business owner commented that the incumbent cable company "is just not investing in the infrastructure here because they don't have to, and it's really expensive for anyone to come in and compete with them."

Business owners—especially those without dedicated or redundant enterprise-level services— also reported speed and reliability issues during seasonal population peaks. This has resulted in a wide variety of negative impacts to businesses operations, including lost revenue, ongoing stress to business owners and employees, and poor customer experience. The group also shared anecdotes of similar problems at their personal residences on the Cape.

One business owner explained that during a large festival in downtown Hyannis, "vendors couldn't get on the internet because there were just so many people and they were just kind of crossing their fingers that all of the transactions would go through at the end of the day."

To compensate for periods of poor connectivity, businesses reported the need to invest in various alternatives and workarounds for their personal and operational connectivity needs. Examples included using mobile devices for credit card transactions, investing in backup systems like hotspots, and ensuring network redundancy by paying for service from two providers.

Businesses related the reliability of internet service to other critical infrastructure such as power and underscored its importance as a year-round consideration for Cape Cod businesses, the customers they serve, and the elected officials who represent them.

3.3.2 Educational institutions

Representatives of educational institutions on Cape Cod reported adequate connectivity at their facilities. They indicated that they feel well-served by the available ISPs and that the service delivered consistently meets the connectivity needs of students and educators.

Rather than being focused on service availability and reliability, teachers, administrators, and IT professionals were concerned with emergent cybersecurity considerations and best practices to mitigate threats. For example, participants discussed how they have increased the use of multifactor authentication (MFA) to manage device access on campus. While MFA is useful, there are associated challenges, such as registering all devices and ensuring students have the appropriate devices (i.e., smartphones) to fully participate in school activities and do so safely.

Participants also reported the need to devote significant time and resources to conducting regular audits of their cybersecurity practices—both to identify vulnerabilities and to make improvements. Participants similarly lamented the costs associated with these best practices, with one participant noting that "security measures should not be based on whether or not the school can afford to take cybersecurity protections."

Within classrooms, participants reported that adequate bandwidth, proactive network management practices, and institutional buy-in have all resulted in high levels of successful classroom technology deployment. Participants noted the wide variety of technology and devices regularly used in their facilities, including Chromebooks, interactive panels, projection equipment, readily accessible cloud-based storage and optimized audio equipment for video calls.

Discussion centered on how most students and educators have embraced this technology landscape, and with most school content and course material online, they see technology as an integral part of everyday learning. Participants shared positive examples of this dynamic, with

one teacher noting that online platforms like Google Classroom allow students to have their notes and assignments available at any time, and another commenting that technology has increased in-class participation among students.

3.3.3 Adult English language learners

Participants in this focus group were students currently enrolled in an English for Speakers of Other Languages (ESOL) program at a local Cape Cod-based nonprofit organization.

Most participants reported that they are Comcast customers, have internet access at home, and are dissatisfied with their current service. Their reasons for dissatisfaction ranged from slow speeds to unreliable connections, with customer service also being cited as unhelpful in dealing with connectivity issues (e.g., maintenance or repairs) or changes to their plans (e.g., rates or switching bundles). Participants generally agreed that service was expensive or unaffordable, and that they do not consistently receive the speeds for which they pay.

Participants also noted issues with inconsistent mobile coverage in the region, and specifically identified it as a safety concern. Examples included a participant who was unable to contact a child for a school pickup. Compounding this problem, few participants reported having a landline at home, and they mentioned the danger of only having one mode of communication when faced with inconsistent cellular coverage.

The group also discussed devices, and all participants reported that they and their family members have a smartphone, most have a laptop, and about half have a tablet. Participants noted cultural differences that impact their ability to use and learn new technology and many expressed a desire to continue developing their digital skills.

3.4 Verizon, Comcast, and OpenCape all say they plan to improve or expand their fiber networks on Cape Cod; the Mashpee Wampanoag and Town of Falmouth are in the process of fiber planning

As part of this study, CTC prepared information requests, reviewed them with the Commission, and issued them to wireline and wireless service providers in the County. CTC also engaged with the Mashpee Wampanoag tribe and the Town of Falmouth (and its Municipal Light Board), which are working on fiber deployments or planning.

The goal was to understand the current state of broadband infrastructure in the County, learn about planned network upgrades and extension projects in the area, and gather input regarding opportunities for the County and towns to encourage and facilitate network upgrade projects.

In late 2023 the Massachusetts Broadband Institute (MBI) announced it was making available up to $145 million in ARPA Capital Projects Funds (CPF) under the Broadband Infrastructure Gap Networks Grant Program to fund the deployment of broadband infrastructure in areas that

currently lack access to 100/20 Mbps service, and with a focus on communities with substantial low-income households and disadvantaged populations. With respect to Round 1 of this grant program, awards were made to Verizon for projects in Brewster, Falmouth, Harwich, Mashpee, Sandwich, Wellfleet, and Yarmouth—suggesting that townwide Fios buildouts might occur.

Information requests to solicit critical network information were sent to the five largest providers serving Barnstable County: Verizon and T-Mobile (covering both wireline and mobile), AT&T Wireless (mobile only – see Section 4), T-Mobile, Comcast, and OpenCape. These requests also asked for explanations of any network capacity gaps and limitations during the peak demand of the high season summer months as compared with other times of the year. Additionally, providers were asked to describe plans for addressing any identified network gaps and capacity issues as well as network investments to serve currently unserved areas.

Separately, a meeting was held with the Mashpee Wampanoag tribal leadership and an information request was sent to the Falmouth MLP.

Summaries of the responses are provided in the subsections below.

3.4.1 Comcast

Comcast's response stated it has made a $958.2 million three-year investment across Massachusetts, resulting in "virtually all" Cape Cod residents and businesses having access to gigabit broadband service on Comcast's Xfinity Network. Comcast describes its network as an all-fiber backbone and a last-mile network with a combination of fiber and upgraded coaxial cable, including some fiber-to-the-premises deployments to commercial and limited numbers of residential customers on Cape Cod.

Comcast stated that its network investments and technology upgrades meet the growing customer demand in the area, including during times of peak usage. It states that it has experienced technicians regularly monitoring network performance and adjusting network capacity through its 24/7 Network Operations Center. It has also deployed "artificial intelligence technologies" to detect damage to the network and reduce repair times and increase reliability. Comcast also offers a "storm-ready" Wi-Fi service with battery and cellular backup to support reliability during network and power outages.

Though it did not provide any timeframe, Comcast stated that its future efforts will allow it to offer multi-gig symmetrical speed services by transitioning the network to DOCSIS 4.0 and 10G platforms, for its fiber network as well as its hybrid fiber coaxial network. Customers with Xfinity Internet have access to a network of 22 million Comcast hotspots across the country.

Comcast stated that its network, service offerings, and customer service capabilities meet the Cape's needs and are comparable to its offerings throughout the rest of the state. It characterizes

deployment as complicated and costly due to multi-jurisdictional easement, permit, and pole attachment requirements. However, it also emphasizes that it regularly meets with local, state and federal officials to manage the deployment process.

Comcast did not provide numbers of current Internet Essentials enrollees on Cape Cod. It did note that it did help educate community groups about ACP in partnership with local groups such as the Falmouth Senior Center and Falmouth Housing Authority. Comcast's response did not provide suggestions or strategies to facilitate network expansion in the area.

3.4.2 Verizon

In its response to the information request, Verizon stated that it is committed to help close broadband gaps in the state by expanding its fiber network facilities. Verizon has an extensive legacy network serving Barnstable County with copper-based DSL and, with the awards by MBI in seven towns, this network will likely be upgraded to fiber in those towns.

On the wireless side, Verizon stated that it is expanding its wireless 5G networks across the state and offers its 5G Home Internet service to "some locations" on Cape Cod using fixed wireless (see Section 3.1.1.4). Verizon provided several links to website material that describe its national plans and network configurations. In these materials, Verizon states that it has the spectrum and advanced electronics deployed on its fiber network to provide necessary capacity to meet the communities' needs. Verizon states that it has deployed its own fiber to connect more than half of its cell sites nationwide to carry increased data traffic.

Verizon provided general language describing its 5G network and how it is expanding 5G coverage nationally, in some cases tripling the amount of available bandwidth. The company also says it is updating its network with artificial intelligence, automation, and "orchestration" to support security measures, increased reliability, and lower latency.

Verizon said it has seen increases in use of 5G devices and increase in data usage. The shift of customers onto Verizon's 5G network also frees up bandwidth on its existing 4G network which should improve service quality, capacity, and reliability for the remaining 4G network customers. Verizon has also seen an increase in home internet customers, many of which are on fixed wireless access.

3.4.3 OpenCape

OpenCape is a nonprofit that owns and operates a fiber network built to serve local governments, businesses, and residents of Cape Cod and other parts of southeastern Massachusetts. It provides fiber connectivity to several hundred institutions, including libraries, government buildings, schools, colleges, hospitals, public safety agencies, and research institutions. In addition, it serves larger businesses that rely on high-speed Internet access and data transfers and has deployed

main street solutions for smaller businesses in Woods Hole, Falmouth, Hyannis, and Buzzards Bay.

Several school districts including Bourne, Falmouth, Barnstable, Mashpee, Nauset, Provincetown and Monomoy Regional have connected to OpenCape fiber to enable high-speed bandwidth to provide the capacity to support mobile devices and online teaching tools. The Town of Falmouth used the network to create a municipal network of 19 town buildings. On the residential side, OpenCape has provided connections on special requests. OpenCape has said it is in talks with partners to perform fiber-to-the-premises buildouts.

3.4.4   T-Mobile

T-Mobile's response to the Commission's request for information about its current network capabilities and deployment did not include information specific to Barnstable County. For example, T-Mobile stated that it has over 4.2 million 5G Home Internet fixed wireless customers nationally but did not break that figure down further for the County or the state. It also did not provide information regarding network investment or facility deployment in the area.

It acknowledged that during the summer months wireless carriers "can experience increased demand on the network." T-Mobile also explains that because its 5G Home Internet service relies on its mobile network, it will require more network capacity to expand the availability of 5G Home Internet.

To invest in network expansion and keep up with growth in demand for wireless services, T-Mobile encouraged the County to ensure that its processes allow for deployment in a "consistent and predictable fashion" and to quickly approve requests to deploy infrastructure in the County. The company stated that its deployment strategy focuses on areas with a "known need" for new wireless technology and any delays in approval processes will hamper meeting customer demand, especially during peak periods.

3.4.5   Mashpee Wampanoag Tribe

The Mashpee Wampanoag Tribe is a federally recognized Tribe with full Tribal sovereignty on 150 acres of land in the Town of Mashpee and 170 acres of land outside of Barnstable County in Taunton, MA. There are approximately 3,200 enrolled citizens in the Mashpee Wampanoag Tribe.

In the fall of 2022, the NTIA awarded the Mashpee Wampanoag Tribe $9.1 million from the Tribal Broadband Connectivity Program (TBCP). The award is intended to fund a 118-mile fiber network to serve tribal members and key community institutions.

The Cape Cod Commission held multiple discussions with tribal members and relevant parties regarding their current work and future broadband deployment plans. The tribe's goals for this deployment include providing affordable internet for tribal members, generating economic

development opportunities for the tribe, and deploying essential infrastructure that will meet future community needs. The tribe has engaged multiple consultants, and at the time of this report, is pursuing a feasibility analysis, conducting financial modeling for multiple deployment options, and considering the possibility of regional partnerships.

A funded network deployment of this scale has significant implications for the region and future fiber deployments across Cape Cod, especially if the tribe chooses to pursue a partnership with an existing middle- or last-mile provider, or to sell services to non-tribal members through its future network. Stakeholders across the region are eagerly awaiting further details on the Tribe's deployment plans.

3.4.6   Falmouth Municipal Light Plant (MLP)

In 2019 the Town of Falmouth's Economic Development and Industrial Corporation (EDIC) conducted a feasibility study detailing potential operating models and financing options of a municipal broadband network. It then obtained construction cost estimate of $56 million to $59 million for a full fiber-to-the-premises network.[19] The question then arose of how and whether the Town might proceed with such an effort—a question of considerable interest to other towns on Cape Cod.

Under Massachusetts law, municipalities can create structures for municipally-owned electric utilities—which can also (or exclusively) operate broadband businesses—through the creation of an entity called a Municipal Light Plant (MLP). This is achieved through two votes of Town Meeting. Falmouth Town Meeting took these steps in 2021 and 2022 and created a five-person Municipal Light Board (MLB) to govern the operation of the MLP. However, as noted in 3.6.1, this step is not a prerequisite for towns to forge broadband partnerships.

The Falmouth MLP presently has no physical plant or budget. It issued a request for information (RFI), seeking information from ISPs about potential partnership models, and received responses from Tilson Broadband (now "Boundless"); Whip City Fiber MLP (a western Massachusetts MLP that provides broadband service in Westfield and several Berkshire towns; GoNetSpeed, OpenCape, MC Fiber, Bonfire Fiber, and Comcast. The Board conducted follow-up meetings (in person or via Zoom) with all but MC Fiber and Comcast (whose response merely described the current system).

Table 9 is a copy of a table created by the Falmouth MLB describing the partnership options it says it is considering. It is important to note that these activities occurred before Verizon received a grant award that may lead to a Fios buildout in Falmouth.

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[19] "History: Falmouth's Fiber Optic Broadband Initiative Overview," Falmouth Broadband, https://falmouthbroadband.net/history/.

Table 9: Partnership options described by the Falmouth Municipal Light Board

	Structure:	Pros:	Cons:
Option 1:	Municipally owned, Municipally operated	Lowest rates Future profitability Full town control	Raise full cost (about $80 million) via bonds, grants, etc.
Option 2:	Municipally owned, Privately operated	Low rates Future profitability Full town control Experienced operator	Raise full cost via bonds, grants, etc. (Possible to build out in stages and use revenue bonds.)
Option 3:	Public/Private Partnership, Town is **majority** owner	Majority town control Experienced operator	Raise partial cost (at least 50%) in bonds, grants, etc. Split profits w/ private partner
Option 4:	Public/Private Partnership, Town is **minority** owner	Lower initial cost to town Experienced operator	Raise smaller portion (less than 50%) in bonds, grants, etc. Higher rates Less control & financial benefit
Option 5:	Private Competitor with fiber	Small cost to town Increased competition	Highest rates Minimal local control No direct financial benefit

Other towns including Bourne, through its Cable, Internet & Telecommunications Advisory Committee, have been exploring municipal models, but none are as far along as Falmouth in terms of taking Town Meeting votes, forming MLPs, or issuing RFIs. Section 3.6 describes options towns have for pursuing FTTP partnerships.

3.5 Qualitative and quantitative evidence points to several challenges with existing fixed broadband infrastructure and infrastructure deployment

This study presents significant evidence that user experiences are impacted by seasonal network slowdowns, and that degradation correlates with periods of increased usage of the network. Information requests to major ISPs on Cape Cod returned little explicit detail about the potential causes of this degradation—however, the level of information most ISPs provided for this report is typical. Private companies are under no obligation to be forthcoming about their private business operations.

This section provides an analysis of the likely technological and market-based causes of the degradation experienced on Cape Cod, inferred from qualitative and quantitative data collected for this report and the independent expertise of the project team.

3.5.1 The lack of competitive wireline deployments reflects a lack of return on investment for ISPs on Cape Cod compared to other areas

The fact that there has not been a new last-mile wireline provider on Cape Cod—especially a fiber to the home provider—is above all else a matter of a lack of return on investment compared to other jurisdictions where deployment is happening. Many Cape Cod towns have significant seasonality, which means a portion of the market cancels service during the off season. For a legacy cable provider like Comcast, this drop in revenue can be absorbed because much of the cable plant was installed decades ago, and the infrastructure is largely paid off. The magnitude of Comcast's incremental investment in upgrades are low relative to the cost of building a new network from scratch. A new fiber provider would face significant upfront capital costs and could then face a tougher business case when working to recoup capital investments in the context of a seasonal market, as well as competition from the incumbent cable provider.

However, in recent years, consumer demand for faster service—particularly on the upload side—and the imperatives of the pandemic era have spurred massive investments in fiber around the country. The pandemic shifted work and schooling patterns in ways that created significant new demands on residential broadband. These shifts are changing market dynamics in ways that may benefit any new fiber provider who attempts to compete.

3.5.2 Both fixed and wireless speeds are significantly impacted by configuration of current networks and network electronics

First, the level of advancement of technology being used on Cape Cod impacts the speeds experienced by residents, and the extent of the degradation in summer months. Verizon's increased use of 5G capable bands, for example, is apparent in the speed test data associated with that provider (see analysis in Section 2.2.5). Because Verizon utilizes more high-capacity bands and 5G-capable bands, the network has higher baseline speeds overall, and therefore is more capable of managing temporary increases in users compared to other providers.

Comcast's speeds are consistent with widespread deployment of DOCSIS version 3.1. However newer DOCSIS protocols allow for faster data transmission, and Comcast noted that they would like to upgrade to DOCSIS 4.0, which can provide symmetrical speeds of up to 1 Gbps[20] in ideal conditions but did not give a timeframe for when this will occur on Cape Cod.

The consulting team has observed that ISPs generally make decisions to invest in network or technology upgrades (other than is required to keep the network functioning) when they have determined that those investments are required to contend with a market challenge and retain market share. To some extent, the rise of 5G home internet services is presenting such a

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[20] Gigabits per second.

challenge to Comcast right now on Cape Cod, but a ubiquitous fiber competitor would present a far greater one.

3.6   FTTP deployment recommendations

The following subsections outline several measures and efforts towns can make to pursue, facilitate, and leverage FTTP deployments. The basic reason towns on Cape Cod have not gotten fiber competitors to date is that it has not been economically feasible—in a market served ubiquitously by Comcast—for a second provider to make a reasonable return on investment. But the MBI grant award to Verizon and the potential for a Fios buildout represents a dramatic turn of events for Brewster, Falmouth, Harwich, Mashpee, Sandwich, Wellfleet, and Yarmouth. For other towns (or for these seven if town leaders wish to pursue other alternatives despite the likely Verizon fiber buildout) municipal leaders may take certain steps to achieve FTTP service. The following sections discuss at a high level how Towns can pursue, facilitate, and leverage FTTP buildouts.

Towns can:

- Pursue deployment of FTTP through four broad categories of business models that differ regarding the role the Towns or partners play;

- Facilitate construction to encourage and reduce costs of deployment, regardless of model or how the project came about; and

- Seek to leverage deployments to obtain fiber for current and future municipal needs, such as connectivity to municipal buildings, backhaul for public safety radios and traffic or security cameras.

The following subsections provide high-level information and guidance on these topics.

3.6.1   Towns on Cape Cod can consider four broad models for pursuing FTTP buildouts, ranging from municipal networks to RFPs seeking private partners or all-private providers

Broadband networks have three basic elements: passive infrastructure consisting of the fiber optic cabling (or "dark fiber" infrastructure) and related elements like conduit; the active infrastructure, consisting of all electronics that power, operate, and manage the network; and service provision, the retail end of the business including sales and marketing and customer service. All capital and operating costs of the network, and all contractual relationships with any partners, involve these three elements. Table 10 explains these elements.

Table 10: Network elements

Passive infrastructure	Active infrastructure	Service provision
Building and maintaining the dark fiber network	Setting up and operating the active electronics on the network	Delivering broadband services to subscribers

Towns or other jurisdictions seeking an FTTP competitor to cable can pursue a range of approaches to achieving this end, from full municipal ownership and operation to full private ownership and operation. Between these two bookends, a range of collaborative public-private models—in which costs, risks, and control are shared—have been demonstrated around the country in which localities procure infrastructure, and the private sector handles most or all aspects of network operations, equipment provisioning, and retail service delivery. Table 11 summarizes the business model types, but the details can vary, as described more fully in a recent Benton Institute report on public-private models.[21]

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[21] Hovis, Joanne; Baller, Jim; Talbot, David; and Blake, Cat; "Public Infrastructure/Private Service: A Shared-Risk Partnership Model for 21st Century Broadband Infrastructure," Evanston, IL: Benton Institute for Broadband & Society, October 2020, https://www.benton.org/sites/default/files/PPP3_final.pdf.

Table 11: General Business model types

Business model	Passive infrastructure	Active infrastructure	Service provision
1 (All-municipal)	Publicly funded/financed and maintained	Municipal ISP	
2 (Municipal with partner)	Publicly funded/financed and maintained	ISP partner (usually private but can be a public-sector ISP)	
3 (Municipal with partners and open access)[22]	Publicly funded/financed and maintained	Active Infrastructure Contractor	Multiple ISPs / Open Market
4 (Private)	Privately funded, financed, maintained, owned, and operated		

These approaches come with a balance of cost (and risk) versus control. The level to which they have been demonstrated in Massachusetts—as opposed to being discussed conceptually — varies greatly. Table 12 illustrates these tradeoffs at a very high level.

It is worth noting that in the Massachusetts context, municipal broadband businesses have been successfully created only in municipalities having longstanding electric utilities and/or in rural towns with only DSL that received MBI "last-mile" construction subsidies in the past decade or so. They have not been launched in any municipality that already has cable and does not have an existing operating municipal electric utility.

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[22] "Open Access" refers to a model in which multiple ISPs compete over the same fiber network. There are only a few examples of this model deployed in the United States.

Table 12: Relative levels of risk and control across business model types

Business model	Cost/risk to Town	Control	Demonstrated in Massachusetts?
1 (All-municipal)	High	High	Yes, in specific contexts[23]
2 (Municipal with partner)	Moderate to low depending on structure	Moderate	Yes, in a subset of specific contexts[24]
3 (Municipal with partners and open access)	Moderate	Moderate	No
4 (Private)	Low	Low	Yes, this is common

3.6.1.1 *Towns can form MLPs and explore building and operating their own networks, but this will likely be costly*

A Municipal Light Plant or MLP is a Massachusetts legal entity that enables a municipality to directly operate an electricity, gas or (more recently) telecommunications company—that is, a broadband company. Massachusetts has 40 longstanding MLPs that operate municipal electric utilities. A subset of these entered the cable broadband business in recent decades, leveraging utility expertise and assets to expand into broadband. In addition to these 40 municipal electric utilities, certain rural western Massachusetts towns that only had DSL service (no cable) created MLP structures solely to provide broadband service using one-time state capital grants.

To establish an MLP, a Town would need approval by a two-thirds vote of Town Meeting, passed twice in two consecutive years, and then ratification by a majority of voters at an annual special election. That said, it must be noted that Town lacking a municipal electric utility is unlikely to be able to build and operate a fiber network as cost-effectively as an experienced private partner could do.

The Town's MLP could have full control over all aspects of the broadband network—ownership, operations, and service provision—but also take on all costs and all commercial and operating risk.

Some western Massachusetts towns formed MLPs and contracted with the Westfield municipal utility's broadband business, Whip City Fiber, to operate the network and provide service. Whip City Fiber is an ISP operated by Westfield Gas & Electric (WG+E), in Westfield, MA. It is also now a regional provider, providing symmetrical 1 Gbps service to homes and businesses in 20

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[23] Full municipal ISP businesses have been demonstrated in municipalities having longstanding electric utilities and/or in rural towns with only DSL that received MBI construction subsidies.

[24] Western Massachusetts towns that received MBI last-mile subsidies to build FTTP networks have entered into a variety of partnerships for network operations and service provision.

communities in western Massachusetts, most of them rural towns that were previously unserved by high-speed broadband. The local municipalities fund and finance the construction of dark fiber, and Whip City Fiber provides the active infrastructure and services to end users through Intergovernmental Agreements (IGAs). This demonstrates how a municipal utility with existing experience in delivering services to customers can expand into the broadband sector. This example is unusual in that WG+E is serving as ISP for many municipalities.

3.6.1.2 *Towns can build and maintain dark fiber and contract with an ISP to provide electronics and deliver service*

Subject to a Town obtaining a legal opinion, it may not be necessary to form an MLP to borrow funds to build a network that would be operated by a partner.[25] A Town could use public funding and/or financing to contract with a private entity to construct and maintain dark fiber owned by the Town—with construction facilitated by the Town in a cooperative manner—and then lease access to the dark fiber network to an ISP following a public procurement. Typically, the partner(s) would provide the electronics, operate the network, and then provide service. But the Town could retain ownership of the fiber infrastructure.

In this model, the private ISP would take the commercial and operating risk and would be incentivized to provide high quality service while compensating the Town for access to the fiber at a level determined through the procurement process and subsequent negotiation. Potentially, the Town could provide low, attractive lease rates to make this possible—a form of subsidy. A town would have the flexibility to structure a combination of lease fees and revenue sharing agreements to potentially partake in any revenue upside.

As noted earlier, Bonfire Fiber proposes a model in which it would operate a Falmouth town network and encourage multiple ISPs to compete over that fiber.

3.6.1.3 *Towns can also issue a procurement seeking an all-private FTTP provider, and learn what level of facilitation or subsidy would be required for the provider to do business*

Following a well-structured RFP process—perhaps preceded by an RFI process such as the one Falmouth undertook—a Town could end up in a partnership with a company that would build a fiber network, provide the electronics, and provide service. Depending on market conditions, the Town might need to be prepared to offer a cash subsidy or enhanced construction facilitation (such as expedited permitting, access to public conduit, or reduced fees).

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[25] CTC does not provide legal advice; we recommend continued consultation with qualified counsel with respect to any legal requirements associated with constructing a network or operating a broadband business.

At the same time, the Town could negotiate for benefits such as stands of fiber for noncommercial Town use, low-cost program for eligible low-income families, or other benefits to the residents and businesses. The Town would reduce its risk but could still potentially:

- Obtain strands of fiber for municipal use,

- Incorporate public policy goals into contracts with private partners,

- Increase choice and competition for subscribers, and

- Minimize financial risk

The private entity would be the sole entity responsible for bringing the project to completion and providing service. Typically, the partner achieves economies of scale by leveraging existing operations and resources.

3.6.2 Towns can facilitate FTTP buildouts to reduce costs and encourage deployment regardless of the specific partnership model

Building FTTP is capital-intensive, and uncertainties around the construction process can add risk and deter investment. Although this engagement did not include Town-level research, there are several general ways a Town can reduce costs and risk to encourage investment.

For starters, Towns may consider leveraging available municipal assets—such as fiber, conduit, and real estate—to reduce the capital costs of broadband deployment. An inventory of these assets should be carried out. Knowing where existing community fiber strands are located (and obtaining a legal opinion on whether these strands can be put to commercial use), where underground conduit exists, and what real estate could be used to place equipment or telecom huts can contribute to a more expedited and less costly deployment process.[26]

Additionally, streamlining permitting can support a more expedited buildout. Broadband buildouts often require multiple permits that require similar information, which can slow down the project timeline. A jurisdiction could create a generalized permit that addresses the duplicative nature and inefficiencies of having multiple permits throughout a review process.[27] The National Telecommunications and Information Administration (NTIA) has suggested e-permitting as a solution for streamlining these processes. This can reduce the timeframe for approvals and allow applicants to better track their submissions and edit their applications if necessary.[28]

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[26] "Gigabit Communities," CTC (6-7), https://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf
[27] "Examples and Best Practices of Streamlining Permitting," NTIA, https://broadbandusa.ntia.gov/sites/default/files/2023-03/Permitting_Best_Practices_Case_Studies.pdf.
[28] Ibid.

3.6.3 Towns can leverage fiber buildouts to meet current and future municipal needs

Cape Cod towns already have some fiber for municipal purposes, such as connecting municipal buildings or providing backhaul to public safety radio towers. But not all communities have all the fiber they need (or may need in the future) for any number of municipal purposes that might include backhaul for traffic cameras, connectivity to remote facilities, or backhaul for Wi-Fi networks in public areas. An FTTP buildout provides an opportunity to meet current and future needs cost-effectively, because adding an extra bundle of fiber strands represents a very small additional capital expense. Towns facing the prospect of a private provider building may want to conduct a review of fiber needs and approach the private provider about including such fiber in the planning process and negotiating reasonable pricing.

4. Mobile service analysis

This section describes mobile broadband performance on Cape Cod, stakeholder experiences with mobile services, provider-supplied information on mobile networks, and recommendations to close existing gaps mobile broadband coverage.

4.1 Data on mobile broadband speeds show a clear trend of seasonal slowdowns

To investigate stakeholder reports of degraded performance during Cape Cod's summer high season, this study analyzed an Ookla dataset focused exclusively on mobile speed tests.[29] The results showed significant seasonal slowdowns across providers, similar to trends demonstrated by the Ookla speed tests on fixed broadband networks.

These speed reductions are almost certainly based on congestion, tracking seasonal fluctuations of user density. However, the data also suggest that network speeds even during the slower months are robust for mobile wireless service. Figure 24 shows a clear trend of slower speeds in the summer, but the bottom of the curve remains as acceptable levels from a network engineering standpoint, which in turn indicates that mobile networks on Cape Cod are configured and engineered to accommodate peak usage times.

However, these data may not be representative of the experiences of everyday users. For example, speed tests do not reflect the experience of a call dropping in a dead zone or a user not being able to initiate a call because of a lack of coverage. Additionally, a user attempting to conduct a speed test during periods of the most severe congestion would not necessarily be able to connect to the internet at all. As such, periods of the worst network performance may go undocumented by Ookla.

Accordingly, Figure 24—which plots 5,475 of Ookla's mobile speed test observations from September 2022 to August 2023—may be considered an indicator of overall trends and an illustration of stakeholders' reported summer dip in speeds. And while Figure 25 shows that the majority of tests analyzed were at or above 100 Mbps, Figure 26 shows there were proportionally fewer high speeds recorded between Memorial Day and Labor Day. Similarly, Figure 26 also shows that across all providers, the proportion of lower speeds recorded was greater in the high season as compared to the off season.

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[29] The 2022 Ookla Speed Test Intelligence mobile data package included 12 months of speed test data covering September 2022 through August 2023. The dataset included 14,982 test results, and the analysis focused on the three major mobile providers in the region: AT&T, Verizon, and T-Mobile. Speed outliers were removed, as well as tests performed on Apple devices because they do not report mobile provider information. Tests performed on older devices not capable of receiving 5G signals were also removed. A total of 5,475 tests were used for the analysis and a Locally Weighted Scatterplot Smoothing (LOESS) line was plotted for each provider. LOESS was used for its ability to handle regions of sparse data within a dataset with varying density by giving more weight to nearby points. This was preferable to using a moving average which would have treated all data points equally.

Figure 24: Cape Cod mobile download speeds (Mbps) for the top three mobile providers, as measured by number of speed tests performed
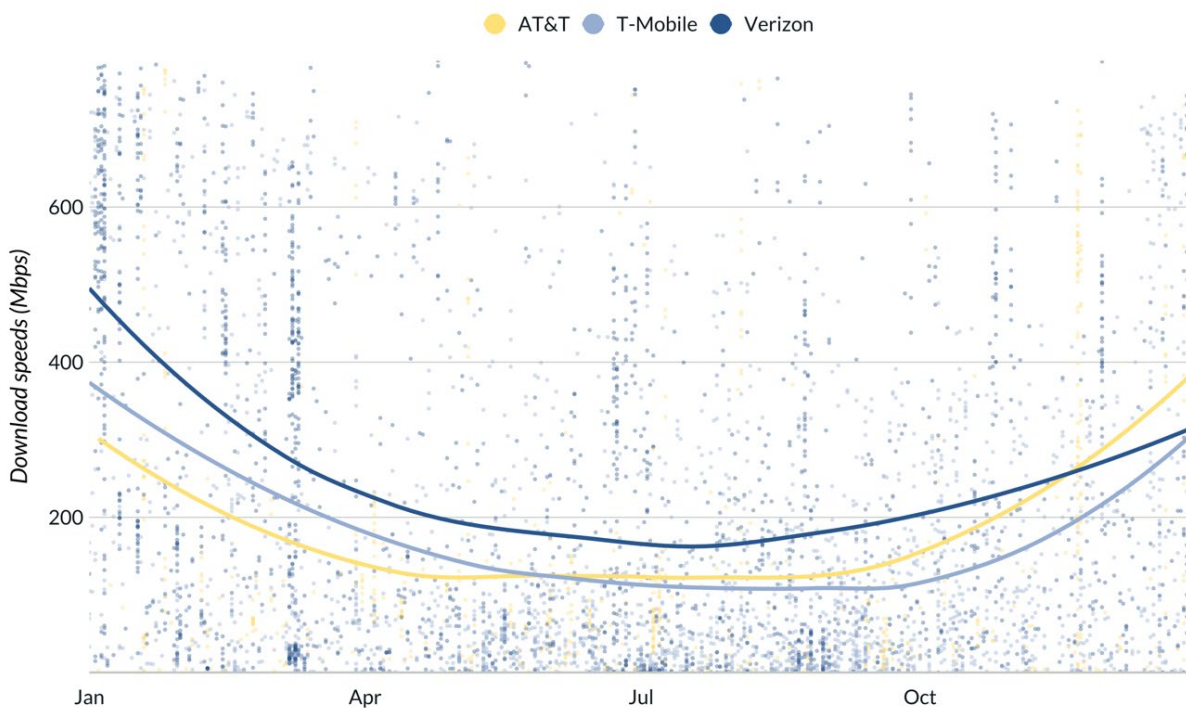
Source: Ookla Mobile Speedtest data
Notes: Lines are plotted using Locally Weighted Scatterplot Smoothing (LOESS). Data was collected from September 2022-August 2023 and converted to a calendar scale.

Figure 25: Distribution of mobile download test results by speed (Mbps)
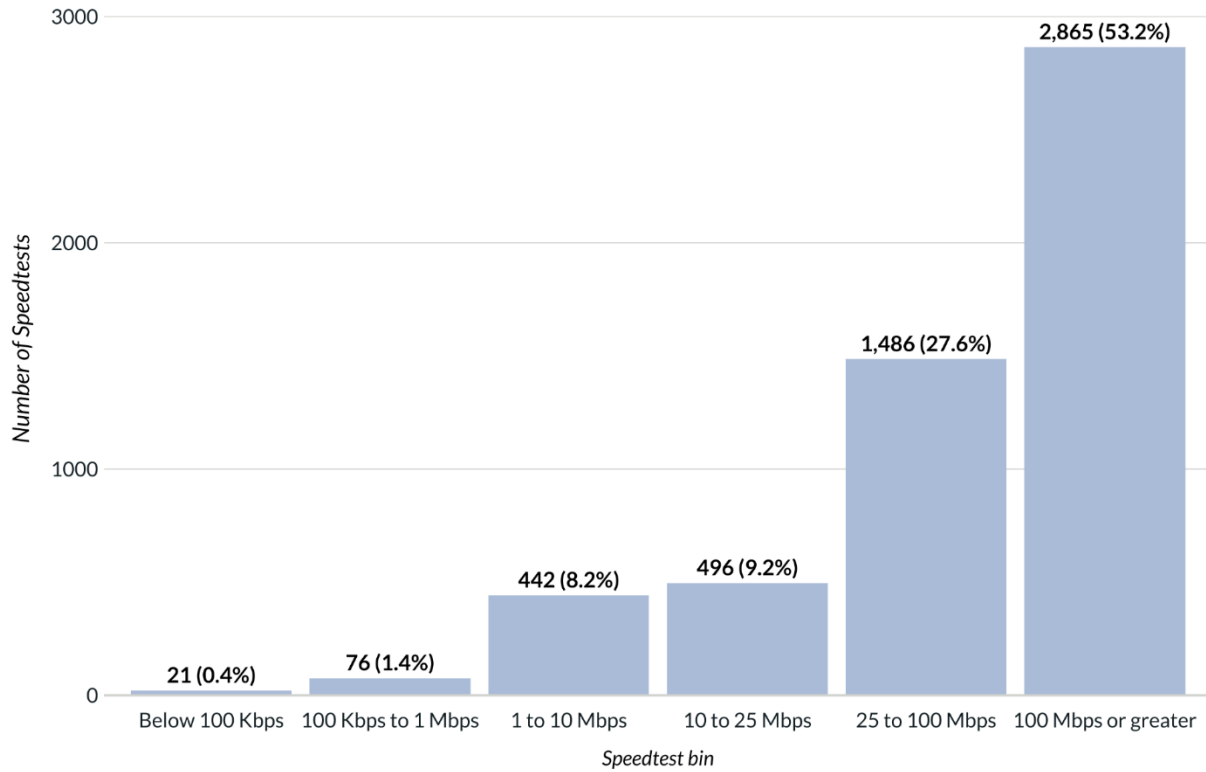
Source: Ookla Mobile Speedtest data

Figure 26: Distribution of mobile download test results by speed (Mbps) in high season (Memorial Day to Labor Day) and off season
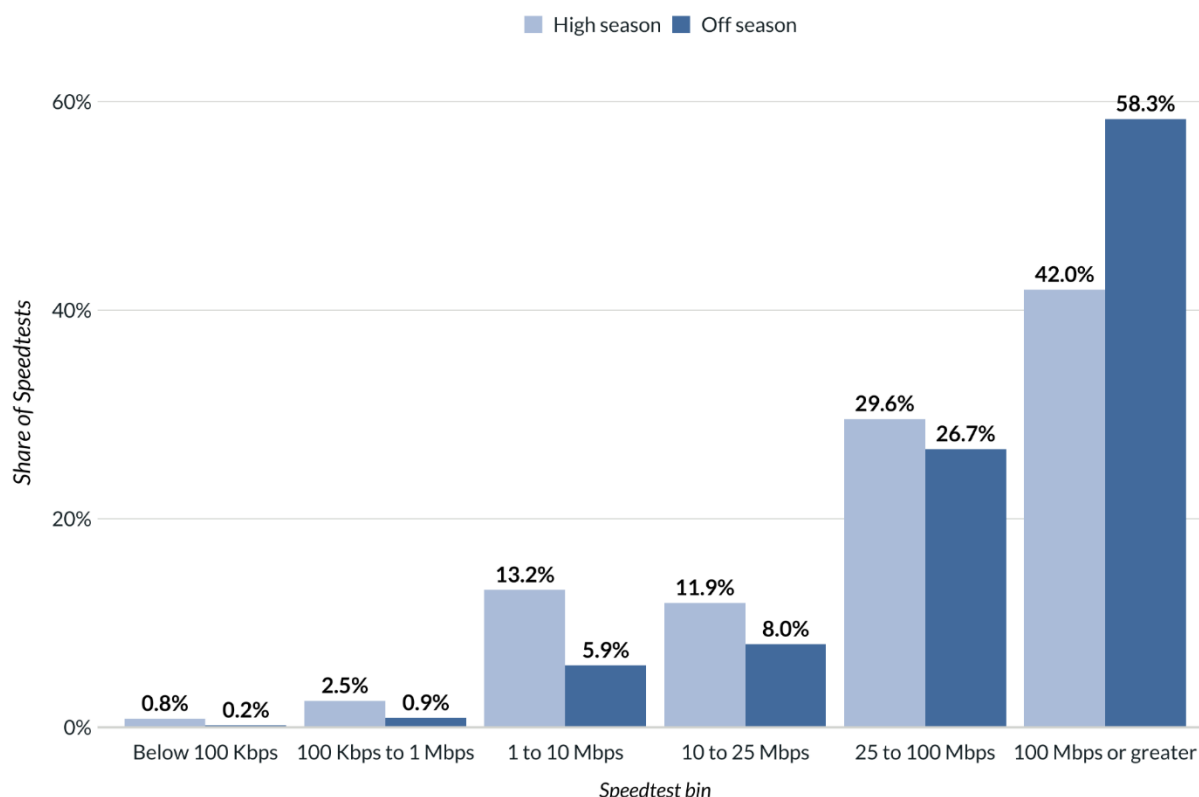
Source: Ookla Mobile Speedtest data

This dataset also captured the bands in use at the time of the speed test. Verizon speed tests occurred on more high-capacity bands and 5G-capable bands compared to AT&T or T-Mobile. This suggests that Verizon has deployed the most capacity in the region, and in turn explains their faster speed test results through the majority of the year.

For all mobile broadband providers, increased foliage in summer months likely also presents additional challenges for their networks and consumer experience. The presence of foliage can impact mobile network performance through signal attenuation, likely compounding congestion-based degradation. Foliage also represents another cyclical and predictable strain on mobile networks for which providers can engineer their networks.

Geographically, the mobile speed test data were widely distributed across the Cape but did not reveal conclusive availability patterns across regions or towns. Anecdotal reports of areas with poor coverage or reliability issues are not possible to verify through this analysis because, as with other speed tests, the lack of a test in an area may falsely indicate a lack of coverage. Similarly, slower tests in a given location may be due to temporary network congestion or challenges with

a user's device; the network may be able to provide ample signal strength to the same area under other operating conditions.

Communities attempting to granularly quantify mobile performance (e.g., measure coverage along a specific stretch of road to investigate reports of a dead spot) frequently use a combination of propagation analyses based on existing radio sites and drive test measurements taken along roadways. (See the related recommendations).

4.2   Key survey findings: Mobile internet usage and gaps

The residential survey conducted for this study covered a wide range of broadband-related topics (see Appendix A and Appendix B). The survey found few gaps in the usage of mobile internet services, but many respondents expressed complaints about the quality of service. The following are key findings:

- **Some mobile internet subscribers have issues with their service.** Thirty-one percent of mobile subscribers are very satisfied with their service, and 33 percent are somewhat satisfied. However, 18 percent are dissatisfied, and 18 percent are neither satisfied/dissatisfied with their service. Primary reasons for being less than very satisfied include service drops from time to time (76 percent), service is too expensive (60 percent), and service is too slow (40 percent).

- **Many customers experience connection issues or drops in voice calls, as well as slowdowns or drops in mobile data service.** Thirty five percent of respondents do not experience any connection issues or drops in voice calls, while 20 percent experience this at least once daily and 20 percent at least weekly. Furthermore, two-thirds of subscribers have experienced slowdowns or drops in mobile data service, including 20 percent who experience this at least daily and 18 percent at least weekly. Forty-three percent of those with connectivity issues said they occur any time of year with no pattern, and 45 percent are unsure if there is a pattern.

4.3   ISP interviews

T-Mobile, Verizon Wireless, and AT&T all provided input for this study, but mainly discussed national plans and did not provide specific information about specific challenges or plans on Cape Cod.

4.3.1   T-Mobile

As noted above in Section 3.4.4, T-Mobile's response to the Commission's request for information about its current network capabilities and deployment focused on its nationwide deployment efforts and did not include information specific to Barnstable County or Cape Cod. It did not provide information regarding network investment or facility deployment in the area.

It acknowledged that during the summer months wireless carriers "can experience increased demand on the network."

To invest in network expansion and keep up with growth in demand for wireless services, T-Mobile encouraged the County to ensure that its processes allow for quick approval and deployment of improved infrastructure in a "consistent and predictable fashion." The company stated that its deployment strategy focuses on areas with a "known need" for new wireless technology and any delays in approval processes will hamper meeting customer demand, especially during peak periods.

4.3.2 Verizon

As noted in Section 3.4.2, Verizon provided several links to website material that describe its national plans and network configurations. In these materials, Verizon states that it has the spectrum and advanced electronics deployed on their fiber network to provide necessary capacity to meet the communities' needs. Verizon states that it has deployed its own fiber to connect more than half of its cell sites nationwide to carry increased data traffic.

Verizon did not provide suggestions or strategies to the County for facilitation of network deployment projects or to address observed dips in speed over the summer months but offered to meet with Town or other interested entities to discuss its plans. It provided general language describing its 5G network and how it is expanding 5G coverage nationally, in some cases tripling the amount of available bandwidth. The company also says it is updating its network with artificial intelligence, automation, and "orchestration" to support security measures, increased reliability, and lower latency.

Verizon said it has seen increases in use of 5G devices and increase in data usage. The shift of customers onto Verizon's 5G network also frees up bandwidth on its existing 4G network which should improve service quality, capacity, and reliability for the remaining 4G network customers. Verizon has also seen an increase in home internet customers, many of which are on fixed wireless access.

4.3.3 AT&T Wireless

AT&T Wireless provided assurances that it is providing strong and reliable service to the 15 Cape Cod towns that is comparable to the service it provides throughout Massachusetts. It further stated that it meets the needs of the community throughout the year, including during peak demand. The company said that since 2018, AT&T has built or upgraded nearly 100 sites on Cape Cod with either small cell or macro site deployments. OpenCape provides fiber backhaul for AT&T's network on the Cape. AT&T continues to study and analyze traffic patterns and network usage in the area to plan additional network investment projects.

AT&T urged public sector officials to ensure that the County and local communities continue to make publicly owned vertical assets available for network deployment. It further suggested that local governments adopt local zoning ordinances and siting process that "facilitate rather than hinder" wireless deployment and it offered to work with public sector officials to share "best practices" that can support strong local zoning policies while also promoting wireless network expansion.

4.4 Permitting challenges may have delayed the addition of capacity to Cape Cod mobile networks, though this is not clearly a driving factor in network challenges

Mobile carriers typically build new towers to shore up gaps in wireless coverage, or to add capacity in a covered area where existing towers are full. Adding new towers with new radios also results in better speeds for users, as this adds capacity to the region.

In Barnstable County, new towers above 35 feet can require the approval of both the Commission and individual town's planning authority. [30] Providers have reported that this dual-track permitting process has added costs and delayed deployments. In 2019, for example, the Town of Mashpee denied the construction of a 150-foot monopole near a local fire station the Commission had approved.[31] After nearly two years of delays and a local appeal, the applicant eventually withdrew. Similarly, a major carrier reported in stakeholder interviews that an ongoing application to construct a new 120-foot monopole was approved by the Commission but denied by the local Planning Board. As a result, this provider is currently appealing the denial to a federal court.

Ultimately, however, conflicts and competing interests regarding tower siting are common across the United States and not unique to Barnstable County. There was not sufficient evidence to conclude that local or regional tower siting practices were driving mobile broadband challenges on the Cape.

Small wireless facilities or "small cell" deployments are also frequently used by mobile carriers instead of or in conjunction with macro deployments—typically to fill holes in the network or shore up capacity in high-usage areas. For example, one mobile provider interviewed for this plan noted that they had deployed small cells to provide infill coverage to sections of Provincetown that were not receiving adequate capacity from their macro sites covering the area.

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[30] "Technical Bulletin 97-001 Guidelines for DRI Review of Wireless Communication Towers Adopted 10/9/97," Cape Cod Commission, https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/regulatory/WirelessTechBulletin093010.pdf
[31] "Special Permit Decision," Town of Mashpee, https://www.mashpeema.gov/sites/g/files/vyhlif3426/f/uploads/blueskydecision_final.pdf.

Small cell deployments are typically under 50 feet in height and located on utility poles, light poles, standalone structures, or the sides of existing buildings, and can even be temporary to augment capacity for particular periods of time. They are generally regarded as less visually obtrusive or environmentally impactful than macro deployments, and their use is frequently aligned with town[32] and regional[33] planning objectives to minimize disturbance caused by new deployments. Despite being aligned with planning objectives, providers consulted for this study who noted difficulties with tower permitting also cited challenges in securing small cell approvals. However, again, there was no clear indication that such difficulties were a significant driver of mobile network issues.

4.5   Mobile service recommendations

Existing data indicates that where mobile broadband coverage exists on Cape Cod, mobile networks are adequately configured for user demand. However, resident reporting of problems with mobile voice and data services, paired with specific accounts of inadequate coverage at notable locations such as beaches, indicate that the primary issue in mobile coverage are gaps in service. These gaps may be of varying sizes—but it does not take a large gap to generate a dropped call and complaint about coverage.

In this context, two deployment solutions, as detailed below, will make meaningful progress towards closing coverage gaps quickly and with minimal disturbance.

- **Targeted in-fill radio deployments—scaled to precise coverage gaps—prioritizing small facilities and existing vertical assets over new towers:**
  Targeted deployments using existing facilities minimize impact on surrounding areas, are relatively fast to deploy, and can be win-win for carriers with lower upfront costs and fewer permitting requirements than larger deployments.

- **Temporary cell-on-wheels (COW) for critical areas that cannot or should not accommodate new, permanent infrastructure:**
  COWs are portable mobile wireless radios, operated by the mobile broadband carriers, that can be set up on a temporary basis. These are ideal for beaches, large events, commercial or downtown areas (where no vertical assets are available), or locations where coverage is critical, but a permanent installation may not be possible or advisable.

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[32] "Zoning Bylaws of The Town of Mashpee," Town of Mashpee, Page 72, https://www.mashpeema.gov/sites/g/files/vyhlif3426/f/uploads/2023_zoning_bylaws.pdf
[33] "Technical Bulletin 97-001 Guidelines for DRI Review of Wireless Communication Towers Adopted 10/9/97," Cape Cod Commission, Page 5, https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/regulatory/WirelessTechBulletin093010.pdf.

These solutions will ultimately require action from mobile network carriers to implement. However, specific actions could make carrier action more likely, more efficient, and more effective. These actions are recommended below.

4.5.1 Implement a rigorous and repeatable drive-test data collection process that measures signal strength on all Cape Cod roadways at a granular level

Collecting granular drive-test data—whether done by Towns, the Commission, or other entities— will help these entities and mobile carriers ensure that new radio deployments are strategically sited and sized to address coverage gaps. This could also support public education around new deployments by allowing stakeholders to speak credibly and specifically to coverage needs and potential solutions that would solve those needs. Finally, it will make it possible to track progress and changes over time.

Two tests should be performed every other year, one in summer, and one in winter. Summer testing will capture network performance with signal loss due foliage, and testing every other year will provide regular data updates by which to measure success of new deployments or changes in network performance (e.g., is less mobile broadband signal available as more people sign up for fixed wireless access). Testing every other year also balances the desire for current data with the time and resources that would be required for more frequent testing.

Testing should focus on Reference Signal Received Power (RSRP) for LTE and Synchronization Signal Reference Signal Received Power (SS-RSRP) for 5G (i.e., the measured power of the signal, spread across spectrum) as the primary data point for service comparison, measured in decibel milliwatts (dBm). Measuring speed is useful to capture the lived experience of a user, but RSRP is a more dependable proxy for mobile coverage as it is not affected by congestion. Generally RSRP of less than -110 dBm (negative 110 dBm) should be considered poor, RSRP of between - 110 and -100 dBm should be considered adequate, RSRP of greater than -100 dBm should be considered good, and a total lack of signal should be considered a "dead zone."

The drive test setup should include three mobile devices to simultaneously measure network performance across the three major carrier networks (AT&T, Verizon, and T-Mobile). Industry experts often prefer Google Pixel devices for testing purposes, with devices rooted (i.e., unlocked) and kept on a particular band in areas where coverage is weak. The devices should run a reputable but cost-effective software solution for mobile network testing, such as RantCell.[34]

While the initial test set up would need to be configured by industry experts, actual drive testing for signal collection does not require specialized skills. The physical configuration of three testing devices should be compact, portable, and easily removed from the drive test vehicle (see walk

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[34] RantCell, https://rantcell.com/.

testing recommendation). For planning purposes, based on recent drive tests in similar regions, the test process itself (not including post-processing or data analysis) will cost approximately $7 per road mile on Cape Cod, inclusive of the cost of mileage, drive labor, software usage, and testing devices, or about $27,000 per full drive test of the County's approximately 3,900 road miles. Entities who wish to reduce the cost of drive testing could bring the actual work of driving in-house once the test set-up was constructed and configured.

Additionally, the Commission is already well acquainted with vehicle-based data collection efforts through their work on annual pavement conditions assessments [35] for Cape Cod, and could explore possibilities around combining the driving required for these two undertakings where feasible.

Data analysis of the drive test data would reveal a defensible, comprehensive, and granular assessment of coverage along roadways not available through existing data sets or wireless propagation analyses.

4.5.2   Encourage relevant stakeholders to perform mobile broadband "walk tests" to measure signal strength in critical non-driving areas

Like the recommendation to conduct drive testing, walk-test data would allow the Commission to use equally granular data but for areas that pedestrians frequent—such as beaches—that have particular public safety needs.

The Commission could collaborate with entities that have jurisdiction over areas off roadways in order to select priority areas for testing (e.g., town-level parks and recreation departments or the National Park Service). Collaborating organizations would ideally conduct walk tests on the same cadence and with the same equipment as the drive tests. Drive testing software solutions have walk testing features and modes, and the same signal testing hardware setup could be removed from a drive test vehicle, loaned to another entity, and carried during walk testing. Since the test equipment will be portable, collaborating entities may be able to leverage their standard vehicles or personnel, such as by mounting the test set-up on all-terrain vehicles already in use by officials along beaches.

Once specific coverage gaps are documented via the drive testing and walk testing, the data and findings should be made publicly available on a platform such as Data Cape Cod.[36] Providers, planners, and public sector officials will then be armed with the foundational information needed to pursue appropriately sized deployments.

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[35] "Pavement Conditions," Cape Cod Commission, https://capecodcommission.org/our-work/pavement-conditions/.

4.5.3 Create a vertical asset database for areas surrounding identified coverage gaps

To enable infill coverage solutions with minimal disturbance, the Commission could conduct a vertical asset inventory in areas identified as problems. This will allow the identification of vertical assets in or adjacent to areas with coverage gaps that could be used to easily deploy new radios. This information will provide carriers with deployment ideas—or alternate ideas—to increase the likelihood of viable deployments and minimize the costs and permitting that may be required for new construction.

Documentation of existing vertical assets will again require extensive field-based collection. Field-based data collection is preferable to remote analysis methods (e.g., parcel and rooftop analysis) because it allows for real-time visual inspection of the assets as well as more detailed assessment of whether additional equipment could be deployed on the asset.

Data collection should target the identified gaps in coverage and surrounding areas. To further target data collection, start by assessing commercially available tower data such as Ookla Tower Source to identify potential vertical assets—but know that this data source is far from complete. An expert in the field would then "drive the market" to verify the purchased data, collect additional information on the assets, and document additional assets (e.g., rooftops of buildings not included in the purchased data). This type of visual data collection is possible in Barnstable County due to generally low scale of development. However, the data collection requires industry expertise.

Information to collect on each asset will include:

1. Location information:
    a. GPS coordinates (latitude and longitude)
    b. Address or nearest cross streets
2. Asset type:
    a. Type of vertical asset (e.g., tower, utility pole, light pole, water tower, building)
    b. Subtype, if applicable (e.g., monopole, guyed tower, lattice tower for cell towers)
3. Physical characteristics:
    a. Height of the structure
    b. Material (e.g., steel, concrete, wood)
    c. Condition (e.g., new, aged, damaged)
4. Existing equipment:
    a. Types of radios or equipment already installed
    b. Estimated number of radios and their approximate positions on the asset
    c. Any visible markings or identification numbers on existing equipment
    d. Presence of any ancillary equipment (e.g., power supplies, cabinets)

5. Potential for co-Location:
   a. Assessment of space availability for additional equipment
   b. Potential interference or compatibility issues with existing equipment
6. Accessibility:
   a. Ease of access to the site for vehicles and equipment
   b. Presence of obstacles that could complicate installation or maintenance (e.g., trees, other structures)
   c. Security features (e.g., fencing, locked gates)
7. Photographic documentation:
   a. Photos of the asset from multiple angles
   b. Close-up photos of any equipment or identifying marks
   c. Photos of surrounding area for context
8. Notes on surrounding area:
   a. Presence of potential future obstructions (e.g., construction sites, trees that may grow to obstruct signals)
   b. General assessment of the area for network needs (e.g., high-density residential area in need of more coverage)

Additional desk research will be required to document useful items such as ownership and contact information as well as environmental and regulatory considerations such as proximity to sensitive areas (e.g., wetlands, schools, hospitals).

4.5.4 Use data collected and proactive posture to encourage collaborative solutions with mobile wireless carriers

Improving mobile wireless coverage is a years-long endeavor, and one that involves negotiation, compromise, politics, public input and opinion, and stakeholder buy-in. However, active prompting and solutions-driven conversations spurred by the public sector can accelerate this work, and the Cape Cod Commission can use their role as the collector and manager of publicly held data on mobile wireless gaps to play a neutral—yet productive—role in closing mobile wireless gaps.

By executing the recommendations in this report, this process may encourage carriers to do more deployments, like how planning bodies can reduce the cost of housing development by packaging information on specific parcels, zoning, codes, building opportunities, and permit requirements, for developers.

To begin, the Commission could let data on granular coverage gaps, public safety needs, and vertical asset availability guide regular conversations with carriers, asking about their deployment plans and what closing gaps would require from an engineering perspective. Furthermore, in areas where temporary solutions to public safety needs are necessary, COWs

may be the prudent solution, but the configuration, partners, and deployment framework for them will be a place-by-place decision that must be shaped by active and open conversation.

In some instances, a carrier may be willing to deploy COWs that allow for coverage across multiple providers. Those involved in carrier conversations could request this arrangement where possible as it allows for not only public safety connectivity (the ability for all users to contact first responders) but for consumers to enjoy the benefits of mobile broadband across carriers. Whether the COWs can be fed by fiber backhaul—or a microwave link from a tower elsewhere on the Cape—will depend on their exact location and existing infrastructure of the partner carriers. (The same is true for whether they can be fed primarily by grid power or a generator).

With other infill deployments, the Commission can provide direction for carriers in creating solutions for particular areas (which may happen with prompting but not over the usual course of business), and even assist with some of the typical barriers to using existing vertical assets to deploy wireless facilities.

For example, carriers often struggle to contact asset owners, and a trusted intermediary can be useful in facilitating initial conversations. Beyond being a trusted intermediary, there are often misunderstandings from the asset owner about the business case for these types of deployments—leading to the assumption that the deployment will generate significant revenue for the carrier and therefore the asset owner should charge significant rent.

If the Commission could help broker conversations and set expectations from the outset the conversations could be more productive. In short, the Commission's role as a trusted source and track record for bringing about solutions will likely productively evolve over time and help with the long-term problem of solving mobile broadband gaps.

5. Digital equity analysis

The following section discusses challenges related to broadband affordability, skills, and device access.

5.1 Existing conditions

5.1.1 ACP adoption is lower than the state average, but the County exceeds the average device ownership and wireline subscription rates

Over the past few years, the Affordable Connectivity Program (ACP) has provided a monthly subsidy toward home internet subscriptions[37] for low-income residents.

5.1.1.1 *Only 16 percent of eligible Barnstable County households participated in the ACP and gained the $30 monthly benefit, lagging state and national adoption rates*

As of December 1, 2023, FCC data on ACP enrollment show that 6,104 Barnstable County households were receiving the ACP subsidy—about 16 percent of the estimated 37,100 eligible households in the County.[38] This enrollment rate is significantly lower than the statewide average of 31 percent (as shown in Table 13) and the national figure of 40 percent, which suggests that Barnstable County residents were less aware of the program, and less able to sign up, than residents in many other jurisdictions.

Table 13: ACP enrollment and gap analysis in Barnstable County

	Eligible households enrolled	Enrolled households[39]	Eligible households	Unenrolled eligible households
Barnstable County	16%	6,104	37,100	30,966
Massachusetts	31%	358,383	1,156,300	797,917
United States	40%	22,190,763	55,179,000	32,988,237

The ACP stopped accepting applications on February 7, 2024, but ACP enrollment rates are still important to note as an illustration of the gap in adoption between eligible households and subscribers. The challenges in enrollment indicated by the gap in ACP usage suggest that any

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[37] The program ended new enrollments as of February 7, 2024.

[38] Estimates of eligible households are based on 2022 American Community Survey reported data on household income, food stamp recipiency, Medicaid recipiency, supplemental security income, and public assistance income. It is important to note that this estimation does not take into account all qualification mechanisms, such as qualification via tribal assistance programs, and therefore may represent an underestimate of the size of eligible populations throughout the state.

[39] "ACP Enrollment and Claims Tracker," USAC, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/.

future affordability program—or existing, private program (such as Comcast's Internet Essentials at $9.95 per month or Internet Essentials Plus at $29.95 per month)—will see similarly limited enrollment unless specific interventions are taken to increase awareness and support subscribers in the enrollment process.

5.1.1.2   *Barnstable County exceeds state and national adoption rates for residential internet subscriptions, but low-income residents face the most significant gaps*

According to ACS data, 93 percent of Barnstable County households subscribe to residential internet services. Most of these subscriptions, 83.7 percent, are via wireline technology (cable, fiber optic or DSL). The county leads both the state and nation in internet subscriptions of any kind and leads the state and nation in wireline internet subscriptions, as shown in Figure 27.

Figure 27: Internet subscription rates in Barnstable County compared to the state and nation
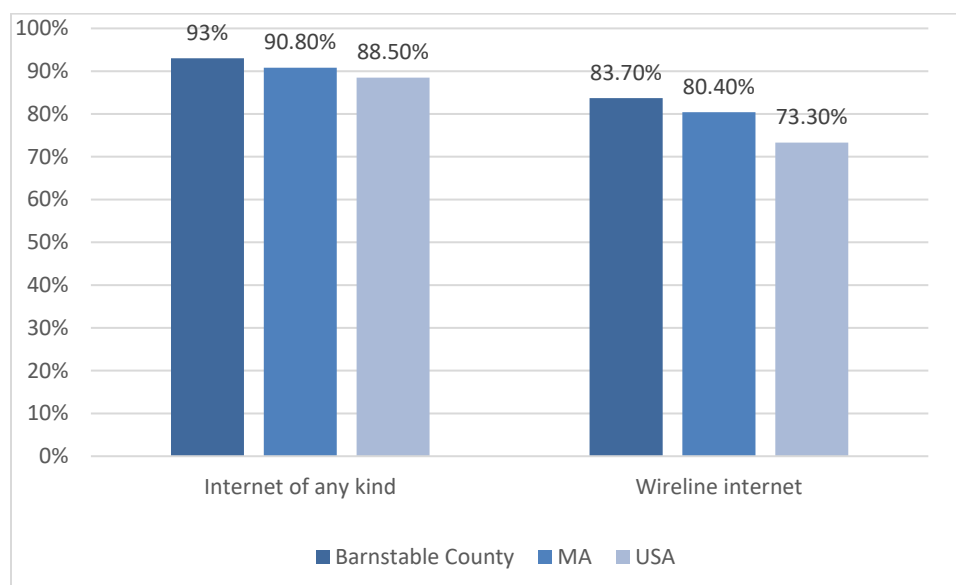
While internet adoption rates are relatively high in Barnstable County, an estimated 16,518 (or 16.3 percent) of households lack residential wireline internet service (Figure 28). Roughly 7.7 percent (or 7,660 households) are solely using a cellular service from their homes. Lower income and cost-conscious households may use their cellular connection and smartphone in lieu of a more robust connection. However, reliance on cellular service will not enable all members of a household to participate in the digital economy, because of data caps, the potential for the service to be throttled in times of mobile network congestion, and the limitations of smaller devices in using critical applications and services.

Figure 28: No access to wireline internet and mobile-only subscriptions compared to the state and nation
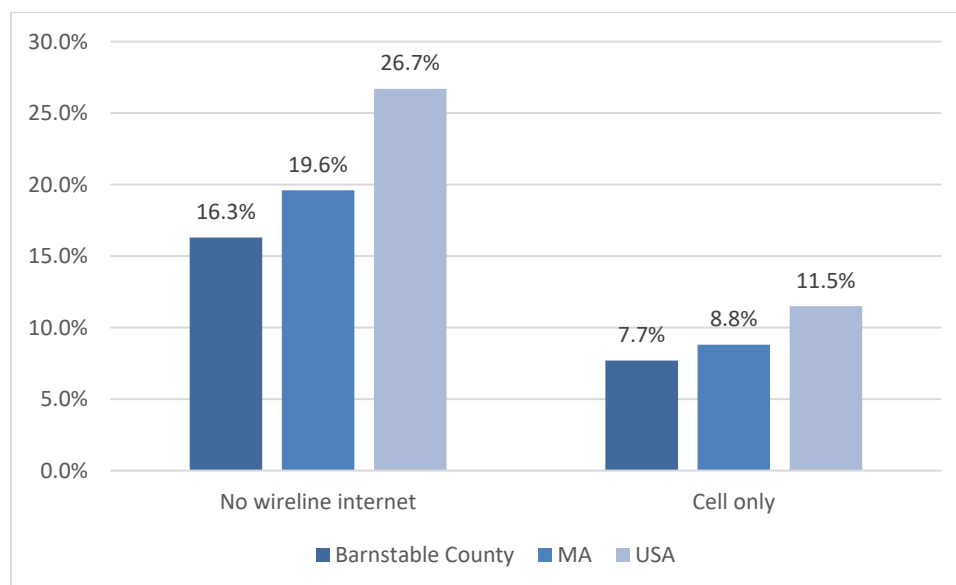
5.1.1.3 *Most Barnstable County households that lack wireline internet access earn less than $75,000 per year*

In Barnstable County, most of the households lacking an internet subscription are lower-income households. Whereas 97.1 percent of households making more than $75,000 subscribe to wireline internet services, only 88.2 percent of households making between $20,000 and $75,000, and 81.6 percent of those earning less than $20,000 do so.[40] After accounting for the total number of households across all three income brackets, an estimated 76.2 percent of (or 5,329 out of 6,992) households without an internet subscription earn less than $75,000 per year. Figure 29 shows subscription rates by income bracket.

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[40] For both of these income brackets, some households are likely able to afford service yet choose not to purchase it because they simply are not interested. For this reason, a 100 percent subscription rate does not represent the ideal or goal rates for any given population.

Figure 29: Wireline internet subscription rates by income level
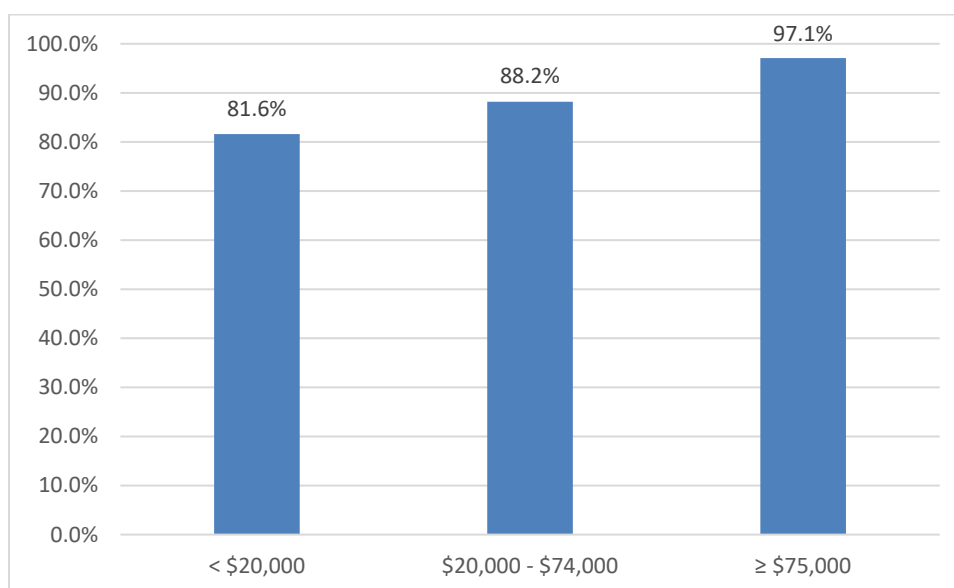
5.1.1.4 *Barnstable County leads both state and national averages in device ownership rates; only 4 percent of households lack device access*

ACS data show that 96 percent of households in Barnstable County own one or more computing devices, a figure that surpasses both the state (94.3 percent) and national (94 percent) figures. Access to affordable devices that meet a household's needs is a critical element of the effort to expand broadband access to any community. Looking across different types of devices, including desktop, laptop, smartphone, and tablet ownership, Barnstable County's ownership rates are higher than both the state and nation across nearly all device types (Figure 30).

Figure 30: Device ownership rates in Barnstable County compared to the state and nation
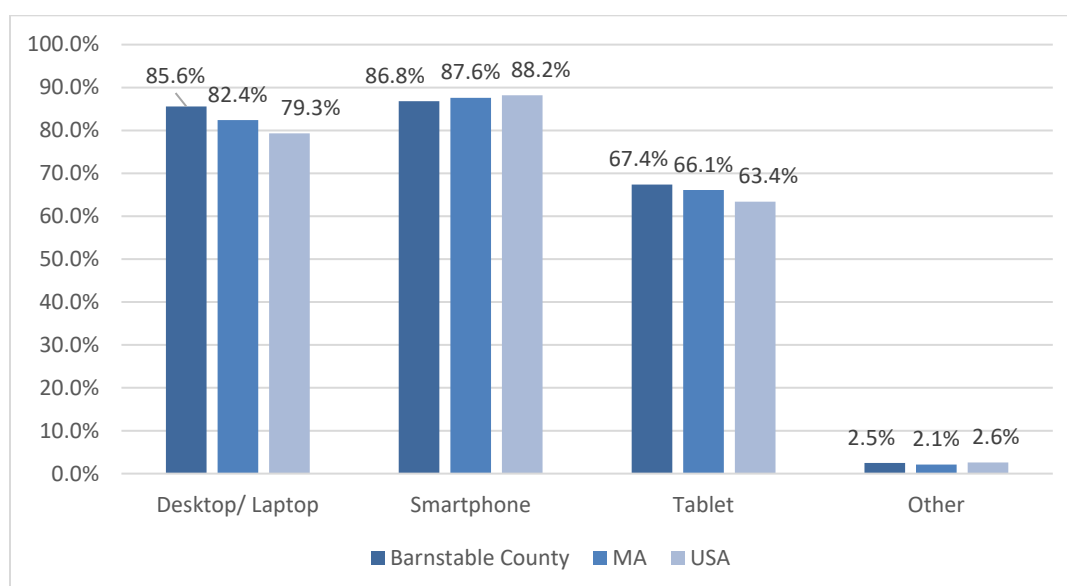
Figure 31 shows that 4 percent of Barnstable households lack a device, which is slightly better than the state and national averages of 5.7 percent and 6 percent, respectively. Additionally, 14.4 percent of households in Barnstable County do not have a laptop or desktop leaving these residents to rely on smartphones or tablets and making it difficult to fully engage in the digital economy or successfully learn and work from home.

Figure 31: Lack of devices in Barnstable County compared to state and national averages
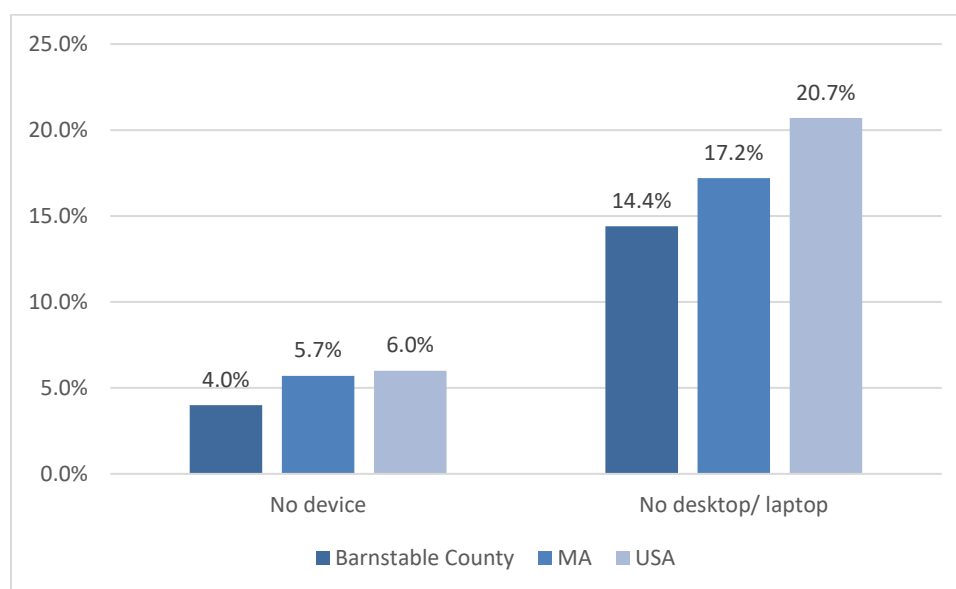
Additional device barriers may exist even after device ownership numbers are improved. For example, for households with many individuals, a single desktop or laptop will likely not deliver sufficient capacity for all members of the household to meaningfully use the internet. Further, ownership of a device is not sufficient to ensure full access to the benefits of broadband. Many households will require digital literacy training and access to technical support to maximize the benefits of these services.

5.1.2 Though the providers on Cape Cod participated in the ACP, there are still affordability challenges with internet service

CTC documented the pricing of the major providers on Cape Cod: Comcast, Verizon Fios, Verizon 5G Home Internet, and T-Mobile 5G Home Internet.[41]

Comcast and Verizon both participated in the ACP, which was available to eligible low-income residents. Comcast offers two low-cost plans (Internet Essentials at $9.95 per month and Internet

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[41] In the residential survey, described later in this report, 94 percent of respondents reported using one of these services. Of the remainder who said they used "other" services, most did not provide detail but five mentioned OpenCape. Others cited Crown Castle (typically a business service offering), Starlink satellite service, and various mobile plans. Some said they did not know.

Essentials Plus at $29.95 per month) that were free with ACP (or low cost without ACP) for eligible households.

Other price plans are locked in for initial promotional periods of 12 months, 24 months or 36 months depending on the plan, and monthly costs rise after the promotional period ends. The tables below show the different pricing plans for Comcast cable, Verizon Fios fiber, Verizon fixed wireless, and T-Mobile fixed wireless plans. Mobile plans are also ACP-eligible, but each household can only use ACP once—so if a household is using the benefit for a mobile plan, they cannot get the benefit again for a home plan.

5.1.2.1   *Comcast service offerings and prices*

Table 14 shows Comcast's data-only service offerings in Barnstable County. For clarity, this table excludes discussion of the many bundled service offerings that include cable and/or phone. Internet Essentials and Internet Essentials Plus were fully subsidized by the ACP benefit. Although funding for that benefit has expired, the underlying Internet Essentials program remains available for eligible customers. Most recently, in April of 2024, Comcast announced "Comcast Now," a lower-cost program available to all. Customers can choose from two speeds: 100 Mbps for $30/month or 200 Mbps for $45/month.[42]

Table 14: Comcast service plans, with programs for low-income customers shaded in green

Package	Internet speed	Monthly cost	Terms
Internet Essentials	50/10 Mbps	$9.95	Available to eligible low-income customers following an application process and subject to certain conditions. Internet Essentials also includes added benefits; customers can purchase a refurbished computer for $149.99.
Internet Essentials Plus	100/20 Mbps	$29.95	Available to eligible low-income customers following an application process and subject to certain conditions. Internet Essentials also includes added benefits; customers can purchase a refurbished computer for $149.99.
Now 100	100/10 Mbps	$30	No introductory rate and no term contract. Requires self-installation and activation of refurbished gateway. Unlimited data.
Now 200	200/10 Mbps	$45	No introductory rate and no term contract. Requires self-installation and activation of refurbished gateway. Unlimited data.

Package	Internet speed	Monthly cost	Terms
Connect More	300/10 Mbps	$35 for the first 12 months, then $90 plus $15/mo. router rental fee	Pricing guaranteed for 12 months. No term contract. Includes $10/mo. automatic payments and paperless billing discount with a stored bank account. Discount is $5/mo. when using a stored credit card. Professional installation fee of $100.
Gigabit	1000/20 Mbps	$60 for the first 12 months, then $115 plus $15/mo. router rental fee	Pricing guaranteed for 24 months. No term contract. Includes $10/mo. automatic payments and paperless billing discount with a stored bank account. Discount is $5/mo. when using a stored credit card. Professional installation fee of $100.
Gigabit Extra	1200/35 Mbps	$80 for the first 12 months, then $120 plus $15/mo. router rental fee	Pricing guaranteed for 24 months. No term contract. Includes $10/mo. automatic payments and paperless billing discount with a stored bank account. Discount is $5/mo. when using a stored credit card. Professional installation fee of $100.
Gigabit X2[43]	2,000/200 Mbps	$100 for the first 12 months, then $120 plus $15/mo. router rental fee	This is a non-promotional rate. No term contract. Includes $10/mo. automatic payments and paperless billing discount with a stored bank account. Discount is $5/mo. when using a stored credit card. Professional installation fee of $100.

5.1.2.2   Verizon Fios service offerings and prices

Verizon's Fios fiber plans—which presently are only available to customers in Bourne who live on the mainland side of the canal—are generally less expensive than those offered by Comcast as shown in Table 15, for similar download speeds. Additionally, Fios offers symmetrical download/upload speeds regardless of plan.

Table 15: Verizon Fios advertised service plans with low-income program shaded in green

Package	Internet speed	Monthly cost	Notes
Fios 300 (Verizon Forward Program)	300/300 Mbps	$49	The $30 ACP subsidy and Verizon discount brought the cost to $0.
Fios 300	300/300 Mbps	$49.99	Pricing guaranteed for 24 months. No term contract. Router included. Possible $99 set up fee, location dependent.

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[43] Only available in some areas of Cape Cod. See Section 3.1.1.4

Package	Internet speed	Monthly cost	Notes
Fios 500	500/500 Mbps	$69.99	Pricing guaranteed for 36 months. No term contract. Router included. Possible $99 set up fee, location dependent.
Fios 1 Gig	940/880 Mbps	$89.99	Pricing guaranteed for 48 months. No term contract. Router included.

5.1.2.3   *Fixed wireless service offerings and pricing*

The fixed wireless options in Barnstable County are priced comparably to the lowest tier of Verizon Fios service, but they deliver significantly lower speeds and performance. Fixed wireless services are not universally available, speeds at individual locations can vary widely, and these services are subject to "throttling" in times of network congestion.

5.1.2.3.1   T-Mobile fixed wireless service offerings and pricing

Table 16 details the fixed wireless offerings of T-Mobile. Speeds vary from 4 to 382 Mbps download and 3 to 32 Mbps upload depending on a household's proximity to either the 5G or 4G LTE network. It is important to note that T-Mobile does not participate in the ACP plan. As is the case in some areas, a mobile plan is not required to subscribe to home internet in the County.

Table 16: T-Mobile fixed wireless advertised service plans[44]

Package	Internet speed	Monthly cost	Notes
5G Home Internet	75/20 Mbps*	$60/month (as low as $40/month	Pricing includes a $5/mo. autopay discount. $30 service is only available to customers with a T-Mobile 5G phone and plan offered between $60-100/mo., plus the cost of a handset. Gateway router provided at no charge but one-time $35 device connection charge at sign up.
4G LTE	4/3 Mbps to 19/4 Mbps	100 Gig for $60/month; 150 Gig for $85/month; 200 Gig for $110/month; 300 Gig for $160/month	Four plans offered with data caps. Pricing requires autopay with a debit card. Activation fee of $35 waived during current promotion. Includes free Wi-Fi Gateway device ($370 value.)

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[44] T-Mobile Policies: Open Internet. Mobile Wireless & Temporary Fixed Wireless https://www.t-mobile.com/responsibility/consumer-info/policies/internet-service. Last visited 12/15/23.

*Speeds are estimated and rounded. Quoted download speeds were 76-245 Mbps with claims that 50 percent of customers experience speeds in this range and the remaining customers could receive service faster or slower than this range. Upload speeds were quoted as 21-40 Mbps.

5.1.2.3.2   Verizon fixed wireless offerings and pricing

As detailed in Table 17, Verizon's fixed wireless offers two services at identical speeds but at different price points. Speeds within each tier range from 25 to 50 Mbps download and 4 to 5 Mbps upload and differ only in the range of benefits included, such as Verizon Cloud services and various tech devices.

Table 17: Verizon Fixed Wireless advertised service plans with low-income program shaded in green

Package	Internet speed	Monthly cost (non-promotional)	Notes
5G Home Internet (Verizon Forward Program)[45]	85/10 to 300/20 Mbps	$30 discount to regular price of subscriptions	Eligibility includes Federal Pell Grant recipient within the last year, qualify for Lifeline (through participation in SNAP, Medicaid, or have income be 125% below FPL), and WIC. Wireless router included; available to existing customers. Can use Lifeline discount if applicable.
LTE Home	Between 25/4 Mbps and 50/5 Mbps	$60 (as low as $35/month)	Price guaranteed for two years (promotional). $35/month rate requires postpaid mobile unlimited plan, paperless, autopay, and paperless billing. Includes wireless router.
LTE Home Plus	Between 25/4 Mbps and 50/5 Mbps	$80 (as low as $45/month)	Price guaranteed for three years (promotional). $45/month rate requires postpaid mobile unlimited plan, paperless, autopay, and paperless billing. Includes wireless router, Whole-Home Wi-Fi, and unlimited Verizon Cloud storage.
5G Home Internet	50/5 to 100/10 Mbps	$60 (as low as $35/month)	Price guaranteed for two years (promotional). $35/month rate requires postpaid mobile unlimited plan, paperless, autopay, and paperless billing. Includes wireless router.
5G Home Plus	85/10 to 300/20 Mbps	$80 (as low as $45/month)	Price guaranteed for three years (promotional). $45/month rate requires postpaid mobile unlimited plan, paperless, autopay, and paperless billing. Includes router, Whole-Home Wi-Fi, and Verizon Cloud Unlimited.

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[45] "Verizon Forward," Verizon, https://www.verizon.com/discounts/verizon-forward/.

5.2 Key findings

CTC conducted a survey of residents on a wide range of broadband-related topics including ones related to digital equity (see Appendix A and Appendix B). The Cape Cod Commission also developed its own insights on digital equity issues. What follows are some of the key findings and indicators from this process.

5.2.1 Survey findings on device utilization gaps

Most respondents have access to home internet service and computers, particularly among higher income households. The following are key findings:

- **Almost all respondents have access to computers and the internet in the home.** Ninety-one percent of households have enough computers in good, working order to efficiently connect to the internet. Saturation is somewhat lower among those earning less than $100,000 (88 percent), compared with those earning $100,000 to $149,999 (97 percent) or $150,000 or more annually (95 percent). Twenty-seven percent of respondents who live alone do not have enough computers in good, working order to efficiently connect to the internet.

- **When considering all respondents at all income levels, most would be able to replace non-working computers within a day (48 percent) or week (42 percent).** However, there were large differences in this ability by income. Only twenty-nine percent of those in households earning less than $50,000 annually could replace a lost or broken computer within a day, compared to approximately one-half of those earning $50,000 or more per year, suggesting that lower-income residents face bigger gaps in maintaining and replacing their computers.

5.2.2 Survey findings on internet skills gaps

Most respondents are skilled in various uses of the internet. However, a segment of respondents—mostly lower-income respondents—reported significant challenges with respect to their ability to perform basic functions online. Key findings include:

- **Most respondents reported they have the skills to perform basic tasks on the internet.** Overall, most respondents are very confident in their internet and computer skills, such as sending and receiving emails (80 percent), accessing online financial services such as banking and paying bills (77 percent), accessing medical/telehealth resources (72 percent), accessing governmental services such as DMV or benefits enrollments (73 percent), and using social media (67 percent).

- **Lower-income residents and those who live alone are less skilled in using the internet.** Respondents who live alone and those in lower-income households are less confident in

their internet skills compared with their counterparts. Just over one-half of those who live alone are very confident in accessing medical resources or government services online, compared with at least three-fourths of other respondents.

- **A subset of respondents are interested in a free or inexpensive class to help them improve their online skills.** Fifteen percent of respondents (13.5 with respect to seniors in particular) would be likely to attend such a class, while 23 percent are neutral. One-half of respondents would be very unlikely to attend online skills training.

- **A separate survey conducted by MBI for a statewide digital equity project provides additional data on these points.** The MBI survey asked similar questions but with different wording and response options and used a different and non-random methodology (wherein the survey was available to anyone who clicked a link). For those reasons, comparisons between the data should be treated with caution. With that said, in the statewide residential survey, 13 percent of respondents stated that online government services are not very or not at all accessible. Individuals with disabilities, low-income individuals, racial and ethnic minorities, and individuals with a language barrier were more likely to find these services inaccessible.[46]

5.2.3 Cape Cod Commission's findings

The Commission is leading digital equity planning studies and supporting subsequent implementation strategies for certain Cape Cod towns, and the Commission supported MBI in regional asset mapping efforts to identify Barnstable County digital equity assets as part of MBI's statewide digital equity planning process.

The Commission has highlighted observations about Cape Cod's digital equity needs and the organizations that are poised to implement or scale work in this area. The below findings reflect findings derived from the sum of these digital equity activities and were shared by Cape Cod Commission staff:

1. Libraries and Councils on Aging are critically important to advancing digital equity across Cape Cod. Most libraries are organized to some extent through the Cape Libraries Automated Materials Sharing (CLAMS) Network and other peer learning networks. Libraries would benefit from a more collective approach to resource-sharing, programming, and peer-learning specific to digital equity, including:

   a. Collective or collaborative approach to hot-spot and device lending, which could involve interorganizational partnerships.

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[46] "Massachusetts State Digital Equity Plan (For public comment)," MassTech, https://broadband.masstech.org/sites/default/files/2023-11/MA%20SDEP%20FINAL%2011.13.pdf.

b. Increased workshops and public programs with a focus on digital equity, accompanied by opportunity for libraries with existing programming to share information and resources with those that are behind.

c. Training for library staff on how to provide technology support to residents.

d. Creation of a referral network that directs residents to digital navigators and other regional agencies in cases where technology needs exceed library capacity.

2. The Council on Aging (COA) departments on Cape Cod are particularly essential due to the number of aging individuals in the region and are organized Cape-wide through COAST and other County coalitions. Many COAs are already benefiting from the Cape and Islands Elder Services provision of Senior Planet programming, but the regions senior population would benefit further from:

    a. Increased digital navigation services to provide 1-to-1 support.

    b. Training for COAs on working with seniors to access essential services, such as MyChart, with accompanying workshops for residents.

    c. System to share existing curriculum and best practices. Some COAs are providing strong programs that could be replicated with a bit of funding (less than $10k) in other towns.

    d. Development or acquiring curriculum to address top community needs such as personal communications, scams/privacy/security, using personal devices. Train-the-trainer model amongst COAs for implementing this curriculum.

3. For many of the Cape's health, human services, and educational agencies, components of digital equity are embedded within programs designed to achieve broader goals (such as wellness or job skills training). Funding, capacity, and knowledge are barriers to developing dedicated digital equity strategies within these agencies. Solutions could include:

    a. Community education on digital equity for practitioners.

    b. Training or consultation to further embed digital equity within existing service models and operations.

    c. Training on enrolling constituents in affordability programs.

    d. Digital navigators to agencies who lack the capacity to provide digital navigation themselves.

    e. For all of the above, focuses on culturally responsive service provision (such as services offered in multiple languages) would be key to success.

4. Generally, programs that advance digital equity exist across the region but are scattered and there is no learning continuum. The region would benefit from organization in this area. The organizing agency would build on identified assets in Barnstable County to advance a local learning network. Through this:

   a. Existing, successful programs could be expanded and replicated across agencies supporting covered populations. The term "covered populations" is defined in the Digital Equity Act and includes low-income households, aging populations, incarcerated individuals (other than individuals who are incarcerated in a federal prison), veterans, individuals with disabilities, individuals with a language barrier, including those who are English learners or have low literacy levels, racial and ethnic minorities and rural inhabitants.

   b. Providers could understand where to send referrals (i.e.: individual completes an entry level computer skills course, where do they go next to continue their learning).

Funding, capacity, training, and a lead agency to act as convenor are a barrier to achieving this.

5. Finally, programs to support the modernization of public spaces and public Wi-Fi improvements would benefit community anchor institutions and other areas of social and economic import across the region. Examples include stronger Wi-Fi both within and surrounding schools, libraries, and public parks.

The following subsections contain recommendations from the CTC team, aligned with the Commission's findings and those of this project. The recommendations include potential convening activities, programmatic, and funding approaches that Barnstable County, through the Commission and other local actors, could consider adopting as it develops strategies for addressing digital equity gaps.

5.3 Digital equity recommendations

5.3.1 Form a countywide Digital Equity Coalition and convene annual or biannual meetings to harmonize efforts and support outreach to funders

Independent of the Commission's observation about the need for more coordination, CTC identified such a need and strongly recommends coordination through regular convenings of entities that might not otherwise connect. Potentially, the Commission can serve as an initiator or lead entity in the formation of a Regional Digital Equity Coalition, which would convene public and nonprofit organizations already providing or planning to provide relevant services on Cape Cod. Representatives from these organizations, meeting twice per year—and with the structure to encourage members of the Coalition to distribute timely and relevant information and

opportunities at other times—would help inform a holistic programmatic strategy and make recommendations to funders and philanthropies.

Such coalitions are critical to engage stakeholders and drive change. The Cape Cod Foundation, and family-based and corporate foundations within the Cape and Islands Funders Network, have previously served in similar roles across the Cape and would be a logical partner. Further, Barnstable County government has a history of regional convening, which include current regional efforts like the Barnstable County's Health and Human Services Advisory Group. The Cape Cod Commission itself has had experience initiating collaboratives, having previously launched the Cape Cod Ponds Network. These examples highlight County assets and capabilities for convening local and regional organizations.

Such efforts will have a logical starting point on May 16, 2024, when the Cape Cod Commission in partnership with MBI hosted a workshop for digital equity practitioners to better understand the region's digital equity needs, priorities, and opportunities. Discussion throughout the workshop focused on areas such as: supporting the region's aging population, leveraging existing programs and resources, and opportunities for further peer-learning, streamlining of services, and collaborative resource-sharing. Participants included librarians, Council on Aging and Senior Center staff and volunteers, school IT staff, and nonprofit, municipal, or community-based organizations practicing digital equity within fields such as healthcare, human services, and education. The goal of the workshop was to identify strategies to bridge the digital divide on Cape Cod, to prioritize future initiatives based on practitioner guidance, and to establish a network of service providers.

The Commission could leverage this workshop into the beginning phase of a digital equity coalition, which can serve as an ongoing resource for disseminating information on best practices on connecting residents in areas such as: subsidy programs, providing devices, assisting with device maintenance and updates, and helping people develop better computer skills. An effective coalition would facilitate partnership between MBI, towns, libraries, senior/aging groups, social service agencies, and public health agencies.

An early role for the coalition would be an assessment of already existing digital equity positions in both the public, private, and nonprofit sectors. After gaining a stronger understanding for the tools already in place, the coalition could consider which agencies are best positioned to take on the role of evaluating and operationalizing recommendations. This may include an analysis of implementation and funding opportunities at a County level, municipal level, or community organization level. The Cape Cod Commission can initiate or lead this coalition without itself being the entity implementing programs.

5.3.2 Consider augmenting state and federal digital equity funds with a regional grant program

The structure and landscape of federal and state digital equity funding is evolving. MBI has recently released the State Digital Equity Plan,[47] and federal agencies are crafting rules for federal grant programs that will distribute $2.75 billion nationwide. However, this level of funding will not meet all needs nationwide. Barnstable County or another regional entity might consider creating a modest initial grant fund to support local or regional nonprofits and community organizations to support existing programs and provide seed funding for new ones. The Digital Equity Coalition, liaising with a Commission staff member, could inform the effort. And the Commission can consider reevaluating the total grant fund amount each year as funding allows.

A grant application, organized and managed by the Commission, could allow local organizations serving the County, or the Towns, to provide specific proposals for training, enrollment support for affordability programs, or device subsidy and assistance programs. The Commission could develop metrics and reporting on timelines, financial accountability, and program results that will demonstrate the impacts and how they help meet digital equity goals and objectives created by MBI.

Additional funders in the region include the Cape Cod Foundation, and family-based and corporate foundations within the Cape and Islands Funders Network. These and other regional and philanthropic funders should be promoted across the Cape to offer more agile and complimentary funding opportunities alongside the recommended County grant program.

Moving forward, the Commission may want to work in a funding and grant advisory role through the coalition, which could take the form of funder participation in regional convenings and subsequent due diligence.

5.3.3 Help pursue funding to community TV stations to support digital skills programs

Public, Educational, and Government Access (PEG) channels run by community TV stations[48] are trusted and proven community partners, and—although this engagement did not include research on Town-level efforts—it is not unusual for these organizations to serve as de facto digital skills training centers. Community TV stations are facing budgetary challenges as cable revenues decline. A potential additional role for these organizations would be to provide technical and skills assistance for residents.

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[47] Massachusetts Draft State Digital Equity Plan, November 2023, https://broadband.masstech.org/sites/default/files/2023-11/MA%20SDEP%20FINAL%2011.13.pdf.
[48] Public, Educational, and Governmental Access Channels ("PEG Channels") | Federal Communications Commission (fcc.gov)

There is a significant need for this type of support. In the survey conducted for this project, approximately 21.5 percent of respondents with household income of less than $50,000 per year stated they would be somewhat or extremely likely to attend a class to improve their internet skills. ACS data indicate there are 33,000 households making between $20,000 and $75,000. With this number as a rough proxy, 6,900 households might be interested in such services, which could be addressed by community TV partner (or other partners and resources). Similarly, 13.5 percent of seniors and 21.6 percent of individuals aged 40 to 49 expressed they would be somewhat or extremely likely to attend a digital skills class.

The Commission could consider pursuing or offering additional funding for these organizations, with programmatic details and precise funding levels subject to further study and recommendations by a countywide digital equity coalition.

5.3.4 Promote digital navigator programs enhancing telehealth and other digital skills at community health centers across Cape Cod

In December, MBI announced that it was awarding $3.7 million to the Massachusetts League of Community Health Centers for the expansion of telehealth services for community health centers across the state.[49] The Community Health Center of Cape Cod (CHC) was among the recipients of this funding, which will support the hiring of digital navigators for telehealth, and enrollment in low-cost broadband programs and other government services.

The Community Health Center of Cape Cod (CHC) provides healthcare, programs, and education to improve the health of residents across Cape Cod. CHC has five centers on the Cape, in Bourne, Centerville, Falmouth, Mashpee, and Sandwich. CHC had more than 85,000 patient visits across all centers in 2023, primarily to low-income and diverse members of the Cape Cod community.[50] Simultaneously, Duffy Health Center and Outer Cape Health Center also have digital navigators or community navigators who embed digital navigation practices within service provision.

There is a significant, ongoing need for all of these services. For example, the residential survey showed that those that earn less than $50,000 per year are less likely to feel very confident than all other income brackets in accessing medical or telehealth resources (66 percent).

Representatives from community health centers should be included in any digital equity coalition if formed in Barnstable County. Representatives from these community health centers could use their communications channels to ensure that their clients, which span across Cape Cod, are aware of these incoming digital navigation services and that they are well used.

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[49] "Healey-Driscoll Administration Awards $20 Million to Boost Digital Equity," MBI, https://broadband.masstech.org/news/healey-driscoll-administration-awards-20-million-boost-digital-equity.
[50] "Facts about the Health Center," CHC Community Health Center, https://chcofcapecod.org/about-us/facts/.

The institutional experience and expertise of these agencies could also be leveraged and shared among new navigators entering the Cape through forthcoming funding opportunities. In the long-term, the Commission can work with MBI to ensure this program continues.

5.3.5 Facilitate the partnership between device provision entities with interested local community organizations on the Cape

Although the percentage is higher than it is for the state and nation, ACS data show that 14.4 percent, or approximately 14,400 households, in Barnstable County lack a desktop or laptop computer. Additionally, approximately 3,900 households rely on smartphones as their only device to access the internet. The residential survey conducted for this report also highlights that only 29 percent of those in households earning less than $50,000 annually reported they could replace a lost or broken computer within a day, compared to approximately one-half of those earning $50,000 or more, suggesting that this population will face the biggest need for device support programs on Cape Cod.

The Commission has also identified a need for device lending and increased workshops and digital training curriculums for residents that can be replicated across the Cape. Device provision organizations such as Tech Goes Home (TGH) offer digital skills and literacy classes that conclude with device provision. TGH partners with schools, healthcare providers, and community organizations to provide such support through those organizations. Upon successful completion of a TGH course through a community partner, students are provided with a device for personal use. Generally, the cost is $1,500 per person. TGH is a longstanding partner with MBI, which has partnered to fund and connect TGH with community-based organizations across the state, prioritizing gateway cities. Other organizations offer similar services. The digital equity coalition could be tasked with identifying organizations on Cape Cod that could become local partners for training, and for more precisely estimating the scale of the demand.

5.3.6 Consider establishing a regional call center to assist in connecting residents with technical support resources and supporting enrollment in current or future broadband subsidy or low-cost programs

The Commission has identified a need across the Cape for increased digital navigation services to provide direct technology support, resource referrals, enrollment support and other digital and user services. The survey, as noted above, also pointed to gaps in these areas. To address this need, the region could consider establishing a call center to assist seniors and others in connecting to local and regional technical support programs and to provide direct assistance in enrolling in Comcast's Internet Essentials (and ACP if new funding is provided for the program), and others.

There is the theoretical potential for expanding some existing call center resources. For example, the state Attorney General's office has a hotline available for seniors to thwart internet and other

scams.[51] Ideally, technical services offered through a call center would be knitted together and added to the AG's hotline and/or other existing social service agency services.

If Barnstable County or another regional entity wanted to set up its own call center, the table below estimates the costs of staffing, marketing, and operations if created from scratch. The first section provides year-one costs; the second section provides annual costs for subsequent years. The numbers are based on CTC's experience with similar initiatives. A relatively modest call center staffed by two people could have a potentially large impact—assisting approximately 5,000 individuals or families per year. (The number could be higher or lower based on demand for the service and the types of services offered. Costs could potentially be lower if these functions were added to an existing resource.

<div align="center">

Table 18: Indicative call center budget for enrollment and tech support[52]

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Year One	Budget
Creation and distribution of informational materials such as web pages, fliers, inserts, and mailers	$20,000
Call center technology and software licenses	$20,000
Two full-time call center staff ($40 hourly rate)	$166,400
Total	**$206,400**
Estimated cost per household if 5,000 households are assisted	*$41*
Subsequent Years	**Budget**
Creation and distribution of fliers, inserts, and mailers	$5,000
Maintenance of call center and equipment	$10,000
Three full-time call center staff, based on an hourly rate of $40	$166,400
Annual Costs for Year Two Onward	**$181,400**
Estimated cost per household if 5,000 households are assisted	*$36*

5.3.7 Consider state program to provide potential capital and operating support for Wi-Fi in local housing authority buildings, and a new program for affordable housing wiring retrofits

MBI has partnered with the Metropolitan Area Planning Council—a regional planning agency serving the 101 cities and towns of Metropolitan Boston[53]—to provide procurement support, capital expense funding, and funding for the first year of operating expenses to provide free Wi-Fi access to residents of public and affordable housing in Massachusetts. Because the program requires the housing owner or other local entity to pay operating expenses after the first year,

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[51] https://www.mass.gov/info-details/the-attorney-generals-elder-hotline
[52] Numbers are estimates derived from CTC's experience designing and operating call centers to support broadband subsidy programs on behalf of state government entities.
[53] "About MAPC," Metropolitan Area Planning Council, https://www.mapc.org/aboutus/.

this option should be considered alongside other options for providing ubiquitous service. Another option includes a procurement for bulk purchases of services paid for by a single entity such as a Town or Housing Authority, subsidizing residential subscriptions for wired broadband in each unit, for faster and more reliable service inside apartments and not requiring any construction. And if the ACP is re-funded in the future, it would support such subscriptions inside the home, not OpEx for apartment-wide Wi-Fi deployments.

The anticipated size of the grant program is $5.6 million, with plans to address roughly 2,400 housing units. [54] The MAPC will initially lead project management and procurement for apartment Wi-Fi projects. Operational expenses for year two and beyond are expected to be assumed by local partners, including municipalities, public housing authorities, and community development corporations.

Whatever the method, efforts to provide reliable connectivity at home would ensure academic continuity for students and help bridge the digital divide for all residents. The Commission has promoted the program to housing authorities across the Cape and says five public housing facilities have applied for this funding.

Housing Authorities can also work with ISPs to pursue grants for wiring retrofits if required. In March, MBI announced a residential retrofit program to deploy fiber at approximately 22,000 public and affordable housing properties to replace deficient wiring and infrastructure through grants to qualified ISPs who will install, own, and maintain equipment.[55]

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[54] "Smart Growth and Regional Collaboration: Apartment Wi-Fi," MAPC, https://www.mapc.org/our-work/expertise/digital-equity/apartment-wi-fi/ (accessed November 17, 2023).
[55] "Residential Retrofit Program," MBI, https://broadband.masstech.org/retrofit.

6. Funding opportunities

Cape Cod's infrastructure and digital equity need may be supported by the federal funding and programs stemming primarily from the American Rescue Plan Act and the Infrastructure Investment and Jobs Act.

6.1 The Massachusetts Broadband Institute (MBI) administers infrastructure and digital equity programs funded by the American Rescue Plan Act (ARPA)

The ARPA State and Local Fiscal Recovery funds went to both the State of Massachusetts and directly to local jurisdictions to support infrastructure and digital inclusion projects to bring internet for all and economic development throughout the Commonwealth.

6.1.1 Gap Networks Grant Program

Through MBI, the state has allocated $145 million in Capital Projects Funds for its Broadband Infrastructure Gap Networks Grant Program to be used for the construction and deployment of broadband infrastructure to connect areas lacking sufficient internet with service at speeds of at least 100/20 Mbps.[56] This program is expected to move Massachusetts extremely close to its goal of 100 percent universal coverage.

To be considered for the first solicitation round, MBI required participants to submit applications no later than December 11, 2023. The second solicitation round was announced on May 23, 2024 with applications due on July 2, 2024. On July 2, MBI announced the recipients of the first round of funding.[57] Eligible applicants include private entities, local governmental entities including municipal light plants that offer broadband service, co-operatives, electric co-operatives, utilities, Tribes, and non-profit organizations.

This program funds last-mile infrastructure projects for unserved and underserved locations. Limited funding will also be available for open access middle-mile projects that are shown to be a necessary part of a proposed last-mile project and do not exceed 25 percent of the total project costs. The program also prioritizes projects with fiber and hybrid fiber-coaxial networks, with fixed wireless projects under consideration on a case-by-case basis; DSL, satellite, fixed wireless that relies upon completely unlicensed spectrum, or cellular wireless projects are not eligible for this grant funding.

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[56] "Broadband Infrastructure Gap Networks Grant Program," MBI, https://broadband.masstech.org/broadband-infrastructure-gap-networks-grant-program.

[57] "Healey-Driscoll Administration Awards More Than $45 Million in Grants to Extend High-Speed Internet Coverage Statewide," MBI, press release, July 2, 2024 Healey-Driscoll Administration Awards More Than $45 Million in Grants to Extend High-Speed Internet Coverage Statewide | MBI (masstech.org)

Through the Gap Networks program, Massachusetts prioritizes projects in economically challenged areas that focus on disadvantaged households and support community empowerment. The program will award extra points to projects located in disadvantaged communities identified as "Gateway Municipalities" [58] or in areas identified by the federal Housing and Urban Development department's Qualified Census Tract program.[59]

Applicants must meet a mandatory funding match of at least 20 percent of the total proposed cost of the project.[60] Applicants must submit letters of support from each municipality that will be served by the proposed project. Additionally, all projects will be scored on the affordability of the services offered over the built network for the residents in the project area and all awardees must participate in federal broadband subsidy programs for low-income consumers until at least December 31, 2034.[61]

A single applicant will not be awarded more than $20 million within each solicitation round. Projects must be complete by December 31, 2026.

6.1.2   Broadband Innovation Fund

The state also has $75 million in state ARPA funding allocated to digital equity and directed $50 million to grants through its Broadband Innovation Fund (Digital Equity Partnership & Municipal Digital Equity Planning). There are no new digital equity grant programs under ARPA accepting funding applications,[62] but other state and local opportunities for future ARPA digital equity grant programs may be released.

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[58] MBI defines a "Gateway Municipality" as having a population of greater than 355,000 and less than 250,000, a median household income below the Commonwealth's average, and a rate of educational attainment of a bachelor's degree or above that is below the Commonwealth's average.

[59] The HUD Qualified Census Tract program identifies census tracts that have at least 50 percent of the households with an income below 60 percent of the local Area Median Gross Income or where the rate of poverty is 25 percent or higher. See, HUD User Portal, Office of Policy Development and Research, Qualified Census Tracts and Difficult Development Areas, https://www.huduser.gov/portal/datasets/qct.html.

[60] Municipal applicants can request a waiver from the match rules upon demonstration of outstanding debt from a prior broadband infrastructure project located in the same area as the proposed project for this gap funding Program. "Grant Solicitation 2024-MBI-01," MBI, https://broadband.masstech.org/sites/default/files/2023-10/Gap%20Networks%20Grant%20Program%20Solicitation%202024-MBI-01.pdf.

[61] "Grant Solicitation 2024-MBI-01," MBI, https://broadband.masstech.org/sites/default/files/2023-10/Gap%20Networks%20Grant%20Program%20Solicitation%202024-MBI-01.pdf.

[62] The Municipal Digital Equity Planning Program and Digital Equity Implementation Program are still open and accepting applications for additional cities and towns in Massachusetts that have not yet signed up to participate until mid-spring 2024.

6.2   The Digital Equity Act and the state plan will create a framework for significant long-term investment in expanded digital equity opportunities

The Digital Equity Act allocates $60 million for planning grants for states, territories, and Tribal governments to develop State Digital Equity Plans. MBI is the lead agency for Massachusetts and is responsible for conducting the planning process and drafting the state plan.

These state plans incorporate extensive outreach, partnerships, data collection and needs assessments to identify solutions to expand digital inclusion and promote the adoption and use of high-speed broadband services. The state plans will also analyze and incorporate any digital equity plans developed by local or regional jurisdictions in the state as a source of local information and input to develop larger state goals. The Cape Cod Commission itself is the lead entity conducting some of these plans for Towns on Cape Cod to be incorporated into the Massachusetts State Digital Equity Plan.[63]

Each state's planning and recommendations will be directed especially toward ensuring that underrepresented and high needs "covered populations" have the skills, capacity, and tools to connect, including the aging, formerly incarcerated, veterans, racial and ethnic minorities, people with disabilities, low-income households and those living in rural areas. MBI conducted a grant program using a portion of these planning funds to distribute targeted funding to nonprofits across the state to support outreach and planning for the state's digital equity plan.[64]

The state digital equity plans set the stage for the $1.44 billion Digital Equity Capacity Building Grant Program.[65] NTIA has not finalized the rules or timeline for the Capacity Grant program; but once the program is launched NTIA will allocate funding over the course of several years. Under this program, states will apply for funding to support the implementation of their digital equity plans. States will receive funding based on a legislatively mandated allocation formula. Once received, states will have five years to use this federal funding to develop their own digital inclusion projects, including competitive grant programs for activities by state agencies, local governments, non-profits, and others.

Following the Capacity Grant program, NTIA will implement the $1.25 billion Digital Equity Competitive Grant program in 2025.[66] This direct funding program will award individual grants to eligible entities, including state and local governments and agencies, Tribal entities, nonprofits,

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[63] Massachusetts Draft State Digital Equity Plan, November 2023, https://broadband.masstech.org/sites/default/files/2023-11/MA%20SDEP%20FINAL%2011.13.pdf.

[64] MBI Digital Equity Partnership Program, https://broadband.masstech.org/partnerships.

[65] "Digital Equity Act Programs Overview," NTIA, BroadbandUSA Portal, https://broadbandusa.ntia.doc.gov/funding-programs/digital-equity-act-programs.

[66] "Digital Equity Act Programs Overview," NTIA, BroadbandUSA Portal, https://broadbandusa.ntia.doc.gov/funding-programs/digital-equity-act-programs.

and community anchor institutions. Rules and funding priorities are still being developed, but these grants will likely focus almost exclusively on the needs of underrepresented "covered populations" to connect through digital equity and inclusion programs. Funding likely will support programs that address affordability of services and devices, provide education and tools to increase privacy and cybersecurity while on-line, develop digital literacy and technical skills for personal and professional growth, and provide technical support and training for repair and updates to devices.

6.3 MBI's Municipal Digital Equity Implementation Program has been launched and is available to municipalities for amounts up to $100,000

MBI launched its direct grant program—the Municipal Digital Equity Implementation Program (MDEIP)—for municipalities to access implementation funds to carry out the efforts proposed through this and similar reports and other local digital equity programming activities. Municipalities interested in applying for this digital equity implementation opportunity must complete a two-step application process by May 31, 2024.[67] Applications will be reviewed by MBI on a rolling basis. The purpose of this funding is to enable municipalities to access direct grants to implement digital equity strategies identified through ongoing planning activities. This money—a one-time grant of up to $100,000—is intended to help municipalities make local digital equity investments and execute projects that will increase access, adoption, and usage of the internet for populations most impacted by the COVID-19 pandemic.[68]

Any municipality that has participated in the Municipal Digital Equity Planning Program or has a pre-existing local digital equity plan or related document can apply for this implementation funding.

6.4 The U.S. Economic Development Agency has opportunities for distressed communities

The Economic Development Administration (EDA) of the U.S. Department of Commerce administers Local Planning and Technical Assistance Programs as well as federal Public Works and Economic Adjustment Assistance Program funding opportunities for a wide variety of projects with a current allocation of $161 million nationwide.[69] These programs are designed to

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[67] "Municipal Digital Equity Implementation Program," MBI, https://broadband.masstech.org/digital-equity-implementation

[68] "Municipal Digital Equity Implementation Program," MBI, https://broadband.masstech.org/digital-equity-implementation.

[69] U.S. Economic Development Administration, Public Works and Economic Adjustment Assistance Programs, Notice of Funding Opportunity, at p. 10 (EDA was appropriated $121.5 million for the Public Works funding program), https://www.grants.gov/search-results-detail/346815; U.S. Economic Development Association,

address needs in economically distressed areas, and projects must meet specific criteria to show the project area is economically distressed. While this federal agency does not receive many broadband applications, communities that can show broadband is needed as an element of their economic development plan may have a strategic advantage.

Grants made under these programs will help communities plan, build, innovate, and put people back to work through infrastructure construction or non-construction projects designed to meet local needs. EDA encourages applicants to present "new ideas and creative approaches to advance economic prosperity in distressed communities" [70] and will consider projects that incorporate priorities related to equity, entrepreneurship, and workforce development. Several of the recommendations and projects discussed above could be eligible for funding under the program.

Cape Cod must apply the "distress criteria"—high unemployment rates or low per capita income relative to the national average—to identify areas and neighborhoods that can take advantage of this opportunity. [71] It is also helpful to consider that projects with a significant showing of "distress" through extremely high unemployment or low per-capita income will generally have the lowest match requirements, and thus more flexibility in how it designs its projects.

6.5   The Federal Communications Commission's E-Rate program can bring discounted services to schools and libraries

The FCC's E-Rate program was created in 1996 to enhance access to advanced telecommunications and information services for all public and nonprofit elementary and secondary school classrooms and libraries. [72] E-Rate is one of four programs comprising the Universal Service Fund (USF) and is funded by fees paid by telecommunications companies to fulfill the Congressional goals of universal service.

Currently, E-Rate is a $4.27 billion federal funding program managed by the Universal Service Administrative Company (USAC) that approves and provides subsidy discounts for telecommunications and information services for schools and libraries. In late 2023, the FCC made the latest addition to the list of eligible services by approving subsidies for Wi-Fi services

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Planning and Local Technical Assistance Programs, Notice of Funding Opportunity, pg. 7 (U.S. EDA was appropriated $43.5 million for these programs), https://www.eda.gov/sites/default/files/filebase/files/programs/eda-programs/FY21-23-Planning-and-LTA-NOFO_FINAL.pdf.

[70] U.S. EDA Planning and Local Technical Assistance NOFO. at p. 5 and U.S. EDA Public Works and Economic Adjustment Assistance Programs NOFO at p. 4.

[71] U.S. EDA Planning and Local Technical Assistance NOFO. at p. 11.

[72] "E-Rate," Universal Service Administrative Co., https://www.usac.org/e-rate/.

on school buses as an eligible program expense to help close the "homework gap" for students with limited broadband access at home.

Eligible schools and libraries identify goods or services they need and submit a request for competitive bids to USAC, which posts these requests on its website for vendors to bid on. After reviewing the vendors' bids, the school or library selects the most cost-effective eligible products and services using price as the primary factor. It then applies to USAC for approval for the desired purchases.

Funds are awarded as discounts ranging from 20 to 90 percent of the eligible costs and discount levels are based on the poverty level of the schools. Rural schools and libraries may also receive a higher discount. Recipients must pay a portion of the service costs. Often, schools and libraries will form consortia to centralize and manage the E-Rate application, reporting, and budgeting processes within a central point of contact.[73]

Eligible schools and libraries in Massachusetts received $10.1 million in E-rate disbursements in 2023.[74] The Massachusetts Board of Library Commissioners[75] tracks E-Rate participation by libraries and library networks and provides information and resources about the program. The Department of Elementary and Secondary Education's Office of Digital Learning provides similar outreach and education for schools.[76] While Massachusetts does not manage a state-wide consortium, several of the State's library networks and school districts participate in E-Rate.

6.6   The BEAD federal program will support infrastructure investment and non-deployment activities for digital inclusion

The federal Infrastructure Investment and Jobs Act (IIJA) allocated $42.45 billion to states, territories, and tribal entities for broadband deployment and digital inclusion projects to help close the country's digital divide. The BEAD program in Massachusetts, administered by MBI, aims to provide universal broadband access and support digital equity initiatives. Funding through this program is distributed primarily based on the presence of "unserved" locations that lack access to reliable speeds of at least 25 Mbps downstream and 3 Mbps upstream (25/3 Mbps) and "underserved" locations that lack access to reliable speeds of at least 100 Mbps downstream and 20 Mbps upstream. Grantees will be required to provide a 25 percent match. Eligible costs for funding reimbursement include deployment projects to upgrade, install, and expand

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[73] "Consortia," Universal Service Administrative Co., https://www.usac.org/e-rate/applicant-process/before-you-begin/consortia/

[74] E-Rate FRN Status Tool FY2016+, Universal Service Administrative Co., https://opendata.usac.org/E-Rate/E-Rate-FRN-Status-Tool-FY2016-/8xzh-ytkh.

[75] "E-rate," Massachusetts Board of Library Commissioners, https://mblc.state.ma.us/programs-and-support/e-rate/index.php.

[76] "E-Rate," Massachusetts Department of Elementary and Secondary Education, https://www.doe.mass.edu/odl/planning-funding/E-rate/.

broadband services, as well as funding for non-deployment projects such as digital equity training and workforce development.

6.6.1 BEAD Five-Year Action Plan and Initial Proposal

As with the State Digital Equity Planning Grant Program, states are required to engage with local stakeholders on BEAD planning. Massachusetts received $4.9 million from the BEAD program to conduct planning activities. These activities provide local entities, non-profit organizations, business and community leaders, tribal entities, and other stakeholders with opportunities to express their needs and shape the state's grant process—including the development of publicly available and granular broadband availability data.

The Commonwealth relied on these activities to support development of its BEAD program goals, broadband access objectives, subgrantee and project qualifications, and program rules. Massachusetts submitted a Five-Year Action Plan and Initial Proposal[77] to NTIA for review and approval.[78] The state's next step will be to conduct a statewide Challenge Process to identify BEAD-eligible locations, including muti-tenant developments and community anchor institutions with access to services at less than 1 Gbps symmetrical.[79]

NTIA has allocated $147 million in funding to Massachusetts for its BEAD grant program implementation.[80] Massachusetts will begin its BEAD grant program upon completion and approval by NTIA of the results of the Challenge Program and the approval of its planning documents, estimated to be in the second half of 2024. States must complete their grant programs and issue a "Final Proposal" with provisional grant awards to NTIA for approval within a year of approval of their Initial Proposals. Subgrantees will have four years to complete projects from the date of the subgrant award.

6.6.2 BEAD deployment projects and non-deployment initiatives will reach unified vision goals

Through its planning process, the Commonwealth determined that its existing broadband infrastructure investment efforts, including its ARPA-funded Broadband Infrastructure Gap Networks Grant Program (Gap Networks Program), may provide the capacity to reach its

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[77] Draft MBI BEAD Initial Proposal Volumes I and II (November 2023), https://broadband.masstech.org/sites/default/files/2023-11/DRAFT%20BEAD%20Initial%20Proposal%20Draft%2011-13-23_Version%20for%20Public%20Comment.pdf.
[78] See, BEAD timeline; "Massachusetts Internet for All Plan," MBI, https://broadband.masstech.org/mainternetforallplan.
[79] "Massachusetts BEAD Challenge Process," MBI, https://broadband.masstech.org/bead-challenge-process.
[80] "Massachusetts Celebrates $147 million in new federal broadband funding," June 26, 2023, https://www.mass.gov/news/massachusetts-celebrates-147-million-in-new-federal-broadband-funding ($142 million is earmarked for infrastructure grants and non-deployment program funding while almost $5 million is allocated for BEAD program planning efforts).

deployment goal of universal service at speeds above 100/20 Mbps in the Commonwealth prior to BEAD funding becoming available.[81]

If MBI can reach its universal service goals with minimal reliance on BEAD funding, it has proposed to NTIA that Massachusetts may use much of its BEAD funding for "non-deployment" programs including cybersecurity and privacy training, digital literacy, remote learning, and digital navigators. This effort will require close coordination with its State Digital Equity Plan to identify support for deeper investment into existing digital equity programs, developing new, complementary programs to improve adoption, service quality, reliability, and security of end-user services. This approach will make the most efficient use of federal funds while advancing progress toward the Commonwealth realizing MBI's unified vision.

MBI's assessment of diverse needs across different regions and demographic groups found that greater affordability, higher quality of service, and increased internet safety are top priorities for residents throughout the Commonwealth.

MBI will prioritize affordability and require grantees for BEAD deployment projects to offer a low-cost broadband option and participate in federal subsidy programs. BEAD grantees will also be required to demonstrate affordability more generally for "middle-class" end users through tracking service pricing, providing bonus points for generally available and robust low-cost service options, and coordinating efforts with local digital equity initiatives.

6.6.3 Funding will increase broadband capacity for community anchor institutions

MBI also plans to allocate funding for projects under the BEAD rules that allow eligible community support organizations to receive funding for upgrades to 1 Gbps symmetrical service, even if the organization is currently served by 100/20 Mbps service. These organizations serve as hubs for digital access in their communities and often have specialized technology needs and require affordable, high-speed, reliable broadband connections to provide their services effectively. MBI has adopted a broad definition of an eligible community anchor institution.

To be eligible, an organization must demonstrate that it facilitates greater use of broadband service by vulnerable populations, including, but not limited to, low-income individuals, unemployed individuals, children, the incarcerated, and aged individuals and does not have access to services at 1Gbps symmetrical currently.

MBI has conducted a detailed data analysis to determine current high-speed fiber availability and community anchor institution access to 1 Gbps symmetrical service throughout the state. MBI

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[81] "Massachusetts Internet for All Plan, Executive Summary," MBI, https://broadband.masstech.org/sites/default/files/2023-11/English%20MBI%20Executive%20Summary.pdf.

will further confirm the eligible institutions without high-speed fiber access through its Challenge Process.[82] It further expects to determine eligibility for proposed deployment projects to serve these community anchor institutions based on the programs or services that the community organization provides that support broadband access, digital inclusion and digital equity and the number of vulnerable populations served by the community anchor institution.

6.6.4   BEAD funding will support broadband access for multi-tenant residents

MBI's BEAD program will also encourage applicants to provide affordable service to MDUs in an efficient and cost-effective manner. The current National Broadband Map counts multi-family housing developments (multi-dwelling units, or MDU) as a single broadband-serviceable location even if they contain numerous individual units or households, not all of which have access to high-speed services. To address this, MBI is proposing to consider each MDU as a collection of individual units or households to better ensure that unserved or underserved units within MDUs are properly identified as eligible for funding. Identification of eligible MDU living units will be part of the Challenge Process.

Additionally, MBI will award additional points to applicants that commit to provide service to every unit within the MDU at a discounted rate by leveraging the economies of scale inherent in deploying facilities to an MDU. Deployment projects that specifically target affordable housing MDUs will also be prioritized and have opportunities to access funds through related programs.[83] Affordable housing in Massachusetts is an integral resource for low-income individuals, aging individuals, and disabled individuals. Residents in affordable housing are often families and may be part of multiple vulnerable populations. Providing long-term, reliable, high-speed internet to these residents within their homes could improve the health and economic well-being and outcomes of vulnerable households in Massachusetts.

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[82] The Massachusetts BEAD challenge process is not yet finalized and has not been launched. See, "Massachusetts BEAD Challenge Process," MBI, https://broadband.masstech.org/bead-challenge-process.

[83] Massachusetts has set aside $21.6 million of ARPA Capital Project Fund monies for a Residential Retro-Fit and Apartment Wi-Fi program to support upgrades and new installations of Wi-Fi capacity and broadband wiring in multi-tenant buildings, including affordable housing. This program has not yet been released. See, Capital Projects Fund (CPF), https://www.mass.gov/info-details/capital-projects-fund-cpf; "Capital Projects Fund Award Fact Sheet: Massachusetts," U.S. Department of the Treasury, https://home.treasury.gov/system/files/136/MA-CPF-Award-Fact-Sheet-2.pdf.

Appendix A: Survey instrument

Barnstable County Internet Survey

The Cape Cod Commission is conducting this survey to find ways to improve internet access on Cape Cod. Even if you do not have home internet service, please answer the relevant questions. Your opinions are important! Your responses will be kept confidential.

1. Enter ambassador's name

2. Enter phone number:

3. What Cape Cod town do you live in? (Do not read list)

- ○ Barnstable
- ○ Bourne
- ○ Brewster
- ○ Chatham
- ○ Dennis
- ○ Eastham
- ○ Falmouth
- ○ Harwich
- ○ Mashpee
- ○ Orleans
- ○ Provincetown
- ○ Sandwich
- ○ Truro
- ○ Yarmouth
- ○ Wellfleet
- ○ Other (please specify)

4. What is your zip code?

5. Please tell us whether you own or rent your home and whether you live on Cape Cod part-time or full-time. (Don't read list)

- ○ Full-time resident, owns home
- ○ Full-time resident, rents home
- ○ Part-time resident, owns home (second home)
- ○ Part-time resident, rents home

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6. Which services do you subscribe to on Cape Code? (Read list, check all that apply)

☐ **Mobile service**: Verizon Wireless

☐ **Mobile service:** AT&T

☐ **Mobile service**: T-Mobile

☐ **Home internet**: Xfinity/Comcast

☐ **Home internet**: Verizon Home Internet (fixed wireless)

☐ **Home internet**: T-Mobile 5G Home Internet (fixed wireless)

☐ I don't subscribe

☐ Other home internet: [could be OpenCape, Crown Castle, or TPx]

[   ]

7. Please estimate how much you pay per month for the primary internet service you use at home (do not read):

○ $0 - $19   ○ $150 - $199

○ $20 - $39   ○ $200 - $299

○ $40 - $59   ○ $300 or more

○ $60 - $79   ○ Unsure

○ $80 - $99   ○ I don't have home internet service

○ $100 - $149

8. Please specify what your monthly service cost includes. (Read options)

○ Internet only

○ Internet and cable

○ Internet and phone

○ Internet, cable, and phone

○ Unsure

9. How would you rate your overall satisfaction with your home internet service?

1 -Very dissatisfied	2 - Somewhat dissatisfied	3 - Neither dissatisfied nor satisfied	4 - Somewhat satisfied	5 - Very satisfied
○	○	○	○	○

10. (Only ask if respondent answered 1, 2, 3, or 4 in Q9): **What is the reason for your lack of satisfaction?** (Do not read - check all that apply)

☐ Service is too slow

☐ Service is too expensive

☐ Service drops from time to time

☐ Data caps prevent me from getting access at certain times

☐ I don't have a choice of provider

☐ Other (please specify)

[_____]

11. How often would you say you experience slowdowns or drops in your home internet service? (Do not read unless respondent needs prompt)

- ○ One or more times per year
- ○ One or more times per month
- ○ One or more times per week
- ○ Daily or more frequently
- ○ I do not have this problem

12. Please describe when these problems tend to occur. (Don't read answers but prompt if needed.)

- ○ Any time of year with no pattern
- ○ Mainly during summer high season
- ○ I am not sure if there is a pattern
- ○ Other (please specify)

  [   ]

13. Thinking about your mobile service on Cape Cod—specifically about voice calls only—how often would you say you are unable to connect a voice call, or the voice call drops? (do not read unless respondent needs prompt)

- ○ One or more times per year
- ○ One or more times per month
- ○ One or more times per week
- ○ Daily or more frequently
- ○ I do not have this problem

14. Thinking about your mobile service on Cape Cod—and specifically regarding data services like texting or internet use, not voice connections—how would you rate your overall satisfaction on a 1-5 scale where 1 is "very dissatisfied" and 5 is "very satisfied"? (no need to read choices)

1 - Very dissatisfied	2 - Somewhat dissatisfied	3 - Neither dissatisfied or satisfied	4 - Somewhat satisfied	5 - Very satisfied
○	○	○	○	○

15. (Only ask if respondent answered 1, 2, 3, or 4 in Q14): **What is the reason for your lack of satisfaction?** (Do not read - check all that apply)

- ☐ Service is too slow
- ☐ Service is too expensive
- ☐ Service drops from time to time
- ☐ Data caps prevent me from getting access at certain times
- ☐ Other (please specify)

> [   ]

16. How often would you say you experience slowdowns or drops in your mobile data service? (do not read unless respondent needs prompt)

- ○ One or more times per year
- ○ One or more times per month
- ○ One or more times per week
- ○ Daily or more frequently
- ○ I do not have this problem

17. Please describe when these problems tend to occur. (Don't read answers but prompt if needed.)

- ○ Any time of year with no pattern
- ○ Mainly during summer high season
- ○ I am not sure if there is a pattern
- ○ Other (please specify)

> [   ]

18. Does your household have enough computers (laptops or tablets, for example) in good, working order to allow each member to effectively connect to the internet?

- ○ Yes
- ○ No
- ○ Not sure

19. Thinking about the computer (such as a laptop or tablet) you primarily use, if it were lost or damaged beyond repair, how long do you think it would take you to replace it?

- ○ Within a day
- ○ Within a week
- ○ Within a month
- ○ Within 6 months
- ○ More than 6 months
- ○ I could not do so in the foreseeable future

20. Please state how confident you are in using the internet for these purposes, using a 1-5 scale where 1 means "not at all confident" and 5 means "very confident":

	1 - Not at all confident	2	3 - Neutral	4	5 - Very confident
Sending and receiving emails	○	○	○	○	○
Using social media, such as Facebook, Instagram, or Tik-Tok	○	○	○	○	○
Accessing medical/telehealth resources	○	○	○	○	○
Accessing governmental services (such as DMV, benefits enrollments, etc.)	○	○	○	○	○
Accessing online financial services such as banking and paying bills	○	○	○	○	○

21. If there were a free or inexpensive class available locally to help you improve your skills for one or more online activities, how likely would you be to attend?

- ○ Extremely likely
- ○ Somewhat likely
- ○ Neutral
- ○ Somewhat unlikely
- ○ Extremely unlikely

22. As County and Town leaders weigh options for improving broadband service on Cape Cod, please indicate to what extent you disagree or agree with the following statements where 1=Strongly Disagree, 2=Disagree, 3=Neutral (or "not sure"), 4=Agree, 5=Strongly Agree)

	1 - Strongly disagree	2 - Disagree	3 - Neutral	4 - Agree	5 - Strongly agree
My town should establish a Town-run broadband service to compete with existing providers	○	○	○	○	○
My Town should work to bring in a new private broadband provider to compete with existing providers	○	○	○	○	○
My Town should take no action with respect to broadband infrastructure	○	○	○	○	○

23. If establishing a new best-in-class private or public broadband service were to require a substantial one-time capital cost, how willing would you be to pay a temporary construction fee to do so. Please answer where 1=Strongly Oppose, 2=Oppose, 3=Neutral, 4=Support, 5=Strongly Support)?

	1 - Strongly oppose	2 - Oppose	3 - Neutral	4 - Support	5 - Strongly support
$200/year for five years	○	○	○	○	○
$400/year for five years	○	○	○	○	○
$800/year for five years	○	○	○	○	○

Barnstable County Internet Survey

The remaining questions are meant to capture household demographic information. This information will be anonymized so you cannot be individually identified.

24. What is your age?

[   ]

25. What is your gender?

( ) Male

( ) Female

( ) Nonbinary

( ) Prefer not to answer

26. How many adults and how many children live in your household?

	0	1	2	3	4 or more
Adults	( )	( )	( )	( )	( )
Children	( )	( )	( )	( )	( )

27. What is your approximate annual household income?

( ) Less than $25,000

( ) $25,000 to $49,999

( ) $50,000 to $74,999

( ) $75,000 to $99,999

( ) $100,000 to $149,999

( ) $150,000 to $199,999

( ) $200,000 or more

( ) Prefer not to answer

28. What races/ethnicities are represented in your household? (Check all that apply)

[ ] Black/African American

[ ] Asian/Asian American

[ ] Hispanic/Latino

[ ] Native American/Indigenous American

[ ] White

[ ] Middle Eastern/Arab American

[ ] Native Hawaiian/Pacific Islander

[ ] Prefer not to answer

29. Are you or anyone else living in your household a(n): [check all that apply]

- ☐ Veteran
- ☐ Individual with a disability
- ☐ Primarily a non-English speaker or have a language barrier
- ☐ Formerly incarcerated individual
- ☐ Actively enrolled in K-12 school
- ☐ A student in college or other higher education

Appendix B: Residential survey and stakeholder findings

As part of this study, the Cape Cod Commission conducted a survey of residents on a wide range of broadband-related topics. The survey was intended to gather data about the types of services to which residents subscribe, their use of these services, their perceptions about service quality and slowdowns (such as during the peak summer season), gaps in broadband skills, and residents' level of interest in the County and Towns taking steps to address broadband-related gaps. This section documents the survey process and presents results.

Survey process

In coordination with the Cape Cod Commission, CTC managed the survey project, including development of the questionnaire, sample selection, data collection, survey data analysis, and reporting of results.

CTC developed the draft survey instrument based on the project objectives and provided it to Cape Cod Commission staff for review and comment. Cape Cod Commission staff provided revisions and approved the final questionnaire. (A copy of the survey instrument is included in Appendix A.)

Data collection and response

The survey was conducted by telephone between July 27 and August 4, 2023. CTC purchased approximately 46,000 phone numbers of residents of Barnstable County from Data Axle, a commercial database company. The numbers included landlines and mobile numbers and, as the data show, reached a mix of year-round and seasonal owners and renters.

The original project scope specified a target return of 500 completed surveys. (The scope specified that the survey would be mail-based but was changed to phone-based with the Commission's permission.) CTC's call center ambassadors conducted the outreach and completed a far higher number of surveys than the scope had promised, with 737 surveys completed.

Margin of error is a common measure of statistical validity or accuracy. The margin of error for aggregate results at the 95 percent confidence level for 737 responses is ±3.6 percent. That is, for questions with valid responses from all survey respondents, one would be 95 percent confident (19 times in 20) that the survey responses are within ±3.6 percent of representing the responses of all residents of Barnstable County. The margin of error is larger for various subgroups, whether demographic subgroups or Towns.

Data analysis

The survey responses were entered into SPSS[84] software and the entries were coded and labeled. SPSS databases were formatted, cleaned, and verified prior to the data analysis. The survey data was evaluated using techniques in SPSS including frequency tables, cross-tabulations, and means functions. Statistically significant differences between subgroups of response categories are highlighted and discussed where relevant.

The survey responses were weighted based on the age of the respondent, household income, race/ethnicity, and residence status (home ownership and seasonal status). Because younger and older individuals, those in lower income households, and racial/ethnic minorities were less likely to respond, the weighting corrects for the potential bias based on the age, household income, and ethnicity of the respondent. In this manner, the results should more closely reflect the opinions of the County's adult population.

Respondent information

Basic demographic information was gathered from survey respondents and is summarized in this section.

Figure 32 summarizes the survey respondents' age category as compared to the overall population distributions. Survey respondents were slightly underrepresented in the 18-29 age category as well as the 65 and over age category. Regarding age-weighting, disproportionate shares of survey respondents were in the middle-aged cohorts relative to the County's adult population as a whole. Approximately 24.8 percent of survey respondents are ages 65+ years, compared with 39.1 percent of the population. Additionally, only 3.6 percent of survey respondents are ages 18 to 29, compared with 12.5 percent of the census. The weighted survey results presented in this report are adjusted to account for these differences and to provide results that are more representative of the County's population, as discussed previously.

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[84] Statistical Package for the Social Sciences (http://www-01.ibm.com/software/analytics/spss/).

Figure 32: Age of respondents and Barnstable County adult population

Legend: ■ Survey Respondents ■ Census Population
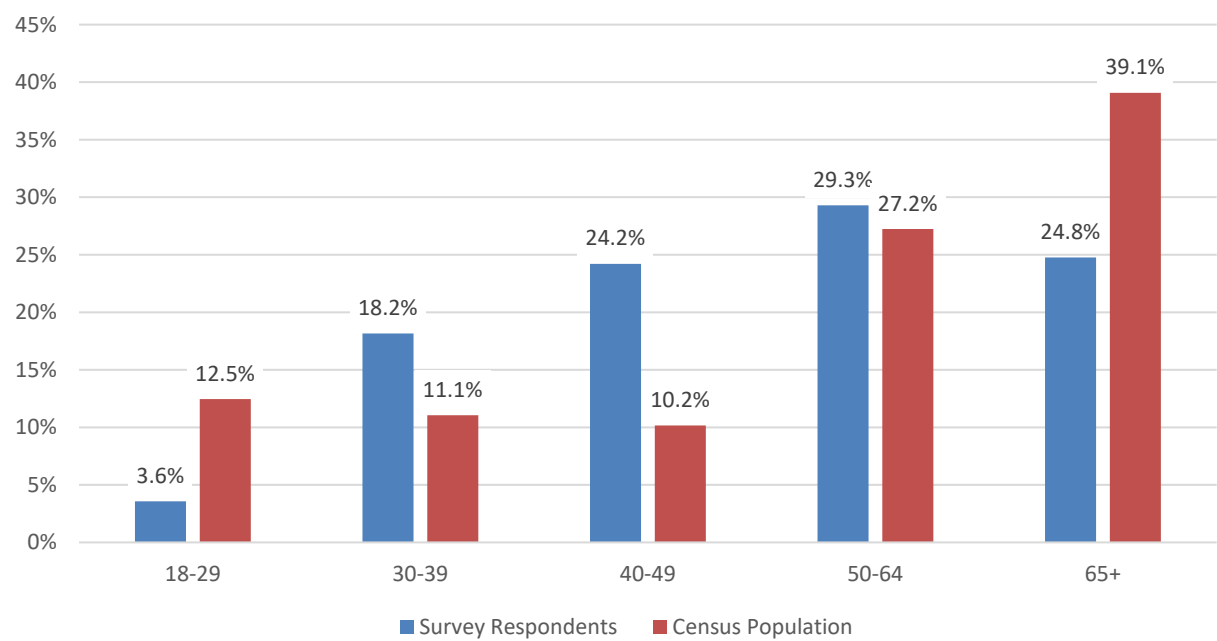
Respondents live throughout Barnstable County, including Upper Cape (31 percent), Mid Cape (32 percent), Lower Cape (18 percent), and Outer Cape (18 percent). As shown in Table 19 , Lower Cape and Outer Cape residents are more likely than Upper Cape residents to be ages 65+. Upper Cape residents are somewhat more likely to be under age 40 and to have children in the household. Households in the Lower Cape are less likely to earn under $50,000 per year, compared with those in other regions of Cape Cod.

Table 19: Demographic profile of respondents by region

		Upper Cape	Mid Cape	Lower Cape	Outer Cape	Total Cape Cod
Age group	Under 40	29%	23%	15%	24%	24%
	40-49	12%	9%	10%	10%	10%
	50-64	29%	28%	29%	21%	27%
	65+	30%	40%	46%	45%	39%
	Weighted count	*228*	*232*	*132*	*131*	*727*
Gender	Male	50%	48%	62%	47%	52%
	Female	48%	52%	38%	53%	48%
	Nonbinary	1%	0%	0%	0%	0%
	Weighted count	*229*	*235*	*133*	*131*	*732*
Household size (adults + children)	One HH member	17%	22%	11%	21%	19%
	Two HH members	40%	40%	58%	55%	46%
	Three HH members	17%	17%	16%	15%	16%
	Four + HH members	27%	21%	15%	9%	19%
	Weighted count	*229*	*233*	*133*	*131*	*729*
Children in household	No Children in HH	65%	70%	70%	72%	69%
	Children in HH	35%	30%	30%	28%	31%
	Weighted count	*229*	*233*	*133*	*131*	*729*
Household income	Less than $50,000	32%	35%	18%	40%	32%
	$50,000 to $99,999	25%	27%	40%	40%	32%
	$100,000 to $150,000	28%	21%	26%	10%	22%
	$150,000 or more	15%	17%	16%	10%	15%
	Weighted count	*169*	*168*	*113*	*119*	*573*
Race/ethnicity	White, non-Hispanic	89%	83%	89%	81%	86%
	Racial/ethnic minority	11%	17%	11%	19%	14%
	Weighted count	*203*	*211*	*128*	*127*	*673*
Other demographics	Veteran	18%	15%	31%	22%	20%
	Individual with a disability	14%	12%	8%	8%	11%
	Primarily a non-English speaker or have a language barrier	1%	4%	1%	1%	2%
	Formerly incarcerated individual	0%	1%	0%	0%	1%
	Actively enrolled in K-12 school	24%	20%	21%	17%	21%
	A student in college or other higher education	20%	18%	13%	12%	16%
	Weighted count	*230*	*236*	*134*	*133*	*737*

More than one-half (52 percent) of respondents are male, and 48 percent are female (see Figure 33).

Figure 33: Gender identity
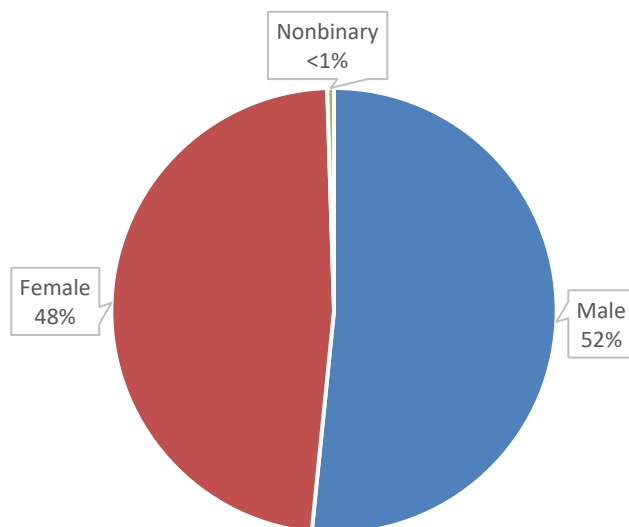
Respondents were asked to indicate the number of individuals in their household in each age category. Forty-six percent of households have two members, and 35 percent have three or more members. Just 19 percent of respondents live alone (Figure 34). Approximately three in 10 households have a child under age 18 (see Figure 35).

Figure 34: Total household size
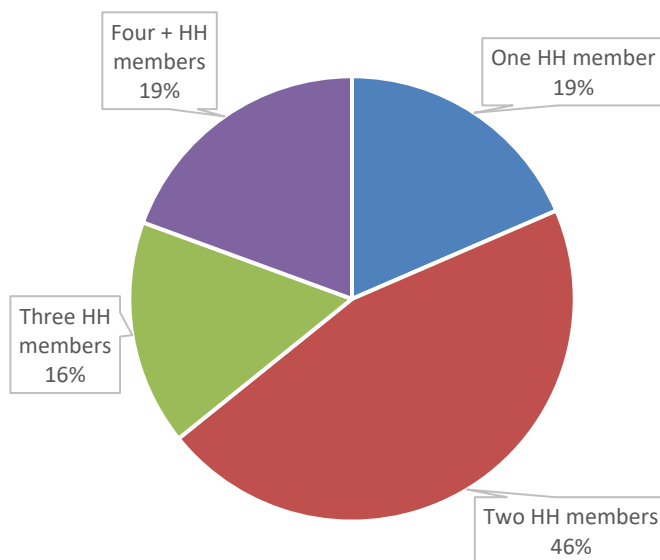
Figure 35: Children in household
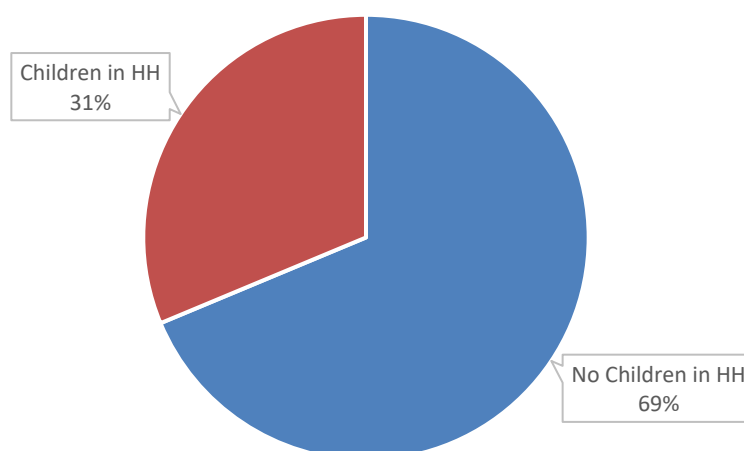
As illustrated in Figure 36, weighted survey data includes 26.8 percent of households earning under $50,000 per year, 27 percent earning $50,000 to $99,999 per year, 18.1 percent earning $100,000 to $149,999 per year, and 28.1 percent earning $150,000 or more per year.

Figure 36: Annual household income
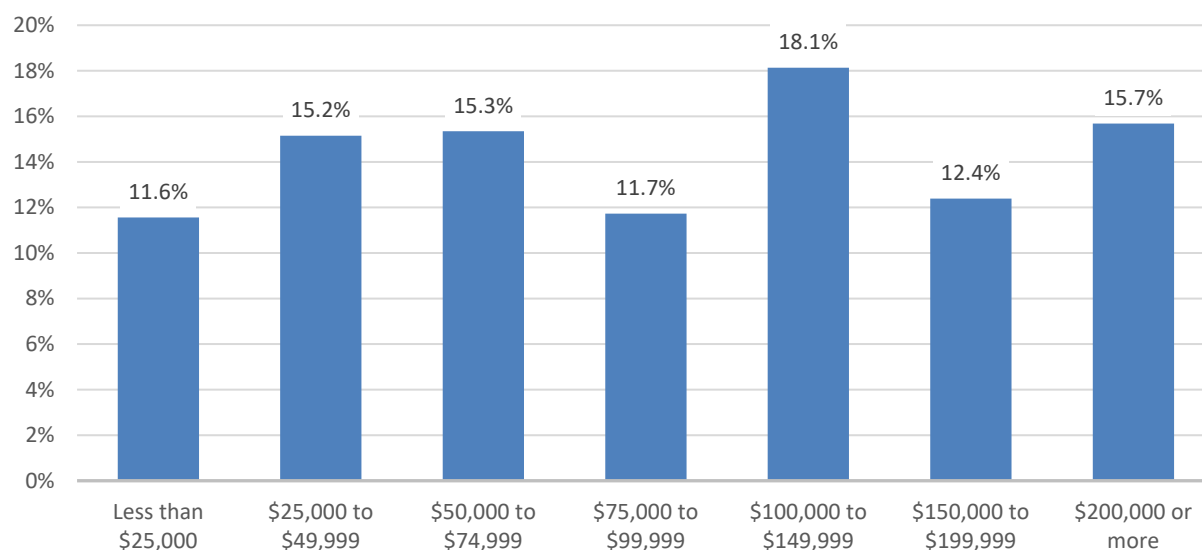
Responses to the race/ethnicity question were grouped to correspond as closely as possible to U.S. Census categories. These categories were used in weighting the survey data by race and ethnicity. Overall, 86 percent of the weighted sample of respondents are White, non-Hispanic and 14 percent are racial/ethnic minorities (see Figure 37).

Figure 37: Race/ethnicity grouped
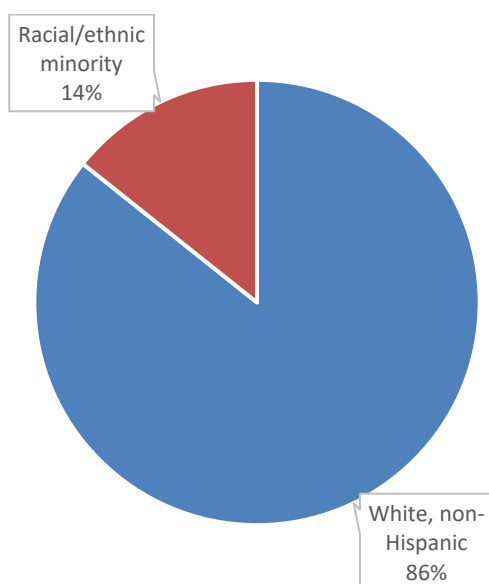
Respondents were asked if there was a household member in various other demographic groups, as shown in Figure 38. One-fifth of households have a Veteran. Twenty-one percent of households have a member actively enrolled in K-12 school, and 16.2 percent have a student in college or other higher education. Respondents are less likely to have an individual with a disability (11 percent), primarily non-English speaker (2.3 percent), or a formerly incarcerated individual (0.5 percent) in the household.

Figure 38: Other demographic groups
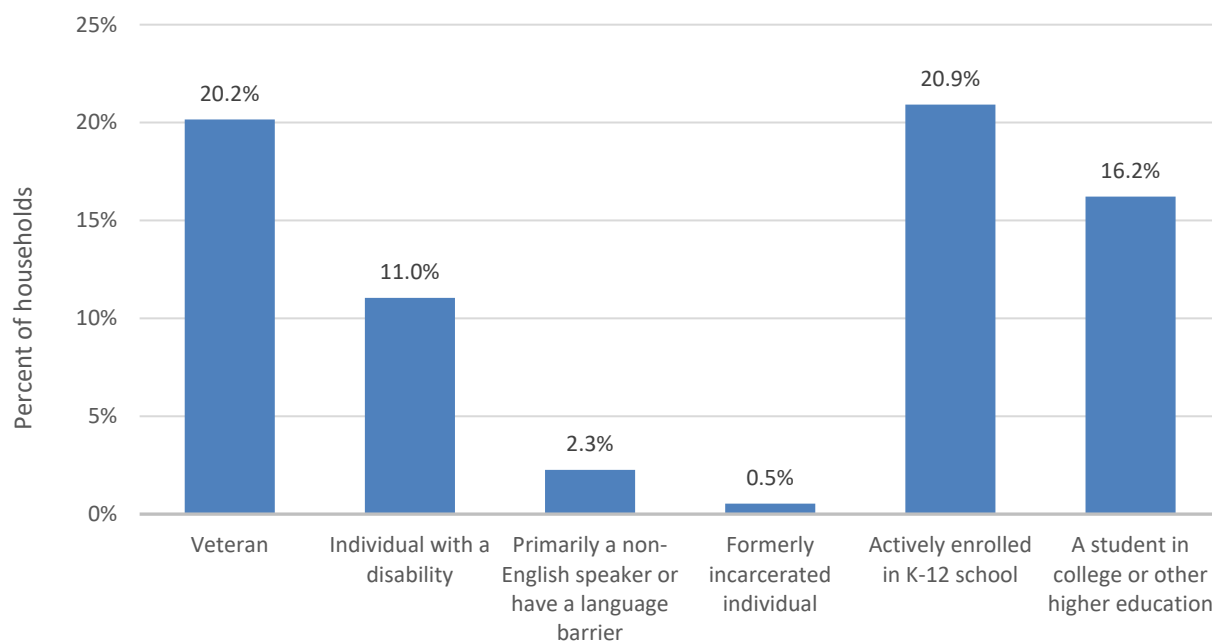
The following section summarizes the survey findings.

Survey results

The results presented in this section are based on analysis of information provided by 737 residents of Barnstable County, from 98,163 households in the County. [85] Results are representative of the set of households with a confidence interval of ±3.6 percent at the aggregate level.

Unless otherwise indicated, the percentages reported are based on the "valid" responses from those who provided a definite answer and do not reflect individuals who said "don't know" or otherwise did not supply an answer because the question did not apply to them. Key statistically significant results (p ≤ 0.05) are noted where appropriate.

Residential internet service

Respondents were asked about internet connection types, including home internet service (e.g., DSL, cable modem, fiber, and fixed wireless) and mobile internet providers. This information provides valuable insight into residents' need for various internet and related communications services.

Two-thirds of households subscribe to Xfinity/Comcast home internet service, as shown in Figure 39. Twenty-four percent of households have Verizon Wireless mobile service, and 5.7 percent have Verizon Home Internet. Just one percent of households do not have any type of internet service (mobile or home). Nearly 6 percent of respondents indicate they used "other" services; most did not provide any detail, but five mentioned OpenCape and others mentioned Crown Castle (typically a business service offering), Starlink, and various mobile plans. Some said they did not know.

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[85] "QuickFacts: Barnstable County, Massachusetts; Berkshire County, Massachusetts," US Census Bureau, https://www.census.gov/quickfacts/fact/table/barnstablecountymassachusetts,berkshirecountymassachusetts/PST045222.

Figure 39: Internet services subscribed to on Cape Cod

Service	Percent
Mobile service: Verizon Wireless	23.6%
Mobile service: AT&T	13.1%
Mobile service: T-Mobile	17.2%
Home internet: Xfinity/Comcast	67.5%
Home internet: Verizon Home Internet (fixed wireless)	5.7%
Home internet: T-Mobile (fixed wireless)	10.6%
Don't subscribe	1.4%
Other home internet	5.9%

Respondents could select more than one type of internet service, and figures

Percent of Households with Internet

Figure 40 highlights internet services that respondents from the four regions of Cape Cod reported using.

Figure 40: Internet services subscribed to on Cape by Region

	Mobile service: Verizon Wireless	Mobile service: AT&T	Mobile service: T-Mobile	Home internet: Xfinity/ Comcast	Home internet: Verizon Home Internet (fixed wireless)	Home internet: T-Mobile (fixed wireless)	Don't subscribe	Other home internet
Upper Cape	20%	14%	22%	65%	8%	12%	1%	5%
Mid Cape	26%	14%	13%	67%	4%	7%	1%	9%
Lower Cape	17%	12%	15%	65%	7%	12%	4%	2%
Outer Cape	32%	11%	18%	74%	4%	15%	0%	3%
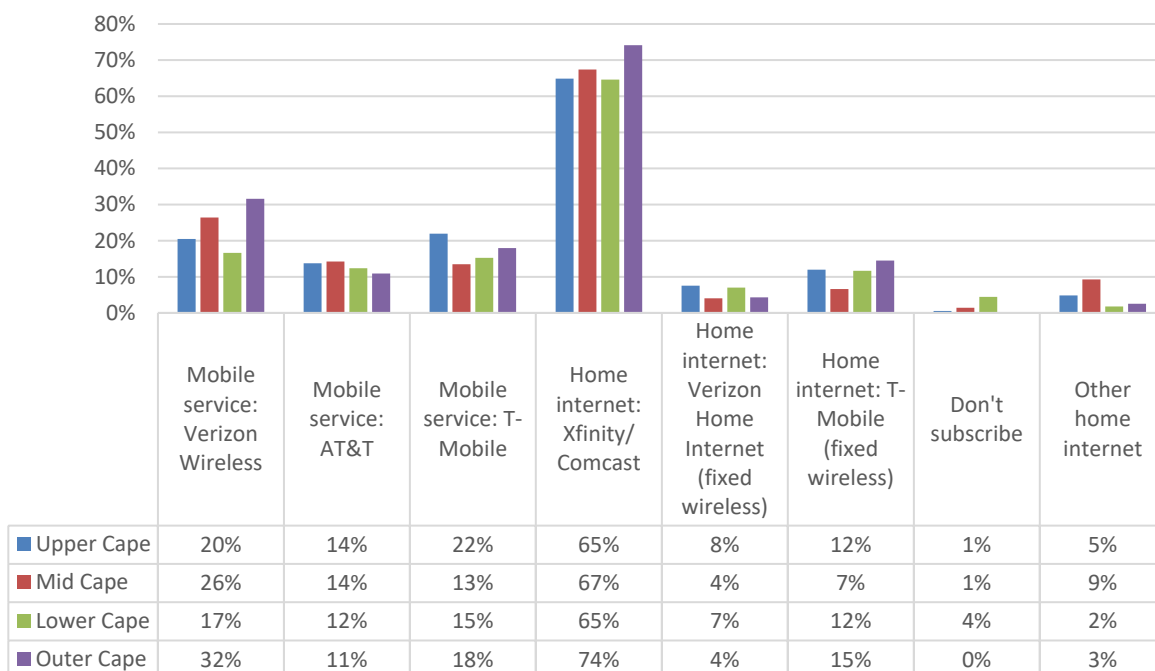
Table 20 highlights the saturation of home internet service subscriptions by key demographic groups. In total, 87 percent of households have home internet service. Usage is relatively high across all demographic groups.

Table 20: Home internet usage by key demographics

|	Total Internet Usage	*Weighted Count*
TOTAL	**87%**	***737***
Respondent Age		
Under age 40	87%	*171*
40-49	89%	*74*
50-64	81%	*198*
65+	90%	*284*
Gender		
Male	86%	*378*
Female..	87%	*351*
Nonbinary...	100%	*4*
Race/Ethnicity		
White, non-Hispanic..	84%	*577*
Racial/ethnic minority	96%	*96*
Household Size		
One HH member	84%	*135*
Two HH members..	87%	*333*
Three HH members	87%	*119*
Four + HH members	89%	*142*
Children in Household		
No children in HH	86%	*501*
Children in HH	88%	*228*
Income		
Less than $50,000...	87%	*182*
$50,000 to $99,999	86%	*184*
$100,000 to $149,999	88%	*123*
$150,000 or more..	83%	*84*
Other Demographic Groups		
Veteran..	91%	*149*
Individual with a disability..	85%	*81*
Primarily non-English speaker	100%	*17*
Formerly incarcerated individual	65%	*4*
Actively enrolled in K-12 school or college or other higher education..	82%	*120*
A student in college or other higher education..	82%	120

Seasonal homeowners who responded were slightly more likely than year-round residents to have home internet service. Specifically, 95.3 percent of part-time residents who own a second home on Cape Cod have internet service at that home (see Figure 41).
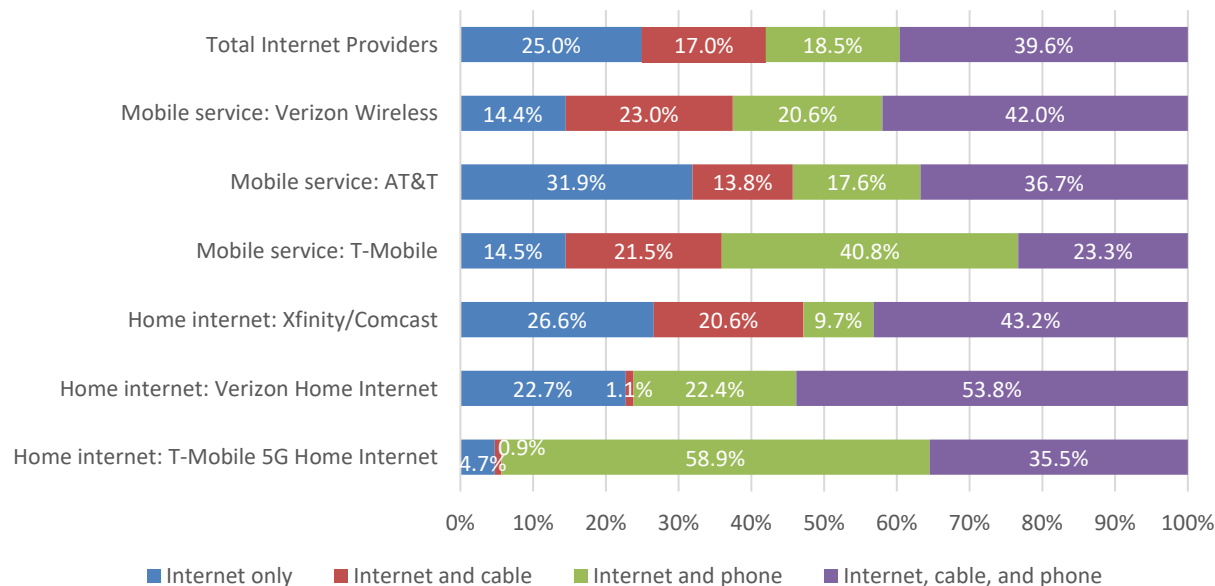
Figure 41: Have home internet service by residence status
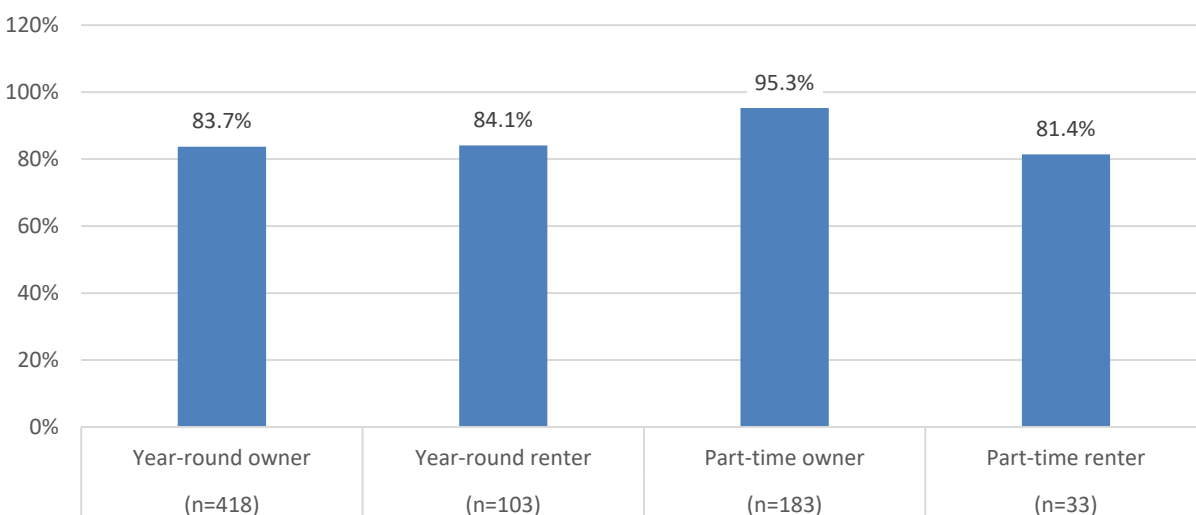
Additionally, Outer Cape households are more likely than others to have home internet service (see Figure 42).
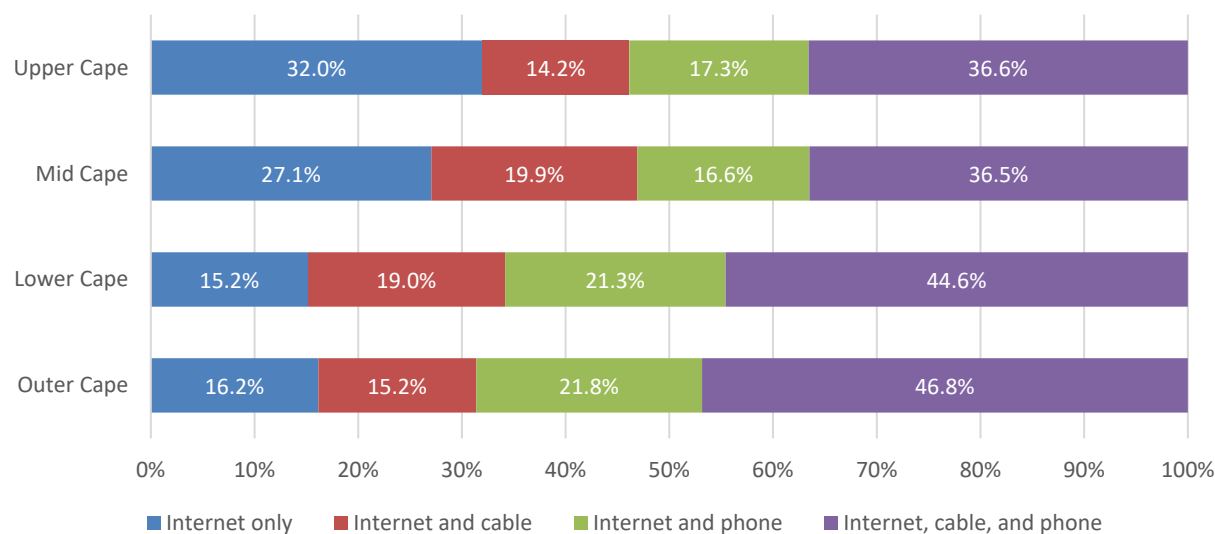
Figure 42: Have home internet service by region
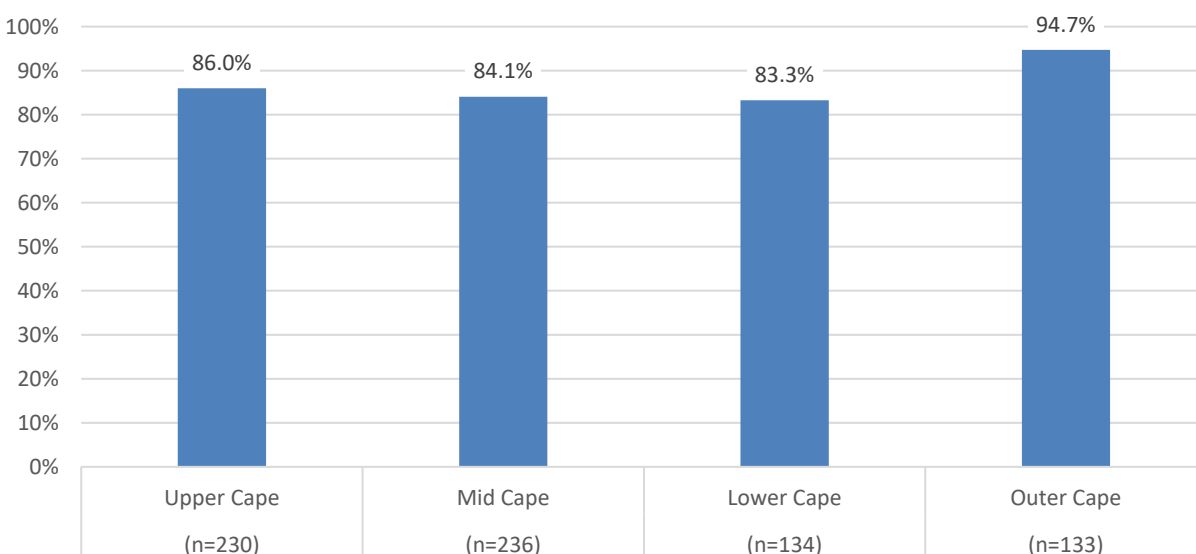
6.6.4.1   *Internet service cost*

Respondents were asked to give the cost of their home internet service, as well as indicate whether or not they bundle internet with TV and/or phone service. Overall, 75 percent of subscribers bundle their internet service, including 40 percent with both cable and phone services (see Figure 43).

Figure 43: Included in monthly service cost

	Internet only	Internet and cable	Internet and phone	Internet, cable, and phone
Total Internet Providers	25.0%	17.0%	18.5%	39.6%
Mobile service: Verizon Wireless	14.4%	23.0%	20.6%	42.0%
Mobile service: AT&T	31.9%	13.8%	17.6%	36.7%
Mobile service: T-Mobile	14.5%	21.5%	40.8%	23.3%
Home internet: Xfinity/Comcast	26.6%	20.6%	9.7%	43.2%
Home internet: Verizon Home Internet	22.7%	1.1%	22.4%	53.8%
Home internet: T-Mobile 5G Home Internet	4.7%	0.9%	58.9%	35.5%

As shown in Figure 44, respondents from Upper Cape and Mid Cape households said they were more likely than those in the Lower Cape and Outer Cape to have internet-only service.

Figure 44: Included in monthly service cost by region

	Internet only	Internet and cable	Internet and phone	Internet, cable, and phone
Upper Cape	32.0%	14.2%	17.3%	36.6%
Mid Cape	27.1%	19.9%	16.6%	36.5%
Lower Cape	15.2%	19.0%	21.3%	44.6%
Outer Cape	16.2%	15.2%	21.8%	46.8%

Four in 10 subscribers pay $200 or more per month for their communications services (see Figure 45). Nearly one-half (46.4 percent) of those who subscribe to internet only pay less than $100 per month, and 44 percent pay $100 to $149 per month, whereas 85 percent of those who bundle internet, cable, and phone services pay $200 or more per month.
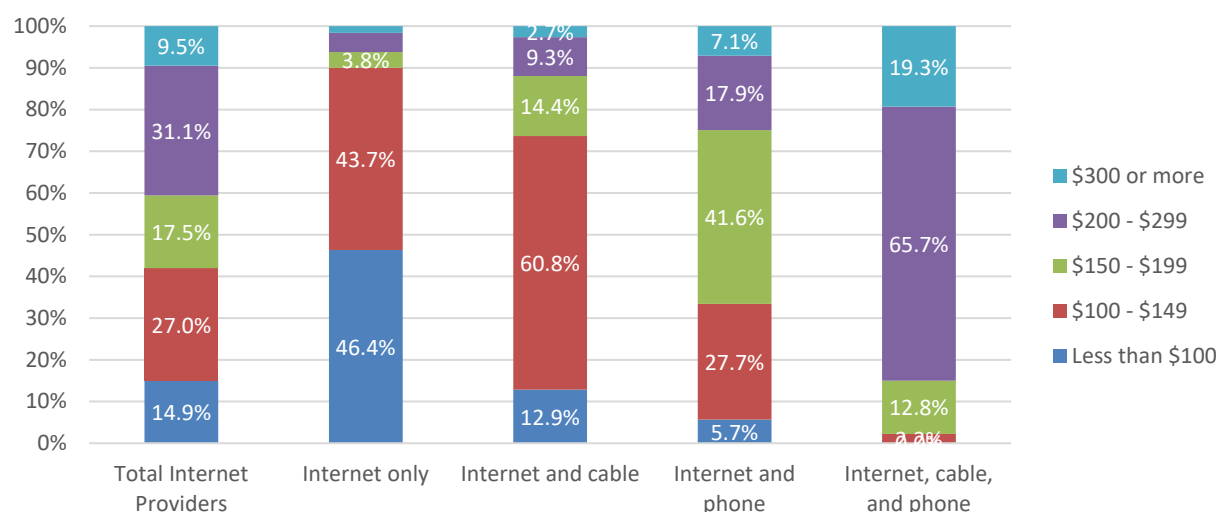
Figure 45: Monthly price for internet service by bundle

Figure 46 shows the cost of communications services for the leading providers, for all bundles. Counts for specific bundles are relatively small when broken out by provider. AT&T mobile service tends to be among the least expensive, while T-Mobile 5G Home Internet service tends to be the most expensive; AT&T mobile service customers are more likely to have internet-only service, while T-Mobile home internet customers are more likely to be internet and phone.

Figure 46: Monthly price for bundled internet service by internet service provider
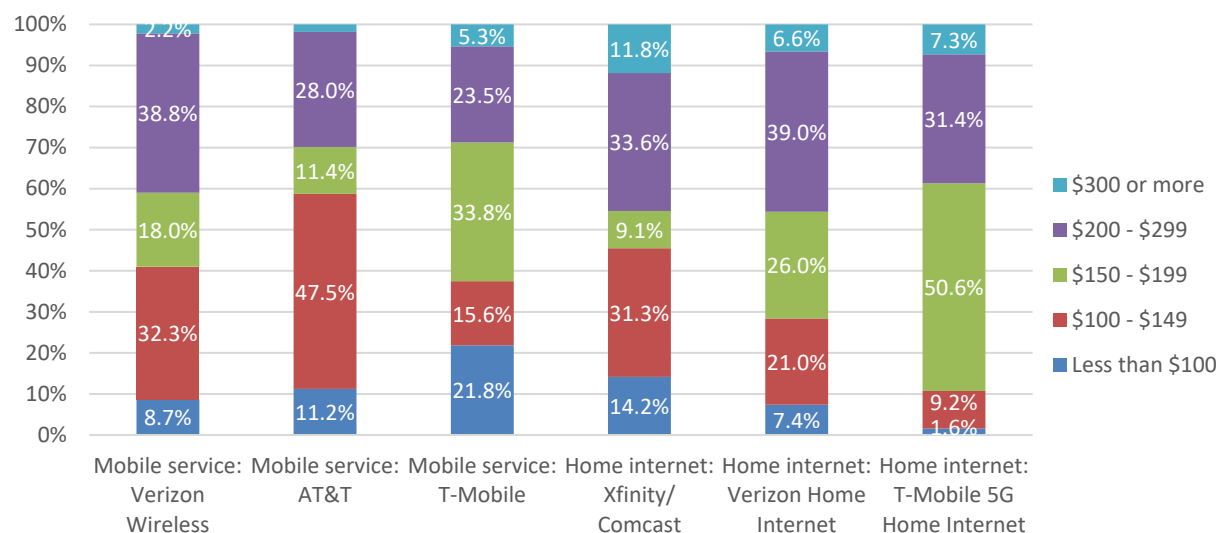
6.6.4.2   *Home internet service*

Respondents were asked a series of questions about their home internet service, including overall satisfaction and issues with slowdowns or dropped service. As shown in Figure 47, one-fourth of subscribers are very satisfied with their service, and 37.7 percent are somewhat

satisfied. A sizeable segment of subscribers is either dissatisfied to some extent (19.2 percent) or neither satisfied/ dissatisfied (18.3 percent) with their service. Only 6.4 percent reported that they were very dissatisfied. Overall, Lower Cape residents who responded said they were more satisfied with their home internet service compared with other subscribers.

**Figure 47: Overall satisfaction with home internet service**
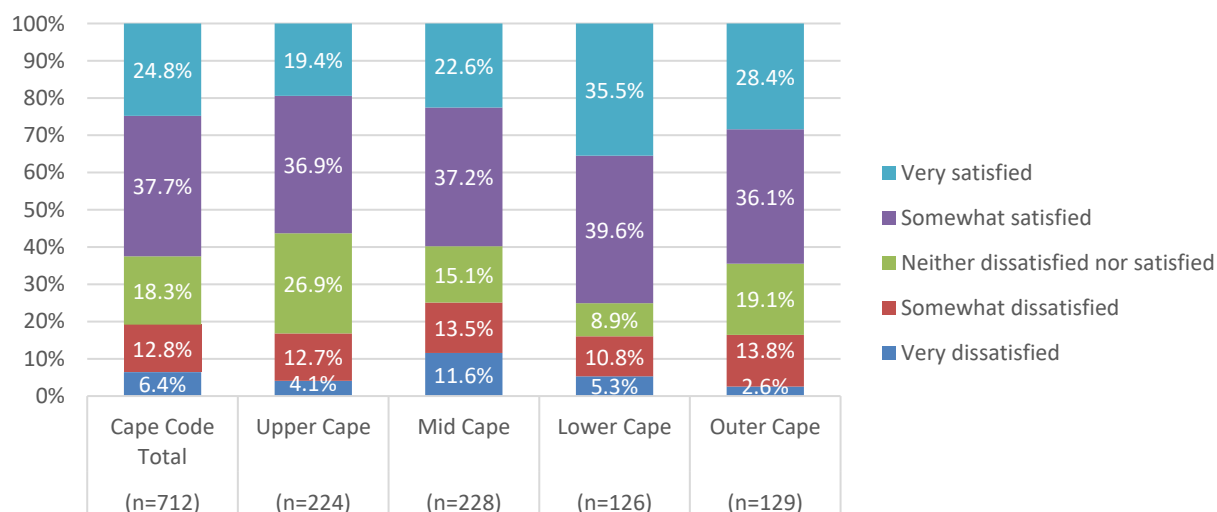
Satisfaction with home internet service by provider is illustrated in Figure 48. Approximately 41.8 percent of respondents who subscribe to Verizon home internet are very satisfied with that service, compared with 23.4 percent of Xfinity/Comcast and T-Mobile 5G home internet subscribers.

Figure 48: Overall satisfaction with home internet service by provider
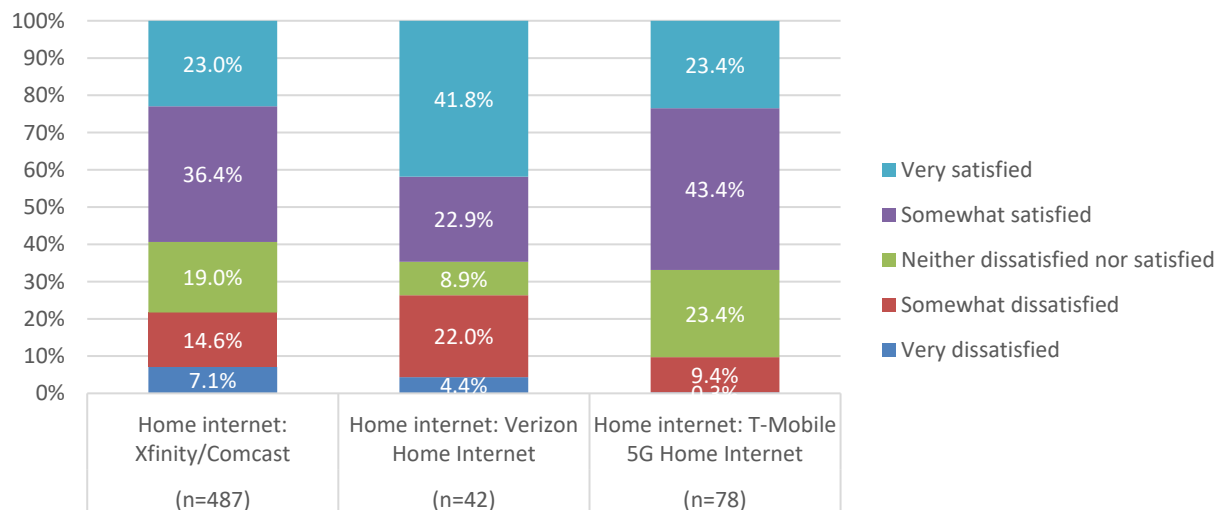
Among those who are not "very satisfied" with their home internet service, 68.8 percent cited being expensive as the primary reason (see Figure 49). Other reasons for lack of satisfaction include service drops (56.8 percent), service is too slow (50.5 percent), no choice of provider (32.9 percent), and data caps (7.3 percent). A total of 45 respondents provided other reasons for their lack of satisfaction with their home internet including cost, reliability, lack of choice among providers, and poor customer service.

Figure 49: Reasons for lack of satisfaction with home internet service
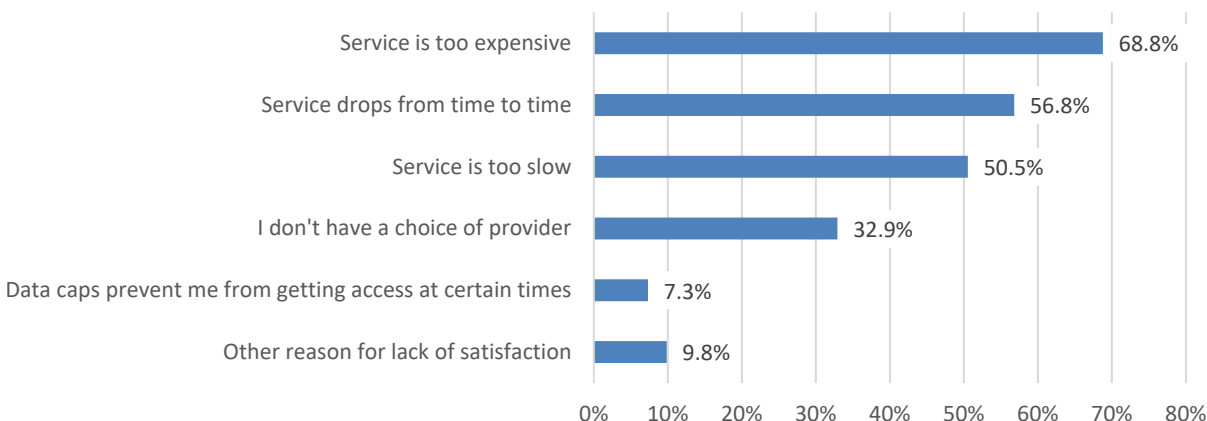
Percent of those who are not "very satisfied" with their home internet service

Three in 10 respondents do not experience any slowdown or drops in their home internet service, but 18.8 percent experience this at least daily and 19.7 percent at least weekly (see Figure 50). Lower Cape residents who responded to the survey said they were less likely than other subscribers to experience slowdowns or drops in their service.

Figure 50: How frequently experience slowdowns or drops in home internet service
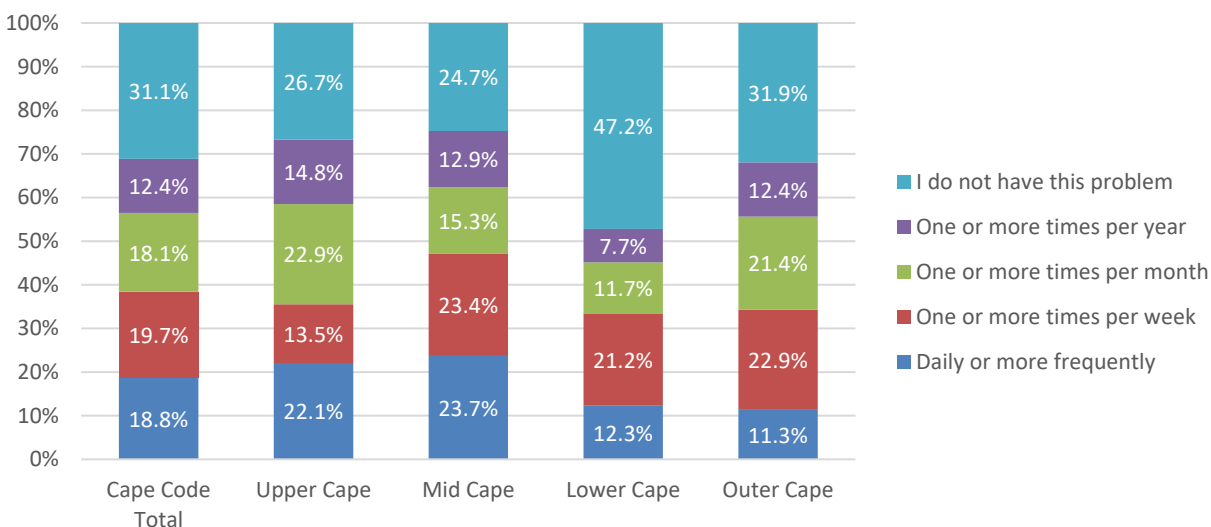

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Frequency of slowdowns or drops in home internet service by provider is illustrated in Figure 51. Forty-five percent of Xfinity/Comcast subscribers said they experience this issue with their service (either Xfinity/Comcast or another service if they have multiple) at least daily (20 percent) or weekly (24.6 percent).

Figure 51: How frequently experience slowdowns or drops in home internet service by providers used
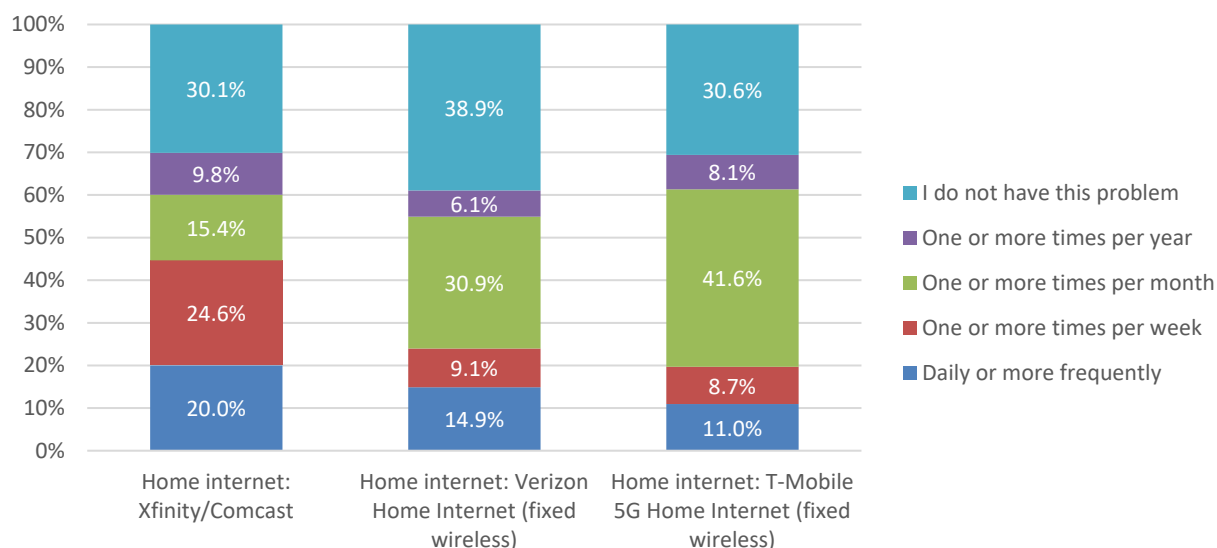

Renters experience slowdowns or drops in service more frequently than do homeowners (see Figure 52). Specifically, 46.4 percent of renters experience issues at least weekly or daily versus 36.7 percent of owners.

Figure 52: How frequently experience slowdowns or drops in home internet service by home ownership
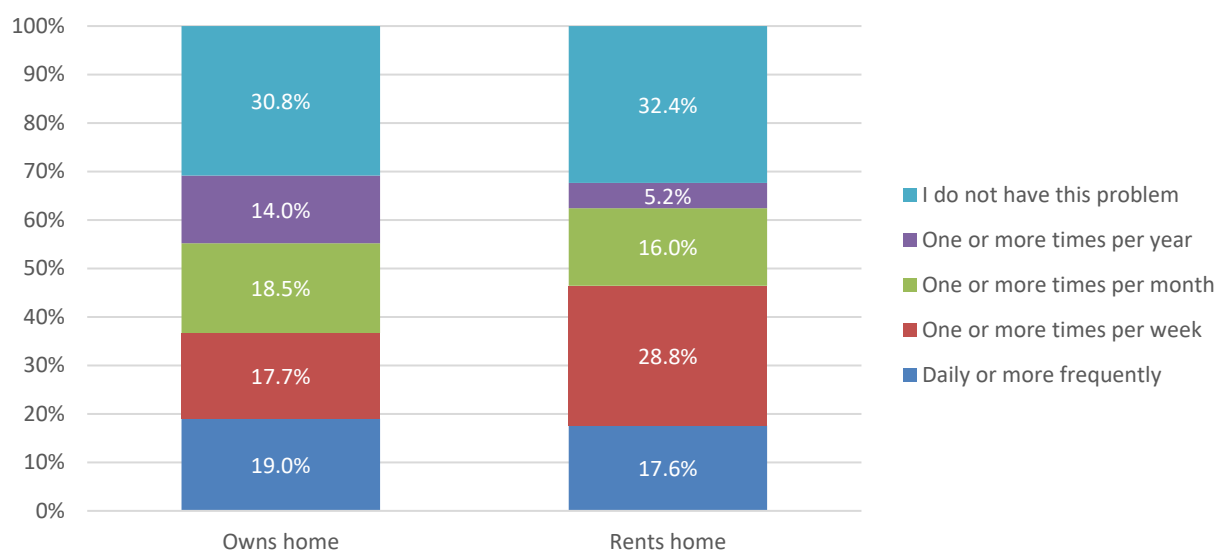
Those who experienced slowdowns or drops in their home internet service were asked to describe when these problems occurred. More than one-half (55 percent) of those with connectivity issues said they occur any time of year with no pattern, and 27 percent are unsure if there is a pattern (see Figure 53). Three percent of respondents cited other times when slowdowns or drops in service occur, including in the early morning, afternoons, during weather events, and during times of heavy streaming.

Figure 53: When slowdowns or drops in home internet service occur (among those who experience the issue)
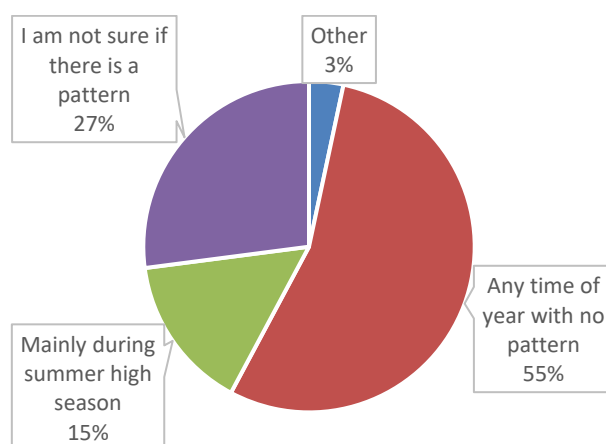
6.6.4.3   Mobile internet service

Respondents were asked a series of questions about their mobile internet service, including overall satisfaction and issues with voice calls, as well as slowdowns or drops in mobile data service. Specifically, 35.5 percent of respondents do not experience any connection issues or drops in voice calls, but 20.1 percent experience this at least daily and 20.1 percent at least weekly (see Figure 54). Differences by region were not found to be statistically significant.

Figure 54: How often unable to connect to voice calls or voice calls drop
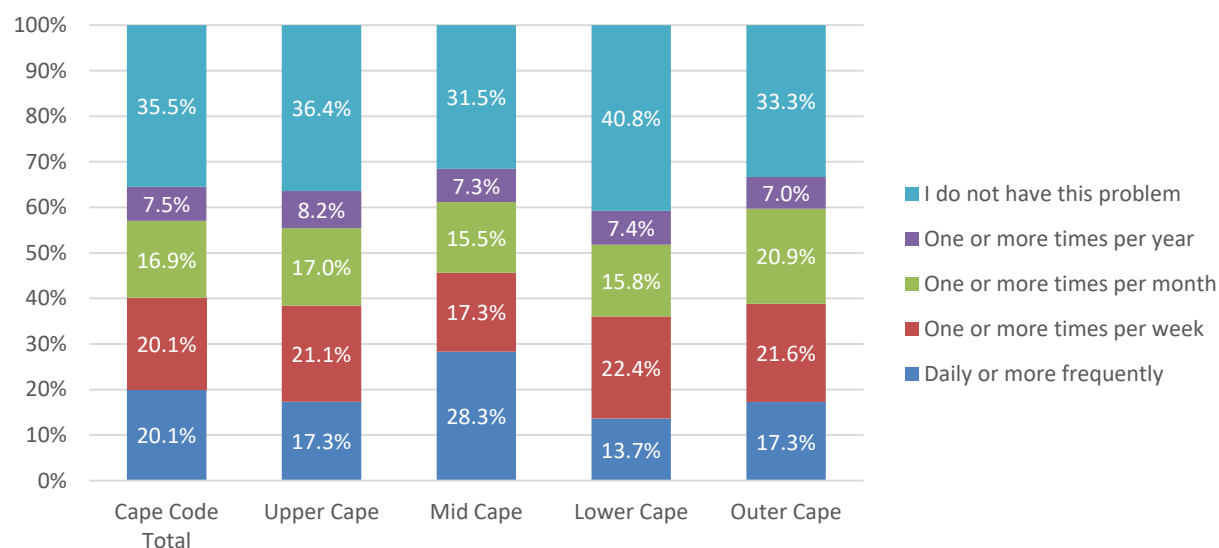
Occurrence of voice calls issues is fairly consistent across mobile services used, as shown in Figure 55.

Figure 55: How often unable to connect to voice calls or voice calls drop by provider
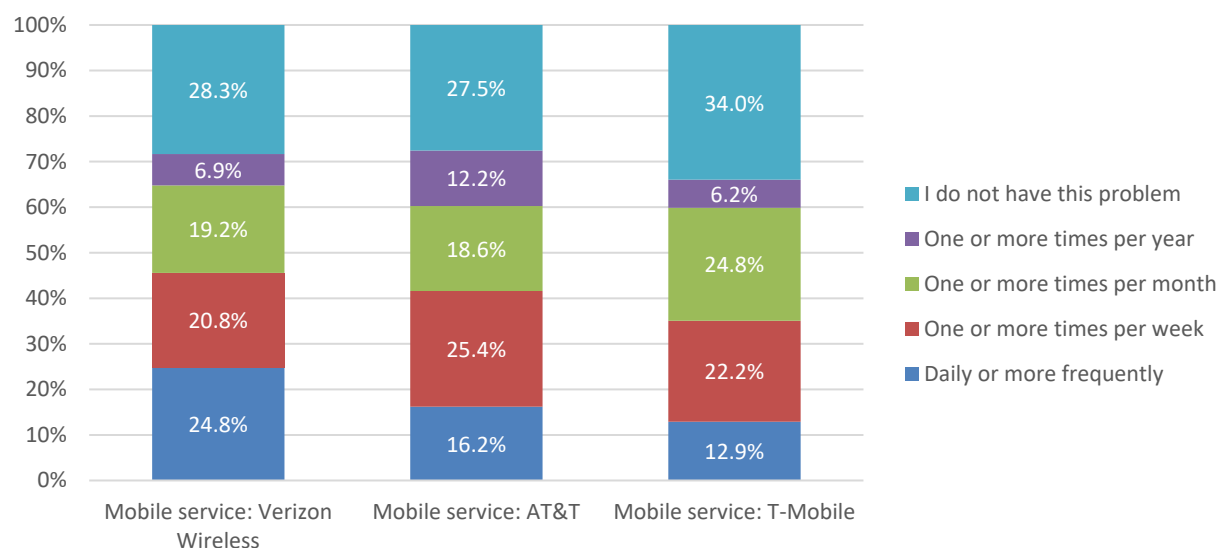
As shown in Figure 56, 30.8 percent of subscribers are very satisfied with their service, and 33 percent are somewhat satisfied. A sizeable segment of subscribers is either dissatisfied to some extent (17.8 percent) or neither satisfied/dissatisfied (18 percent) with their service. About one-fourth of Mid Cape and Outer Cape subscribers who responded said they were dissatisfied to some extent with their mobile data service.

Figure 56: Overall satisfaction with mobile data service
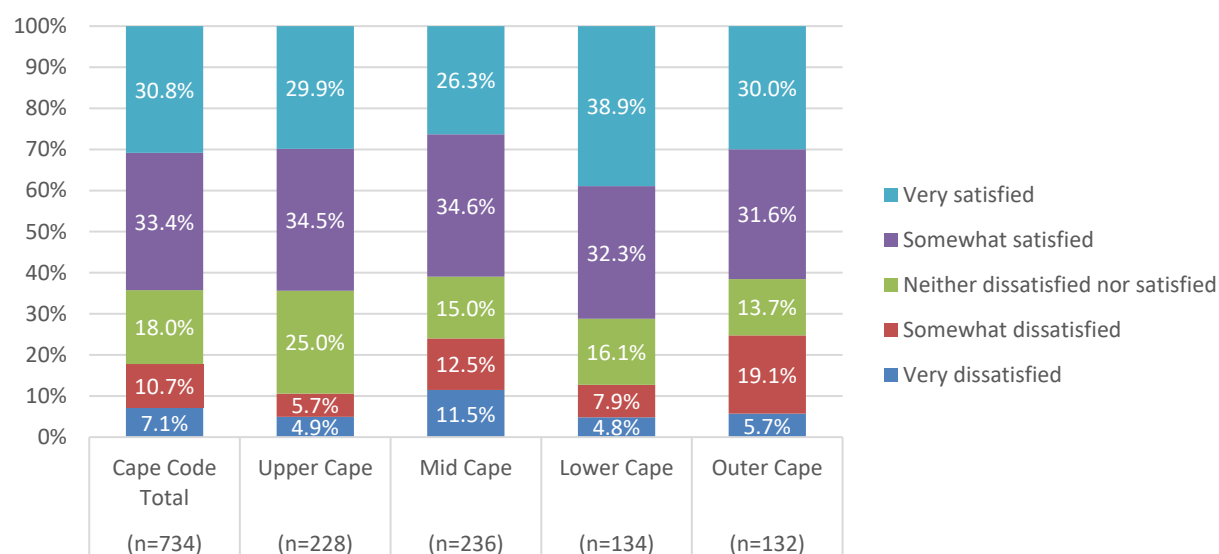
Satisfaction with mobile data service by provider is illustrated in Figure 57. Verizon Wireless customers are somewhat less satisfied with their mobile data service compared with those who subscribe to AT&T or T-Mobile as their primary mobile internet provider.

Figure 57: Overall satisfaction with mobile data service by providers used
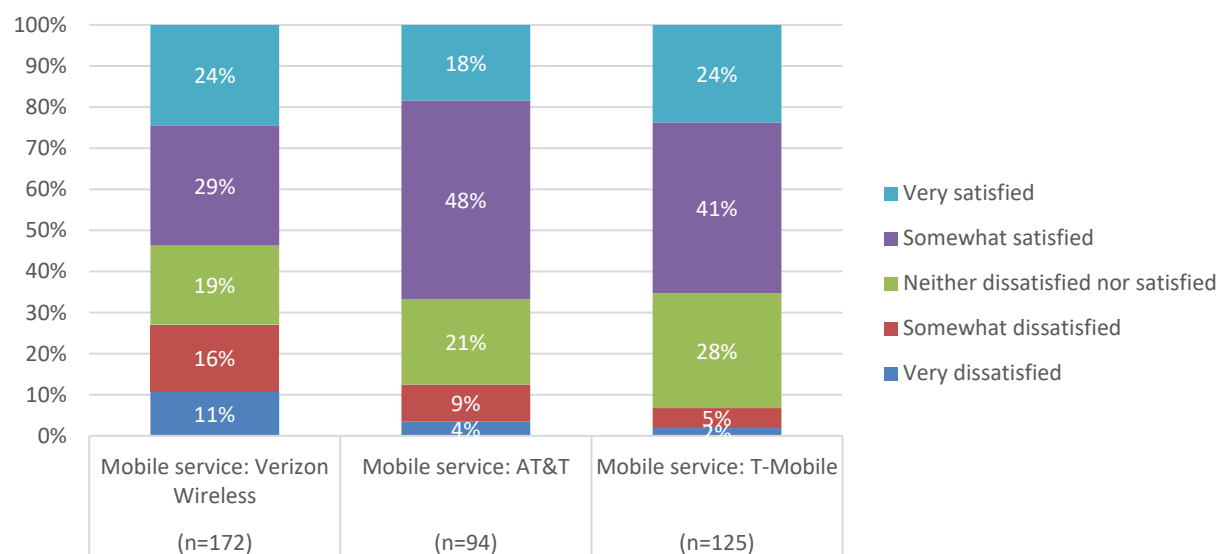
Among those who are not "very satisfied" with their mobile data service, 76.3 percent cited service dropping as the primary reason for lack of satisfaction (see Figure 58). Other reasons for lack of satisfaction include service is too expensive (60.3 percent), service is too slow (40.4 percent), and data caps (1.6 percent). Of the 16 percent of respondents who selected "other,"

the reasons they provided for lack of satisfaction with their mobile service included poor existing coverage, dead zones, low signal strength, and aging infrastructure.

Figure 58: Reasons for lack of satisfaction with mobile data service
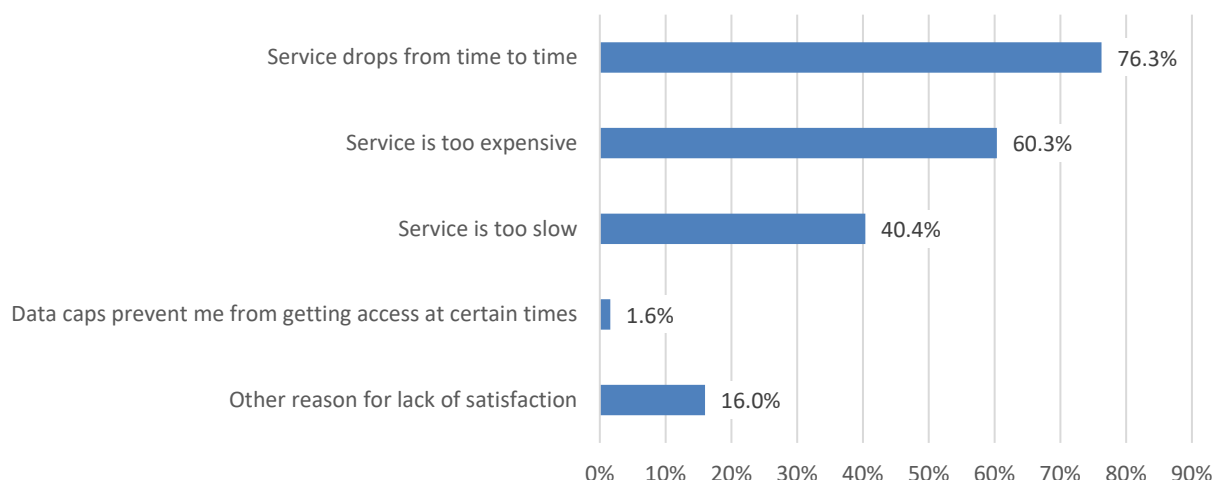
Percent of those who are not "very satisfied" with their home internet service

Approximately one-third of respondents do not experience any slowdown or drops in their mobile data service, but 20.2 percent experience this at least daily and 18.1 percent at least weekly (see Figure 59). Mid Cape respondents are more likely than other subscribers to experience slowdowns or drops in their mobile data service daily.

Figure 59: How frequently experience slowdowns or drops in mobile data service
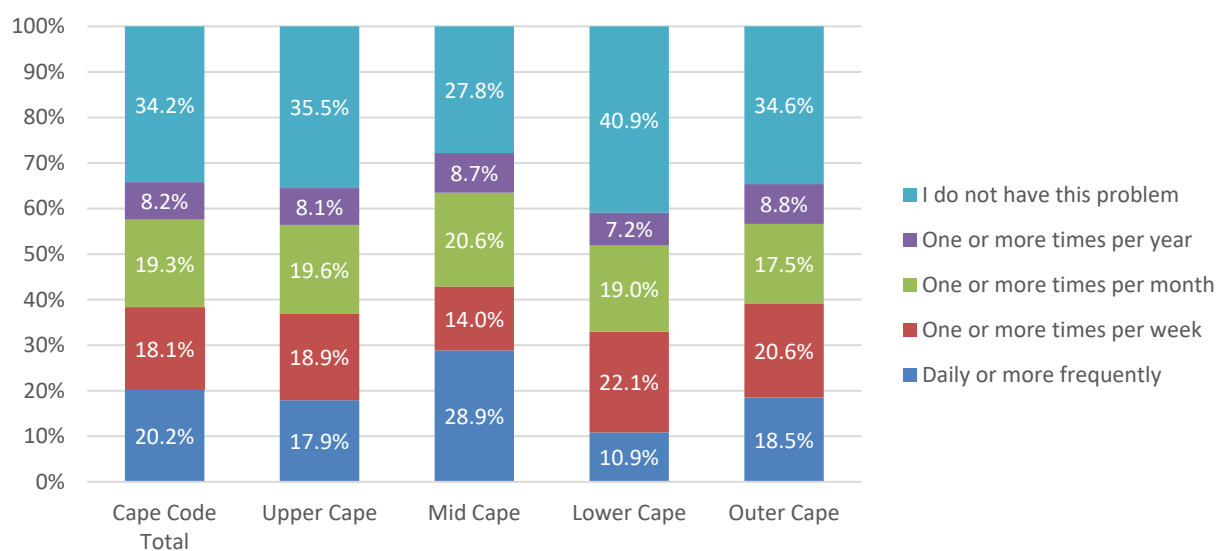
Frequency of slowdowns or drops in mobile data service by provider is illustrated in Figure 60. Most subscribers of various internet providers said they at times experience this issue with their

service (or one of their services if they have multiple), including 46.2 percent of Verizon Wireless customers who experience this issue with a provider either weekly or daily.

Figure 60: How frequently experience slowdowns or drops in home internet service by provider
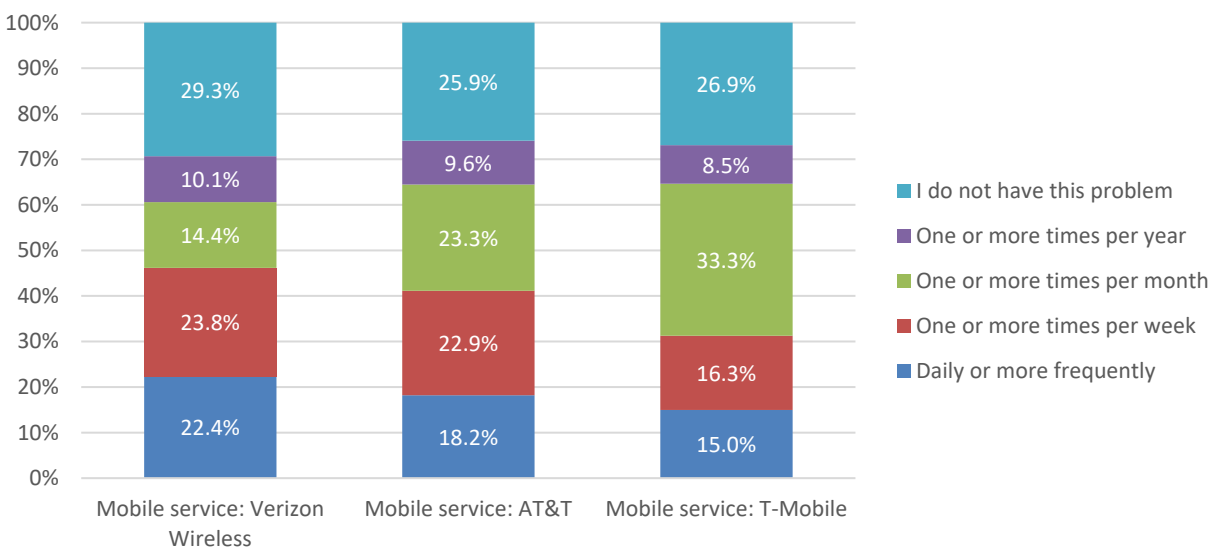
Renters experience slowdowns or drops in service more frequently than do homeowners (see Figure 61). Additionally, 35.6 percent of owners said they never experienced this problem, compared with 28.1 percent of renters.

Figure 61: How frequently experience slowdowns or drops in mobile data service by home ownership
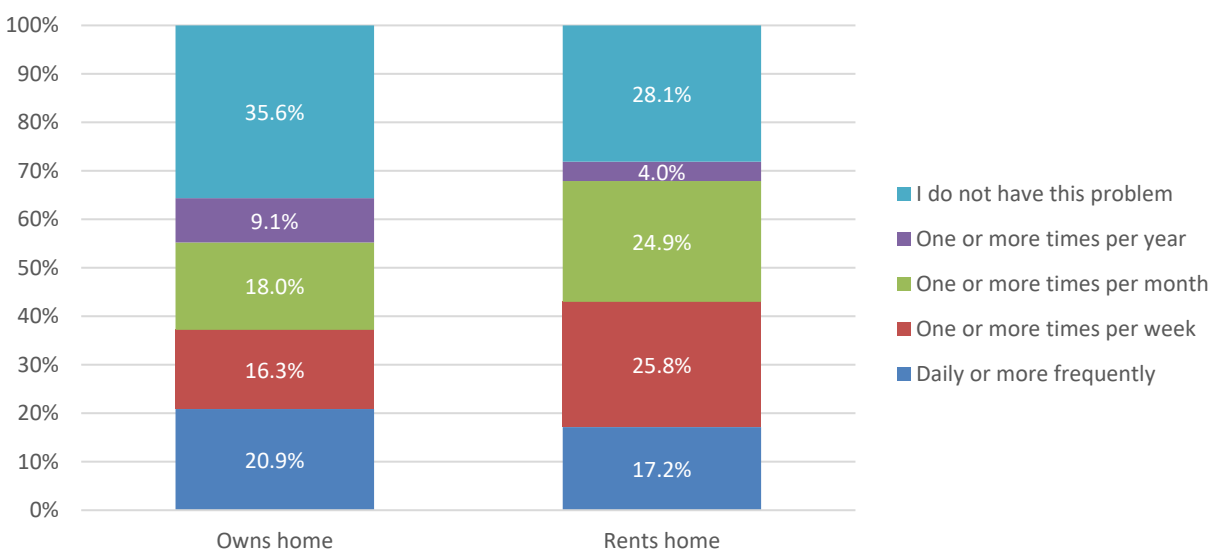
Those who experience slowdowns or drops in their mobile data service were asked to describe when these problems occur. Forty-three percent of those with connectivity issues said they occur any time of year with no pattern, and 45 percent are unsure if there is a pattern (see Figure 62).

Figure 62: When slowdowns or drops in mobile data service occur (among those who experience the issue)
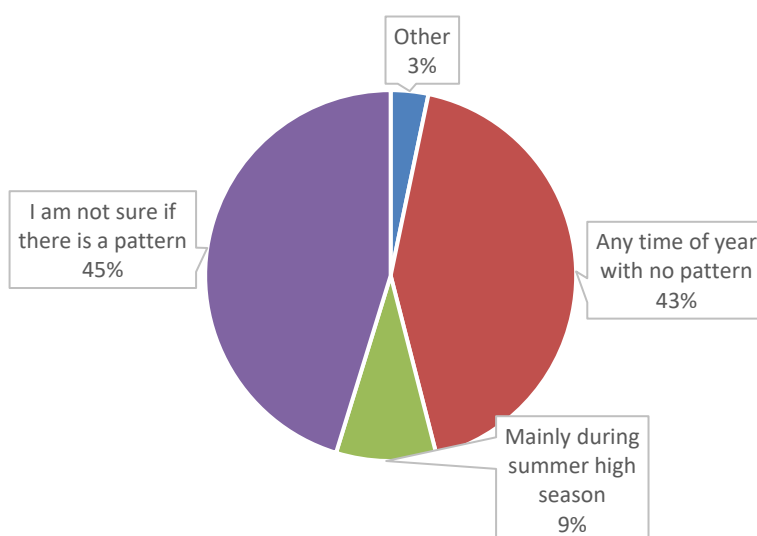
Computing devices used in household

Respondents were asked a series of questions about computing devices used in their household, as well as how long it would take to replace a lost or damaged computer. Table 21 highlights the saturation of devices in the household by key demographic groups. In total, 91 percent of respondents believe they have enough computing devices in good, working order to efficiently connect to the internet. This was not found to vary significantly by region within Cape Cod. Twenty-seven percent of respondents who live alone do not believe they have enough computing devices in good, working order to efficiently connect to the internet or are not sure.

Table 21: Have enough computing devices to efficiently connect to the internet by key demographics

	Have Enough Computers	Weighted Count
TOTAL	**91%**	*731*
Region		
Upper Cape..	90%	*226*
Mid Cape	91%	*236*
Lower Cape..	94%	*134*
Outer Cape	93%	*131*
Respondent Age		
Under age 40...	91%	*169*
40-49	96%	*74*
50-64	97%	*198*
65+	85%	*284*
Gender		
Male	91%	*377*

	Have Enough Computers	*Weighted Count*
Female..	90%	*348*
Nonbinary..	100%	*4*
Race/Ethnicity		
White, non-Hispanic..	90%	*576*
Racial/ethnic minority	96%	*94*
Household Size		
One HH member	73%	*135*
Two HH members...	95%	*333*
Three HH members	93%	*118*
Four + HH members	96%	*141*
Children in Household		
No children in HH	88%	*500*
Children in HH	96%	*226*
Income		
Less than $50,000..	88%	*182*
$50,000 to $99,999	88%	*183*
$100,000 to $149,999	97%	*121*
$150,000 or more..	95%	*84*
Other Demographic Groups		
Veteran..	97%	*149*
Individual with a disability..	85%	*81*
Primarily non-English speaker	100%	*15*
Formerly incarcerated individual	100%	*4*
Actively enrolled in K-12 school or college or other higher education......................................	98%	*154*
A student in college or other higher education..	97%	*120*

Most respondents said they could replace their primary computer within a day (47.6 percent) or a week (41.9 percent) if it were lost or damaged beyond repair (see Figure 63). Approximately 10.1 percent of respondents would need one month or longer to replace their computer. This was not found to vary significantly by region within Cape Cod.

Figure 63: Length of time to replace a lost or damaged computer
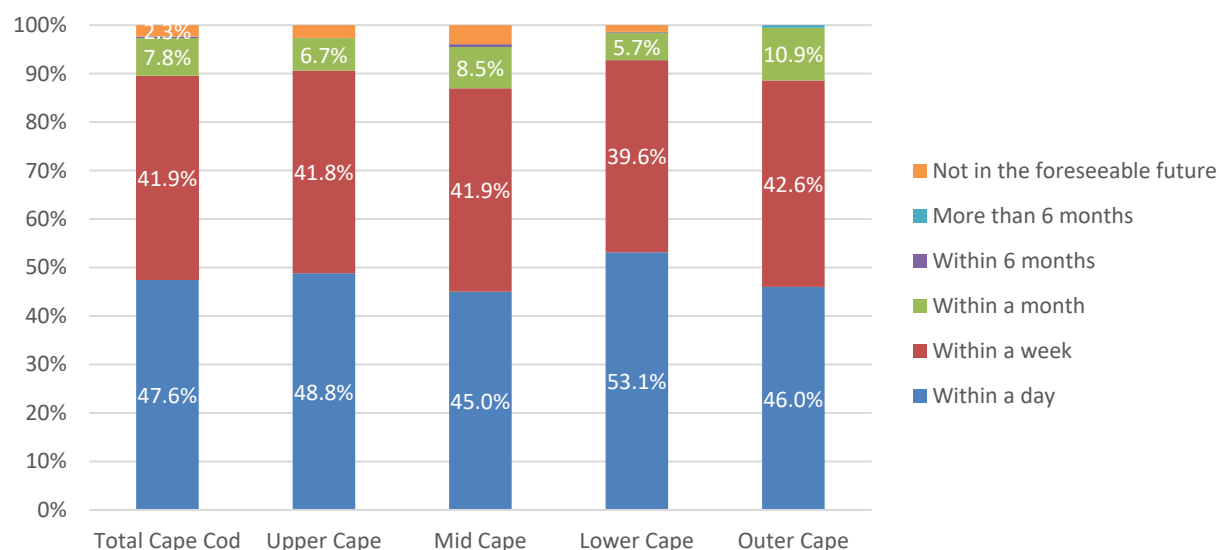
Respondents in lower-income households would take longer to replace a lost or broken computer, compared with those in higher-income households (see Figure 64). Specifically, 21.8 percent of those in households earning less than $50,000 annually would need a month or longer to replace a lost or broken computer, compared to four percent of those earning $50,000 or more per year.

Figure 64: Length of time to replace a lost or damaged computer by household income
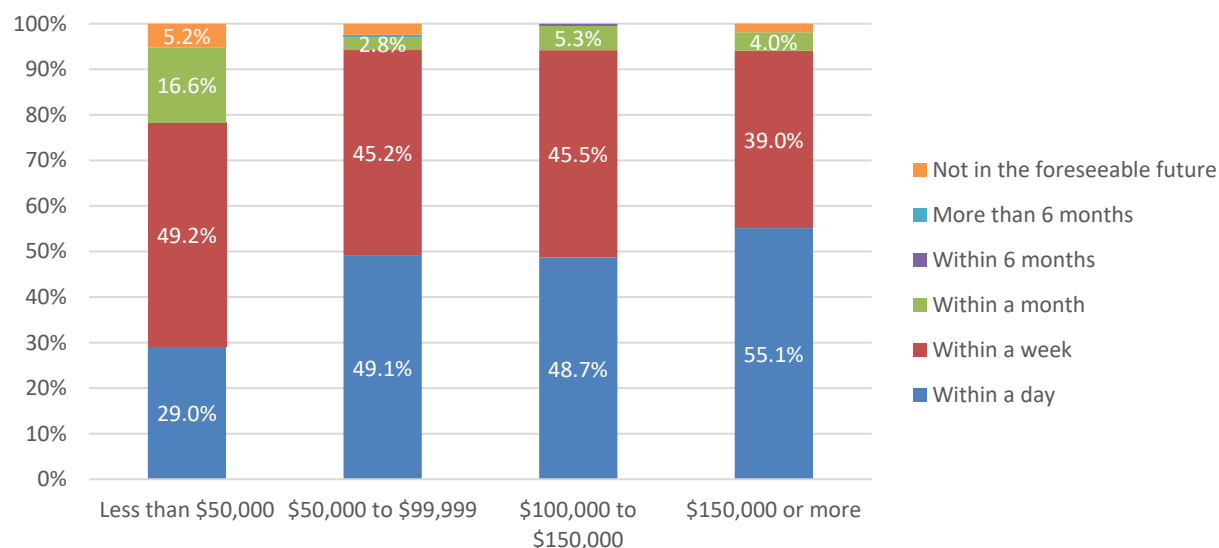
Internet skills

Respondents were asked to indicate how confident they are with various internet skills. This information provides valuable insight into where there may be gaps in abilities and opportunities

to educate residents. Barnstable County residents generally feel highly skilled in all areas evaluated, with the majority feeling very confident in their digital literacy skills.

For example, 79.8 percent of respondents said they are very confident sending and receiving emails, as shown in Figure 65. Most respondents said they are very confident accessing online financial services (76.6 percent), accessing medical/telehealth resources (71.9 percent), accessing governmental services (72.6 percent), and using social media (67 percent).

Figure 65: Confidence in internet skills
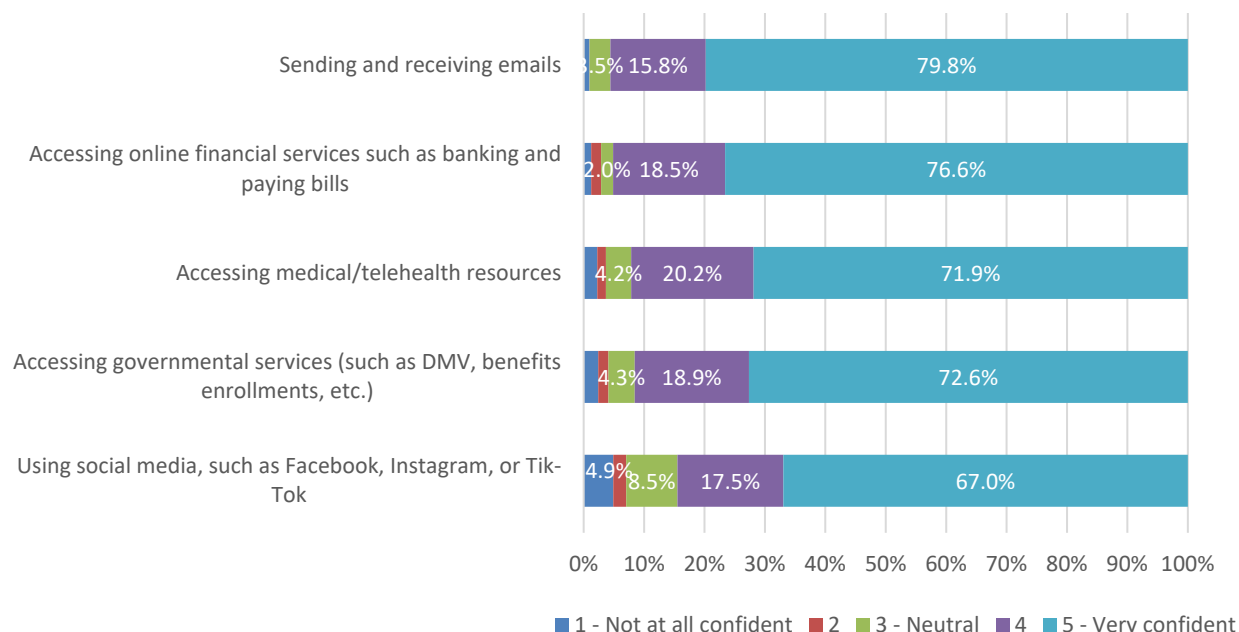
Outer Cape respondents were more likely than Upper Cape and Mid Cape respondents to say they are very confident sending and receiving emails (see Table 22).

Table 22: Percent of respondents very confident in their internet skills by region

	Upper Cape	Mid Cape	Lower Cape	Outer Cape
Sending and receiving emails	78%	76%	83%	89%
Using social media, such as Facebook, Instagram, or Tik-Tok	67%	63%	71%	71%
Accessing medical/telehealth resources	69%	71%	77%	74%
Accessing governmental services (such as DMV, benefits enrollments, etc.)	70%	71%	82%	74%
Accessing online financial services such as banking and paying bills	72%	76%	84%	80%

Respondents under age 40 were less likely than older respondents to say they are very confident in accessing online financial services (see shown in Table 23). Also, 61 percent of respondents ages 65+ are very confident in using social media, compared with 74 percent under age 40.

Table 23: Percent of respondents very confident in their internet skills by respondent age

	Under 40	40-49	50-64	65+
Sending and receiving emails	78%	78%	79%	81%
Using social media, such as Facebook, Instagram, or Tik-Tok	74%	69%	69%	61%
Accessing medical/telehealth resources	69%	74%	69%	75%
Accessing governmental services (such as DMV, benefits enrollments, etc.)	74%	75%	70%	73%
Accessing online financial services such as banking and paying bills	71%	79%	79%	78%

Respondents who live alone are less confident in their internet skills compared with those who reside with other household members, as shown in Table 24. Just over one-half of those who live alone are very confident in accessing medical resources or government services online, compared with at least three-fourths of other respondents.

**Table 24: Percent of respondents very confident in their internet skills by household size**

	One HH member	Two HH members	Three HH members	Four + HH members
Sending and receiving emails	65%	80%	90%	83%
Using social media, such as Facebook, Instagram, or Tik-Tok	44%	68%	77%	78%
Accessing medical/telehealth resources	52%	77%	76%	76%
Accessing governmental services (such as DMV, benefits enrollments, etc.)	54%	75%	81%	77%
Accessing online financial services such as banking and paying bills	66%	80%	81%	75%

Similarly, those in lower-income households are less confident in their internet skills than are those in higher-income households (see Table 25).

Table 25: Percent of respondents very confident in their internet skills by household income

	Less than $50,000	$50,000 to $99,999	$100,000 to $150,000	$150,000 or more
Sending and receiving emails	76%	78%	80%	83%
Using social media, such as Facebook, Instagram, or Tik-Tok	62%	64%	69%	69%
Accessing medical/telehealth resources	66%	69%	77%	75%
Accessing governmental services (such as DMV, benefits enrollments, etc.)	66%	70%	77%	80%
Accessing online financial services such as banking and paying bills	65%	75%	82%	81%

Respondents were asked how likely they would be to attend a free or inexpensive class locally to help improve skills for one or more online activities. A small segment (14.7 percent) of respondents would be likely to attend such a class, while 22.7 percent are neutral (see Figure 66). One-half of respondents would be very unlikely to attend online skills training. The likelihood of attending a class was not found to vary significantly by region within Cape Cod.
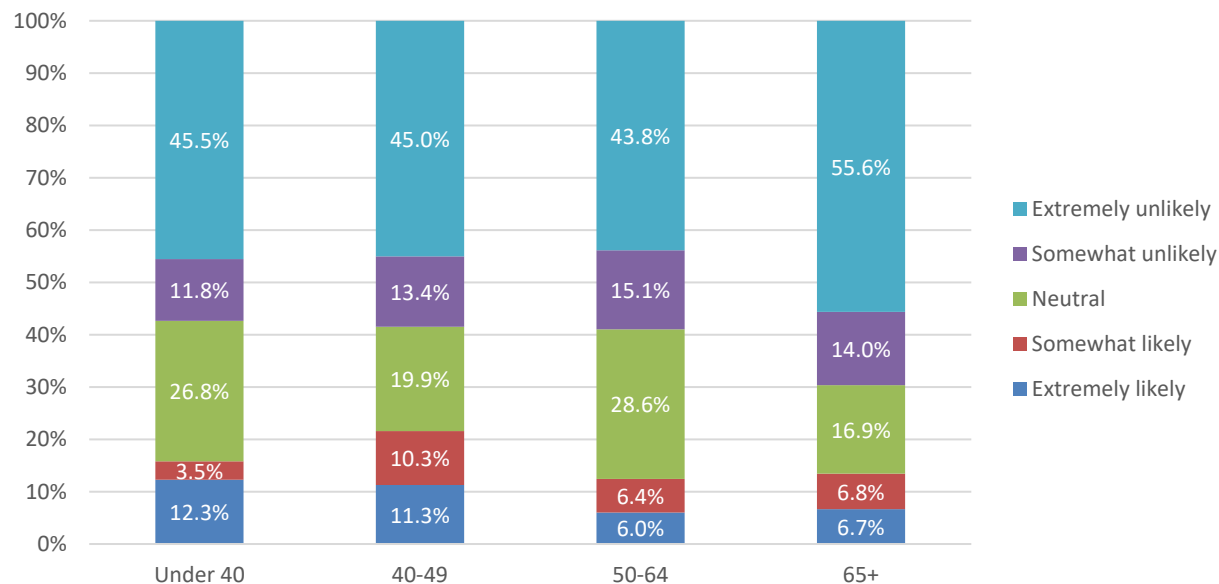
Figure 66: Likelihood of attending class to improve internet skills
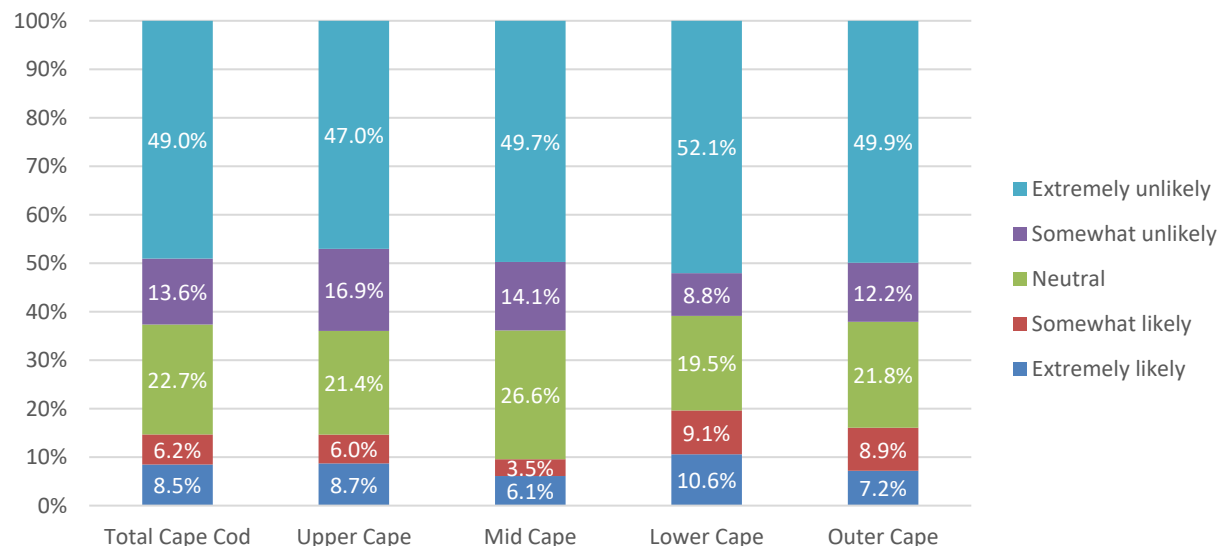
Seasonal residents would be more likely than full-time residents to attend a class to improve their internet skills, including 16 percent who said they would be very likely (see Figure 67).

**Figure 67: Likelihood of attending class to improve internet skills by seasonal residence**
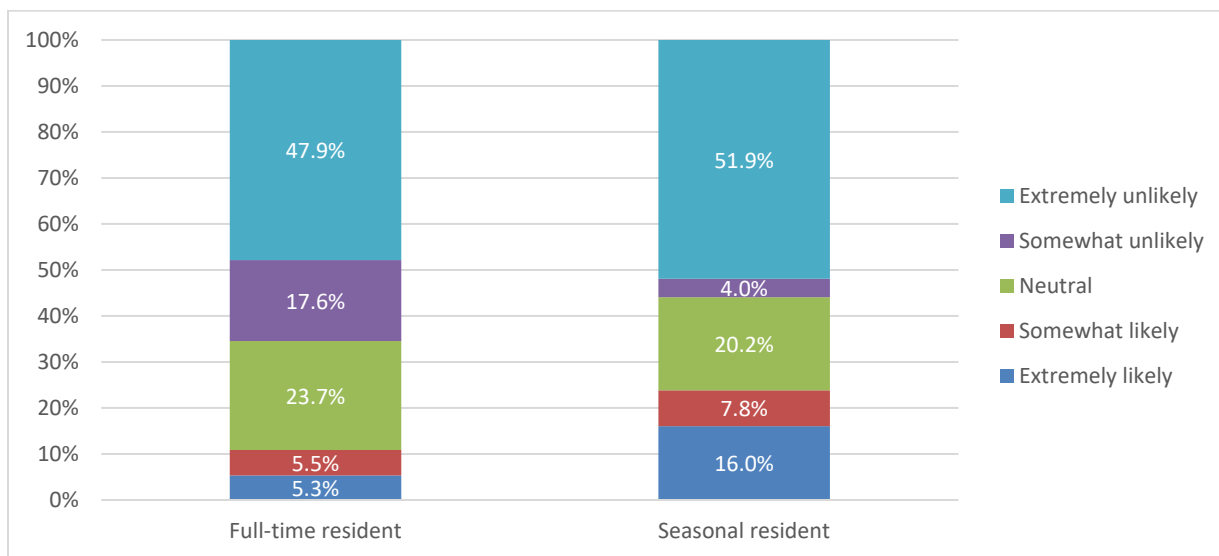
Respondents under age 65 would be somewhat more likely than seniors to attend a free or inexpensive class to improve online skills (see Figure 68).

Figure 68: Likelihood of attending class to improve internet skills by respondent age

Respondents earning $150,000 or more per year would be somewhat more likely to attend an online skills training class, compared with those earning below $150,000 per year (see Figure 69).

Figure 69: Likelihood of attending class to improve internet skills by household income
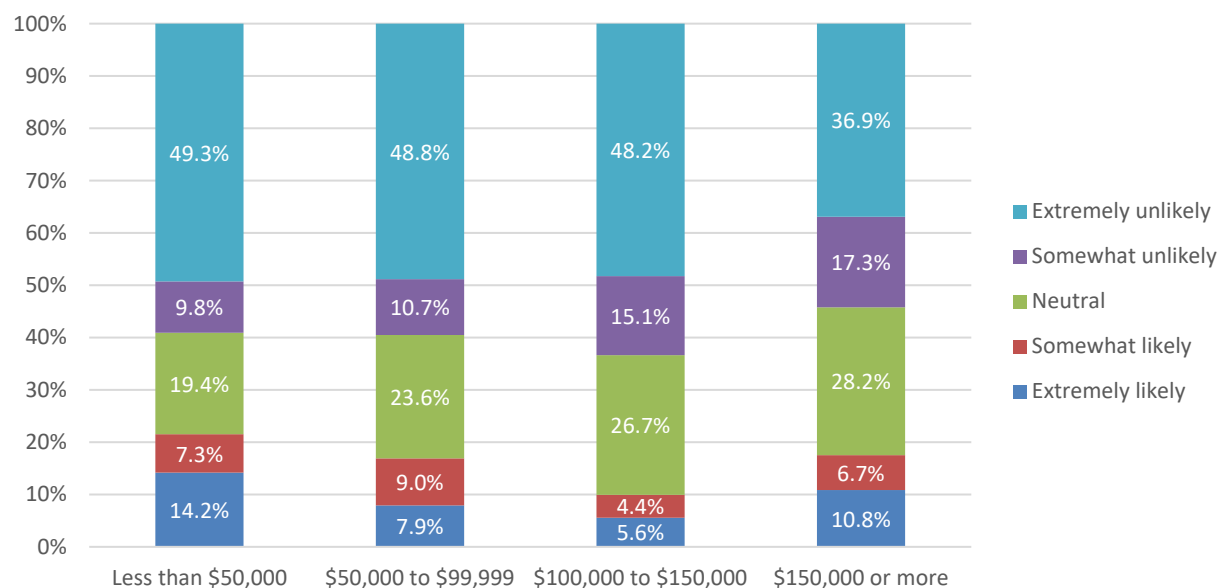
Respondent opinions on role of government

Respondents were asked their opinions about the role of local government in providing or promoting broadband communications services within their town. Figure 70 illustrates the mean ratings, while Figure 71 provides detailed responses to each portion of the question.

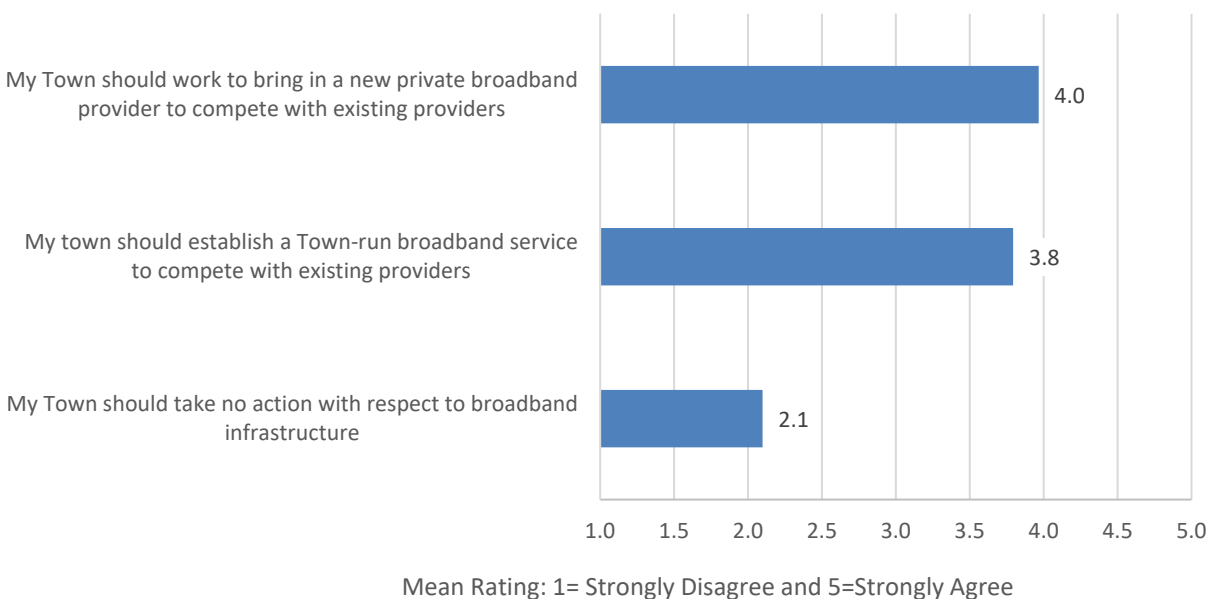**Figure 70: Opinions about the role for local government (mean ratings)**

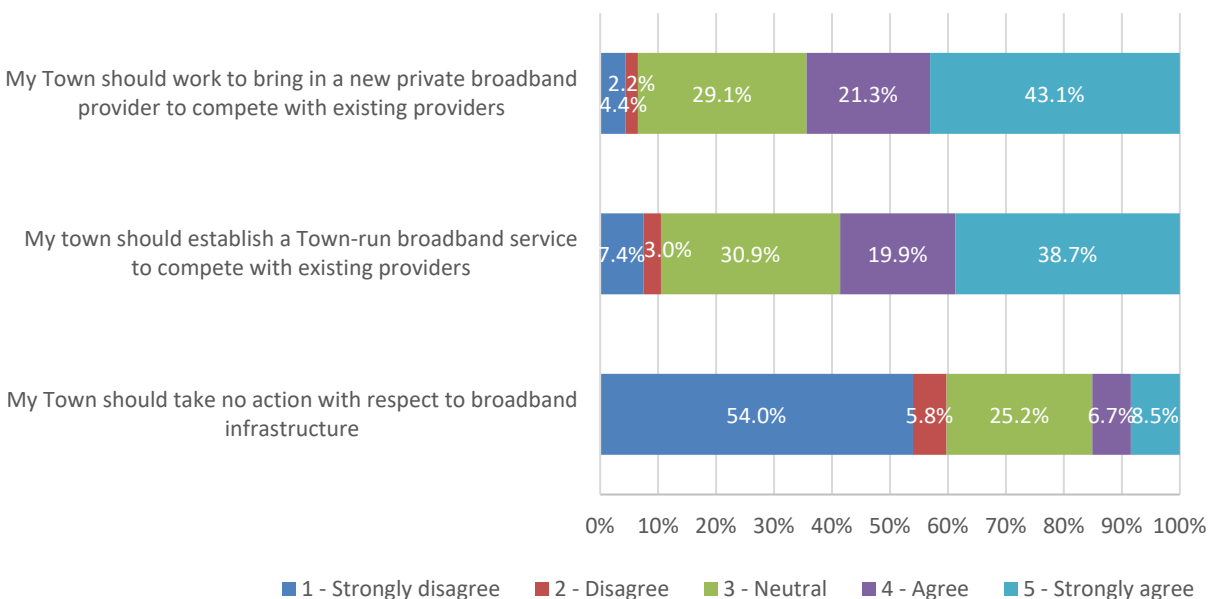Mean Rating: 1= Strongly Disagree and 5=Strongly Agree

Figure 71: Opinions about the role for local government

Overall, there is some support for expanding provider options in the area. Forty-three percent of respondents strongly agreed that their town should work to bring in a new private broadband provider to compete with existing providers, and 21 percent agreed. Additionally, 39 percent strongly agreed their town should establish a Town-run broadband service to compete with existing providers, and 20 percent agreed. More than one-half (54 percent) of respondents strongly disagreed that their town should take no action with respect to broadband infrastructure.

In general, support for these efforts is somewhat high across various demographic groups. However, seasonal residents were more likely than full-time residents to strongly agree their town should establish a Town-run broadband service to compete with existing providers (51 percent vs. 34 percent), as shown in Table 26. At the same time, seasonal residents also expressed a somewhat higher level of agreement that their town should take no action with respect to broadband infrastructure, compared with full-time residents.

Table 26: Opinions about the role(s) for local government by residence status

		Full time	Seasonal
My town should establish a Town-run broadband service to compete with existing providers	1 - Strongly disagree	9%	4%
	2 - Disagree	4%	1%
	3 - Neutral	30%	33%
	4 - Agree	23%	12%
	5 - Strongly agree	34%	51%
	Mean	*3.7*	*4.0*
	Weighted count	*517*	*213*
My Town should work to bring in a new private broadband provider to compete with existing providers	1 - Strongly disagree	6%	0%
	2 - Disagree	2%	2%
	3 - Neutral	24%	41%
	4 - Agree	23%	17%
	5 - Strongly agree	45%	39%
	Mean	*4.0*	*3.9*
	Weighted count	*517*	*213*
My Town should take no action with respect to broadband infrastructure	1 - Strongly disagree	58%	43%
	2 - Disagree	8%	0%
	3 - Neutral	23%	30%
	4 - Agree	4%	14%
	5 - Strongly agree	6%	13%
	Mean	*1.9*	*2.5*
	Weighted count	*515*	*213*

Additionally, younger respondents were somewhat more likely than older respondents to agree or strongly agree their town should take no action with respect to broadband infrastructure (see Table 27).

Table 27: Opinions about the role(s) for Barnstable County by respondent age

		Under 40	40-49	50-64	65+
My town should establish a Town-run broadband service to compete with existing providers	1 - Strongly disagree	4%	7%	5%	11%
	2 - Disagree	1%	1%	4%	4%
	3 - Neutral	37%	29%	29%	30%
	4 - Agree	20%	22%	27%	14%
	5 - Strongly agree	38%	41%	34%	41%
	Mean	*3.9*	*3.9*	*3.8*	*3.7*
	Weighted count	*170*	*74*	*196*	*283*
My Town should work to bring in a new private broadband provider to compete with existing providers	1 - Strongly disagree	3%	3%	2%	7%
	2 - Disagree	0%	1%	4%	2%
	3 - Neutral	38%	29%	27%	25%
	4 - Agree	19%	21%	28%	18%
	5 - Strongly agree	39%	45%	39%	47%
	Mean	*3.9*	*4.0*	*4.0*	*4.0*
	Weighted count	*170*	*74*	*196*	*283*
My Town should take no action with respect to broadband infrastructure	1 - Strongly disagree	35%	43%	51%	70%
	2 - Disagree	6%	5%	8%	4%
	3 - Neutral	35%	25%	26%	20%
	4 - Agree	14%	8%	7%	1%
	5 - Strongly agree	11%	19%	8%	4%
	Mean	*2.6*	*2.5*	*2.1*	*1.7*
	Weighted count	*170*	*74*	*195*	*282*

As shown in Table 28, residents of the Lower Cape were somewhat less likely to agree their Town should take no action with respect to broadband infrastructure. Specifically, 56 percent of Lower Cape residents strongly agreed the Town should bring in a private broadband provider, and 48 percent strongly agreed the Town should establish a Town-run broadband service, to compete with existing providers.

Table 28: Opinions about the role(s) for Barnstable County by region

		Upper Cape	Mid Cape	Lower Cape	Outer Cape
My town should establish a Town-run broadband service to compete with existing providers	1 - Strongly disagree	6%	8%	13%	5%
	2 - Disagree	3%	1%	4%	6%
	3 - Neutral	36%	34%	12%	37%
	4 - Agree	21%	19%	24%	17%
	5 - Strongly agree	34%	39%	48%	35%
	Mean	3.7	3.8	3.9	3.7
	Weighted count	*228*	*235*	*132*	*131*
My Town should work to bring in a new private broadband provider to compete with existing providers	1 - Strongly disagree	3%	6%	4%	5%
	2 - Disagree	1%	3%	4%	1%
	3 - Neutral	36%	27%	14%	36%
	4 - Agree	23%	16%	23%	27%
	5 - Strongly agree	37%	48%	56%	31%
	Mean	3.9	4.0	4.2	3.8
	Weighted count	*228*	*235*	*132*	*131*
My Town should take no action with respect to broadband infrastructure	1 - Strongly disagree	49%	55%	68%	46%
	2 - Disagree	8%	6%	5%	3%
	3 - Neutral	30%	25%	9%	35%
	4 - Agree	6%	6%	11%	4%
	5 - Strongly agree	8%	8%	7%	12%
	Mean	2.2	2.1	1.8	2.3
	Weighted count	*226*	*235*	*132*	*131*

Willingness to pay temporary per-household fee

Respondents were asked their level of support or opposition for paying a temporary construction fee at various price levels to establish a new best-in-class private or public broadband service. The mean support rating across this array of questions is illustrated in Figure 72, while detailed responses are illustrated in Figure 73.

Overall, respondents are opposed to neutral about paying a temporary fee to help cover construction costs at various price points. The mean rating falls from a high of 3.2 at $200 per year for five years to 2.1 at $800 per year for five years. From another perspective, 13 percent of

respondents are strongly opposed to paying a temporary construction fee of $200 per year, increasing to 42 percent for $800 per year.

Figure 72: Willingness to pay temporary construction fee for five years (mean ratings)
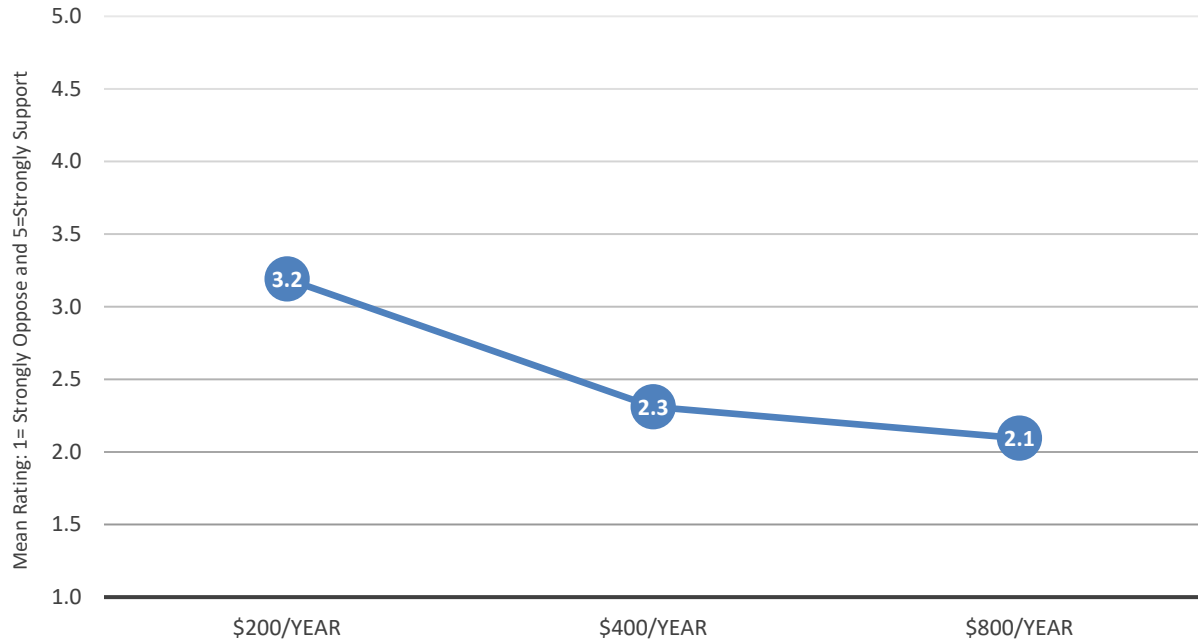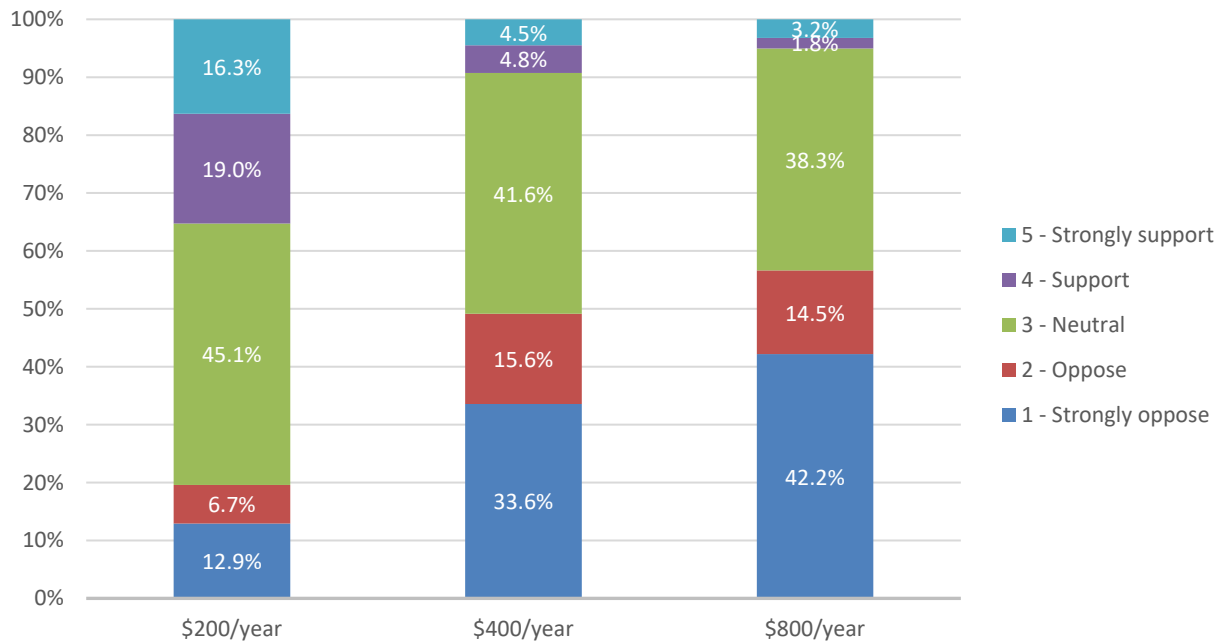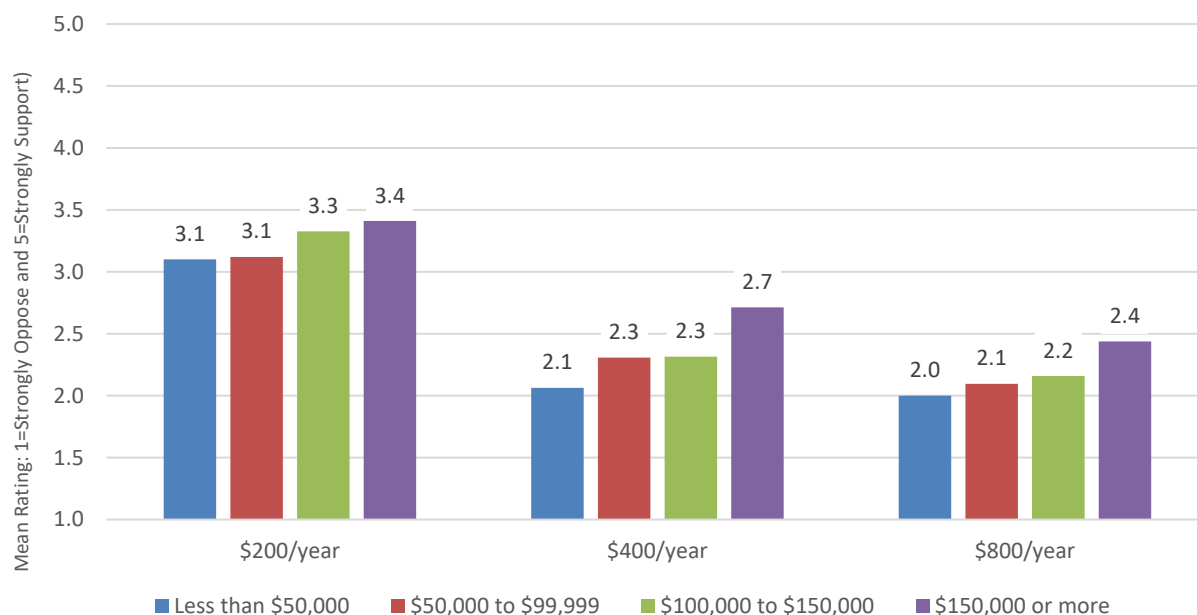

**Figure 73: Willingness to pay temporary construction fee for five years**

At various price points, respondents with an annual household income of $150,000 or more would be more likely to support paying a temporary construction fee than would those in lower-earning households (see Figure 74).

Figure 74: Willingness to pay temporary construction fee for five years by household income

Differences in mean ratings by region are illustrated in Figure 75; however, these were not found to be statistically significant.

Figure 75: Willingness to pay temporary construction fee for five years by region
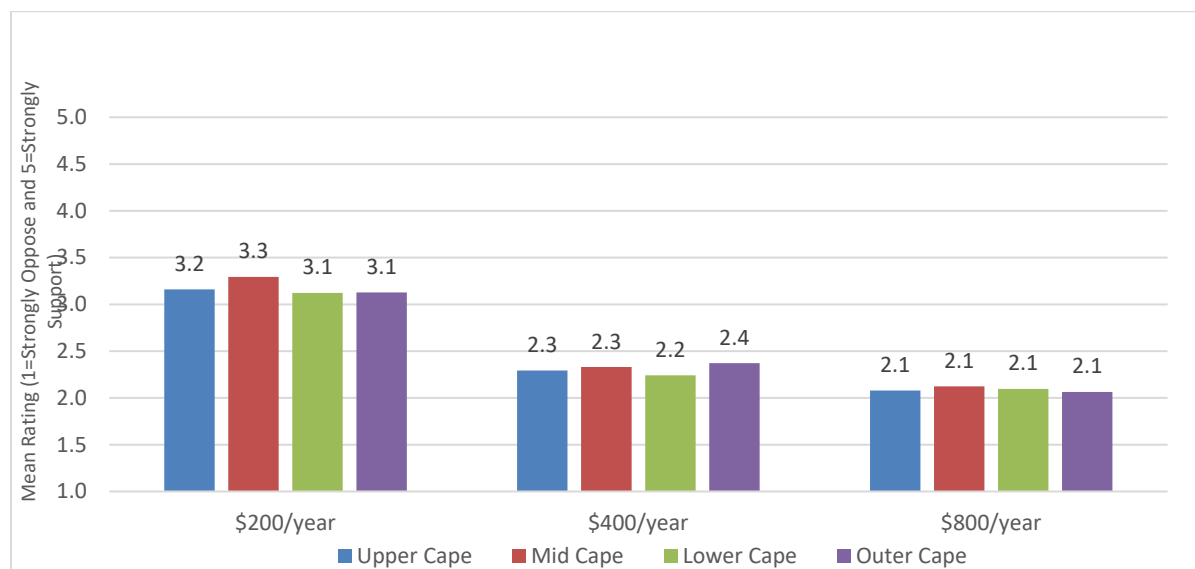
Appendix C: Overview of the broadband market structure

As a foundation for the analysis presented in the remainder of this report, this section briefly describes the structure of the broadband market, including deployed infrastructure, market participants, and customer segments.

The broadband market is divided by types of providers, types of services based on the use of infrastructure, and types of customers served. In larger metropolitan areas, long-haul fiber bridges the distance between cities, often connecting at data centers. In Barnstable County, the relevant infrastructure for this analysis consists of:

1. **Middle-mile fiber**, which delivers enterprise-level services to large businesses, institutions, and government clients in a local or regional area and connects wireline and wireless last-mile infrastructure with the long-haul network

2. **Last-mile infrastructure** (fiber/wireline or wireless), which delivers consumer-grade services to residences and business-class services to small businesses

Table 29 summarizes the broadband market for middle- and last-mile market segments. The sections below describe the middle-mile and last-mile segments specific to Barnstable County in more detail.

Table 29: Broadband market overview

		Infrastructure Provider	Enterprise Service Provider	National Incumbent	Local Incumbent	Competitor
		Leverages real estate & infrastructure to support ISPs	Sells high-end services to sophisticated end users & ISPs	Operates regional networks to serve multiple segments	Operates local networks to serve multiple segments	Builds new networks to compete with incumbents
Middle mile	1. **Middle Mile** (transport & internet bandwidth) ISP customers	�	�	�		
	2. **Wireless Backhaul** Wireless ISP customers	�	�		�	
Last mile	3. **Enterprise** Business & institutional customers		�	�	�	
	4. **Business Class** Small/medium business customers			�	�	▂
	5. **Consumer-Grade** Residential & small business customers			▂	▂	▂

Middle-mile market segment

Middle-mile service providers connect last-mile ISPs (both wired and wireless) to the backbone of the internet at major data centers and other interconnection points. Middle-mile services include the following:

- **Transport** is a service from one point to another over a middle-mile network that enables the buyer to transport its traffic between its local network and a major network hub; this is a high-end service, often with service-level guarantees, which is used by more sophisticated ISPs.

- **Commodity internet bandwidth** enables local ISPs to put their traffic on the internet. It can be purchased locally (at the interconnection point with the middle-mile provider), offering simplicity for the local ISP, or at a data center (with transport services then necessary to move the bandwidth between the data center and the ISP's local network).

- **Interconnection services** allow ISPs to connect to the internet backbone and to each other; these include access to data centers or field exchange points; rack space at data centers; and access to splice enclosures or other interconnection elements.

- **Dark fiber** enables sophisticated ISPs to use their own electronics to "light" and operate fiber strands along a middle-mile route; the dark fiber owner offers physical maintenance guarantees and splicing and related services to access the fiber.

A range of entities provide middle-mile services, though remote locations and cost effectiveness may create challenges for different types of last-mile ISPs to connect to these middle-mile providers:

- **Incumbents** operate large networks to support their own last-mile operations, both fixed and mobile; these providers sometimes sell middle-mile services to competitors.

- **Infrastructure companies** deploy network infrastructure assets and bundle access to those assets including fiber, wireless towers, and "small cells" on street furniture to sell middle-mile services to ISPs.

- **Enterprise ISPs** may or may not deploy their own network infrastructure, but their primary business model is to sell very high-end middle-mile (and last-mile) services to sophisticated users, including last-mile ISPs, multi-location business enterprises, and large anchor institutions.

- **Platform companies** such as Google and Meta own massive long-haul and middle-mile fiber networks to support their own needs; in limited cases, these assets are also used to deliver services to ISPs.

Last-mile market segment

ISPs offer a range of data services over the last-mile portions of their networks to residences, businesses, institutions—and to other ISPs. Last-mile services and customer types include the following:

- **Consumer-grade internet** services are sold to households and cost-conscious small businesses; these are "best efforts" rather than guaranteed levels of service, which is indicated by advertisements for speeds "up to" a certain level.

- **Business-class internet** services are sold to many smaller and mid-size businesses that require a bit more support than households; these are still "best efforts," but they may include symmetry (i.e., matching download and upload speeds), lower levels of oversubscription (meaning the infrastructure will be supporting fewer customers), and prioritization at the ISP's network operations center.

- **Enterprise-level services** are the services sold to sophisticated institutions and businesses that require "quality of service" guarantees; these are high-end services that include point-to-point transport and point-to-point dark fiber.

- **Backhaul** is a type of service sold to other ISPs (primarily wireless) to "backhaul" their internet traffic from the neighborhood to the internet backbone; these are high-end services that may be delivered over lit or dark fiber.

Key last-mile market players include incumbent, competitive, and mobile/fixed wireless providers:

- **Incumbent providers** include "telephone companies" like AT&T offering voice and internet over legacy copper, DSL, or (in limited cases) fiber infrastructure, as well as cable companies such as Comcast offering internet over legacy cable TV infrastructure.

- **Competitive providers** include fiber-to-the-premises providers like Verizon with its Fios service. Competitive providers include smaller, niche, and community providers as well as larger enterprises and they market to a mix of residential and business customers. These providers often have to "over-build" the legacy incumbent networks to bring newer technology into the area. In Barnstable County fixed wireless is a significant portion of the technology used by competitive providers.

- **Mobile companies** such as AT&T, Verizon, and T-Mobile also offer "fixed wireless" services in the last mile, though with entirely different service attributes and utility. As these incumbent providers expand their 5G networks over the next several years, and resellers (or Mobile Virtual Network Operators) such as Tracfone market services over those networks, faster and more reliable fixed wireless may become increasingly available.

Appendix D: Town-level average fixed download speeds by census block

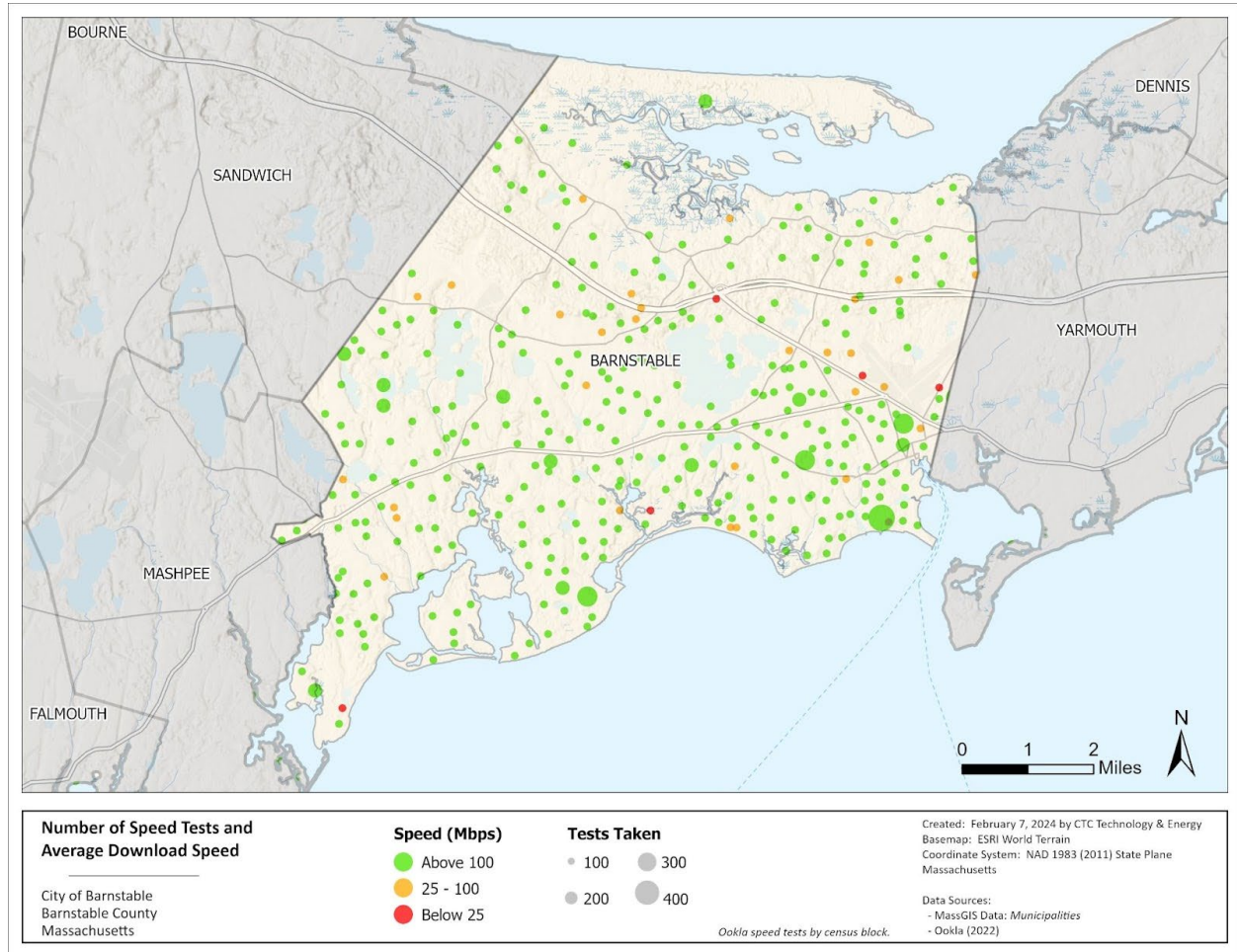**Figure 76: Town of Barnstable average fixed download speeds by census block**

Figure 77: Town of Bourne average fixed download speeds by census block
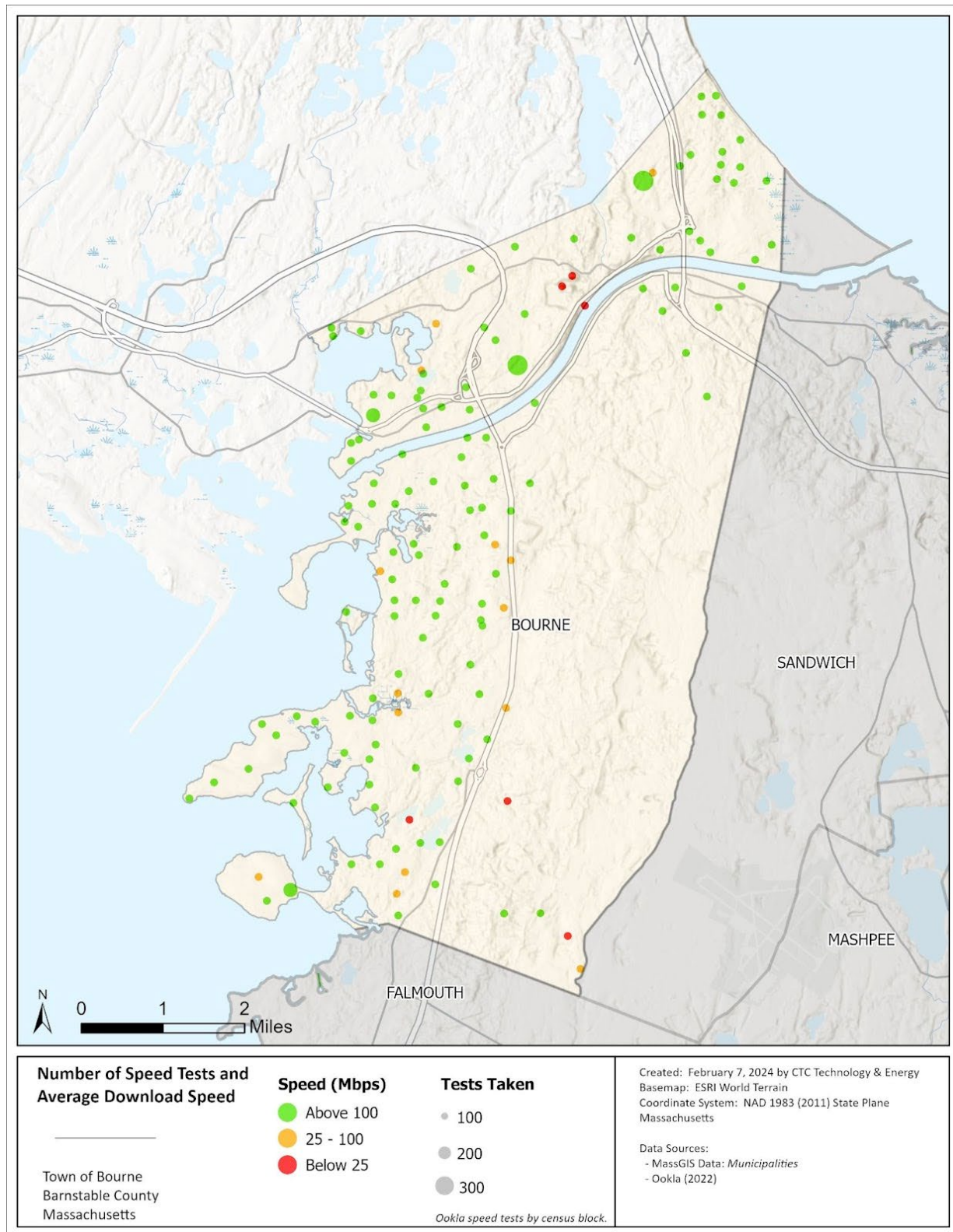
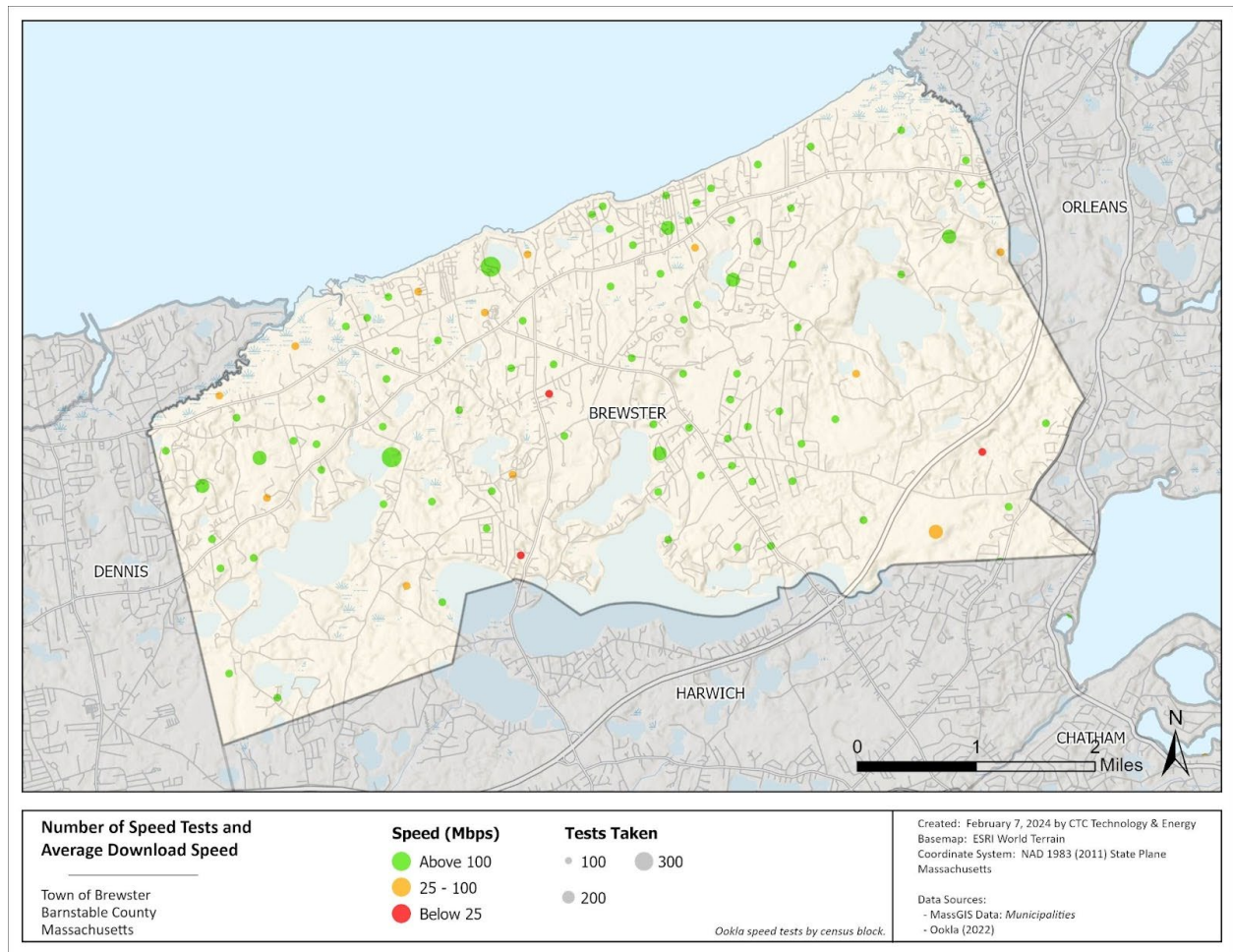**Figure 78: Town of Brewster average fixed download speeds by census block**

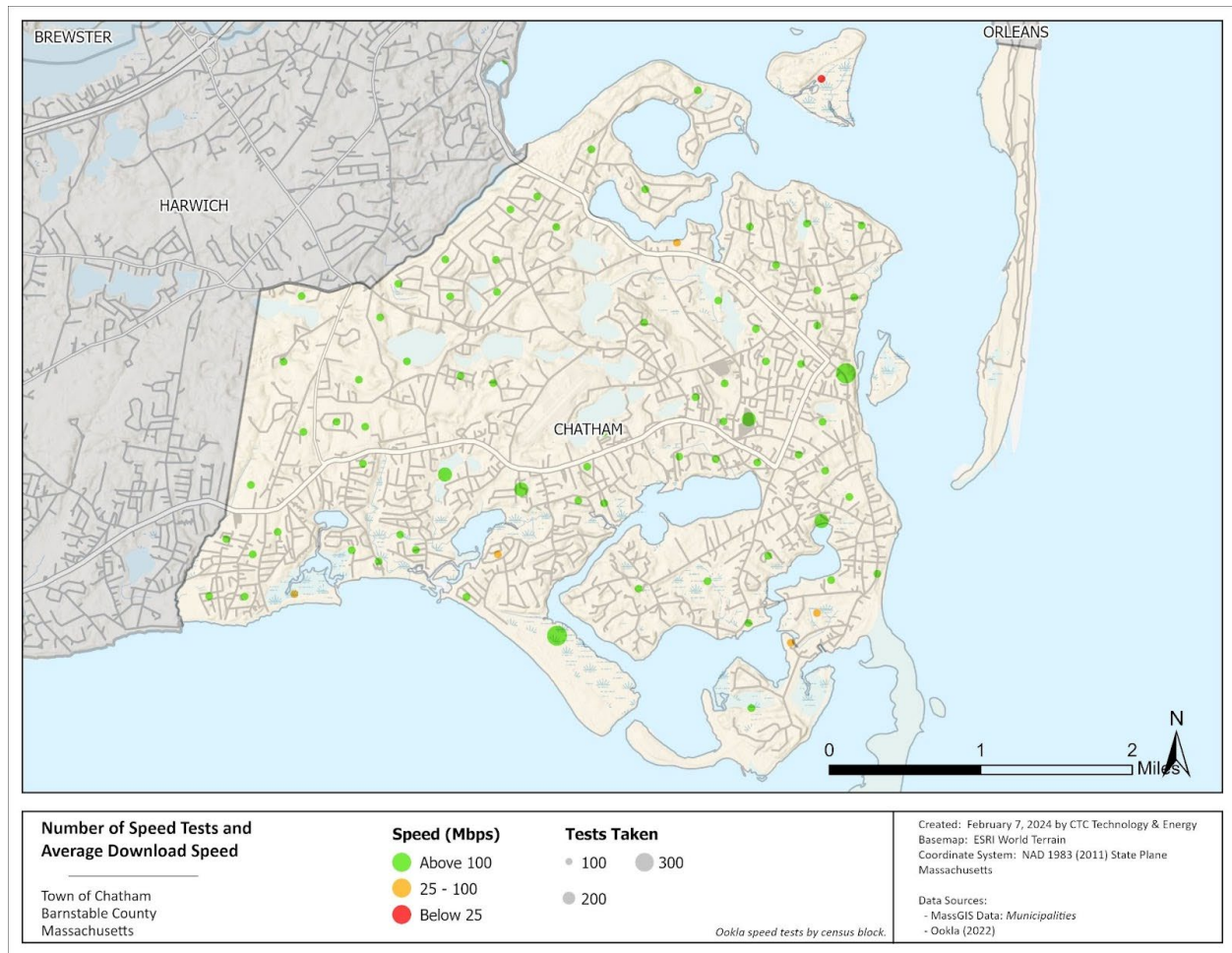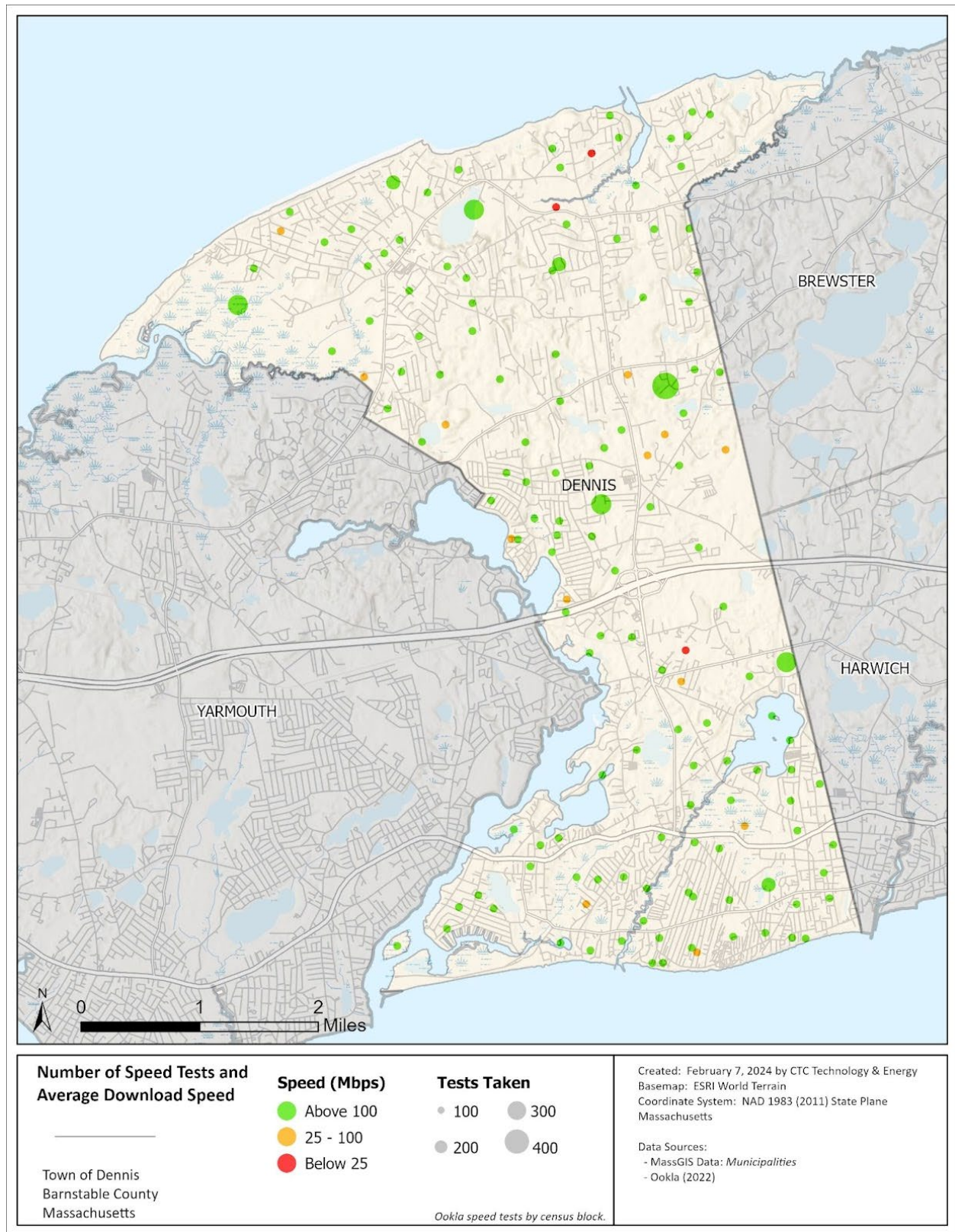**Figure 79: Town of Chatham average fixed download speeds by census block**

Figure 80: Town of Dennis average fixed download speeds by census block

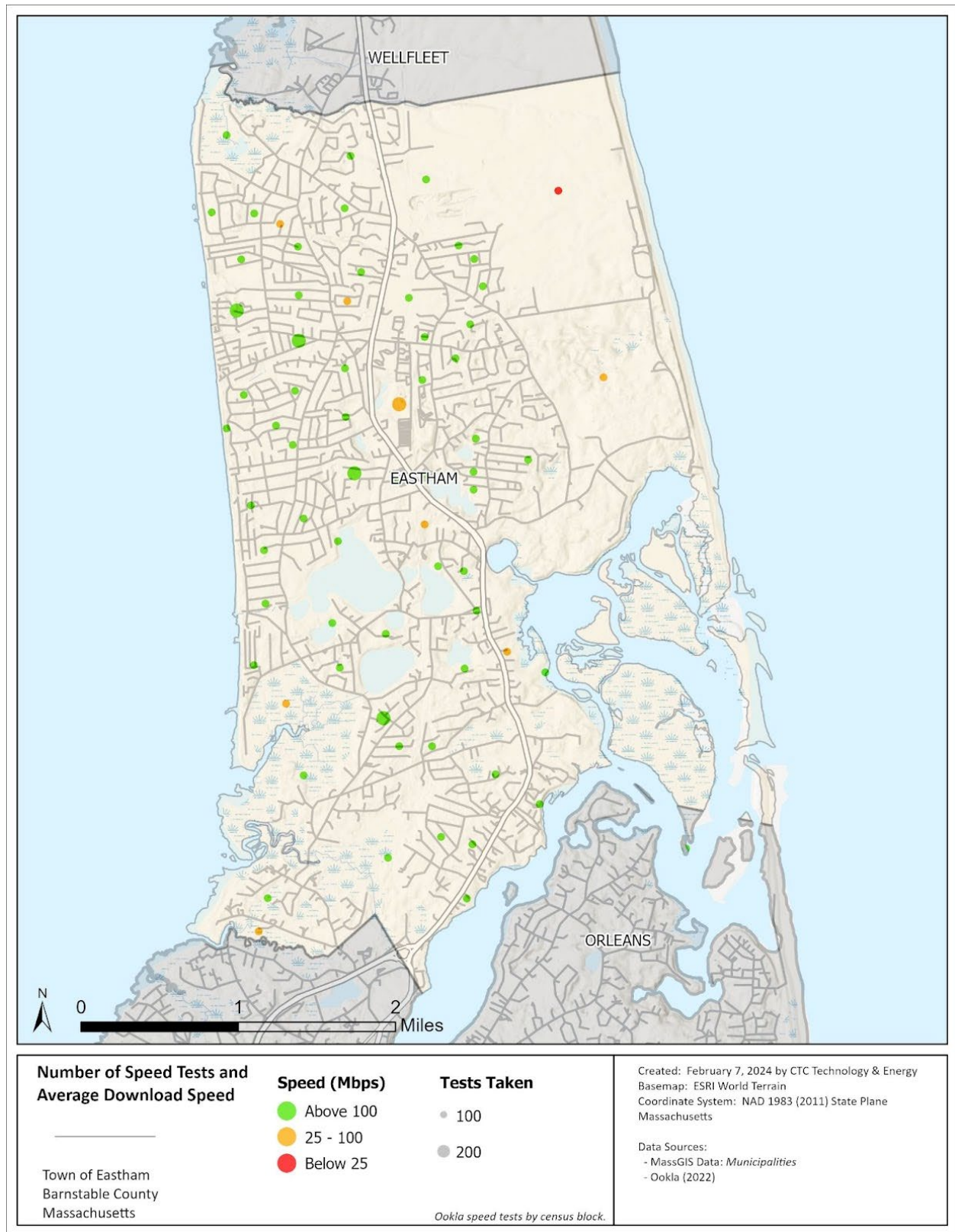**Figure 81: Town of Eastham average fixed download speeds by census block**

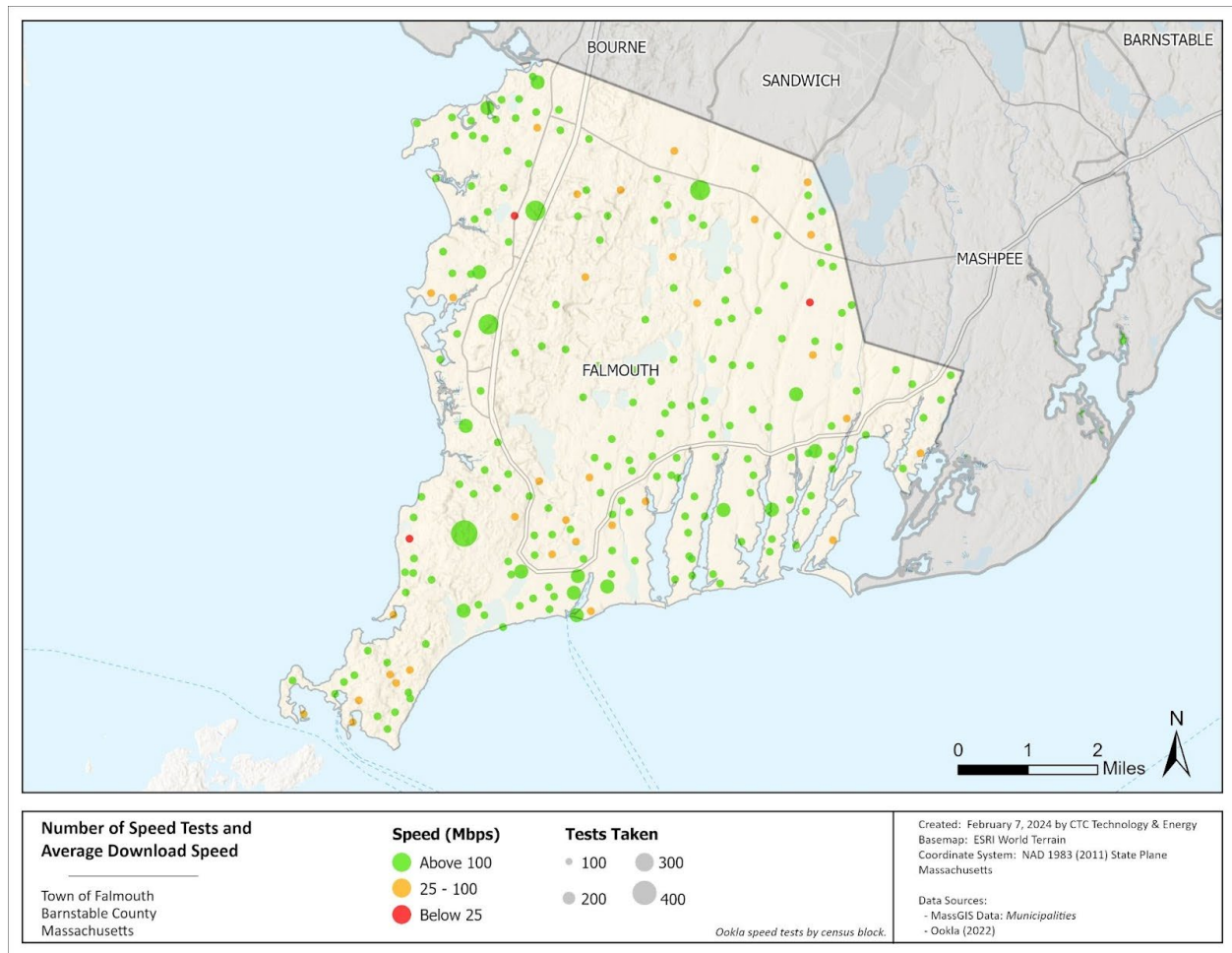**Figure 82: Town of Falmouth average fixed download speeds by census block**

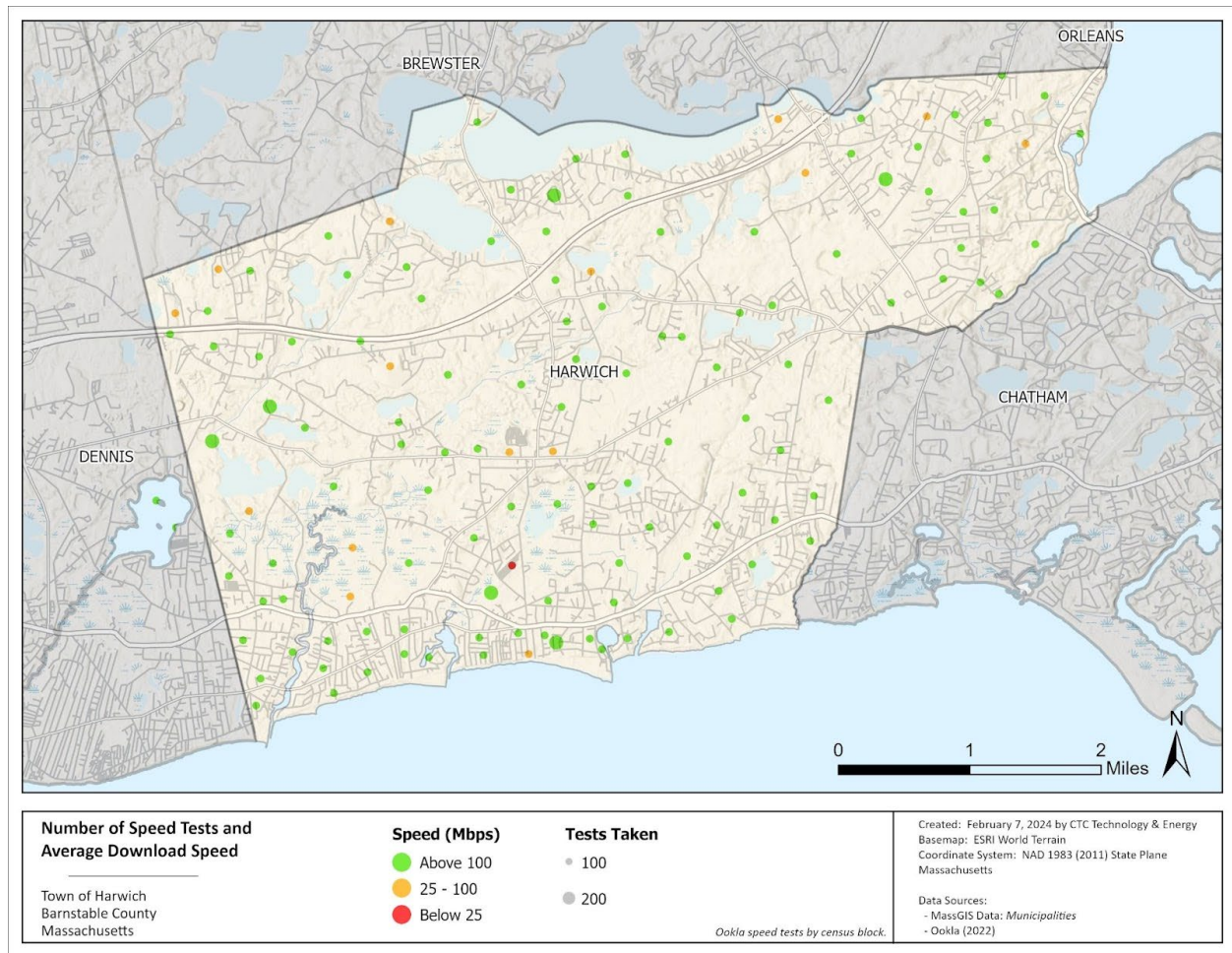**Figure 83: Town of Harwich average fixed download speeds by census block**

Figure 84: Town of Mashpee average fixed download speeds by census block
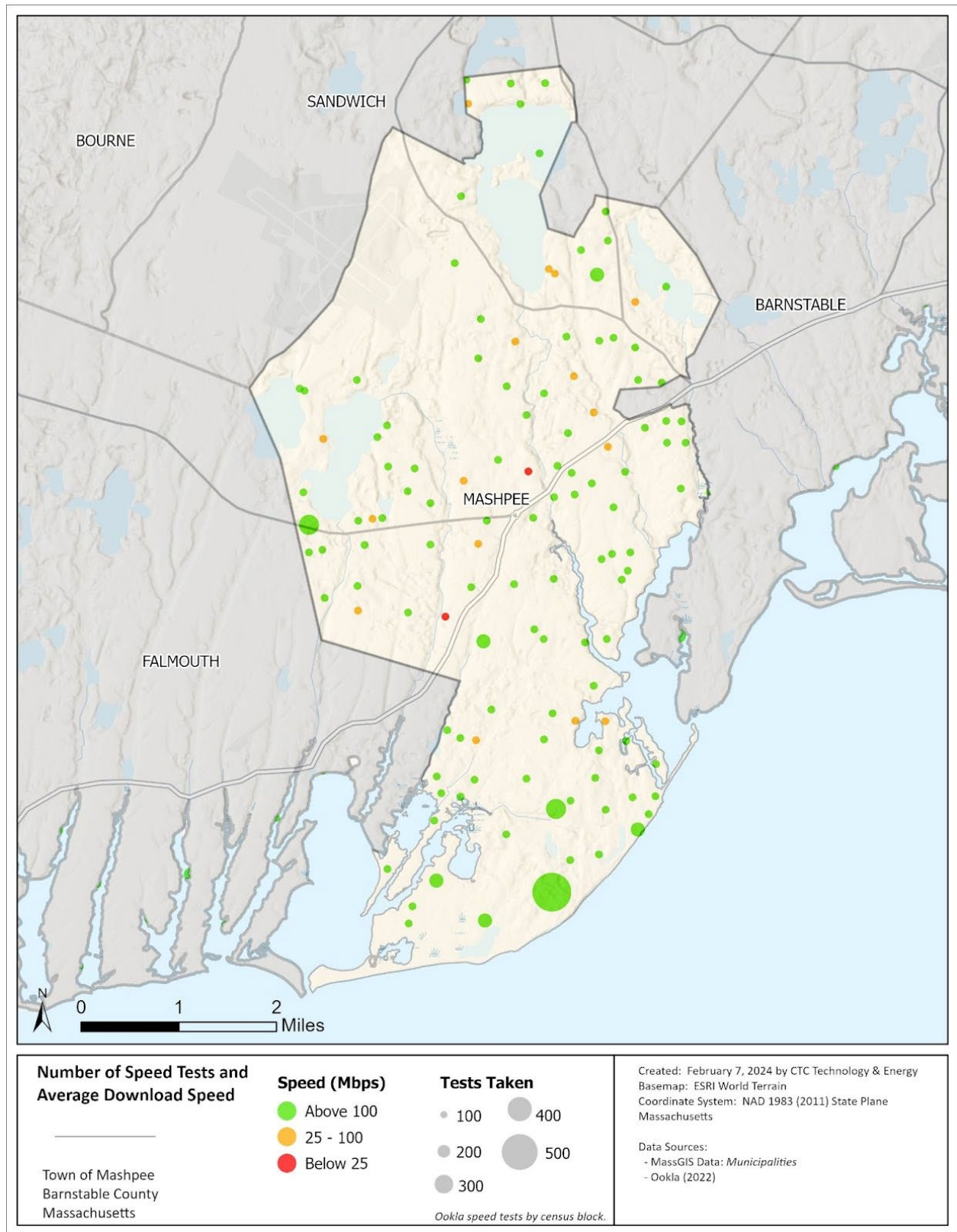
Figure 85: Town of Orleans average fixed download speeds by census block
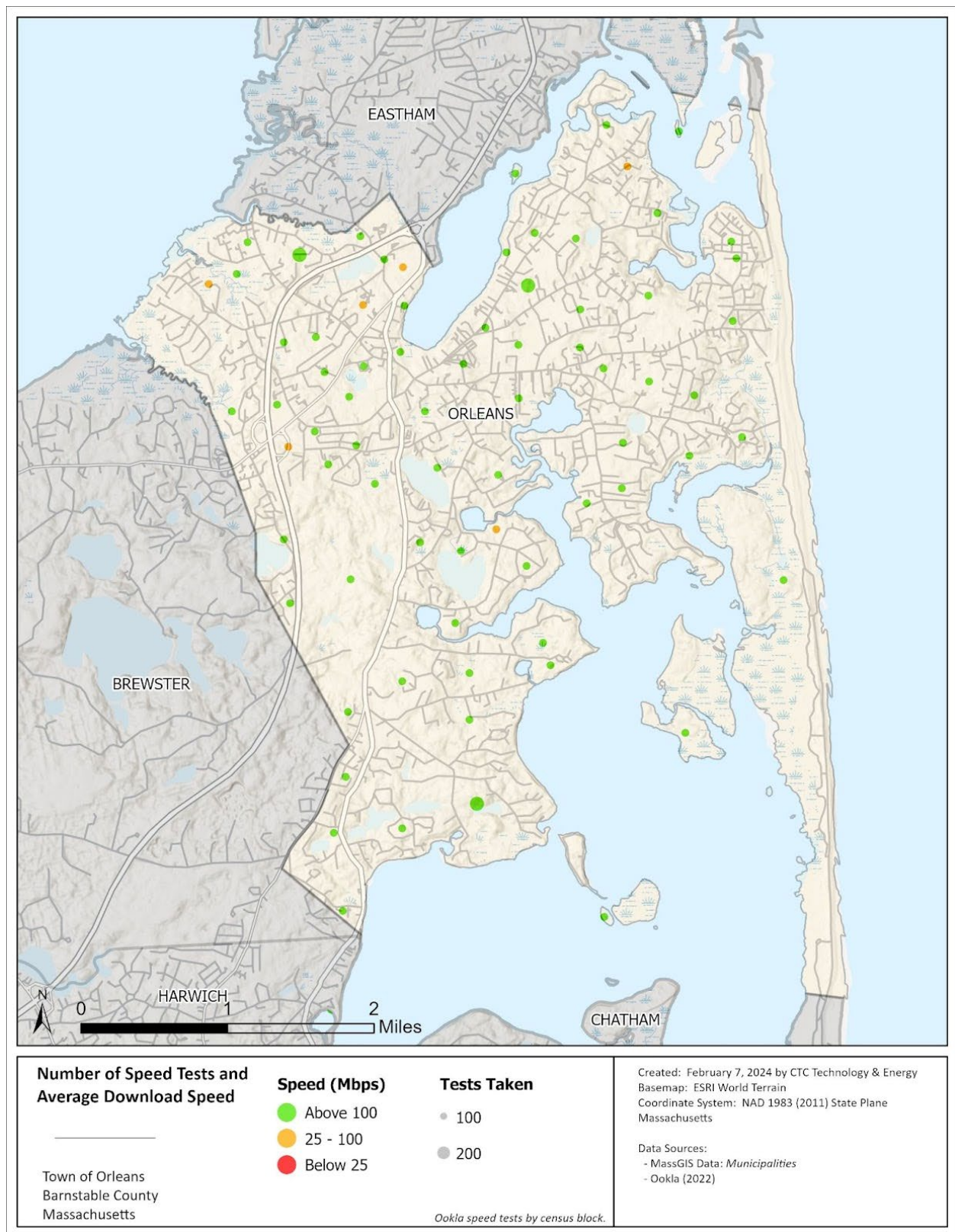
Figure 86: Town of Provincetown average fixed download speeds by census block
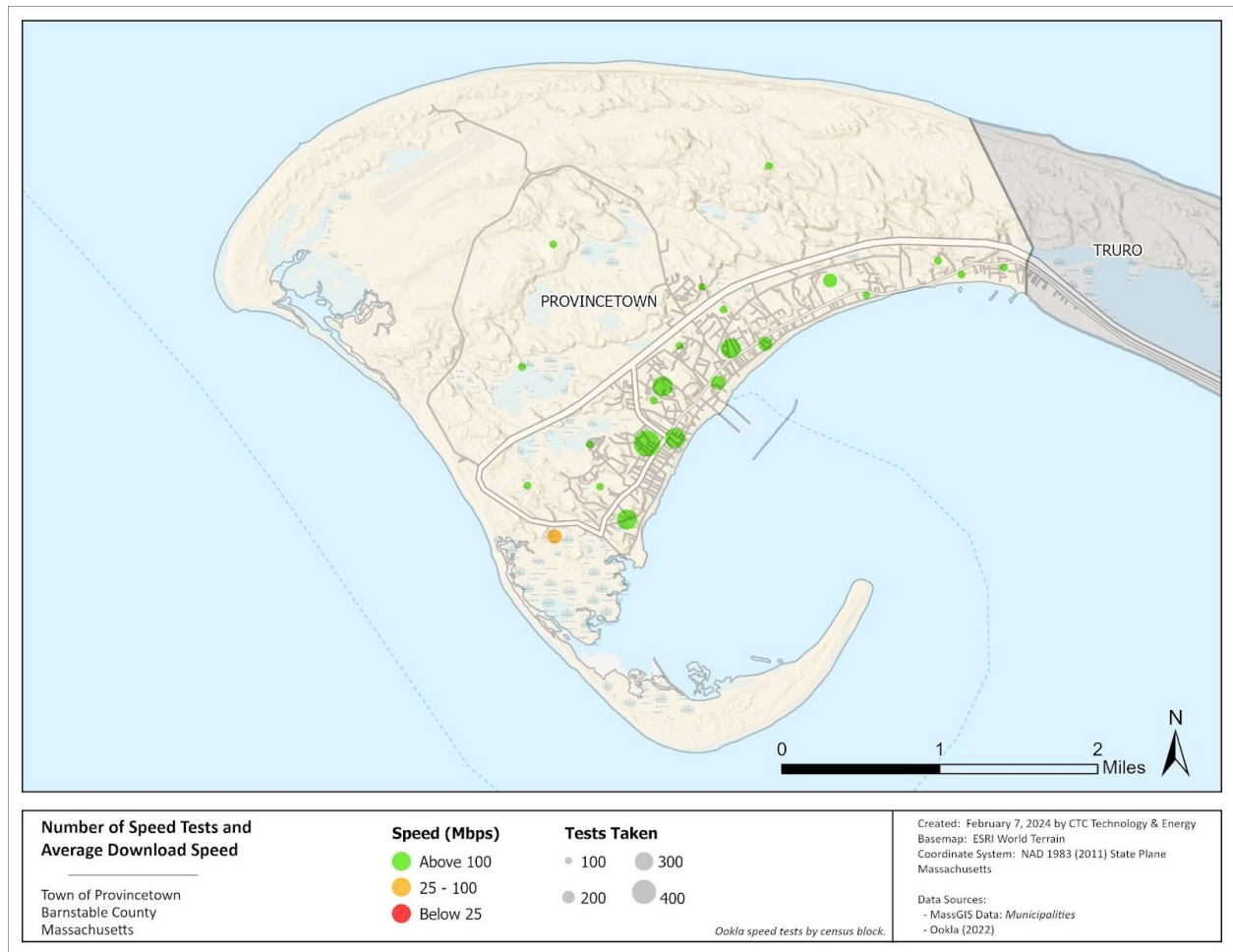
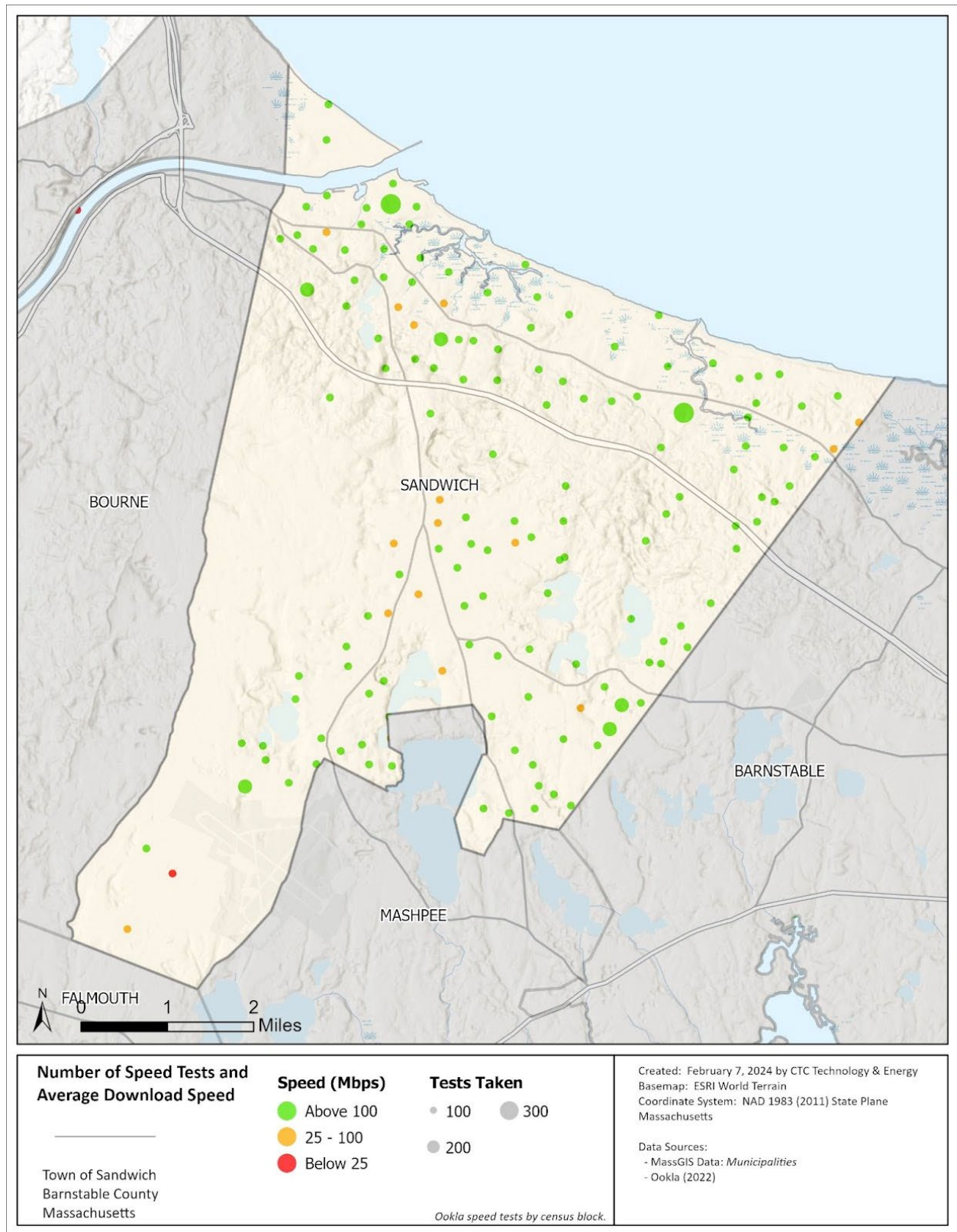**Figure 87: Town of Sandwich average fixed download speeds by census block**

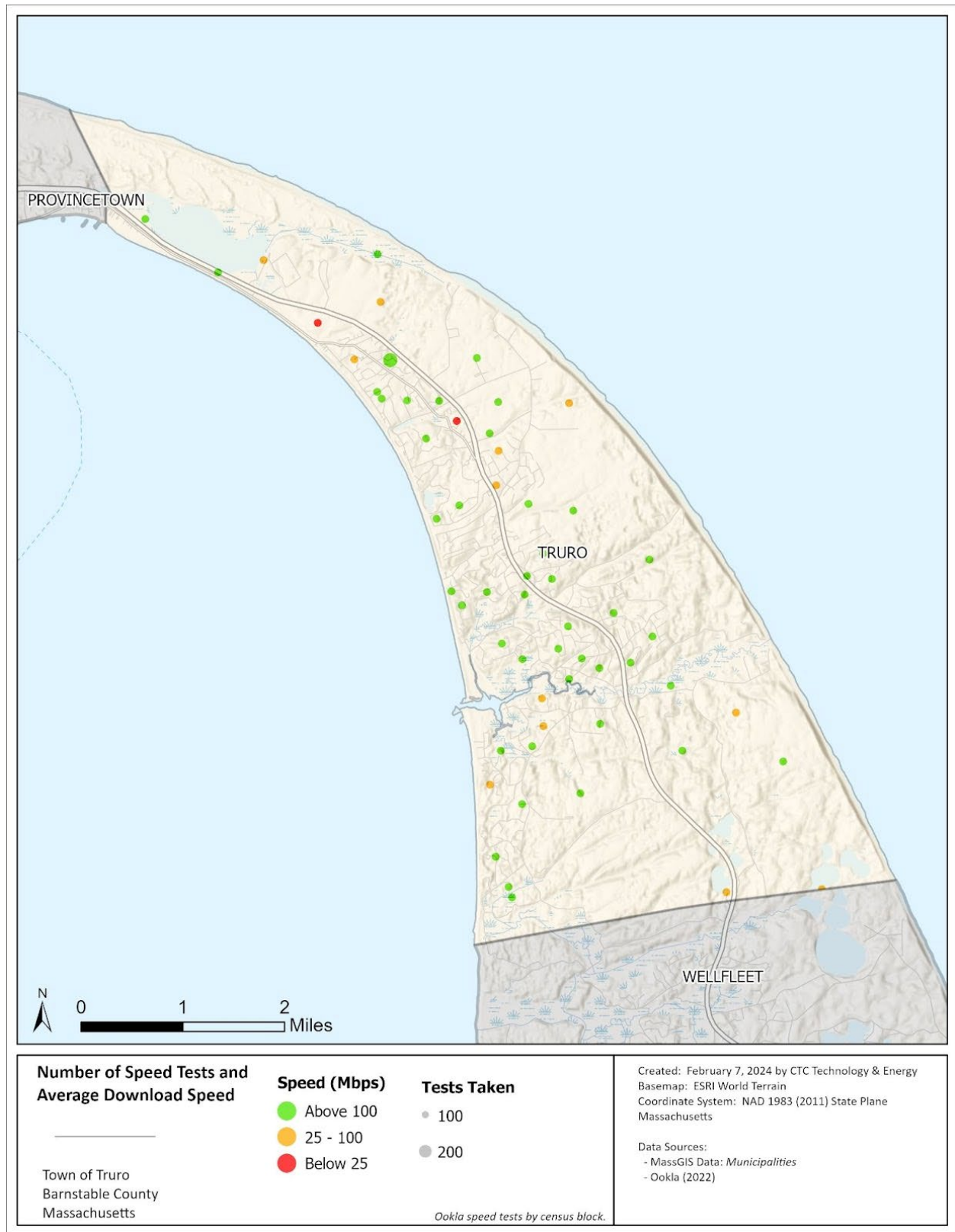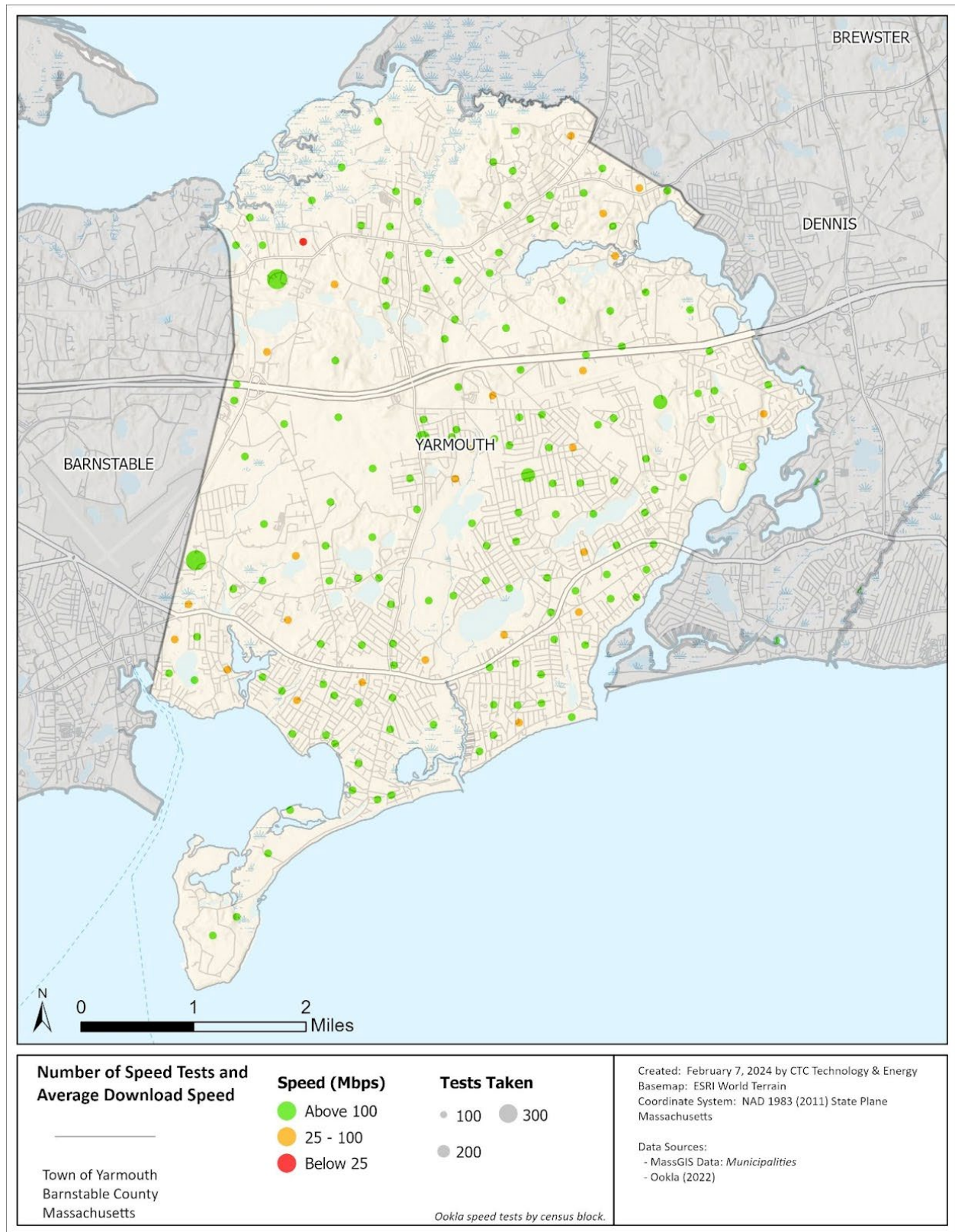**Figure 88: Town of Truro average fixed download speeds by census block**

Figure 89: Town of Yarmouth average fixed download speeds by census block

Appendix E: Broadband activities by Town

Town	Year	Activity
Barnstable	2023	Use of Community Development Block Grant (CDBG) funds for OpenCape Corporation Hyannis Downtown Broadband Initiative.	$297,000
Barnstable	2024	Contracted with Cape Cod Commission to develop a Digital Equity Plan.
Bourne	2022	Awarded Municipal Fiber Grant from MBI which expanded OpenCape fiber optic network to Buzzards Bay Main Street businesses.	$250,000
Bourne	2023	Reactivated and expanded charge to Bourne Cable, Internet and Telecommunications Advisory Committee.
Brewster	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network	$194,109
Chatham	2019	The Chatham 365 Task Force identified the need to strengthen the town's high-speed internet connectivity to maintain and attract remote businesses and workers.
Dennis	2022	Awarded Municipal Fiber Grant from MBI for replacement of the town's current fiber optic municipal area network.	$250,000
Eastham	2020	Five outer Cape Towns - Provincetown, Truro, Wellfleet, Eastham, and Orleans - jointly negotiated the latest 10-year contract with Comcast in 2020. Language updated the homes per mile requiring service from 25 to 15. The intent was to expand access to broadband, as well as cable.
Eastham	2020	The marketing and project study for the T-Time property included several references to high-speed internet availability as being key infrastructure that was not reliable. The current quality of service was viewed as a barrier to commercial development, and the project was identified as a possible opportunity to make broadband investments.
Eastham	2023	Awarded Municipal Fiber Grant from MBI to add T-Time Property and the Town Center Plaza Project to the Town's network.	$78,000
Falmouth	2018-Present	Falmouth residents have actively pursued options, forming private and public organizations to advocate (FalmouthNet.org) and pursue (Falmouth Municipal Light

Town	Year	Activity
		Board) a competitive broadband market. Efforts of the MLP are associated with the Town, as authorized by Town Meeting, but remains a separate political and governmental entity. As discussed elsewhere, the town and MLP are currently in discussions with private firms with the intent to bring broadband competition/choice to residents.
Falmouth	2019	The OpenCape Main Street Gigabit Project, offered through the Falmouth Economic Development Industrial Corporation and funded through MassDevelopment, provided free installation for up to 50 businesses.
Falmouth	2024	Contracted with Cape Cod Commission to develop a Digital Equity Plan.
Falmouth	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network | $203,458
Harwich	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network | $194,107
Mashpee	2022	Awarded Municipal Fiber Grant from MBI for connection of additional town owned assets to the OpenCape fiber network. | $231,969
Orleans	2020	Five outer Cape Towns - Provincetown, Truro, Wellfleet, Eastham, and Orleans - jointly negotiated the latest 10-year contract with Comcast in 2020. Language updated the homes per mile requiring service from 25 to 15. The intent was to expand access to broadband, as well as cable.
Orleans	2020	An ad hoc broadband committee researched broadband availability, options, costs, conducted provider interviews and a business and resident survey. The committee reported its findings and recommendations to the select board in October 2022.
Orleans	2023	Contracted with Cape Cod Commission to develop a Digital Equity Plan.
Orleans	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network | $250,000

Town	Year	Activity
Provincetown	2016	Awarded a Community Compact Grant and produced "Broadband Best Practice," prepared by Office of Municipal & School Technology, OTSS, which used a CrowdFiber Campaign to gage the interest of visitors and residents to improve access of high-speed internet throughout the town. OpenCape was a partner.
Provincetown	2020	Five outer Cape Towns - Provincetown, Truro, Wellfleet, Eastham, and Orleans - jointly negotiated the latest 10-year contract with Comcast in 2020. Language updated the homes per mile requiring service from 25 to 15. The intent was to expand access to broadband, as well as cable.
Provincetown	2020	Funds included in Massachusetts IT Bond Bill to expand OpenCape Main Street Initiative to Provincetown and Chatham, "backbone" extensions in Wellfleet, Truro and Eastham and outreach in Falmouth. Funding has yet to be released.	$1,700,000
Provincetown	2021	Continued meetings with OpenCape with a potential to apply for a Community Compact Grant to bring new provider to Provincetown commercial area.
Provincetown	2022	Awarded Municipal Fiber Grant from MBI for expansion of the town's municipal airport fiber optic infrastructure.	$250,000
Sandwich	2023	Contracted with Cape Cod Commission to develop a Digital Equity Plan.
Sandwich	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network	$238,653
Truro	2020	Five outer Cape Towns - Provincetown, Truro, Wellfleet, Eastham, and Orleans - jointly negotiated the latest 10-year contract with Comcast in 2020. Language updated the homes per mile requiring service from 25 to 15. The intent was to expand access to broadband, as well as cable.
Truro	2010	The Truro Cable Advisory Committee drafted a Broadband Availability Report, which included a street-by-street analysis of service availability. A "strand map" of existing coverage from Comcast was also provided.

Town	Year	Activity
Truro	2023	Truro Cable and Internet Advisory Committee (renamed in 2011) issued a "Cable and Internet Access Survey" to assist the committee in future planning and grant funding possibilities.
Truro	2024	Select Board has since 2021 identified a "Broadband Needs Assessment" for Truro as a priority. Pending completion of this County-wide needs assessment, the town may choose to use ARPA funding to further that work in 2024.
Truro	2024	Awarded Municipal Fiber Grant to connect various municipal facilities to the existing municipal fiber network | $250,000
Wellfleet	2020	Expanded the scope and charge of the Cable Internet and Cellular Service Advisory Committee.
Wellfleet	2020	Five outer Cape Towns - Provincetown, Truro, Wellfleet, Eastham, and Orleans - jointly negotiated the latest 10-year contract with Comcast in 2020. Language updated the homes per mile requiring service from 25 to 15. The intent was to expand access to broadband, as well as cable.
Wellfleet	2021	Funds in state Economic Recovery Bond Bill for three utility companies to make poles ready for high-speed internet. Funding has yet to be released. | $200,000
Wellfleet	2023	Awarded Municipal Fiber Grant from MBI for extension of municipal fiber network to cover currently unserved beach zones. | $200,000
Yarmouth	2019	Contracted with CTC to perform an "Analysis of Business Data in Yarmouth" to help identify the potential broadband needs of Yarmouth businesses.
Yarmouth	2021	Broadband identified among the issues in Yarmouth Visioning process, noting lack of reliable access and competition, and a vision to increase the desirability of the area through improved access.
Yarmouth	2024	Awarded Municipal Fiber Grant to replace Yarmouth's outdated and failing iNet infrastructure| $236,151