DECEMBER 6, 2022

Broadband Feasibility Study
Southern Chester County

Magellan ADVISORS

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Executive Summary

Magellan Advisors was selected by an Evaluation Committee of community stakeholders, led by the Chester County Intermediate Unit (CCIU), to conduct a comprehensive broadband market analysis to examine the level of broadband coverage and the relevant market characteristics including social and economic barriers across the communities served by four school districts in the southern portion of the county: Kennett Consolidated, Oxford Area, Avon Grove, Unionville-Chadds Ford. The study was funded by a grant from the Pennsylvania Department of Labor and Industry through the Chester County Department of Community Development.

These four school districts are located in some of the most rural, economically distressed regions of Chester County, if not the entire state of Pennsylvania, where the quality of life of its residents is negatively impacted by the lack of robust, high-speed broadband access.

Based on the geographic and socio-economic realities facing students and their families who live in the communities served by these four school districts, Chester County stakeholders chose to pursue a data-driven approach to determine the availability of reliable broadband access services in their region.

The data collected and the subsequent analysis performed by Magellan provides useful insights into the existing level of coverage and speeds based on community input and survey data. This study underscores the importance of making sure residents, businesses, and institutions throughout the footprint of these school districts have access to affordable and reliable high-speed broadband service regardless of income, language barriers or rurality.

Overview of the broadband coverage survey

Magellan's broadband coverage analysis is based on the collection of broadband user experience survey data provided by local residential, business, agricultural and anchor institution customers throughout the four school districts. The experience of every community member regardless of geography and income must be included in its analysis to ensure the results are as inclusive and comprehensive as possible.

The broadband coverage and adoption survey is part of a larger examination of the actual level of broadband coverage and availability currently experienced by families, businesses and anchor institutions (healthcare providers, community-based organizations, farms, law enforcement and local government entities).

The results of this survey can be used to guide local, County, State and National leaders and interested stakeholders in determining how best to expand affordable and reliable broadband access to underserved communities in rural Southeastern Pennsylvania.

In early March of 2022, the Southern Chester County stakeholders distributed a broadband coverage and adoption survey (in both English and Spanish) to families, township officials, and businesses including farms and nonprofit organizations throughout the four school districts.

Over 1,000 respondents completed the broadband coverage survey, and their results were geocoded and added to a geospatial map to illustrate where the gaps in broadband coverage exist throughout the region. The survey results indicate several areas where broadband service is insufficient, causing economic and social dislocation to families and businesses. The survey results were also examined within the context of federal socio-economic data pertaining to poverty levels in each township and borough. Magellan's broadband feasibility analysis included the following core workstreams that contributed to the key findings and conclusions of this study.

- **Stakeholder engagement:** In partnership with the CCIU and local broadband digital literacy advocates from the Southern Chester County Opportunity Network, Magellan had the opportunity to conduct the extensive stakeholder outreach performed for this study. Magellan conducted interviews with over 40 individual organizations, institutions and businesses including local townships, and county and state officials to gather input about their broadband usage and connectivity needs.
- **Broadband coverage and user experience survey**: Magellan developed its survey in both English and Spanish and the Southern Chester County stakeholders distributed it widely to residents and businesses throughout the region to identify areas where coverage is insufficient. Data collected from the survey served as the baseline for the level of coverage available in the region. Survey results were then compared with advertised coverage purported by commercial providers and federal agencies, such as the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC).
- **Boots on the ground field validation:** Survey findings were further analyzed by Magellan's field team who conducted field validation of a sampling of addresses in each school district. These addresses were located where survey respondents reported little to no coverage and where school district technology directors suggested field validations occur.

- **Market analysis:** Magellan evaluated the current market conditions for expanding broadband service and coverage, including barriers facing communities throughout Southern Chester County. This segment includes a deep evaluation of provider websites, advertising materials and other publicly available materials from the industry.
- **High-level network options and cost analysis:** Magellan identified the associated network construction and deployment costs to meet the coverage needs and requirements and developed a conceptual design of a fixed wireless last mile network to serve core areas of need identified in this study.
- **Recommendations, funding opportunities and next steps:** Based on the evidence collected from end user surveys, stakeholder input, local broadband market analysis and broadband mapping data, the recommended next steps towards the end of this study should serve as a roadmap for local leaders in the region to pursue various strategies to improve broadband access and adoption among residential and business customers.

This study also includes recommendations regarding various state and federal funding opportunities that can support projects that deploy cost-effective broadband networks in unserved areas throughout the four school districts.

KEY FINDINGS:

- Poverty and the lack of affordability are significant barriers to families in the region. The average monthly bill for residential broadband service is $111.36 per month and the average cellular phone bill of $172. These costs make mobile and fixed broadband out of reach for most residents.
- Participation rates in the Affordable Connectivity Program (ACP) are low, despite the fact that most consumers in the region are eligible. According to the FCC's ACP participation data collected from January – May 2022,[1] only 3,160 qualified low-income consumers are receiving the benefit and 29 consumers are claiming the benefit for eligible devices across all of Chester County.
- FCC and NTIA broadband mapping data shows the entire area as being well served with over 100Mbps download. However, these maps contrast with survey results and consumer feedback collected by Magellan outlined in this study.
- Several middle-mile and long-haul fiber facilities are present throughout Southern Chester County which can be leveraged by any last-mile provider to

[1] ACP-Households-and-Claims-by-County-January-May-2022.xlsx (live.com)

offer competitive offerings to end users. However, last-mile broadband infrastructure (connectivity to the end user) remains the core challenge for the region. Most large incumbent broadband providers who serve the region have some infrastructure present in residential areas as noted by Magellan's field team. Yet, the majority of low-income households and mushroom farms remain unserved with affordable and reliable last-mile infrastructure.

- To achieve 100% last-mile broadband coverage to the entire region, Magellan recommends a fixed wireless network design that would provide connectivity to residential consumers and mushroom farms. This technology approach would be less costly, more reliable and faster to deploy than any other technology platform (fiber, cable and satellite). Tower facilities are located throughout the region and could be leveraged to provide coverage to all of Southern Chester County.
- It is strongly recommended that local leaders establish a governance structure to pursue broadband grant opportunities at the state level with public or private partners. The data in this study provides a basis for building a network in the southern portion of the county.

WHY AFFORDABLE AND RELIABLE BROADBAND MATTERS TO FAMILIES AND BUSINESSES IN SOUTHERN CHESTER COUNTY

Like electricity in the 1930s, broadband is an essential utility and vital to the economic growth and survival of rural, agriculturally based communities throughout Pennsylvania. Rural households and businesses throughout Southern Chester County continue to struggle with inadequate bandwidth, costly service plans and spotty coverage. Due to the demographics of the region, a significant percentage of low-income residents live in sparsely populated areas. Yet, incumbent broadband providers have not demonstrated a willingness to invest in network upgrades given the low average revenue per user (ARPU) generated by consumers in these areas.

Despite the availability of federal broadband subsidies over the last 20 years to offset fiber last-mile deployment costs of incumbent wireline providers in underserved communities, the lack of adequate broadband service remains unchanged in these communities.

ACTION IS NEEDED

In the absence of action, rural households and businesses throughout Southern Chester County continue to endure extraordinary social and economic hardship due to the lack of reliable and/or affordable broadband connectivity. The situation was made worse during the COVID-19 pandemic when telework, distance learning, telehealth and public safety services were out of reach for most households in these remote communities.

This socio-economic deficit must be brought to the attention of state and federal officials who are preparing to allocate federal Infrastructure Act funds statewide to help rural Pennsylvania communities transform their local communities with affordable high-speed broadband network facilities.

Magellan encourages local leadership to continue to make inroads with officials in Harrisburg and in Washington, D.C. to ensure it is not left behind in the distribution of Infrastructure Act funds as well as all other federal funding opportunities distributed at the local, county and state level.

Magellan applauds the County for supporting steps toward evaluating broadband projects in the Request for Proposals issued in late February 2022 soliciting potential broadband projects for funding using a portion of the County's American Rescue Plan Act (ARPA) allocation. Applications were due March 16 and awards are expected to be announced summer of 2022.[2]

IDENTIFYING THE LEVEL OF NEED IN THE REGION

The townships and boroughs throughout Southern Chester County are some of the most rural and ethnically diverse communities in the entire state of Pennsylvania. The nation's supply of mushrooms is produced in Kennett, Avondale, West Grove, Landenberg and portions of Oxford. The mushroom industry is the backbone of the region's economy and a vital part of the state's agricultural leadership in value added crop production. Southern Chester County is the nation's largest producer of mushrooms and requires year-round labor to support the demand for mushroom production.

Migrant farm workers from Mexico, Guatemala and El Salvador have come to this region to work on mushroom farms year-round, ultimately becoming permanent

[2] American Rescue Plan Act (ARPA) | Chester County, PA - Official Website (chesco.org)

residents. However, most migrant families remain in chronic poverty and have little to no English proficiency or basic reading skills. Most do not own a computer and only use their cell phone for internet access.

Below is a socio-economic summary of the challenges facing residential households in this region.

Widespread poverty and food insecurity throughout the four school districts

The prevalence of persistent poverty and food insecurity among Hispanic migrant farm workers is well known and directly correlated with low broadband adoption and computer usage in the region. Over 22%[3]of Oxford families live below the federal poverty rate vs. 6.9%[4] for the rest of Chester County. Poverty in Avondale is 43%[5] with over 35.4%[6] without health insurance coverage. These percentages are staggering and underscore the economic hardship experienced by residential consumers in these communities.

According to numerous interviews with community advocates and case workers who work closely with the migrant farm worker community, over 400 families visit local food banks in Oxford, Kennett and West Grove each week. Monthly costs for broadband are simply out of reach for most low-income families.

Inadequate fixed and mobile broadband coverage on mushroom farms

Residents and businesses in Kennett, Avondale, Oxford, Landenberg, New Garden, Avon Grove, West Grove, Nottingham and East Marlborough also indicated that both cell and fixed broadband coverage is spotty and unreliable. During an in-person field visit in April 2022 to several farming operations along Kaolin Road in Kennett Square, less than one bar of cell coverage was available both in farm offices as well as outside the farm facilities near farm entrances.

During in person meetings with mushroom farm owners from Kennett, Avondale, Oxford and West Grove hosted by the American Mushroom Institute (AMI), all indicated they had minimal broadband coverage and experienced frequent internet service outages in their home and in their farm office.

[3] 22.0% Poverty Rate in Oxford borough, Pennsylvania (welfareinfo.org)

[4] [1] 6.9% Poverty Rate in Chester County, Pennsylvania (welfareinfo.org)

[5] Demographic Data (chescoplanning.org)

[6] [1] DP03: SELECTED ECONOMIC... - Census Bureau Table

The lack of reliable and robust connectivity on these farms became a health risk during the pandemic where remote access to health care and mental health counseling was unattainable.

Lack of fixed and mobile broadband access in the home and its impact on remote learning

Most school age children from farm worker families have no broadband access in their residential premises needed to complete homework assignments and engage in remote learning on a desktop or laptop computer. Instead, like most farming communities in the U.S., school children complete schoolwork on their mobile phone by creating a mobile hotspot that they either pay for or through a hot spot device provided by their school.

These and many other socioeconomic factors contribute to the unique and persistent challenges facing the region in attaining affordable, high quality broadband coverage in their home and at their place of employment.

Many of the meetings were organized by local broadband and digital literacy and inclusion advocates, who committed their personal time in connecting Magellan's team with many of the stakeholders listed below. The next section documents the qualitative research performed by Magellan's project team that supplements the mapping and market analysis portions of this study.

Stakeholder Engagement

EXECUTIVE OVERVIEW

Magellan conducted extensive interviews, in person meetings, focus groups and weekly meetings over a six-month period with over 40 individual residential and business consumers, community leaders, municipal officials, commercial entities, farmers, farm workers, state legislators and local law enforcement officials about their experience with broadband service in their homes and work locations.

Their comments indicate that despite the publicly available federal broadband mapping data and carrier reported advertising that suggests the availability of sufficient fixed and mobile broadband service, communities throughout Southern Chester County attest to a far different reality on the ground. Most local and regional stakeholders uniformly affirm that existing broadband coverage and service is well below the standards advertised and reported by the FCC.

Common themes and key observations from all stakeholder meetings and interviews.

The following themes were shared during interviews and meetings with Magellan Advisors since December 2021 regarding the level of broadband coverage in the region and its impact on local communities across the Oxford Area, Kennett Consolidated, Unionville-Chadds Ford and Avon Grove school districts.

- Southern Chester County residents feel forgotten and excluded from the rest of the County, largely due to poor internet coverage that is exacerbated by economic dislocation, rurality and cultural differences. These residents live in geographically remote communities with low population density and high percentages of persistent poverty. Many of these families also do not speak or read English and most work in the mushroom farming sector year-round.

- The lack of sufficient broadband access in Oxford, Kennett, Avondale, New Garden and Avon Grove has become a major barrier to economic development and investment in these communities. Opportunities to attract high wage, knowledge-based jobs to the region are limited as a result.

- Many families with school age children do not have adequate fixed or mobile broadband connectivity in the home to complete school assignments or to

access health care, job applications, federal benefit enrollment forms, workforce development training or to inquire about municipal or social service resources.

- Affordability is a major barrier for families and school children needing internet access in the home. Most families have no means to afford even the basic service offerings or the resources to purchase a computer for in home use. This challenge is magnified due to a lack of basic computer skills. Many rural low-income family members do not have email addresses. Rather, they mostly use pre-paid cell phones to conduct homework and communicate with their employers and case workers.

- Migrant families from Mexico and Central America are reluctant to discuss household matters such as the quality of broadband access they receive in the home for fear of retribution. Most families who live and work in the region are from cultures where employers and authorities impose punishments on those who speak publicly about quality-of-life concerns like access to electricity, water, affordable housing and broadband services.

- First responders cannot fulfill mission critical activities due to a lack of robust broadband and cellular coverage. Police/Fire/EMS cannot do their jobs and respond to crime events to connect with the Chester County 911 dispatch without sufficient broadband access.

INPUT FROM COMMUNITY-BASED STAKEHOLDERS

Below is a summary of Magellan's outreach to various segments of community-based social service stakeholders who work closely with the most unserved low-income families in the region. The key points raised during in-person and web-based meetings are outlined below.

Southern Chester County School District Technology Directors, December 13, 2021 (Kennett Consolidated, Oxford Area, Avon Grove, Unionville-Chadds Ford school districts)

Magellan conducted weekly meetings with the school district technology directors in all four school districts as well as administrators with the CCIU. Throughout these

weekly meetings, the following themes emerged, which tracked closely with the comments and observations made by almost every other stakeholder.

Most migrant farm worker families struggle with language barriers and literacy challenges. They also lack basic computer skills. Many do not own a computer in the home and their children often use cell phones to download homework assignments.

Affordability is a significant barrier towards adoption. Students in the region struggled during the pandemic due to a lack of affordable and reliable broadband service in their home. Cell phone coverage is also spotty and unreliable but was the only means for accessing school assignments.

The region is extremely rural with an extensive agricultural history. Areas around the Kennett Consolidated School District are remote and have no connectivity. The same is true for areas outside of Oxford, Nottingham, Avondale, West Grove, as well as the areas between Jennersville and Cochranville. These areas are completely unserved and economically distressed.

In person and virtual meetings with the following community stakeholders/social service benefit navigators.

- **Hispanic Health Ministries on January 27, 2022**
- **La Communidad Hispana on January 28 and February 3, 2022**
- **Kennett Area Community Service on April 20, 2022**
- **Oxford Neighborhood Services on April 20, 2022**

Social service workers and public benefits navigators are frustrated by the lack of affordable and reliable broadband in the home. The Kennett Area Community Service agency and the Oxford Neighborhood Services organization indicated that most families in Kennett and Avon Grove have only a cell phone for internet access rather than a computer due to cost and low digital literacy comprehension.

Many low-income migrant community members do not have basic computer skills. Affordability was also raised as a major barrier to adoption. In Oxford, Hispanic low-income students often sit outside of the Wendy's fast food restaurant to do their homework. They simply cannot afford monthly service in their home.

Accessing the internet and knowledge of its use often ranks lower in the priority scale for these families when compared to access to food and housing. Access to affordable transportation is another barrier, leaving families without the ability to receive remote counseling or specialized health care services.

Most of these families live in trailer or mobile homes. Some live on mushroom farms, while others who reside in Avondale or West Grove live in old houses with multiple families living in the same home. Many landlords who rent to migrant workers also want broadband but have not been successful in getting it to their premises.

Each organization listed above suggested that the best way to reach migrant families in the rural portions of each school district, particularly in Oxford, Avondale and Kennett is through case workers who interact with this population frequently. They also indicated that having access to affordable, high-quality broadband is vital for their clients who rely on social service and public benefits which can only be applied for and tracked online and require internet access and a computer to complete enrollment forms and verification documentation for upload.

La Communidad Hispana indicated that the lack of broadband was also a major challenge for their case workers and clients. They could not launch a new patient portal because their clients could not access it in their homes due to not having a computer or adequate broadband services available.

A significant number of migrant families have children with special needs who need remote medical and occupational care and other services to manage their developmental needs. Broadband is essential for these families and was an even bigger struggle during the pandemic.

- **Mighty Writers on January 25 and April 21, 2022**
- **The Garage Community and Youth Center on January 27 and April 21, 2022**

During our in-person and virtual meetings with the directors of both the Mighty Writers and the Garage Community and Youth Center, similar themes concerning the lack of affordability, persistent poverty, language barriers and poor broadband coverage were reiterated.

The areas in and around Landenberg, Avondale and West Grove were reported to have minimal broadband access causing many school age children to fall behind academically since the start of the pandemic. Chronic poverty experienced widely among migrant farm worker families increased the likelihood of having no internet access in their home.

The children who spend their afternoons at both Mighty Writers and the Garage complete homework assignments at their facilities because they have no internet access or a computer in their homes. These children also tend to use Wi-Fi hotspots

through Mi-Fi devices provided by the school district or their cell phone to complete homework assignments at home.

INPUT FROM THE LOCAL MUSHROOM FARMING SECTOR

- **In person meeting with members of the American Mushroom Institute (AMI) on April 21, 2022**

Over 26% of the nation's mushrooms are produced in New Garden township. All mushroom farms need broadband access to improve logistics and manage input costs. Yet, both cellular and fixed broadband coverage is inadequate for most mushroom farms in Southern Chester County. Broadband service goes down frequently which causes disruptions for farms during financial transactions with vendors and customers.

The pandemic created huge challenges for mushroom farm managers who needed to notify workers about vaccines, stay at home orders and testing. Farm workers were solely relying on their employers for COVID information but there was no easy way to notify them. Farm workers need essential information but the only way they get information is through their cell phones, even though signal quality is poor.

INPUT FROM LOCAL TOWNSHIP OFFICIALS (PAST AND PRESENT)

- **Chester County Association of Township Officials (CCATO) on February 1, 2022**
- **Advisory Commission on Latino Affairs (ACOLA), Kennett Borough on January 17, 2022**
- **Office of the Fire Chief, Kennett Township on April 20, 2022**

In our meetings with local township officials, both past and present, the major concern focused on the lack of quality fixed and mobile broadband coverage to support first responders, health care workers and hospitals.

Local township officials also indicated that last mile broadband access is lacking in the region, leaving most rural and economically distressed communities with no options other than to continue with their existing cellular or fixed broadband service provider.

Township officials also noted that cell phone coverage is spotty throughout Kennett, causing major problems for first responders. Firefighters often encounter dead spots on route to or at the scene of an emergency. They also emphasized that paramedics cannot do their jobs properly due to a lack of connectivity.

The lack of affordable access to health care is also a major challenge. There are reports that two big hospitals in Southern Chester County are closing due to financial hardships. Communities throughout the region served by these hospitals must now drive over 40 minutes away to receive emergency care. Telehealth is needed but lacking due to poor internet access.

INPUT FROM LOCAL AND COUNTY ECONOMIC DEVELOPMENT LEADERS

- **Chester County Economic Development Council (CCEDC) on December 22, 2021 and January 11, 2022**
- **Chester County Planning Commission on January 11, 2022**
- **Southern Chester County Chamber of Commerce on January 17, 2022**

These officials reiterated a common theme: Southern Chester County is struggling economically and compared it to "the last frontier." The region simply cannot grow economically without access to affordable broadband.

These officials also indicated that Oxford Area and Avon Grove are the top two school districts that are in dire need of help from the county or state agencies due to their income status, low English proficiency and a lack of stable housing. Most families have no ability to drive to where they can get access because they do not own a car or have sufficient resources to purchase alternative forms of transportation. Broadband is vital for these communities to survive.

INPUT FROM BROADBAND INDUSTRY STAKEHOLDERS

- **Comcast on December 14, 2021**
- **Upward Broadband on December 30, 2021**
- **Chesconet on January 4, 2022**
- **Armstrong on January 6, 2022**
- **Crown Castle on January 7, 2022**
- **Verizon on March 2, 2022**

Middle mile fiber access is more available throughout Southern Chester County than last mile services to end users. Some of the existing providers suggested that additional public investments were needed to offset the costs of deploying fiber to the home in the more remote areas, but none provided any information to Magellan about their future deployment and or investment plans in the region.

More consumers subscribe to cable video services than a video/data bundled package due to cost. Local fixed wireless offerings are available and may be expanding but will take time to reach across the entire region and require additional capital and tower and backhaul access which can be costly.

Crown Castle owns and operates a significant amount of middle mile fiber facilities in the region that provide connectivity to multiple county agencies, schools, libraries and other public facilities. Their fiber assets could be leveraged in some meaningful way to help increase competition for last mile services.

Magellan requested information from all internet service providers (ISP) regarding the location and availability of their current infrastructure and offerings. Crown Castle was the only ISP that shared this data.

INPUT FROM STATE LEGISLATIVE AND AGENCY OFFICIALS

- **Pennsylvania Department of Agriculture on January 22, 2022**

Broadband is needed on farms across Pennsylvania. The Pennsylvania Department of Agriculture understands the needs of mushroom farms and the economic benefits it generates for the state. Pennsylvania is the largest organic producer of produce on the east coast. This market cannot be accessed without broadband.

Farm worker mental health is another major priority for the state. Telehealth is critical to this effort but there is a lack of affordable broadband throughout the state to provide these services remotely.

Magellan also visited with the following officials in Chester County and the state regarding this study and the broadband needs in the region.

- **Chester County Board of Commissioners**
- **Chester County Department of Human Services**
- **Chester County Library System**
- **Pennsylvania Public Utilities Commission**
- **Office of State Senator John Kane**

Broadband Coverage Survey

Magellan Advisors administered a broadband coverage survey to residents and businesses throughout the four school districts selected for this study: Kennett Consolidated, Unionville-Chadds Ford, Avon Grove and Oxford Area. Magellan worked closely with the technology directors for all four school districts to ensure their students and families were provided with the survey and instructions for completion. (Appendix 5)

Awareness about the importance of this survey was raised widely throughout each community in the four school districts. Advocates from Southern Chester County Opportunity Network helped improve the quality of the survey data collected by connecting Magellan to several local community support organizations such as the Garage Community and Youth Center, Mighty Writers and La Communidad Hispana who shared the survey with their case workers who interact directly with low-income families both in the field and at their facility.

The survey was also widely distributed by the American Mushroom Institute (AMI) who sent the survey to its membership, and to all the community stakeholders identified in the stakeholder engagement and outreach section of this study.

Magellan also participated in a virtual meeting with the Chester County Association of Township Officials (CCATO) to raise awareness about the survey among township managers. Magellan also consulted at length about the survey with library officials in Oxford, at the county level and with local law enforcement leaders.

The survey was provided to the public to complete either online or in paper form and was available in both English and Spanish. Magellan kept the survey open from February through May 13, 2022. Magellan also used community translators to assure the Spanish communication was colloquial and at the level of the client comprehension.

ANALYSIS OF BROADBAND SURVEY RESULTS FOR SOUTHERN CHESTER COUNTY

The final results of the survey are as follows: over 1,310 residential surveys were taken and over 1,064 completed the survey correctly. There were over 246 invalid or partial results that could not be counted toward the final total. Roughly 77% of all survey respondents completed the English version of the survey whereas less than 6.4% of respondents took the survey in Spanish.

The table below illustrates the final breakdown of respondents who completed the survey correctly as well as those who took the survey in English and Spanish.

Table 1 - Final Broadband Survey Results Summary

Final Broadband Survey Results		
Total Surveys Taken	1,310	100%
Valid-Complete	753	57.48%
Valid-Partial	311	23.74%
Total Valid	**1,064**	**81.22%**
Invalid/Test/Dups	246	18.78%
Valid Surveys by Language Type		
English	818	76.88%
Spanish	68	6.39%
School District Provided Data	178	16.73%

Percentage breakdown of survey respondents by school district

Below is the breakdown of all survey respondents by school district. As stated earlier, the technology directors for each school district (Avon Grove, Kennett Consolidated, Unionville-Chadds Ford and Oxford Area) were instrumental in getting this survey distributed throughout their entire school district and surrounding communities.

The results in the table below underscore the engagement of all four technology directors that helped increase survey participation. These results also validate the concerns among the technology directors regarding the lack of qualified broadband access in their communities as evidenced by the level of interest in this topic.

Table 2 – Broadband Survey Respondents Breakdown by School District

School District	Count	Percentage of total respondents
Avon Grove	**410**	**38.53%**
Kennett Consolidated	**232**	**21.80%**
Oxford Area	**125**	**11.75%**
Unionville-Chadds Ford	**174**	**16.35%**

Cultural and language barriers facing the sample population

Due to the cultural and language barriers facing many families in Southern Chester County, Magellan encountered some resistance from non-English speaking survey respondents regarding the use and purpose of the survey itself. Language barriers caused some challenges in getting the survey completed among farm workers who either do not speak English or in many cases, do not speak Spanish.

Most families who reside within the four school districts are either of Mexican or Central American descent (Guatemalan), where Spanish is not spoken. Farm worker families from Guatemala only speak local dialects that are dissimilar to Spanish. Therefore, many survey respondents were somewhat dependent on a caseworker or family member to help translate the survey and explain each question.

Migrant farm workers throughout the region also come from cultures where it is not customary to provide information about activity in the home – even if it is regarding

a third-party service like broadband – to outside entities. A general lack of trust exists toward anyone seeking information about their personal experiences in the home.

Magellan also encountered some reluctance among mushroom farm owners and managers to provide farm worker housing data for broadband mapping purposes. Regardless of these challenges, Magellan, in partnership with the CCIU, local volunteers, the Southern Chester County Chamber of Commerce, the American Mushroom Institute and several community-based organizations, was able to obtain a robust sample size of surveys for this study.

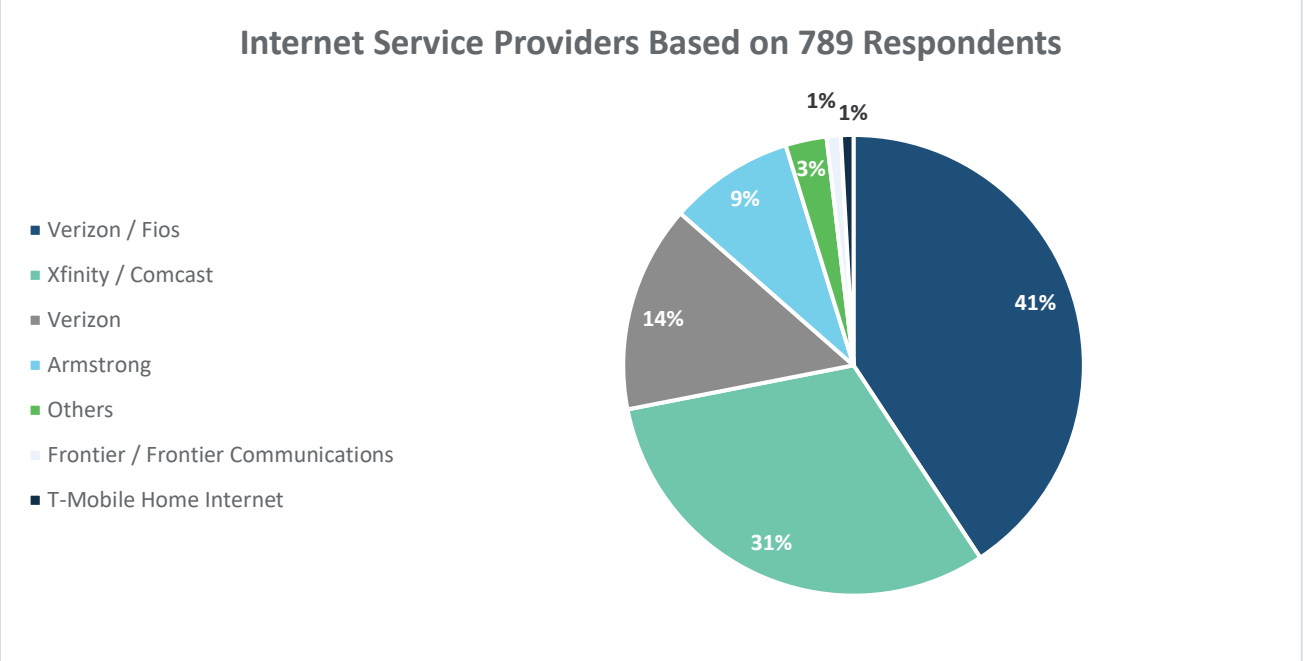
We learned that any future surveys would get a more robust response if they were administered in the field and managed by field representatives who can visit with respondents in person and discuss each question to obtain a larger completion rate.

Breakdown of Existing Service Providers' Speeds and Costs

Below is a breakdown of each provider that serves survey respondents. As illustrated in Figure 1 below, Verizon serves over 40% of respondents (789 total) whereas Comcast serves 31%. These results mirror the market data collected for the communities in all four school districts which confirm the marketshare percentages listed below.

Verizon is the leading incumbent fixed wireline broadband provider in Chester County by marketshare, followed by Comcast and Armstrong cable. Verizon wireless also serves over 14% of survey respondents which is sizable relative to Armstrong cable which serves only 9% of survey respondents and provides multichannel video and broadband services mainly in the Oxford Borough.

Figure 1 - Internet Service Provider Distribution Among Broadband Survey Respondents



Among the 1,064 survey respondents, only 614 took the actual speed test embedded in the survey. Among those who took the speed test, roughly 55% reported having speeds of less than 50 Mbps download which is classified as underserved by the National Telecommunications and Information Administration (NTIA) and Rural Utilities Service (RUS).

The survey data also indicate that over 200 (roughly 20%) respondents did not take the speed test because they lack internet access. These results underscore the connectivity challenges facing residential consumers in Southern Chester County.

Figure 2 below illustrates the speed test results for the zip codes identified for this study. The majority of zip codes where respondents live, reported median download speeds in excess of 100 Mbps with the exception of Kennett Square, Cochranville and Nottingham.

However, in many zip codes respondents chose not to take the embedded speed tests in the online survey either because they only wanted to take the paper version or they chose to skip the speed test entirely.

Figure 2- Summary of Broadband Survey Speed Test Results per Zip Code and Mbps Upload and Download Speeds

Speed Test	Download (in Mbps)	Upload (in Mbps)	Latency
	Southern Chester County		
Number of Surveys / Speed Tests	1,063	621	58%
Average	196	74.09	17
Median	108	32	13
Min	0.78	0	0
Max	914	1.2 Gbps	993
	Zip Code 19348 (Kennett Square)		
Number of Surveys / Speed Tests	130	233	56%
Average	171	69	14
Median	78	38	12
Min	0.93	0.03	0
Max	896	630	72
	Zip Code 19363 (Oxford)		
Number of Surveys / Speed Tests	52	105	50%
Average	127	39	49
Median	136	10	29
Min	0.78	0	0
Max	457	379	993
	Zip Code 19330 (Cochranville)		

Speed Test	Download (in Mbps)	Upload (in Mbps)	Latency
Number of Surveys / Speed Tests	7	13	54%
Average	123	83	13
Median	96	89	11
Min	21	1.63	10
Max	309	212	29
	Zip Code 19362 (Nottingham)		
Number of Surveys / Speed Tests	9	17	53%
Average	89	12	29
Median	47	10	28
Min	19	1.8	1
Max	241	20	66
	Zip Code 19352 – (Lincoln University)		
	72	97	74%
Average	221	96	17
Median	107	38	13
Min	4.52	0.32	6
Max	878	926	91
	Zip Code 19350 (Landenberg)		
Number of Surveys / Speed Tests	88	128	69%
Average	175	41	17

Speed Test	Download (in Mbps)	Upload (in Mbps)	Latency
Median	109	23	14
Min	1.32	0.21	2
Max	905	779	71
	Zip Code 19311 (Avondale)		
Number of Surveys / Speed Tests	55	122	45%
Average	206	68	13
Median	125	33	12
Min	2.5	0.75	1
Max	617	505	47
	Zip Code 19317 (Chadds Ford)		
Number of Surveys / Speed Tests	29	37	78%
Average	231	83	9
Median	137	50.5	9
Min	11	5.5	5
Max	914	378	19

While high speed service is available in selected parts of the region, its only offered in isolated pockets. The fiber mapping data based on the Fiber Locator tool[7] indicates that both Verizon's FIOS and Comcast's Xfinity do not have middle mile fiber routes in the area and have few fiber connections to households..

[7] Solutions - FiberLocator

Due to the remoteness of the boroughs in each of the four school districts, affordable and reliable broadband access is not widely available to most residential locations.

Figure 3 - Overview of Respondents' Contracted Download Speeds

Download Speeds in Mbps	
Total respondents	488
Average	577
Median	500
Min	0
Max	2,000

The average monthly bill for residential broadband service among survey respondents is roughly $111.36 per month as illustrated in Figure 4 below. Some respondents indicated they pay close to $500 per month. Affordability remains a barrier among families living in poverty and low-income families are often unable to afford a computer or internet enabled devices (and speeds) needed to participate in remote learning, job training, job searches, telehealth and other critical activities.

Figure 4 - Overview of Respondents' Monthly Internet Cost

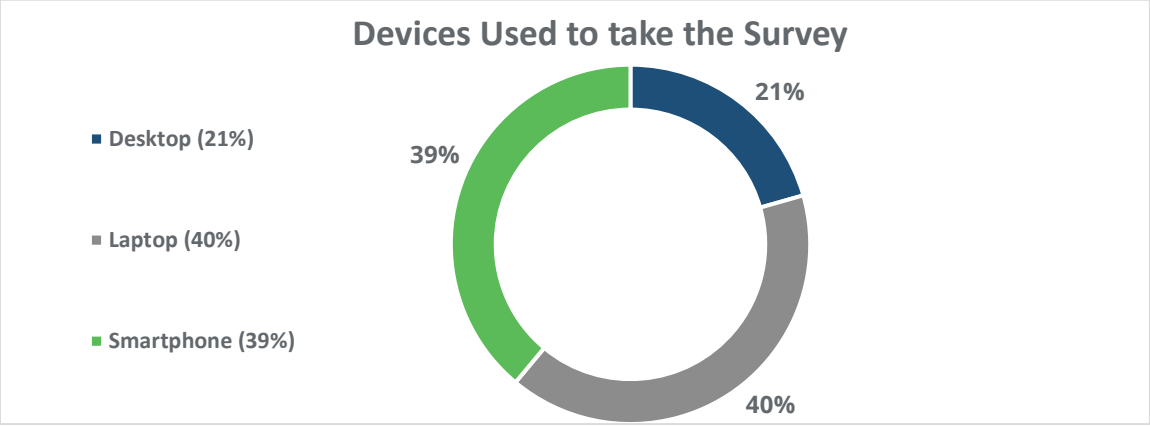
Respondents Monthly Internet Cost	
Average	$111.36
Min	0.00
Max	$510.00

Type of devices used by respondents who took this survey

As illustrated in Figure 5 below, over 39% of survey respondents used their smartphone and/or a mobile device to complete the survey whereas over 40% took the survey on a laptop. The laptop segment likely took the survey on a computer

located at either a community-based organization or with a case worker at a customer's residential premises or at a farm location. These scenarios also apply to the 21% of respondents who took the survey using a desktop computer.

Figure 5 - Types of devices Used to take the Broadband Survey



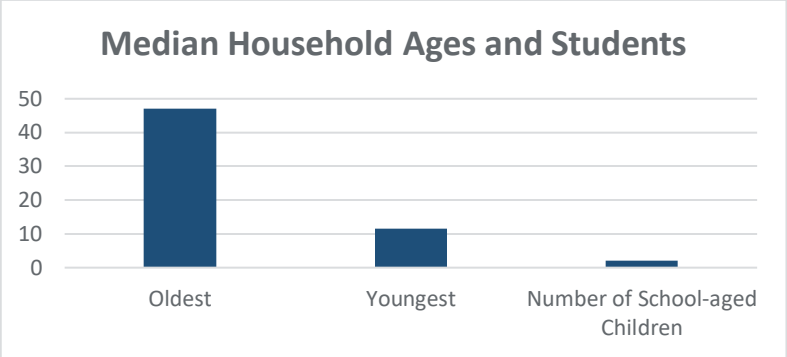
Demographic characteristics of survey respondents

Survey results indicate that the median ages of those living in households ranged from the youngest of 11 years old to the oldest of roughly 46 years old which is illustrated in Figure 6. It's important to note that most migrant family households consist of several families living in different rooms in one house or apartment dwelling. Therefore, the dispersion of ages across the sample population exists where multiple family members are living side by side with several families in a single residential premise.

The median number of school aged children reported per household was roughly 3 although as indicated above, most households have multiple families under one roof that also include school aged children per family.

Figure 6 below shows the age dispersion of family members and school age children per household who took the survey.

Figure 6 - Median Age per Household

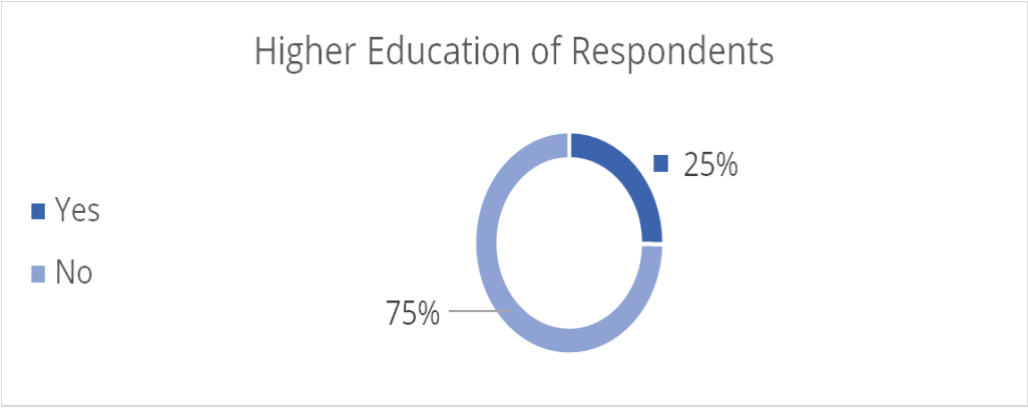


Education levels among survey respondents

In Figure 7 below, the percentage of respondents attending a college or university is less than 25%. Approximately 75% of the entire survey population reported having no college level education. These statistics are consistent with the information gathered from local community-based support organizations who work with families with minimal to no English reading comprehension.

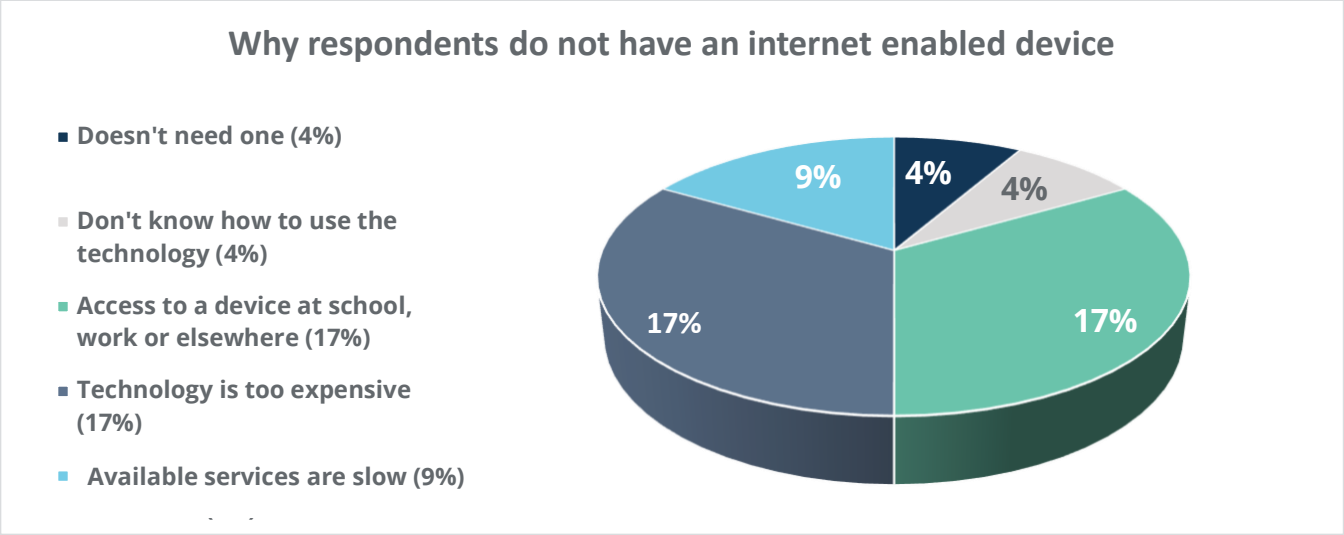
The results reflected in Figure 7 below also underscore the social and economic challenges facing migrant farmworkers and their families who have limited employment prospects and remain at or below the federal poverty levels.

Figure 7 - Percentage of households with members who have some form of Higher Education



Poverty is a likely cause for why respondents do not have a computer or internet enabled device in their home.

Figure 8 - Reasons for Not Having a Device Reported Among Survey Respondents



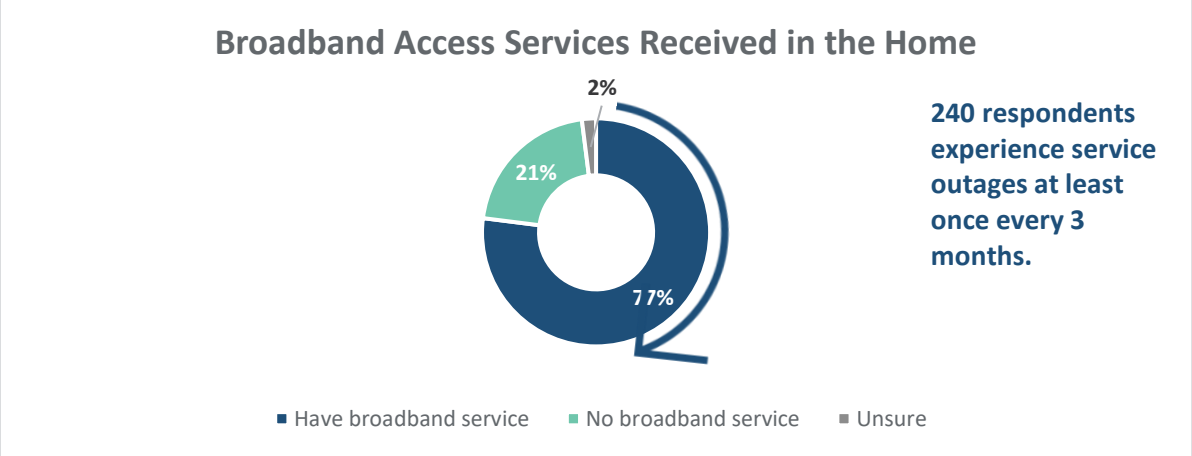
*The remaining 49% of the respondents who do not have internet enabled devices did not state the reason for not having it.

As the chart above in Figure 8 illustrates, over 17% of respondents said they do not have an internet enabled device at home such as a computer or tablet, mainly due to cost or because they can access the internet at their school or community center outside of the home. This result underscores the comments shared by multiple community-based organizations who confirmed that chronic poverty is pervasive, especially among farm worker families who cannot afford fixed broadband service and or a device needed to access the internet for a wide variety of critical uses.

Percentage of high-speed broadband access services received in the home

Over 77% of respondents indicated they receive some level of broadband access in their home while only 21% say they do not receive any broadband service in their home as illustrated in Figure 9 below.

Figure 9 - Percentage of High-Speed Broadband Access Received in the Home



Roughly 240 respondents reported experiencing internet service outages intermittently, and at least once a quarter. When comparing monthly reoccurring prices to the level of service quality provided, consumers are not receiving internet access services sufficient to provide access to telehealth, distance learning, precision agriculture and other important use cases in the home and on their premises.

Percentage of internet enabled activities performed in the home daily and weekly

As illustrated in Figure 10 below, survey respondents indicated the type of activities they engage when using the internet. As the chart below illustrates, roughly 100% of respondents depend on internet access for social media and communications needs such as email and entertainment such as video streaming.

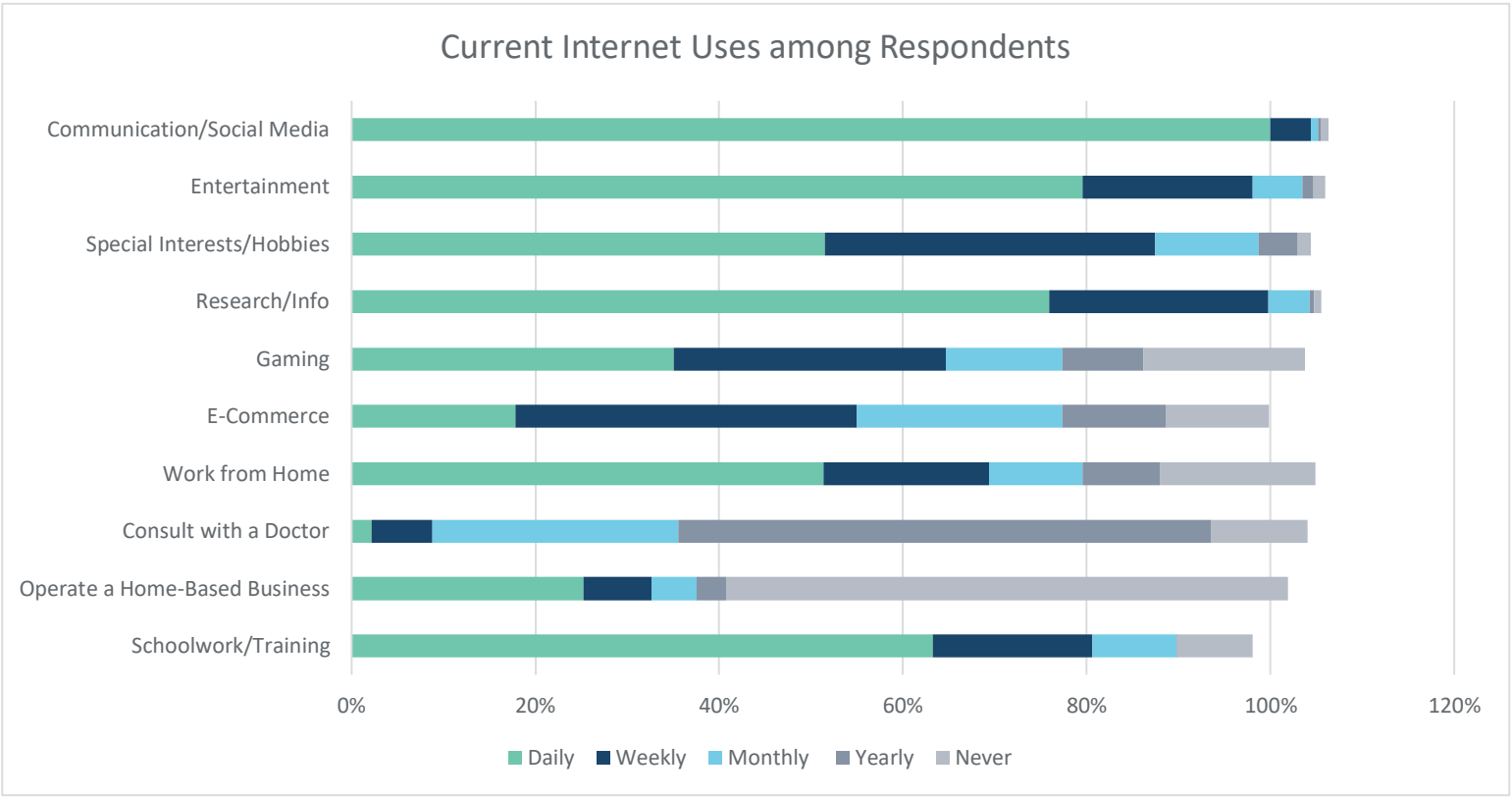
The cost of monthly cable television service is often out of reach for most low income families in the region which is a likely reason why they depend on internet access to stream television, videos and other entertainment programming.

Over 65% of respondents also indicated that they depend on some form of internet access almost daily to perform school work or engage in remote learning. This percentage increases to 80% when adding respondents who indicated they depend on internet access to engage in online training, whether it be work related or personal development, on a weekly basis.

Over 78% of respondents also indicated they use the internet to obtain and complete federal benefits applications like the Affordable Connectivity Program (ACP) or Medicaid and Supplemental Nutrition Assistance Program (SNAP) benefits.

Another revealing data point is the low percentage of survey takers who engage in teleheath services in their home which is less than 10% on a weekly basis. Again, this result is strongly correlated to the lack of affordable and reliable highspeed broadband access available in the home. This percentage would jump considerably if such connectivity was available to families with school age children including disabled family members who cannot travel on their own to see a doctor.

Figure 10 - Frequency of Internet Usage of Respondents per Classification



ANALYSIS OF CELLULAR SURVEY RESULTS FOR SOUTHERN CHESTER COUNTY

The final survey results for those who took the survey using their cell phone are as follows: over 927 cellular surveys were taken and 472 completed it correctly. There were over 455 invalid or partial results that could not be counted toward the final total. Roughly 43% of the results could be utilized for this analysis. The chart below illustrates the final breakdown of respondents who completed the cellular survey.

Table 3 - Summary of Results for Cellular Survey

MAGELLAN CELLULAR SURVEY		
Total Surveys Taken	927	100%
Valid-Complete	**399**	**43.04%**
Valid-Partial	73	7.87%
Total Valid	472	50.91%
Invalid/Test/Dups	455	49.09%

Percentage breakdown of survey respondents by school district

Table 4 below illustrates the breakdown of all survey respondents by school district. As stated earlier, the technology directors for each school district (Avon Grove, Kennett Consolidated, Unionville-Chadds Ford and Oxford Area) were instrumental in getting this survey distributed throughout their surrounding communities.

Table 4 – Cellular Survey Respondents Breakdown by School District

School District	Count	Percent
Avon Grove	**138**	**31.44%**
Kennett Consolidated	**101**	**23.01%**
Unionville-Chadds Ford	**96**	**21.87%**
Oxford Area	**63**	**14.35%**

The results in Table 4 above underscore the engagement of all four technology directors across the school districts that helped increase survey participation. These results also validate the concerns among all four technology directors regarding the lack of qualified broadband access as well as reliable cell phone coverage in their communities as evidenced by the level of interest in this topic.

Cellular providers based on reported speeds and cost

Figure 11 - List of Top Cellular Providers Who Serve Survey Respondents

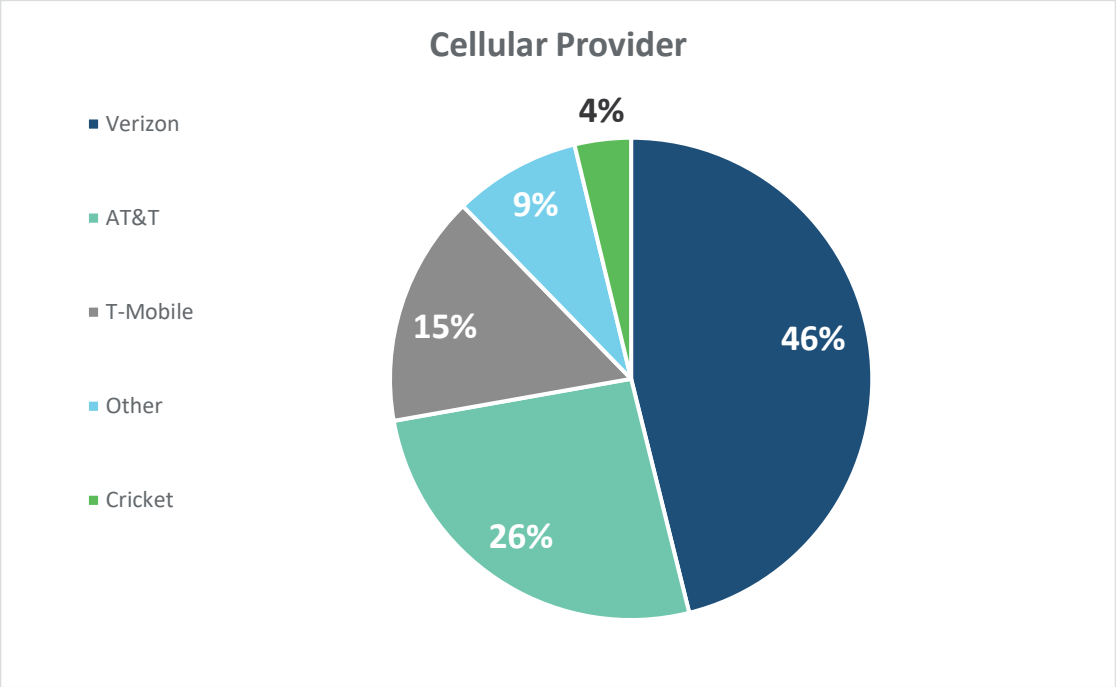


Figure 11 above shows the breakdown of each cellular provider in the region that serves survey respondents with cellular services. As illustrated above, Verizon serves 46% of respondents (230 total) where as AT&T serves 26%. These results mirror the market analysis data for the study collected confirming the incumbent providers in the area and their corresponding market share. Similar to the fixed broadband survey results outlined above, Verizon Wireless remains the dominant wireless provider, followed by AT&T and T-Mobile.

Cellular survey respondents also reported average download speeds of 150 Mbps with a maximum of 865 Mbps. The median speed was less than half of the average (74 Mbps). In many communities in and around Kennett Township, Avondale, Oxford and West Grove, consumers reported speeds much lower than the median. Inadequate cell coverage in these areas was a reoccurring theme throughout the duration of Magellan's engagement and is consistent with the reported survey results. Coverage concerns were also raised during most stakeholder engagement meetings with first responders, low-income benefits case workers, mushroom farms as well as with school district technology directors.

Table 5 - Summary of Cellular Survey Speed Test Results

Speed Tests	Download (in Mbps)	Upload (in Mbps)	Latency
Average	150	38	21
Median	74	12	15
Min	0.09	0.01	0
Max	865	498	174

Survey respondents reported an average cellular phone bill of $172, a median of $169, and a maximum of $500. Due to the average and median being less than $10 apart, monthly end user bills are high and not commensurate with the level of service quality, coverage and speeds they are paying for. This data is supported by the stakeholder input provided during interviews.

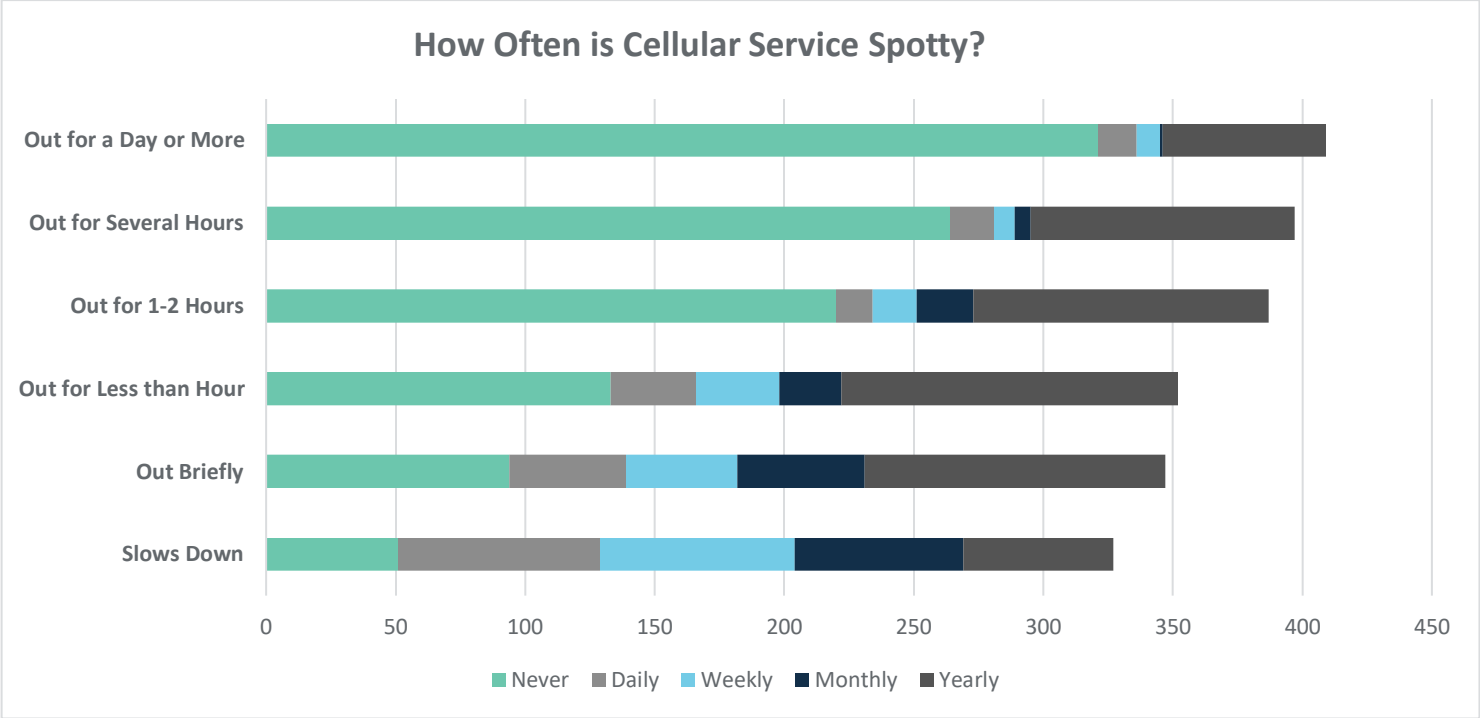
Table 6 - Summary of Cellular Survey Monthly Internet Cost Results

Cellular Cost	
Average	$172.28
Median	$169.00
Min	$0.00
Max	$500.00

Coverage and service quality concerns

Over 200 out of 399 respondents stated that their cellular service either slows down or is out of service during various lengths of time on a daily basis, which equates to nearly 50% of the survey respondents. The chart below (Figure 12) demonstrates how respondents experience various levels of intermittent cellular service quality.

Figure 12 - Frequency of Spotty Internet Service in the Home



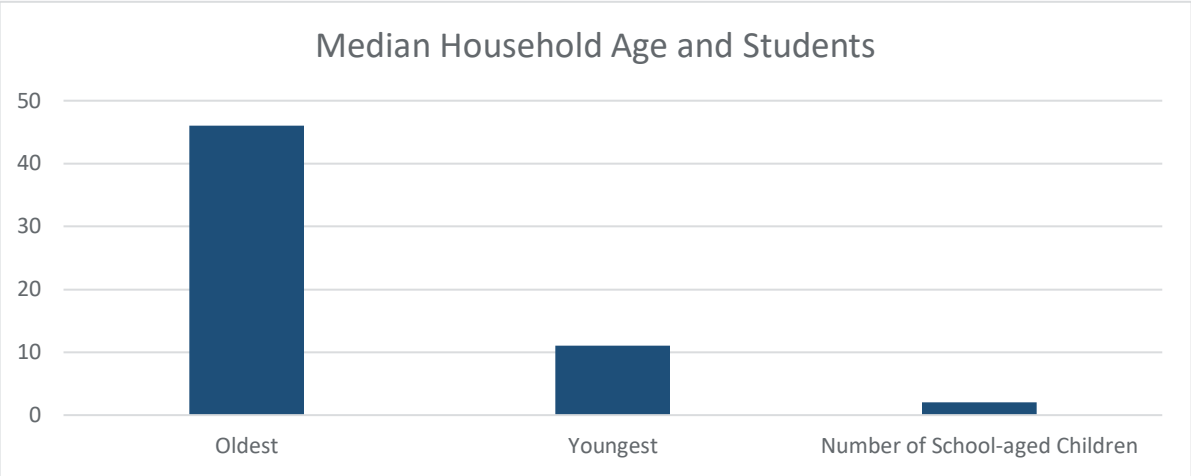
Demographics of Survey Respondents

Cellular survey results also indicate that the median ages of survey respondents range from the youngest of 11 years old to the oldest of roughly 46 years old, which equates to the same range as in the broadband survey.

The median number of school aged children reported per households among cellular survey respondents was roughly 1.5, although most households have multiple families under one roof that also include school aged children per family. Respondents who took the fixed broadband survey reported approximately 3

children per household. The chart in Figure 13 shows the dispersion of ages of family members and school age children captured by cellular survey respondents.

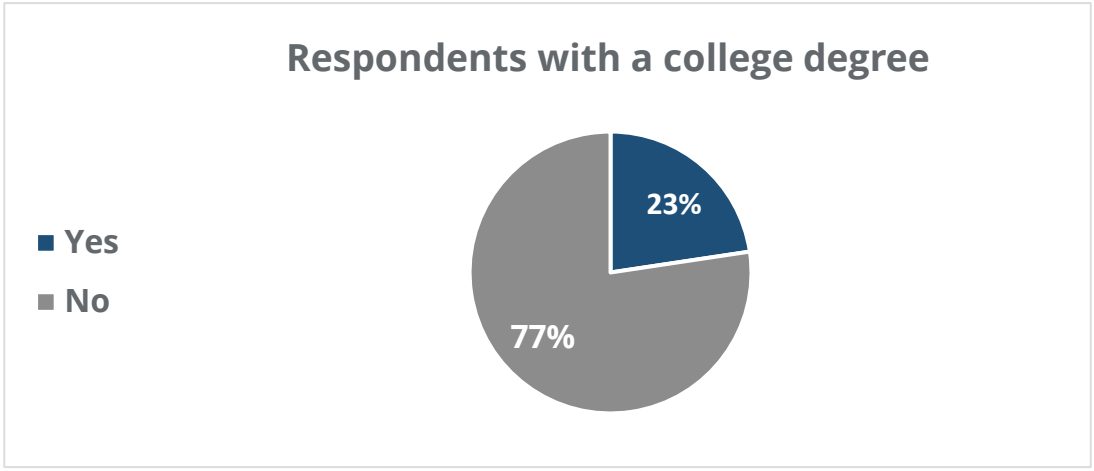
Figure 13 - Median Age per Household Among Cellular Survey Respondents



Educational levels among survey respondents

The chart below (Figure 14) illustrates the percentage of respondents who attend college or university. Approximately 77% of the entire survey population reported as not having a household member with a secondary or advanced degree which is consistent with the information gathered from the fixed broadband survey and from local community-based organizations. This data also underscores the social and economic challenges facing the low-income farmworkers and their families who are limited in their employment prospects, and at or below the federal poverty levels.

Figure 14 - Percentage of Households Where One or More Residents Have a College Degree.



Percentage of Internet enabled activities performed in the home among cell phone respondents

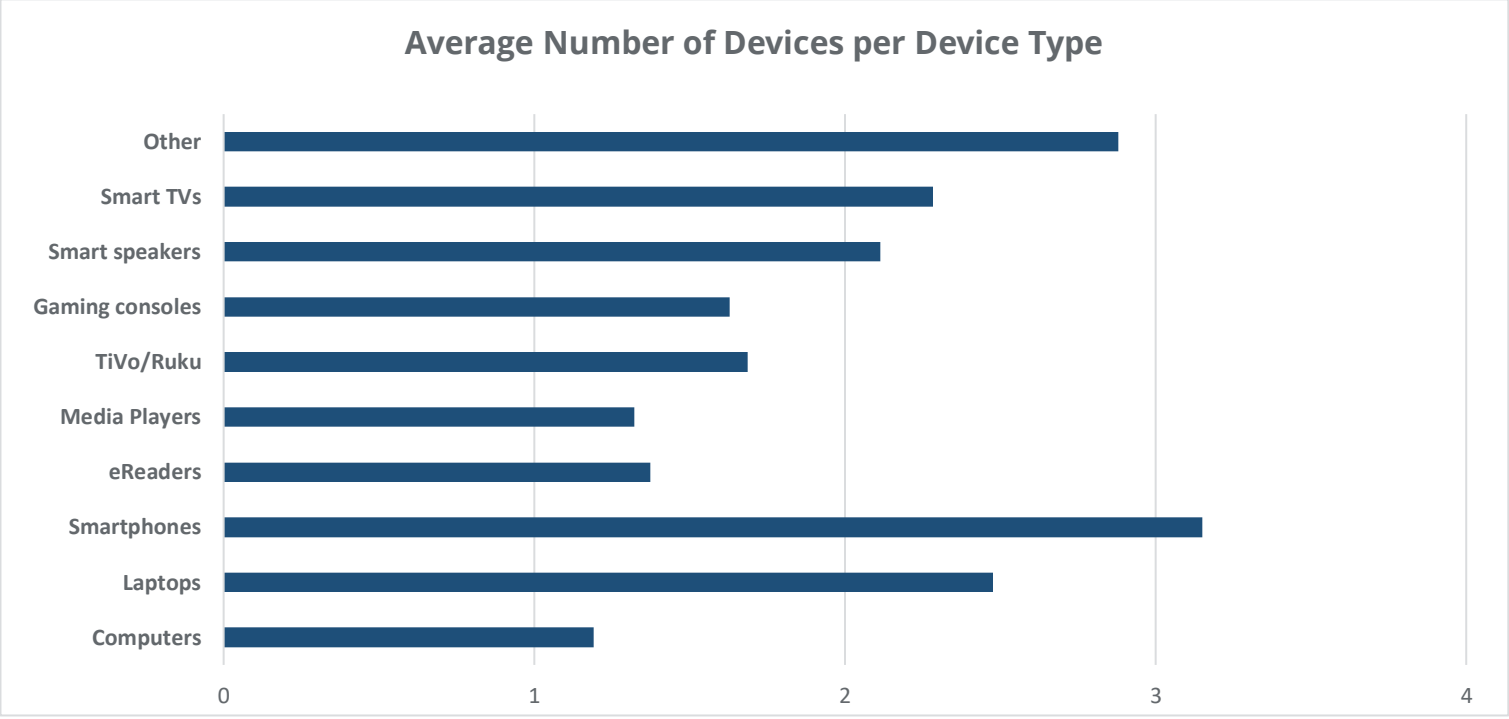
Similar to the results for the same question among those who responded as having fixed broadband in the home, over 60% of cellular survey respondents indicated they conduct schoolwork using a cell phone daily rather than a computer or tablet. This percentage jumps to 80% when combined with those who study doing it weekly.

This response rate validates the input received from dozens of community leaders and benefits counselors regarding the struggle facing migrant farmworker families in helping their children access high speed broadband both easily and affordably to complete schoolwork online and engage in distance learning.

Average number of devices in the home by type

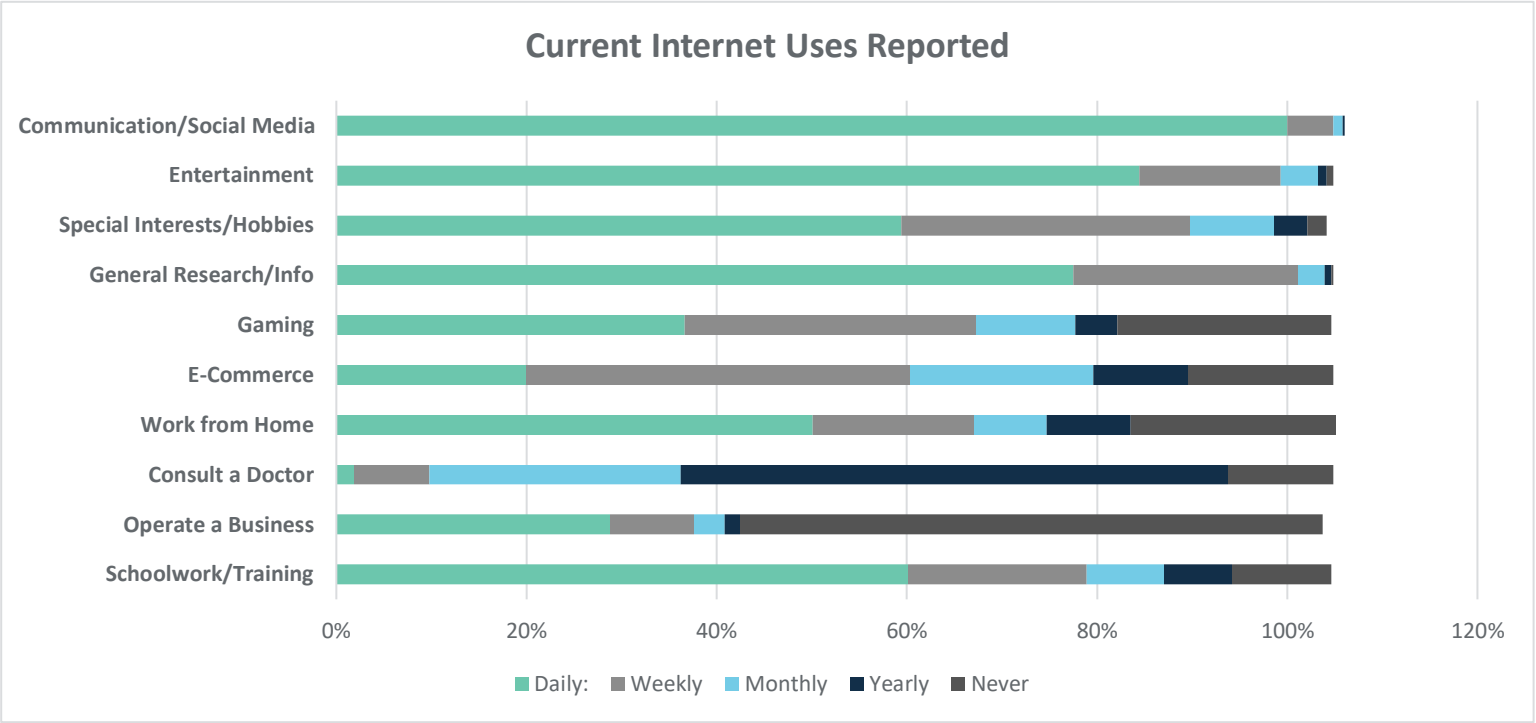
The data in Figure 15 below indicates that majority of survey respondents own 3 or more smartphones, followed by smart TVs and laptops that may have been provided by the school district. The average number of total devices per household is 6 which suggests that respondents are heavily dependent on their cell phones to conduct schoolwork.

Figure 15 - Distribution of Devices Used Among Cellular Survey Respondents



As the graph below (Figure 16) illustrates, roughly 100% of cellular survey respondents depend on internet access for social media and communications needs such as email and over 80% for entertainment such as video streaming.

Figure 16 - Frequency of Internet Usage of Cellular Survey Respondents per Activity or Use Case



Conclusion

Based on the survey responses to all the survey questions summarized in the graphs above, the majority of survey respondents utilize their cell phone for a variety of basic needs including homework and school assignments. Yet, their level of service quality is intermittent and unreliable in the home.

Consumers are paying on average of $169 per month for cellular services which is in addition to what they are paying for internet access in the home. It is unclear whether these price points factor any reductions from the Affordable Connectivity Program (ACP) monthly subsidy to the end user bill.

Either way, respondents use their cell phone for most needs either because they do not have adequate internet access in their home and do not have a computer for personal/school use or because they cannot afford to have both. Affordability and access are significant barriers for these users in Southern Chester County.

BROADBAND MARKET ANALYSIS

Magellan conducted a market analysis of existing last mile and middle mile providers in the region and documented their existing coverage, download speeds and pricing tiers. Magellan supplemented its market research with qualitative data collected from one-on-one meetings (remotely and in person) with state, local, and federal officials as well as key stakeholders throughout Southern Chester County.

A comprehensive list of each provider's service offerings and their advertised price and download speeds were also collected and compared to a random sampling of residential and business end user locations across Southern Chester County to verify the accuracy of carrier reported and advertised offerings.

The qualitative and quantitative research results revealed a significant disparity between advertised service offerings and the actual level of coverage received by residential, business and anchor customers. As documented in this section, consumers are not receiving the level of coverage, speeds and prices advertised or as reported by the Federal Communications Commission (FCC) or the NTIA.

Due to the absence of competitive pressure on existing incumbent providers, measures to improve coverage and existing service quality is not likely to occur.

Key findings from market research, mapping analysis and qualitative inputs

- The actual speeds available as reported by residential, business, nonprofit and municipal customers are vastly different from what existing providers in the region are reporting to federal agencies (NTIA and FCC). For example, in Appendix 2, Verizon offers seven different service offerings in Oxford with download speeds ranging from 15 to 1,000 Mbps. However, based on Verizon's public facing website, they offer only one package to the selected residential address in this area with download speeds of roughly 7 Mbps.

- Verizon and Comcast are the two largest providers serving residential and business consumers throughout the four school districts, with the exception of Armstrong cable which mainly serves the Oxford Borough and township.

- Last mile connectivity is limited given the cost of deployment to rural unserved households and farms in the region. Incumbent providers with whom we spoke indicated that the cost of deployment could be an additional $4,000 to $7,000 per home passed. Middle mile connectivity is less of a concern due to the availability of diverse fiber routes in and around Oxford, Kennett, Avondale and

Toughkenamon served primarily by Crown Castle and others (see Fiber Locator data[8]).

- The actual level of affordable, high quality broadband coverage in the region is far less than what is advertised according to interviews with over 40 stakeholders. For example, as illustrated in Appendix 2, Verizon reports providing over 99.4% coverage in Avondale, but based on the carriers' website, none of their services are available.

- Some of the monthly recurring rates for residential and business services are higher than those advertised for the top three providers in the region (Verizon, Comcast, Armstrong cable). Despite the availability of federally subsidized programs like the Affordable Connectivity Program (ACP) used by all providers in the area, monthly rate plans for broadband service are out of reach for most low-income families.

- Cellular and fixed broadband coverage on mushroom farms are poor; some farms get less than one or no bars of coverage (based on in person speed and service testing).

- For business and enterprise services, only Comcast is available in all the selected business addresses (See Appendix 2 for the broadband provider's service offerings' availability per business address' zip code). The FCC's Affordable Connectivity Program (ACP) benefit is used by all providers in the area[9].

- None of the service providers we interviewed shared any information about their future buildout plans in Southern Chester County. Therefore, this study contains no information about potential future broadband projects in the region.

Market Research Methodology

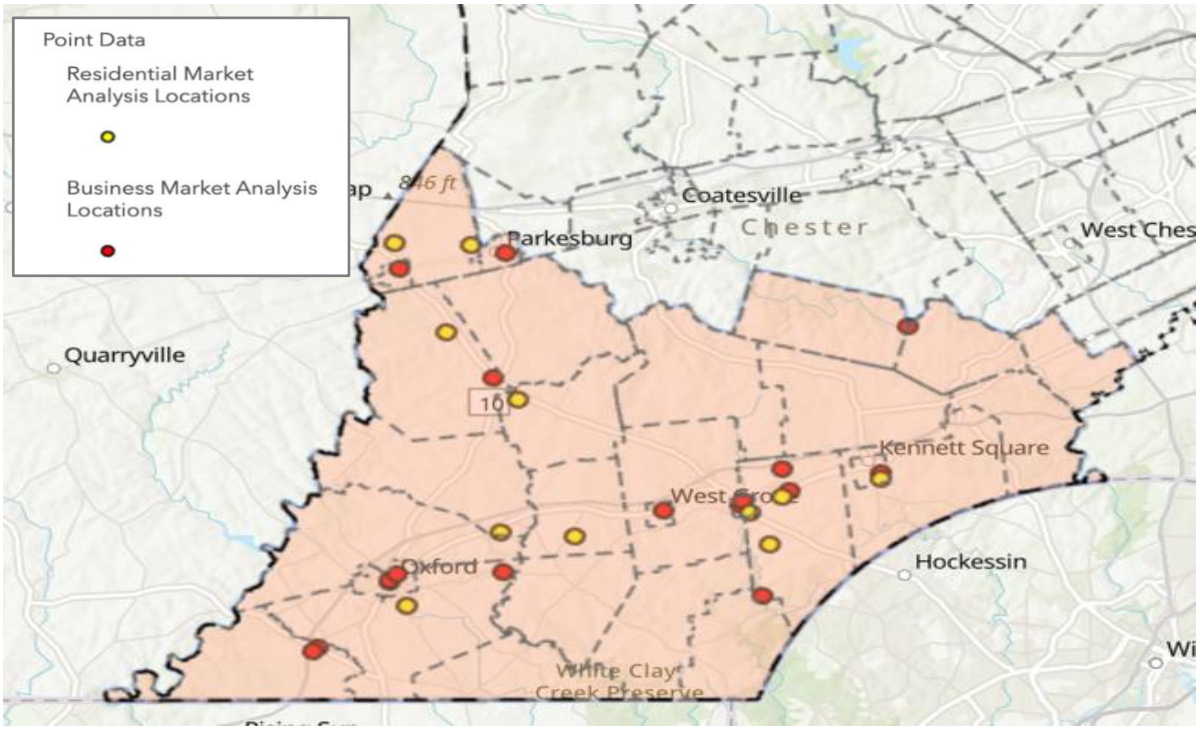
Magellan utilized a specific sample of zip codes in each school district to identify the actual level of speeds, service offerings and coverage levels for this study. Magellan then pulled advertised coverage and pricing data for each provider in each zip code in the BroadbandNow.com market analysis tool. Southern Chester County is made

[8] https://www.fiberlocator.com/

[9] Companies Near Me - ACP - Universal Service Administrative Company (affordableconnectivity.gov)

up of 14 zip codes and several addresses were chosen in each area as mapped in Figure 17, to check the service availability of each provider.

Figure 17 - Location of Residential and Businesses Addresses Used to Evaluate Market Conditions



Magellan examined the speeds and pricing for each provider including the specific broadband technology platform (DSL, fixed wireless, satellite, wireless, fiber to the home and cable modem service).

Magellan then gathered the actual broadband service offerings (not including other services such as voice, video and other bundled services to compare fairly the prices and corresponding speeds offered by different providers) provided to residential and business addresses in each zip code (see Figure 18).

These locations were randomly selected to ensure a wide and diverse sample size. Other service details such as price increases over a 3 to 24-month period, inclusion of long-term contracts, inclusion of data caps, the specific retail brand of each package and the variance on download speeds throughout a service contract period were also collected and examined.

Figure 18 -Zip Codes Used to Evaluate Market Conditions in Southern Chester County

Zip Codes	
19390 West Grove	19382 West Chester
19311 Avondale	19317 Chadds Ford
19348 Kennett Square	19365 Parkesburg
19363 Oxford	19374 Toughkenamon
19362 Nottingham	19350 Landenberg
19352 Lincoln University	19330 Cochranville

Retail service offerings listed on BroadbandNow.com[10], as well coverage data generated by the FCC and NTIA were used as comparison points to the advertised speeds and pricing reported by end user customers. The following fixed broadband service providers listed in Figure 19 are recorded as offering some level of high-speed broadband service in Southern Chester County.

Figure 19 - Internet Service Providers (ISPs) Identified as Serving Residential and Business Customers in the Region

Residential	Business
Verizon	Verizon
Xfinity	Comcast Business
Viasat	Crown Castle
HughesNet	CenturyLink Business
Armstrong Cable	Armstrong
Frontier	Frontier

[10] https://www.broadbandsearch.net/.

Upward Broadband	Windstream
T-Mobile (Ultra Home) 5G Internet	

Using the FCC's broadband coverage and speed data as a baseline for comparison

The FCC's most recent fixed broadband coverage map[11] as of December 2020, shown in Figures 20, 21, 22 and 23 are based on self-reported data from existing broadband providers. Carrier reported coverage data is used widely but can be somewhat misleading due to the historical studying requirements based on service availability within a census tract. Most importantly, an entire tract is deemed served if one household receives coverage which is usually not the case in rural communities and in Southern Chester County in particular.

Directed by the Broadband Data Collection (BDC) framework authorized under the DATA Act of 2020[11] the FCC adopted a new broadband coverage and service area validation process called the Broadband Serviceable Location Fabric. The Fabric is a common dataset of all locations in the U.S. where fixed broadband internet access service either exists at the time of the studying deadline or can be installed.

All broadband providers are required to file their most recent coverage data with the FCC and its mapping vendor CostQuest no later than Sept 1, 2022[12]. The FCC may not release its revised broadband maps until Q4 of 2022 at the earliest. In the meantime, communities must continue to rely on the current FCC mapping data as shown below.

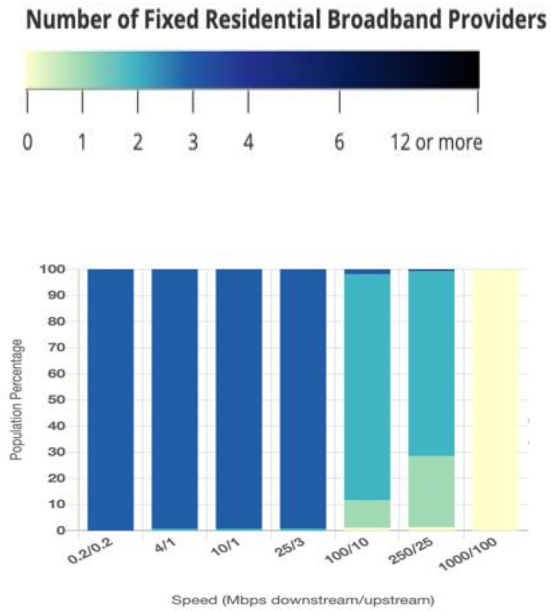
Magellan encourages local and county leaders to follow the FCC's actions regarding broadband mapping as it will have a direct impact on whether portions of the region will be eligible for federal grant funds discussed later in this study.

The existing FCC data and maps below indicate that most of Southern Chester County is well served with robust competition and the revised maps that will be published in Q4 may be the same. See Figure 20 below.

[11] FCC Map for Chester County - https://go.usa.gov/xud6v

[12] How Fixed Broadband Service Providers Can Access the Location Fabric – BDC Help Center (fcc.gov)

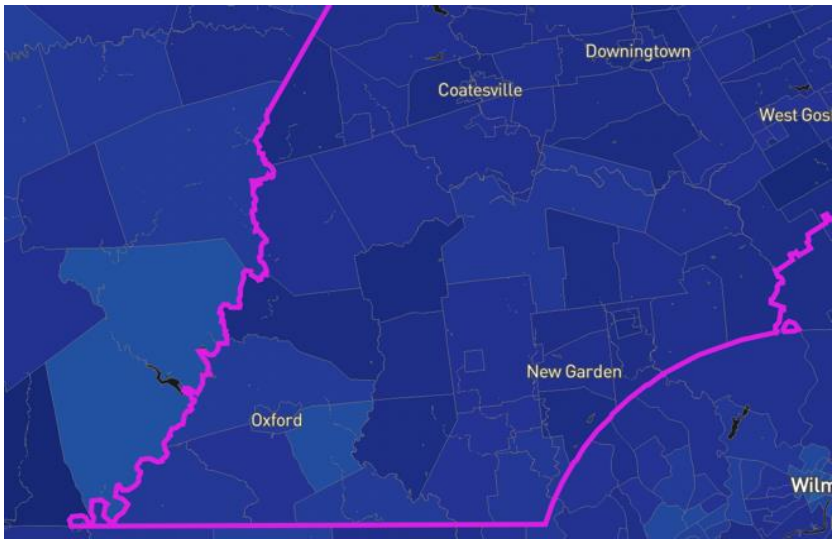
Figure 20 - FCC's Coverage Map Showing the Number of Fixed Residential Broadband Providers by Speed Category



In Figure 20 (above) the black and darker shading on the right side of the legend represents 12 or more ISPs in the region (see list of ISPs in Figure 19). The lighter colors, such as yellow indicate there are no providers offering that class of service in those areas in Southern Chester County.

As illustrated in Figure 21 below, FCC mapping data shows there are **4 ISPs -** Verizon, Comcast, Viasat and HughesNet[13] providing at least **25/3 Mbps** service across 99% of Chester County.

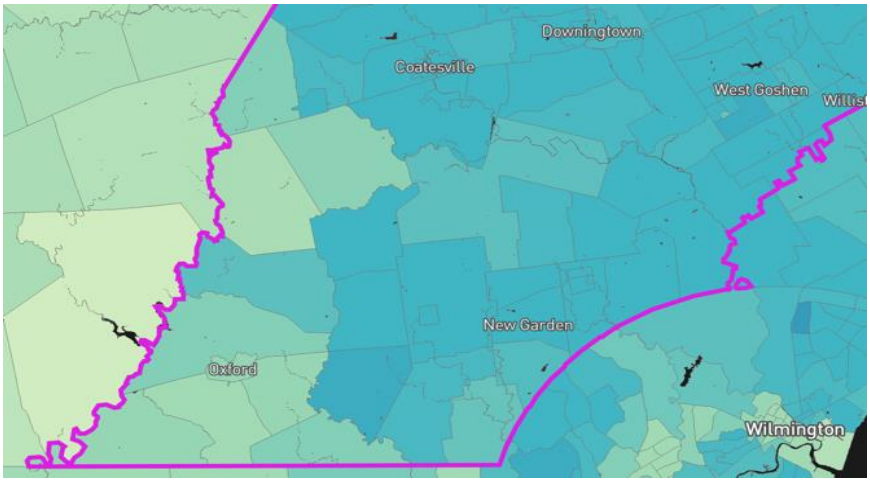
Figure 21 - FCC Map Indicating the Availability of 25/3 Mbps Speeds in the Region



[13] FCC website: https://go.usa.gov/xud6v

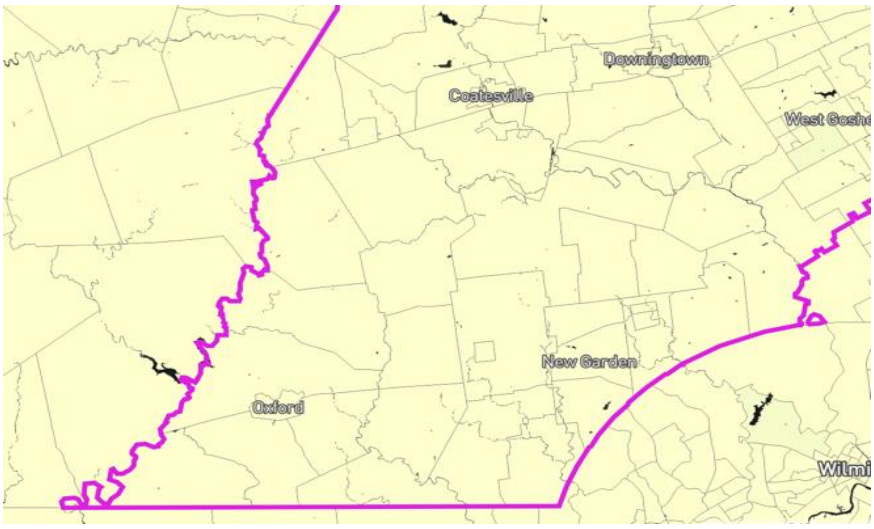
FCC mapping data as illustrated in Figure 22 below, indicates that **only 2 ISPs** – Verizon and Comcast[14] provide at least **100/10 Mbps** of service that cover 86% of the entire county. This map also indicates that the Oxford, Nottingham and Upper Oxford areas are served by only one provider or, in some cases, no providers which correlate closely to the input received by stakeholders in the region.

Figure 22 - FCC Map Showing the Availability Of 100/10 Mbps Speeds



As illustrated in the FCC map depicted in Figure 23 below, there is only **1 ISP** that provides **1000/100 Mbps** service which is Armstrong Cable.[15]

Figure 23 - FCC Map showing the availability of 1000/100 Mbps speeds



[14] FCC website: https://go.usa.gov/xudFY

[15] FCC website: https://go.usa.gov/xudFZ

ANALYSIS OF CELLULAR COVERAGE IN SOUTHERN CHESTER COUNTY BASED ON FCC REPORTED DATA

Magellan used coverage data reported by the three largest mobile wireless providers in Southern Chester County based on their FCC Form 477 filings which are captured in the FCC's existing broadband map listed on the FCC's website. Magellan also used Ookla recorded performance data to assess the coverage and speed of each provider.

FCC Form 477 data is based on a predictive map using a standard propagation tool. The solid colors indicate at least 5 Mbps/1 Mbps speed levels. This is the result of a propagation simulation; no real test data is provided.

All carriers indicate blanket, regionwide coverage except for the southern part of the county, as indicated by T-Mobile's map (Figure 26). Verizon (Figure 25) reports the most coverage, AT&T (Figure 24) and T-Mobile, respectively show more areas not covered.

Figure 24 - AT&T's FCC Reported LTE/Cellular Coverage Map

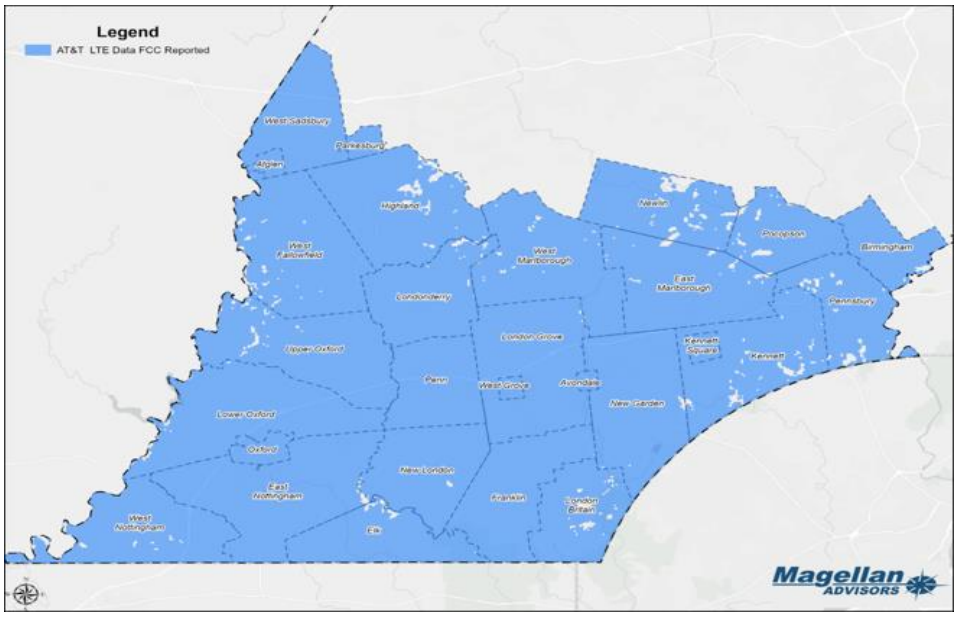


Figure 25 - Verizon's FCC Reported LTE/Cellular Coverage Map

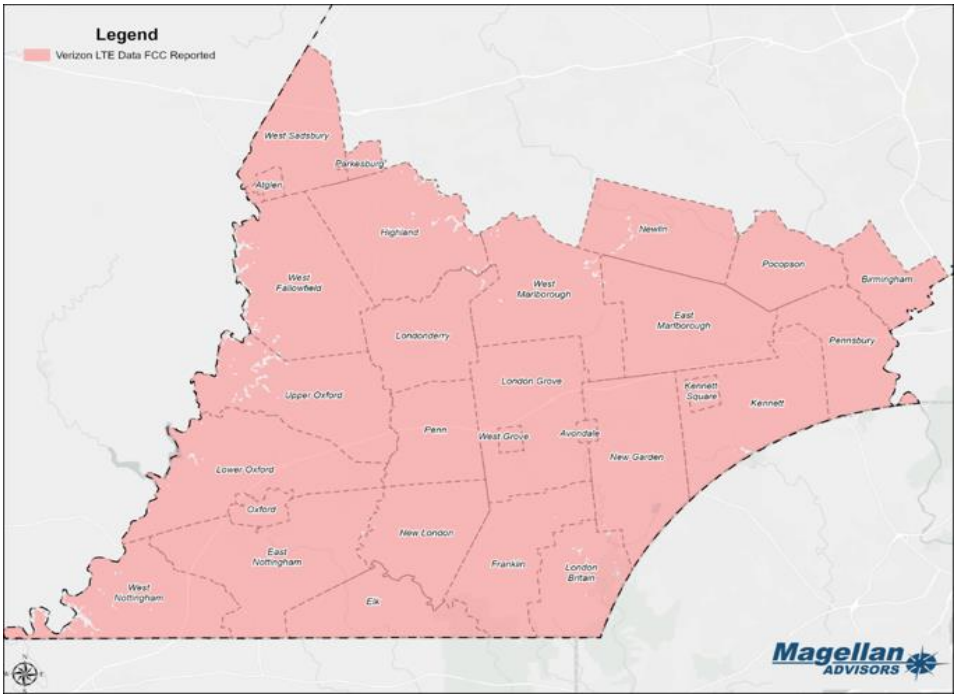
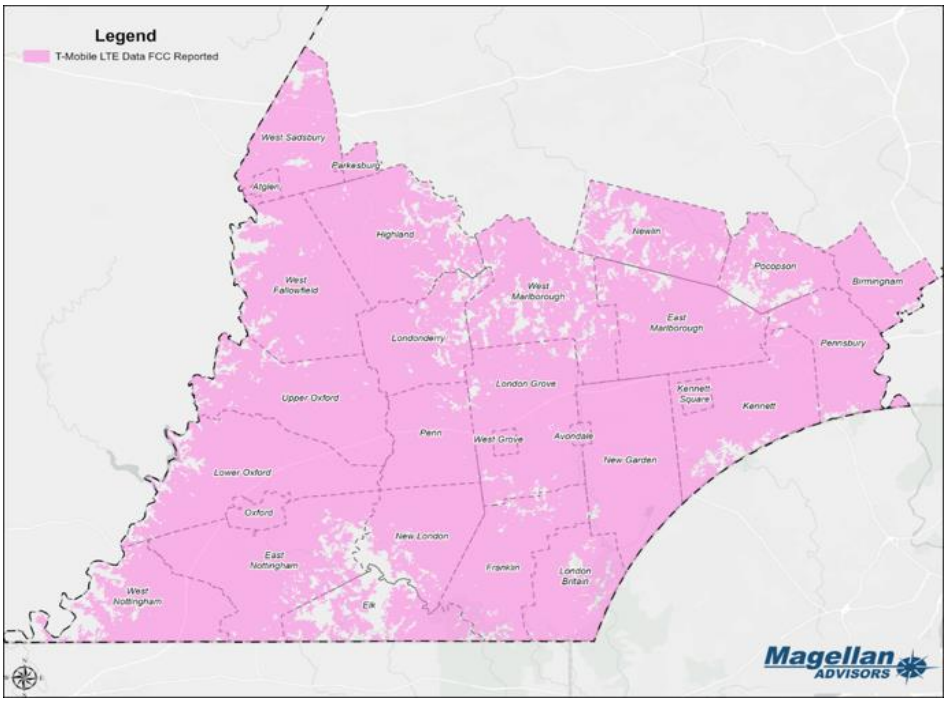


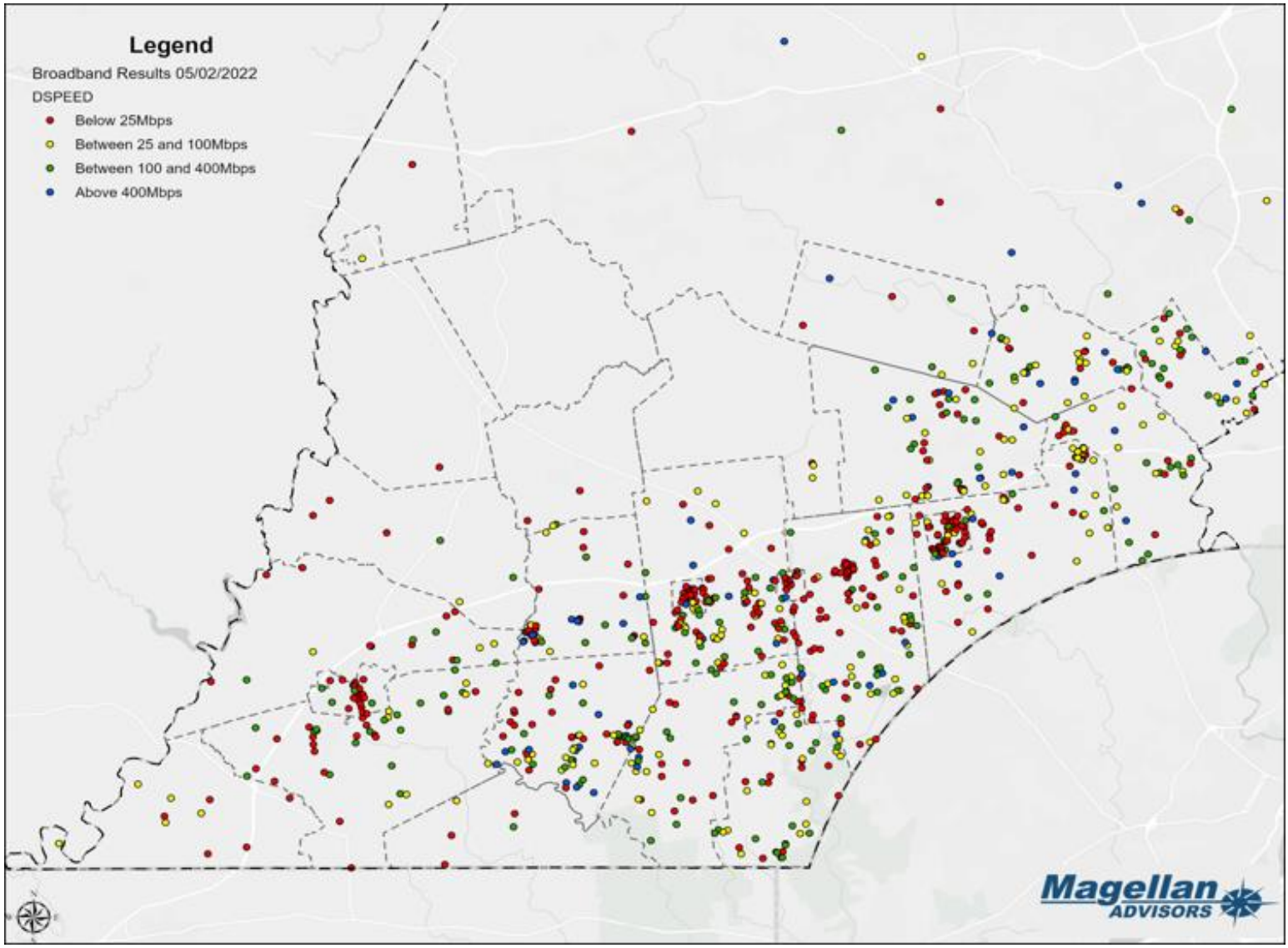
Figure 26 - T-Mobile's FCC Reported LTE/Cellular Coverage Map



BROADBAND COVERAGE SURVEY SPEED TEST RESULTS

The map below shows the broadband speed test data recorded from the Magellan broadband coverage surveys. The dots represent speed test results from respondents indicating they are either unserved (<25 Mbps) or underserved (25-100 Mbps). The data points are evenly dispersed across the four school districts which suggest the unserved households exist throughout each school district in this region.

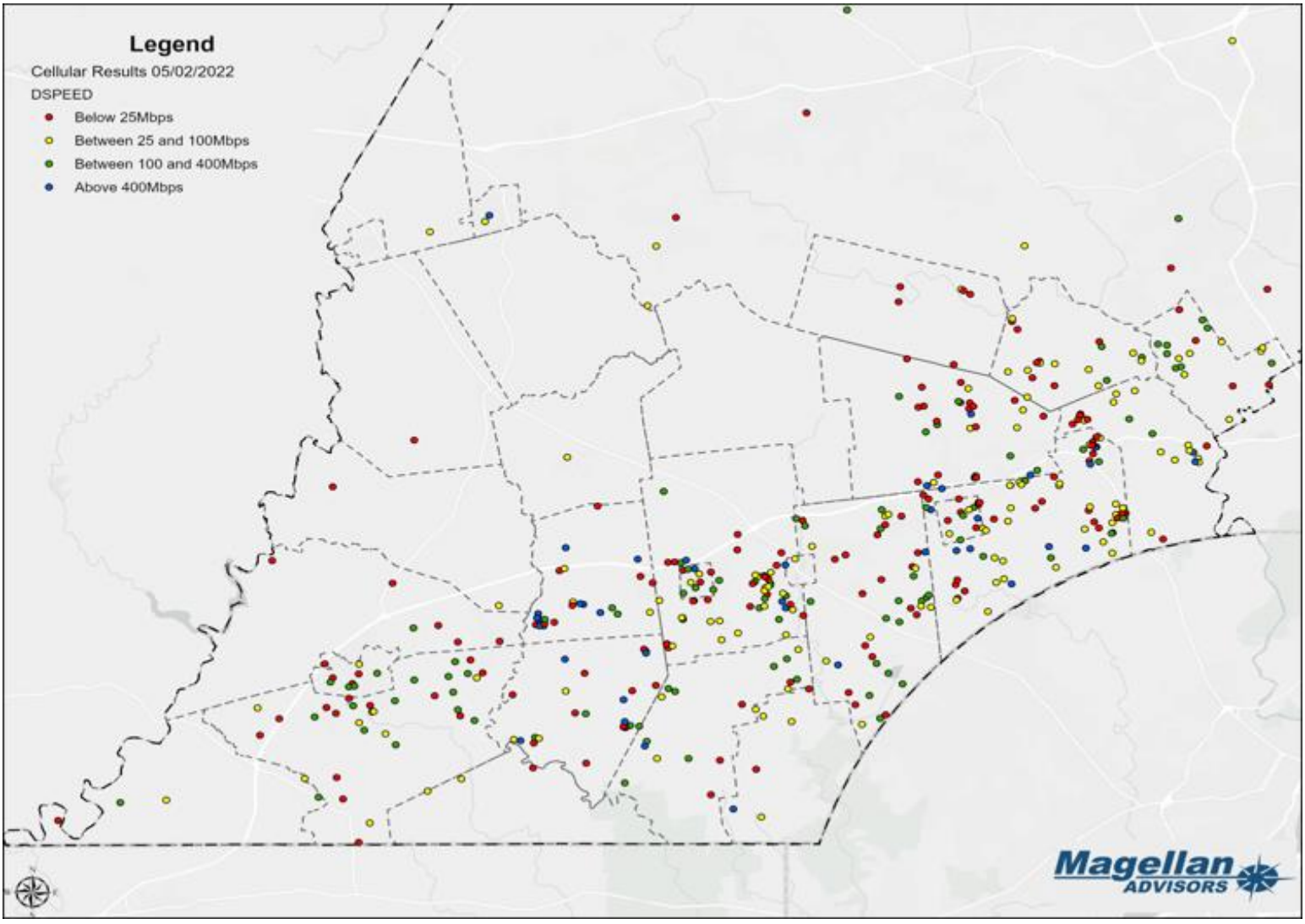
Figure 27 - Broadband Survey Speed Test Results in Southern Chester County by Speed Range



SOUTHERN CHESTER COUNTY CELLULAR SPEED TEST RESULTS FROM SURVEY RESPONDENTS.

The map below (in Figure 28) illustrates that among the cellular survey respondents, the majority of reported speeds at residential premises were less than 100 Mbps which is indicated in the yellow and red dots. The respondents who recorded speeds of 400 Mbps or more were the outliers in the survey sample.

Figure 28 - Cellular Survey Speed Test Results in Southern Chester County by Speed Range



The Magellan broadband coverage survey results illustrated above contrast significantly with FCC and NTIA broadband mapping data which indicates the area has robust fixed and mobile broadband services and corresponding speeds. The coverage survey clearly indicates that consumers are not getting the speeds and

coverage levels depicted on the federal maps. These results provide stakeholders with an independent data set reported by actual consumers that can be used to demonstrate need and coverage challenges that have not been addressed.

CONCLUSION

As stated earlier, the FCC's broadband maps are just one of many inputs used to evaluate the level of coverage in any community and not an authoritative indicator. FCC and NTIA mapping data clearly suggests that the region is well served with affordable and reliable broadband services to homes and business. The coverage depicted on these maps does not align with the user experience reported among survey respondents or community stakeholders.

Despite carrier advertised offerings in these areas, consumers have reported a far different experience as illustrated in Appendix 2. Based on the randomly selected residential addresses selected by Magellan in Oxford, consumers only have access to one out of seven advertised offerings from Verizon (with 88% reported coverage in the area). The selected residential address in Avondale has access to 0 out of the 7 advertised offerings by Verizon (with a 99.4% reported coverage in the area).

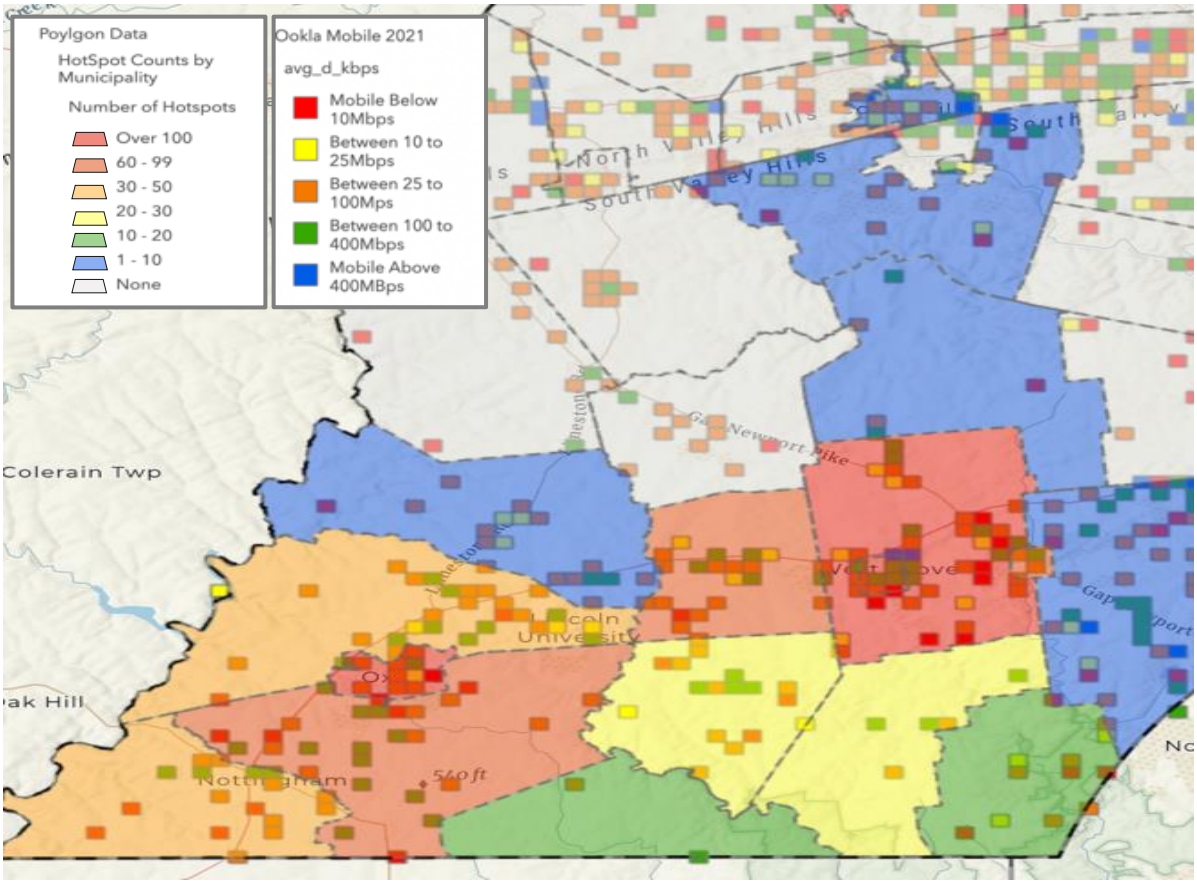
A revised set of broadband maps will be published by the FCC in the 4th quarter, which could be more accurate. However, Magellan encourages stakeholders to conduct their own independent broadband mapping analysis and continue evaluating the coverage and service levels provided to consumers in order to tell their own story.

NTIA BROADBAND MAPPING DATA

Similar to the FCC's broadband maps, the NTIA's National Broadband Availability Map (NBAM) shown below suggests that most of Southern Chester County has a median speed of roughly 400 Mbps download. Ookla's speed test data is one of the mapping layers embedded in the NTIA's National Availability Broadband map. This data is not commensurate with Magellan's survey results, market analysis or stakeholder feedback.

OOKLA[16] MOBILE AND FIXED BROADBAND SPEED TEST DATA

Figure 29 - Ookla Mobile Speed Data and Hotspot Counts

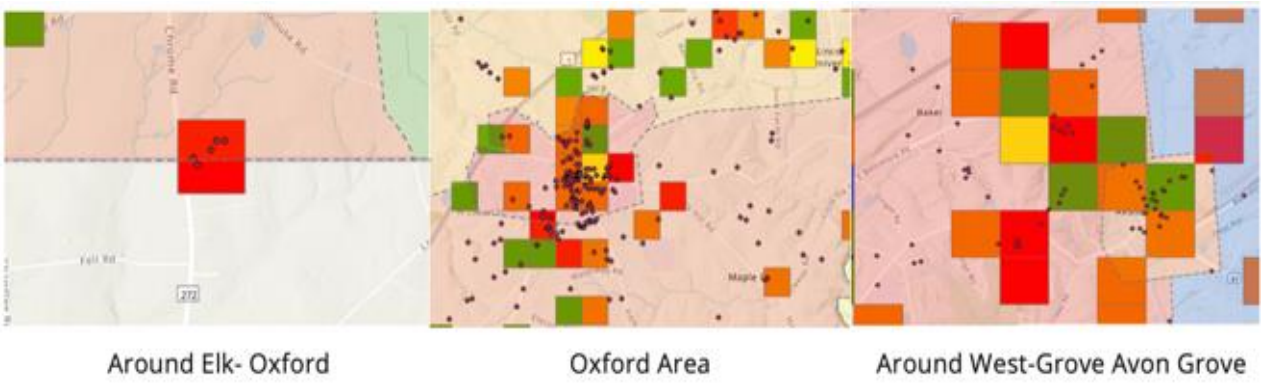


Magellan mapped the locations of over 100 hotspots that were distributed to students in the Oxford Area, Avon Grove, Kennett Consolidated and Unionville-Chadds Ford school districts. The Ookla Speed Test data for mobile connections in Figure 29 above, shows numerous spots in these same areas receiving less than 25 Mbps down. This data provides a useful comparison point to the broadband mapping data illustrated by the FCC and NTIA.

Ookla's publicly available broadband speed test for mobile use as shown in Figure 30 below, indicates that speeds are well below 10 Mbps in areas where hotspots are used by students around Southern Chester County.

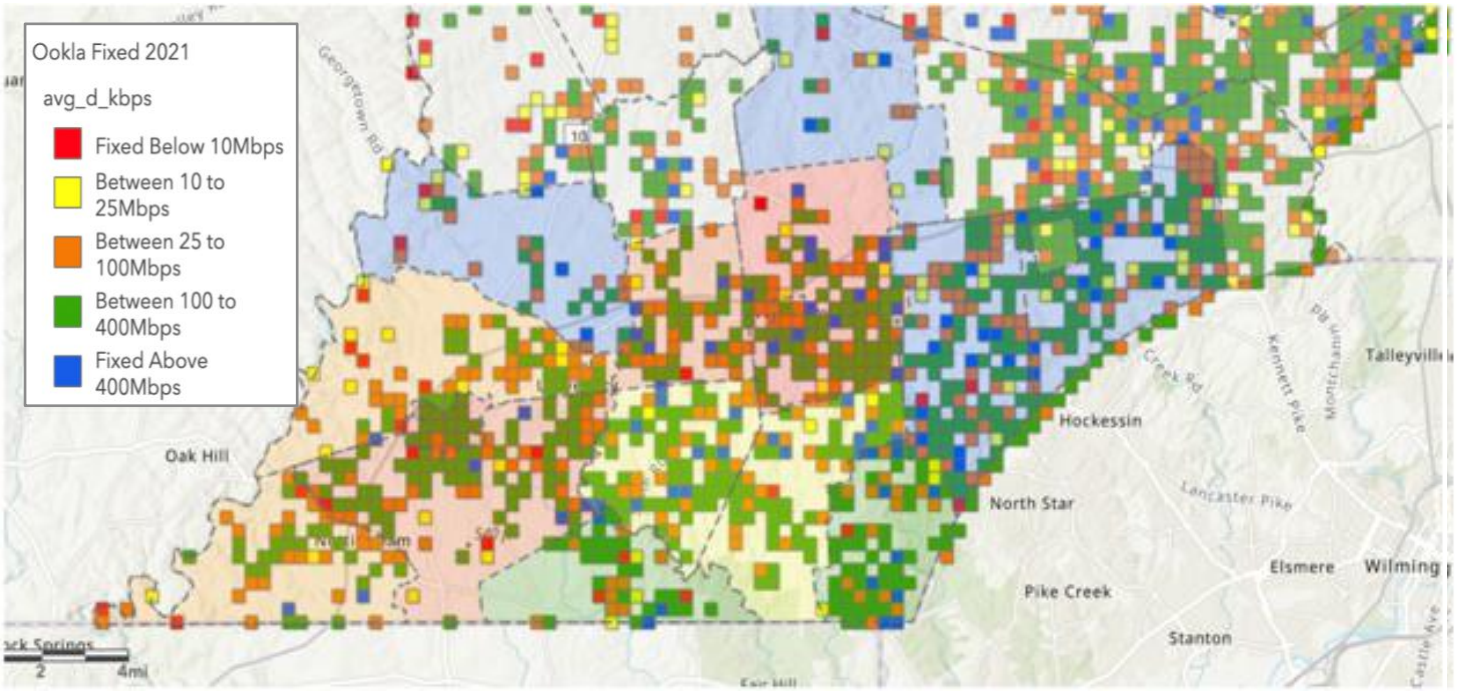
[16] Speedtest by Ookla - The Global Broadband Speed Test

Figure 30 - Low Mobile Speed Test Data and Area with >100 Hotspots Distributed



Ookla's data for fixed broadband connections in Figure 31 below, also shows that most households in Southern Chester County have reported a wide dispersion of download speeds at their home. Most reported speeds of at least 10 to 25 Mbps down. Few consumers reported speeds of 400 Mbps and above.

Figure 31 - Ookla Fixed Broadband Speed Test Data



Not all locations in the same census block can access the same level of service. To reiterate, federal mapping data as well as advertised speeds and availability claims can be overstated and not supported by stakeholder testimonials and other

independent, publicly available data pertaining to end user speeds and service availability as illustrated in the next section below.

INCUMBENT BROADBAND SERVICE PROVIDER MARKET DATA IN SOUTHERN CHESTER COUNTY

The analysis outlined below is from data pulled from the websites of each Internet Service Provider (ISP) in Southern Chester County as well as from several independent broadband market research tools[17].

Based on these inputs, the two major wireline service providers in Southern Chester County are Verizon and Comcast's Xfinity broadband offering. Both vary in their percentage of coverage across the Southern Chester County market depending on the geographical location. The region is also served by six other providers: HughesNet, Viasat, T-Mobile 5G Home Internet, Windstream, Frontier and Upward broadband. All providers listed below, with the exception of fiber backbone providers, offer a discounted service tier to qualified low-income households under the Affordable Connectivity Program which is discussed in further detail later in this study. Below is a summary of each provider and their corresponding market share.

xfinity

Xfinity, Comcast's retail broadband service offering, is reported and advertised as serving over 83% of all households throughout Southern Chester County (see Figure 32 for the list of advertised service offerings). Twelve of the 14 residential locations selected are shown as covered by Xfinity with multiple packages available according to their website[18]. However, stakeholders in the region indicate that Xfinity service and coverage is inadequate in these areas.

Comcast's Xfinity is less prevalent in Oxford (zip code 19363), serving less than 3% of households, and in Cochranville (zip code 19330), serving less than 6.1% of all households. Prices also vary per location. These are locations where Armstrong cable is the dominant provider. All of Xfinity's advertised pricing is introductory and increases incrementally year after year depending on the package, which varies depending on the location.

[17] Broadbandsearch.net- a data resource that aggregates data from the FCC, NTIA and the Bureau of Labor and Statistics, and performs data confirmation with each of the providers https://www.broadbandsearch.net/

[18] https://www.xfinity.com/learn/internet-service

Figure 32 - Xfinity's Advertised List of Service Offerings

Download Speeds in Mbps	Type	Price per Month	Contract Terms
50	Cable modem	$65.00	No term contract
100	Cable modem	$83.95	No term contract
200	Cable modem	$29.99	Price for 24 months; 1-year contract
400	Cable modem	$59.99	Price for 24 months; 1-year contract
800	Cable modem	$69.99	Price for 24 months; 1-year contract
1200	Cable modem	$79.99	Price for 24 months; 2-year contract
3000	Cable modem	$299.95	Price for 24 months; 2-year contract

COMCAST BUSINESS Comcast Business offers bundled services that include internet, phone, cable television as well as home monitoring to businesses. However, this study's market research only focused on the minimum Business Internet offerings (excluding bundle packages, to compare fairly with other providers' speed and price offerings) as shown in Figure 33 below.

According to its website[19], Comcast Business offerings are available in all the selected addresses around Southern Chester County (shown in Appendix 2). However, based on publicly available data,[20] the service packages offered do not match the service information for all addresses on the provider's website.

[19] https://business.comcast.com/shop/offers

[20] www.broadbandnow.com

Figure 33 - COMCAST Business List of Advertised Service Offerings

Offering Package Name	Download Speed in Mbps	Type	Price per Month	Contract Terms
Starter Internet	**35**	Cable modem	$35.00	Price for 24 months with 2-year contract
Starter Internet	**35**	Cable modem	$60.00	Price for 24 months with 3-year contract
Starter Internet	**35**	Cable modem	$70.00	Price for 24 months with 2-year contract
Business Internet 200 + Security Solution	**200**	Cable modem	$90.00	Price for 24 months with 3-year contract
Business Internet 300 + Security Solution	**300**	Cable modem	$180.00	Price for 24 months with 3-year contract
Business Internet 1 Gig + Security Solution	**1000**	Cable modem	$250.00	Price 24 months with for 3-year contract
Business Internet 100 + Security Solution	**100**	Cable modem	$149.95	Price for 24 months with 2-year contract
Business Internet 600 + Security Solution	**600**	Cable modem	$349.95	Price for 24 months with 3-year contract

Verizon is the incumbent DSL and fiber broadband provider in Southern Chester County serving residential and business locations throughout the communities within the four school districts. Verizon also advertises a 5G fixed wireless broadband offering and a bundled voice and fiber broadband package under its Fios brand to residential and business customers. The service offerings are shown below in Figures 34, 35 and 36.

According to data found on Verizon's website[21], only 9 of 14 residential addresses can receive service (shown in Appendix 2). However, the service packages offered are not the same for all addresses. For example, in Oxford where the study shows Verizon providing coverage to 88% of the service area, it only offered one type of service out of the seven that is advertised in the area. This one available DSL/high-speed internet service provides a maximum of 7 Mbps down for $40.00 per month, even though it's advertised as delivering up to 15 Mbps for the same price.

[21] https://www.verizon.com/5g/homehttps://www.verizon.com/business/products/networks/connectivity/5g-business-internet

Figure 34 - List of Verizon's High-Speed Internet Service Offerings

Speed in Mbps	Type	Price per Month	Other Information
15	DSL	$40	No term contract
15	DSL	$74.99	No term contract, Verizon home phone service required

Figure 35 - List of Verizon's 5G Home Internet Service Advertised Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
300	Fixed Wireless	$50.00	Price for 24 months then adjusted to the regular rate; Requires Autopay; Includes Disney+ for 6 months, one month of 5G Home, Verizon Stream TV Device, and Sling TV for 2 months.
1000	Fixed Wireless	$70.00	Price for 36 months then adjusted to the regular rate; Requires Autopay; Includes Disney+ for 6 months, one month of 5G Home, Verizon Stream TV Device, and Sling TV for 2 months.

Figure 36 - List of Verizon's Fios Advertised Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
940	Fiber	$159	No term contract; Includes $100 Verizon Gift Card plus Disney bundle for 12 months.
300	Fiber	$39.99	No term contract; Includes $50 Verizon Gift Card (online only) plus Disney bundle for 6 months.
500	Fiber	$64.99	No term contract; Includes $50 Verizon Gift Card (online only) plus Disney bundle for 6 months.
940	Fiber	$84.99	No term contract; Includes $100 Verizon Gift Card plus Disney bundle for 12 months.

Viasat | exede Viasat's Exede satellite broadband offering is available to residential households in Southern Chester County. Viasat provides unlimited internet with no data caps. Viasat's service offerings shown in Figure 37, are available to all residential addresses used in this sample (shown in Appendix 2). However, monthly residential rates are higher than those advertised. For example, in West Grove, the advertised price[22] for the "Unlimited Bronze 12" costs $49.99 as shown in Figure 37, but the available price is $64.99, which is expected to increase to $84.99 after three months[23] (shown in Appendix 2).

[22] https://broadbandnow.com/Viasat-Internet-deals

[23] https://buy.viasat.com/en-US/r/pln

Figure 37 - List of Viasat's Advertised Service Offerings in Southern Chester County

Offering Package Name	Download Speed in Mbps	Type	Price per Month	Contract Terms
Unlimited Bronze 12	**12**	Satellite	$49.99	$49.99/mo promo rate for the first 3 Months, $69.99/mo regular rate; After 40 GB of High-Speed Data usage, you still have unlimited access to Standard Data, which may result in slower speeds.
Unlimited Silver 25	**25**	Satellite	$69.99	$69.99/mo promo rate for the first 3 Months, $99.99/mo regular rate; After 60 GB of High-Speed Data usage, you still have unlimited access to Standard Data, which may result in slower speeds.
Unlimited Platinum 100	**50**	Satellite	$99.99	$149.99/mo promo rate for the first 3 Months, $199.99/mo regular rate; After 150 GB of High-Speed Data usage, you still have unlimited access to Standard Data, which may result in slower speeds.
Unlimited Gold 50	**100**	Satellite	$149.99	$99.99/mo promo rate for the first 3 Months, $149.99/mo regular rate; After 100 GB of High-Speed Data usage, you still have unlimited access to Standard Data, which may result in slower speeds.

HughesNet offers satellite broadband services in the Southern Chester County market with a 25 Mbps plan with different data caps. The plans range from 15GB data cap for $44.99 after promo discount to 75GB data cap for $139.99 per month. Offers require a 2-year contract as shown below in

Figure 38. HughesNet's website[24] indicates that its service offerings are available in all residential addresses (also shown in Appendix 2). They are consistent with their advertised service offerings with what is available to residents based on the data collected for this study. However, their prices are only introductory and will increase after 6 months which is similar to other providers' plans.

Figure 38 - List of HughesNet's Advertised Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
25	Satellite	$44.99	24-month commitment required; Price for 6 months; 15 GB data allowance
25	Satellite	$54.99	24-month commitment required; Price for 6 months; 30 GB data allowance
25	Satellite	$89.99	24-month commitment required; Price for 6 months; 45 GB data allowance
25	Satellite	$139.99	24-month commitment required; Price for 6 months; 75 GB data allowance

T-Mobile provides 5G and 4G LTE fixed wireless service nationwide. Their advertised download speeds range between 33-182 Mbps and may vary depending on the location, time of the day, weather, and other factors. The service offerings are shown below in Figure 39.

Based on the per address research performed by Magellan, T-Mobile is only offering its services to 6 out of the 14 Southern Chester County residential addresses[25] selected for this study (See Appendix 2).

[24] https://internet.hughesnet.com/order-online

[25] https://www.t-mobile.com/isp/eligibility

Figure 39 - List T-Mobile's 5G Home Internet advertised Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
115	Fixed Wireless	$50.00	No term contract; Get one year of Paramount+ Essential monthly plan for free.
115	Fixed Wireless	$55.00	No term contract; *Speeds may vary. Sales taxes & regulatory fees included in the monthly price for qualified accounts. Not available in all areas.

ARMSTRONG Armstrong cable's Zoom brand is the dominant offering in the Oxford area for both residential and business consumers. Their advertised speeds range from 25-500 Mbps. Armstrong's services are only available to 2 out of the 14 residential addresses, according to their website's residential service offerings page[26] and shown below in Figures 40 and 41. The two locations are Oxford and Cochranville. These services are only available to one out of 14 business addresses and is located in Oxford (See Appendix 2).

Figure 40 - List of Armstrong's Advertised Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
25	Cable modem	$34.95	300 GB monthly data allowance
150	Cable modem	$54.95	Price for 6 months; 1 TB monthly data allowance
300	Cable modem	$69.95	Price for 6 months; 2 TB monthly data allowance
500	Cable modem	$89.95	Price for 3 months; Unlimited monthly data allowance

[26] https://armstrongonewire.com/Internet/ServiceLevels

Figure 41 - List of Armstrong's Advertised Fiber Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
100	Fiber	$69.95	Term contract required for pricing. Additional monthly fees apply. Pricing may vary depending on location.
200	Fiber	$109.95	Term contract required for pricing. Additional monthly fees apply. Pricing may vary depending on location.
300	Fiber	$134.95	Term contract required for pricing. Additional monthly fees apply. Pricing may vary depending on location.
400	Fiber	$184.95	Term contract required for pricing. Additional monthly fees apply. Pricing may vary depending on location.
500	Fiber	$254.95	Term contract required for pricing. Additional monthly fees apply. Pricing may vary depending on location.

Frontier advertises its broadband service being available throughout Southern Chester County as listed in Figure 42. However, according to Frontier's service availability webpage[27] they are only available in 2 (Cochranville and Atglen) out of 14 residential locations, and 1 (Cochranville) out of 14 business addresses (See Appendix 2).

Figure 42 - List of Frontier's Advertised Service Offerings

Download Speed in Mbps	Type	Price per Month	Contract Terms
115	DSL	$49.99	No term contract
500	Fiber Optic – Cable	$49.99	No term contract
940	Fiber Optic – Cable	$74.99	No term contract
2000	Fiber Optic – Cable	$149.99	No term contract

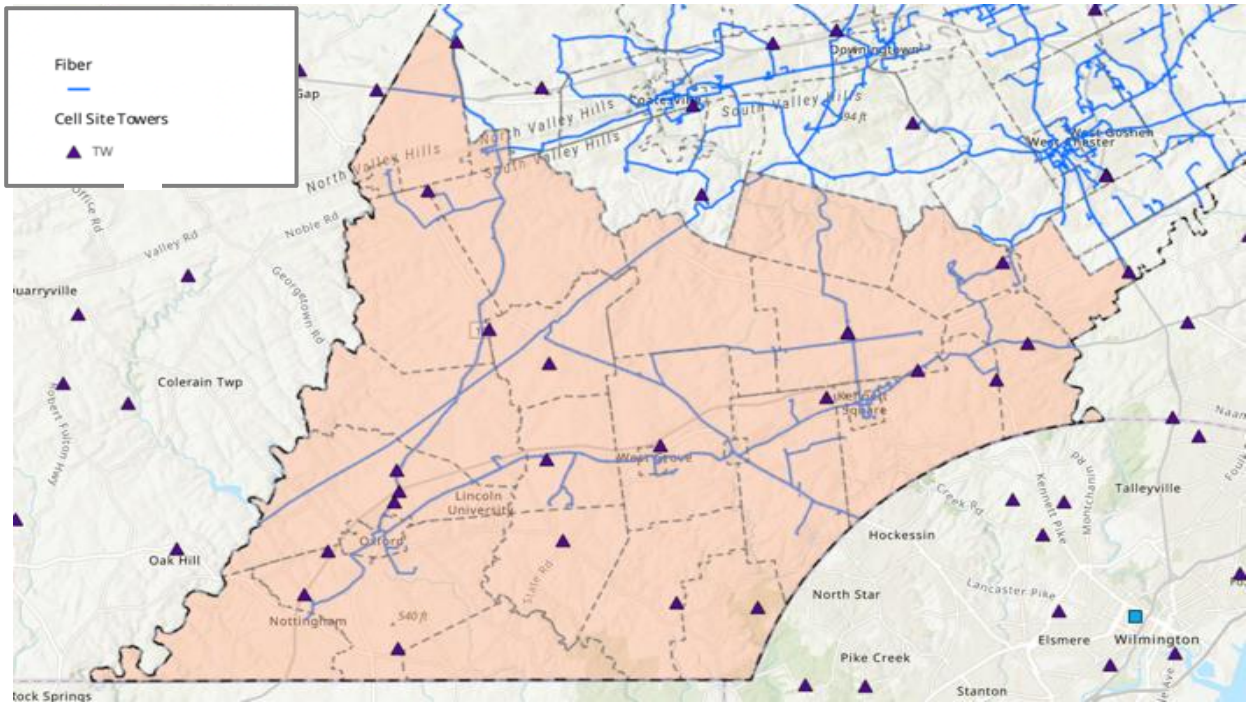
[27] https://internet.frontier.com

Chesconet is a regional, member-driven, middle mile, fiber-based service provider that utilizes Crown Castle's wholesale fiber network to connect every school district and library within the region. Their website[28] advertises a minimum of 1 Gbps download and upload speeds to its members.

Crown Castle fiber services are widely available throughout Southern Chester County, spanning 500 miles of optical fiber facilities. The map shown in Figure 43 below indicates a substantial number of wireless tower facilities and middle-mile fiber routes located across Southern Chester County.

These network assets are ideally located in areas where an affordable last mile solution is needed and can be offered. For example, there are several towers located north and south of Oxford township and several just outside of Kennett Township where numerous mushroom farms are located.

Figure 43 - Crown Castle Fiber Routes and Cell Towers in Southern Chester County



[28] https://www.chesco.net/service-package

MIDDLE MILE FIBER ROUTES EXIST THROUGHOUT THE REGION

There are multiple providers with fiber network assets in Southern Chester County, which include regional "middle-mile" and national and international "long-haul" networks that pass through the area. Several of these providers are regionally focused. Some provide IP transport and enterprise network services, some lease dark fiber that customers must light and manage on their own. As illustrated in Figures 44, 45 and 46 below, there are numerous providers that own fiber in Southern Chester County.

The maps below indicate a robust supply of middle-mile fiber connectivity throughout the region. As a result, the infrastructure needs of local governments in Chester County should be focused on last mile (reaching the end user premises) network construction to ensure affordable services are provided to end user residential, business, farm and anchor customers.

Figure 44 - Middle-Mile and Long-Haul Networks Identified on the Fiber Locator Tool

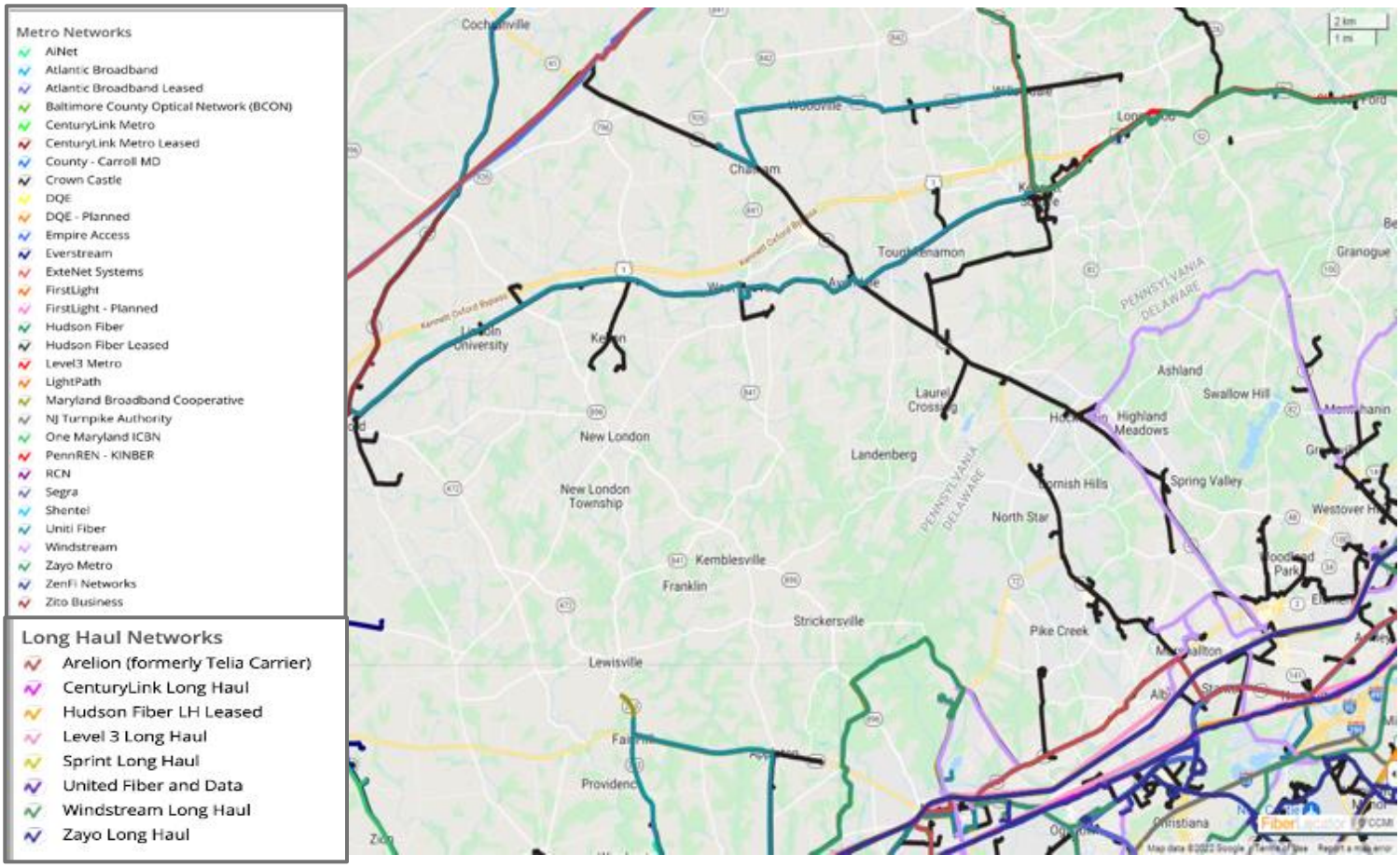


Figure 45 - Middle-Mile Networks Serving Southern Chester County Found on Fiber Locator

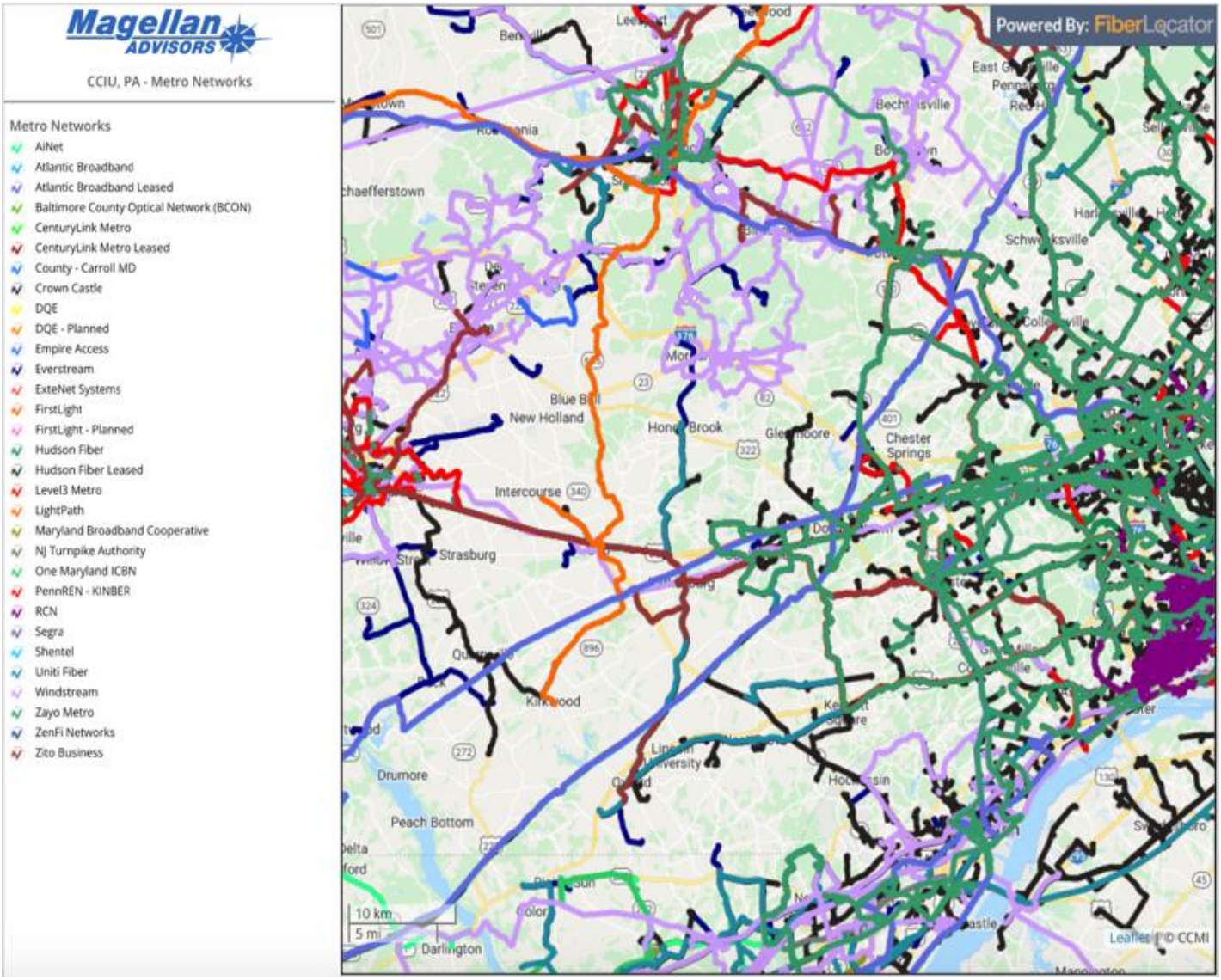
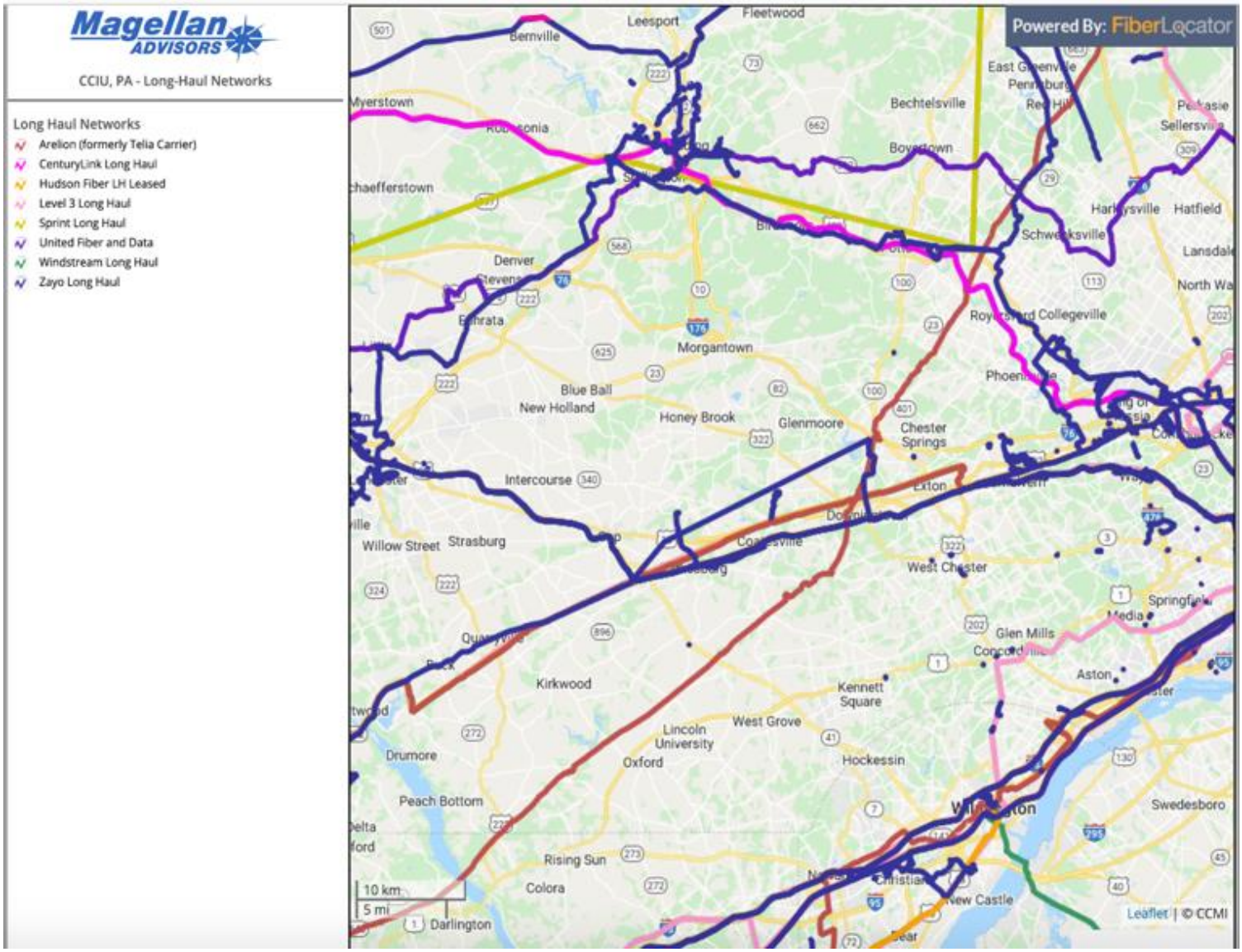


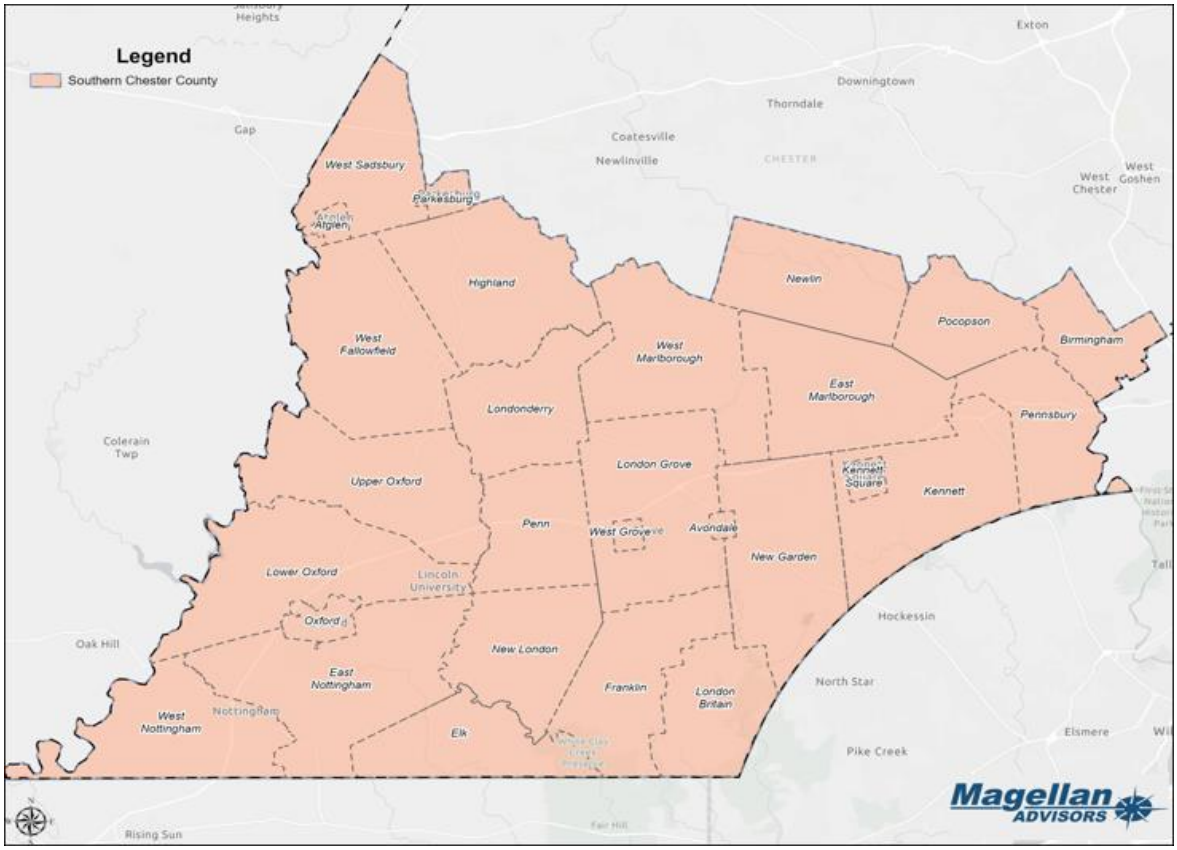
Figure 46 - Illustration of All Long-Haul Fiber Middle Mile Networks



Comprehensive Mapping Analysis of Southern Chester County Region

This section includes numerous mapping layers illustrating important characteristics of the project area for this study. The map in Figure 47 below shows each municipality in Southern Chester County.

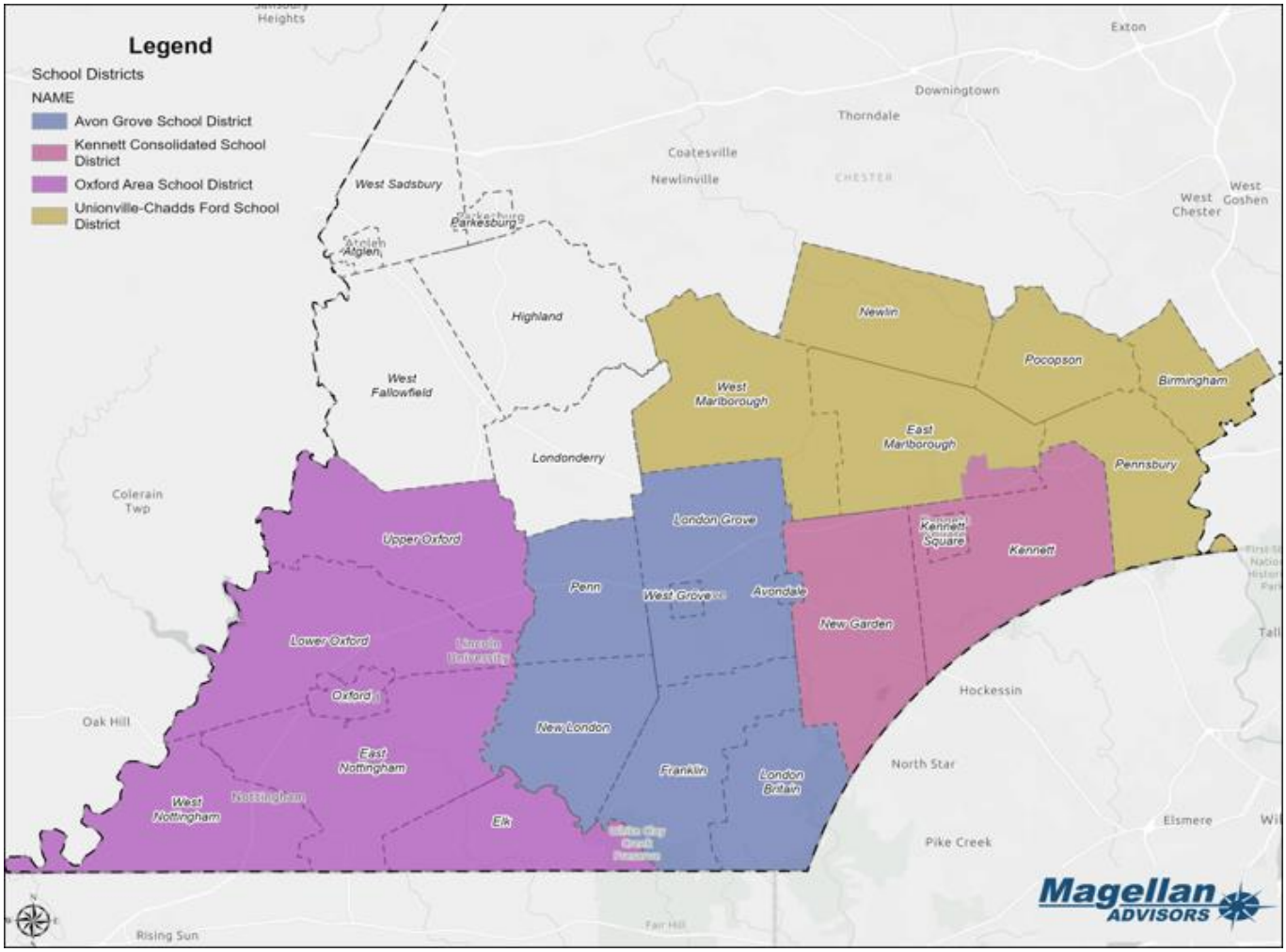
Figure 47 - Southern Chester County Base Map



Southern Chester County's School District Map

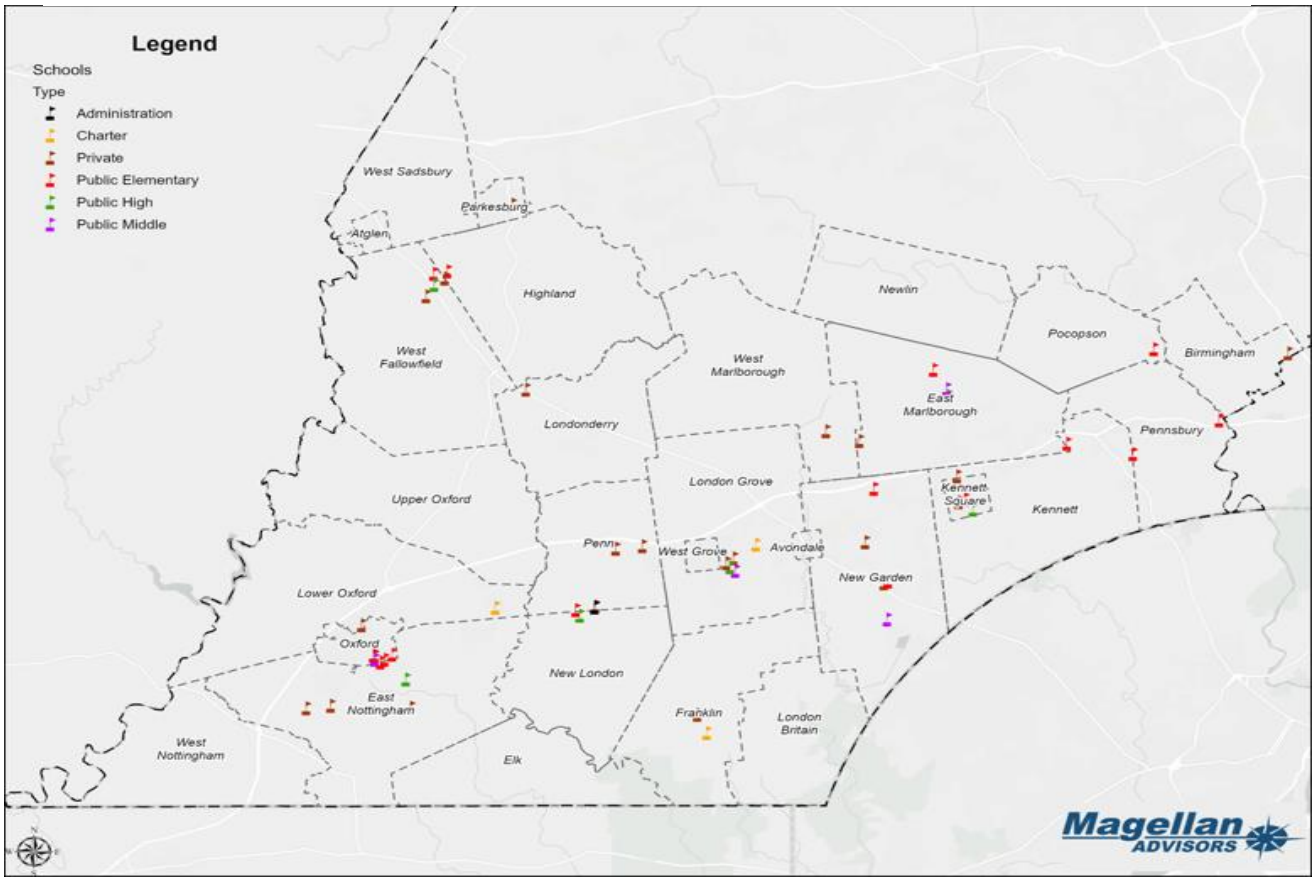
Figure 48 below is an illustration of Southern Chester County's base map overlayed with the four school district boundaries identified as the main project areas for this Study. These school districts are Avon Grove, Kennett Consolidated, Oxford Area and Unionville-Chadds Ford.

Figure 48 - Project Area by School District



School locations by type are pinned across the region shown in Figure 49 below

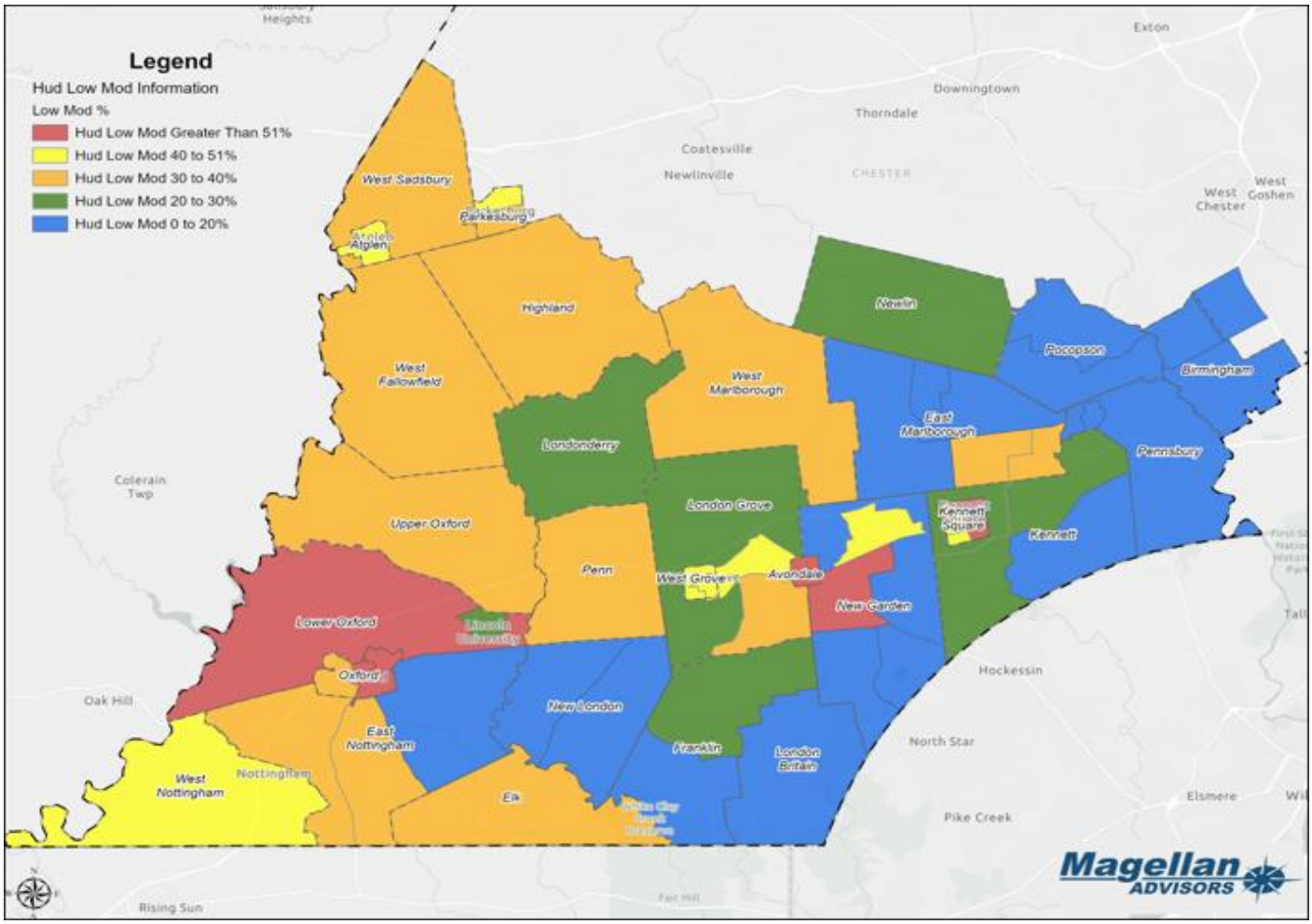
Figure 49 - School Locations



Location of Low-Income Eligible Areas[29] in the region defined by HUD

U.S. Department of Housing and Urban Development (HUD) data was utilized to determine areas that may be eligible for HUD grant programs such as the Community Development Block Grant (CDBG) based upon Low and Moderate Income (LMI) statistics which consider persistent poverty levels for at-risk populations. The map in Figure 50 below indicates that Avondale, part of Kennett Square, New Garden and Lower Oxford all have a Lo/Mod score of 51% or more, which means they are located in areas with "at risk" populations. This metric is a useful benchmark for identifying persistent poverty households in any given census block.

Figure 50 - Low Income Eligible Areas Defined by HUD



[29] Low and moderate income, as defined by the Census Bureau are communities that have a household median income that are either: (a) less than 50% of their specific area's median income (low income), or (b) household median incomes that are at least 50% and 80% of the area's median income (moderate income).

FCC Form 477 broadband mapping data

The FCC defines an area as being "served" with sufficient broadband access if one or more locations receive at or above 25Mbps down and 3Mbps up.

Areas defined as underserved are those receiving speeds below 25 Mbps down and 3 Mbps up and above 10Mbps down and 1 Mbps up.

Areas defined as wholly undeserved are those receiving speeds at or below 10Mpbs down and 1 Mbps up.

Figure 51 -FCC'S Broadband Speed Definitions

Unserved	Less than 10 Mbps down/1 Mbps up
Underserved	At least 10 Mbps down/1 Mbps up and less than 25 Mbps down/3 Mbps Up
Served	At or above 25 Mbps down/3 Mbps up

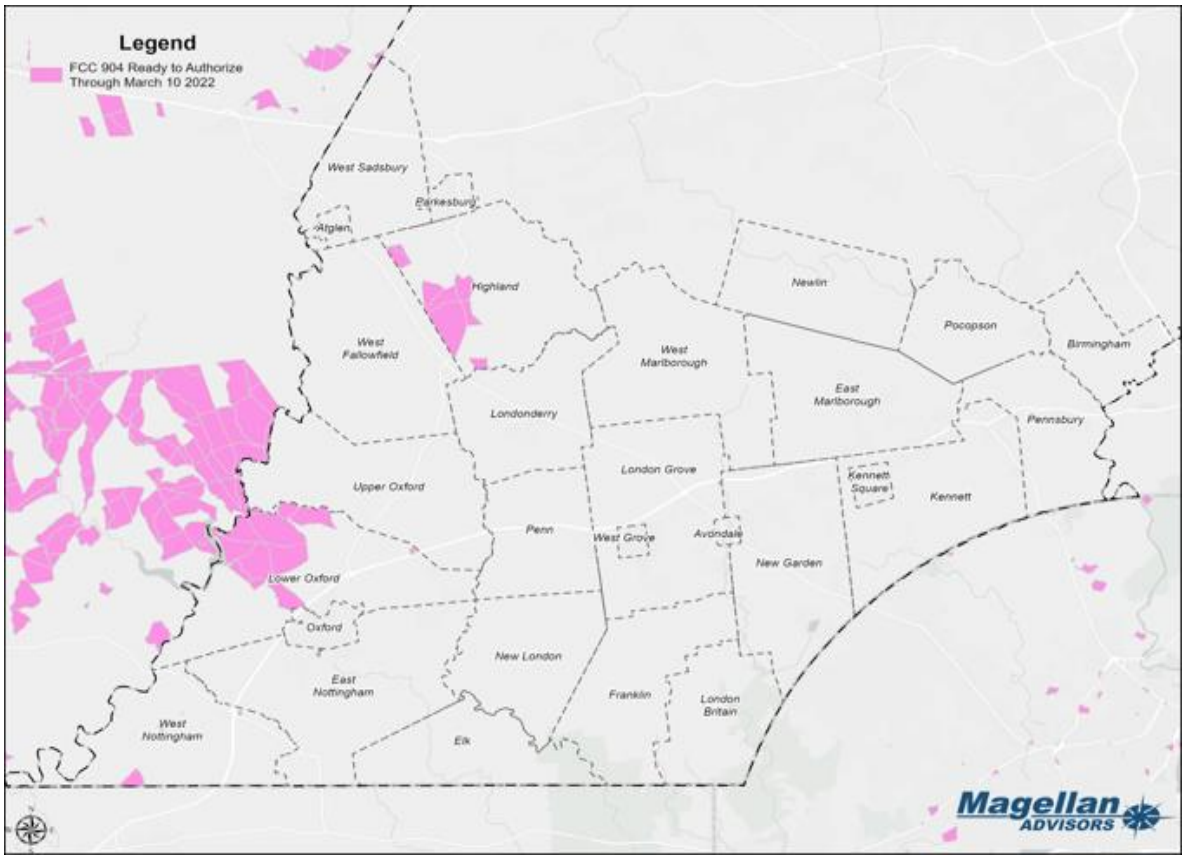
The FCC form 477 coverage data serves as the basis for all its federal support programs with the Universal Service Fund (USF)[30] which include the Affordable Connectivity Program (ACP), the Rural Digital Opportunity Fund (RDOF) subsidy.

[30] Universal Service - Universal Service Administrative Company (usac.org)

FCC's Rural Digital Opportunity Fund (RDOF) funded areas reported as of March 10, 2022

The areas shaded in pink in Figure 52 show census blocks awarded to Windstream Communications in the RDOF auction.[31] These are areas where a provider is awarded federal funds from the FCC based on enforceable build out commitments that must be completed within 10 years. These areas are generally not eligible for other federal funds unless there is a compelling case to do so based on speed to market, build out timelines and other benefits to end users.

Figure 52 - FCC RDOF Auction Awarded Areas to Windstream Communications



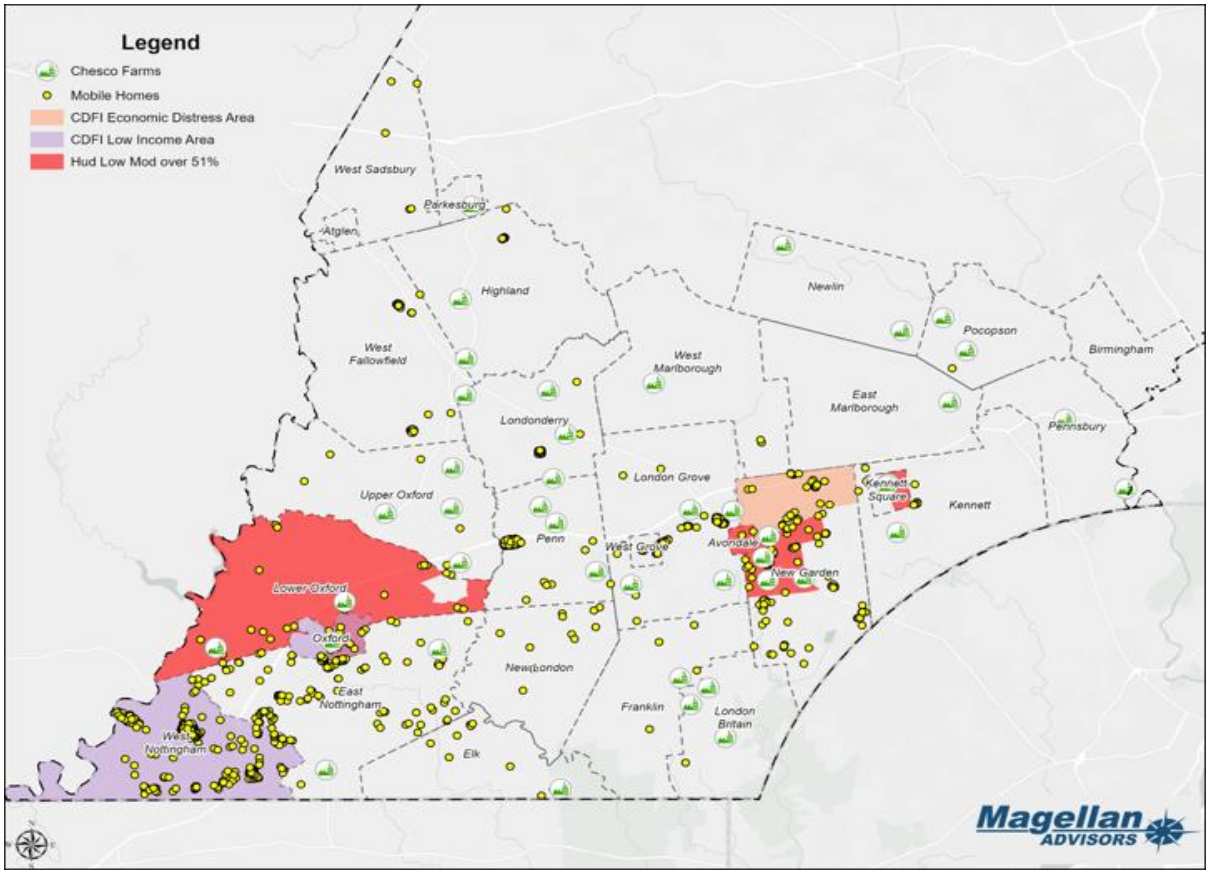
[31] Auction 904: Rural Digital Opportunity Fund | Federal Communications Commission (fcc.gov)

Mushroom Farming Facilities, Mobile Homes and Community Development Financing Initiative (CDFI)[32] data added to further refine the areas of concern

To identify a common set of poverty characteristics in the areas of concern for this study, multiple layers of additional economic and demographic data such as the Southern Chester County's farming facilities, mobile/trailer homes and CDFI data were overlayed as shown in Figure 53 below.

The location of mobile homes are clustered in areas that score over 51% Low/Mod classified by HUD as well as low income and economically distressed areas according to the U.S. Treasury Department. These areas are in Avondale, New Garden, Kennett Township, Lower Oxford and West Nottingham.

Figure 53 - Multiple Demographic Indicators of Poverty Throughout Southern Chester County

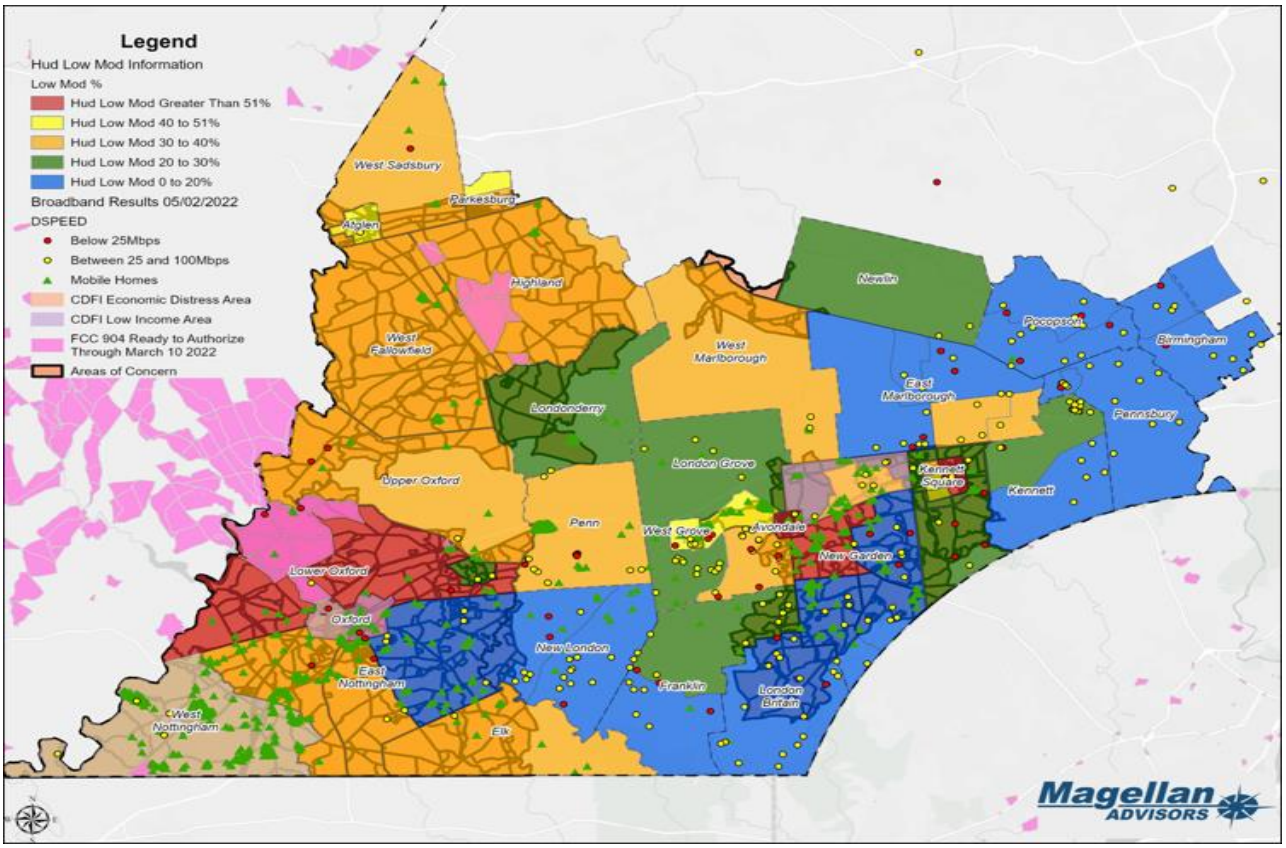


[32] https://www.cdfifund.gov/documents/geographic-studys

OVERLAYED MAPS: HUD/LOW INCOME ELIGIBLE AREAS, MAGELLAN SURVEY SPEED TEST DATA, CDFI DATA, FCC AUCTION 904 DATA (RDOF) AND KEY AREAS OF CONCERN

The map below shows several data layers overlayed to illustrate the primary areas of concern identified for this study. The map includes HUD Low to Moderate Income poverty determinations, Magellan's broadband survey data, Treasury's economic distress determinations based on the CDFI[33]and the FCC's Rural Digital Opportunity Fund (RDOF) subsidized areas in the region. This map shows the areas that are the most in need according to federal poverty benchmarks used by HUD and Treasury as indicated in orange and red.

Figure 54 - Multiple Data Layered Map

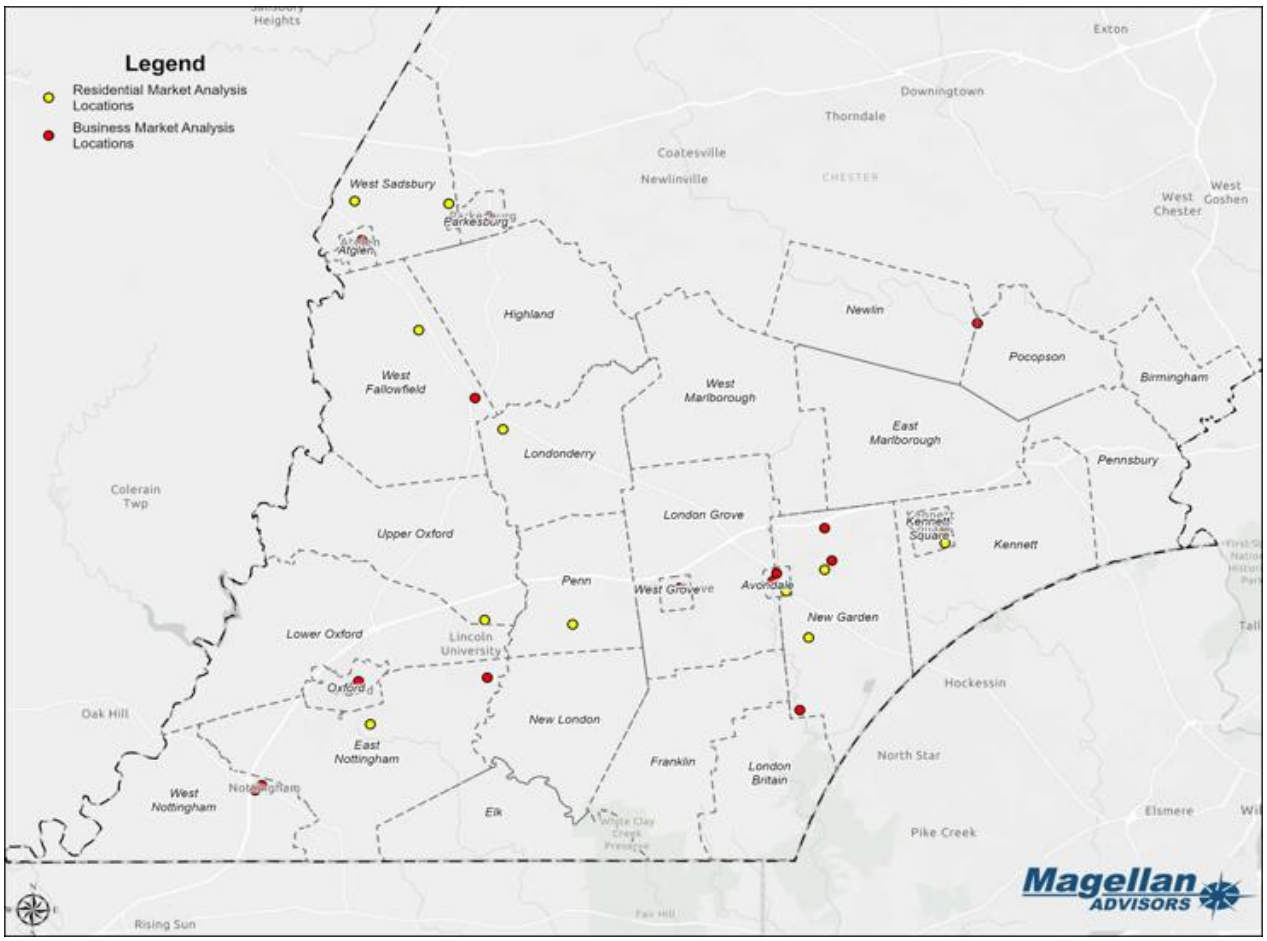


[33] Community Development Financial Institution (CDFI) Certification is a designation given by the CDFI Fund to specialized organizations that provide financial services in low-income communities and to people who lack access to financing - https://www.cdfifund.gov/

MARKET ANALYSIS OF RESIDENTIAL AND BUSINESS LOCATIONS

Magellan selected a random sample of residential and business addresses around the project area per zip code for both residents and businesses to verify the services that the citizens are receiving. The map below shows the location of those addresses.

Figure 55 - Market Analysis Test Locations Among Residential and Business Addresses



KEY AREAS IDENTIFIED AS CHRONICALLY UNSERVED.

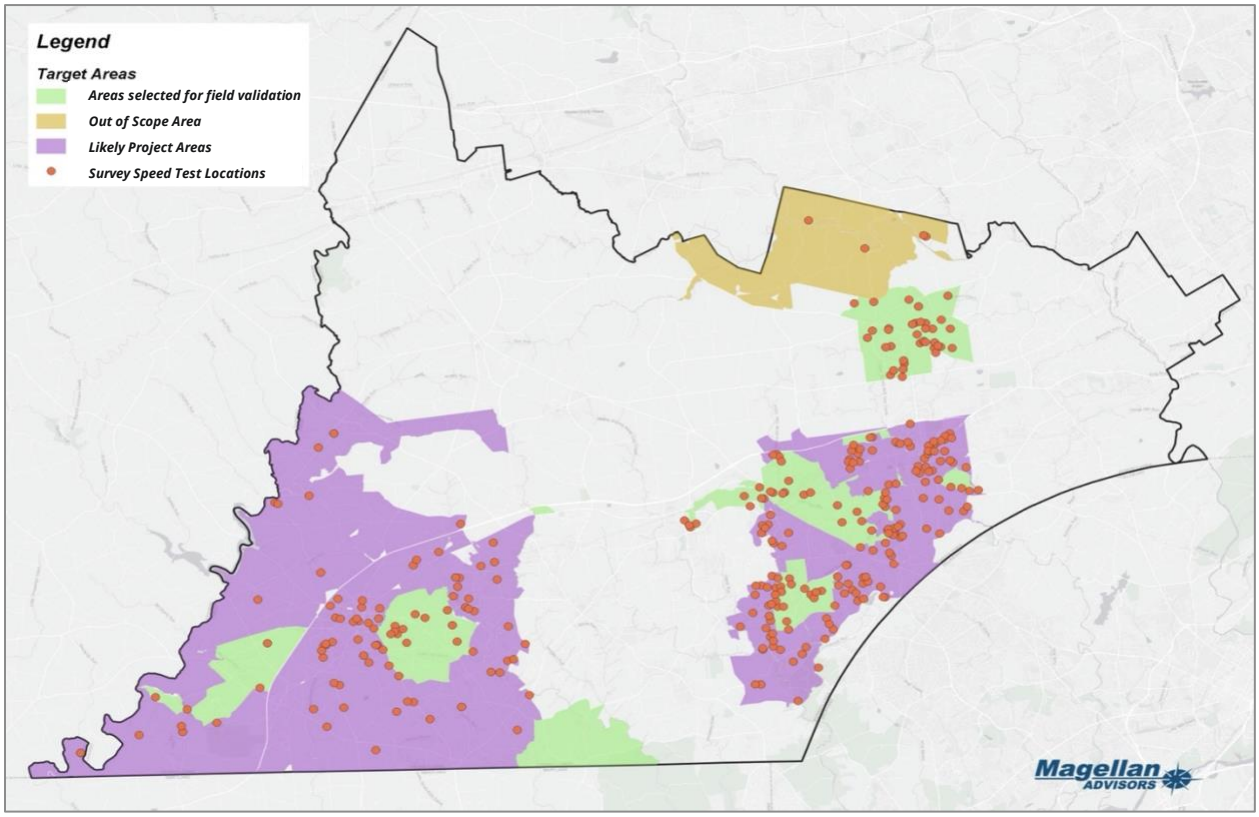
The areas shaded in purple in the map below (Figure 56) are the key areas identified as those with the greatest need and the poorest service and coverage based on all data sets reviewed and integrated into Magellan's mapping analysis identified in this study. The areas in light green were reviewed by Magellan's field validation team.

These areas should be the focus of the local leaders going forward for last mile broadband infrastructure projects. Magellan used the following criteria and data to select these areas which include the data reflected in Figures 56.

1. NTIA census blocks with reported broadband speeds of less than 100 Mbps
2. NTIA census blocks with reported poverty greater than 20%
3. HUD Low Mod households greater than 51%
4. CDFI reported low income and economic distressed blocks as reported by U.S. Treasury
5. Areas classified as underserved by Penn State Cooperative Extension
6. Magellan survey speed test results

The map in Figure 56 below indicates that the areas of greatest need (shaded in purple) are located throughout Kennett, Avondale, Elk Township, Oxford, Freemont, East Marlborough, Landenberg, East and West Five points and Penn Township.

Figure 56 - Areas of Concern Identified for Further Field Analysis Performed by Magellan

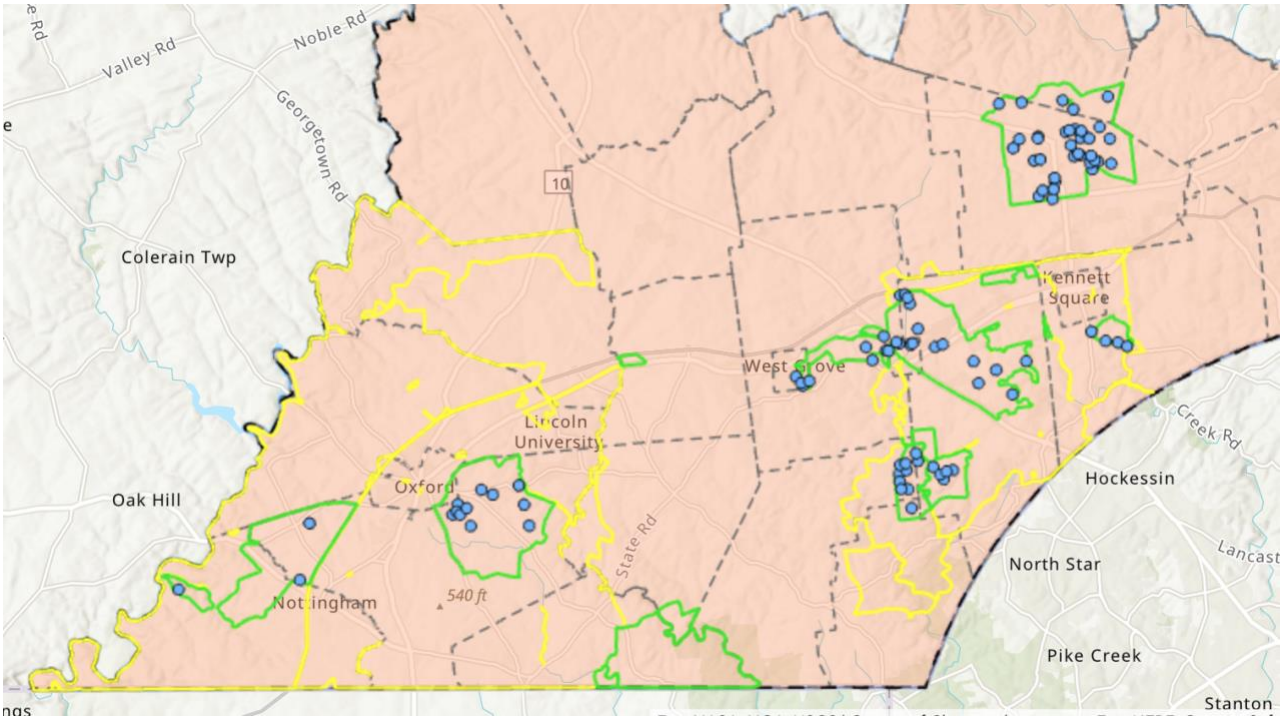


FIELD VALIDATION RESULTS AND CONCLUSIONS

Magellan sent its broadband field validation team into the Southern Chester County region to physically identify and verify network infrastructure within areas where our survey and mapping data showed a potential lack of coverage or where project team members requested further verification of certain areas around the school districts.

Figures 57 and 58 illustrate the areas where field analysis was conducted by Magellan. The fielding team was provided with specific residential addresses for field inspection to determine if any form of broadband infrastructure was visible either on the street or attached to the home.

Figure 57 - Addresses for Field Verification



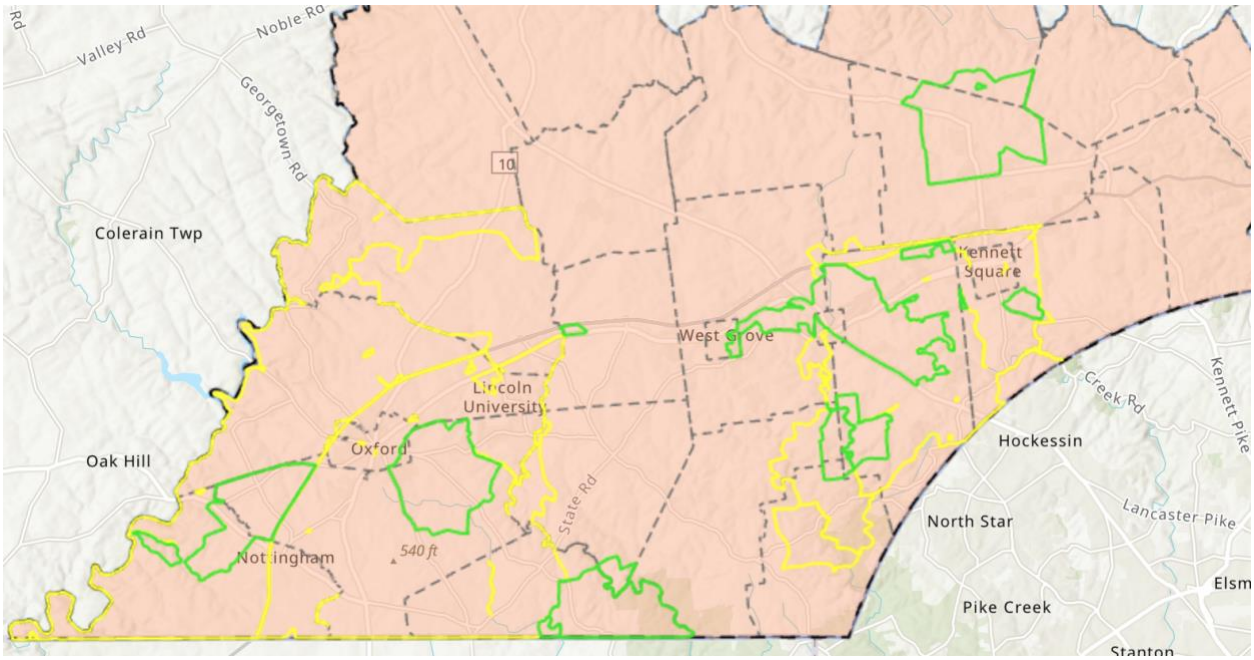
Of the 110 of addresses provided for field analysis, Magellan's fielding team identified each one as having some form of telecommunications facilities either attached to the home or located at the street level on poles.

The existence of these facilities does not alone suggest that households are receiving qualified broadband service as defined by the FCC and other federal agencies identified in this study. In most cases, it does not. Poor service quality and reliability persists for most residential consumers in the region and additional public

investments in these areas would help increase connectivity to households and businesses.

Most households in these areas are economically distressed and unable to afford service even if the facilities are on or near their home. While some infrastructure may exist, it does not mean residents can access those services due to price. Income, education levels, remoteness and other socioeconomic factors were evaluated to supplement the survey to identify where gaps in high-speed broadband access exist.

Figure 58 - Areas Selected for Field Validation (Green) and Proposed Project Areas (Yellow)



As stated earlier, Magellan in coordination with the school district technology directors identified the areas bordered in yellow (see figure 58 above) as the main areas of concern that warranted field validation. The areas bordering in green are the locations where the field teams conducted on the ground validation by walking the streets within these areas.

Table 7 - Field Validation Findings

Community Name	Level of Facilities Present
Elk Township	Broadband or DSL equipment present on some houses
Freemont	No broadband equipment noted
East Oxford/Maple Grove	High amount of infrastructure noted
Landenberg	Minimal infrastructure noted
West Penn Township	No infrastructure noted
East Five Points	Very little infrastructure noted
West Five Points	Very little infrastructure noted
Avondale (West side of Avondale has less infrastructure than the East.)	High amount of infrastructure noted
West Kennett Square	Very little infrastructure noted
East Marlborough Township	Broadband equipment available among all premises checked

Throughout the identified communities marked for field validation, the fielding team made notations of where broadband specific infrastructure was present at the residential locations checked. The specific types of broadband equipment and infrastructure present include pedestals[34], vaults[35] and hand holes[36].

The maps of each area that were validated by the Magellan fielding team (shown in figures 59 -62) suggest that some form of infrastructure and or equipment was visibly present on or near the homes, but this information did not provide enough detail on whether those consumers were truly served with high quality connectivity.

[34] **Pedestal** - a general-purpose, outdoor enclosure. It is the main node for voice, data and video distribution, in a passive optical network (PON). The pedestal is the network interface - at the neighborhood. Options, for its internal components, were designed, according to the global standards bodies.
[35] **Vault -** A fiber optic splice vault essentially serves as a demarcation point for incoming trunk cable in a central office, data center, or other large-scale application.
[36] **Hand holes** - underground vaults that provide access to fiber optic cable and other utilities for splicing & repairs. They are often called pull boxes, splice boxes, underground enclosures, or vaults.

Figure 59 – Infrastructure/Equipment Identified in Maple Grove

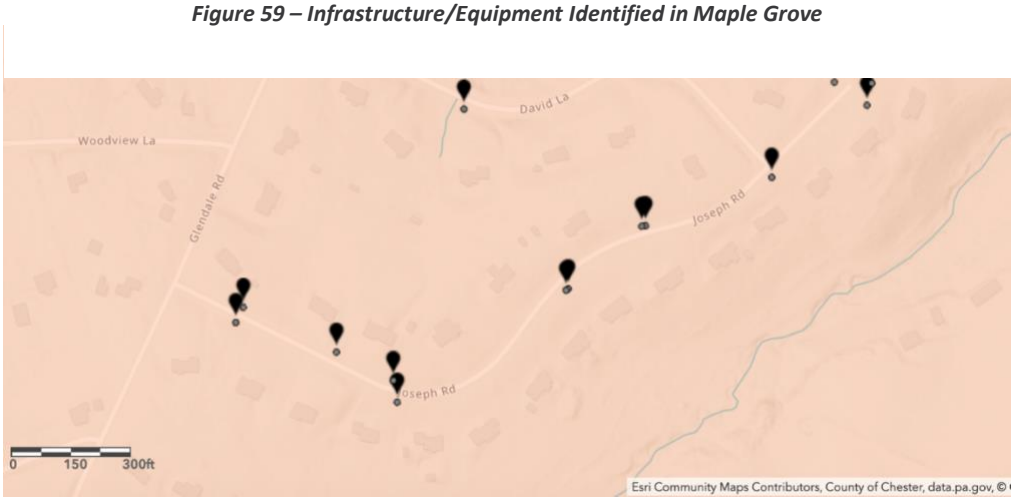


Figure 60 - Infrastructure/Equipment Identified in Elk Township

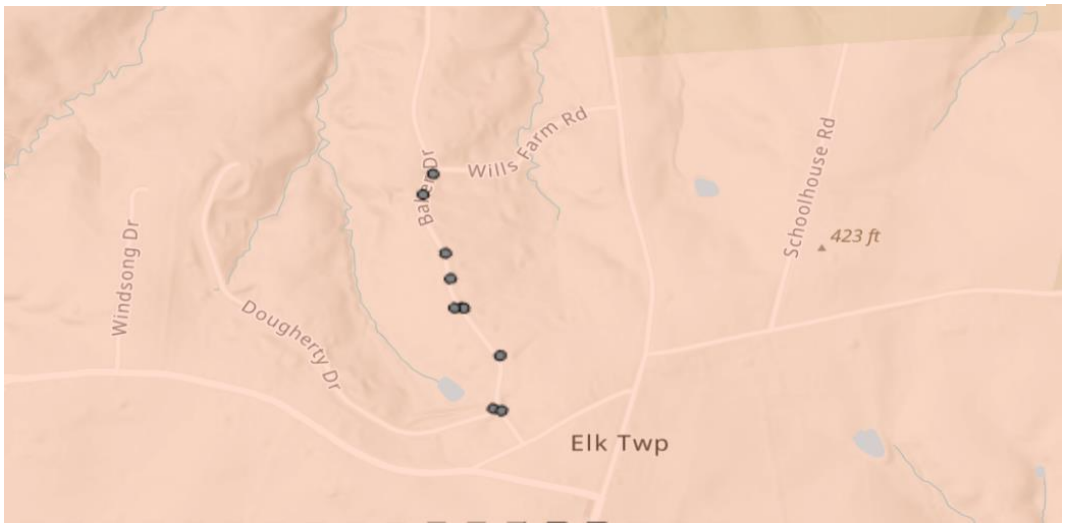


Figure 61 – Infrastructure/Equipment Identified in North Landenberg

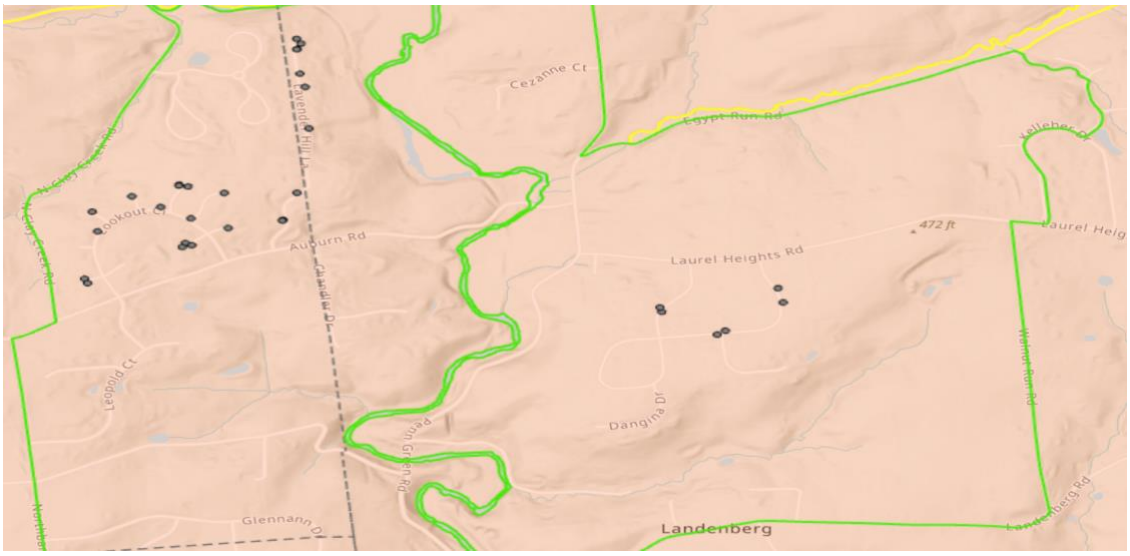
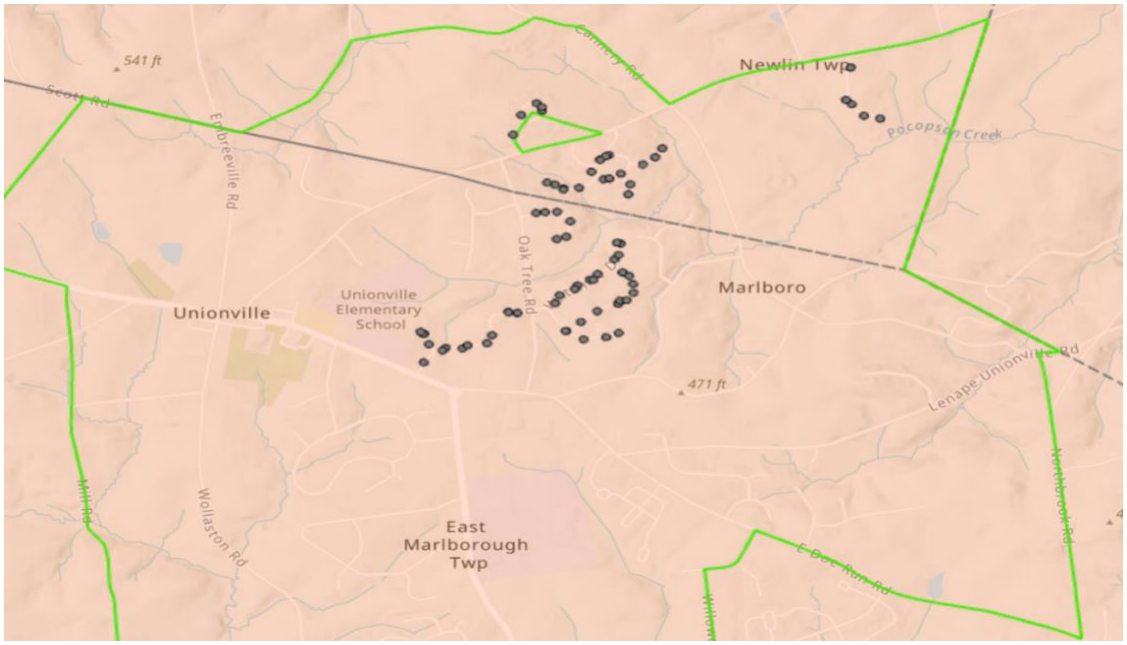


Figure 62 - Infrastructure/Equipment Documented in Unionville-Marlboro



CONCLUSION

The results of the field validation reaffirmed the assumptions of the school district technology directors as well as numerous stakeholders – the primary barriers for consumers in the region continue to center on a lack of affordability and access to reliable, high-quality broadband in their home or business location.

While broadband equipment may be visible in some locations, it is not the primary determinant of whether the residential household is receiving broadband service offered at price points they can afford. Therefore, Magellan recommends that township leaders consider low-cost solutions that may provide affordable universal broadband access to the entire region.

Broadband Project Options for Southern Chester County

As stated throughout this study, last mile broadband access (providing connectivity to the end user premises) is lacking throughout most communities in the region. Due to the presence of numerous cellular towers in the area (owned by Crown Castle), and backhaul capacity (fiber between the towers), Magellan recommends local leaders consider the benefits of pursuing a fixed wireless solution to provide 100% last mile connectivity directly to farms, homes and businesses.

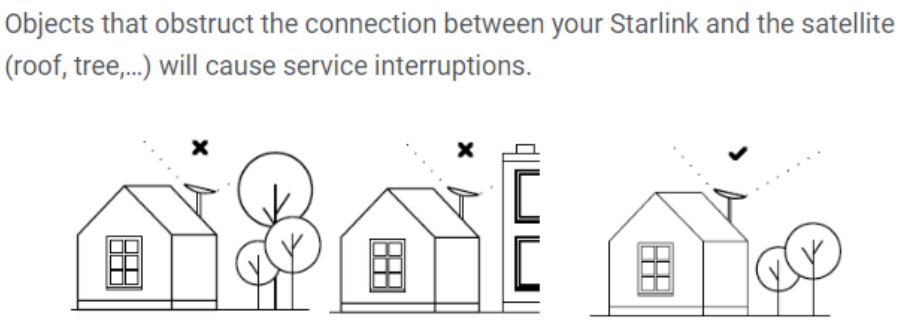
Magellan developed a High-Level broadband network Design (HLD) for a wireless overlay network to connect both residential, business and agricultural customers (mushroom farms) with a robust broadband solution using mid band spectrum (3.5Ghz to 3.7Ghz) known as the Citizens Band Radio Service (CBRS). A description of CBRS is shown in Appendix 3.

This option is far less costly than pursuing a fiber to the premises project that would be both time consuming and cost prohibitive to the region. Given the inherent supply chain delays in procuring fiber assets and the limited supply of skilled workers capable of trenching and installing fiber facilities, a fixed wireless solution could connect these communities faster and with less cost.

A satellite network may also offer similar speed to market benefits as a fixed wireless but may encounter latency challenges especially in rural areas during inclement weather which makes it a less reliable and less cost-effective option. A GEO stationary satellite network means the satellite is in a fixed position in orbit around earth. Two major providers use GEO systems today, HughesNet and ViaSat. Both are relatively

slow in speeds and expensive per megabit transmitted. A LEO satellite is a one where there are multiple satellites in Low Earth Orbits. The customer equipment for these networks switches from satellite to satellite as they pass over the sky. LEO satellites are closer to the Earth, so the latency is less than the GEO. Starlink is the only LEO commercial service available today, but the customer equipment is expensive, and the customer must have a clear view of the whole sky to have reliable service which makes this solution untenable for Southern Chester County.

Figure 63 - Starlink's Equipment Installation Illustration From its User Manual



FIXED WIRELESS SOLUTIONS TO PROVIDE BROADBAND TO MUSHROOM FARMS AND RESIDENTIAL COMMUNITIES

Mushroom farms are a critical segment of the agriculture economy in Pennsylvania, yet they continue to struggle with poor connectivity, thus constraining their productivity and competitive standing in the mushroom production sector nationally.

The mushroom farming sector throughout Southern Chester County is increasingly dependent on high-speed broadband connectivity to boost productivity, enhance supply chain efficiencies and maintain contact with employees.

These benefits are expected to grow and help mushroom farmers remain economically sustainable and expand revenue growth. Precision farming is also essential for helping farmers manage the health and safety of their workforce. Mushroom farms encountered enormous challenges during the pandemic as they tried to stay in touch with their workers to inform them about vaccination locations.

Fixed wireless radios (base stations) transmit data from either a water tank, grain silo, commercial or public safety tower or any tall structure to connect end user premises such as homes, fields or mushroom facilities.

EXTENDING FIXED WIRELESS NETWORKS ON MUSHROOM FARMS INTO RESIDENTIAL PREMISES

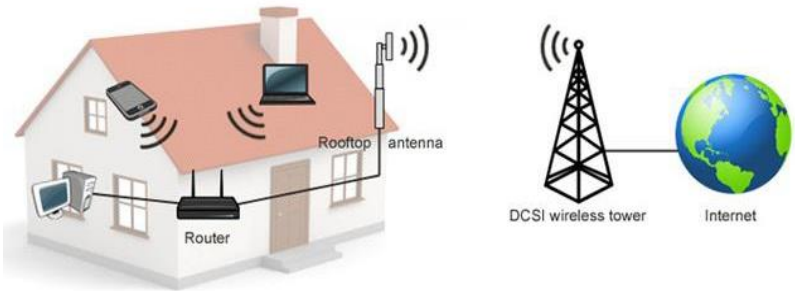
Installing equipment on a home or mushroom farm office or facility is the same. Customer premises equipment (CPE) is the device that picks up the wireless signal from the tower and delivers it into the home or farm. The CPE is mounted on the side of the residence or building or can be installed on a pole adjacent to the home or facility.

A high gain antenna is embedded into the CPE that must be pointed to the radios on a tower or vertical structure. The device has an Ethernet connection that is fed into the residence. Figure 64 is a simple graphical depiction of how a fixed wireless network transmits broadband data to and from the public internet back to a customer's premises or farm location.

Figure 64 – Illustrations of Precision Agriculture Technologies Used on Farm Fields

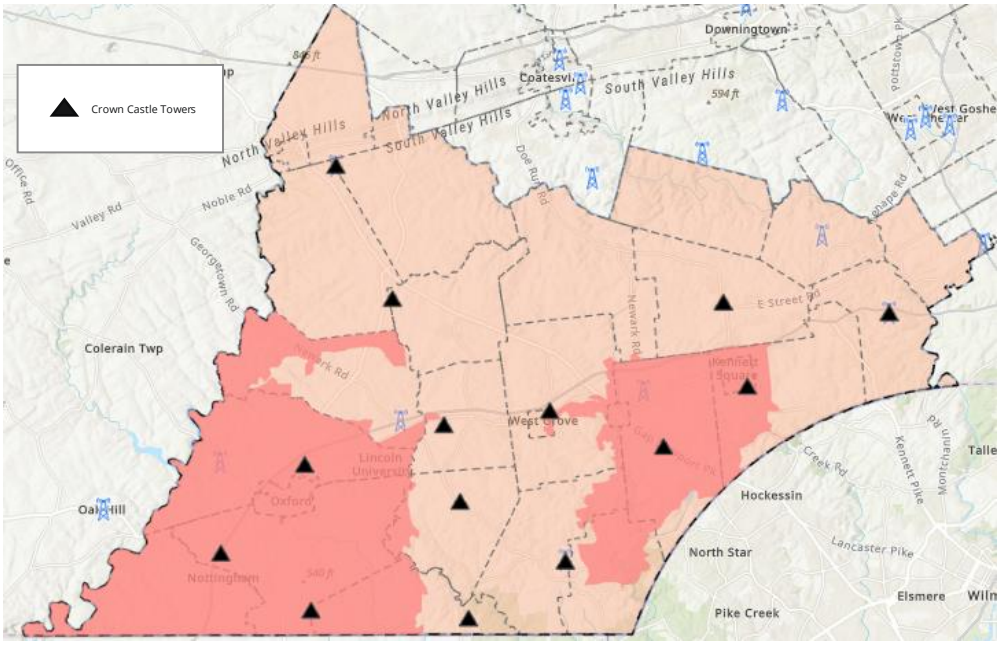
The mushroom farmers interviewed for this study indicated that connectivity was virtually nonexistent on at their mushroom facility. Most mushroom farmers cannot

Figure 65 - Customer Premise Equipment Illustration



afford a fiber last mile connection due to high deployment costs. Therefore, Southern Chester County is an ideal location for a precision agriculture network that can serve as a model for other farms and agricultural communities in the state. Federal and state funding agencies are likely to provide favorable scoring to projects that address the economic barriers facing local industries such as agricultural production. Southern Chester County is uniquely suited to reiterate the need for funds to support the agricultural sector with a fixed wireless network solution as outlined in this study.

Figure 66 - Crown Castle Towers



PROPOSED FIXED WIRLESS NETWORK OVERVIEW OF COVERAGE AND COSTS

The proposed fixed wireless network outlined in this section is designed to achieve 100% coverage that would provide speeds ranging from 50 to 100 Mbps download and 10 to 20 Mbps upload. Fourteen cell sites (towers) would be required to provide coverage to the area defined. We recommend 4 base stations per tower for maximum coverage, totaling 56 across 14 individual towers identified across the region (see map above)

Crown Castle towers (listed on the map) were selected for this proposed design since they are located along numerous Chester County fiber routes. Four base stations

were added to each tower with a 90-degree antenna to produce 360-degree coverage. Two 20 MHz channels were used. Channel 1 is used on the North South sectors. Channel 2 is used on the East West sectors.

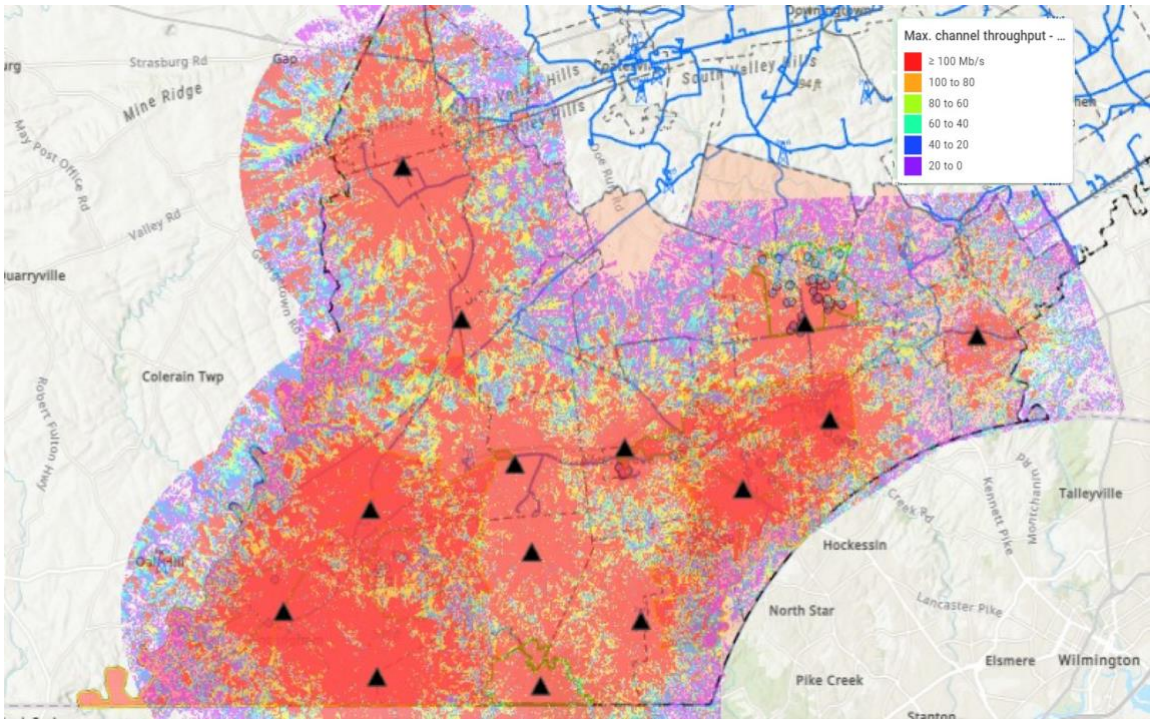
It should be noted that this is a high-level design. The towers were not physically visited or examined by a structural engineer to determine if they are capable of adding additional radio equipment. This will be required before installation can commence.

COVERAGE AND SPEEDS PROVIDED USING FIXED WIRELESS

The Google Network Planner propagation tool[37] was used to perform the propagation analysis (see map below) and considers terrain, obstacles, and equipment parameters (frequency, power, etc.). Using this tool produced the following coverage of the defined area.

The towers selected for this network design will require backhaul connections to the internet of at least 1 Gbps to support throughput from 4 base stations with 90-degree antenna to provide 360-degree coverage. The propagation study shown above illustrates the maximum throughput wirelessly that customers can expect if all the backhaul is properly configured to provide that throughput.

Figure 67 - Wireless Propagation Analysis Using CBRS Spectrum



[37] Network Planner (google.com)

ESTIMATED COST

The following tables present the estimated capital expenditures (CAPEX) and operational expenditures (OPEX) for this network. All federal grant programs cover CAPEX costs for both fixed wireless and fiber deployments. The total CAPEX cost for this network solution is $1,619,800 which is far less than a fiber to the home or premises project. This estimate includes all the "if needed" items. Since commercial towers are recommended for this deployment, those items will likely be provided.

Table 8 - Estimated CAPEX Cost for the Entire Region

Total Area Estimated CBRS Wireless Overlay Cost-CAPEX			
Item	**Cost**	**Units**	**Total Cost**
Tower Capex Existing Towers	$ -	14	$ -
Tower Cost New (if required)	$ 150,000	-	$ -
County Owned Towers/Water Tanks	$ -	-	$ -
Base Station + Antenna Cost	$ 15,000	56	$ 840,000
Base Station Installation	$ 2,000	14	$ 28,000
Microwave Equipment	$ 3,000	-	$ -
Outdoor Router	$ 1,000	14	$ 14,000
Outdoor Cabinet (if needed)	$ 4,000	14	$ 56,000
Electric Service (if needed)	$ 5,000	14	$ 70,000
UPS (if needed)	$ 10,000	14	$ 140,000
10 KW generator (if needed)	$ 5,000	14	$ 70,000
Tower inspection (if required)	$ 2,000	14	$ 28,000
CPE cost ($356 equipment, $350 labor)	$ 706	-	$ -
WiFi Router for Home/Office	$ 300	-	$ -
EPC Access Fee Per CPE	$ 35	-	$ -

Total Area Estimated CBRS Wireless Overlay Cost-CAPEX			
Item	**Cost**	**Units**	**Total Cost**
Subtotal			$ 1,246,000
Engineering, Project & Construction Mgmt	30%		$ 373,800
Total Estimated Capex Cost			**$ 1,619,800**

Subscriber estimates are not included in this scenario, but the CAPEX cost for external CPE equipment is listed above. In areas with robust signal strength, a CPE that is a MiFi device can be used instead of the external pole and high gain antenna.

This type of unit can also be self-installed to cut costs. The self-installed units are compact and can sit on a desk or table. They should be placed in windows. The units have signal strength indicator lights on them that help the user to place them in the best signal location.

Below is the estimated OPEX cost per month for this network. Tower rent is estimated at $1,000 per month and the utilities and backhaul estimates are derived from previous projects. A Spectrum Access System (SAS) fee is also required for each CPE device of $2.00 per premise. Therefore, the minimum monthly OPEX cost would be roughly $21,125.

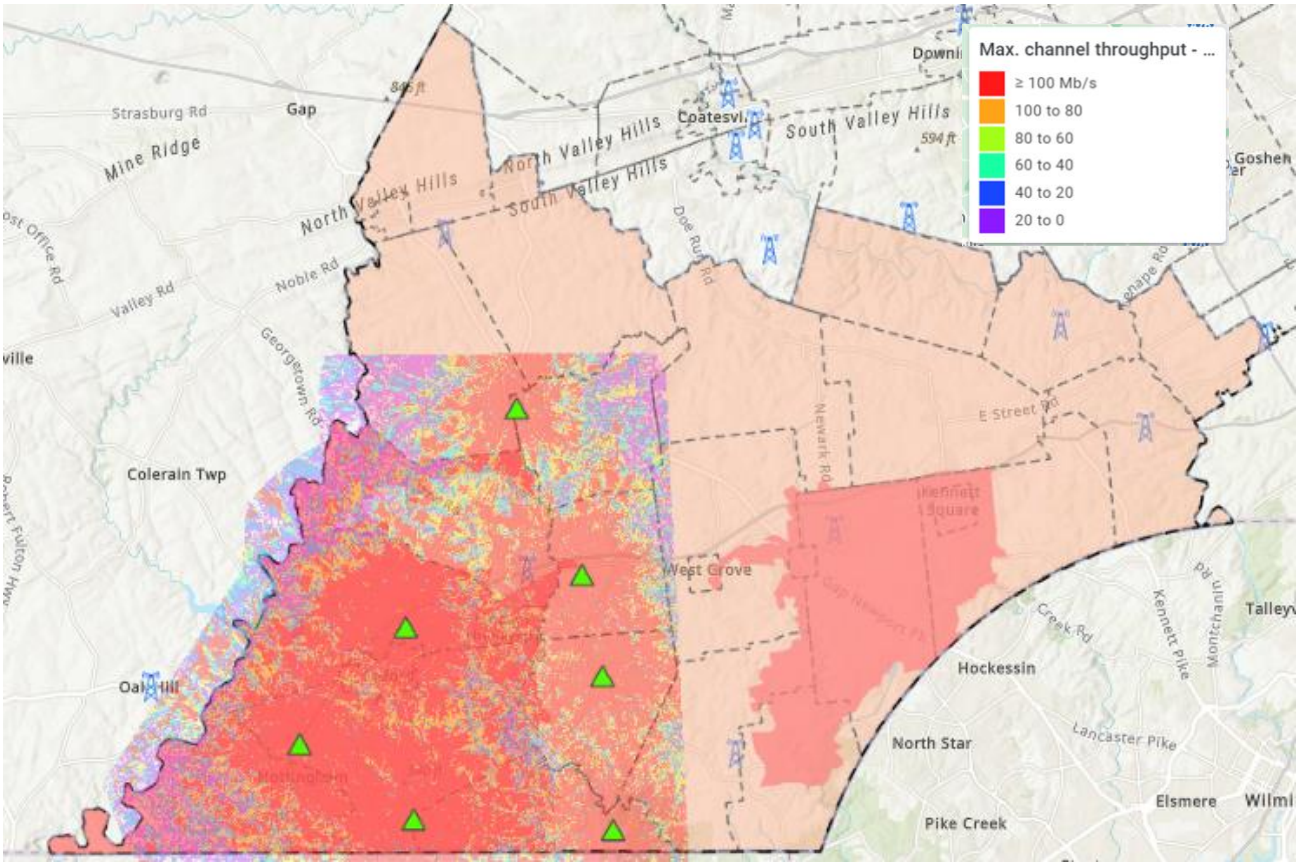
Table 9 - Estimated OPEX Cost

Estimated CBRS Wireless Overlay Cost-OPEX/Month			
Item	**Cost**	**Units**	**Total Cost**
Tower Rental for Commercial Towers	$ 1,000	14	$ 14,000
Utilities	$ 100	14	$ 1,400
Internet Data (if needed)	$ 1,500	1	$ 1,500
SAS fee per CPE	$ 2	-	$ -
Subtotal			$ 16,900
Contingency	25%		$ 4,225
Total Estimated Cost /MO			**$ 21,125**

To manage costs, Magellan recommends a phased approach to implement fixed wireless network throughout the entire region or the project. The areas of concern can be addressed first then the complete area design created if desired. This will allow incremental areas to be completed.

Phase 1 includes a proposed project area covering the areas of concern in the western portion of the defined area. Below is the conceptual design for that area alone. The incremental CAPEX and OPEX cost follow the Phase 1 design.

Figure 68 - Phase 1 Area Conceptual Design

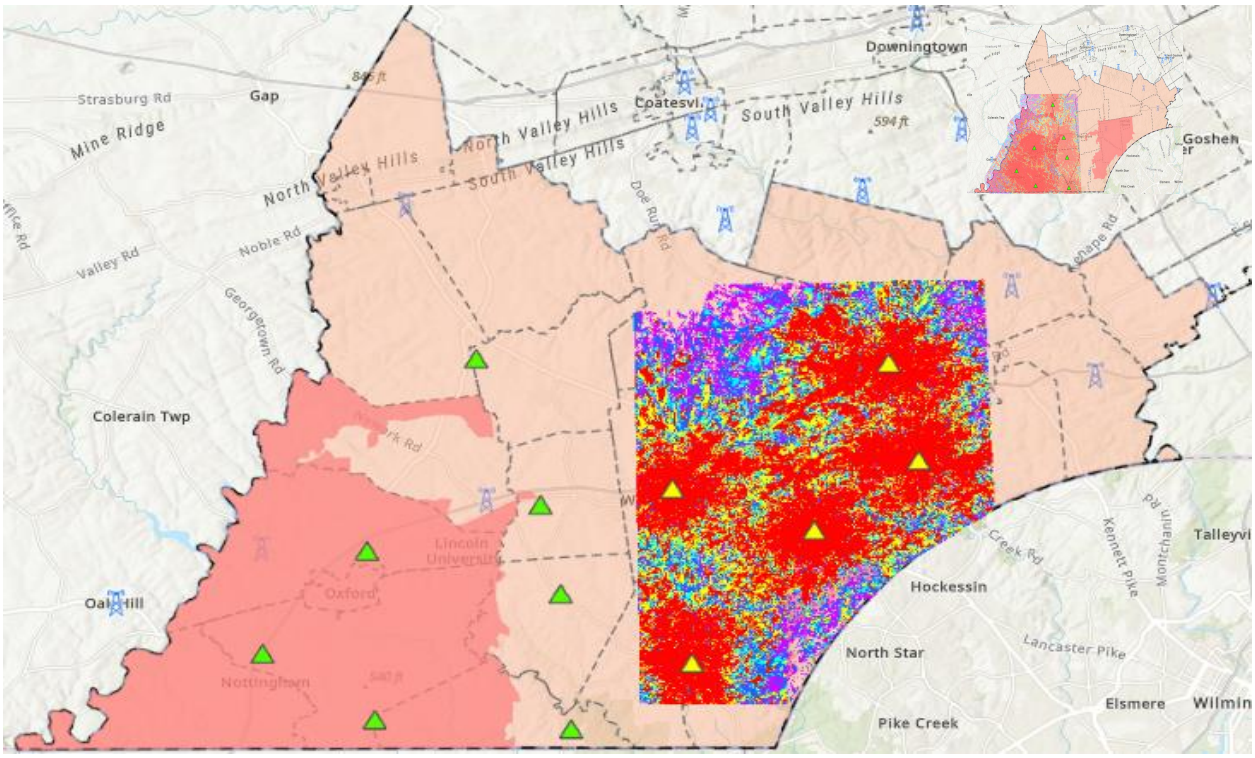


Phase 1 Total Area Estimated CBRS Wireless Overlay Cost-CAPEX			
Item	**Cost**	**Units**	**Total Cost**
Tower CAPEX Existing Towers	$ -	7	$ -
Tower Cost New (if required)	$ 150,000	-	$ -
County Owned Towers/Water Tanks	$ -	-	$ -
Base Station + Antenna Cost	$ 15,000	32	$ 480,000
Base Station Installation	$ 2,000	32	$ 64,000
Microwave Equipment	$ 3,000	-	$ -
Outdoor Router	$ 1,000	7	$ 7,000
Outdoor Cabinet (if needed)	$ 4,000	7	$ 28,000
Electric Service (if needed)	$ 5,000	7	$ 35,000
UPS (if needed)	$ 10,000	7	$ 70,000
10 KW generator (if needed)	$ 5,000	7	$ 35,000
Tower inspection (if required)	$ 2,000	7	$ 14,000
CPE cost ($356 equipment, $350 labor)	$ 706	-	$ -
WiFi Router for Home/Office	$ 300	-	$ -
EPC Access Fee Per CPE	$ 35	-	$ -
Subtotal			$ 733,000
Engineering, Project & Construction Mgmt	30%		$ 219,900
Total Estimated Capex Cost			**$ 952,900**

Estimated Phase 1 CBRS Wireless Overlay Cost-OPEX/Month			
Item	Cost	Units	Total Cost
Tower Rental for Commercial Towers	$ 1,000	7	$ 7,000
Utilities	$ 100	7	$ 700
Internet Data (if needed)	$ 1,500	1	$ 1,500
SAS fee per CPE	$ 2	-	$ -
Subtotal			$ 9,200
Contingency	30%		$ 2,760
Total Estimated Cost /MO			**$ 11,960**

Phase 2: This phase includes the eastern area of concern with 5 tower sites. Below is the conceptual design and costs.

Figure 69 - Phase 2 Area Conceptual Design



Phase 2 Total Area Estimated CBRS Wireless Overlay Cost-CAPEX			
Item	**Cost**	**Units**	**Total Cost**
Tower Capex Existing Towers	$ -	5	$ -
Tower Cost New(if required)	$ 150,000	-	$ -
County Owned Towers/Water Tanks	$ -	-	$ -
Base Station + Antenna Cost	$ 15,000	20	$ 300,000
Base Station Installation	$ 2,000	20	$ 40,000
Microwave Equipment	$ 3,000	-	$ -
Outdoor Router	$ 1,000	5	$ 5,000
Outdoor Cabinet (if needed)	$ 4,000	5	$ 20,000
Electric Service (if needed)	$ 5,000	5	$ 25,000
UPS (if needed)	$ 10,000	5	$ 50,000
10 KW generator (if needed)	$ 5,000	5	$ 25,000
Tower inspection (if required)	$ 2,000	5	$ 10,000
CPE cost ($356 equipment, $350 labor)	$ 706	-	$ -
Wi-Fi Router for Home/Office	$ 300	-	$ -
EPC Access Fee Per CPE	$ 35	-	$ -
Subtotal			$ 475,000
Engineering, Project & Construction Mgmt.	30%		$ 142,500
Total Estimated Capex Cost			**$ 617,500**

Estimated Phase 2 CBRS Wireless Overlay Cost-OPEX/Month			
Item	Cost	Units	Total Cost
Tower Rental for Commercial Towers	$ 1,000	5	$ 5,000
Utilities	$ 100	5	$ 500
Internet Data (if needed)	$ 1,500	1	$ 1,500
SAS fee per CPE	$ 2	-	$ -
Subtotal			$ 7,000
Contingency	30%		$ 2,100
Total Estimated Cost /MO			**$ 9,100**

CONCLUSION

The fixed wireless network designs outlined above would provide another option for both farms and residential locations near mushroom facilities and could be constructed faster than a fiber network involving costly and time consuming boring and siting costs. They also provide the region with options depending on costs and where they wish to devote time and resources first.

Both CAPEX and some OPEX costs are eligible for funding under NTIA's BEAD broadband grant program (discussed in the next section below) but many of the details will depend on how the Pennsylvania Broadband Development Authority decides whether to fully fund projects like those outlined above. The State may be amenable to funding projects that concurrently support economic development by promoting precision agriculture.

Similarly, the cost benefits to the state are notable since they are far less than the costs of a fiber to the premises network that are often time consuming to complete. Time to market is a critical factor for broadband projects and funding authorities may favor those which can deliver connectivity to consumers faster.

Recommendations Regarding Funding, Governance and Next Steps

At the conclusion of this study, the communities throughout Southern Chester County will still be without sufficient broadband access to meet the needs of residential and business customers, including farms.

Community based stakeholders and volunteers throughout Southern Chester County have made tremendous strides in defining the scope of the broadband access and adoption problem and have begun to develop a governance model to continue the momentum generated by public and private stakeholder engagement and mapping analysis performed over the past year.

Magellan recommends local leaders support this momentum by adding staffing capacity and financial resources to the work already underway in the following manner:

1. Identify a lead agency to collaborate closely with key stakeholders in Southern Chester County. The lead agency will help the region apply for state and federal funding for broadband infrastructure and digital equity projects. There are several existing samples of local broadband organizations of various sizes and scopes that involve public and private sector stakeholders to convene and make decisions about broadband.

2. Convene briefings about the findings in this study for the staff and leadership at the Pennsylvania Broadband Development Authority for input and support.

3. Create a broadband leadership team that can advise county, state and local officials about broadband access, deployment and adoption issues facing unserved and underserved communities throughout Southern Chester County. The leadership team will also seek state and federal grant funds for broadband projects in sections of Southern Chester County that have the greatest need.

Short-term goal: Identify a lead agency within Southern Chester County to coordinate all relevant broadband stakeholders and begin governance planning

This study finds a clear case for the creation of a lead agency to coordinate all broadband initiatives for Southern Chester County.

Magellan recommends that the lead agency, in coordination with the township officials and the Southern Chester Chamber of Commerce, create or designate an existing non-profit agency to lead the development of a Southern Chester County broadband strategy. As a starting point, the selected agency may begin by hosting informal discussions with the stakeholders listed above to identify a governance structure and draft a charter for the primary broadband leadership entity.

The governing board may then seek to apply for federal and or state grant funds [38] to finance broadband network projects in rural and unserved areas throughout the region. Such funds are available for this purpose under ARPA as well as the Infrastructure Act and can be used for this purpose.

Purpose and scope focused on the needs of local communities

A local government leadership team could serve to represent the interests of townships and boroughs on matters before the state and provide a cohesive voice on behalf of rural communities throughout Southern Chester County before the recently formed Pennsylvania Broadband Development Authority.[39]

The legislature authorized the creation of a statewide authority to distribute federal broadband funds awarded by NTIA under the Broadband Equity, Access, and Deployment (BEAD) Program[40]. A Southern Chester County agency or leadership team must be well positioned to advocate and apply for funds on behalf of its underserved and unserved communities through partnerships with commercial entities.

Based on meetings and interviews conducted by Magellan over the past six months, the following stakeholders would serve as ideal partners and members of a newly launched Southern Chester County broadband leadership team.

- Chester County Economic Development Council (CCEDC)
- Township managers and supervisors: local government representation is critical towards achieving municipal support for infrastructure projects
- Chester County Intermediate Unit (CCIU): CCIU has been engaged in broadband mapping, coverage analysis and adoption
- American Mushroom Institute (AMI): the connectivity needs of agricultural producers provide an important perspective in broadband planning

[38] Digital Equity Programs | BroadbandUSA (doc.gov)

[39] Pennsylvania Broadband Development Authority - PA Department of Community & Economic Development

[40] Broadband Equity, Access, and Deployment (BEAD) Program | BroadbandUSA (doc.gov)

- Southern Chester County Chamber of Commerce
- Southern Chester County Opportunity Network: advocates Jim Mercante and Joan Holliday have been instrumental in garnering local support and bringing attention to the needs of community residents and businesses

Network governance and oversight

A first step in developing a broadband leadership team is to establish a working group of stakeholders empowered to oversee the operational and regulatory requirements of a new network and to ensure its long-term evolution and financial sustainability. The central element of the governance structure is a governing board that will oversee the following:

1. Making and executing contractual obligations for the management and use of network assets
2. Establishing business practices consistent with local, state, and national laws and regulations
3. Providing oversight of network management, operations, and uses

A formal charter must be developed to address the scope that will inform the roles and responsibilities of the appointed governance board members. The primary goal of the board is to set priorities, and to make objective investment decisions based on the coverage needs of various communities.

Network MOU and model resolution

Governing board members may develop a memorandum of understanding (MOU) for building and using the network and a model resolution in support of the network as a precursor to formalizing the network entity. The MOU would identify roles, responsibilities, and expectations of each and would lay out the basics of the authority's purpose, structure, and operations.

Network management under an "open access model"

The lead agency or leadership team will need to keep track of network assets that it funds, deploys and/or manages, including their ownership and use. The major management task is to track ownership and utilization of fiber strands, towers, and other vertical assets.

The network should be "neutral" to the extent that whoever provides the infrastructure will not block, filter, or slow content from any sources. The network should be "open" for users to access broadband internet access services.

The network would only be designed as a wholesale open access platform for lease arrangements to third party commercial providers for last mile access – it would not

be used to provide retail broadband services to end users. Local governments find open access a compelling model since it attracts multiple service providers to their areas, which generates competition and contains prices for consumers.

Additional recommendations to refine the existing coverage analysis after the completion of this study throughout Southern Chester County

The results of this study provided the county and technology directors for all four school districts with empirical data that validated their anecdotal understanding, experiences, and assumptions regarding the lack of coverage in several areas within their respective regions. The data collected from surveys and other inputs provided by Magellan used for this study also provides a baseline for additional analysis and survey research to continue to occur in the future.

Magellan recommends that local governments and the associated school districts, in coordination with other local and county stakeholders, continue to conduct survey analysis in areas where the current survey participation rate was low or none. As we have stated throughout this study, the residential population throughout these school districts are difficult to reach both physically and culturally and may require field workers to visit them in their home and translate and or explain the purpose of each survey question to elicit a more robust response.

This type of survey work requires trained field staff with bilingual language and cross-cultural awareness skills to effectively interact with members of these households to increase the survey response rate in certain areas.

As our mapping data illustrates, the communities with lowest response rates from the Magellan broadband coverage survey are located northeast and northwest of Avondale, areas throughout Newland township, all of Lower and Upper Oxford as well as the majority of West Nottingham.

Federal and State Funding Analysis and Options for Southern Chester County

Below is an overview of the federal and state broadband funding programs that are the best fit for the region, its stakeholders, and consumers. As indicated earlier in this study, Southern Chester County is an ideal candidate for broadband project funding from county, state or federal agencies but needs greater support and coordination from countywide leaders to increase its chances for an award. At this

time, there is no municipal or nonprofit organization within Southern Chester County that is prepared to apply for these funds.

The need for organizational capacity as well as technical, financial, or operational support from local and regional leaders and their subsequent agencies could not have come at a more important time for the communities in need. The upcoming deadlines for federal funding opportunities for broadband infrastructure projects are on the horizon so time is of the essence for the Southern Chester County region to organize a leadership body involving broadband governance, mapping and infrastructure deployment.

The broadband mapping data developed for this study indicates that there are several pockets of unserved and underserved areas that are noncontiguous yet eligible for funding under certain federal grant programs outlined below. A broadband network solution may require localized focus where these noncontiguous areas are funded and built out separately and connected with middle-mile fiber routes.

Like many rural communities throughout the Northeast, the Southern Chester County region is not geographically homogenous. Rural areas are interspersed with more urbanized towns – resulting in a "patchwork" of areas in need that are not inherently obvious to anyone who is unfamiliar with the region.

Therefore, Magellan recommends a hybrid fiber/fixed wireless network solution that delivers the desired coverage to last mile consumers via fixed wireless that is based on a robust middle-mile network path. This solution is also best suited to meet the needs of farms in the region as well who cannot find any provider to build fiber to reach their farm due to the inherent costs of deployment which to date has been prohibitive. A fixed wireless solution is less costly, easier and faster deploy to reach households and farms in this region.

NTIA'S BROADBAND EQUITY, ACCESS, AND DEPLOYMENT (BEAD) PROGRAM

The Infrastructure Investment and Jobs Act of 2021 (Infrastructure Act) authorized over $42.5 billion to the National Telecommunications and Information Administration (NTIA) to administer the BEAD program, which provides an allocation of grant funds to the states for distribution to subgrantees for last mile broadband infrastructure projects in rural underserved areas.

Eligible subgrantees are determined by the state. These funds will be managed and distributed by the Pennsylvania Broadband Development Authority directed by the

Pennsylvania legislature. All projects must be completed within 5 years from the date of award.

Coverage requirements

Specifically, BEAD program funds must be used to deploy network facilities to last mile "unserved" areas, which are defined as an area where 80% of the residential households receive broadband services at speeds that are less than 25 Mbps down and 3 Mbps up. The next criteria for funds are those areas defined as "underserved" which are areas where 80% of the area receives at or below 100 Mbps down and 20 Mbps up.

Applicants must also offer gigabit connections to community anchor institutions such as libraries and community centers that lack such connectivity.

All projects must offer a low-cost option to eligible subscribers, require all states to have plans to address affordability, and prioritize proposals that improve affordability.

Applicants must also provide an irrevocable standby letter of credit from their financial institution committing to their application for grant funding.

Key Dates:

- States and Territories must submit a letter of intent (signed by the Governor) to NTIA through the application portal to participate by **midnight EST on 7/18/22.**
- The state's Point of Contact (SPOC) may at that time request initial planning funds through the application portal by **midnight EST on 8/15/22.**
- States seeking initial planning funds must **submit a five-year action plan** no later than 270 days **of receipt of the planning funds (9 months later).** States must incorporate a State Digital Equity Plan into their five-year plan.

Total grant amounts for each state will be determined by the revised FCC broadband maps

- States will be notified about future deadlines after the FCC releases its revised broadband maps **(anticipated Nov/Dec 2022).**
- Once FCC maps are published, NTIA will publish the amount of funds each state is eligible to receive from the BEAD program.

States must submit their initial proposals to NTIA after the FCC maps have been released

- **States then have 180 days to submit their initial proposals to NTIA from the date fund amounts are published.** The initial proposal must detail the

subgrantee grant process, etc. These proposals must be made available for public notice/comment including stakeholder input.
- Once the NTIA approves a state's initial proposal, they will allow the state to draw up to 20% of its grant fund allotment to conduct statewide grant programs.

States must submit their final proposals to draw their remaining 80% of total funds

- Final proposals will be due to NTIA one year from the date of approval of the state's initial plan, after which the remaining 80% of the total amount will be available for draw from the state.

Funding amounts:

- Each state may receive a minimum of $100 million and may request up to $5 million for initial planning costs including staffing, onboarding consulting support and mapping costs, etc.
- After the publication of the FCC's broadband coverage maps, the final allocation amount for each state will be determined based on the number of unserved locations identified by the FCC.
- After the NTIA approves a state's initial proposal, it will authorize the state to draw 20% of its total award amount.

Matching requirements:

- States and or subgrantees must provide matching funds of at least 25% of project costs. Funds from CARES, ARPA, the Infrastructure Act or the consolidated appropriations act of 2020 can qualify for match purposes under this program. Projects that contribute more than 25% match may be scored higher than those that do not.

State Challenge Process:

- After states submit their initial proposals to NTIA, they must conduct a challenge process to allow stakeholders to challenge the state's initial proposal regarding whether an area is served or unserved. States must submit all successful challenges to NTIA for review and approval.

Non-infrastructure eligible costs for states:

States are also permitted to use their BEAD allocation to fund non-infrastructure related costs such as:

- User training for cybersecurity, privacy and other digital safety.

- Remote learning or telehealth services/facilities.
- Digital literacy/upskilling (from beginner-level to advanced).
- Computer science, coding and cybersecurity education programs.
- Implementation of digital equity plans (to supplement, but not to duplicate planning grant funds received by the Eligible Entity).
- Broadband sign-up assistance that provides technology support.
- Multi-lingual outreach to support adoption and digital literacy.
- Prisoner education to promote pre-release digital literacy, job skills, online job acquisition skills, etc.
- Digital navigators (trusted guides who assist community members in internet adoption and the use of computing devices).
- Direct subsidies for broadband subscription, where the Eligible Entity shows the subsidies will improve affordability for the end user population (and to supplement, but not to duplicate or supplant, the ACP).
- Costs associated with stakeholder engagement, including travel, capacity-building or contract support.
- Other allowable costs to carry out programmatic activities of an award.

These non-infrastructure costs and use cases will be developed based on the required stakeholder engagement conducted by states prior to developing and submitting its five-year plan to NTIA.

BEAD program analysis for Chester County:

We encourage Southern Chester County leadership to begin to engage local stakeholders in that region, such as local township officials and Southern Chester County Chamber of Commerce to establish an action plan to formalize a leadership structure that would be eligible to apply for these funds.

It is recommended that the Leadership Team begin to identify funding which may be available to help the leadership team meet the 25% match requirement. Projects that commit a higher percentage of cash match over in-kind will be scored higher than those who commit only in-kind resources.

The BEAD grant program contains rigorous build out, operational, financial, and engineering requirements as well as labor, workforce development and study obligations. Applicants must also commit to providing a “low-cost offering” to low-income consumers during the useful life of the assets funded by the grant.

To meet these obligations, a newly created leadership team or agency may increase its chances for an award by partnering with a fiber provider or an established fixed wireless provider committed to the goals of the communities outlined in this study.

In the near term, local leaders should brief members and staff at the Pennsylvania Broadband Development Authority on a monthly basis about the findings in this study and discuss its goals for participating in the BEAD program when it opens next year.

AFFORDABLE CONNECTIVITY PROGRAM (ACP)

Eligible low-income households enrolled in the Affordable Connectivity Program (ACP) may receive a monthly benefit of up to $30 per household per month from qualifying providers who participate in the program.

The ACP benefit can be used for internet access services and a one-time discount of up to $100 for eligible households to purchase a laptop, desktop computer or tablet from participating providers if they contribute more than $10 and less than $50 toward the purchase price.

The ACP benefit is limited to one monthly service discount and one device discount per household. Eligible households are those with incomes at or below 200% of the Federal Poverty Guidelines, or if a member of the household meets at least *one* of the criteria below:

- Received a Federal Pell Grant during the current award year;
- Meets the eligibility criteria for a participating provider's existing low-income internet program;
- Participates in one of these assistance programs:
  - The National School Lunch Program or the School Breakfast Program, including through the USDA Community Eligibility Provision;
  - SNAP
  - Medicaid
  - Federal Public Housing Assistance
  - Supplemental Security Income (SSI)
  - Women Infants and Children (WIC)
  - Veterans Pension or Survivor Benefits
  - Monthly benefits under the federal Lifeline program.

Consumers may find a qualifying ACP service provider in their community by visiting the Companies Near Me tool that identifies the participating providers by zip code[41]

41 Companies Near Me - Universal Service Administrative Company (lifelinesupport.org)

To apply for the ACP benefit, a qualifying consumer must apply by visiting AffordableConnectivity.gov to submit an application or print out a mail-in application.

Similar to the federal Lifeline monthly end user subsidy, the ACP benefit is provided to the participating provider from the FCC/USAC who then discounts the consumer's monthly broadband bill. All new providers seeking to participate in the ACP program must file an election notice with the FCC and USAC and provide the following to participate:

- A statement identifying where the provider received Bureau approval to participate in the ACP.
- A statement confirming whether the provider intends to distribute connected devices and supporting documentation. Providers seeking reimbursement for connected devices must submit a statement of intent to distribute connected devices as part of their election notice.

ACP analysis for Southern Chester County

Affordability is problematic for residential consumers throughout Southern Chester County across the four school districts. The chronic levels of poverty experienced in this region have put broadband access out of reach for these consumers. Yet the participation in the FCC's Affordable Connectivity Program is low relative to the total eligible population county wide.

According to the FCC's ACP participation data collected from January – May 2022,[42] only 3,160 qualified low-income consumers are receiving the benefit and 29 consumers are claiming the benefit for eligible devices across all of Chester County. Both existing providers, local and county leaders can do better to help eligible consumers become aware of this program.

To raise awareness and increase participation in the ACP, local and county leadership in coordination with stakeholders in Southern Chester County such as La Communidad Hispana, Mighty Writers and the Garage Community and Youth Center among others could conduct workshops at mushroom farms and/or other community service organizations about the benefit and how eligible low-income families can apply.

The Affordable Connectivity Program flyer is included as Figure 70 and the FCC and the Universal Service Administrative Company (USAC) has numerous training and

[42] ACP-Households-and-Claims-by-County-January-May-2022.xlsx (live.com)

outreach resources including videos and materials translated in Spanish[43]. Magellan staff also has extensive expertise in this program and can assist local and county leaders with outreach and training efforts to increase participation in this important program.

We encourage local and county leaders and public or private sector partners to download the all the application materials and enrollment information from the USAC website[44] and provide the information to eligible consumers at food banks, senior centers, mushroom farms, churches and community support organizations. If local leaders create a broadband entity for the purpose of applying for any of the funding opportunities outlined above, they will be required by law to participate in the ACP program as well.

[43] Programa de Descuentos Para Internet (ACP) | Federal Communications Commission (fcc.gov)

[44] Application and Eligibility Resources - Universal Service Administrative Company (usac.org)

Figure 70 - FCC's Affordable Connectivity Program Flyer That Can Be Distributed Widely to Low Income Households

AFFORDABLE CONNECTIVITY PROGRAM

WHAT IS IT?

The Affordable Connectivity Program is an FCC program that helps connect families and households struggling to afford internet service.

The benefit provides:

- Up to $30/month discount for internet service;
- Up to $75/month discount for households on qualifying Tribal lands; and
- A one-time discount of up to $100 for a laptop, desktop computer, or tablet purchased through a participating provider.

WHO IS ELIGIBLE?

A household is eligible for the Affordable Connectivity Program if the household income is at or below 200% of the Federal Poverty Guidelines, or if a member of the household meets at least one of the criteria below:

- Participates in any of the following assistance programs: SNAP, Medicaid, Federal Public Housing Assistance, Veterans Pension or Survivor Benefits, SSI, WIC, or Lifeline;
- Participates in any of the following Tribal specific programs: Bureau of Indian Affairs General Assistance, Tribal TANF, Food Distribution Program on Indian Reservations, or Tribal Head Start (income based);
- Participates in the Free and Reduced-Price School Lunch Program or the School Breakfast Program, including through the USDA Community Eligibility Provision;
- Received a Federal Pell Grant during the current award year; or
- Meets the eligibility criteria for a participating broadband provider's existing low-income internet program.

TWO STEPS TO ENROLL

1

Go to **AffordableConnectivity.gov** to submit an application or print a mail-in application

2

Contact your preferred participating provider to select an eligible plan and have the discount applied to your bill.

Some providers may have an alternative application that they will ask you to complete.

Eligible households must both apply for the program and contact a participating provider to select a service plan.

LEARN MORE

Call 877-384-2575, or

Visit **fcc.gov/acp**

Appendices

APPENDIX 1- STAKEHOLDER OUTREACH LIST

Date	Name	Title	Affiliation	Location
12/14/21	Catlin Ganely, John Walker and Jessica Sibley	Senior Directors, Government Affairs	Comcast	Freedom Region.
12/13/21	Chester County School Technology Directors kick off meeting	All four Technology Directors from each School District in the project scope	CCIU	Kennett Consolidated, Unionville-Chadds Ford, Avon Grove, Oxford Area
12/22/21	Michael Roth	Senior Advisor	PA Dept of Agriculture Office of the Secretary	Harrisburg
12/28/21	Jim Mercante and Joan Holliday	Community Volunteers	Chester County Digital Equity Coalition	Kennett
12/30/21	Rob Troxell	Business Outreach Manager	Upward Broadband	Paradise
1/4/22	Dave Houseman	President	Chesconet	Downingtown
1/6/22	Shawn Beqaj	VP of Regulatory & Interconnection	Armstrong Cable	Pittsburgh
1/7/22	Tom Robb and Jim Geiger	Directors	Crown Castle Fiber	King of Prussia
1/14/22	Bob Norris	Kennett Square Council Member	Kennett Sq Borough	Kennett Square
1/17/22	Jorge Duchini	Deputy Director	Advisory Council on Latino Affairs	Kennett Square
1/17/22	Cheryl Kuhn	Executive Director	Southern Chester County Chamber of Commerce	Avon Grove

Date	Name	Title	Affiliation	Location
1/20/22	Maricela Ayllon	Family Services Director	Tick Tock Early Learning Center	Avon Grove
1/27/22	Donna Sensing	Community Health Nurse	Hispanic Health Ministries	Avon Grove
2/1/22	Ernie Holling	Executive Director	Chester County Assoc. of Township Officials (CCATO)	Chester Springs
2/2/22	Mike Murphy	Director	Chester County Dept of Emergency Services	West Chester
2/3/22	Amanda Blevins	Community Engagement Manager	La Communidad Hispana	Kennett
2/3/22	Bobby Kagel	County Manger	Chester County	West Chester
2/4/22	Joe Sherwood	Director	Chester County Library System	West Chester
2/11/22 5/3/22	Pat Bokovitz	Director	Chester Count Dept. of Human Services	West Chester
2/15/22	Marian Moskowitz	Chair	Chester County Board of Commissioners	West Chester
2/21/22	Eden Ratliff	Township Manager	Kennett Township	Kennett
2/21/22	Harry Chrissy	Economic Resource Development Agent	Penn State Cooperative Extension Service	Allentown
2/22/22	Brian O'Leary	Executive Director	Chester County Planning Commission	West Chester

Date	Name	Title	Affiliation	Location
2/24/22	Matthew Franchak	Broadband Advisor	Office of State Senator John Kane	Harrisburg
2/28/22	Ronan Gannon	Executive Director	Las Communidad Hispana	Kennett
3/2/22	Robert Pantucci	Director	Verizon Wireless - PA/DE	Coatesville
3/3/22	Whitney Hoffman	Former Town Supervisor	Kennett Township	Kennett Township
4/20/22	Amy Scheuren	Program Director	Kennett Area Community Service	Kennett
4/20/22	Rachel Lebus	Executive Director	Oxford Area Neighborhood Services Center	Oxford
4/20/22	Carey Bresler	Director	Oxford Public Library	Oxford
4/20/22	Bill Steller	CFO	Phillips Mushroom Farms	Kennett
4/21/22	Sara-Dickens Trillo	Director	Mighty Writers	Kennett
4/21/22	Kristin Pronto	Director	The Garage Community & Youth Center	Kennett
4/21/22	Rachel Roberts	President	American Mushroom Institute	Throughout Southern Chester County
	Amy Ducharme	Project Coordinator	American Mushroom Institute	
	Meghan Klotzbach	Owner Operator/VP of Sales and Marketing	Mother Earth Organics	
	Stephanie Chapman	HR Director	Phillips Mushroom Farms	
	John D'Amico	Owner Operator	J.D. Mushrooms Inc.	
	Emily Bettencourt	Government Relations	South Mill Champs	
	Chris Alonzo	Owner/Operator	Pietro Industries	
5/2/22	Gary Smith and MaryFrances McGarrity	President/CEO And Vice President	Chester County Economic Development Council	Exton
5/3/22	Carlos Obrador	Consular General	Mexican Consulate	Philadelphia

APPENDIX 2 - BROADBAND AVAILABILITY AT SPECIFIC RESIDENTIAL AND BUSINESS ADDRESSES

Residential	Xfinity	Verizon	Viasat	HughesNet	T-Mobile Home Internet	Ultra Home Internet	Armstrong Cable	Upward Broadband	Frontier	Earthlink
19390 Westgrove - 492 Kelton Pennocks Bridge Rd	✓	✗	✓	✓	✗	✓	✗	✗	✗	✗
19311 Avondale - 37 Gap Newport Pike	✓	✗	✓	✓	✓	✓	✗	✗	✗	✗
19348 Kennett Square - 800 Park Ave	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
19363 Oxford - 499 5th St	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗
19362 Nottingham - 190 Kirks Mill Rd	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
19382 West Chester - 988 Centennial Dr	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
19317 Chadds Ford - 5 Brook Ln	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
19365 Parkesburg - 3229 Strasburg Rd	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
19374 Toughkenamon - 144 Pine St	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗
19350 Landenberg - 709 Penn Green Rd	✓	✗	✓	✓	✗	✓	✗	✗	✗	✗
19352 Lincoln University - 120 Turners Pond Dr	✓	✗	✓	✓	✗	✓	✗	✗	✗	✗
19330 Cochranville - 124 Honeycroft Blvd	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓
19320 Coatesville - 1798 Ridgeview Dr	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
19310 Atglen - 1196 Zook Rd	✓	✗	✓	✓	✓	✓	✗	✗	✓	✗
	12	9	14	14	6	13	2	0	2	1
% Coverage in Southern Chester County	86%	64%	100%	100%	43%	93%	14%	0%	14%	7%

Businesses	Comcast Business	Crown Castle	Verizon Business	Verizon	Windstream	CenturyLink Business	Armstrong Cable	Frontier	Telesystem
19390 Westgrove - 10 Exchange Pl	✓	✗	✗	✓	✗	✗	✗	✗	✗
19311 Avondale - 122 Pennsylvania Ave	✓	✗		✓	✗	✗	✗	✗	✗
19348 Kennett Square - 401 Birch St, Kennett Square	✓	✓	✓	✓	✗	✗	✗	✗	✗
19363 Oxford - 306 Market St	✓	✗	✓	✓	✗	✗	✓	✗	✗
19362 Nottingham - 196 Baltimore Pike	✓	✗	✗	✓	✗	✗	✗	✗	✗
19382 West Chester - 1810 Beagle Rd	✓	✗	✓	✓	✗	✗	✗	✗	✗
19317 Chadds Ford - 1617 Baltimore Pike	✓	✗	✓	✓	✗	✗	✗	✗	✓
19365 Parkesburg - 108 W 1st Ave	✓	✗	✓	✓	✗	✗	✗	✗	✗
19374 Toughkenamon - 1470 Baltimore Pike	✓	✗	✓	✓	✗	✗	✗	✗	✗
19350 Landenberg - 100 Landenberg Rd	✓	✗	✓	✓	✗	✗	✗	✗	✗
19352 Lincoln University - 633 Oxford Rd	✓	✗	✗	✗	✗	✗	✗	✗	✗
19330 Cochranville - 1074 Gap Newport Pike	✓	✗	✗	✗	✗	✗	✗	✓	✗
19320 Coatesville - 152 Strode Ave	✓	✗	✓	✓	✗	✗	✗	✗	✗
19310 Atglen - 120 Liberty St	✓	✗	✗	✗	✗	✗	✗	✗	✗
	14	1	8	11	0	0	1	1	1
% Coverage in Southern Chester County	100%	7%	57%	79%	0%	0%	7%	7%	7%

APPENDIX 3 – OVERVIEW OF ALL AVAILABLE BROADBAND TECHNOLOGY PLATFORMS

The term "broadband" refers to high-speed connectivity to facilitate seamless access to content, data streaming and high resolution file exchanges that include video and voice. Although demand for high-speed data are rapidly increasing, the FCC defines broadband as delivering at least 25 Mbps downstream and 3 Mbps upstream. Cable, DSL, fiber, and wireless are the prime broadband delivery systems used to meet these demands by connecting users to the internet.

Broadband networks are divided into several general components, each of which has some different technological options:

1. Bulk, whole Internet Protocol exchange to Tier 1 providers
2. Backhaul transport to internet exchange point

3. Local "backbone" feeder and/or middle-mile network
4. Access and distribution network

The foundational component is internet exchange or peering. There are a few organizations that operate tier 1 Internet Protocol (IP) networks that peer—or connect—directly to each other for the internet core. Generally, tier 2 networks connect to tier 1, and tier 3 connect to tier 2. Any device or network must be physically connected to and exchange data with one of these networks to access the internet.[45] All of these networks are interconnected at a few Internet Exchange Points (IXP), which are basically data centers, almost universally via fiber-optic technology.

Each provider also has a core network that connects all of its major sites and into one or more IXPs. No customers are connected directly to these core networks, including "long haul," which consist of fiber with some microwave. Providers' core networks are extended to customers via feeder "metro" or "middle-mile" networks. Major customers may be connected to the feeder networks, but most customers get service from access networks that are interconnected via the distribution infrastructure. Distribution and feeder networks are almost entirely fiber and can also act as backbones for connecting multiple sites into a network.

Access networks provide the widest technology options. The traditional options were coaxial cable and twisted pairs of wires. These "legacy" technologies from analog voice and television services were transformed into digital connections but could not overcome inherent limitations of wires. Fiber and wireless are becoming more common because they are more capacious and/or flexible.

FIBER BASED NETWORKS

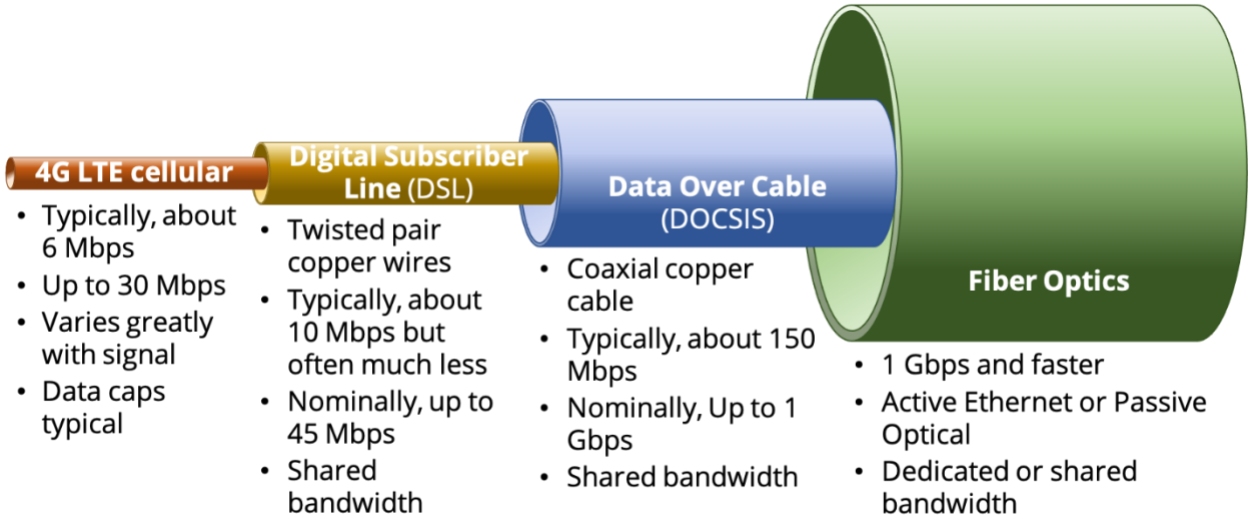
Fiber can carry light signals for miles without degradation. The light spectrum within fibers can be subdivided into "colors"—referred to as "lambdas"—each of which can carry separate data streams. The number of lambdas is limited only by the laser technology. Currently, 200 lambdas are common for what is called Dense Wavelength Division Multiplexing (DWDM), but thousands are possible. The new standard is 100 Gbps over a single lambda, which gives a single fiber an effective throughput of 20 terabits per second.

Fiber-optic cables (or just "fiber") are strands of glass the diameter of a human hair that carry waves of light. Unlike other connections that carry electrons across copper wire, fiber supports fast, reliable connections by using photons across glass, giving it the capacity to carry nearly unlimited amounts of data across long distances at

[45] It is quite possible to have a private IP network that is *not* physically connected. No devices on such networks can reach the internet or vice versa.

spectacularly fast speeds. Fiber's usability and resiliency have brought it to the forefront of broadband, making it a highly desired asset for all entities, public and private, that own or control it. The availability of a reliable, cost-effective fiber connection creates opportunities for the communities it serves.

Figure 71 - Network Technologies Compared



The figure above illustrates the relative difference between common internet connection methods, comparing access technologies from basic dial-up through DSL, cable, and fiber. Whereas traditional broadband technologies have an upper limit of 300 Mbps, next-generation broadband that utilizes fiber-optic connections surpasses these limitations and can provide data throughputs of 1 Gbps and greater.

FIXED WIRELESS BROADBAND PLATFORMS

Wireless uses radio frequencies, sent and received via antenna and radios that generate signals which can be anywhere in the radio spectrum band, from 30 Hz to 300 GHz, although most radio communications use frequency bands are from 300 KHz to 30 GHz. Wi-Fi operates in unlicensed 2.4 and 5.9 GHz bands. Cellular services, in contrast, uses multiple bands to balance distance and speed. Generally, higher frequency radio spectrum carries more information but covers shorter distances.

5G BROADBAND SERVICE

"5G" is the fifth generation of wireless technology driving evolution of the wireless communications technology platform. First generation, "2G" and "3G" wireless service was provided beginning in the 1980s and 1990s using large towers, "4G" was

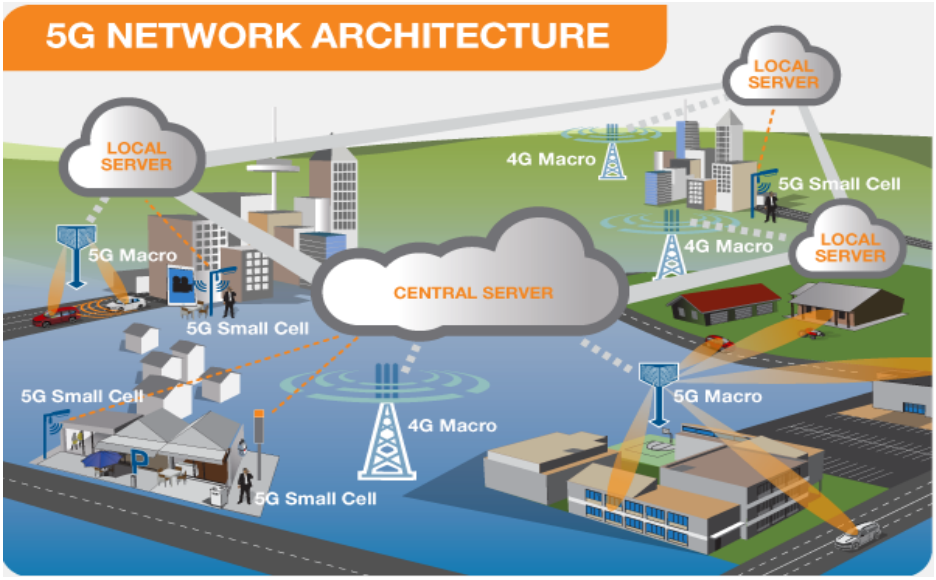
characterized by development of “apps” that needed sustained reliable connectivity which in turn drove antenna densification, while “5G” relies upon even more closely spaced, small antennas.

Current 4G deployments are aimed at densification and increasing capacity in high-use areas while “5G” small cell facilities are also being deployed in larger numbers to greatly increase speed and data capacity on a “fill-in” basis. 5G uses relatively low power transmitters which cover a radius of approximately 400 feet, thus it requires more antennas spaced closer.

5G networks operate multiple frequencies in three bands using millimeter wavelengths, the highest of which is anticipated to offer download/upload speeds of 1 Gbps. The actual speed and range the consumer gets depends on a variety of factors, including what frequency is being used by the service provider – low-band, mid-band, or high-band. There are tradeoffs among the different bands, between speed and distance/coverage. Low-band and mid-band deployments would likely be most useful and beneficial in Southern Chester County.

Low-band frequencies work well across long distances and in rural areas; speeds are greater than 4G but slower than other 5G frequencies. Mid-band frequencies are currently sought after since they permit greater speeds while covering relatively large areas. High-band frequencies provide the fastest speeds but in more limited circumstances such as close to the antenna and in areas without physical obstructions (i.e., windows, buildings, walls). Also, obtaining 5G service requires the use of a 5G-ready device, of which at present there are only a handful (though the number is growing).

Figure 72 - 5G Network Architecture[49]



Local governments in Chester County should be cautious about the "hype" regarding the promises of 5G but should consider the benefits of spectrum enabled fixed wireless and mobile use cases in rural areas. 5G provides the basic infrastructure for Smart City applications based on the "Internet of Things" (IoT), which can transparently connect many, small devices. This trend can be applied to revolutionize industrial processes and applications including agriculture, manufacturing, and business communications.

The pandemic is accelerating shifts for 5G internet technologies and business trials. Perhaps the obvious example is the ubiquitous use of Zoom meetings to communicate, conduct remote learning and receive job training.

CITIZENS BRAOADBAND RADIO SERVICES (CBRS)

4G LTE[46] cellular, which is evolving to 5G, is the most common radio access network (RAN) technology, but 4G is limited to providers with licenses for essential spectrum. LTE can also be used in other spectrum, specifically the 4.9 GHz band that is set aside for public safety broadband and the 3.5 GHz Citizens Broadband Radio Service (CBRS) spectrum.

The FCC set aside the 3550-3700 MHz (3.5 GHz) spectrum in 2015 for CBRS. The spectrum can be used for fixed or mobile broadband. Fixed services provide access to the internet from a specific location. It typically requires an external antenna with

[46] LTE stands for "Long Term Evolution."

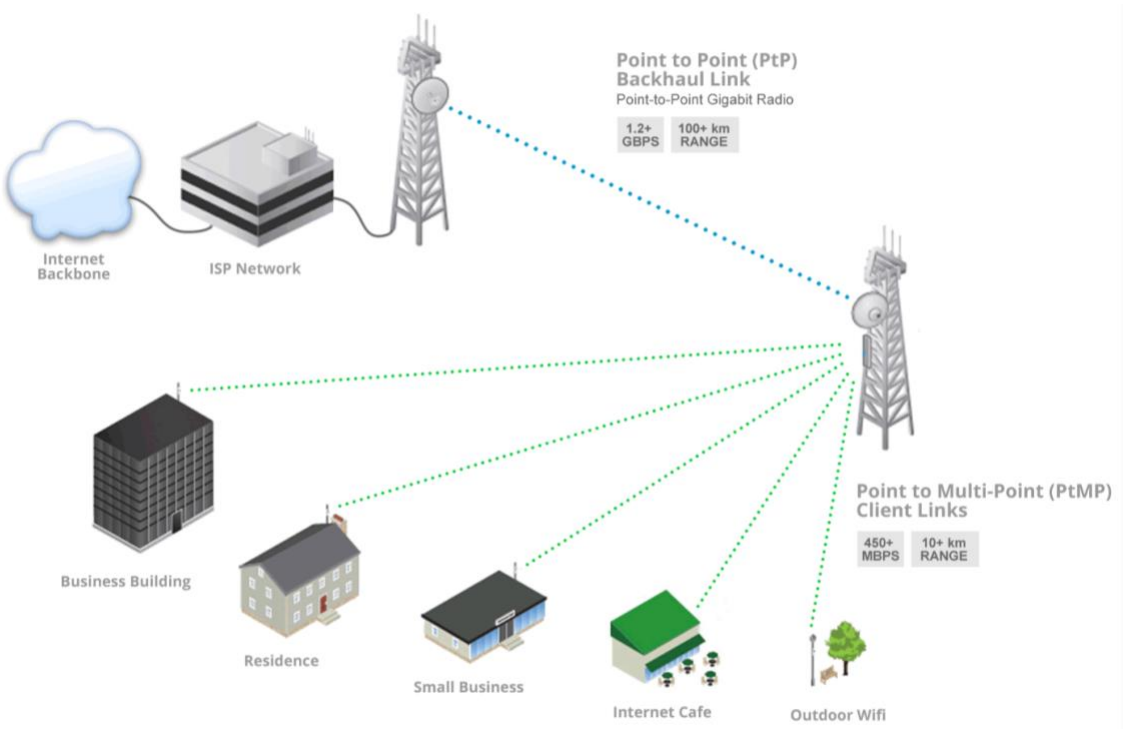
direct line-of-sight to the central base station antenna. Speeds are generally comparable to DSL and cable modem offerings.

Fixed wireless can be deployed as a Point-to-Point (PtP) or Point-to-Multipoint (PtMP), and we recommend both for Southern Chester County. PtP involves a one-to-one relationship between antennas at different locations. It is typically used for interconnecting sites, such as a headquarters or main buildings, to a remote facility. Internet service providers typically use this approach for connecting to customer locations where they do not have wired infrastructure. End-users typically use it as a backup or secondary connection or for non-critical sites because the connections have less capacity than fiber and are susceptible to environmental degradation from foliage, weather, and other factors.

PtMP involves multiple—even hundreds of—users' antennas connecting to a single, central base station. This model and infrastructure are very similar to cellular but with more bandwidth and without the mobility. As illustrated Figure 69 PtP and PtMP are complementary technologies. PtP can be used to interconnect PtMP base stations as well as for remote sites (although fiber is preferable due to its capacity and reliability).

The networks require Line of Sight (LOS) or near Line of Sight (nLOS) to operate. The systems utilize proprietary protocols and specialized devices to achieve the long ranges and high throughputs. Different vendors' products may not interoperate with each other.

Figure 73 -How PtMP and PtP Wireless Connect Communities



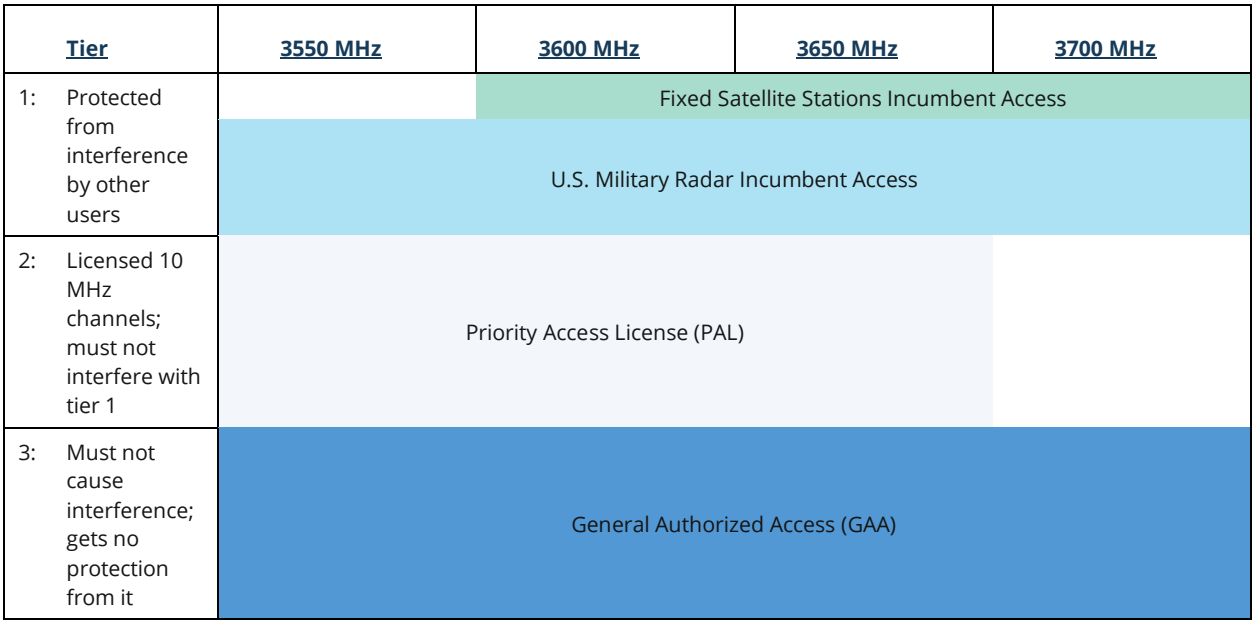
The FCC used a new, shared spectrum approach for CBRS with three tiers of users, diagrammed in the figure below. Current, incumbent, tier 1 spectrum users, which include US military, fixed satellite stations, and, for a limited time, wireless internet services providers (WISPs) are protected from interference by other users. Ten Priority Access Licenses (PAL) for 10 MHz channels between 3550 and 3650 MHz in a specific county were auctioned off by the FCC in July 2020. These licensees are protected from interference by other users. A licensee may aggregate up to 4 PALs. Any portion of the spectrum may be used without a license for General Authorized Access (GAA), but this may not interfere with incumbent or PAL users.

CBRS uses will be managed by a Spectrum Access System (SAS) with which all Citizen Broadband Service Device (CBSD) base stations must be registered. There are two classes of CBSD. Class A base stations, which can transmit at 1 watt of power, are meant for smaller-scale indoor, enterprise, or campus use. Class B base stations can transmit at 50 watts, giving them much greater range. Strategically placed radio signal sensors will ensure that uses do not interfere with each other, particularly military radar.

Another important characteristic of CBRS is the LTE protocol commonly used with the spectrum. LTE is also used for 4G cellular data service, so it is widely implemented in user equipment. CBRS involves different spectrum, but some smartphones have

antennas that operate in the CBRS bands. It is relatively easy and economical to add CBRS/LTE to devices without changing their operating characteristics or systems. Therefore, there are few barriers to end user adoption.

Figure 74 - CBRS User Tiers



The combination of CBRS/LTE base stations and user equipment is referred to as a radio access network (RAN), which includes a network core that authenticates and authorizes user equipment and manages connections to multiple base stations. This allows for mobile roaming from base station to base station without loss of connectivity and makes RANs very secure. The downside of a CBRS/LTE RAN is that some entity must operate the network core and the Spectrum Access System (SAS). These are relatively inexpensive services that can be purchased from vendors or can be installed and maintained on private servers.

STARLINK AND OTHER LOW-EARTH ORBIT SATELITE ACCESS NETWORKS

Starlink (https://www.starlink.com/) is an initiative of Space X to use thousands of low-earth orbit satellites (LEOS) as infrastructure for wireless internet access. It follows a couple of similar efforts that failed and is competing against several newer efforts, including OneWeb (https://www.oneweb.world/), an Amazon, Inc., effort and another by China's state space agency. Like any other wireless connection, each and every one of these satellites must have a radio transceiver, with a power source, and

spectrum. They must also be placed into orbit and have means to aggregate traffic to IXPs. All of this creates huge barriers to coverage and performance, only some of which can be overcome with financial resources.

As of August 2020, Starlink has placed approximately 700 low-orbit. Each Starlink rocket launch places 60 of these very small satellites in orbit. Starlink estimates they will need a minimum of 12,000 units activated to provide any significant kind broadband coverage in the US. Starlink estimates it will take at least 48,000 units to provide adequate broadband worldwide. Presently Starlink is experiencing about 3% failure rate among launched units.

Starlink has recently begun a limited beta test in Washington state due to the limited number of satellites available and the best area of coverage. Participants in the alpha test paid $499 for equipment and $99 per month for between 50 and 150 Mbps. Anecdotal evidence suggests users are getting even faster speeds.[47]

Starlink has not released detailed information on the results, and it is unclear of the actual speeds achieved or any technical issues encountered. Given the current rate of the launch schedule and assuming no major difficulties we project that it will take 3 to 5 years for Starlink to have enough satellites in place to provide meaningful services across the U.S. and another 3 years to provide robust world-wide services.

It is still unknown what areas and strategy Starlink will use to market, price and support services. What geographic areas will it serve? What will be its pricing strategy? Will Starlink have data caps? Will it be robust enough for commercial and governmental services? Regardless of any of these issues, Starlink will need ground support services of Fiber/Fixed wireless backhaul and long-haul transport to provide reasonable co-location services to become economically viable. Based on these and other "unknown" variables we believe that it is a risk to rely on Starlink providing meaningful, economical robust services until another 3 to 5 years, at least.

WI-FI

Wi-Fi is a wireless local-area network (LAN) protocol based on the IEEE's 802.11 Ethernet standard. Wi-Fi is quite flexible and inexpensive to deploy but requires substantial expertise to manage effectively and can be difficult monetize.

It is not technically an access technology, although it is sometimes used as such. A Wi-Fi access point simply bridges wirelessly connected devices into a wired network. Each access point can support multiple logical networks—a password-protected

[47] Source: https://www.businessinsider.com/starlink-internet-satellite-public-beta-speed-spacex-mbps-elon-musk-2020-11

"private Wi-Fi" and an open "public Wi-Fi," for example—each of which has a unique service set identifier (SSID). An additional layer of management and security is typically provided via an integrated router.

Wi-Fi uses unlicensed spectrum that has multiple other uses, including cordless phones and garage openers, and can be subject to interference. This issue can usually be circumvented by adding access points and careful configuration. Like other wireless technologies, multiple Wi-Fi access points can be integrated into a network via PtP wireless links, which is part of the protocol, as well as being physically wired together. Indeed, multiple access points in various locations can be integrated into a logical network, all using a single SSID, via a centralized server.

The latest version, Wi-Fi 6, is faster, more efficient, and more flexible than ever before.[48] Wider channels allow for faster data rates. More sophisticated encoding—translating digital data into radio signals—reduces interference and improves propagation. Wi-Fi 6 handles more devices at lower power, making it more suitable for use in sensors and other remotely located, small-scale devices.

[48] For additional information, see https://www.wi-fi.org/discover-wi-fi/wi-fi-certified-6.

APPENDIX 4 - FCC FORM 477 BROADBAND MAPPING DATA: DEFINITION OF SERVED VS. UNSERVED

The FCC currently defines an area as being "served" with sufficient broadband access if one or more locations receive at or above 25 Mbps down and 3 Mbps up.

Areas defined as underserved are those receiving speeds below 25 Mbps down and 3 Mbps up and above 10Mbps down and 1 Mbps up.

Areas defined as wholly unserved are those receiving speeds at or below 10Mpbs down and 1 Mbps up.

Unserved	Less than 10 Mbps down/1 Mbps up
Underserved	At least 10 Mbps down/1 Mbps up and less than 25 Mbps down/3 Mbps Up
Served	At or above 25 Mbps down/3 Mbps up

The FCC form 477 coverage data serves as the basis for all its federal support programs with the Universal Service Fund (USF)[49] which include the Affordable Connectivity Program (ACP), the RDOF subsidy program, the Rural Health Care Program and the Schools and Libraries program (E-rate).

The coverage definitions above are not universally used by other federal departments and agencies who administer broadband funds such as the NTIA, the U.S. Treasury and the USDA's Rural Utilities Service (RUS). However, the FCC's coverage definitions typically set the watermark for the broadband industry since the bulk of their subsidy funding is derived from the FCC programs listed above.

[49] Universal Service - Universal Service Administrative Company (usac.org)

APPENDIX 5 – SURVEYS: PAPER AND ONLINE

Paper Survey

CCIU Broadband Survey

We are trying to determine where affordable, reliable, accessible high-speed broadband internet is available to our residents and especially our students attending K-12 schools in the districts. The COVID-19 pandemic shed a strong spotlight on the digital divide in Chester County and there are many residents who continue to face difficulty to access the internet for school, work, health care, and finances, completing regular homework assignments online, let alone engage in virtual learning. Your feedback is important to this study to help assess where students are in most need!

Please take a moment to complete this survey from a computer at home as there is a speed test embedded within the survey. If you'd like to take a survey from your device connected to Wi-Fi/Internet service, please visit the CCIU Broadband Survey.

From your smartphone
(please be certain you're connected to Wi-Fi at home or business)

From a computer at home
http://s.alchemer.com/s3/CCIU-Broadband-Survey

******Please use this paper-based survey if you do not have internet access at home or a smartphone device.***

1) How many students are attending K-12 school in your household? And what school do they attend?

   # of students _____ School District(s)_____

2) Address for the location where you reside and where the survey is being taken. *We need to know your address to identify where broadband is and is not available.*

   Street Address _____

   Apartment or Suite _____

   City _____ State _____ Zip Code _____

3) What is the primary language spoken in the home? _____

4) Are there any language barriers for any members of the household that would create issues for using the internet or computer devices? Circle one - YES NO

5) Does the family own a desktop or laptop computer, tablet, or smartphone?

Page 1 of 2

Circle one - YES NO
If yes, how many? _____ How many are provided by the schools? _____
If no, and if because of the ability to use the computer, would the family member(s) be interested in attending a digital literacy class if offered by the public school system or library? Circle one - YES NO

6) Do you use your cellphone as a hotspot to provide Wi-Fi to other devices?
Circle one - YES NO

7) What activities do household members typically use the connected device for and how often?

	Daily	A few times a week	A few times a month	A few times a year	Never
Do schoolwork or training	☐	☐	☐	☐	☐
Operate a home-based business	☐	☐	☐	☐	☐
Consult a doctor or other healthcare professional	☐	☐	☐	☐	☐
Telecommute or work from home	☐	☐	☐	☐	☐
E-Commerce/Buy or Sell Products	☐	☐	☐	☐	☐
Gaming	☐	☐	☐	☐	☐
General research and information	☐	☐	☐	☐	☐
Special interests, hobbies, causes	☐	☐	☐	☐	☐
Entertainment, music, movies	☐	☐	☐	☐	☐
Interpersonal communications: email, social media, etc.	☐	☐	☐	☐	☐

8) If you do not have internet at the location from which you are completing this survey, why does this location not have broadband internet? *Choose all that apply.*
- ○ Access available elsewhere (work, school, library, public/free Wi-Fi, etc.)
- ○ Available services are too expensive
- ○ Available services are too slow or unreliable
- ○ Broadband is not available at this location
- ○ Do not need internet services
- ○ Smartphone meets internet needs
- ○ Other - _____

9) What would better internet or broadband mean to you, your family, your organization and the area? Is there anything you would like to know about broadband in the area?
_____
_____

Return to Chester County Intermediate Unit (CCIU) or fold here, seal, stamp, and mail

From: _____
_____
_____

Place Stamp Here

Chester County Intermediate Unit (CCIU)
455 Boot Road Downingtown, PA 19335

Online Broadband Survey

CCIU Broadband Survey

Address/Location Data

1. Address for the location where you reside and where the survey is being taken. *

House Number *

Street Name *

City *

State *

PA

Zip Code *

2. What is the age of the oldest and youngest person in the household?

Oldest

Youngest

3. How many students are attending K-12 school in your household?

Number of Students

4. What type of device are you taking this survey on?

Desktop
Laptop
Tablet
Smartphone

5. What school district do they attend? Please choose from the list, choose all that apply.

- ☐ Avon Grove
- ☐ Coatesville Area
- ☐ Downingtown Area
- ☐ Great Valley
- ☐ Kennett Consolidated
- ☐ Octorara Area
- ☐ Owen J Roberts
- ☐ Oxford Area
- ☐ Phoenixville Area
- ☐ Tredyffrin/Easttown
- ☐ Unionville-Chadds Ford
- ☐ West Chester Area
- ☐ Charter School
- ☐ Non-public/Private School
- ☐ Other

6. Does anyone in your household attend a higher education institution (college, university, community college) ?

- ○ Yes
- ○ No

7. Does the family own a connected device (desktop or laptop computer, tablet, or smartphone)? *

- ○ Yes
- ○ No

8. How many connected devices (desktop or laptop computer, tablet, or smartphone) does the household own?

# of devices

9. How many communications and other electronic devices do you currently have in the home (computer, tablet, cell phone, etc.)? Estimates are fine.

Computers	eReaders	Smart speakers
Laptops	Media Players	Smart TVs
Tablet	AppleTV/Streaming Device	Other
Smartphones	Gaming consoles	

10. Why doesn't your family own a desktop or laptop computer, tablet, or smartphone?

- ☐ Do not need or want one
- ☐ I don't know how to use the technology
- ☐ Access to a device at school, work or elsewhere
- ☐ Technology is too expensive
- ☐ Broadband is not available to this location to support the technology
- ☐ Available services to support the technology is slow or unreliable

11. If the reason you don't own a computer, laptop, tablet or smartphone because of having the ability to use the computer, would the family member(s) be interested in attending a digital literacy class if offered by the public school system or library?

- ○ Yes
- ○ No
- ○ Unsure

12. How many devices in your household are provided by the school district?

13. Do you use your cellphone as a hotspot to provide Wi-Fi to other devices?

- ○ Yes
- ○ No
- ○ Unsure

14. What is the primary language spoken within the home?

- ☐ English
- ☐ Spanish
- ☐ Mandarin
- ☐ Hindi
- ☐ Other - Write In

15. Are there any language barriers for any members of the household that would create issues for using the internet or computer devices?

- ○ Yes
- ○ No
- ○ Unsure

16. What activities do household members typically use the connected device for and how often?

	Daily	A few times a week	A few times a month	A few times a year	Never
Do schoolwork or training	☐	☐	☐	☐	☐
Operate a home-based business	☐	☐	☐	☐	☐
Consult a doctor or other healthcare professional	☐	☐	☐	☐	☐
Telecommute or work from home	☐	☐	☐	☐	☐
E-Commerce/Buy or Sell Products	☐	☐	☐	☐	☐
Gaming	☐	☐	☐	☐	☐
General research and information	☐	☐	☐	☐	☐
Special interests, hobbies, causes	☐	☐	☐	☐	☐
Entertainment, music, movies	☐	☐	☐	☐	☐
Interpersonal communications: email, social media, etc.	☐	☐	☐	☐	☐

17. Do you have high-speed, broadband internet to your home?*

- ○ Yes, this location has internet.
- ○ This location only has internet via dial-up, satellite or cell phone
- ○ No, this location does not have internet access

Internet Access

18. Who is you internet provider(s)? *

- ☐ Xfinity / Comcast
- ☐ T-Mobile Home Internet
- ☐ Ultra-home Internet
- ☐ Verizon
- ☐ Windstream
- ☐ Viasat
- ☐ Verizon / Fios
- ☐ Earthlink
- ☐ HughesNet
- ☐ Armstrong
- ☐ Upward Broadband
- ☐ Other - Write In
- ☐ Frontier / Frontier Communications
- ☐ Service Electric Cablevision

19. How much do you pay for your internet service each month?

20. What is your contracted internet speed?

21. How often is your broadband out or slow?

Select the option that best describes how often the location experiences each of the following problems.

	Never	Once a year or less	Every few months	Every few weeks	Every few days	Daily, every day
The service slows down.	○	○	○	○	○	○
The service is out briefly.	○	○	○	○	○	○
The service is out for less than an hour.	○	○	○	○	○	○
The service is out for an hour or two.	○	○	○	○	○	○
The service is out for several hours.	○	○	○	○	○	○
The service is out for a day or more.	○	○	○	○	○	○

Speed Test

22. What is the actual speed of your internet service? Click the "Start Test" button below to find out! Wait for the tests to finish. Results will be automatically entered in the survey.

Oops! Something went wrong and the NDT test didn't load!

Please Try Again

If this continues to happen, please contact

support@measurementlab.net

The NDT (Network Diagnostic Tool) is a bandwidth test that will test your upload and download connection speeds as well as provide additional diagnostics about your network.

To run the test, you'll be connected to Measurement Lab (M-Lab) and your IP address will be shared with them and processed by them in accordance with their privacy policy. M-Lab conducts the test and publicly publishes all test results to promote internet research. Published information includes your IP address and test results but doesn't include any other information about you as an internet user.

Start Test

Download: 0 Mbs
Upload: 0 Mbs
Latency: 0 ms

Download	
Upload	
Latency	

No Broadband Internet

23. Why does the location for which you are completing this survey not have broadband?

Select all that apply

- ☐ Do not need or want internet services
- ☐ Access internet elsewhere (work, school, library, public/free Wi-Fi, etc.)
- ☐ Available services are too expensive
- ☐ Available services are too slow or unreliable
- ☐ Broadband is not available to this location
- ☐ Smartphone meets internet access needs

24. Do students in your household complete schoolwork on a mobile phone because internet is not available?

- ○ Yes
- ○ No
- ○ Unsure

25. If you had affordable, high-speed internet, what would you use it for?

Select all that apply

- ☐ Schoolwork
- ☐ Telework
- ☐ Telehealth
- ☐ Gaming
- ☐ Video streaming
- ☐ Security cameras
- ☐ Online research
- ☐ Other - Write In

Final Thoughts

26. What would high-speed, affordable broadband internet do for your household?

Online Cellular Survey

CCIU Cellular Internet Survey

Address/Location Data

1. Address for the location where you reside and where the survey is being taken. *

House Number *

Street Name *

City *

State *

PA

Zip Code *

2. What is the age of the oldest and youngest person in the household?

Oldest

Youngest

3. How many students are attending K-12 school in your household?

Number of Students

4. What type of cellular phone are you taking this survey on?*

iPhone
Android
Other

5. What school district do they attend? Please choose from the list, choose all that apply.

- Avon Grove
- Coatesville Area
- Downingtown Area
- Great Valley
- Kennett Consolidated
- Octorara Area
- Owen J Roberts
- Oxford Area
- Phoenixville Area
- Tredyffrin/Easttown
- Unionville-Chadds Ford
- West Chester Area
- Charter School
- Non-public/Private School
- Other

6. Does anyone in your household attend a higher education institution (college, university, community college) ?

- ○ Yes
- ○ No

7. Does the family own a connected device (desktop or laptop computer, tablet, or smartphone)? *

- ○ Yes
- ○ No

8. How many connected devices (desktop or laptop computer, tablet, or smartphone) does the household own?

on computers

9. Why doesn't your family own a desktop or laptop computer, tablet, or smartphone?

- ☐ Do not need or want one
- ☐ I don't know how to use the technology
- ☐ Access to a device at school, work or elsewhere
- ☐ Technology is too expensive
- ☐ Broadband is not available to this location to support the technology
- ☐ Available services to support the technology is slow or unreliable

10. If the reason you don't own a computer, laptop, tablet or smartphone because of having the ability to use the computer, would the family member(s) be interested in attending a digital literacy class if offered by the public school system or library?

- ○ Yes
- ○ No
- ○ Unsure

11. How many communications and other electronic devices do you currently have in the home (computer, tablet, cell phone, etc.? Estimates are fine.

Computers		TiVo/Ruku	
Laptops		Gaming consoles	
Smartphones		Smart speakers	
eReaders		Smart TVs	
Media Players		Other	

12. How many devices in your household are provided by the school district?

13. Do you use your cellphone as a hotspot to provide Wi-Fi to other devices?

- ○ Yes
- ○ No
- ○ Unsure

14. What is the primary language spoken within the home?

- ☐ English
- ☐ Spanish
- ☐ Mandarin
- ☐ Hindi
- ☐ Other - Write In

15. Are there any language barriers for any members of the household that would create issues for using the internet or computer devices?

- ○ Yes
- ○ No
- ○ Unsure

16. What activities do household members typically use the connected device for and how often?

	Daily	A few times a week	A few times a month	A few times a year	Never
Do schoolwork or training	☐	☐	☐	☐	☐
Operate a home-based business	☐	☐	☐	☐	☐
Consult a doctor or other healthcare professional	☐	☐	☐	☐	☐
Telecommute or work from home	☐	☐	☐	☐	☐
E-Commerce/Buy or Sell Products	☐	☐	☐	☐	☐
Gaming	☐	☐	☐	☐	☐
General research and information	☐	☐	☐	☐	☐
Special interests, hobbies, causes	☐	☐	☐	☐	☐
Entertainment, music, movies	☐	☐	☐	☐	☐
Interpersonal communications: email, social media, etc.	☐	☐	☐	☐	☐

17. Do you have high-speed, broadband internet to your home?*

- ○ Yes, this location has internet.
- ○ No, this location does not have internet access or only through cellular service.

Cellular Internet Access

18. Who is your cellular provider(s)? *

- [ ] AT&T
- [ ] Cricket
- [ ] T-Mobile
- [ ] Verizon
- [ ] Other - Write In

19. How much do you pay for your cellular service each month?

20. Do you have data caps on your cellular plan? If so, what is the data cap and what is the charge?

- ( ) Yes
- ( ) No

21. What is the data cap and what are the costs for exceeding the data cap?

Data cap

Cost

22. How often is your cellular service spotty or do you have dropped calls?

Select the option that best describes how often the location experiences each of the following problems.

	Never	Once a year or less	Every few months	Every few weeks	Every few days	Daily, every day
The service slows down.	○	○	○	○	○	○
The service is out briefly.	○	○	○	○	○	○
The service is out for less than an hour.	○	○	○	○	○	○
The service is out for an hour or two.	○	○	○	○	○	○
The service is out for several hours.	○	○	○	○	○	○
The service is out for a day or more.	○	○	○	○	○	○

Speed Test

23. What is the actual speed of your internet service? Click the "Start Test" button below to find out! Wait for the tests to finish. Results will be automatically entered in the survey.

Oops! Something went wrong and the NDT test didn't load!

Please Try Again

If this continues to happen, please contact

support@measurementlab.net

The NDT (Network Diagnostic Tool) is a bandwidth test that will test your upload and download connection speeds as well as provide additional diagnostics about your network.

To run the test, you'll be connected to Measurement Lab (M-Lab) and your IP address will be shared with them and processed by them in accordance with their privacy policy. M-Lab conducts the test and publicly publishes all test results to promote internet research. Published information includes your IP address and test results but doesn't include any other information about you as an internet user.

Start Test

Download: 0 Mbs
Upload: 0 Mbs
Latency: 0 ms

Download	
Upload	
Latency	

No Broadband Internet

24. Why does the location for which you are completing this survey not have broadband? *

Select all that apply

- ☐ Do not need or want internet services
- ☐ Access internet elsewhere (work, school, library, public/free Wi-Fi, etc.)
- ☐ Available services are too expensive
- ☐ Available services are too slow or unreliable
- ☐ Broadband is not available to this location
- ☐ Smartphone meets internet access needs

25. Do students in your household complete schoolwork on a mobile phone because internet is not available?

- ○ Yes
- ○ No
- ○ Unsure

26. If you had affordable, high-speed internet, what would you use it for?
Select all that apply

- ☐ Schoolwork
- ☐ Telework
- ☐ Telehealth
- ☐ Gaming
- ☐ Video streaming
- ☐ Security cameras
- ☐ Online research
- ☐ Other - Write In

Final Thoughts

27. What would high-speed, affordable broadband internet do for your household?

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25. https://www.t-mobile.com/isp/eligibility
26. https://armstrongonewire.com/Internet/ServiceLevels
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30. Universal Service - Universal Service Administrative Company (usac.org)
31. Auction 904: Rural Digital Opportunity Fund | Federal Communications Commission (fcc.gov)
32. https://www.cdfifund.gov/documents/geographic-studys
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34. **Pedestal** - a general-purpose, outdoor enclosure. It is the main node for voice, data and video distribution, in a passive optical network (PON). The pedestal is the network interface - at the neighborhood. Options, for its internal components, were designed, according to the global standards bodies.
35. **Vault -** A fiber optic splice vault essentially serves as a demarcation point for incoming trunk cable in a central office, data center, or other large-scale application.
36. **Hand holes** - underground vaults that provide access to fiber optic cable and other utilities for splicing & repairs. They are often called pull boxes, splice boxes, underground enclosures, or vaults.
37. Network Planner (google.com)
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