TEHAMA COUNTY

BROADBAND PLANNING AND FEASIBILITY STUDY

TILSON

2023

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INTRODUCTION

1.1 Executive Summary

Tilson was engaged by the Golden State Finance Authority (GSFA) to research the telecommunications industry landscape in Tehama County, including the locations of existing fiber optic cable and other assets, the service areas and service offerings – by technology – of retail Internet service providers (ISPs) in the county, the locations of premises lacking access to adequate broadband service, and available funding for broadband infrastructure. These findings then informed custom recommendations to support Tehama County's pursuit of network deployment.

We are currently experiencing a monumental period for broadband infrastructure funding opportunities. The Coronavirus Pandemic has led to the passage of significant federal and state legislation providing billions of dollars for broadband infrastructure nationwide, including over eight billion dollars in California alone. The American Rescue Plan Act Capital Projects Fund (ARPA CPF) allocated the State of California with $540,249,909 in broadband infrastructure funding,[1] and the Infrastructure Investment and Jobs Act Broadband Equity, Access, and Deployment (IIJA BEAD) program allocated another $1,864,136,508.[2] In addition to these federal funds, California has allocated $6 billion to broadband infrastructure with the passage of Senate Bill 156, with $2 billion of this earmarked for broadband infrastructure to unserved residences and $3.25 billion earmarked for "an open-access statewide broadband middle-mile network."[3] In total, the CPUC plans to distribute $4 billion statewide between 2022 and 2028 for infrastructure to unserved and underserved homes and businesses.[4]

Table 1: Broadband Deployment Funding Summary

Funding Source	California's Total	Last Mile	Middle Mile	Other
California SB156	**$6,000,000,000**	$2,000,000,000	$3,250,000,000	$750,000,000
IIJA BEAD	**$1,864,136,508**	$1,864,136,508		
ARPA CPF	**$540,249,909**	$540,249,909		

The California Public Utilities Commission (CPUC) will distribute these federal and state funds using multiple competitive grant processes that differ in a few respects, such as how they define eligible deployment areas, what requirements applicants must satisfy, and how projects are evaluated for funding. For the purpose of grant funding eligibility, the term *unserved* generally means any location without access to service of speeds at or above 25 Mbps download and 3 Mbps upload, while the term *underserved* means any location without access to services of speeds at or above 100 Mbps download and 20 Mbps upload. However, grant programs may include or exclude certain technologies from this service availability evaluation. The BEAD program considers all wireline and licensed fixed wireless services, while California's Federal Funding Account (FFA) generally focuses on cable and fiber services. Eligible locations may also be limited to those meeting each program's

[1] U.S. Treasury, "Coronavirus Capital Projects Fund Allocations for States, District of Columbia, and Puerto Rico," August 2021, https://home.treasury.gov/system/files/136/Allocations-States.pdf.

[2] National Telecommunications and Information Administration (NTIA), "Biden-Harris Administration Announces State Allocations for $42.45 Billion High-Speed Internet Grant Program as Part of Investing in America Agenda," June 26, 2023, https://www.ntia.gov/press-release/2023/biden-harris-administration-announces-state-allocations-4245-billion-high-speed.

[3] California SB 156 (2021-2022 Regular Session), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB156; https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-implementation-for-california.

[4] California Public Utilities Commission (CPUC), "Last Mile Federal Funding Account," https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-implementation-for-california/last mile-federal-funding-account, accessed August 2023.

definition of *unserved* but may consider the inclusion of served locations under certain circumstances. All currently available broadband infrastructure funding heavily favors the deployment of wireline technology, primarily fiber.

The amount of federal and state funding currently available for broadband infrastructure is more significant than any time in history and will likely never be exceeded again. Now is the time to connect critical unserved and underserved locations within Tehama County, bridge the digital divide, and provide historically unconnected communities with internet service that allows residents to work remotely, participate in distance-learning opportunities, and take advantage of telehealth services.

To provide a review of Tehama County's broadband needs, availability, suggested broadband expansion strategies, and funding opportunities, this document is divided into nine additional sections. While the sections are ordered in the most logical way Tilson could determine, they are easily accessible as standalone sources if a reader has focused interests or would like to concentrate on actionable sections, such as funding strategies, permitting, digital inclusion or smart communities.

Section 2: Broadband, Benefits, and Challenges reviews essential concepts and details about broadband that are necessary to understand the deployment and funding landscape. Broadband service has become a vital part of communities' economic development, education, public health, and other social policy strategies, so the benefits of broadband are discussed across a number of policy areas. Leaders looking to combat the digital divide are also provided with a review of the basic economic and social barriers that have led to the availability and adoption challenges in their communities.

Section 3: Current and Future Needs Assessment looks more closely at the digital divide in Tehama County, identifying the portions of the households that remain unserved or underserved and exploring factors that further shape adoption challenges in the county. The section also reviews the broadband needs of businesses, community anchor institutions (CAIs), and tribal communities within the county. Using the BEAD program's eligibility definitions, Tehama has:

- 3,882 households (14.2 percent) classified as *unserved*, lacking 25/3 Mbps service
- 1,835 households (6.7 percent) classified as *underserved*, lacking 100/20 Mbps, but not 25/3 Mbps service

Section 4: Analysis of Current Broadband Market and Expansion Strategies identifies the current service areas of each ISP offering retail broadband services in Tehama County, using maps and availability information to develop an understanding of where broadband services with different performance characteristics are and, more importantly, are *not* available. This review of ISP service areas and any committed deployments resulting from previous broadband funding programs are used to explore the most likely expansion and service upgrade opportunities throughout the county.

Table 2: Households Receiving Each Level of Service across Tehama County

Households (HHs) – 27,341 Total	25/3 Mbps	100/20 Mbps	250/25 Mbps
Served by any wireline or fixed wireless	85.8% (23,459)	79.1% (21,624)	45.6% (12,465)
Served by any wireline technology	47.8% (13,069)	45.7% (12,498)	45.6% (12,465)
Served by fixed wireless	81.7% (22,343)	75.0% (20,517)	0%
Served by only fixed wireless at speed	38.0% (10,390)	33.4% (9,126)	0%
Wireline Technologies:			
➢ **Cable**	45.6% (12,465)	45.6% (12,465)	45.6% (12,465)
➢ **DSL**	2.2% (604)	0.1% (33)	0%
➢ **DSL as only wireline option at speed**	2.2% (604)	0.1% (33)	0%

Levels of Broadband Service Availability:

- **Many locations are still critically unserved:** Tehama County has a reported 1,301 locations (4.8 percent) that do not yet receive any wireline or wireless service meeting the 10/1 Mbps standard, according to FCC data.
- **Very high dependence on fixed wireless:** An estimated 38.0 percent of locations can receive basic broadband service via only fixed wireless technologies, while 33.4 percent depend upon it for access to 100/20 Mbps services. This connectivity has been vital for these households, but in the long term, they should remain a priority to receive high-speed wireline services.
- **Available DSL is inadequate:** A claimed 26.7 percent of households in Tehama County have access to DSL services offering 10/1 Mbps, but only 2.2 percent can receive DSL service providing the basic broadband speed of 25/3 Mbps. ISPs providing inadequate DSL service may not have an incentive to upgrade these networks if the projected return on investment is insufficient. However, if provided financial support, these providers may be best positioned to deploy fiber through their DSL service areas using existing access to telephone poles and rights-of-way to install fiber at a lower cost than competitors.
- **Almost no fiber-to-the-home options:** While Charter claims to serve 64 locations with fiber, other FCC data states that there is no fiber service to the home in Tehama County.
- **High-speed broadband availability gap:** A reported 45.6 percent of households can receive high-speed broadband service from either fiber or cable, whose presence in the county has been fully upgraded to serve future bandwidth demands. This level of availability is low compared to the rest of California and the nation.
- **Large areas do not have adequate wireline broadband:** Digger Butte, Hooker, Government Gulch, Richfield, and multiple communities along the Sacramento River such as Vina, Los Molinos, and Dairyville all have large collections of unserved and underserved locations that should be among the highest priorities to be connected. The state middle mile network will come within 6 miles of most of these locations, but ISPs will need to construct about a 14 mile stretch of fiber to reach all of the locations in need near Table Mountain.

Tehama County Broadband Market Summary:

Residents of Tehama County can experience three very different broadband markets. The first group can receive high-speed cable service from either Comcast or Charter. Comcast generally serves the Corning area, reaches 2,464 locations, and has submitted an application to the CPUC's Federal Funding Account (FFA) program to expand to more. Charter primarily serves the Red Bluff and Lake California areas, connecting 9,169 locations, and has reported that it has begun connecting some households to fiber as well, representing the only home fiber service available in the county. Households receiving these services can experience the benefits of broadband shared by the vast majority of households across the rest of the county.

The second group of residents must rely upon a mixture of DSL and fixed wireless options.[5] Unfortunately, the FCC reports that only 604 locations can receive DSL services providing at least 25/3 Mbps, so a majority of these locations cannot actually receive broadband via DSL. Ducor Telephone Company and Frontier report to provide DSL connectivity to 760 and 169 locations, respectively. In the populous regions of the county through the Sacramento Valley, AT&T has offered DSL to 11,395 locations as well but has announced that it will no longer be taking on new DSL subscribers as it retires its DSL networks. Instead, AT&T has applied to the FFA program to replace major portions of its network with fiber.

[5] We note that a few other providers claim to offer services to a very small number of residential locations. TPx Communications claims to offer DSL to 9 locations, while GeoLinks and King Street Wireless claim to serve a total of 5 locations with their wireless services.

The second group's fixed wireless options are often faster than DSL. A reported 75 percent of households across the county can receive fixed wireless services of 100/20 Mbps or more, with 33.4 percent of households able to receive only this level of performance via fixed wireless options. The largest fixed wireless provider is DigitalPath, which uses a more traditional wireless network to reach 23,524 residences. T-Mobile, AT&T and Verizon provide a mix of mobile and fixed wireless services with their networks, claiming to reach 14,020, 781, and 56 households, respectively.

The third group of residents have very poor internet service options. The 1,301 locations (4.8 percent) are reported to not even receive 10/1 Mbps services from either wireless or wireline networks but may still have some form of connectivity. About 219 households across the county can receive slower wireless service, and 5,640 are claimed to able to receive a slower DSL service than 10/1 Mbps. These locations must be prioritized to receive improved connectivity.

- **Tehama County Improvement Opportunities Summary:**
  - Comcast and Charter can explore expanding services in and around their existing service areas of Red Bluff and Corning, respectively. The new state open-access middle mile network through these areas will provide more essential data bandwidth for backhaul necessary to support high-speed broadband networks to these locations while reducing costs to construct last mile networks to new customers. Comcast submitted an FFA application that target areas around Corning, across the Sacramento River in Los Molinos, and up to Table Mountain.
  - AT&T has a large network of old DSL infrastructure in parts of the county and is looking to replace it with fiber, as indicated from their FFA applications. This strategy should be encouraged, as it will fill out most of the pockets in need along Interstate 5.
  - Several unserved and underserved communities, such as Paynes Creek, Mineral, Mill Creek, and St. Bernard, are along the state's planned open-access middle mile route. Existing incumbents or new entrants will soon be able to build wireline networks into these areas at reduced cost. In particular, the northeastern portion of the county along State Route 36 should be prioritized to receive better wireline connectivity.
  - The GSCA has submitted applications for multiple fiber projects in the county to address pockets of eligible unserved locations along the state's planned middle mile route. If these projects are awarded, they will introduce open-access last mile fiber service into areas around Corning, north of Red Bluff, including Bend and Blunt, Proberta-Flores-Gerber, and communities along State Highway 99E, such as Vina and Los Molinos. Once their presence is established, this new entrant is likely to expand into other areas of need, so localities should consider this potential partner in addition to the existing ISPs.
  - The most remote locations may still need to be connected via fixed wireless networks. The BEAD program did not classify any part of the county as a high-cost area, so fixed wireless options will not be able to receive funding unless certain areas remain unserved after the initial BEAD application period. Wireless companies will need to monitor the BEAD application areas to identify whether some locations will remain unserved after the BEAD funding is distributed.

Section 5: Asset Inventory and Gap Analysis presents the current middle mile infrastructure available to ISPs across the county to better understand ISPs' backhaul capabilities and how California's planned open-access middle mile network may change any deployment strategies. This section also reviews the Golden State Connect Authority's (GSCA) evaluation of priority areas.

Section 6: Broadband Funding Strategies reviews a number of state and federal funding programs that can be used to develop grant-eligible broadband deployment projects. These opportunities can support network expansions to areas that would otherwise be difficult or impossible to serve. While these programs share many requirements and rules, they also have subtle differences regarding location eligibility, buildout requirements, applicant matching requirements, and other project

planning considerations. These differences can make a particular funding option better suited for a given area in need. This section focuses on three significant last mile funding opportunities:

Table 3: Location Eligibility Considerations for California's Three Primary Last Mile Grant Programs

Grant Program	Grant Availability Timing	Eligible Areas	Additional Location Considerations
Last Mile Federal Funding Account (FFA)	First application cycle ended Sept. 29, 2023; cycles expected every 6 months	Must lack access to 25/3 Mbps service from "reliable" wireline source	DSL and cable using DOCSIS 2.0 or below are presumed not "reliable."[6]
California Advanced Services Fund Broadband Infrastructure Account (BIA)	Recent application cycle ended June 1, 2023[7]; expected to occur annually	Must lack access to 25/3 Mbps service from wireline or fixed wireless sources	Strong focus on areas without any service whatsoever. Median household income also influences priority areas.[8]
Broadband Equity, Access, and Deployment Program (BEAD)	First application cycle expected to begin mid-2024 at the earliest; at least two application cycles expected	Likely restricted to locations that lack access to 25/3 Mbps service from "reliable" wireline or licensed fixed wireless	"Reliable" defined as "available with a high degree of certainty."[9]

- **Federal Funding Account:** The State of California allocated $74,801,160 to Tehama County to be distributed through the FFA program. On behalf of the county, GSCA, the joint powers authority working with UTOPIA Fiber, filed a FFA application in September 2023 to connect 4,397 unserved locations to an open-access last mile fiber network. The proposed project requested $74,798,880 to build this network, which will provide the physical fiber connections to each home and allow residents to choose between multiple competing online service providers to manage this connection. This innovative new entrant hopes to use these locations as a starting point to expand services both deeper into unserved and underserved areas and into served areas to introduce competition. These proposed areas are shown below.

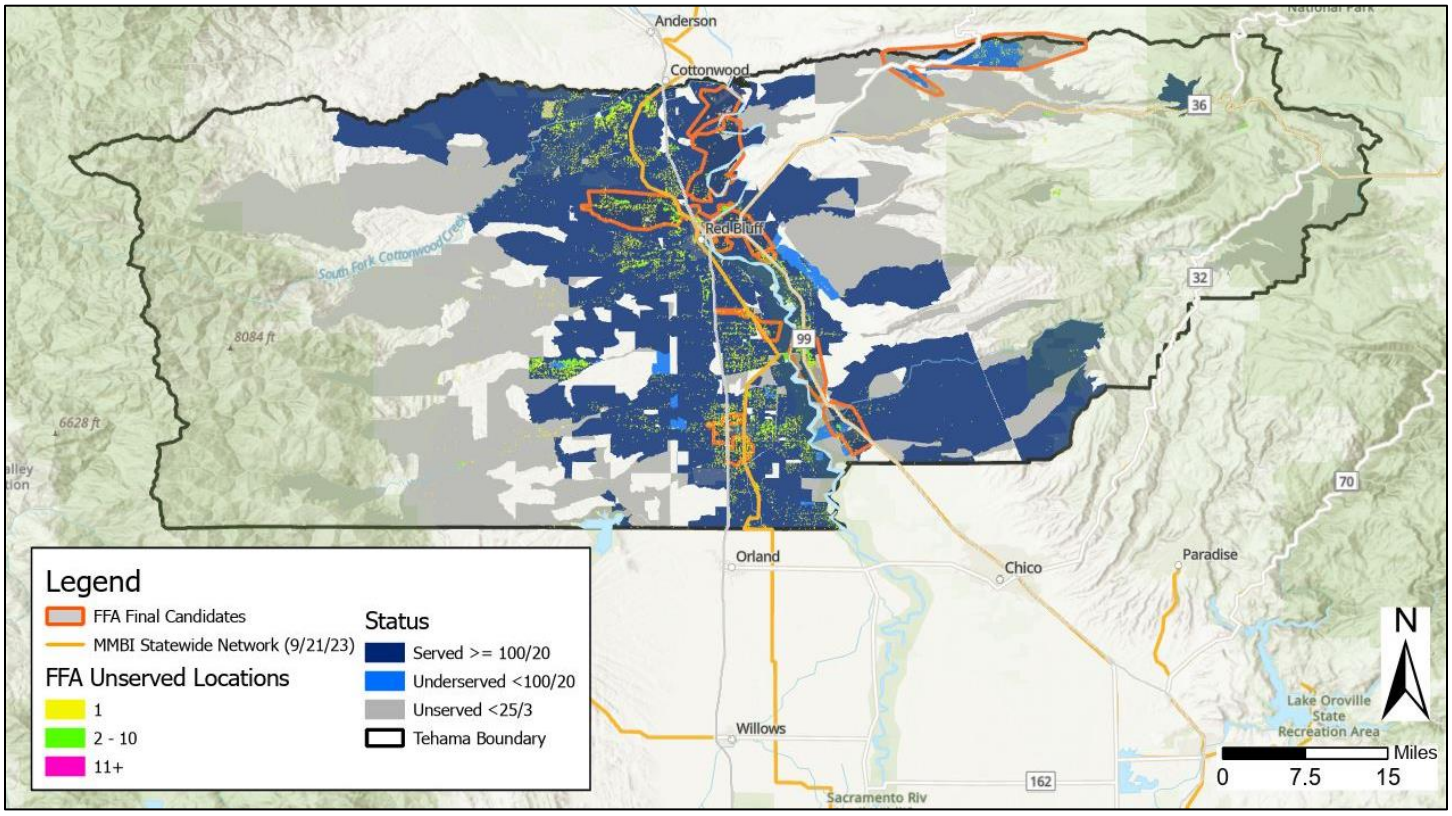
[6] CPUC, Federal Funding Account Program Rules and Guidelines, Order Instituting Rulemaking Regarding Broadband Infrastructure Deployment and to Support Service Providers in the State of California, Rulemaking 20-09-001, Decision 22-04-055, Appendix, April 21, 2022, pp. A-8, A-16, ("FFA Guidelines"), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M470/K481/470481278.PDF; CPUC, "Frequently Asked Questions(FAQs) – Federal Funding Account, Last Mile," April 2023, p. 3, https://www.cpuc.ca.gov/-/media/CPUC%20Website/Files/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Communications_-_Telecommunications_and_Broadband/FFA%20Webpage%202023-04/FFA%20FAQs%20V2.pdf.

[7] CPUC, "Second Postponement of the 2023 CASF Infrastructure Application Deadlines," April 18, 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/2023-letters/20230418-exec-dir-casf-infra-extension-deadline-letter.pdf.

[8] CASF, Broadband Infrastructure Grant Account Program Requirements, Guidelines and Application Materials, Order Instituting Rulemaking Regarding Revisions to the California Advanced Services Fund, Rulemaking 20-08-021, Decision 22-11-023, Attachment 1, p. A-10, updated May 31, 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/broadband-infrastructure-grant-account---landing-page/decision-docs/d2211023attachment-1casf-guidelinesw-coverheader053123.pdf.

[9] NTIA, Broadband Equity, Access, and Deployment Program Notice of Funding Opportunity, 15, May 12, 2022, ("BEAD NOFO"), https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf.

Figure 1: Tehama County FFA Application Final Candidates and BEAD Eligible Unserved and Underserved Areas



The recent round of the CPUC's FFA grant program closed on September 29, 2023 and received 484 applications requesting more than $4.6 billion. An application was received for every county in the state. The CPUC received a total of eight applications for Tehama County, one from the Golden State Connect Authority and two from Comcast, and five from AT&T, three of which extend beyond the county's boundaries At the time of this writing, applications are still being reviewed, and winners have not yet been announced. Detailed information about each application, including maps of proposed funded service areas, can be found here:

https://broadbandportal.cpuc.ca.gov/s/objection-page

Table 4: Applications for Tehama County Submitted to the Federal Funding Account by September 29, 2023

Organization	Project Name	Amount Requested	Unserved Locations
AT&T	Butte – 1*	$10,000,000	2,347
AT&T	Glenn – 1*	$4,499,414	1,633
AT&T	Tehama – 1	$3,079,345	1,524
AT&T	Tehama - 1A*	$7,872,878	3,354
AT&T	Tehama - 1E	$27,825,000	2,568
Comcast	Tehama Glenn Stagecoach*	$55,333,035	3,518

Comcast	Tehama Hoag	$22,077,051	2,380
GSCA	GSCA Tehama County Broadband Network	$74,798,880	4,397

**Denotes a project that spans multiple counties*

- **Broadband Infrastructure Account:**

Tehama County has a reported 1,301 locations (4.8 percent) that do not yet receive any service meeting the 10/1 Mbps standard. Some of these hard-to-identify locations are somewhat scattered and will likely require access to the CostQuest address fabric to be identified. BIA projects can identify areas as small as individual properties and combine them in one application, so long as the residents of each property are low-income households. As a result, this program is a unique option for smaller project proposals across the county that focus on expanding or upgrading existing networks to reach economically disadvantaged areas. Localities can work with the ISPs serving nearby neighborhoods in each area to develop potential projects that could connect a number of small, non-contiguous areas to reach the lowest income unserved households prioritized by this program. Including areas that may already receive 10/1 Mbps service but not 25/3 Mbps service, there are a few clusters in low-income census blocks that should be considered for the BIA program:

  - A few clusters of unserved locations in low-income census blocks are located along Paskenta Road between the towns of Henleyville, Flournoy, and Paskenta. Access can be brought here from Corning Rd, which connects to the eponymous city where AT&T's DSL network and Comcast's cable network are located. Additionally, just southeast of this area, there may be another cluster of unserved locations on the northern side of Black Butte Lake, including the Buckhorn Recreation Area, but this area may need to be accessed by a different fiber route, along Newville Road into Glenn County.
  - Paynes Creek contains a number of unserved locations in low-income census blocks. These households are more dispersed along CA-36, including Dales to the west and a neighborhood in Ponderosa Way, to the east. A smaller concentration of unserved households is located to the south between Round Mountain and Middle Ridge. The state open-access middle mile network will run along these areas, and GSCA has submitted an FFA application to serve Manton slightly north of this area, putting it in an excellent position to consider this program.
  - Further along CA-36, there are small clusters of unserved locations in low-income census blocks in the town of Mineral, extending along SR172 in the Mill Creek community, Morgan Summit Snowmobile Park, and further along in Deer Creek-St. Bernard. The state middle mile network extends through these communities and into Plumas County, so GSCA could propose to connect these areas, or alternatively, Frontier can look to replace its DSL service in Mineral by extending its existing fiber on the other side of the border in Stover Mountain.

- **BEAD Grant Program:** A significant portion of BEAD-defined unserved locations are likely to be scattered in partially served census blocks, but there are a few clusters worth highlighting:
  - All of the areas suggested for BIA consideration above should also be considered for the BEAD program. Comcast and AT&T should consider serving the unserved locations around Henleyville, Flournoy, and Paskenta, although Comcast is unlikely to be willing to deploy fiber as currently required by the BEAD program. The GSCA and other ISPs should consider the Paynes Creek and Mineral areas as well.
  - A few unserved areas exist on both sides of the county where the Sacramento Valley grades to the mountains. In the west, about 20 miles northwest of Red Bluff, there are unserved locations clustered along State Route CA-36 at Baker Fire Station, then more scattered about 10 miles west. The closest available service is licensed fixed wireless from GeoLinks, but a bit closer to the interstate, AT&T DSL's network is nearby and connects to their fiber offering further north in Shasta, which could enable them to submit BEAD applications to bring this infrastructure to the north portion

of the county and extend wireline service to these locations. GSCA has a committed FFA application between this area and Red Bluff, so if they are successful, they will also have a close enough fiber presence to connect these passings.

- Further south, unserved locations are clustered in the main clearing of Red Bank. Multiple locations are scattered throughout the mountains, following Coyler Springs Rd, then extend into Lowery and disperse again in Brushy Mountain. Ducor Telephone Company has available DSL service near Gleason Peak, but GSCA's proposed project area is equally nearby and would have better access to main roadways leading to these neighborhoods.

Section 6 also reviews how counties and localities can work to ensure that unserved locations are eligible for grant funding. These funding programs require applicants to rely upon broadband service maps from either the FCC or the State of California, but not all locations are accurately classified on these maps. Local governments, ISPs, non-profits, and in some cases, the residents themselves may attempt to reclassify locations to make them eligible for funding if sufficient evidence is gathered to demonstrate that a location is not served. Local governments can implement a number of strategies to gather this information and ensure residents with unreliable or slower services can be included in deployment planning during this unique and brief funding window.

Section 7: Fostering a Healthy Broadband Deployment Environment: Permitting, Coordination, and Other Local Policies reviews how localities can help to encourage ISPs to serve unserved and underserved areas by adopting policies and strategies that can reduce deployment costs in their communities. From improving permitting and asset access policies to improving local coordination both within the local government and between other key stakeholders, localities can reduce the costs and efforts required by ISPs to expand services while developing strategies that can benefit from the input of community groups, businesses, and neighboring localities.

Section 8: Digital Inclusion Considerations and Strategies expands upon the analysis of broadband needs found in Section 3 and provides more ways of understanding the different groups needing broadband service adoption assistance. Localities are encouraged to work with community anchor institutions (CAIs) to improve the use of service subsidy programs such as the Affordable Connectivity Program (ACP) and the California LifeLine program and to expand local efforts to close the digital divide by planning programs that will utilize a new wave of digital inclusion programming soon to come from the IIJA's funding to California, funding that is in addition to the IIJA BEAD infrastructure funding.

Section 9: Smart Communities analyzes how Tehama County can best utilize the capabilities of broadband-enabled technologies to improve quality of life for all residents. Vanasse Hangen Brustlin (VHB), a firm with extensive experience in urban planning and smart community strategy, partnered with Tilson for this study to evaluate critical smart community applications to consider when addressing broadband deployment, area funding prioritization, and enabling technologies that help mitigate risk to constituents. By analyzing environmental, transportation, energy, economic, and other factors within the county, this section develops a list of prioritized strategies and reviews how they and other smart community strategies can be planned and implemented. Tehama County's top smart communities strategy priorities should include:

- Expand Wildfire Detection and Monitoring Systems to Improve Safety
- Expand Flood and Landslide Monitoring Systems to Improve Safety
- Use Weather Monitoring & Analysis to Predict and Prepare for Climate Hazards
- Use Smart Water Systems to Optimize Conservation Efforts
- Deploy Charging and Fueling Infrastructure to Support Zero Emissions Vehicles (ZEVs) and Electric Vehicles (EVs)

Section 10: Recommendations and Next Steps presents a list of actions and strategies that Tehama County should prioritize to make the best use of this unique period of broadband funding to address the digital divide. Drawing together insights found throughout the rest of this report, these recommendations will pull together the market assessment, review of infrastructure

assets, funding opportunities, and digital inclusion considerations to develop a roadmap that the local governments of Tehama County and incorporated towns and cities within it can follow to guide their next steps toward a more digitally inclusive future.

SECTION

02

INDUSTRY OVERVIEW, BROADBAND BENEFITS AND CHALLENGES

The telecommunications industry has a history of significant transformation driven by technological advances and regulatory changes. What was once an industry that delivered television signals over the air and telephone calls over wires now provides telephone service over mobile wireless networks and high-definition video over wired broadband networks. This flip has occurred due to bandwidth demands of new applications, technological advances of wireless and wireline networks, regulatory changes in retail and wholesale competitive practices and access to the wireless spectrum.

Competitive changes in the telecommunications industry stem directly from the 1982 antitrust case and consent decree that brought about the divestiture of the Bell System and AT&T's separation from the Regional Bell Operating Companies.[10] Subsequently, the 1996 Telecommunications Act mandated the Regional Bell Operating Companies provide wholesale access to certain telecommunications facilities to competitive carriers. This wholesale access facilitated competitive voice carriers, long distance carriers, and competitive DSL carriers for Internet access.[11]

Since these fundamental transformational events, competition in the telecommunications industry has expanded due to regulated access to additional licensed spectrum for fixed and mobile wireless services, the creation of spectrum bands for unlicensed use, and the establishment of subsidy regimes to incentivize carriers to provide voice and broadband service to even the most difficult to serve locations.

Technological changes have perhaps been the industry's most significant. The transition from copper telephone lines to mobile calling and from broadcast television to the high bandwidth demands of 4K and even 8K streaming video required advances in wireless and fiber technology (and to a degree the technology behind hybrid fiber-coax cable television and cable broadband networks). Advances in wireless technology have largely centered around the creation of the mobile wireless industry and widespread deployment of mobile wireless networks. Mobile telephone calls now greatly outnumber landline telephone calls and smart phones are now ubiquitous. The mobile industry, and the advent of smartphones and the mobile networks capable of handling the data traffic they produce, have caused a paradigm shift in American culture around communication and access to information. These technological advances were enabled by access to portions of the radio frequency spectrum and technological advances allowing smartphone capabilities and cost efficiencies of enabling hardware.

Advances in the wireless industry extend to advances in the fixed wireless industry as well. While technological advances have been significant in terms of speed, performance, hardware size and cost, these advances have also been enabled by access to portions of the frequency spectrum not previously available for commercial use. Higher frequency portions of the radio frequency spectrum allow for higher bandwidth and faster speeds but do have the drawback of having a shorter range and being more susceptible to signal degradation from foliage and topography. As a result, more wireless nodes are typically required to achieve the desired coverage and performance. The type of fixed wireless technology most often used to provide rural internet service, point to multipoint technology, which involves a base station radio (the "point") that serves multiple end users (the "multipoints") has seen impressive advances in technology over recent years as a result of newly available spectrum such as the Citizens Band Radio Spectrum (CBRS) and the Educational Broadband Service (EBS) spectrum. Fixed wireless point to multipoint systems can now provide service in excess of 100 Mbps download speeds. However, these systems are still largely asymmetrical meaning the upload speeds are limited and the actual speeds and performance at a subscriber's location will depend entirely on the signal strength at that particular location which can be greatly affected by foliage and topography. Also, technological advances allowing for low-cost consumer-grade hardware have been critical.

Technological advances in the fiber optics industry are also significant. Not just the technological advances and speeds and capacity of modern fiber networks, but also the widespread implementation of fiber networks over copper networks by providers building new broadband networks. Fiber has categorically replaced copper in most aspects of the

[10] https://en.wikipedia.org/wiki/Harold_H._Greene

[11] https://en.wikipedia.org/wiki/Unbundled_network_element

telecommunications industry. Major circuits between regions, undersea cables, long haul cross country circuits, are all now ubiquitously fiber. Copper is an antique in the telecommunications industry, oxidizing and rotting away and waiting to be replaced by fiber. Even in the cable television industry, which has enormous sunk costs in their decades-old, hybrid fiber coax networks, the switch to all fiber networks has begun.

As with the specific advances in point to multipoint wireless technology, advances in fiber technology have also centered around advances in point to multipoint fiber to the premises (FTTP) technology. Historically, fiber has been a point to point technology, with every connected location having a dedicated fiber home run from it to the serving switch port. More recent technology, known as Passive Optical Networks (PON), are able to use a single switch port (the "point") to serve dozens of end users (the "multipoints"). This technology allows the deployment of fiber to the premise networks at a significantly lower cost. Less fiber is required, fewer active electronics are required, less splicing, less labor, etc. Recent advances in PON technology have brought the standard from GPON with a shared downstream path of 2.4 Gbps and a shared upstream path of 1.2 Gbps (typically shared among 32 users) to XGS-PON with a shared symmetrical 10 Gbps (typically shared by 32 to 64 subscribers). Even more advanced PON technologies are under development that will allow for even greater capacity.

More recent industry advances take the form of historic amounts of grant funding currently available for broadband infrastructure. The COVID-19 pandemic revealed the true inequities of households without broadband and ushered in significant pieces of federal and state legislation, providing funding for broadband infrastructure not seen before and likely never to be seen again. Early into the COVID public health emergency and the migration of activity from businesses and schools to the home, the challenges of legacy technologies became more apparent. Much of the country discovered that what functioned as acceptable connectivity for basic home consumption no longer functioned for work, school, and usage by multiple people at the same time.

During the pandemic, the federal government expanded its broadband deployment funding programs significantly, but it also recognized the scope of the challenge was too large for federal agencies to address alone. Many of these funding opportunities included provisions for broadband, devices, and access, such as the Coronavirus Aid, Relief, and Economic Security Act (CARES); Coronavirus Response and Consolidated Appropriations Act of 2021; and American Rescue Plan Act (ARPA).[12] In November 2021, the Infrastructure Investment and Jobs Act (IIJA) was passed, with billions of dollars to develop broadband infrastructure and digital equity programs.[13] [14] All four of these federal funding packages identified the need for better broadband technology and higher service speeds, raising the standard for broadband service above and beyond past standards.

In December 2020, the California Broadband Council released the California Broadband for All Action Plan with support from state legislators, agencies, and local organizations.[15] The plan outlines the current state of broadband availability and adoption across California, challenges, opportunities, and a plan of action to ensure universal adoption for all Californians through access to affordable highspeed broadband, devices, and skills to use devices and connectivity. The plan recognizes the challenges specific to California, considering geographic as well as socio-economic barriers.

In July of 2021, the California State Legislature passed Senate Bill 156 (SB156), which allocated $6 billion toward broadband efforts, introducing new funding, financing, and planning programs. The legislation also significantly updated the program

[12] Benton Institute for Broadband & Society, "Federal Broadband Support During the COVID-19 Pandemic," April 23, 2021, https://www.benton.org/blog/show-us-money-federal-broadband-support-during-covid-19-pandemic.

[13] Infrastructure Investment and Jobs Act (IIJA), 135 Stat. 429, 117th Congress, November 15, 2021, https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf.

[14] Federal Communications Commission, "Emergency Broadband Benefit Program," https://www.fcc.gov/emergency-broadband-benefit-program, accessed August 2023.

[15] California Broadband Council, *Broadband for All Action Plan, 2020* December 30, 2020, ("CA Broadband for All Action Plan"), https://broadbandcouncil.ca.gov/wp-content/uploads/sites/68/2020/12/BB4All-Action-Plan-Final.pdf.

requirements of existing broadband funding opportunities to meet unserved Californians' current and future broadband needs.[16] The bill allocated $3.25 billion of this funding to construct a statewide open access middle mile network that would extend deep into the rural areas across California, significantly reducing the cost to deploy last mile networks needed to connect nearby unserved locations. SB156 also allocated $2 billion dollars for last mile fiber to the premises networks, which is in addition to the $1.8 billion allocated to the state of California by the IIJA BEAD program, also for broadband last mile networks.

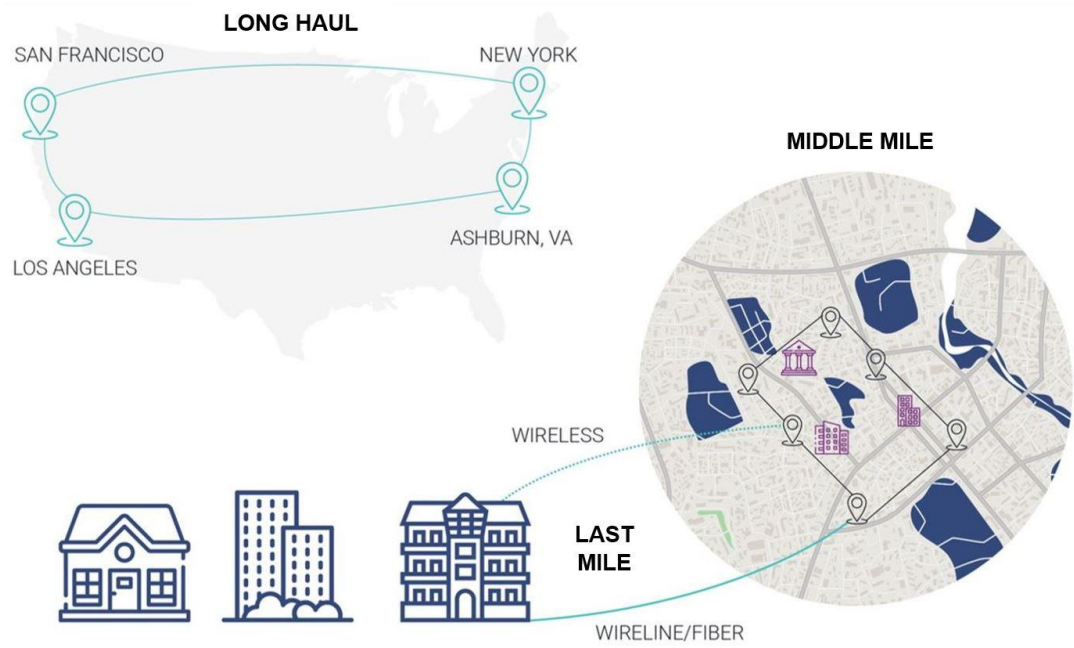
2.1 Overview of Broadband Terminology

This section is a primer and reference for the reader to understand, engage with, and utilize the terminology of this Tehama County Feasibility Plan. This section will outline common terms, define them in plain language, and provide examples where appropriate. If the reader feels a broadband industry primer is not required, they can proceed directly to other sections.

2.1.1. Physical Infrastructure and Delivery

The terms *Long Haul, Middle Mile*, and *Last Mile* describe the fundamental network segments of broadband delivery. In much the same way as roads connect a delivery driver with a package to a home or business, these networks deliver content to and from a home, business, or Community Anchor Institution (CAI).Long haul, middle mile, and last mile can refer to both wireless and wired connections.

Figure 2: Network Types



[16] California SB 156 (2021-2022 Regular Session), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB156.

Long Haul

Long haul infrastructure can be compared to an interstate highway, allowing large volumes of traffic to move long distances and at high speeds. This infrastructure moves data over long physical distances, connecting major cities across the county to one another or across international boundaries.[17] This network level is usually buried fiber optic infrastructure that covers hundreds and even thousands of miles, including undersea cables.[18]

Long haul fiber optic networks are the backbone of all internet and phone traffic, providing national and global transport of data. Long Haul networks generally connect major internet points of presence in major cities and geographic areas such as Los Angeles, San Franscisco, Seattle, Denver, Dallas, Chicago and New York and Miami. Continental long haul networks connect to international long haul networks from Europe, Asia and South America at submarine cable landing stations along the Pacific coast and the atlantic coast. There are currently eight submarine cable landing stations along the California coast.[19] Long haul networks offer virtually unlimited capacity, offering large fiber strand counts and employing the latest technology. While long haul networks do traverse through many rural communities on their way from point A to point B, they are often inaccessiblele locally due to their design and operating model.

Middle Mile

Middle mile networks are like regional long haul networks, spanning distances between major connection points at the state or regional level. The middle mile is the infrastructure between communities and major routes within communities. Sometimes middle mile networks provide direct connections to high bandwidth users such as schools and hospitals, but they do not provide direct connections to homes or small businesses. In the road metaphor, middle mile is a state highway or major thoroughfare through a community. Fiber middle mile can be *lit*, with the middle mile operator providing transmission services, or *dark*, allowing a company to lease individual fibers, connect its own electronics (to "light" the fiber), and control the transmissions itself. This choice enables last mile providers of different sizes to choose between purchasing bandwidth as a service and focusing on other efforts or operating their own middle mile facilities in conjunction with their last mile operations and expansion efforts. The closer a middle mile connection point is to a potential service area, the less last mile infrastructure needs to be installed, so last mile extensions can be very convenient when new middle mile networks are added.

The state of California's Middle Mile initiative plans to construct as much as ten thousand miles of underground fiber optic cable traversing all counties in the state.[20] This network will be available for use by projects locally, allowing any last mile networks, including those funded by current and future broadband infrastructure grant programs, to connect to it for transport to internet points of presence in Los Angeles and San Franscisco where the data traffic can be handed off to a Long Haul network as needed for transport to other states and countries. Details on middle mile providers in the county and California's state middle mile initiative are included in Section 5.

Last Mile

Last Mile networks provide the final connection to homes, businesses, local government facilities and other community anchor institutions and connect them to middle mile networks such as the state middle mile network,[21] which in turn connect

[17] The Pew Charitable Trusts, *Broadband Basics: How it Works, Why It's Important, and What Comes Next*, August 18, 2023, https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2023/08/broadband-basics-how-it-works-why-its-important-and-what-comes-next.

[18] California Legislative Analyst's Office, Overview of Last Mile Broadband Infrastructure Project Administration and Funding, April 6, 2022, accessed August 2023, https://lao.ca.gov/handouts/socservices/2022/Last mile-Broadband-Infrastructure-040622.pdf.

[19] https://www.submarinecablemap.com/

[20] https://middle mile-broadband-initiative.cdt.ca.gov/

[21] Nevada County, California, Last mile Broadband Grants Program, accessed August 2023, https://www.nevadacountyca.gov/2894/Last mile-Broadband-Grants-Program.

to long haul networks to move data between end users regardless of their location. To continue the comparison between broadband networks and road networks, last mile networks are akin to the neighborhood streets. The part of the network connecting the last mile to the house or business is known as a service *drop* or *line extension* and can be thought of as a driveway.

Last mile networks can be wireline or wireless, however the optimal solution is generally considered to be a fiber to the premises (FTTP) network where each premises can receive a service drop of fiber cable directly to their building. Last mile FTTP networks can be installed either on existing utility poles or buried underground, the latter being more expensive but also more resistant to service outages. Underground fiber is generally protected from things that typically affect aerial fiber cabling such as wildfires, ice storms or cars crashing into utility poles.

2.1.2. Speed and Performance

Bandwidth is the capacity of a broadband or other telecommunications network to move data across the network, similar to how a road system moves vehicle traffic. Internet speeds are measured in *bits per second* or *bps*.[22] Previously, data was measured in *kilobits per second* or *Kbps* – this unit was used to describe the bandwidth of dial-up modems and is still applied to fax machines. Today we measure data in *Megabits per second*, or *Mbps*, and *Gigabits per second*, or *Gbps*. Each of these measurements is 1,000 times faster than the prior measurement: Gbps is 1,000x faster than Mbps, which is 1,000x faster than Kbps.

It is important to note that speed is not the only measure of an internet connection's performance. The latency, or delay, of a connection is also very important. High latency can be caused by a bottleneck or point of congestion in a network. For example, if a last mile network connects to a middle mile network with an insufficient connection (or a middle mile network connects to a long haul network with an insufficient connection) that does not have enough capacity to allow all traffic to flow without contention, this will cause data to be buffered or even dropped. This will slow the overall delivery of data regardless of the advertised speed of an internet connection. Latency is frequently a problem during times of heavy network usage.

Network congestion and contention can also cause jitter, which is when there is a time delay in the delivery of data caused when data packets are dropped and need to be resent. Jitter often takes the form of streaming video pixelation and voice delays, applications that rely on real-time usage. ISPs and network operators can control both latency and jitter by maintaining sufficiently robust connections not only to their last mile customers, but to middle mile and long haul connections.

- **FCC Definition**

The FCC defines *broadband service* as internet service that provides a minimum of twenty-five (25) megabits per second (Mbps) download and three (3) megabits per second upload, commonly written as 25/3 Mbps. *Download* is the consumption of data from the internet, such as watching YouTube videos, checking emails, and surfing the internet. *Upload* is sending data over the internet, such as sending emails or posting pictures to Instagram. One of the challenges many people and organizations discovered through the wide use of Zoom, Teams, Hangouts, and FaceTime is the need for faster upload speeds. Any speed below 25/3 Mbps is not considered broadband and locations with this level of service are considered

[22] The Pew Charitable Trusts, "Broadband Basics: How it Works, Why It's Important, and What Comes Next," August 18, 2023, https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2023/08/broadband-basics-how-it-works-why-its-important-and-what-comes-next.

unserved by the FCC. Still, there have long been discussions that 25/3 Mbps is too low a threshold[23] and does not reflect the needs of advancing technology.[24]

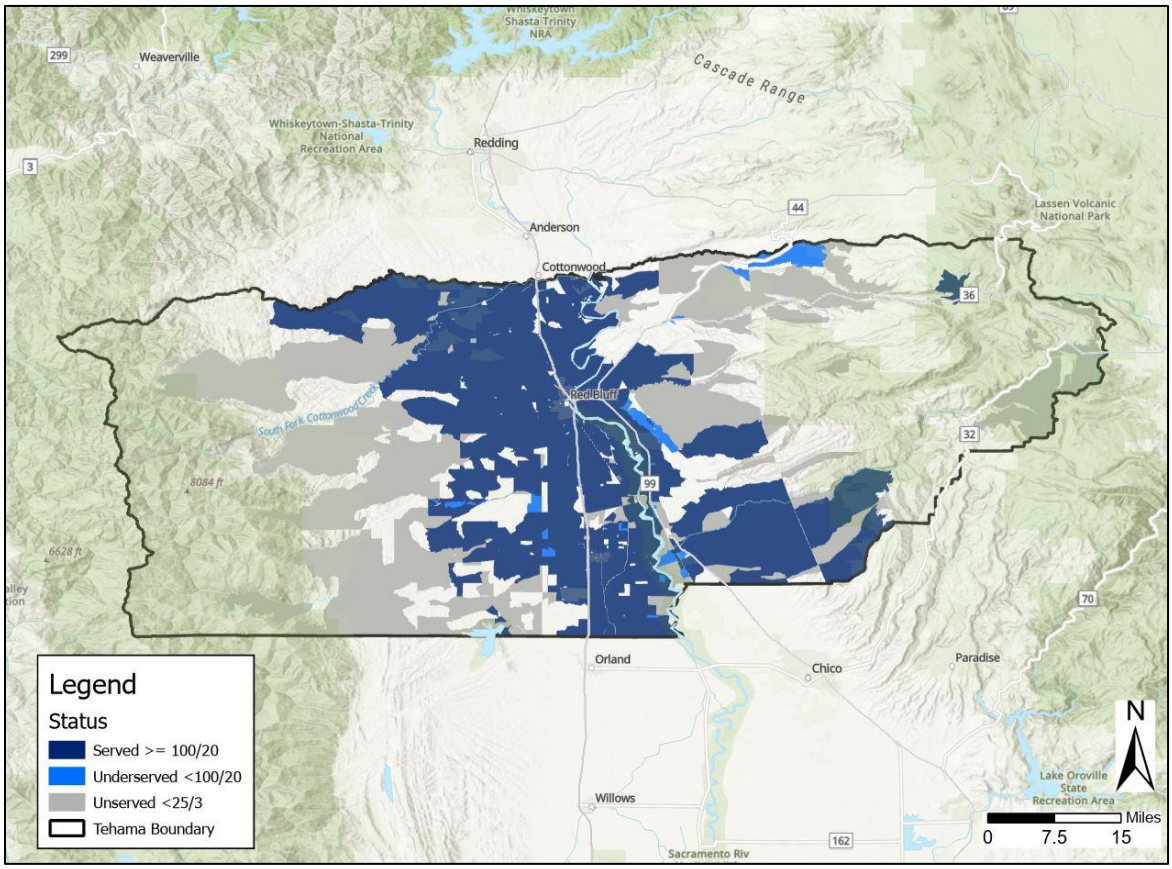
Infrastructure Investment and Jobs Act

The Infrastructure Investment and Jobs Act (IIJA) of 2021 set aside unparalleled funding for broadband and digital equity deployment.[25] As part of this legislation, the IIJA added the classification of underserved, in addition to unserved. The Broadband Equity, Access, and Deployment (BEAD) program, established in the IIJA, defines the two as follows:[26]

- Unserved are those locations without any service offerings at or above 25/3 Mbps
- Underserved are those locations with 25/3 Mbps but less than 100/20 Mbps

Figure 3 below illustrate the areas of Tehama County that are unserved, underserved, and served as defined by the IIJA.

Figure 3: Served, Underserved, and Unserved Areas in Tehama County



Note: Each census block shows the highest service speed available from the wireline or fixed wireless services in that area. This map uses the BEAD program's definitions for served, underserved, and unserved locations. See Section 6 for details.

[23] Congressional Research Service, *Raising the Minimum Fixed Broadband Speed Benchmark: Background and Selected Issues*, July 12, 2021, https://crsreports.congress.gov/product/pdf/IF/IF11875/2.

[24] US Government Accountability Office, *Broadband Speed: FCC Should Improve Its Communication of Advanced Technologies Capability Assessments*, April 25, 2023, https://www.gao.gov/products/gao-23-105655.

[25] Infrastructure Investment and Jobs Act, Public Law 117–58, 117th Congress, November 15, 2021, https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf.

[26] BEAD NOFO, p. 7.

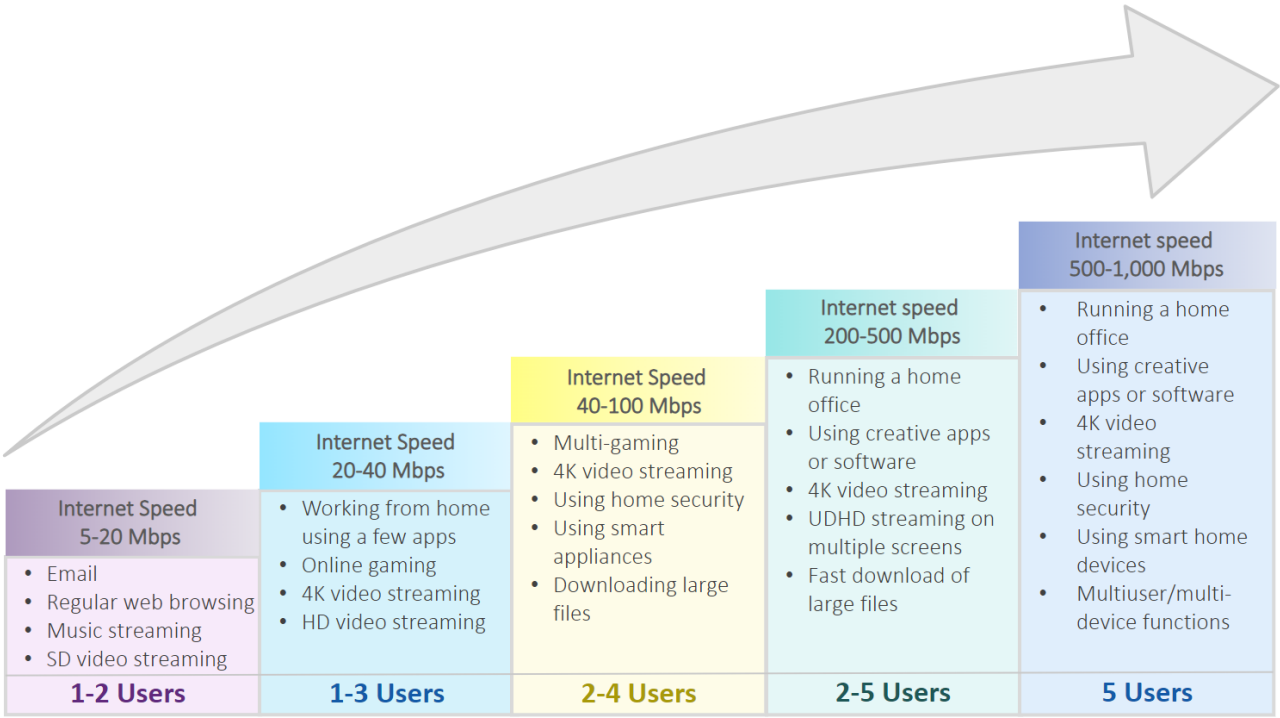
Most of the county is classified as unserved or underserved, with speeds of less than 100/20 Mbps available.

This is significant, as the IIJA and BEAD program recognize the need to scale data consumption to meet future connectivity needs. The IIJA dictates that any networks constructed with funding from the BEAD program must be capable of delivering speeds of at least 100/20 Mbps to end-users to account for ever-growing capacity demands and prioritizes the funding of high bandwidth fiber to the premises last mile networks.[27]

California Definition

The 2020 California Broadband for All Action Plan (Action Plan) advocated that the minimum speed used to define broadband in California be increased dramatically from 6/1 Mbps to at least 25/3 Mbps, to align with the FCC standard. Additionally, the Action Plan called for the goal of all deployments be at least 100/20 Mbps, aligning the State with federal funding requirements.[28]

Figure 4: Estimated Home Service Speeds Needed per Number of Users[29]



[27] Infrastructure Investment and Jobs Act, Ibid.

[28] California Broadband Council, *Broadband for All Action Plan 2020*, December 2020, https://broadbandcouncil.ca.gov/wp-content/uploads/sites/68/2020/12/BB4All-Action-Plan-Final.pdf.

[29] All Connect, "Frequently Asked Questions on Internet Speeds: What Are Mbps and How Many Do I Need?," https://www.allconnect.com/blog/faqs-internet-speeds-what-speed-do-you-need, accessed August 2023.

2.2 Broadband Technologies

2.2.1 Wired and Wireless

There are a variety of technologies and methods to bring connectivity into homes and businesses. Generally, two basic transmission technologies provide internet connectivity: wired and wireless. Within each category, there are multiple variations. Simply, *wireless* is connectivity that uses electromagnetic waves through the air to transmit information, while *wired* is connectivity that uses physical transmission media such as copper wire of fiber optic cable. This section will provide the reader with a high-level summary of each common type of technology.

In this feasibility plan, satellite technology is generally not considered, nor is it factored into our service availability maps and discussions. Areas that receive only satellite service, whether it be from Low Earth Orbit satellites, such as Starlink, or traditional geosynchronous orbit satellites, including HughesNet and ViaSat, are not considered served by current funding opportunities, regardless of the coverage or speeds.

Wired Technologies

- **Digital Subscriber Line**

When using Digital Subscriber Line (DSL), data is transmitted over copper telephone wires consisting of a twisted pair of thin copper wire. Often, these telephone wires are decades old and nearing the end of their useful lifespan. The speed and performance of a DSL internet connection is very distance sensitive, the farther a subscriber is from the main hardware (the Digital Subscriber Line Access Multiplexer (DSLAM)) the more signal quality declines and speeds decrease. Copper lines are also used by fax machines and older dial-up modems. While DSL can provide speeds above 25/3 Mbps, residential consumers typically cannot receive speeds above 100/20 Mbps. Factors affecting DSL's capabilities include equipment, infrastructure age, and distance between the customer premises and the DSL network equipment. Distance to facilities and age of DSL systems are generally more acute in rural areas than in urbanized areas.[30] Many current funding programs, such as those created by IIJA, will not fund the deployment of this technology due to the inability to consistently reach 100/20 Mbps and scale to higher speeds.[31]

Some internet service providers (ISPs), such as AT&T, are phasing out their DSL offerings. As of October 1, 2023, existing subscribers will be able to continue their service, but AT&T will not offer new DSL services.[32] In many areas, they now offer a fixed wireless service using their mobile networks to offset this loss, but as AT&T and other providers face higher repair costs from aging DSL infrastructure often dating back to the prior century, DSL networks are gradually being replaced in favor of fiber when feasible.

[30] Alisher Aldashev and Birzhan Batkeyev, "Broadband Growth Infrastructure and Economic Growth in Rural Areas," *Information Economics and Policy*, December 2021, https://www.sciencedirect.com/science/article/abs/pii/S016762452100024X.

p[31] Federal Communications Commission, "Types of Broadband Connections," https://www.fcc.gov/general/types-broadband-connections#dsl, accessed July 2023.

[32] AT&T has stated that it "no longer offers DSL services" on the company website. AT&T, "AT&T Internet – DSL," https://www.att.com/internet/dsl/, accessed October 2023.

Table 5: DSL Providers in Tehama County

Provider	Availability Number of Locations	Infrastructure Type
AT&T Inc	11,395	DSL
Ducor Telephone Company	760	DSL
FRONTIER	169	DSL
TPx Communications	9	DSL

■ Cable

Cable generally refers to coaxial cable made up of a copper inner conductor insulated from a conductive shield. Cable is usually installed on utility poles or buried in the rights-of-way (ROW), and then terminated into the building. Cable internet uses the same infrastructure that provides cable television to homes. Cable television systems were originally engineered and installed to broadcast television signals in one direction, from the satellite head end down to subscribers' homes. To provide internet access the cable systems had to be reengineered to be bidirectional, allowing data to be transferred both upstream and downstream. As a transmission medium, cable has more resistance and signal loss across distances when compared to fiber.

Most modern cable plants are Hybrid Fiber Coax (HFC) systems which use fiber optics to transmit data deep into neighborhoods, then transferring to coaxial cable within the neighborhood. To provide higher speeds, Cable ISPs must install fiber deeper into neighborhoods than they had in the past as capacity demands increase. When placed sufficiently close to the end user HFC cable systems can support downloads of 1 Gbps or more. However, most cable systems are asymmetric and simply cannot provide the high upload speeds offered by fiber systems.

Cable systems depend on transmission electronics throughout multiple nodes from the originating data center to the end user's location. These electronics use different transmission standards to send and receive signals through the cable at different frequencies, packing more data through more sophisticated use of these signals. Currently, the most widely used standards are DOCSIS 3.0 and 3.1,[33] which can provide 1 Gbps download speeds but allocate most of the capacity to downloads. The next standard, DOCSIS 4.0, can allocate more transmission capacity to upload speeds, but will require that cable ISPs upgrade electronics across many sections of their networks. DOCSIS stands for Data Over Cable Service Interface Specifications.

Table 6: Cable Providers in Tehama County

Provider	Number of Locations Served	Infrastructure Type
Charter Communications Inc	9,169	Coaxial cable
Xfinity	2,464	Coaxial cable

[33] DOCSIS stands for Data Over Cable Service Interface Specification.

Fiber Optics

Fiber optic cables are glass filaments, roughly the width of a human hair, that carry data in the form of light to equipment that converts the light to electrical signals.[34] Fiber is generally considered the gold standard of broadband as it has practically infinite speed and data capabilities, limited only by physics and the performance capabilities of the equipment used to light the fiber and recognize the light sent through these glass tubes. The main thoroughfares of the first layer of the internet are in the form of fiber optic subsea cables and cross-county long haul routes, transmitting hundreds of terabits of data per second between and across continents. Fiber optics have been utilized for decades to transmit data in this manner, but until recently, it was relatively uncommon to have fiber reach private residences. Fiber cables are also long-lasting with an expected lifetime of 50 years or more without requiring significant maintenance. As fiber middle mile becomes more accessible and components become cheaper, deploying fiber to a residence has become the end goal for many providers because of low upkeep costs and the ability to upgrade to electronics to keep up with demand well into the future.

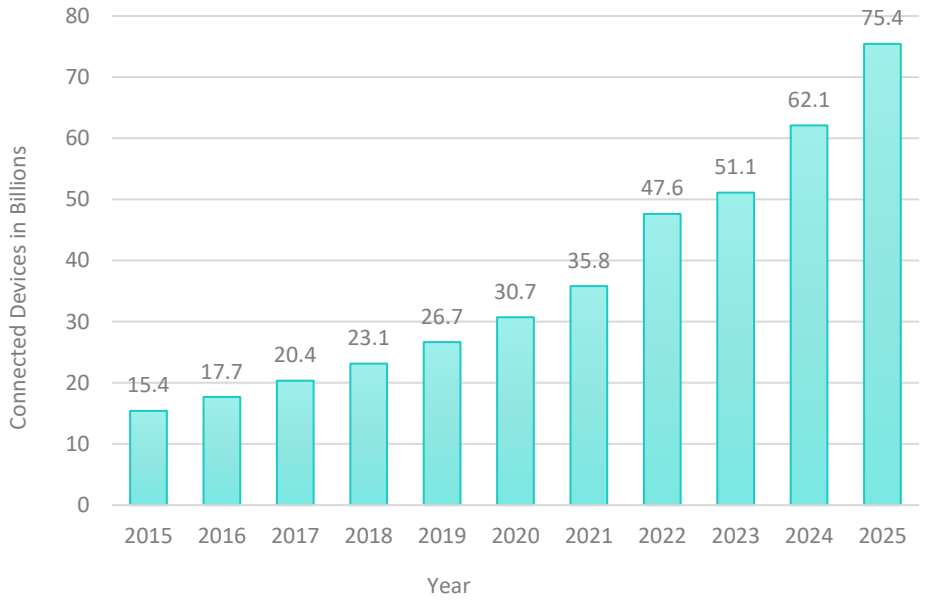
Fiber to the Premises (FTTP) systems generally use Passive Optical Networking (PON) technology, where a single strand of fiber is connected to a port (generally a 10Gbps capable port) at an ISPs facility such as a hut or a cabinet, and that single fiber then goes into a neighborhood where it is split, using passive splitters requiring no electronics or power, into 32 or 64 fiber strands that connect to 32 or 64 premises. This shared (or tapped) technology lowers deployment costs by reducing the strand count of fiber and labor required.

Table 7: Fiber Providers in Tehama County

Provider	Number of Locations Served	Infrastructure Type
Charter Communications Inc	64	Fiber to Premises

[34] Federal Communication Commission, "Types of Broadband Connections," accessed July 2023, https://www.fcc.gov/general/types-broadband-connections#fiber.

Figure 5: Number of Devices Estimated to be Connected to the Internet Globally[35]



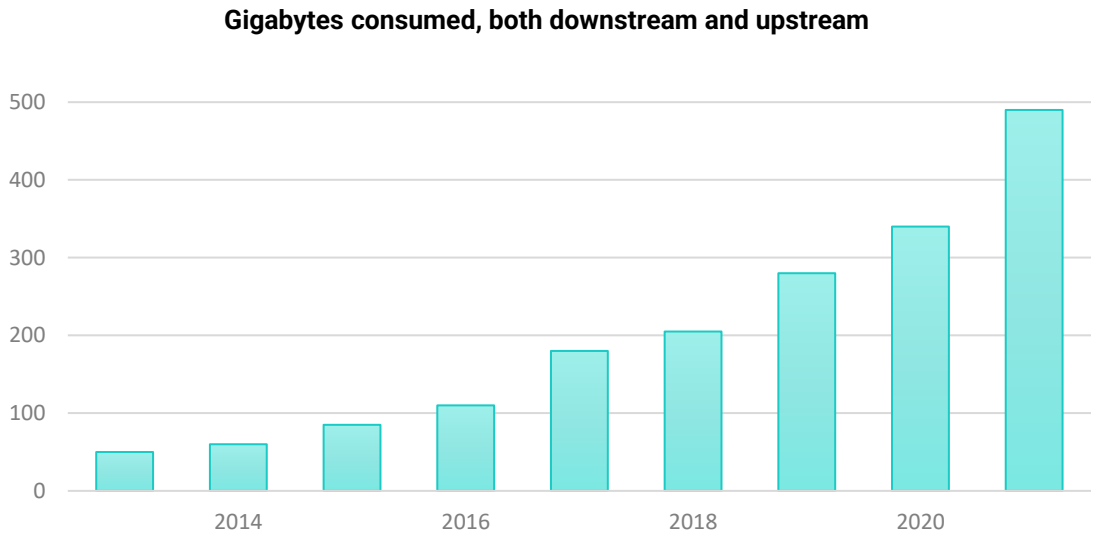
As implied by Figure 5, the need for increased bandwidth and speed grows as both devices and data consumption increase. Unsurprisingly, broadband technology that can scale with increased use is essential. This exponential growth is leading to the push and growth of scalable technologies such as FTTP. Upcoming federal and state funding are generally focused on bringing fiber and other scalable technologies to homes, businesses, and community anchor institutions.

In densely populated markets, FTTP and high-performance coaxial cable systems have become widely available. The majority of connected households in these areas have rapidly increased demand for and use of data. At the end of 2022, the average household downloaded nearly 600 GB of data per month, up from 462 GB in early 2021 and more than double the average household's use of 270 GB per month at the end of 2018.[36]

[35] T. Poongodi et al, "IoT Sensing Capabilities: Sensor Deployment and Node Discovery, Wearable Sensors, Wireless Body Area Network (WBAN), Data Acquisition," in Peng, SL., Pal, S., Huang, L. (eds), *Principles of Internet of Things (IoT) Ecosystem: Insight Paradigm*. Intelligent Systems Reference Library, vol 174. Springer, Cham, Switzerland, (November 2019), https://www.researchgate.net/publication/337259363_IoT_Sensing_Capabilities_Sensor_Deployment_and_Node_Discovery_Wearable_Sensors_Wireless_Body_Area_Network_WBAN_Data_Acquisition.

[36] OpenVault, *Broadband Insights Report*, Q1 2021, p. 6, https://openvault.com/ovbi-average-monthly-broadband-usage-nears-600gb/; OpenVault, *Broadband Industry Report*, 4Q 2019, p. 2, https://openvault.com/NEW-SITE-OV3/wp-content/uploads/2021/02/Openvault_Q419_OVBI.pdf.

Figure 6: Average Broadband Consumption per Household[37]



Wireless Technologies

Wireless broadband functions much like wired broadband but sends data through the air via a link between equipment on a tower and the consumer's house or business. Wireless connectivity includes mobile or cellular connectivity, fixed wireless, and community or campus wide Wi-Fi networks. Speeds vary greatly depending on the equipment, the internet service provider's middle mile connection, number of people on the network, and obstructions between or proximity to the antenna or tower.[38] Even weather conditions such as heavy rain can negatively affect the performance of certain wireless systems. Generally speaking, when compared to FTTP or cable networks wireless last mile networks are far less expensive and faster to deploy but provide reduced speed, performance and reliability.

■ Fixed Wireless

Fixed wireless networks are simply wireless networks that are point to mulit-point, such as from a tower to homes in a neighborhood. Usually, a line (preferably middle mile fiber) is run to a vertical asset such as a tower, tall building, or pole which feeds a wireless access point (AP) that communicates with a subscriber module (SM) receiver on a consumer's property to obtain internet access through the wireless link. They are not mobile, as the SMs are 'fixed' to a static location such as the sidewall or eaves of a house, unlike cellular networks. Additionally, the capability of this technology depends on the amount of wireless spectrum available for the ISP to utilize. Traditionally, unlicensed fixed wireless relies on line-of-sight (LoS) between the AP and SM to communicate and is operated at a relatively low transmit power. However, licensed spectrum, which is more costly and resource intensive to acquire, can penetrate through trees and some structures using higher transmit power, depending on the frequency of the spectrum.

[37] Sara Fischer and Margaret Harding McGill, "Gigabytes Consumed," *Axios*, May 4, 2021, https://www.axios.com/2021/05/04/broadband-usage-post-pandemic-increase.

[38] Federal Communication Commission, "Types of Broadband Connections," https://www.fcc.gov/general/types-broadband-connections#wireless, accessed July 2023.

Wireless technology can also be used as backhaul for wired network deployments, with dedicated multi-gigabit per second capacity being used to move information between two towers.[39] Some companies have seen success in using this model to deploy fiber to certain households, then use a multi-gigabit wireless link to bring the signal into and out of remote communities too far from existing middle mile fiber. While this can cause some issues, such as lack of redundancy and susceptibility to obstructions and weather, this hybrid approach is a powerful way of providing modern connectivity to homes where middle mile fiber backhaul would be extremely costly.

- **Wi-Fi Networks**

Wi-Fi Networks are commonly used in households and businesses to create a wireless network for devices used in the business or home. The equipment in the house or business translates a wired or wireless signal to a Wi-Fi signal that devices can understand. Wi-Fi networks can be limited to a single building or can span entire city blocks or college campuses. Wi-Fi networks are particularly convenient for users because most commercial internet devices, such as smart phones, tablets and laptop computers come with a Wi-Fi radio built into the device.

- **Mobile & 5G**

Mobile wireless, commonly referred to as cell or cellular, allows the user with a connected mobile device to move about a wider area than a Wi-Fi connection would allow. Mobile wireless Aps are located on towers or other vertical assets in close enough proximity to one another such that when a user is moving, in a car or otherwise, their data can seamlessly be handed off from one tower's AP to the next without the consumer realizing there has been a handoff. Examples of mobile devices include smartphones, tablets, and portable hotspots. These devices use a radio within the device that is different than a Wi-Fi radio.

Recently, mobile providers such as Verizon, T-Mobile, and AT&T have started offering a home internet service based on mobile networks. By using the same tower based equipment and the same licensed spectrum they use for their mobile wireless service, they provide a fixed wireless service by providing consumers with an antenna and radio (SM) that can be mounted to the house or even kept inside the house, preferably near a window with good exposure to the serving tower. This service can provide important connectivity to homes that are otherwise unable to receive any other service. However, in some instances, these service offerings will create barriers for those seeking grant funds to deploy higher capacity wireline networks such as fiber and coaxial cable.

5G is shorthand for fifth-generation mobile connectivity standard, which does offer improved performance compared to 4G. Hardware vendors rely on established standards to manufacture products that can be widely implemented. The 5G (and 4G) standard can be used for both fixed wireless and mobile networking. Prior to the pandemic, many ISPs were promoting 5G as a solution to connectivity challenges. Post-pandemic, the broadband funding landscape has changed and does not support grant funding for the deployment of 5G or any cellular connectivity as solutions to connect homes, businesses or CAIs.

2.3 Broadband Benefits

Before the pandemic, internet connectivity was used for a wide variety of purposes: education, entertainment, business, social networking, telehealth, reverse 911 and more. Many rural and urban households and businesses struggled with connectivity – both access and affordability. The pandemic intensified the need for affordable access to high-quality and high-speed broadband. In the pandemic-altered world, access to affordable broadband services has become a necessity. Unfortunately,

[39] An 18GHz radio between two towers with LOS can achieve this level of backhaul connectivity.

many rural and urban households and businesses continue struggling to gain access to affordable, high-speed internet service. This section highlights some of the multifaceted benefits of high-speed connectivity.

Education

Broadband can facilitate access to education, from the K-12 system to higher education including certifications, continuing education, and advanced degree programs. While many online programs were growing prior to the COVID-19 pandemic, access to online education has only accelerated after the public health emergency.

Before the pandemic, students ranging from grade school to graduate school utilized the internet to do research at home and on campus. Many students struggled with connectivity at home prior to the pandemic. In California public schools with the highest rates of poverty, three in ten households reported lacking the ability to do basic online activities.[40] As social distancing forced students home and into online education, the need for high quality broadband access was accentuated.

In addition to supporting primary and secondary education, broadband can also facilitate access to postsecondary programs. Individuals can take continuing education courses, gain numerous certifications, and receive technical degrees such as nursing and medical billing. In recent years the number of bachelor's, Master's, and even PhD programs online have expanded greatly. Continuing education, technical degrees, and higher education opportunities benefit individuals, households, and communities through increased earning potential. Improved access to education is especially important in communities that lack local education options.

Economic Development

Economic development is very closely tied to educational opportunities.[41] Individuals with some education past high school or a GED typically have higher incomes, those with bachelor's degrees and higher also have higher wages than their counterparts with a high school or equivalent education. In California, average earnings are close to twice as much with a bachelor's degree compared to high school graduates.[42] Ensuring individuals and household have access to broadband can help support educational attainment, and therefore increased income. With an increased income, broadband can bring additional funding outside of the community through remote work, tourism, and business growth. Access to broadband and increased opportunity can maintain local circular economies within a community through increased spending locally, thus supporting local businesses and jobs.

Improved access to broadband can also facilitate economic development by connecting, attracting, and retaining businesses. Small, local establishments increasingly rely on online advertising to reach customers and cloud-based applications to support productivity. When evaluating locations to establish new facilities, many larger employers in industries including logistics and manufacturing require that suitable connectivity is already present. These industries rely on speeds capable of supporting large file transfers and near-continuous updates to internal databases. Broadband is therefore critical to both retaining local businesses and attracting new employers.

Remote Work

Another aspect of economic development enabled by broadband is the growing availability of remote work opportunities. While some effects of the pandemic were temporary, such as students needing to learn from home, the effects of the

[40] Jackie Botts and Ricardo Cano, "The Wires May Be There but the Dollars Aren't: Analysis Shows Why Millions of California Students Lack Broadband," CalMatters, April 18 2021, https://calmatters.org/projects/california-broadband-student-access/.

[41] Center for American Progress, "Better Learning Outcomes Can Help Kick-Start the Economy," August 26, 2020, https://www.americanprogress.org/article/better-learning-outcomes-can-help-kick-start-economy/.

[42] Hans Johnson and Marisol Cuellar Mejia, "Higher Education and Economic Opportunity in California," Public Policy Institute of California, November 2020, https://www.ppic.org/publication/higher-education-and-economic-opportunity-in-california/.

pandemic on remote work are more permanent. Many companies have embraced remote work for certain jobs, either fully remote or hybrid, and find the reduced cost of less office space a benefit to their operations. While communities have historically focused on attracting employers as an economic development initiative, often using tax and other incentives, they can now also attract remote workers directly, provided the community has sufficient broadband infrastructure to facilitate remote working. By combining the availability of broadband infrastructure capable of facilitating remote working with other aspects of the community, such as recreation and quality of life, communities can attempt to attract remote workers from almost any industry from anywhere in the country. One example of a concerted effort to attract remote workers is Tulsa Remote, where a philanthropic organization, working in concert with the city of Tulsa, offers remote workers a monetary stipend and other incentives to move to the city of Tulsa, and bring their remote job with them.[43]

■ Public Safety

Improvements in connectivity for law enforcement, fire departments, emergency medical services, and other public safety services can be realized from the expansion of broadband services. A more comprehensive network allows for faster response times, increased information, and better mapping while responding to incidents. More public safety benefits are discussed in Sections 3 and 7.

Since 2015, Tehama County has experienced six disastrous fires and winter storm events that were large enough to be declared National or State Emergencies. One of these events occurred after December of 2022 and the drafting of this document.[44] Designing broadband networks for resiliency so that people and businesses in disaster-prone areas can connect with vital support and services is critically important.

■ Local Governmental Functions

Broadband can help promote civic engagement by providing convenient options for online participation. Broadband can help support increased productivity and efficiency by enhancing organizational coordination via online communication, leading to a reduction in labor costs. Government offices and facilities connected to a common last mile or middle mile network can save money by sharing services such as data disaster recovery locations and software licensing.

Access to robust high-speed connectivity is rapidly changing how governments operate. Broadband is critical to modern IT, GIS, and other technology-based departments of county, municipal, and quasi-governmental organizations. Many different applications such as GIS software, Microsoft Office, Google Workspace, video conferencing, and many others now operate as cloud-based services. The shift from on premise software to cloud-based software can provide cost savings through the reduction of software deployment costs, equipment replacement costs, and increased cybersecurity capabilities.

■ Civic Engagement

Community engagement underpins all government functions, from planning to participation in public meetings and budgeting. Before the pandemic, public engagement usually required attending meetings and events in person. However, the pandemic forced rapid changes to community engagement. As local agencies were forced to pivot to online engagement, many local governments experienced an increase in public participation. Community members and other stakeholders were able to attend meetings and contribute to public discourse in larger numbers due to technology and broadband access. Numerous communities and counties now utilize in-person and online applications for public participation, while various companies have developed software and tools for hybrid approaches to civic engagement.

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[43] https://tulsaremote.com/

[44] State of California Franchise Tax Board, "List of California Disasters," https://www.ftb.ca.gov/file/business/deductions/disaster-codes.html, accessed August 2023.

Smart Transportation Applications

Smart transportation operations involve the use of advanced technologies and data analytics to enhance transportation efficiency. This includes integrating sensors, GPS, and AI to collect and analyze data for informed decision making in route planning, traffic management, and vehicle maintenance. Decarbonized mobility is another focus, emphasizing the shift from fossil fuels to low-carbon or zero-emission transportation, including electric and hydrogen vehicles. Strategies include utilizing intelligent transportation systems, offering mobility as a service, implementing digital wayfinding, smart parking solutions, and deploying charging and fueling infrastructure for zero emissions and electric vehicles, as well as microtransit solutions to reduce congestion and expand transportation options. The overall goal is to improve mobility, reduce emissions, and ensure safe and efficient transportation.

Utility Operational Efficiency

Traditionally, utility management required monitoring, testing, visual inspection, and significant field work to find damage in utility systems. With the advent of new technology, providers can automate much of the monitoring and testing. Remote monitoring supports the continuous observation of utility operations. Utilities that use fiber optics to monitor operations include water, wastewater, and electric systems. Remote monitoring systems can proactively reduce maintenance and operational costs to utility systems in the following ways:

- Sensors can detect temperature and pressure of water and wastewater systems and notify staff of changes and locations to prevent expensive leaks,
- In-stream sensors monitor, in real time, the quality of water and the effluence of wastewater. These systems help maintain quality compliance with state and local laws,
- In electric utility systems, a remote sensing system can provide information about operations, line damage, power surges, and the ability to turn off systems during fire and weather events.

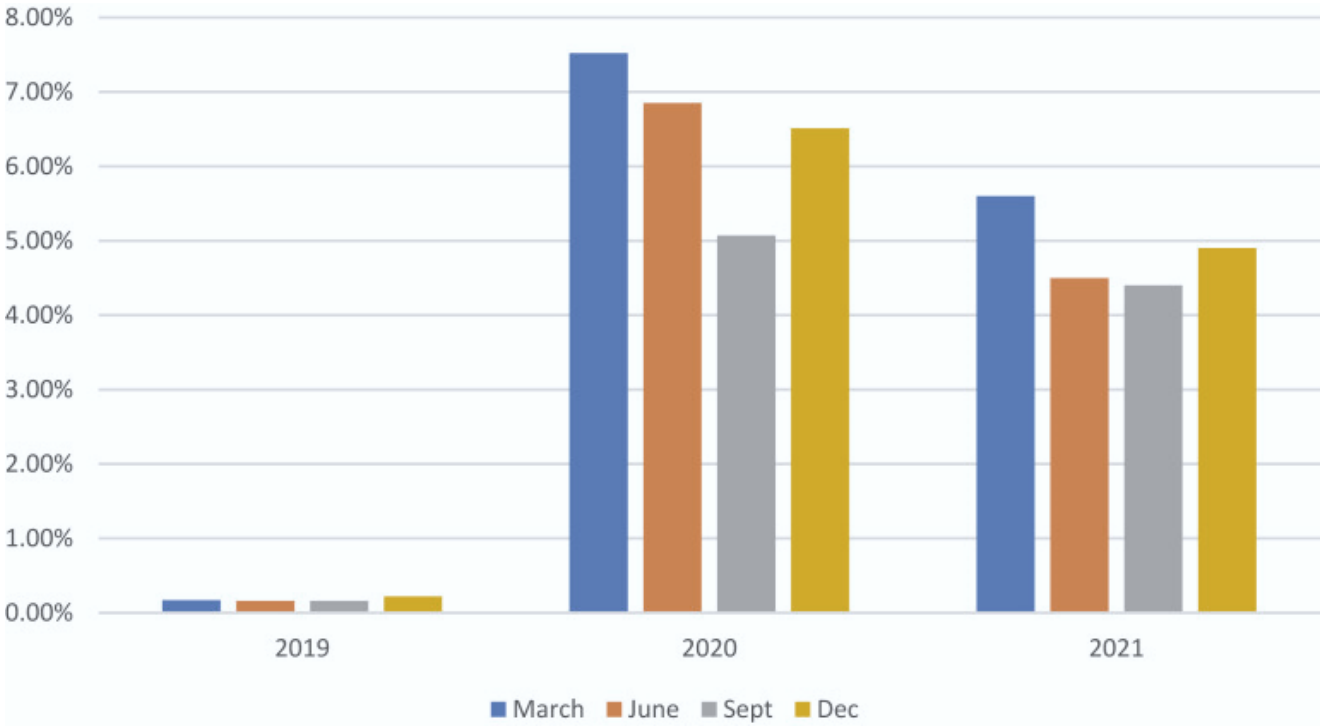
Healthcare

The U.S. Department of Health and Human Services (HHS) declared an end to the COVID-19 public health emergency in the United States, effective May 11, 2023.[45] While the public health emergency has ended, the long-term effects of the pandemic continue to resonate through society. Telemedicine allows access to healthcare and specialists without the cost and time of trips to the nearest hospital. In the rural areas, telemedicine is even more important with the closure of many rural hospitals in recent years.[46]

[45] David J. Sencer CDC Museum, "COVID-19 Timeline," , accessed October 2023.

[46] Alexander Marré, "Bringing Broadband to Rural America," *Community Scope*, 8(1), 2020, https://www.richmondfed.org/-/media/RichmondFedOrg/publications/community_development/community_scope/2020/community_scope_2020_no1.pdf.

Figure 7: Increase in Telehealth Visits from 2019-2021[47]



During the COVID-19 pandemic many people were unable to access doctors due to travel restrictions, concern for infection risks in public spaces, and lack of access to specialists. Due to the public health emergency, telehealth became widespread. For example, Medicaid saw a drastic increase in use of telemedicine, 15x the pre-pandemic levels, while Medicare saw a 10x increase.[48] Working-age individuals also benefited from online healthcare access, with a 766 percent increase in telehealth encounters from March 2020 through July 2020.[49] Many individuals were able to access medical care as video and phone visits became eligible for insurance reimbursement as part of the COVID-19 response.

2.4 Broadband Barriers and Challenges

Barriers to broadband adoption can range from physical, social, and economic. Physical barriers create high costs to install infrastructure while social and economic barriers create obstacles to affordability and service adoption. Regardless of what the barriers are, they make providing service to rural, lower income, low English literacy users and across physically challenging terrain such as mountains and forests more difficult.

■ Physical Barriers

Much of broadband planning requires an assessment of the geographic areas surrounding a planned network deployment. Buried lines are laid through trenching or directional drilling and take substantial equipment to install. Fiber is usually placed

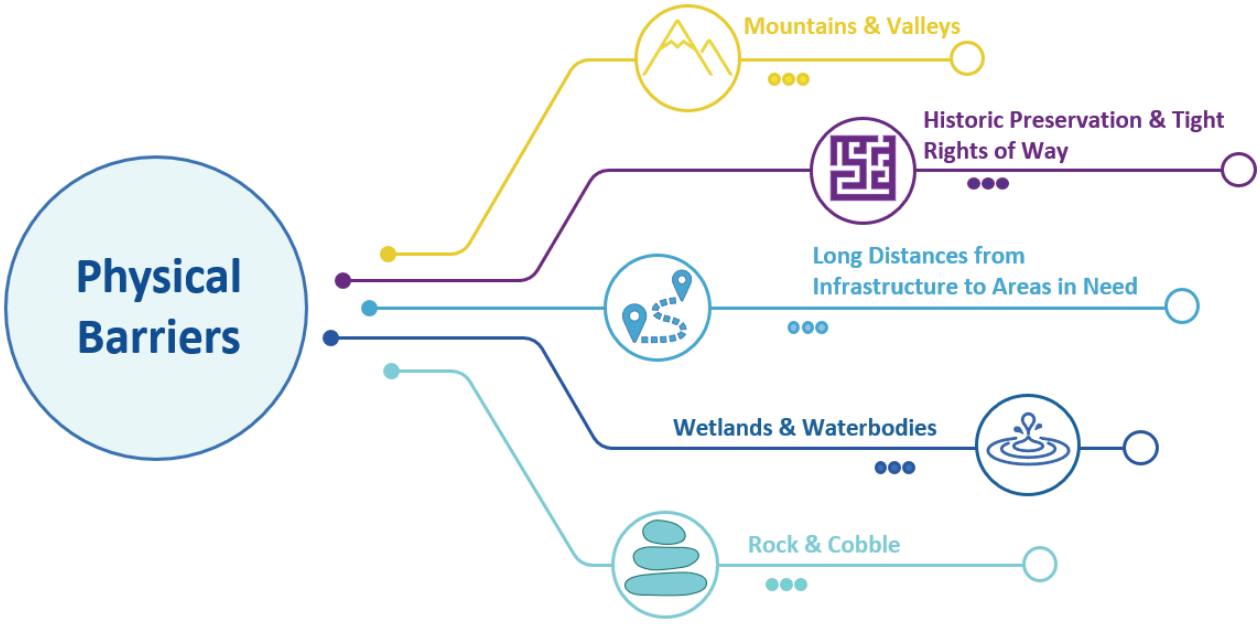
[47] Ibid.

[48] U.S. Government Accountability Office, "Telehealth in the Pandemic – How Has it Changed Health Care Delivery in Medicaid and Medicare?," September 29, 2022, https://www.gao.gov/blog/telehealth-pandemic-how-has-it-changed-health-care-delivery-medicaid-and-medicare.

[49] Julia Shaver, "The State of Telehealth Before and After the COVID-19 Pandemic," *Prim Care*, 49(4): 517–530, December 2022, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9035352/.

24-48 inches below the surface, but in many areas of California, it is placed deeper to protect the assets from damage from natural disasters, including fire. In locations where fiber can be hung from utility poles, this approach can be more cost effective. However, in more rural areas, utility poles may be aged and unable to support the additional weight and loading of fiber optic lines. These older utility poles also may not meet cable height and spacing requirements if more lines are added. In these instances, poles must be replaced, which can be very costly.

Figure 8: Physical Barriers to Broadband Development



In areas such as the Central Valley, where the soil is soft and the land is generally flat, it is vastly easier to install buried infrastructure than in areas such as the Sierra Nevada Mountains where the soil horizon is thin, and the land is steep and rocky. Hard rock and steep terrain increase deployment costs significantly, to the point of deterring infrastructure development in some instances. Topography can create challenges for wireless broadband development as well, with valleys and hills limiting the required line-of-sight needed for a suitable signal.

State and federal rules require many infrastructure projects to submit an Environmental Impact Statement. Common environmental and historic preservation considerations affecting network deployment include:

- Wetlands, bodies of water, rivers, streams, and irrigation ditches must be protected to maintain animal habitats and preserve water sources. These features can create challenges when deploying broadband infrastructure through areas with many waterways. Working with state and local agencies to adhere to regulations during the planning phase can help minimize these challenges.
- Historic preservation is important to maintain the character and heritage of a community. However, encountering historic artifacts, buildings, and other items of significance during deployment can delay projects. Broadband planning efforts should engage with the California Office of Historic Preservation (OHP) and the Tribal Historic Preservation Office as needed, to manage any potential issues.[50]

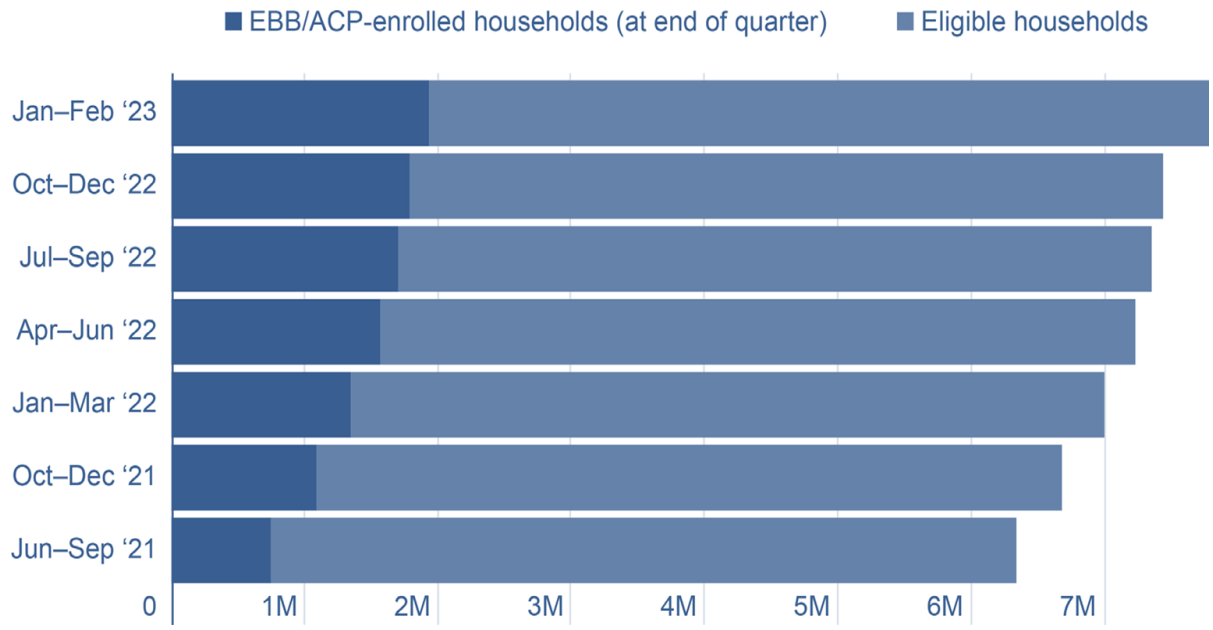
[50] California Office of Historic Preservation, (website homepage), https://ohp.parks.ca.gov/, accessed September 2023.

Social and Economic Barriers

Equally as important to the development of broadband infrastructure are the social and economic barriers preventing service adoption. These barriers can be as challenging to overcome as physical obstacles, and include unaffordable service, unaffordable or inadequate devices, and insufficient digital skills. Despite this, ISPs, local governments, and nonprofit organizations can help communities overcome these challenges by developing deployment and digital equity strategies with the following factors in mind:

- In rural areas with low population density, private ISPs typically have a difficult time recouping the cost of network deployment. This lack of return on investment, or ROI, can limit private ISPs' desire and ability to invest in such areas. Additionally, if a network is constructed, the ISP may be forced to charge customers higher subscription rates to offset these higher deployment costs. Local funding, state grants, and federal grants can help provide the additional resources needed for private ISPs to enter these low-density markets, which then reduces the need to charge higher prices to recoup the full cost of the deployment. As a result, these deployment subsidies can help to keep service offerings more affordable.[51]
- Communities with a low median income typically subscribe to broadband service at lower frequency than their higher-income counterparts. This can impact an ISP's willingness to invest in an area due to concern about take rate (the number of customers who will subscribe to their services). Even in areas where adequate service is available, it may not be priced at rates affordable to low-income residents.[52] Enrollment in internet subsidy programs can help offset this burden. However, even though enrollment increased in such programs during the acute phase of the COVID-19 pandemic, only one third of eligible households in California receive(d) federally subsidized internet through either the Emergency Broadband Benefit (EBB) program or the Affordable Connectivity Program (ACP).

Figure 9: California Households Enrolled in ACP[53]



[51] CA Broadband for All Action Plan.

[52] Botts and Cano, "The Wires May Be There but the Dollars Aren't: Analysis Shows Why Millions of California Students Lack Broadband."

[53] Darriya Starr, Joseph Hayes, and Niu Gao, "California's Digital Divide," Public Policy Institute of California, June 2023, https://www.ppic.org/publication/californias-digital-divide/.

- Another barrier to utilizing the internet and broadband access is digital literacy.[54] The American Library Association defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills."[55] This ability depends not only on possessing skills, but also having the confidence to go online drawn from one's understanding of how the digital world works. Much of this comes from simply working with digital technologies to develop the knowledge and skills to navigate the vast world online, and people on the other side of the digital divide often lack digital skills from the lack of opportunity to have enjoyed online access for so long. There are many factors that may affect an individual's confidence in their ability to use the internet, including:
    - English language fluency
    - Age
    - Concerns about safety and cybersecurity
    - Prior online access opportunities
    - Access to family and friends with high digital skills

  As with other forms of literacy, digital literacy can be positively impacted through culturally appropriate skills development, training, and support. Through these community-based programs, individuals can have the knowledge to safely utilize broadband resources to fully participate in modern life.

Technologies, Benefits, and Barriers Conclusion

High-speed broadband access plays a pivotal role in enabling productivity, competitiveness, and innovation. Broadband needs are dynamic, evolving in response to escalating consumer demands, an ever-growing range of uses, and the impact of events such as the recent pandemic. County stakeholders must be cognizant of this evolving landscape and the opportunities and challenges it presents. The federal government's substantial investments in broadband infrastructure provide a window of opportunity for localities to leverage improved technology and higher service speeds. These initiatives require a keen understanding of compliance and eligibility for accessing funding that can support technology upgrades and expansion.

For Tehama County, Senate Bill 156 is a significant opportunity. The allocation of approximately $6 billion towards broadband efforts, coupled with the restructuring of program requirements, opens avenues for groups to participate in the development of a statewide, open access middle mile networks, reducing the cost of last mile connectivity in remote areas. This improved middle mile access will present better opportunities for residents to not only benefit from enhanced connectivity but also for leaders to actively contribute to bridging the digital divide.

Understanding the diversity of wired and wireless options is vital to optimize connectivity strategies. This section highlighted key aspects of these technologies and the implications they have for business operations and development. Ultimately, the

[54] State of California, "State of California - State Digital Equity - Planning Application," (draft submitted to the NTIA), July 19, 2022, https://broadbandforall.cdt.ca.gov/wp-content/uploads/sites/19/2022/07/DRAFT-Project-Narrative-and-Eligibility.pdf.

[55] American Library Association, "Digital Literacy," https://literacy.ala.org/digital-literacy/, accesses October 2023. For a further exploration of the digital literacy concept and related concepts like technological literacy and internet literacy, see Etem Yeşilyurt and Rabia Vezne, "Digital Literacy, Technological Literacy, and Internet Literacy as Predictors of Attitude toward Applying Computer-Supported Education," *Education and Information Technologies*, 28, 9885–9911 (2023).

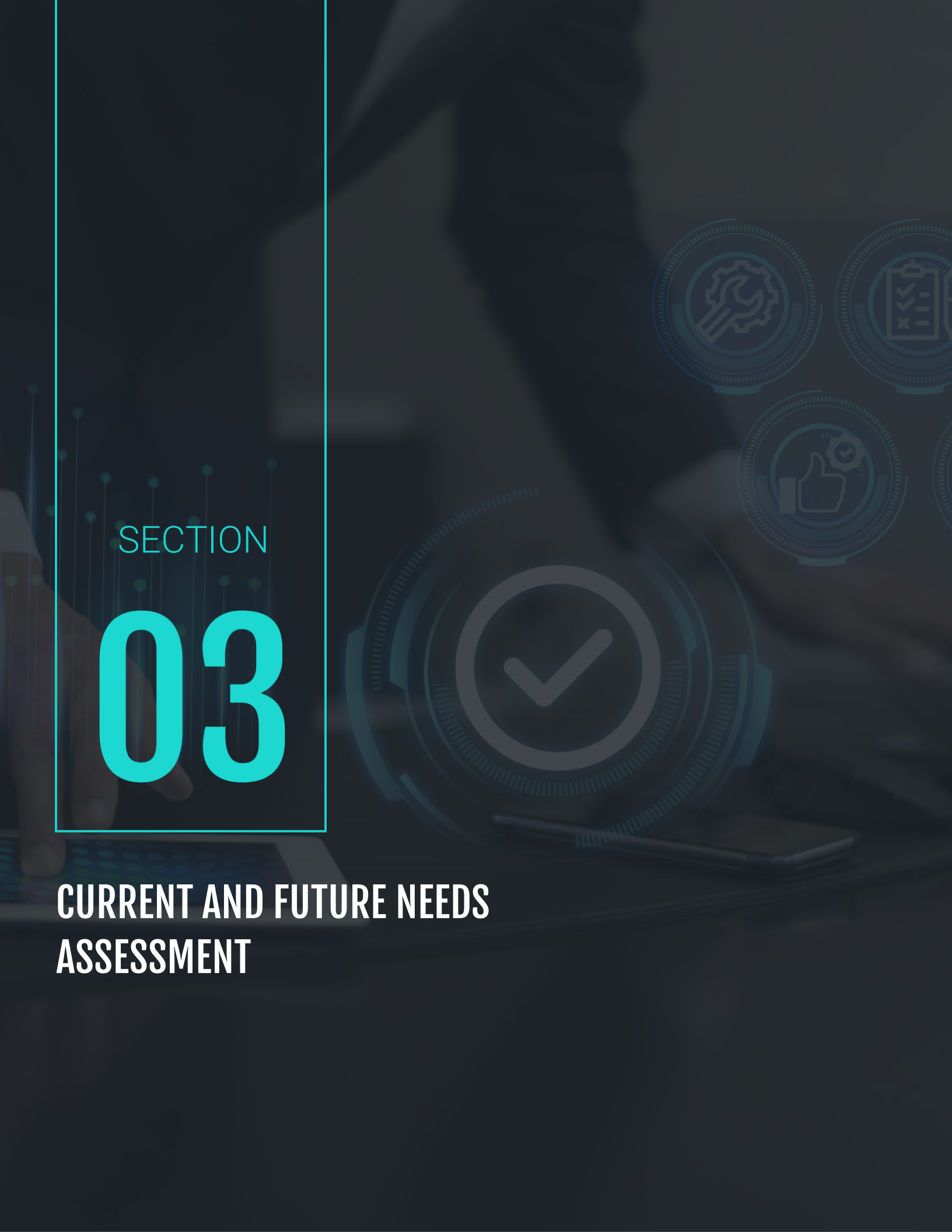
transition to fiber is crucial as the demand for bandwidth increases, driven by the proliferation of smart devices and data-hungry applications.

Broadband benefits span various domains and have never been more critical in a pandemic-changed world. From local governmental functions and public safety enhancements to increased civic engagement, high-speed broadband brings efficiency, coordination, and participation. Broadband is instrumental in smart transportation applications, supporting transit, electric charging, and traffic management. Utilities benefit from operational efficiency through real-time monitoring, cost reduction, and compliance assurance. Broadband provides opportunities for local businesses to connect with customers online and is crucial for attracting and retaining larger employers in industries such as manufacturing and logistics, and crucial for attracting remote workers.

In a residential context, broadband is a lifeline for the community. It enables access to online education resources, which have seen exponential growth since the pandemic. Broadband also fuels economic development by increasing income potential and supporting local circular economies. Healthcare is revolutionized with telemedicine, a necessity in remote areas with fewer healthcare facilities.

Governments must not only embrace the advantages of broadband but also be aware of the barriers and actively engage in initiatives to overcome them. Some of the multi-faceted obstacles include physical barriers posed by terrain and environmental regulations, as well as social and economic barriers that impact service affordability and digital literacy. Low-income and rural areas often face underinvestment from private ISPs, necessitating government and grant support. Communities with low median incomes may struggle to access affordable broadband, and digital literacy remains a key concern. Fortunately, there are opportunities for policies and initiatives to help mitigate these challenges.

The current broadband funding landscape presents a unique strategic opportunity. By seizing it, the county can harness the power of broadband to drive productivity, competitiveness, and long-term growth in an increasingly digital world.

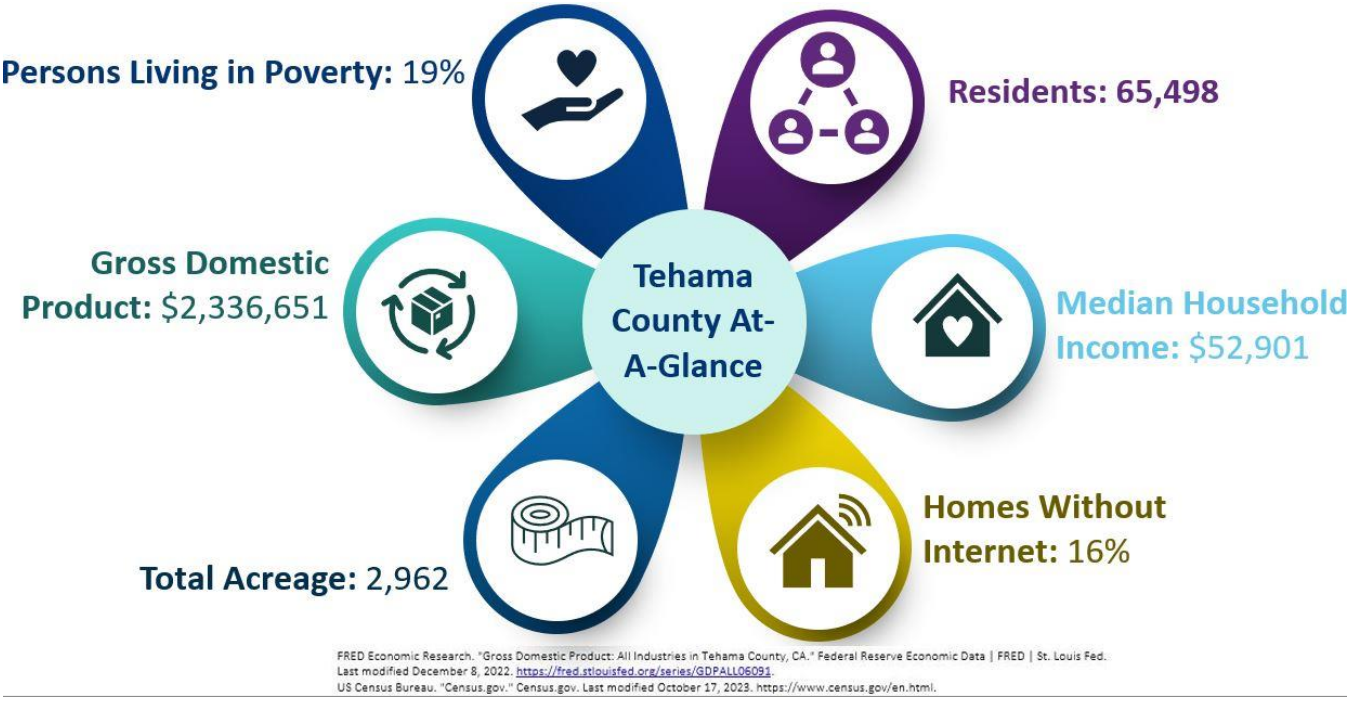


SECTION

03

CURRENT AND FUTURE NEEDS ASSESSMENT

Figure 10: Tehama County At-A-Glance



FRED Economic Research. "Gross Domestic Product: All Industries in Tehama County, CA." Federal Reserve Economic Data | FRED | St. Louis Fed. Last modified December 8, 2022. https://fred.stlouisfed.org/series/GDPALL06091.
US Census Bureau. "Census.gov." Census.gov. Last modified October 17, 2023. https://www.census.gov/en.html.

County leadership faces an ongoing challenge of assessing the requirements and impacts of facilitating broadband infrastructure deployment, involving not only technological change but social change as well. This section is intended to identify the need to bridge the digital divide and describe the potential short-term benefits, intermediate outcomes and long term impacts of doing so. Here we will address the current broadband ecosystem in Tehama County, initiatives planned and currently underway, and provide a summary of required resources and an analysis of gaps and barriers to broadband deployment in the county.

Bringing broadband to rural counties is challenged by incomplete or inaccurate broadband availability mapping and the reluctance of ISPs to provide accurate information on service availability, cost, and service speeds.

Until the COVID-19 pandemic highlighted connectivity and affordability challenges for millions of Americans, broadband expansion was expected to be solved by a patchwork of programs and providers. The pandemic exposed what rural communities already knew—the digital divide is a reality for many and will only get more pronounced without local intervention.

5.1 Broadband Needs Assessment

3.1.1 Economic Development and the Role of Broadband

Broadband can be a powerful tool for meeting the economic goals of the county. Densely populated areas have significantly higher rates of broadband availability than rural areas. Closing this gap in connectivity offers future economic growth opportunities for the county's unincorporated areas.

The agricultural economy in Tehama County has faced challenges in recent years, including lower crop prices, higher costs, and a loss of markets and agricultural infrastructure for traditional crops.[56] According to the county 2030 General Plan, production has remained relatively stable despite technological advances. Since the county's rainfall is insufficient to sustain most crops, agriculture relies on irrigation water supply from a combination of groundwater and surface water. However, the demand for agricultural water is expected to remain stable or slightly decline due to the increasing use of higher value, permanent crops, and efficient irrigation systems.

The business of farming and ranching benefits from broadband by the development of new markets, ability to communicate with customers, precision agriculture (technology that improves crop yields and increases production, reduces labor time, manages water, fertilizer, and pest management), etc. which aid improvements in efficiency and profitability. Additionally, internet access supports agriculture workers by improving access to education, healthcare, and other quality-of-life services. Precision agriculture is examined in detail in Section 9.

Figure 11: Tehama County Priorities

> “Tehama County’s strong agricultural background grew from the fertile valley lands along the Sacramento River and the expansive foothills where grazing activities are prevalent.”
>
> ***Tehama County General Plan 2009-2029***

As the county looks forward to not only recovery but also COVID-19 post-pandemic impacts, the need to support a robust information core to maximize social and economic resiliency has never been more important.

Robust broadband is a critical element to economic sustainability. In their article, Broadband Adoption and Availability: Impacts on Rural Employment During COVID-19, authors Catherine Isley and Sarah A. Low note “[ ] a causal relationships with the employment rate in low-population rural counties. Specifically, a one percentage point increase in the rate of broadband availability would have led to a 0.37 percentage point increase in the employment rate. A one percentage point increase in the rate of wired broadband adoption would have led to a 0.87 percentage point increase in the employment rate.”[57] In simple terms, increasing broadband access is projected to produce favorable increases in the employment rate.

Employers looking for locations to establish businesses often require areas with robust broadband. Even more so for employers embracing remote work policies including a hybrid remote work policy where they require employees to be in the office only part of the time. In this case employers find it attractive that their community have broadband infrastructure for their employees not only at their office, but at their homes as well. Rural areas with robust broadband infrastructure available at most homes, the essential tool necessary to participate in the digital workplace, can be very attractive for fully remote workers who can live wherever they choose. The ability of residents to live and work in the communities of their choice and spend their paychecks in the communities of their choice, provides economic benefits to small communities and businesses and reduces the effects of over-population on the environment in urban and suburban areas. On an individual basis, remote work can improve the well-being of individuals by connecting them to the communities of their choice.

[56] Microsoft Word - 6_AgEconomicDevGP.doc (Tehamacounty.org)
[57] Catherine Isley and Sarah A. Low, "Broadband Adoption and Availability: Impacts on Rural Employment during COVID-19," *Telecommunications Policy*, 46(7) (2022): 102310, https://doi.org/10.1016/j.telpol.2022.102310.

3.1.2 Unserved and Underserved

For practical purposes, unserved locations are those lacking access to internet access of 25/3 Mbps from any service provider other than satellite, unlicensed fixed wireless or mobile wireless. Underserved locations are those that do have access to 25/3 Mbps service but lack access to 100/20 Mbps from any service provider other than satellite, unlicensed fixed wireless or mobile wireless.

Due to many factors including population density, unincorporated areas and areas of low density per mile of the county often have the greatest number of un- and underserved households. In addition to population density, there are other factors impacting deployment to rural areas, including median incomes.

Table 8: Population Statistics for Tehama County

Area	Population (2022 Estimated)	Population Density per Square Mile (2020)	Land Area in Square Miles
Tehama County as a whole	65,245	22.3	2,949.14
Incorporated Cities			
Corning	8,226	2,324.2	3.55
Red Bluff	14,416	1,945.5	7.56
Tehama	423	532.6	0.79
Total of Incorporated Area	**23,065**	**1,937.6**	**11.90**

The differences between incorporated and unincorporated areas and the density of population are further defined by the availability and/or absence of wireline service and provider competition as detailed in Section 4.

Section 4 describes that wireline service is sufficient in incorporated areas of the county. Whereas the rural areas, characterized by lower population density, are often served by only fixed wireless technology offered by one provider.

Fixed wireless service is distinct from wireline by its line-of-sight requirements and its sensitivity to adverse weather conditions. The total available bandwidth of fixed wireless is also limited by the spectrum range it uses, so more users during peak times divide the bandwidth available to each user. Researchers testing the reliability of fixed wireless systems have found them to often lag behind cable and fiber systems, with more variations about what speeds are available at any given time.[58] This research team also explained that "[ ] anecdotally, fixed wireless does appear to face more frequent downtime or dropouts than fiber or cable wireline broadband products."[59] For these reasons, fixed wireless may not be as reliable as fiber or cable, but its flexibility and lower cost of deployment, particularly in rural areas, may nevertheless justify the performance tradeoffs.[60]

[58] Linda Hardesty, "Fixed Wireless Service Quality Lags Wired Broadband Says Evercore," *Fierce Wireless*, February 15, 2022, https://www.fiercewireless.com/wireless/fixed-wireless-service-quality-lags-wired-broadband-says-evercore.

[59] Ibid.

[60] See Ibid.

For many functions in a digital world, a reliable connection is critical. Business, education, healthcare, and government services rely on stable network connections.

An evaluation of un- and underserved connections in the county (census block level) demonstrates the difficulty in making deployment decisions. For additional information and funding strategies, see Section 6.

■ Who are the Unserved and Underserved?

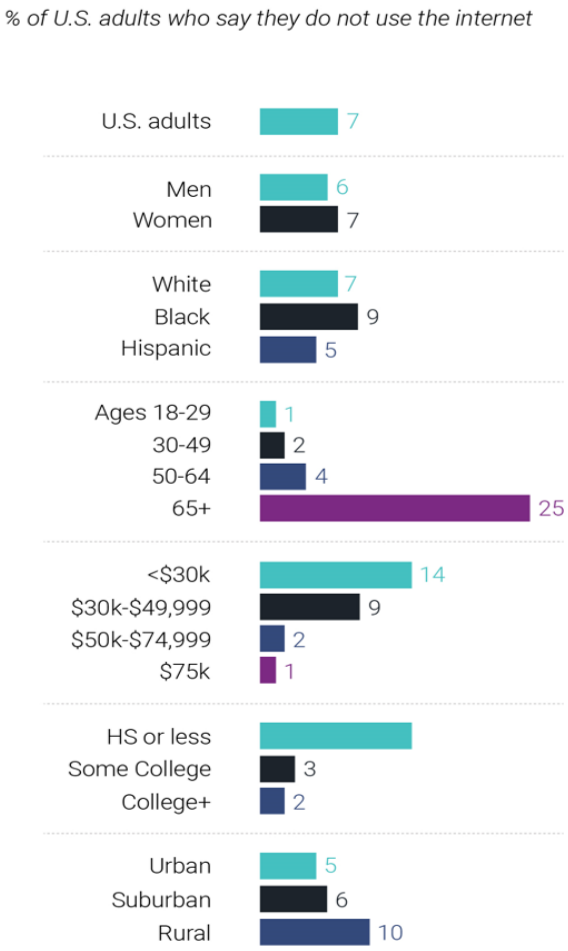
Access to service by the current definitions of broadband is the prevailing factor in assessing who is un- and underserved in a county, especially in relation to planning for funding opportunities. However, this study will be using the FCC's 'broadband serviceable location' fabric as the basis for determining if a residence is eligible for service, as this is the standard for most major funding opportunities going forward. More information on the uses, limitations, and eventual challenge process considerations for this data can be seen in Sections 4-7.

In rural-agricultural defined counties, the demographics of the area also present a picture of those who do not have access to internet connectivity. The return on investment for deploying service to widely dispersed households and communities with low population densities is generally longer than 5–10-year average Return on Investment (ROI). Combined with a lower than average income base and the ability of an ISP to recoup investment in these areas may be negatively impacted.

The costs of both service and devices are well known barriers to adoption and play a critical role in determining what and who can afford broadband service. They also play a role in the decision-making of private entities as they plan deployment projects in rural areas.

A 2021 survey conducted by the Pew Research Center reported the following:

Figure 12: Who's Not Online?[61]



Note: White and Black adults include those who report being only one race and are not Hispanic. Hispanics are of any race. Respondents who did not give an answer are not shown.
Source: Survey of U.S. adults conducted Jan. 25-Feb. 8, 2021.
PEW RESEARCH CENTER

Respondents earning less than $30,000 a year, those with only a high school education, those living in rural areas, and those over the age of 65 reported to use the internet at lower rates than their higher-income, more educated, younger urban and suburban counterparts.

3.1.3 Broadband Speed and Bandwidth

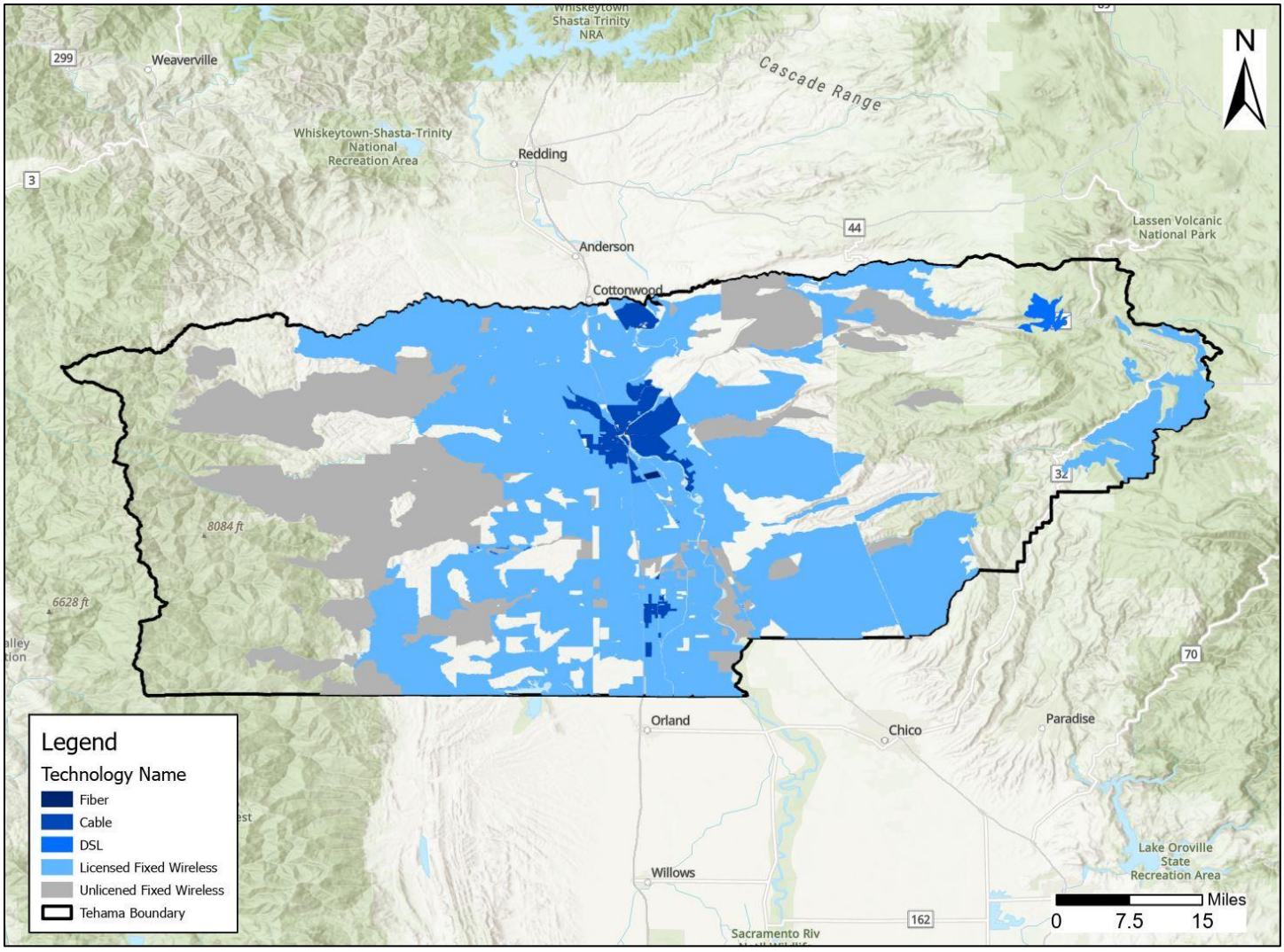
In its rules for the American Rescue Plan Act's broadband funding programs, the U.S. Treasury Department identifies that a family of five who telecommute and use remote education simultaneously require least 100 Mbps of download capacity to

[61] Andrew Perrin and Sara Atske, "7% Of Americans Don't Use the Internet. Who Are They?," Pew Research Center, April 2, 2021, https://www.pewresearch.org/short-reads/2021/04/02/7-of-americans-dont-use-the-internet-who-are-they/.

meet their needs.[62] The FCC also acknowledges that a single student or telecommuter can easily overwhelm a broadband connection capable of only 25/3 Mbps.[63] The current definition of broadband's minimum speed requirements described in Section 2 does not adequately consider today's requirement for full digital participation. The proliferation of connected devices, i.e., printers, cellphones, security, laptops, tablets, etc. makes lower-tier services almost unusable. To close the digital divide, broadband plans should be developed to provide ample bandwidth growth so that rural areas will not continue to lag behind urban areas.

The below examination of technology in the county portrays a distinct lack of high-speed options, detailing how existing services may not meet current needs.

Figure 13: Tehama County Current Internet Service by Fastest Technology Type



[62] Department of the Treasury, "Coronavirus State and Local Fiscal Recovery Funds," Interim Final Rule, 31 CFR Part 35, p. 72.

[63] The FCC has identified that a single student or telecommuter can need up to 25 Mbps alone, with combined use requiring "Advanced Service" with downloads above 25 Mbps. FCC, "Broadband Speed Guide," https://www.fcc.gov/consumers/guides/broadband-speed-guide, accessed September 2023; FCC, "Household Broadband Guide," https://www.fcc.gov/sites/default/files/household_broadband_guide.pdf, accessed September 2023.

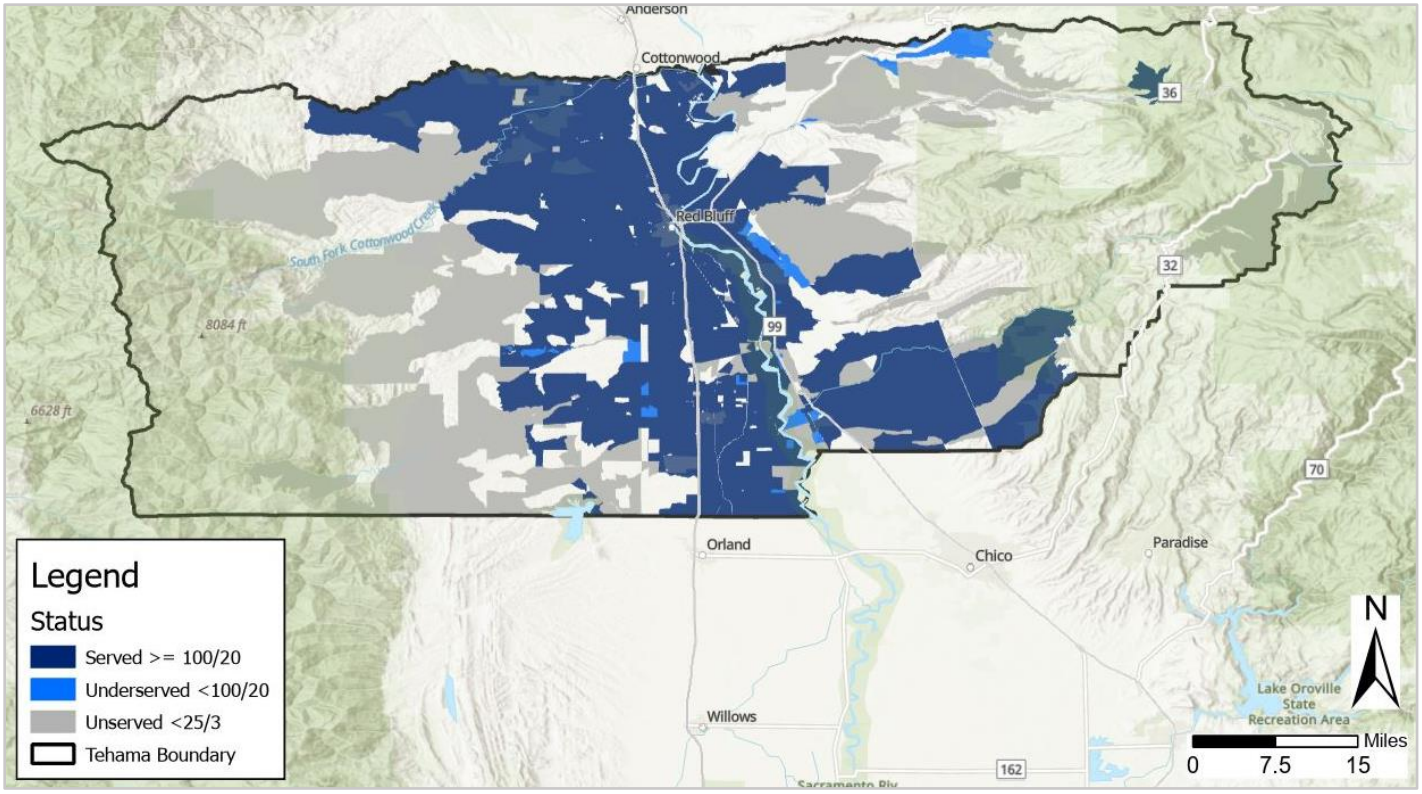
Service from satellite, unlicensed fixed wireless or mobile wireless is purposely excluded here.

Table 9: Households Lacking Broadband Service across Tehama County[64]

Broadband-Serviceable Households	Amount	Percent	Notes
Total number of Households (HHs)	27,341	100%	Defined by FCC address fabric
HHs lacking 25/3 Mbps wireline service	14,272	52.2%	May still receive fixed wireless service
HHs lacking any 25/3 Mbps service	3,882	14.2%	BEAD-defined "unserved"**
HHs with 25/3 but not 100/20 Mbps service	1,835	6.7%	BEAD-defined "underserved"**

*Note that the FCC reports comprehensive, technology-based availability information on the "household" level, rather than by count of locations. This distinction is discussed more in Section 4. **When evaluating the internet service levels available at a broadband-serviceable location (BSL), the BEAD program does not consider satellite, unlicensed fixed wireless, or mobile services. The BEAD program defines an "unserved" location as any BSL that cannot receive reliable internet services providing speeds of at least 25/3 Mbps, and an "underserved" location as any BSL that cannot receive reliable internet services providing speeds of at least 100/20 Mbps but can receive reliable internet services providing speeds of 25/3 Mbps.

Figure 14: Tehama County Service Status



Note: Broadband Service locations will alter the number likely representing a different view of un- and underserved households.

[64] This data is available on the FCC's National Broadband Map platform, under the option to download the "Broadband Summary by Geography Type." FCC, "Data Download," National Broadband Map, https://broadbandmap.fcc.gov/data-download/nationwide-data?version=jun2023, accessed November 2023. CostQuest also provides more detailed information about the distribution of residential and non-residential units by county. CostQuest, "About the Units in the Broadband Serviceable Location Fabric Data," September 19, 2022, https://www.costquest.com/resources/articles/about-the-units-in-broadband-serviceable-location-fabric-data/.

3.1.4 Affordability and Adoption

The development of broadband infrastructure to households across Tehama County is the first step in creating access to broadband, but affordability should be a parallel step and affordability requirements are often part of broadband infrastructure grant programs. Both the state and the federal government address affordability, understanding it is a critical step to broadband adoption.

The state's 2020 Broadband for All Plan identifies affordability as the second challenge to achieving broadband for all. In 2019, prior to the pandemic and the growth of federal and state funding, the California Emerging Technology Fund Survey found that over half of the Californians without a home broadband connection either cannot afford it or do not have a computer.[65]

The federal government has long sought to make broadband affordable. However, many programs prior to the pandemic were challenging to use and therefore underutilized. As a result of the pandemic, federal funding was allocated to create the first wide-ranging broadband affordability program.

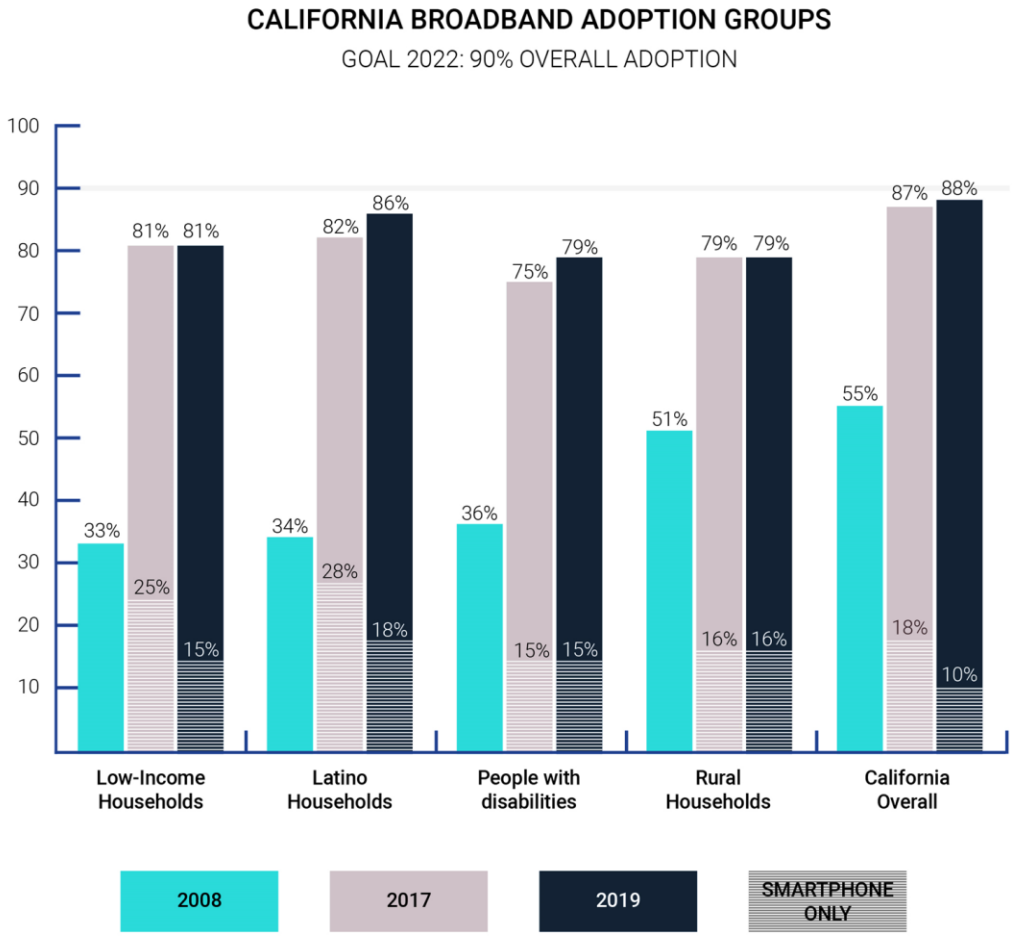
- December 2020, the federal government recognized affordability as a barrier and created the Emergency Broadband Benefit (EBB) fund to help households pay for connectivity by providing $3.2 billion in funding.[66]
- November 2021, the EBB was replaced with a longer-term program with more available funding, the Affordable Connectivity Program (ACP). The ACP was allocated $14.2 billion from the IIJA.
- October 2023, the White House requested an additional $6 billion to support the ACP program, which will run out of money in 2024 if not refunded.[67]

[65] CA BEAD Five-Year Plan.

[66] Federal Communications Commission, "Emergency Broadband Benefit Program," https://www.fcc.gov/emergency-broadband-benefit-program, accessed August 2023.

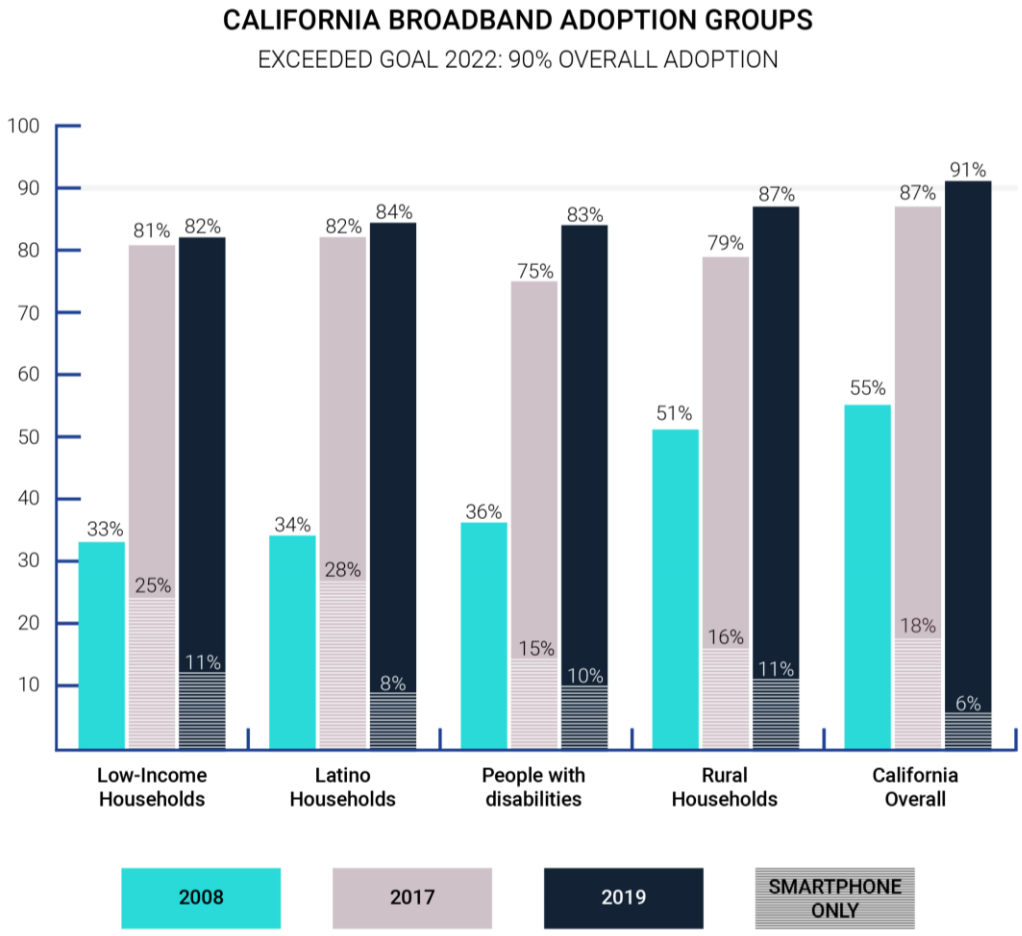
[67] https://www.telecompetitor.com/biden-asks-congress-to-fund-acp-low-income-broadband-through-2024/

Figure 15: California Adoption Rates 2019[68]



[68] California Emerging Technology Fund, *Statewide Survey on Broadband Adoption*, 2019, accessed July 2023, https://www.cetfund.org/action-and-results/statewide-surveys/2019-statewide-surveys/

Figure 16: 2021 California Adoption Rates[69]



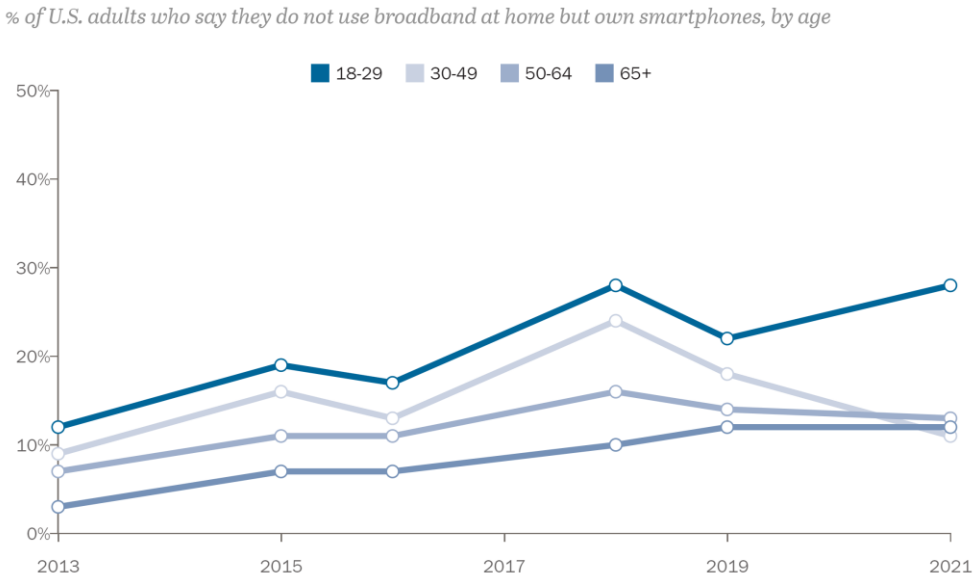
The State Broadband for All plan uses 2019 data. California Emerging Technology Fund released a survey in 2021, which incorporates the EBB and ACP subsidies for a significant number of households across the state and Tehama County. Through making broadband more affordable, along with investment in broadband infrastructure, more people are able to adopt broadband. After the EBB and ACP subsidies were put in place, there was a noticeable increase in broadband adoption for all recorded demographics, except for people identifying as Latinos. Through making broadband more affordable, along with investment in broadband infrastructure, more people were motivated and able to adopt broadband.

The two graphics above displaying California Broadband Adoption Groups from 2019 and 2021 demonstrate marginal 1-2 percent growth in adoption for low-income households while smartphone-only use has declined. Pew Research shows that a "substantial majority of Americans are cellphone owners across a wide range of demographic groups. By contrast, smartphone ownership exhibits greater variation based on age, household income and educational attainment.[70]

[69] California Emerging Technology Fund, "Statewide Survey on Broadband Adoption, 2021," https://www.cetfund.org/action-and-results/statewide-surveys/, accessed July 2023.

[70] Pew Research Center, "Mobile Fact Sheet," April 7, 2021, https://www.pewresearch.org/internet/fact-sheet/mobile/?tabId=tab-011fca0d-9756-4f48-b352-d58f343696bf.

Figure 17: Smartphone dependency by age[71]



As discussed in the subsection 'Who are the Unserved and Underserved," lower-income households are often the ones with no or limited access to the internet. They are also the most likely to subscribe to budget-friendly services that may not adequately meet household needs. While significant federal funding initiatives have been developed to address barriers to universal broadband as discussed below, careful attention needs to be paid to developing pre-funding requirements and post-award compliance monitoring to ensure that the public's investment is serving the intended need for the long-term.

Table 10: Major Policy Initiatives to Address Barriers to Universal Broadband Access

Availability	Amount
➢ **NTIA Broadband Equity, Access, and Deployment Program**	$42 billion
➢ **FCC Rural Digital Opportunity Fund**	$20 billion
➢ **California Senate Bill 156**	$6.5 billion
➢ **NTIA Tribal Broadband Connectivity Program**	$2 billion
➢ **USDA ReConnect Program and Rural Development Broadband Program**	$2 billion
Affordability	
➢ **FCC's Affordable Connectivity Program**	$14 billion
➢ **NTIA Digital Equity Programs**	$2.75 billion
Adoption	
➢ **CPUC Broadband Adoption Programs (multiple)***	not established
➢ **NTIA Digital Equity Programs**	$2.75 billion

[71] Pew Research Center, "Mobile Fact Sheet," April 7, 2021, https://www.pewresearch.org/internet/fact-sheet/mobile/.

The lure of a fast broadband connection and new internet-enabled devices are likely to be squashed by the cost of essentials such as housing. California ranked as the state with the highest median monthly housing expense, totaling $2,111. Not only did California rank highest for this metric, but California is also among the states with the most expensive square footage; the $2,111 median monthly housing expense will pay for less space when compared to other states.[72] The cost of housing has a demonstratable relationship with broadband adoption rates. To address the cost of internet service, the IIJA included $14.2 billion in funding for the Affordable Connectivity Program (ACP), a broadband affordability program to be administered by the FCC. The ACP began accepting applications on December 31, 2021.

The ACP program provides up to $30 a month toward the cost of internet service for eligible households and $75 for qualifying households in some high-cost areas and tribal households. Eligible households can also receive $100 to purchase an internet-enabled device such as a laptop, desktop, or tablet (with a minimum household contribution of $10). Both benefits are limited to one service and one device discount per household.

Eligibility is based on income or participation in another government assistance program.[73]

■ Income

Federal broadband subsidy programs frequently define low-income households as having income at or below 200% of the Federal Poverty Guidelines:

Table 11: FCC ACP Federal Poverty Guidelines

2023 POVERTY GUIDELINES FOR THE 48 CONTIGUOUS STATES AND THE DISTRICT OF COLUMBIA	
Persons in family/household	**Poverty guideline**
1	$14,580
2	$19,720
3	$24,860
4	$30,000
5	$35,140
6	$40,280
7	$45,420
8	$50,560

For families/households with more than 8 persons, add $5,140 for each additional person.

[72] Robin Rothstein, "Examining The Cost Of Living By State In 2023," *Forbes Advisor*, August 24, 2023, https://www.forbes.com/advisor/mortgages/cost-of-living-by-state/.

[73] More information about the ACP and other subsidy programs is found below in Section 8.

■ **Government Assistance Programs:**

Households may also qualify for ACP based on at least one household member's participation in one or more of the following government assistance programs:

- 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:
    - Free and Reduced-Price School Lunch Program or School Breakfast Program, including at U.S. Department of Agriculture (USDA) Community Eligibility Provision schools.
    - SNAP
    - Medicaid
    - Federal Housing Assistance, including:
        - Housing Choice Voucher (HCV) Program (Section 8 Vouchers)
        - Project-Based Rental Assistance (PBRA)/Section 202/ Section 811
        - Public Housing
        - Affordable Housing Programs for American Indians, Alaska Natives or Native Hawaiians
    - Supplemental Security Income (SSI)
    - WIC
    - Veterans Pension or Survivor Benefits
    - or Lifeline[74]
- Participates in one of these assistance programs and lives on Qualifying Tribal lands::
    - Bureau of Indian Affairs General Assistance
    - Tribal TANF
    - Food Distribution Program on Indian Reservations
    - Head Start (income based)[75]

In Tehama County, 58% of households qualify for the ACP program; however only 36% of eligible household are currently enrolled.[76]

[74] Federal Communications Commission, "Helping Households Connect," https://www.fcc.gov/acp, accessed August 29, 2023

[75] Federal Communications Commission, "Helping Households Connect," https://www.fcc.gov/acp, accessed August 29, 2023

[76] California All| Broadband for All, "Affordable Connectivity Program Enrollment Tracker," https://broadbandforall.cdt.ca.gov/affordable-connectivity-program/acp-enrollment/#, accessed August 28, 2023

Table 12: Tehama County ACP Participation

Name of county	Total households	Eligible households	Eligible households' percentage	Enrolled households	Enrolled households' percentage
Tehama	23,875	13,730	58%	4,929	36%

It is important to note that ACP will terminate when the $14.2 billion in funding is exhausted. In October 2023 the White House requested an additional $6 billion to fund the ACP program through 2024 but the funding request has not yet been considered by congress. Both California's Last Mile Federal Funding Account (FFA) and the BEAD Act both require that ISPs participate in the ACP. Analysts predict ACP will run out of money sometime in 2024.[77]

Depletion of ACP funding will further exacerbate the issue of access and device affordability for low-income and other participating households. To narrow the gap, funders and funded projects should consider alternate methods for ensuring affordability.

5.2 Stakeholder Asset Inventory

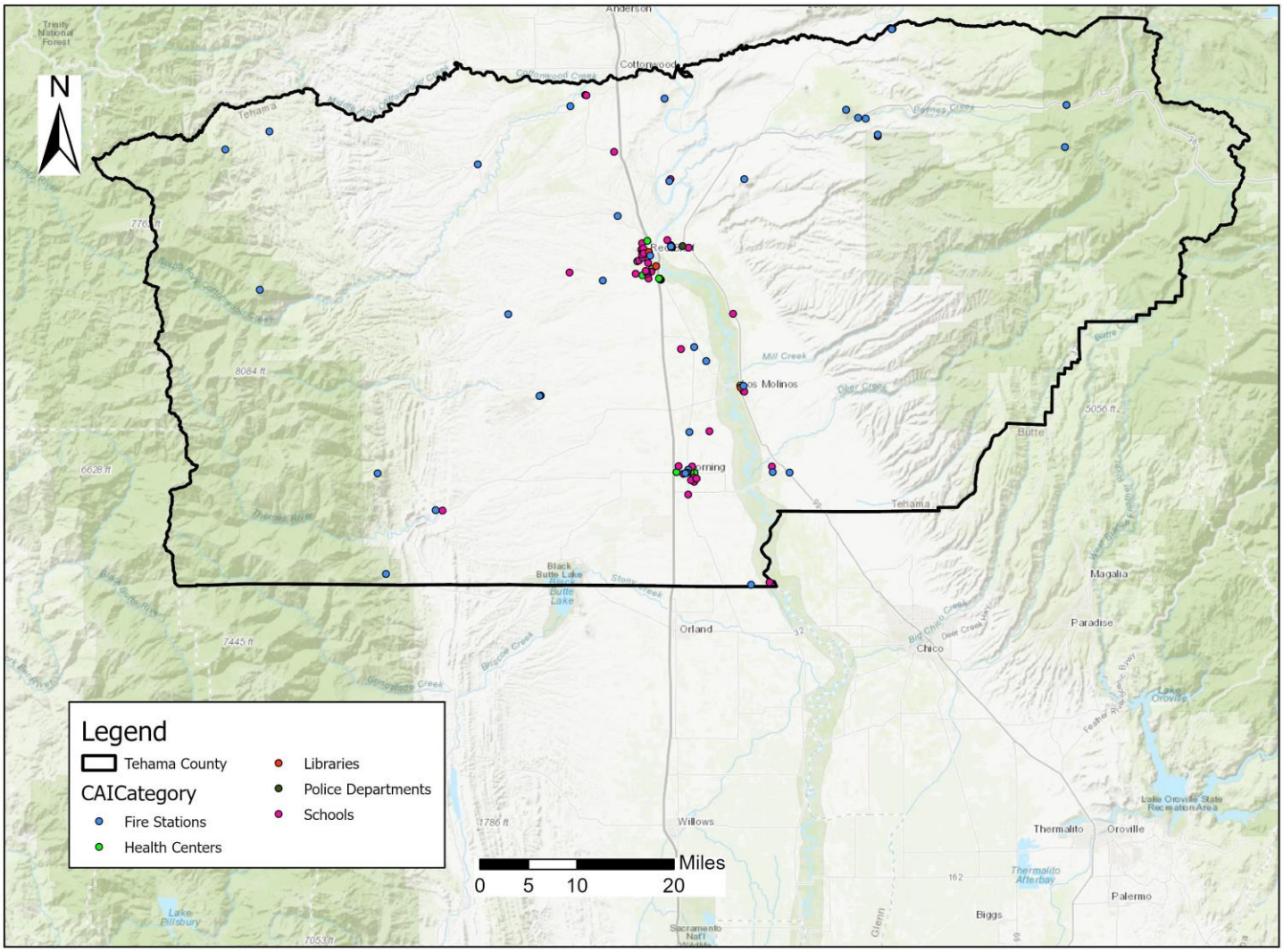
3.2.1 Community Anchor Institutions (CAIs)

Community Anchor Institutions (CAIs) play a critical role in maintaining community. CAIs provide quality-of-life services such as healthcare and education, serve as resiliency centers during emergencies and natural disasters, drive growth in economically depressed areas, and offer safe gathering places to foster a sense of connection to neighborhood. CAIs must have reliable, high-speed access to broadband internet to provide maximum benefit to the community.

An analysis of CAIs demonstrates that a majority of those locations are clustered in the urban, heavily populated areas of Tehama County.

[77] See, e.g., Kathryn de Wit, "Closing the Digital Divide With the Affordable Connectivity Program," Pew Research Center, June 1, 2023, https://www.pewtrusts.org/en/research-and-analysis/articles/2023/06/01/closing-the-digital-divide-with-the-affordable-connectivity-program; Nicole Ferraro, "Bipartisan Group of Congress Members Calls for ACP Funding," *Light Reading*, August 18, 2023, https://www.lightreading.com/digital-divide/bipartisan-group-of-congress-members-calls-for-acp-funding; Ry Marcattilio-McCracken, "A New Tool to Track Federal Funding for Affordable Broadband," Institute for Local Self-Reliance, August 31, 2022, https://ilsr.org/new-resource-tracking-the-affordable-connectivity-program/. The latter link provides an enrollment tracker that enables users to analyze when the funding will run out under a range of different assumptions.

Figure 18: Tehama County Community Anchor Institution (CAI) Locations



3.2.2 Community Anchor and Business Needs Survey Results

The needs of businesses and CAIs for economic development and sustainability cannot be overstated. This section provides detailed information from the survey activities pertaining to these entities conducted by Tilson. Separately, Tilson conducted an Internet Service Provider (ISP) outreach survey that can be seen in Section 4. The findings suggest that access to high-speed broadband to support business growth and critical county functions, as well as innovation in rural and farming communities, is crucial to positive economic outcomes.

These surveys were disseminated using the ESRI Survey123 platform. More specifically, these were sent to CAIs, business owners, and ISPs who serve the counties included in this study. A separate outreach survey was provided to RCRC "Point-of-contacts" (POCs) at the beginning of this program, which was not collected through this platform.

The following section will detail general insights learned from these surveys. Further analysis of the business survey results are included in Appendix A.

Community Anchor Institution Survey Findings – Summary

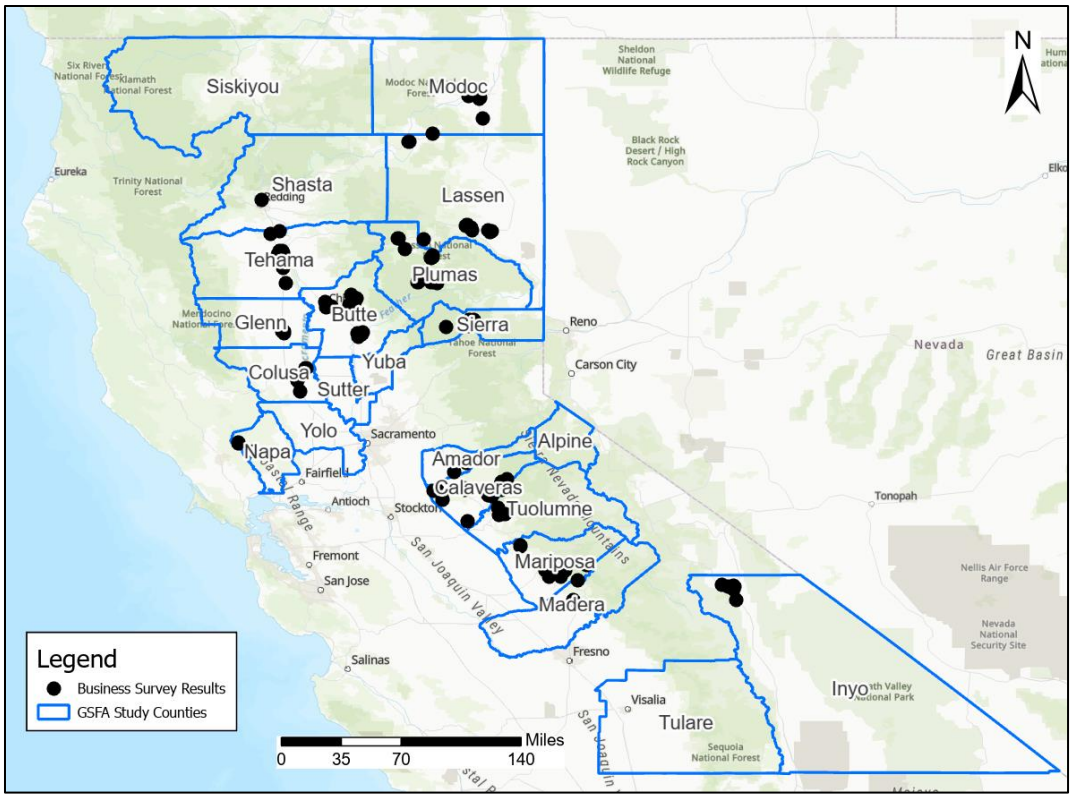
The survey collected information from various CAIs in California, including schools, libraries, and fire protection districts, though there were only 11 responses out of the more than 500 that were engaged. These institutions serve multiple counties and rely on different ISPs, with AT&T, COMCAST, and Frontier among the prominent choices. The methods of internet delivery varied, spanning DSL, fiber optics, and wireless connections. Most organizations procured internet services, while some also acquired phone and television services, and the associated monthly costs ranged from $85 to $1,208.

These responses underscored the need for better awareness and access to federal programs to bolster internet connectivity and infrastructure. The small population of data also highlighted the complexity of challenges faced by these institutions, with some seeking to change ISPs due to concerns related to service quality and speed. Some institutions have benefitted from programs such as E-Rate and CalREN subsidies provided by the Corporation for Education Network Initiatives in California (CENIC). A notable interest in broadband planning efforts was evident, indicating a desire to access potential funding opportunities. However, a significant portion of institutions remained unfamiliar with the upcoming federal BEAD program and the consequential challenge process that could affect their eligibility for crucial funding.

Business Survey Findings – Summary

The aim of the business survey was to ask businesses in the study area (at all scales) about their current connectivity, possible options available in the area, and gauge demand for higher bandwidth and applications that would improve their existing or anticipated processes. Notably, Alpine, Madera, Siskiyou, Sutter, Tulare, Yolo, and Yuba received no responses. Below are the locations of all businesses that have responded to the survey:

Figure 19: Locations of Business Survey Results



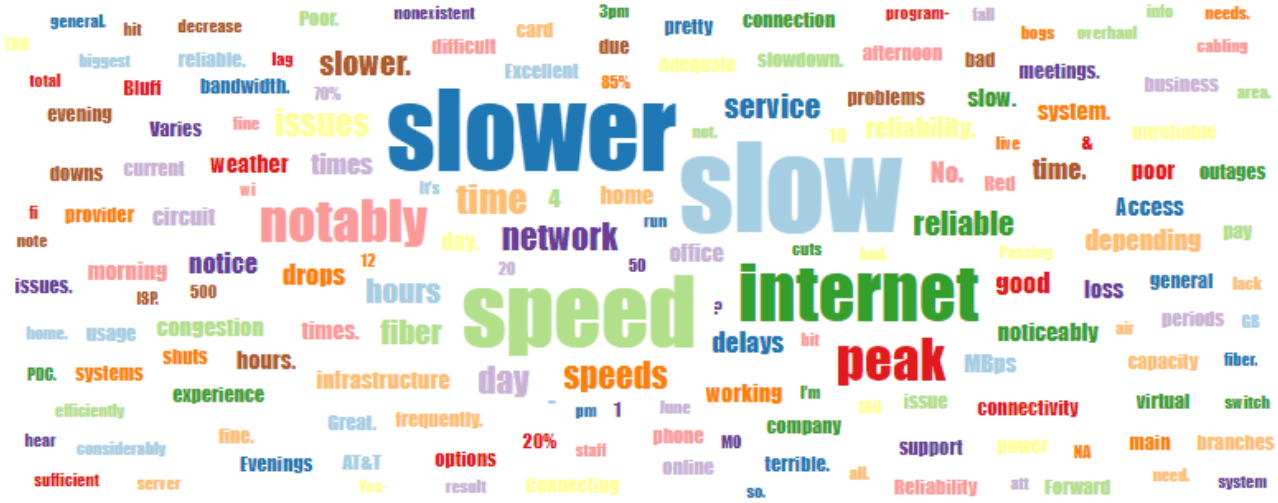
In asking about current internet speeds, a notable 31 percent of respondents claimed that they were operating at less than 10 Mbps. In total, 50 percent of respondents were operating with a connection less than 50 Mbps, and 63 percent under 100

Mbps. Only 6.5 percent had a connection of greater than 500 Mbps. Of these respondents, 41 percent said that their current speeds were not sufficient for their business needs (with 14 percent with non-response to this query).

When asked about future bandwidth requirements, 15 percent responded that they would not need anything more than 10 Mbps. Most businesses falling into this category were small retail stores, campgrounds, and farms, whose main critical function requiring internet is their Point-of-Sale (POS) system. Some of these can be supplemented by cell service, which lowers the immediate demand or need to upgrade. However, some other respondents of this category mentioned that they were realtor offices, sheriff offices, chamber of commerce departments, or other entities that would require a more robust connection, justified by their use cases such as security cameras, web development, and even video conferencing. Because of the disparity in these responses, it is assumed that more digital literacy outreach would be required to inform these businesses of the actual speeds necessary to run their critical day-to-day functions more effectively.

When asked about their infrastructure, 59 percent of businesses stated that they had modern or fairly modern (0-10 years old) wiring and networking equipment. 23 percent stated that they had a fiber optic connection, while 19 percent had a copper based connection. The following is a word cloud describing the most common responses received when asked about network congestion during peak hours.

Figure 20: Word Cloud of Responses from ESRI Survey 123 Regarding Current Internet Speeds



Half of the respondents have Comcast, AT&T, Frontier, or Spectrum as providers (50 percent). The average satisfaction with their current provider was an average of 3.1 out of 5 stars. Surprisingly, 32 percent of businesses were aware that they had some type of fiber in the area, even though 22 of them reported having speeds of 50 Mbps or less. The most common budget for a monthly connection was around $100 or less, which could be a factor. Only 22 businesses had a budget greater than $200 a month.

Finally, there was a varying degree of demand for connection-based security, where most of the businesses already had that component figured out to the level of their current needs, but some needed a VPN tunnel, email encryption, separation of employee and guest access, or cheaper managed IT services. In most cases, medium- to large-scale businesses had a professional on staff or a contractor handle their security needs. Further, battery backups and redundant satellite connections are the main mechanisms for disaster recovery, if available.

5.3 Overview of Smart Community Technologies

As broadband becomes more universally deployed, opportunities to use internet access to transform and improve the efficiency of government services increases. Smart community technologies have the potential to drive advancement in sustainability, resilience, and equity. Smart community technologies can be adopted to meet the individual needs of each community and the stakeholders it includes.

- **Connecting to Government**

For instance, smart communities offering public Wi-Fi might develop a landing page for users that provides critical updates, assesses users for specific needs such as emergency housing or substance abuse treatment, and provides easy ways to make use of existing government programs.

- **Infrastructure optimization**

Smart technologies can provide opportunities to optimize the performance and control of existing infrastructure, managing the energy grid, water and waste systems, and traffic flow.

- **Agriculture**

Smart agriculture technologies, such as soil and irrigation sensors, can help the county reach its economic goal to increase the overall wine and wine grape production by helping to monitor plant health.

- **Public Safety**

Smart communities offer the ability to connect body-worn, traffic, and security camera footage, as well as traffic flow information, social media activity and other real time data sources. This "single-pane of glass" approach allows real-time situational awareness for emergency managers by tracking all available emergency resources and assisting with decision-making about the deployment of resources—thereby reducing property loss and saving lives.

In addition to using a broadband availability-based approach to identify crucial and high priority areas for expanding high-speed access, VHB have identified issues in the county that could be addressed through connectivity-enabled smart community deployments, which will be detailed in Section 9.

The next map depicts census tracts in the county that fall under the designation of disadvantaged by the Justice40 initiative under the U.S. Department of Transportation. Enabled by Executive Order 14008, with this program the federal government has made it a goal that "40 percent of the overall benefits of certain Federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution."[78]

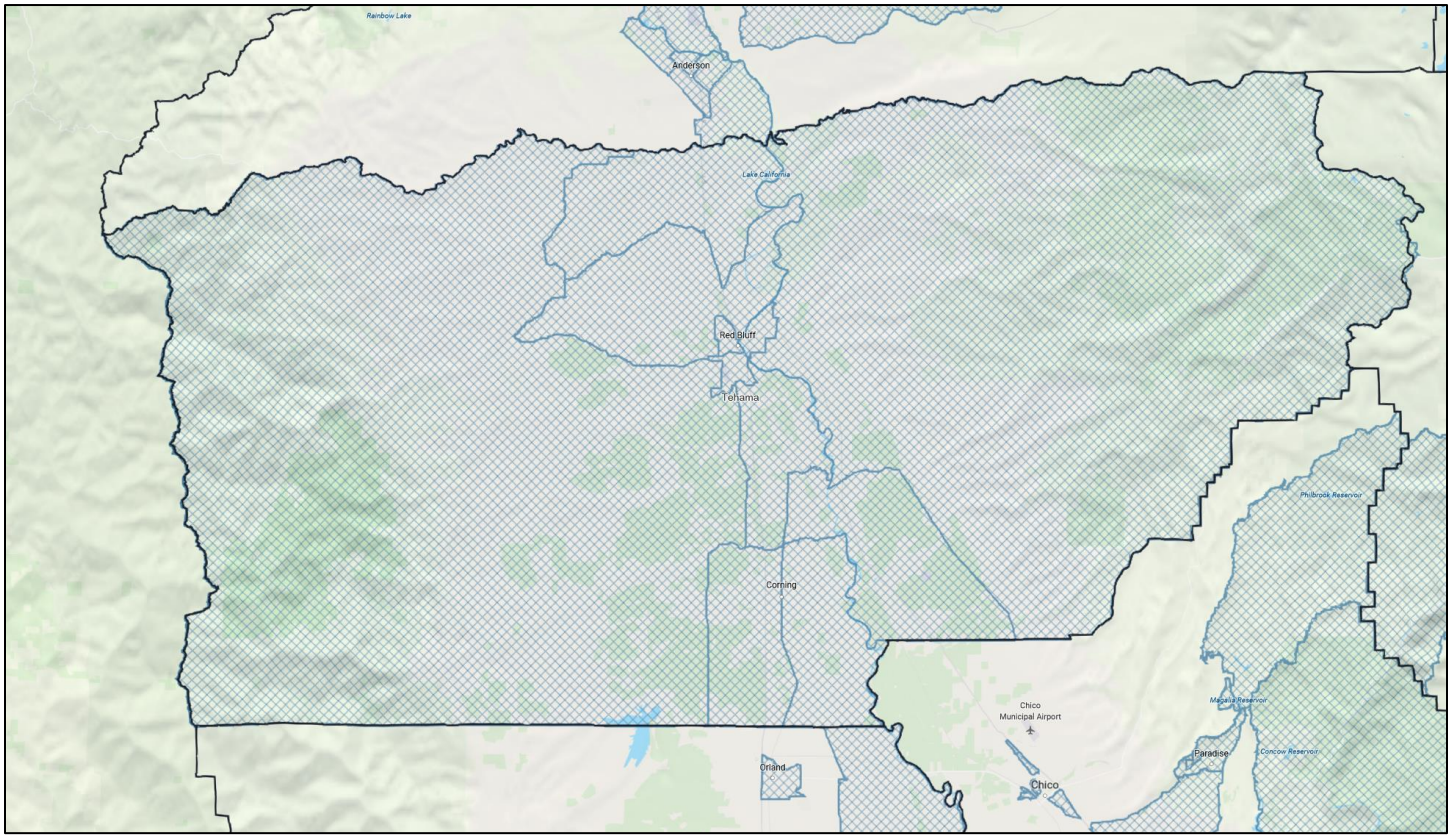
The categories of investment include "climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure."[79]

[78] https://www.whitehouse.gov/environmentaljustice/justice40/

[79] Ibid

This data set looks at multiple different factors such as environmental dangers, income, and resource availability based on the most recent census data and other factors to create aggregate need levels and list the top threats a community might be vulnerable to.[80]

Figure 21: Map of Justice40 Disadvantaged Tracts (Hatched)



The Justice40 map identified that at least some Tehama County census tracts were classified as disadvantaged in 8 of its 12 categories. To meet the threshold, a census tract must be among the lowest 35 percent of annual household income and satisfy the category's additional requirements:

- **Climate Change**

Areas are identified as disadvantaged if they are at or above the 90th percentile for any of the following:

- Expected agriculture loss rate
- Expected building loss rate
- Expected population loss rate
- Projected flood risk
- Projected wildfire risk

[80] More info about the methodology and ethos of the program are available at https://www.transportation.gov/equity-Justice40.

Energy

Areas are identified as disadvantaged if they are at or above the 90th percentile for any of the following:

- Energy cost
- Fine airborne particulate matter (PM of 2.5 microns or less in diameter)

Health

Areas are identified as disadvantaged if they are at or above the 90th percentile for any of the following:

- Asthma
- Diabetes
- Heart disease
- Low life expectancy

Housing

Areas are identified as disadvantaged if they have experienced historic underinvestment or are at or above the 90th percentile for any of the following:

- Housing cost
- Lack of green space
- Lack of indoor plumbing
- Lead paint

Legacy Pollution

Areas are identified as disadvantaged if they have at least one abandoned mine land or formerly used defense sites or are at or above the 90th percentile for any of the following:

- Proximity to hazardous waste facilities
- Proximity to Superfund sites (National Priorities List (NPL))
- Proximity to Risk Management Plan (RMP) facilities

Transportation

Areas are identified as disadvantaged if they are at or above the 90th percentile for any of the following:

- Diesel particulate matter exposure
- Traffic proximity and volume
- Transportation barriers

Water and Wastewater

Areas are identified as disadvantaged if they are at or above the 90th percentile for any of the following:

- Underground storage tanks and releases
- Wastewater discharge

Workforce Development

Areas are identified as disadvantaged if fewer than 10 percent of people ages 25 or older in that area have a high school education (i.e. graduated with a high school degree) and are at or above the 90th percentile for any of the following:

- Linguistic isolation
- Low median income
- Poverty
- Unemployment

These factors, as well as the economic benefits of bringing broadband to these specific locations, should be weighed when planning and prioritizing future deployments. For additional information and recommendations for smart community technology, refer to Section 9. VHB's Smart Community Web Experience webmap depicting the full layers and data provided by VHB can be accessed here:

https://experience.arcgis.com/experience/a5845d235e1749f38374f325cfad53eb/

SECTION

04

ANALYSIS OF CURRENT BROADBAND MARKET AND EXPANSION STRATEGIES

4.1 Introduction and Expansion Strategy Roadmap

This section reviews the current residential broadband market in Tehama County, identifying each significant ISP's current service areas. The ISPs' service area maps will develop an understanding of where broadband services with different performance characteristics are and, more importantly, are *not* available. At a high level, the BEAD grant program will focus on the following two location eligibility criteria.

- ***Unserved* households lacking 25/3 Mbps service:** 3,882 households (14.2 percent)[81]
- ***Underserved* households lacking 100/20, but not 2/53 Mbps service:** 1,835 households (6.7 percent)

Tehama County has a *moderately high* proportion of unserved households, creating significant challenges for the 3,882 households on the other side of the digital divide. These households will benefit greatly from the BEAD program, but there are only a few major clusters of unserved locations that lend themselves to significant project areas. Most others are distributed throughout the county and will likely require different deployment projects to reach scattered unserved addresses.

Comparatively, the county has a *moderate* proportion of underserved households. These areas are less likely to receive BEAD funding, because the CPUC does not believe it has enough funding to cover all unserved and underserved locations across the state.[82] These households nevertheless should remain a priority for localities interested in bridging the digital divide, but require a more detailed understanding of the current technologies offered nearby.

These two criteria do not tell the full story either. To explore other aspects of the digital divide, the table below provides a snapshot of the availability of different technologies across the county, based on the FCC's most recent 2023 household data. We note that this information is presented by household, and not by location, because it is the best FCC data available at this level of detail and allows for a better understanding of the impact of the digital divide on the population.

Table 13: Locations Receiving Each Level of Service across Tehama County

Households (HHs) – 27,341 Total	25/3 Mbps	100/20 Mbps	250/25 Mbps
Served by any wireline or fixed wireless	85.8% (23,459)	79.1% (21,624)	45.6% (12,465)
Served by any wireline technology	47.8% (13,069)	45.7% (12,498)	45.6% (12,465)
Served by fixed wireless	81.7% (22,343)	75.0% (20,517)	0%
Served by only fixed wireless at speed	38.0% (10,390)	33.4% (9,126)	0%
Wireline Technologies:			
➢ **Cable**	45.6% (12,465)	45.6% (12,465)	45.6% (12,465)
➢ **DSL**	2.2% (604)	0.1% (33)	0%
➢ **DSL as only wireline option at speed**	2.2% (604)	0.1% (33)	0%

[81] This data is derived from the FCC's National Broadband Map Area Summaries, which detail these percentages by "units." Residential Broadband Serviceable Locations (BSLs) may represent single-family homes or buildings like apartments that contain multiple distinct dwellings. "Units" represent individual dwellings or households, so a BSL with an individual FCC Location ID can contain multiple units. We note that apartment buildings tend to be constructed in more densely populated areas, which also tend to be more likely to receive high-speed broadband service. As a result, the percentage of units connected will tend to be higher than the percentage of locations connected. This issue is an inherent limitation of the publicly available data provided by the FCC.

[82] CPUC, State of California Five-Year Action Plan: Broadband Equity, Access, and Deployment (BEAD) Program, Final Initial Draft, July 13, 2023, p. 87, ("CA BEAD Five-Year Plan"), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M513/K977/513977116.PDF.

Of the 27,341 households across the county, a reported 12,465 households (45.6 percent) can receive cable service capable of a claimed 250/25 Mbps or more. The remaining households do not yet have access to such relatively future-proof technology. The information above highlights the following top broadband availability issues:

- **Many locations are still critically unserved:** Tehama County has a reported 1,301 locations (4.8 percent) that do not yet receive any wireline or wireless service meeting the 10/1 Mbps standard, according to FCC data.
- **Very high dependence on fixed wireless:** An estimated 38.0 percent of locations can receive basic broadband service via only fixed wireless technologies, while 33.4 percent depend upon it for access to 100/20 Mbps services. This connectivity has been vital for these households, but in the long term, they should remain a priority to receive high-speed wireline services.
- **Available DSL is inadequate:** A claimed 26.7 percent of households in Tehama County have access to DSL services offering 10/1 Mbps, but only 2.2 percent can receive DSL service providing the basic broadband speed of 25/3 Mbps. ISPs providing inadequate DSL service may not have an incentive to upgrade these networks if the projected return on investment is insufficient. However, if provided financial support, these providers may be best positioned to deploy fiber through their DSL service areas using existing access to telephone poles and rights-of-way to install fiber at a lower cost than competitors.
- **Almost no fiber-to-the-home options:** While Charter claims to serve 64 locations with fiber, other FCC data states that there is no fiber service to the home in Tehama County.
- **High-speed broadband availability gap:** A reported 45.6 percent of households can receive high-speed broadband service from either fiber or cable, whose presence in the county has been fully upgraded to serve future bandwidth demands. This level of availability is low compared to the rest of California and the nation.
- **Large areas do not have adequate wireline broadband:** Digger Butte, Hooker, Government Gulch, Richfield, and multiple communities along the Sacramento River such as Vina, Los Molinos, and Dairyville all have large collections of unserved and underserved locations that should be among the highest priorities to be connected. The state middle mile network will come within 6 miles of most of these locations, but ISPs will need to construct about a 14 mile stretch of fiber to reach all of the locations in need near Table Mountain.

The map below shows locations across the region that do not yet have access to fiber or high-speed cable services offering speeds of at least 25/3 Mbps. California's Federal Funding Account grant program essentially used this eligibility standard to identify locations it would accept in the application process, providing a map of them in clustered areas.[83] By excluding fixed wireless, DSL, and older cable system services, this program adopted a standard of service toward which all localities should strive. Locations not yet receiving 25/3 Mbps service are generally eligible for most funding opportunities, so localities, such as the governments of Tehama County and incorporated towns and cities in the county, should prioritize projects to these locations. However, localities looking to facilitate deployments to locations receiving wireless but not wireline services capable of 100/20 Mbps must be savvy and identify more specific opportunities to improve services that will benefit from middle mile expansions, ISPs' own expansion and upgrade incentives, and the eligibility rules in each funding opportunity.

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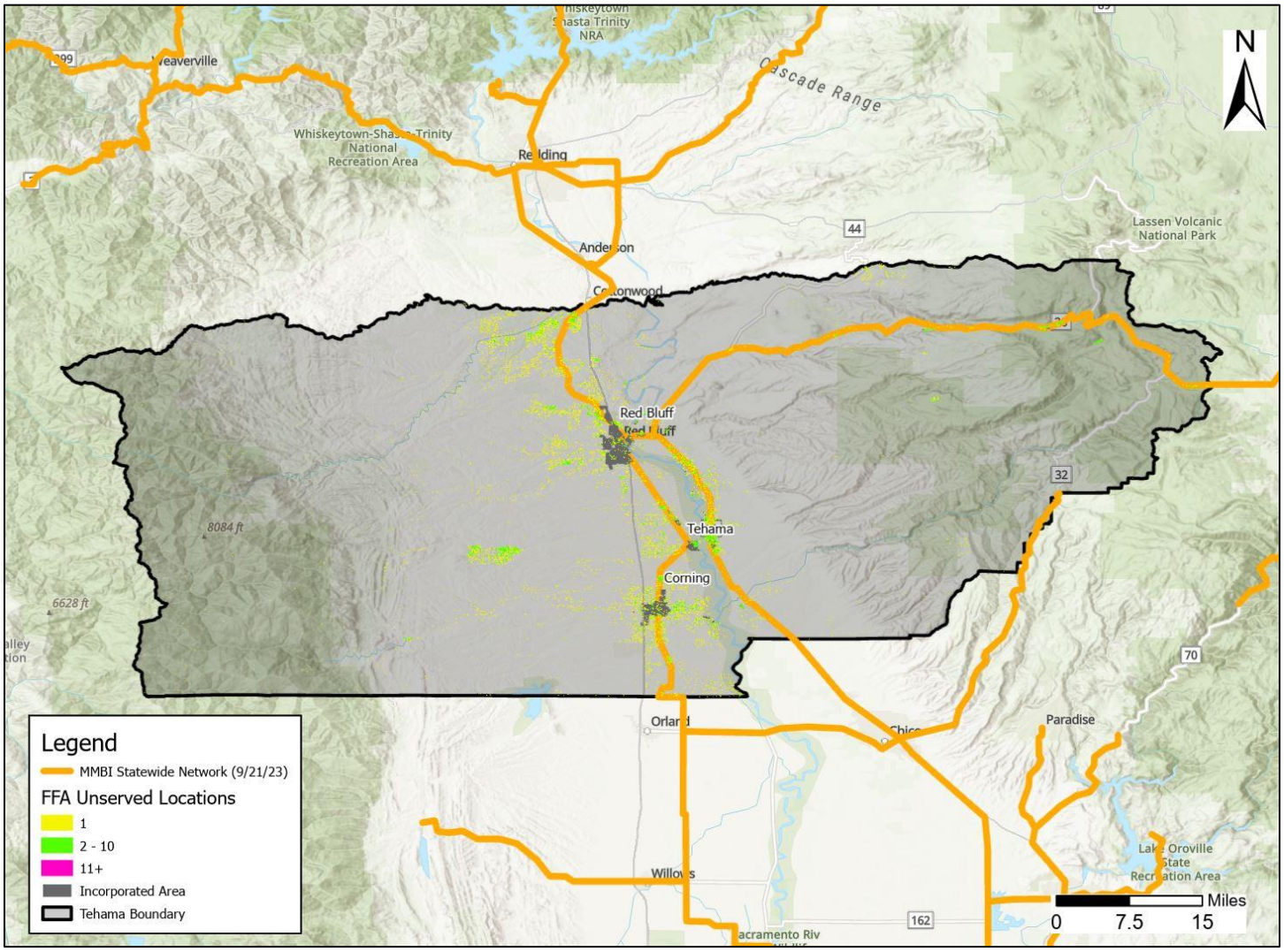
[83] The FFA defined "unserved" locations as all locations that did not receive reliable wireline services capable of 25/3 Mbps, while classifying DSL services and older cable services as presumptively unreliable. The Federal Funding Account's eligibility criteria are reviewed in more detail in Section 6. The program did not provide individual location information but did provide a mesh of small hexagonal areas and identified how many eligible locations were in each "hexbin." In the following figure, these have been converted to dots centered on the Hexbin locations.

Figure 22: Planned California Middle Mile Network Routes and Locations Unserved by Modern Cable or Fiber at Speeds of at Least 25/3 Mbps in Tehama County



Market Summary: Residents of Tehama County can experience three very different broadband markets. The first group can receive high-speed cable service from either Comcast or Charter. Comcast generally serves the Corning area, reaches 2,464 locations, and has submitted an application to the CPUC's Federal Funding Account (FFA) program to expand to more. Charter primarily serves the Red Bluff and Lake California areas, connecting 9,169 locations, and has reported that it has begun connecting some households to fiber as well, representing the only home fiber service available in the county. Households receiving these services can experience the benefits of broadband shared by the vast majority of households across the rest of the county.

The second group of residents must rely upon a mixture of DSL and fixed wireless options.[84] Unfortunately, the FCC reports that only 604 locations can receive DSL services providing at least 25/3 Mbps, so a majority of these locations cannot actually receive broadband via DSL. Ducor Telephone Company and Frontier report to provide DSL connectivity to 760 and 169

[84] We note that a few other providers claim to offer services to a very small number of residential locations. TPx Communications claims to offer DSL to 9 locations, while GeoLinks and King Street Wireless claim to serve a total of 5 locations with their wireless services.

locations, respectively. In the populous regions of the county through the Sacramento Valley, AT&T has offered DSL to 11,395 locations as well, but has announced that it will no longer be taking on new DSL subscribers as it retires its DSL networks. Instead, AT&T has applied to the FFA program to replace major portions of its network with fiber.

The second group's fixed wireless options are often faster than DSL. A reported 75 percent of households across the county can receive fixed wireless services of 100/20 Mbps or more, with 33.4 percent of households able to receive this level of performance only via fixed wireless options. The largest fixed wireless provider is DigitalPath, which uses a more traditional wireless network to reach 23,524 residences. T-Mobile, AT&T and Verizon provide a mix of mobile and fixed wireless services with their networks, claiming to reach 14,020, 781, and 56 households, respectively.

The third group of residents have very poor internet service options. The 1,301 locations (4.8 percent) are reported to not receive even 10/1 Mbps services from either wireless or wireline networks but may still have some form of connectivity. About 219 households across the county can receive slower wireless service, and 5,640 are claimed to able to receive a DSL service slower than 10/1 Mbps. These locations must be prioritized to receive improved connectivity.

This section's review of individual ISP service areas can be used to explore the most likely expansion and service upgrade opportunities throughout the county. Combined with insights in Section 3's analysis of broadband needs, localities can use this understanding of each ISP's expansion opportunities to identify the ISPs most likely to deploy or upgrade service to un- and underserved locations in their jurisdictions that have been identified in the map above.

Improvement Opportunities Summary:

- Comcast and Charter can explore expanding services in and around their existing service areas of Red Bluff and Corning, respectively. The new state open-access middle mile network through these areas will provide more essential data bandwidth for backhaul necessary to support high-speed broadband networks to these locations while reducing costs to construct last mile networks to new customers. Comcast submitted an FFA application that target areas around Corning, across the Sacramento River in Los Molinos, and up to Table Mountain.
- AT&T has a large network of old DSL infrastructure in parts of the county and is looking to replace it with fiber, as indicated from their FFA applications. This strategy should be encouraged, as it will fill out most of the pockets in need along Interstate 5.
- Several unserved and underserved communities, such as Paynes Creek, Mineral, Mill Creek, and St. Bernard, are along the state's planned open-access middle mile route. Existing incumbents or new entrants will soon be able to build wireline networks into these areas at reduced cost. In particular, the northeastern portion of the county along State Route 36 should be prioritized to receive better wireline connectivity.
- The GSCA has submitted applications for multiple fiber projects in the county to address pockets of eligible unserved locations along the state's planned middle mile route. If these projects are awarded, they will introduce open-access last mile fiber service into areas around Corning, north of Red Bluff, including Bend and Blunt, Proberta-Flores-Gerber, and communities along State Highway 99E, such as Vina and Los Molinos. Once their presence is established, this new entrant is likely to expand into other areas of need, so localities should consider this potential partner in addition to the existing ISPs.
- The most remote locations may still need to be connected via fixed wireless networks. The BEAD program did not classify any part of the county as a high-cost area, so fixed wireless options will not be able to receive funding unless certain areas remain unserved after the initial BEAD application period. Wireless companies will need to monitor the BEAD application areas to identify whether some locations will remain unserved after the BEAD funding is distributed.

Some of these potential efforts to improve broadband availability will be eligible for broadband funding grants, a topic reviewed in Section 6 below, while other areas may receive new or upgraded networks due to local efforts to encourage ISP

action, a topic discussed in Section 7. Still, other areas may receive improved service options gradually as a result of last mile construction catalyzed by new middle mile networks such as the State of California's open access middle mile network.

To better understand how to interpret this broadband market assessment, we will first review key factors influencing the three basic ways that improved broadband services can reach more people: expansions, upgrades, and new market entry. Next, this section will review a list of ISPs in Tehema County, along with their service areas, technologies they offer, and the service pricing ranges they charge for residential services. Localities looking to encourage deployments should focus on working with fiber service providers, while considering cable providers if they are willing to deploy their most current network technologies.[85] Areas served above 25/3 Mbps by only DSL should be included in the locality's list of areas of broadband need, but as Section 6 will discuss, several key grant programs may not provide funding to such areas, requiring that localities encourage new expansions or upgrades through other strategies.

■ Key Factors Influencing Service Availability Improvements

Traditional expansion: ISPs in the region will generally expand their current service footprints when the costs to expand to nearby areas will generate a reasonable long-term return on investment. This traditional expansion process is often incremental, requiring each ISP to consider the entire range of adjacent areas across its regional or even national network and focus its limited investment resources on the least risky location choices. As a result, this expansion process can be slow and tedious, particularly in rural areas.

The incredible amount of funding available over the next few years is changing how ISPs think about this expansion process. As last mile grant programs have gradually reduced matching funds requirements over the past decade, locations that were once less appealing investments have become significantly more attractive. Major middle mile projects, such as California's upcoming open access network, have also reduced the total costs to reach many un- and underserved areas, creating many new deployment opportunities for ISPs that had remained out of reach from lack of adequate backhaul. With so many funded deployments and upgrades soon to change the broadband availability landscape, the threat of new competition will also encourage existing ISPs to plan their own expansions or potentially cede nearby un- and underserved areas to competitors.

Not all new deployments need to be major expansions either. Across Tehama County, there are pockets of un- or underserved locations that are partially surrounded by served areas. The last mile funding programs have recognized this trend across the nation and adapted accordingly, allowing project submissions with smaller areas. In some cases, the FFA's data depicts only 1-2 unserved locations contained in each biddable area (represented as hexbins). The best approach to connect these scattered unserved locations is for the incumbent to be encouraged to serve these addresses. The funding programs also generally allow applicants to include several noncontiguous deployment areas, so these pockets of unserved areas can be combined together or included with a larger nearby expansion plan, preferably by the incumbent for the most efficient use of funding.

Upgrading existing networks: Some ISPs have already begun to upgrade older technologies such as DSL that generally cannot achieve the higher broadband speeds demanded by modern households.[86] These upgrades to existing networks are often substantially less costly than new construction by other ISPs. An existing ISP already has a physical presence and infrastructure, has secured many essential rights-of-way and installation space on utility poles, and is familiar with the area's permitting requirements. An upgrading ISP also has an existing customer base and customer support coverage in the area. As grant funding has become more plentiful, ISPs offering older technologies are facing the threat of competitive entry by

[85] Section 2 discusses the distinction between DOCSIS 3.1 and DOCSIS 4.0, the latter able to offer significantly faster upload speeds that can compete directly with fiber systems in nearly all consumer applications.

[86] See discussions of the performance limitations of DSL and older fixed wireless systems and of the broadband usage demands of modern households in Section 2.

other ISPs offering fiber. As a result, these ISPs are very interested in obtaining funding and local support to upgrade their networks to maintain their customer base. This market assessment identifies each ISP offering multiple wireline technologies to encourage discussions that may facilitate these updates and improved services.

New regional market entry: While rarer in rural areas, ISPs without a nearby service area can deploy an entirely new network and begin to offer new services in a region. Generally, market entry is based on the perceived return-on-investment (ROI) from the proposed area. An ISP must serve a certain number of households in an area to cover the costs of on-going support efforts. Combined with the other economic challenges of unserved and underserved areas and the competition present in served areas, there are few opportunities for new ISPs to find areas large enough to support new deployments. However, GSCA, in partnership with UTOPIA Fiber, has developed plans for its entry into Tehama County. This possible entrant could change the region's broadband services market significantly, putting more competitive pressure on existing providers to expand or upgrade their networks before UTOPIA can expand into their areas. With this example, localities should not assume new regional entrants are impossible to attract and should consider this new entrant when developing plans to work with ISPs to improve services in their jurisdictions.

■ Mapping Considerations

To identify each ISP's service areas and develop deployment plans utilizing upcoming funding opportunities discussed in Section 6, this broadband market assessment analyzes the most current available broadband data provided by the FCC's Broadband Data Collection (BDC) program and National Broadband Map.[87] Initially released in November 2022, the FCC's National Broadband Map presents BDC availability data that corresponds to location information defined in the National Broadband Location Fabric, ascribing a service status to each individual address considered a Broadband Serviceable Location (BSL).[88] Unfortunately, the address-level information is available via license only, and at the time of this writing, neither Tilson Technology, nor GSFA have been able to obtain a license to use this proprietary data. As a result, many parts of the analysis must then occur on the census block-level, which hinders the identification of unserved locations in partially served census blocks in general maps, a problem that has become more pronounced over the last decade. To alleviate this issue for grant applicants, the NTIA have recently announced that a new tier of license is available to certain entities that must gain access to the address fabric data used by the FCC's BDC program to apply to a grant program.[89]

The CPUC also requests data from service providers for its own mapping program, and the results are also generalized to the census block level, similar to the FCC's previous Form 477 reporting. Of the two maps, the FCC's map was selected as the primary basis for analysis over CPUC's,[90] because it serves as the basis for California's BEAD program planning documents and upcoming grant program and is used as a supplement to the CPUC's own California broadband map. However, conflicts between the two do exist. The CPUC's coverage areas generally overlap with the FCC's BDC data, but the BDC data identifies more census blocks as partially or fully served by fixed wireless and/or wireline services offering at least 25/3 Mbps. As part of the BEAD planning process, the CPUC must reconcile these two data sets and manage a challenge process (discussed more in Section 6.4) to identify where self-reported ISP service claims may not be accurate. As a result, localities reviewing these maps should look closely and identify areas where these service claims are suspect, then challenge them to ensure un-

[87] Federal Communications Commission, "FCC National Broadband Map," updated May 30, 2023, https://broadbandmap.fcc.gov/data-download/nationwide-data?version=dec2022.

[88] A broadband serviceable location is a residential or business location where fixed broadband internet access service is or can be installed, as determined by the FCC. https://www.costquest.com/resources/articles/clarity-on-bdc-challenge-process-and-definition-of-broadband-serviceable-locations/; see also https://www.fcc.gov/sites/default/files/bdc-challenge-overview.pdf.

[89] NTIA, "NTIA Tier D License Request," https://apps.costquest.com/NTIArequest/, accessed September 2023.

[90] CPUC, "CPUC Annual Collected Broadband Data," updated April 2023, https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-mapping-program/cpuc-annual-collected-broadband-data.

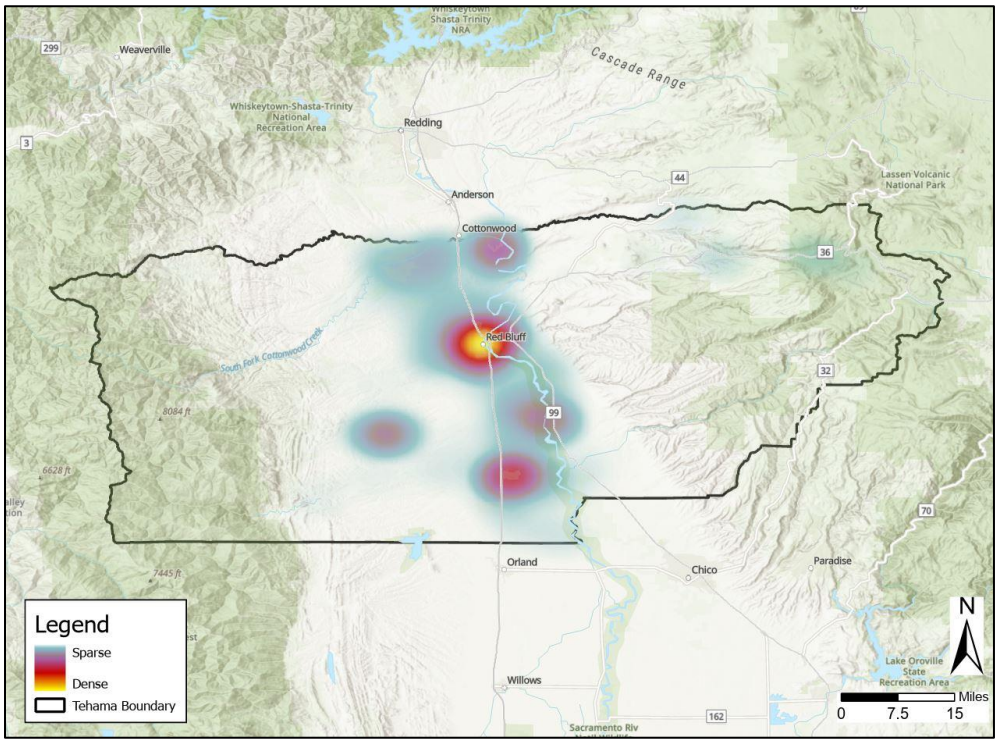
and underserved areas are eligible for grant funding. It's worth noting that county governments are among the limited eligible entities allowed to participate in the BEAD challenge process soon to be conducted by the CPUC.

When availability information is presented on the census block-level, partially served census blocks cannot be distinguished from fully served ones. There are few sources that can be used to identify unserved locations in more detail to correct this issue. One such source, the CPUC's Federal Funding Account (FFA) program, used a series of very small hexbins to identify areas containing locations that were eligible for funding under its program rules.[91] This data was included in the map above to identify priority areas.

4.2 Residential Providers and Service Breakdown

Tehama County, located in Northern California, boasts a diverse geography characterized by flat agricultural lands and rolling hills in the eastern and western regions, while the Sacramento River bisects the county. Tehama County's population layout is a mix of rural communities and small towns. The largest city, Red Bluff, serves as the county seat and a central point for commerce and government. Other communities, such as Corning, contribute mainly to the county's population, while towns such as Los Molinos and Vina are situated along the river. The county's population density varies, with rural areas in the northern and eastern regions and a more concentrated population along Red Bluff and in the southern part.

Figure 23: Tehama County Relative Population Density



[91] Hexbins are used in mapping to divide an area into hexagons which join together to completely cover the area in question.

In terms of transportation, Interstate 5 runs through the county, serving as a major north-south highway and a vital transportation corridor connecting the region to other parts of California and Oregon. State Route 36 provides access to the communities in the northwestern portion of the county, while State Highway 99E provides southern access to Glenn.

The following table presents the internet service providers in Tehama County with their available speed offerings and corresponding price ranges (agnostic of technology deployed), as of August 2023:

Table 14: Tehama County Providers by Technology

Provider	Dominant Technology	Speed Range	Monthly Recurring Cost	Notes
AT&T Inc	DSL	-	-	AT&T no longer offers DSL service
AT&T Inc	Fixed Wireless	100 Mbps	$55	
Charter Communications Inc	Cable	300 Mbps – 1 Gbps	$50 - $90	
Com-Pair Services	Fixed Wireless	12/2 Mbps – 25/4 Mbps	$50 - $100	
DigitalPath, Inc.	Fixed Wireless	50/10 Mbps - 200/20 Mbps	$70 - $110	
DM-Tech Internet	Fixed Wireless	30/10 Mbps – 80/20 Mbps	$55 - $105	
Ducor Telephone Company	DSL	25/3 Mbps	$60	
FRONTIER	DSL	0.4/0.4Mbps - 115/7Mbps	$65	No speed indicator
ShastaBeam	Fixed Wireless	100/10 Mbps	$140	
Stream IT Networks LLC	Fixed Wireless	25/10 Mbps - 100/25 Mbps	$385 - $145	
T-Mobile US	Fixed Wireless	245 Mbps	$50	
Velocity Communications, Inc.	Cable	10/1.5 Mbps - 150/10 Mbps	$35 - $75	
VERIZON	Fixed Wireless	300 Mbps - 1 Gbps	$25 - $65	
Xfinity	Cable	50/10 Mbps - 1.2 Gbps/35 Mbps	$10 - $80	

Wireline Broadband Availability

Broadband service over fiber or cable offers a significantly greater maximum bandwidth capacity for users throughout an area than competing technologies. Without the spectrum limitations of wireless systems, more users can access the internet simultaneously, without much concern for peak demand hours or the need to meter the amount of data used per month. Wireline services also are more resilient to environmental conditions and weather, making them more reliable, and they tend to be substantially less expensive to maintain once installed. Fiber, and to a lesser extent, cable systems (hybrid fiber-coaxial cable, with the cable portion moved deeper into neighborhoods) can also be upgraded to handle even higher speeds and more overall capacity as the electronics enabling each technology continue to improve.

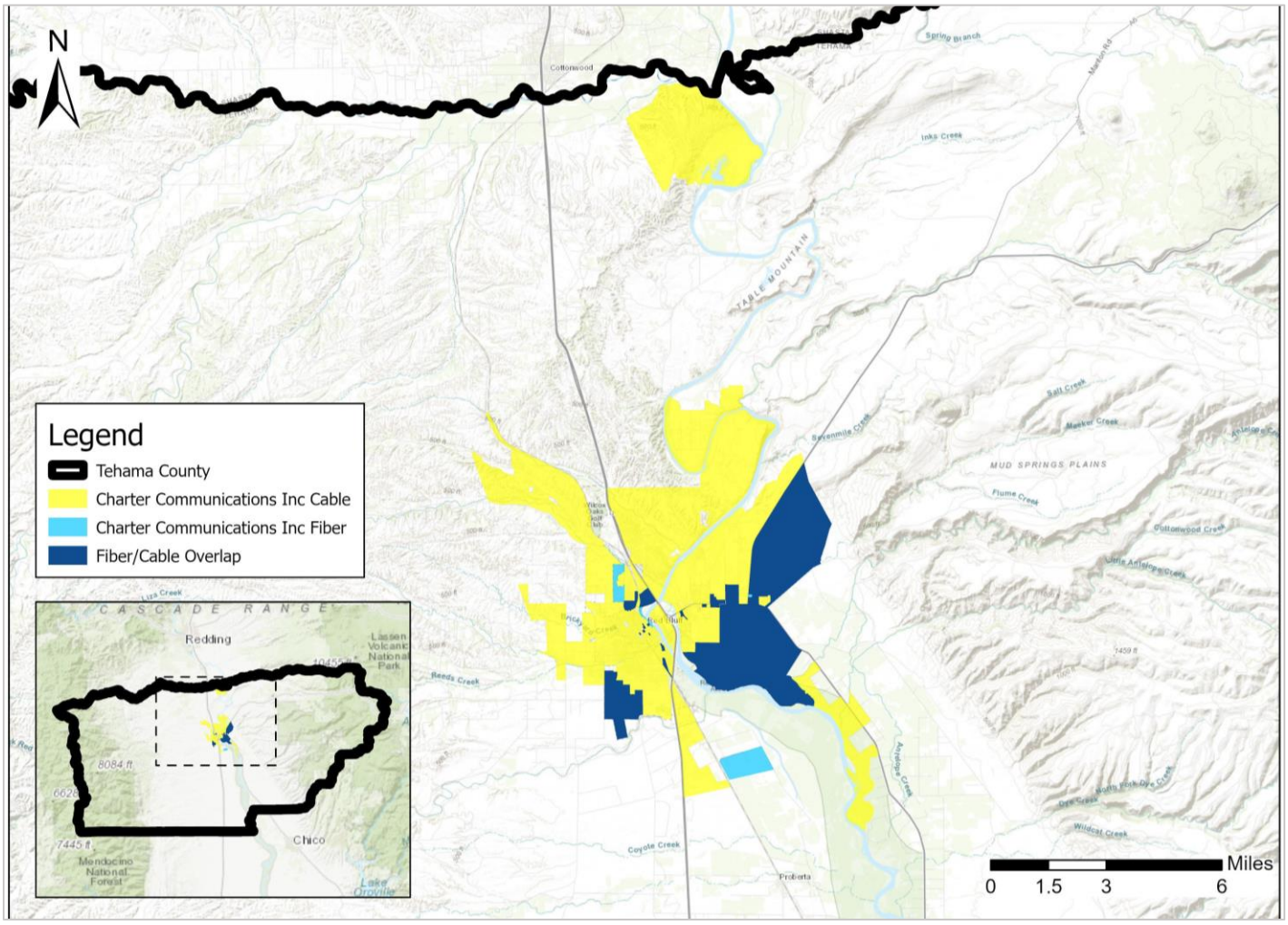
In the table below, the availability of each wireline technology is presented at three key speeds: 25/3 Mbps, 100/20 Mbps, and 250/25 Mbps. The first two speeds are based on the FCC's 2016 definition of broadband and the more modern understanding of what households now need to enjoy the current range of telecommuting, remote learning, telehealth, and online communications activities. The highest speed presented, 250/25 Mbps, offers an adequate glimpse into the availability of services that can meet the higher demands of e-commerce, video-based content creators and editors, heavy online database users, or simply households with several online-savvy family members. Wireline technologies that can achieve these speeds generally offer downloads of up to 1 Gbps and either currently offer or may be upgraded to upload speeds of 500 Mbps or more. By presenting the availability of these technologies across these three key speed points, the data also reflects the extent to which cable and fiber systems have been adequately upgraded, while contrasting them against the level of performance upgrades that competing DSL technologies have received as well.

Table 15: Wireline Service Availability in Tehama County

Households (HHs) – 27,341 Total	25/3 Mbps	100/20 Mbps	250/25 Mbps
HHs served by any technology	85.8% (23,459)	79.1% (21,624)	45.6% (12,465)
HHs served by any wireline technology	47.8% (13,069)	45.7% (12,498)	45.6% (12,465)
HHs served by only fixed wireless at speed	38.0% (10,390)	33.4% (9,126)	0%
➢ **Fiber**	0.0% (0)	0.0% (0)	0.0% (0)
➢ **Cable**	45.6% (12,465)	45.6% (12,465)	45.6% (12,465)
➢ **DSL**	2.2% (604)	0.1% (33)	0%
➢ **DSL as only wireline option**	2.2% (604)	0.1% (33)	0%

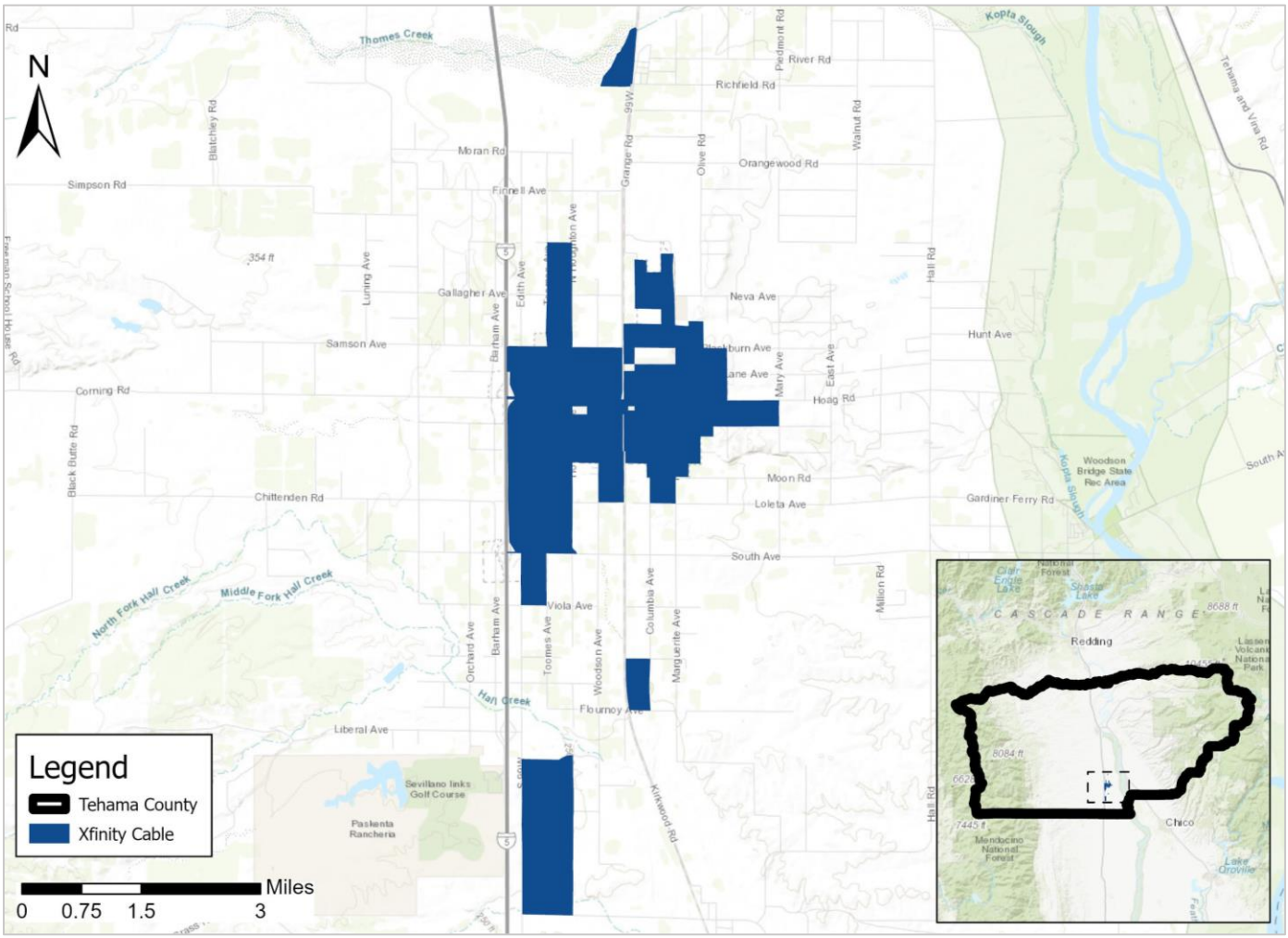
Most portions of the cable systems in this region have been fully upgraded to offer at least 250/25 Mbps, but there is no residential fiber available in the county. The DSL systems in the area reach a total of 12,935 (47.3 percent) of households but are rarely upgraded to provide basic broadband at 25/3 Mbps.

Figure 24: Charter Service Availability by Technology



Charter provides both cable and fiber services to communities in and around Red Bluff in the central region of the county. Charter reports that it offers service to 9,169 cable customers and 64 business fiber customers in Red Bluff and the northern neighborhood along River View Dr. Most of the households in Red Bluff appear "served" under the California Federal Funding Account program's definition, but the state's open-access middle mile network is along I-5, State Highway 99E, and up through State Route 36. This network will pass directly through Charter's existing service area, enabling them to upgrade their existing network to meet future demand by way of increased available bandwidth and allow them to extend the network further to reach other areas in the county. However, Charter does compete with AT&T in this service area. Both AT&T and GSCA, with its partner UTOPIA, submitted applications to the FFA to upgrade or deploy networks through and beyond Charter's existing service area. If Charter is to consider upgrading its network in this area, it likely must do so without support from funding opportunities, as key portions of this region will be considered ineligible if AT&T or GSCA is awarded funding under the FFA.

Figure 25: Comcast Service Availability by Census Block

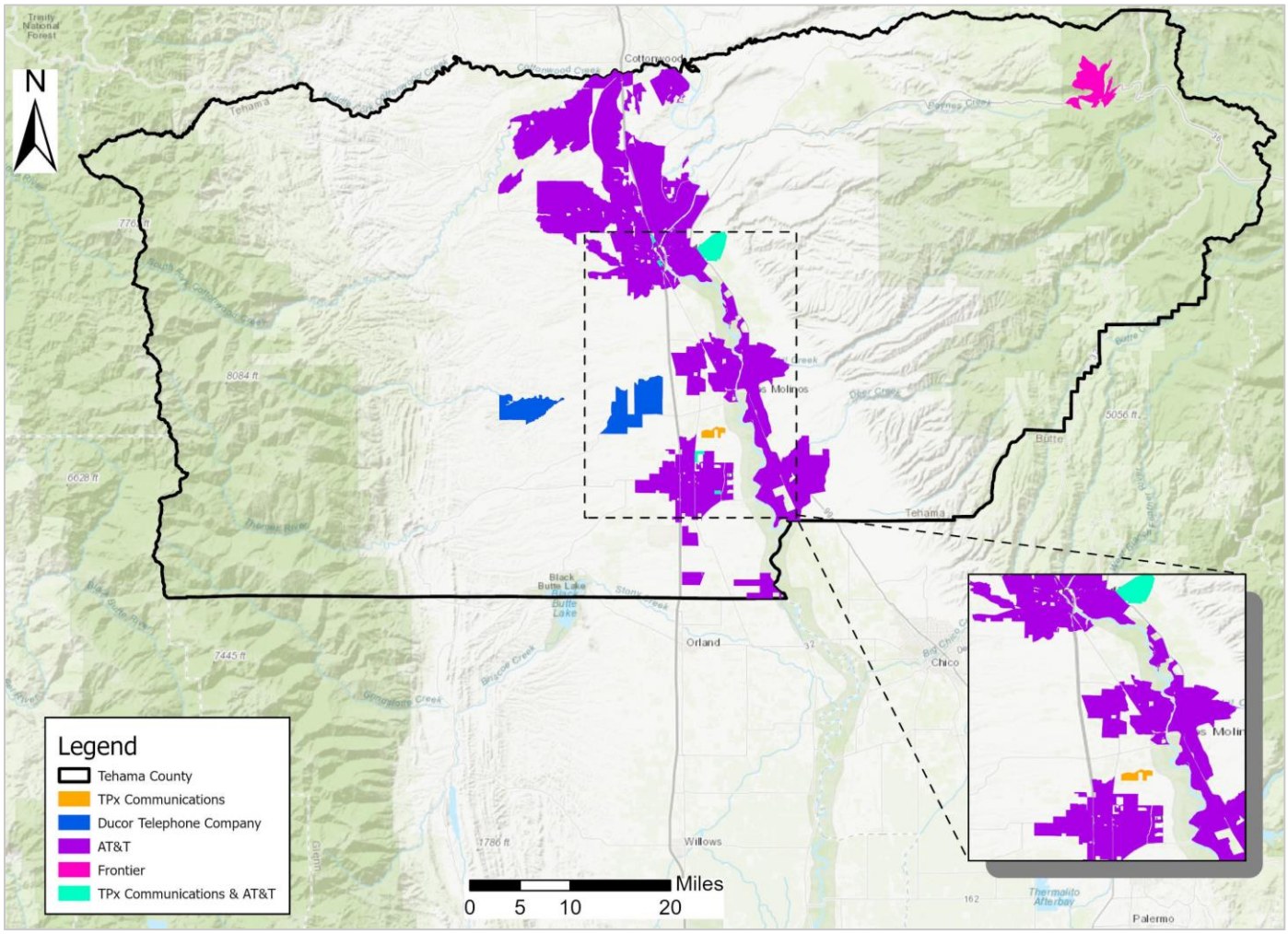


Comcast maintains a small cable service area in the south-central region of the county, serving a reported 2,464 locations in Corning along I-5. Both GSCA with its partner UTOPIA, and AT&T have submitted applications to the FAA to upgrade or deploy networks through and directly adjacent to Comcast's existing service area. Comcast itself applied to this program to receive funds to better serve a similar area. If Comcast does not receive an award from the FFA, the provider may consider increasing the capacity of the services it offers through its existing network, as the state's planned open access middle mile network will travel through Corning along I-5, likely bringing with it cheaper options for backhaul transport services. This increased capacity will enable Comcast to increase the bandwidth of its service offerings more cost effectively than in the past.

While Comcast may compete with other providers for FFA funding to serve communities in and around Corning, the provider also submitted applications to the FFA to expand services to Red Bank, in the west-central region of the county near Table Mountain, and Gerber just north of the provider's existing service area in Corning. If awarded, Comcast could use the new network segment in Red Bank to reach addresses surrounding this area that appear unserved, which are prioritized under the BEAD program. With its current reach, Comcast is well positioned to expand to many of the remaining unserved and

underserved locations across this portion of the county. However, with the BEAD program heavily favoring funding recipients that will deploy fiber, it is unlikely that Comcast will aggressively participate in the program in this County. [92]

Figure 26: DSL Service Availability by Census Block



Legacy DSL is available in most of the lived-in areas of the county. AT&T and Ducor Telephone Company are the primary providers of this service. AT&T has the largest connected network in the county, serving 11,395 locations, while Ducor provides connection to 760 locations. AT&T has stated that it is phasing out its DSL service by not accepting any new customers on this network. Through their own middle mile network (discussed in Section 5), as well as the planned state middle mile network, AT&T can consider introducing fiber into this market and replacing major portions of its DSL network. In fact, this intent has been signaled through their FFA applications, which have targeted large clusters of addresses throughout the main thoroughfares passing Interstate 5. Ducor could follow this strategy to upgrade its network in a similar fashion in Red Bank, near Table Mountain, if Comcast is not successful with their FFA application.

[92] Comcast has provided FTTP in some limited instances, but generally has not demonstrated a willingness to switch to fiber for residential applications to obtain funding from more restrictive grant programs. Procedurally, the BEAD program does allow a non-fiber project to be funded if the location in need does not receive any fiber deployment proposals, so Comcast may participate in later BEAD application rounds in some instances.

We note that DSL services provided by Frontier and TPX Communications in this county likely focus on enterprise and business connections, so it is very unlikely they will expand their residential service areas. Frontier reports to offer services to 169 residential locations, while TPx claims a mere 9 locations.

■ Fixed Wireless Availability

In those areas not covered by fiber, cable, or DSL, fixed wireless services have offered a vital source of connectivity to a reported 10,390 households and a competitive option to even more. Indeed, with wireless speeds of at least 100/20 Mbps offered to 75.0 percent of the county, fixed wireless services are currently reported to be the only source of broadband at those speeds for 9,126 households. The table below identifies the portion of households across Tehama County receiving fixed wireless services at three key speeds.[93]

Table 16: Fixed Wireless Service Availability in Tehama County

Households (HHs) – 27,341 Total	25/3 Mbps	50/5 Mbps	100/20 Mbps
HHs served by any tech	85.8% (23,459)	83.5% (22,827)	79.1% (21,624)
HHs served by fixed wireless	81.7% (22,343)	81.0% (22,154)	75.0% (20,517)
HHs served by only fixed wireless at speed	38.0% (10,390)	37.6% (10,272)	33.4% (9,126)

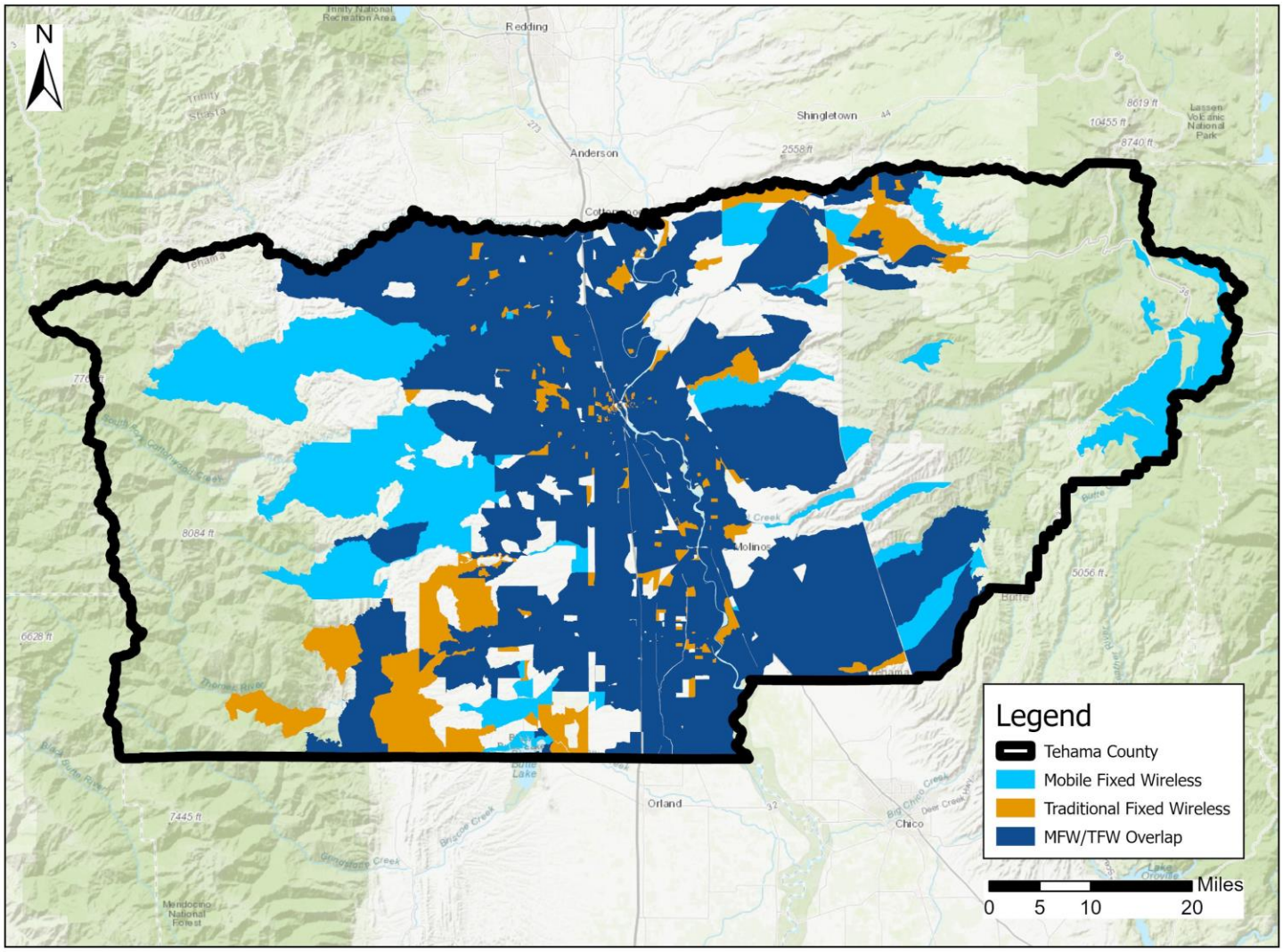
While this coverage has likely been a vital lifeline for those who use it, it does mean that locations served by wireless services at speeds of 100/20 Mbps are not eligible for BEAD funding, and areas that are served only by fixed wireless at 25/3 Mbps will be considered underserved, placing them after the unserved areas in terms of the program's priorities. As a result, locations served only by fixed wireless at these speeds will likely remain in need of wireline solutions to achieve higher service speeds now available to a vast majority of Californians.[94]

The map below shows census blocks that fixed wireless providers claim to cover. If locations are not in fact served by these fixed wireless services, they should be among the most important places to participate in the various challenge processes discussed in Section 6.2. Fixed wireless service areas are somewhat difficult to predict and model with certainty, so wireless ISPs can sometimes claim services are available to locations when the local geography hinders connectivity. These errors can prevent locations in need of broadband funding from being eligible for it, so the challenge processes play an important role to ensure that fixed wireless service areas are correctly understood by the CPUC and FCC.

[93] Note that the FCC data and some service maps will express service coverage at lower speeds than the FCC's current minimum definition of broadband. For example, the FCC reports that 93.2 percent of households can receive at least some fixed wireless signal, and 92.4 percent can receive services achieving at least 10/1 Mbps.

[94] The FCC data contains nearly no claims of fixed wireless services offering speeds of 250/25 Mbps, which is the next speed tier tracked by their data.

Figure 27: Fixed and Mobile Wireless Deployments

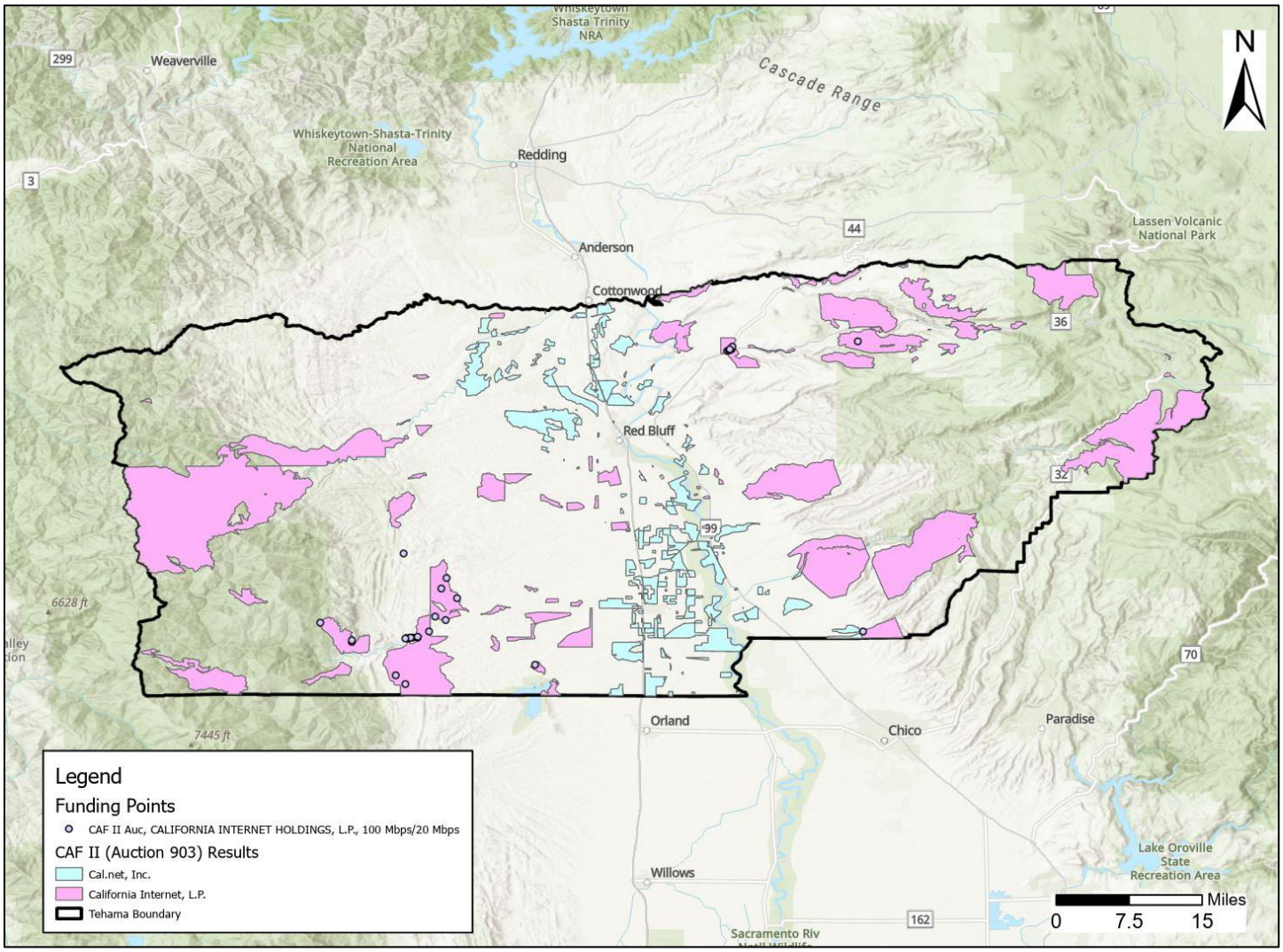


The above map reflects the claim that 93.2 percent or 25,493 households in Tehama County can receive some level of fixed wireless service. As the information in the table above shows, there are pockets across the county where fixed wireless service can achieve speeds over 100/20 Mbps as well. However, similar to DSL, these technologies struggle to offer any faster speeds in a cost-effective manner, generally either requiring 5G transmitters connected to fiber routes to be placed close to home users or significant spectrum allocations per user that limit the number of possible users.

Mobile service providers such as AT&T, Verizon, and T-Mobile can now use their wireless facilities to offer dedicated home broadband services that compete with the traditional fixed wireless companies, a strategy now reflected in the FCC data. The above map shows that most of the areas served by traditional fixed wireless ISPs are also served by these mobile providers, which has also begun to offer services in areas where no current licensed fixed wireless provider exists. Unfortunately, just like the traditional wireless service areas, these mobile fixed service areas can be considered "served" under the rules of some of the grant programs, so they may not be eligible for BEAD and other wireline network deployment funding opportunities.

4.3 Current and Proposed Deployments

Figure 28: Previously Funded Areas



Out of all the funding opportunities that have recently been awarded, Tehama County received multiple awards through the Connect America Fund Phase II Auction (CAF II Auc). As shown in the map above, Cal.Net has been awarded projects in the blue census blocks in the middle of the county. GeoLink's project areas can be seen in the pink blocks, having some residences deployed already.

This data was taken from the Universal Service Administrative Co.'s (USAC) Connect America Fund Broadband Map,[95] and accordingly, no other funding opportunities have been awarded to carriers in Tehama County in recent years that will provide service at over 100/20 Mbps.

[95] "Connect America Fund Broadband Map," Universal Service Administrative Company, https://data.usac.org/publicreports/caf-map/ (accessed September 2023).

A good resource for identifying areas previously funded by federal awards is maintained by the FCC and can be found here:[96]

https://fundingmap.fcc.gov/home

4.4 ISP Survey Review

For context about the methodology of the survey, see Section 3. For a full list of the survey results, see Appendix A.

Internet Service Provider Survey Findings - Summary

Out of all 88 providers contacted, there were only 12 responses in total. The majority (10) were fixed wireless providers, with 4 fiber, 2 cable, 1 copper. Many of these companies provide additional services, such as Voice-over-IP phone services, colocation, IP video, and many other managed connectivity-based services. Many seek to expand their service area, but most notably, 3 fixed wireless providers aim to expand their offerings into the fiber market.

The majority of these respondents have not been awarded grant funding, and do not expect to receive any. There are 2 companies that have active applications in for California Advanced Services Fund (CASF) areas and a USDA Community Connect grant, but those are still in progress. All but one have stated that they are willing to work with local, state, and federal entities to develop more infrastructure. The most common barriers to expansion that they have identified are the lack of middle mile fiber available, funding, difficulties permitting new towers or obtaining space on existing towers, and geographic barriers. Build cost and supply chain issues were stated to be additional difficulties faced by these respondents, with a common thread being prohibitive ROI for rural deployments.

When asked about current partnerships, there were varying degrees of activity, with some having unofficial, working relationships with school boards, housing authorities, and other government utility organizations, but the remaining claiming that they have not had a suitable opportunity, have not been approached, or prefer not to because it allows them to deploy faster without having to provide a cost share model. Regardless, all have answered yes to being interested in partnering financially with state, county, and federal organizations.

Internet Service Provider Survey Findings – County Specific

For Tehama County, in total there were three active ISP respondents to our ESRI 123 ISP survey:

1. **DIGITALPATH, INC**

1. **Succeed.Net**

2. **Stream IT Networks, LLC**

[96] https://fundingmap.fcc.gov/home

Table 17: ISP Survey Results (Toughest aspects of rural deployment)

Response	Count	Percentage
Permitting-Municipal	1	25%
Permitting-County	3	75%
Permitting-State	0	0%
Prohibitive build cost	3	75%
Lack of access to middle mile infrastructure	1	25%
Supply chain issues	1	25%
Skilled labor	1	25%
Maintaining affordability to the consumers	2	50%
Other	0	0%

SECTION

05

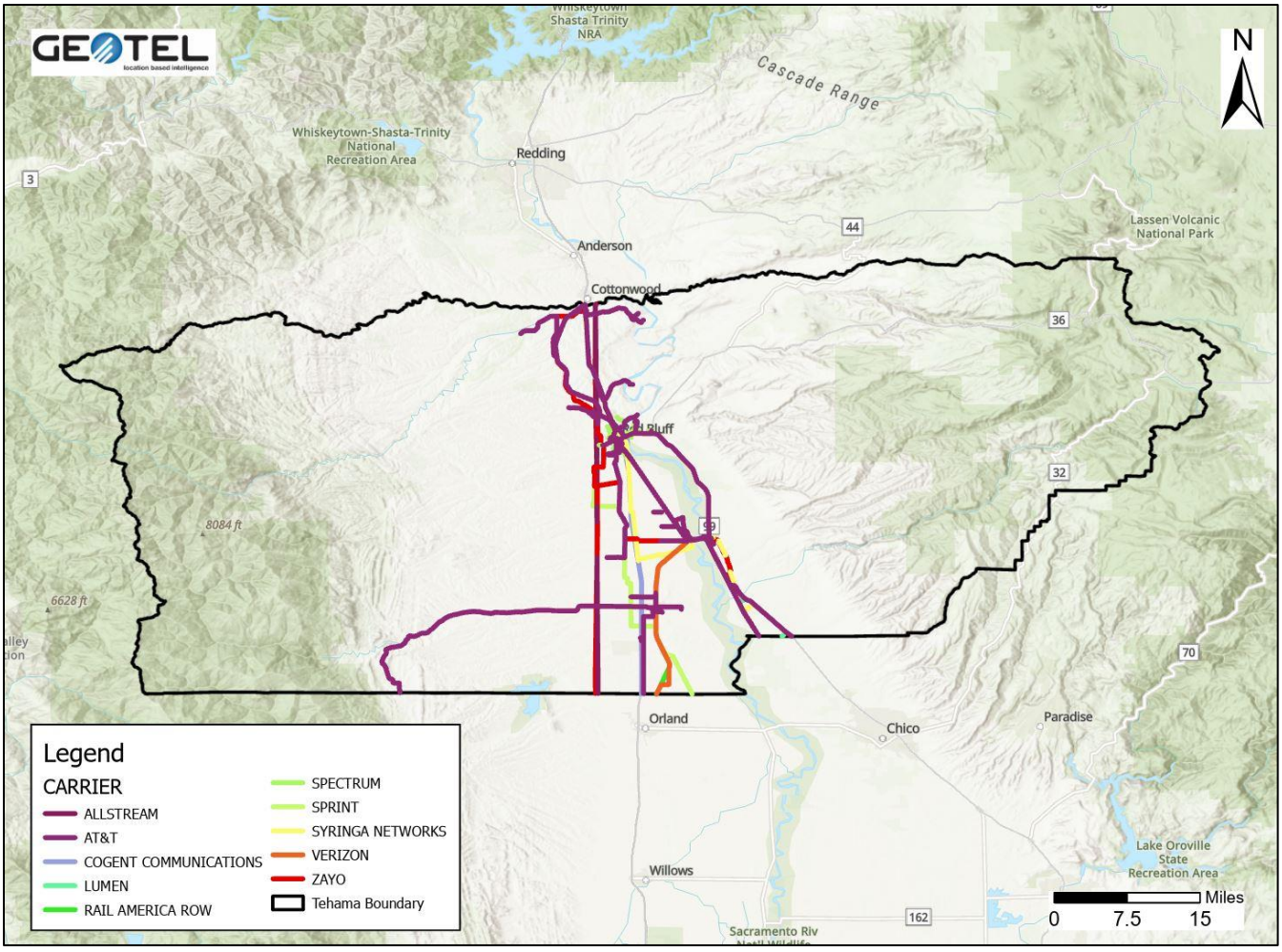
ASSET INVENTORY AND GAP ANALYSIS

This section explores the currently available broadband infrastructure within Tehama County, including public assets that could potentially be leveraged for expansion. It also provides a gap analysis to highlight areas of need currently lacking sufficient connectivity. This inventory of existing infrastructure assets serves as the foundation upon which any broadband expansion initiatives can be built. In turn, the gap analysis will help identify the disparities between current infrastructure and the broadband connectivity goals recommended here, providing valuable insights into the steps required to bridge these gaps and pave the way for enhanced digital connectivity and economic growth. GIS layers depicted in this section are packaged as an additional deliverable together with this document, in order to empower the county with data that can be used for decision making when prioritizing areas for grant-funded deployments through cooperation or partnerships with ISPs.

5.1 Middle-Mile Fiber Route Inventory

Middle-mile fiber infrastructure provides high-capacity bandwidth and data communications from an aggregation point, such as a central office or cable headend, to a fiber point-of-presence (PoP). Access to adequate middle-mile infrastructure is a major determinant of the feasibility of last mile broadband infrastructure projects and the basis from which wireline and fixed wireless services are offered to customers.

Figure 29: County Middle-Mile Carriers



This preceding map depicts the carriers who have middle-mile infrastructure in Tehama County. The listed carriers are as follows: Allstream, AT&T, Cogent Communications, Lumen, Rail America Row, Spectrum, Sprint, Syringa Networks, Verizon, and Zayo. These fiber-optic carriers do not publish, report, or make their routes available publicly, so information about the routes was acquired from GeoTel, a geospatial data provider that continually updates its database of middle mile carrier routes. The data provides a limited number of details, such as whether the fiber is "off-road", "on-road", or running concurrently with a "railroad." These designations roughly approximate which routes are aerial or in rights-of-way but are not conclusive in some cases.

Based on these fiber optic routes, there are fiber carriers along most of the major thoroughfares in the county. These middle mile fiber deployments run through main city centers, towns, and unincorporated communities. Overlaid on the population density heatmap, the routes hit every noticeable pocket. Rural last mile networks deployed to reach unserved broadband-serviceable locations (BSLs) may be able to interconnect with these middle mile fiber routes, providing the ability to scale up service offerings over time as household bandwidth demands continue to increase. However, existing middle mile fiber is not always accessible for interconnection at a location convenient for a last mile network.

The following table shows the middle mile carriers that provide dark fiber and datacenter/colocation services, which will allow for providers to weigh their backbone connectivity options when expanding into un- and underserved areas.

Table 18: Middle-Mile Carrier Service Offerings

Carrier	Dark Fiber	Data Center and Colocation
Allstream	YES	YES
AT&T	NO	YES
Cogent Communications	NO	YES
Lumen	YES	YES
Rail America ROW	NO	NO
Spectrum	NO	YES
Sprint	NO	YES
Syringa Networks	NO	YES
Verizon	NO	YES
Zayo	YES	YES

Dark fiber allows carriers to light and manage their own infrastructure at a fixed cost, being responsible for the equipment cost themselves. Dark fiber allows the carrier to scale up with their demand requirements through their own upgrades, compared with having to buy more bandwidth from their provider. This option might be more expensive for smaller businesses but is a better choice for carriers who need full control of their own network, have operation and management capabilities, and foresee that they will be using the infrastructure for the long-term, allowing them to lock into an Indefeasible Right of Use (IRU) contract to secure access to that dark fiber for 5, 10, or 20 years or more.

Data center connectivity, and by extension, collocation, can also provide advantages to providers and business alike. Carriers can lease space in data centers to house their electronics connecting this leased dark fiber, avoiding the need to have their own real estate to host servers and ensure reliability through backup power and redundancy. This type of connection also can provide the ability to collocate with other providers in an Internet Exchange Point (IXP), which allows for 'peering' with other networks, reducing latency by keeping internet originating traffic as local and redundant as geographically possible.[97] This geographical redundancy enhances the resilience of the network, ensuring that users experience consistent and reliable internet services. Moreover, data center colocation extends additional advantages to businesses, enabling them to leverage data center facilities to host their critical infrastructure, benefiting from the same secure, scalable, and well-connected environment. As a result, they can focus their resources on core operations, while the data center experts handle the complexities of infrastructure management, security, and compliance.

In essence, data center connectivity and colocation services create a symbiotic relationship that bolsters the performance and reach of carriers while providing a solid foundation for businesses to thrive and scale up as required. Together, they form a critical part of the strategy required for both carriers and business to expand their enterprises.

5.2 Additional Inventory of County Assets

To expand broadband services efficiently, ISPs must collaborate with local authorities to access and utilize publicly owned resources that may either be essential to the deployment or significantly reduce deployment costs. Local governments can use their assets to encourage interested ISPs to work with them, serving as a basis to develop coordination agreements or partnerships that will allow the locality to influence the deployment area and other factors.

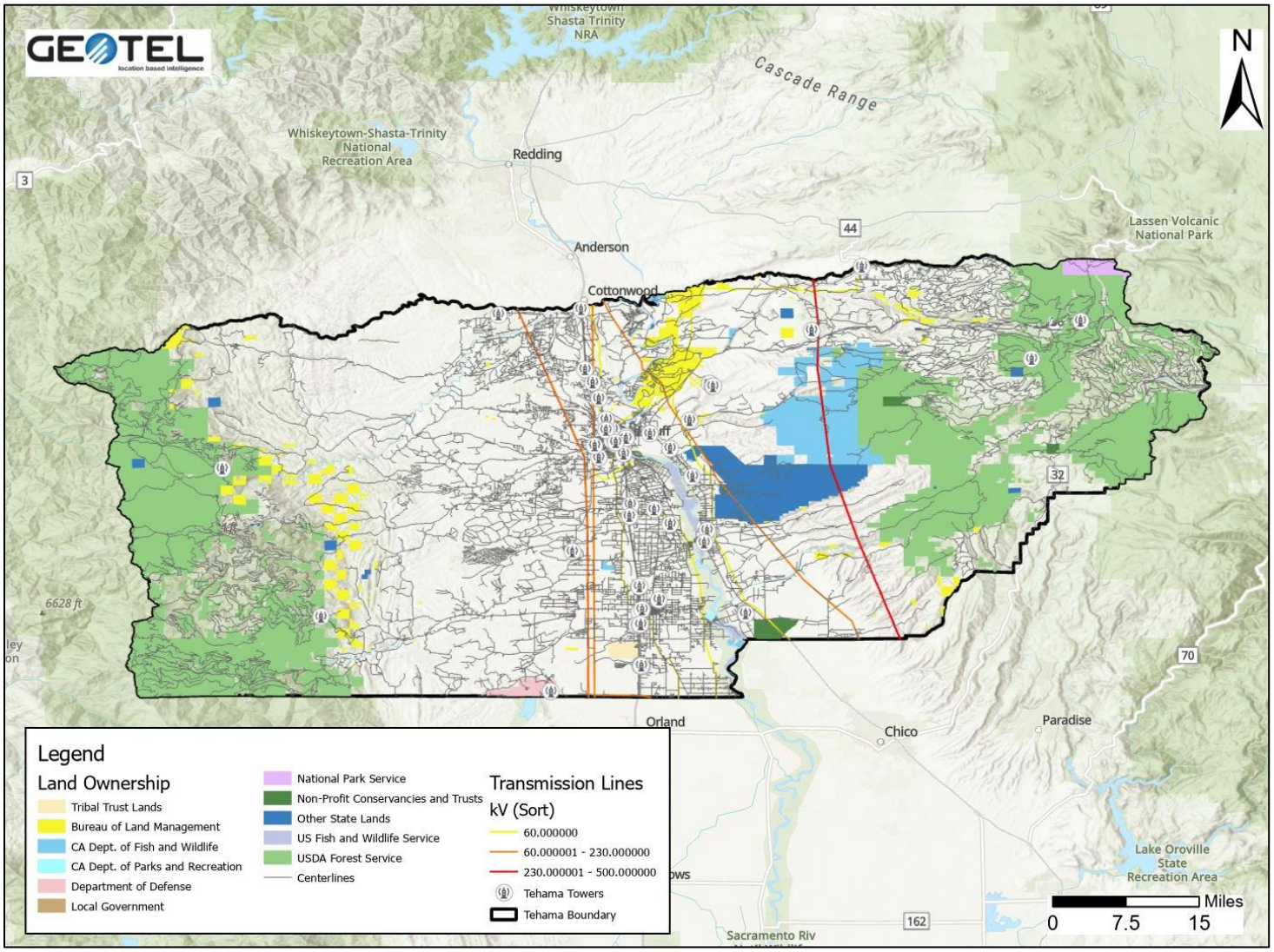
The following map is a starting point for localities to create inventories of available assets, establish processes to lease them to ISPs, and develop asset access agreements. ISPs can lease assets used for co-locating or installing various broadband-related infrastructure components such as antennas, towers, buildings, and substations, underground conduits, fiber optics, spectrum resources and land and space resources such as public rights-of-way and land parcels. ISPs that would benefit from access to several of these asset categories may also be very interested in a partnership, which will improve coordination further and enhance the availability of cutting-edge broadband infrastructure and services across the region, benefiting households, enterprises, agriculture, and industry.

To plan deployments in areas of need, ISPs and localities must consider land ownership, registered towers, and electric transmission lines. Utilizing existing towers can facilitate cost-effective co-location of fixed and mobile broadband equipment, enabling last mile wireless service or providing backhaul to remote locations and facilitating nearby wireline deployments. In cases where no nearby towers are available, ISPs can consider constructing a new tower on publicly owned city or county land, preferably within the footprint of an energy utility. Locations near transmission lines and substations can make more appealing development locations, offering a clear party to contract with and often power for broadband huts or nodes.

An inventory of towers and available space can also assist fixed wireless partnerships, which will be crucial to serve the most remote locations in the county. Free tools, such as Cambium LinkPlanner, can show tower path quality by using LiDAR data depicting potential obstructions between two points or modeling non-line-of-sight (LoS) deployments using the CBRS spectrum. These materials are made available in the additional GIS deliverables, with key details presented below.

[97] Netrality, "Internet Exchanges: The Glue That Holds the Internet Together," https://netrality.com/data-centers/internet-exchanges-the-glue-that-holds-the-internet-together/, accessed September 2023.

Figure 30: Assets to Leverage for Infrastructure Deployments (Depiction of contents of GIS Package)



New broadband infrastructure must be designed with a forward-looking approach, capable of accommodating the expected growth in demand in the targeted areas. Shared infrastructure solutions should be explored to reduce costs and better leverage resources. For example, Section 7 explores the 'dig-once' coordination efforts Caltrans introduced with traffic projects that can enable opportunities to lay conduit concurrently, saving time and resources in the case of future expansion.

5.2.1 CALTRANS Alignment and Golden State Net Middle Mile Project

As mandated by California Assembly Bill 154913 (2016)[98] the California Department of Transportation (Caltrans) was tasked to inform broadband deployment organizations about transportation projects suitable for broadband installation through its website. This notification occurs during the planning phase of specific highway construction projects led by Caltrans, who

[98]"California Assembly Bill AB-1549," California State Legislature, http://www.leginfo.ca.gov/pub/15-16/bill/asm/ab_1501-1550/ab_1549_bill_20160630_amended_sen_v93.htm, Section 1, subsec. C (accessed September 2023).

regularly update their website with GIS layers of active, planned, and completed road projects of all types. Upon receiving notification from Caltrans, broadband deployment organizations can partner with Caltrans to incorporate the installation of broadband conduit into the project, if the project type aligns with this type of work.

Since this legislation was initially passed, Caltrans has made great strides working in conjunction with Golden State Net (GSN) to use these priority corridors in the deployment of a state-wide middle mile network.[99] In July of 2021, the California State Legislature passed Senate Bill 156, which allocated $3.25 billion toward the construction of an open access middle mile network that would provide many areas without adequate access to essential middle mile with the connectivity they need to build or expand networks to unserved and underserved communities.[100] California has a robust state-wide research and education middle mile network known as CalREN, provided by the Corporation for Education Network Initiatives in California (CENIC). This organization formed GSN, which California Department of Technology (CDT) approved to be the third-party administrator for the open access middle mile network created by SB 156.[101] On June 30, 2023, NTIA announced that CDT and, by extension, GSN, were awarded a further $73 million from the NTIA's middle mile grant program to fund construction activities for the proposed state-wide network and run 288-count fiber across California.[102]

The middle mile network comes together from a patchwork of different approaches. Many of the routes through the Sacramento Valley are leased from existing providers, while the portion of I-395 from Alpine to Los Angeles was purchased outright. The remaining routes are categorized as joint builds, and many of the spokes placed to provide service to un- and underserved communities will be new construction from GSN. The open access nature of this infrastructure can make it appealing for new providers, facilitating entry into existing markets to directly compete with or outperform incumbents.

For any routes not captured by this project, or even small laterals that would be required in Tehama County to reach remote locations, AB 1549 also addresses guidelines to streamline the process of installing broadband conduit through these proposed project ROWs. According to these guidelines, broadband stakeholders have two approaches:[103]

- **Stand-alone Encroachment Permit Project:** This option is suitable for broadband deployment entities that prefer to independently manage the planning, design, and installation of their conduit, utilizing contractors of their choice.
- **Planned Transportation Partnering Project:** For broadband deployment entities desiring closer cooperation with Caltrans throughout the planning, design, and installation phases of the conduit, they can opt for a planned transportation partnering project.

In both scenarios, broadband stakeholders must obtain encroachment permits before proceeding with the installation of broadband conduits. This strategy can be used by providers to expand their service into available parts of the county.

To keep up with Caltrans project progress updates, follow this link to the CA.gov website: https://dot.ca.gov/programs/asset-management/caltrans-project-portal.

For updates on the Middle Mile Broadband Initiative, visit this link: https://site-cammbi.hub.arcgis.com/pages/statewide-middle mile-network-map

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[99] "GSN Statewide System Level Design," California Department of Technology, https://cdt.ca.gov/wp-content/uploads/2022/04/GSN-Statewide-System-Level-Design-04222022.pdf (accessed September 2023).

[100] California SB 156 (2021-2022 Regular Session), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB156.

[101] Golden State Net, "About CENIC California Middle Mile Broadband Initiative, LLC dba GOLDENSTATENET," https://goldenstatenet.org/about, accessed October 2023.

[102] California Department of Technology, "California Department of Technology Secures $73 Million Grant for Middle mile Broadband Initiative," June 30, 2023, https://techblog.cdt.ca.gov/2023/06/california-department-of-technology-secures-73-million-grant-for-middle mile-broadband-initiative/.

[103] California Department of Transportation, "Encroachment Permits Application Guide Utility Booklet," section 603.2A-1 (Wired Broadband Facility Installation Processes), revised July 2022, https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/encroachment-permits/chapter-6-ada-a11y.pdf.

5.3 Broadband Gap Analysis

The purpose of this section is to detail the areas of Tehama County in need of strategies to address lack of high-speed broadband access, as well as give detail on recent efforts taken on a county, regional, and state level to support his effort.

5.3.1 County Priority Areas and Discussion of GSCA Process

This study was requested by the Golden State Financing Authority (GSFA) and is accompanied by a parallel effort by Tilson with the Golden State Connect Authority (GSCA), both under the umbrella of the Rural County Representatives of California (RCRC). Under this initiative, a number of RCRC counties received strategic plans and high-level designs for robust fiber network for various jurisdictions under RCRC that were awarded a LATA (Local Agency Technical Assistance) grant. Tilson was directed to collaborate with UTOPIA (Utah Telecommunication Open Infrastructure Agency), acting as the engineering manager, to guide Tilson with engineering standards and cost estimate assumptions. Tilson was provided various engineering deliverables, such as a conceptual network design, a subsequent refined high-level design, and a limited low-level design, with the end goal of creating shovel-ready network designs. These three key deliverables are intended to identify and estimate constructable project areas that maximize various funding opportunities available now and in the future.

- **Conceptual Network Design**

The conceptual design (CD) is an all-encompassing network design that provides connectivity to every household within the LATA awardee's unincorporated jurisdiction, with the exclusion of incorporated cities (unless otherwise specified). Using publicly available address and road databases, Tilson created serviceable address lists for all counties to use as inputs for the automated fiber design software, Biarri FOND. This program enables Tilson's engineering team to customize and optimize wireline broadband network designs by using the centerline layer and address point layer to run a network analysis and generate complete fiber designs using a set of parameters and requirements. For this specific program, UTOPIA dictated that the designs would be based on an Active Ethernet deployment that terminates a fiber cable to the end premise, offering a 'best-case scenario' in terms of deployable speed compared to a PON architecture. Tilson designed around this parameter as specified by UTOPIA and developed a bill of materials (BOM) from FOND's proposed designs and engineers' reviews and manual adjustments. After producing these designs, Tilson engineers perform a high-level quality check (QC) of the network design as well. Following design completion, the engineers passed along the BOM to a financial analyst who integrates it into a financial model to produce build cost projections. The build cost projections include a breakdown of the entire network infrastructure build and key evaluation metrics, such as the cost per mile and cost per passing. The results of this work product are a conceptual network design and high-level build cost projections to every unincorporated serviceable location across the county.

- **Refined High Level Design**

After delivery of the conceptual design, a briefing call was held with each LATA-awardee county to gather input on priority project areas. A Tilson principal consultant then used the areas of interest (AOI) identified by the awardee to develop GIS polygons, which were then used to carve up the county based on the CPUC 23 availability datasets and prioritize 'unserved' address point clusters as target areas for high priority of grant funding. Analysts developed metrics identifying plant mileage, potential unserved passed, and estimated costs for serving these areas with an Active Ethernet deployment. The best candidates for funding were grouped and categorized as high-priority areas (group 1), and designs were generated.

Tilson engineers also analyzed other potential project areas. Areas with clusters of additional unserved addresses not included in group 1 were placed in group 2, which also had a higher portion of served locations relative to the first group.

Group 3 project areas focused on high-density clusters to allow for the network to be optimized operationally and financially and had the highest portion of served locations of the three groups. As a result of this analysis, a candidate summary sheet was produced with all identified project areas. Tilson, GSCA, and UTOPIA collaborated on financial thresholds to guide selections of project areas that would progress to HLD. Identical to the design process used in the conceptual design, Tilson engineers produced a high-level design using the new project area and delivered a network design and build cost projections.

■ Leveraging the designs for FFA Applications

The first real use-case to leverage these designs was for the CPUC's FFA program, which utilized state funding for broadband to subsidize last mile deployments. This initiative was spearheaded by GSCA, in conjunction with UTOPIA, who ultimately prepared the applications on behalf of the participating counties. The applications were submitted prior to the program's September 29, 2023 deadline. Using the AOI process Tilson conducted, counties worked with UTOPIA and GSCA to identify a subset of AOIs that they would put forward for funding. These AOIs were created around connection back to the in-flight GSN state open access middle mile project, planning to leverage the new influx of available fiber throughout the region to finally serve pockets in need of access. These pockets were formally identified by the CPUC through both a collaboration with CostQuest Associates and their cost-modeling efforts.[104] CQA used their proprietary BSL fabric as the basis for locations eligible in this program that could be funded, but without an additional license, this information was available only as a shapefile generalizing the number of unserved locations through hexbins (similar to how the FCC's BDC map is presented), so identification of individual unserved locations using this data was not possible. The location eligibility criteria could be viewed only through these hexbins, which:

> "Show[ ] the range of the number of unserved mass market locations lacking access to wireline 25 Mbps downstream and 3 Mbps upstream excluding legacy technology (e.g., Digital Subscriber Line and Cable DOCSIS 2.0 or older) using a GIS technique known as "feature binning." Individual unserved locations are aggregated into hexagonal container bins of more than one unserved location, where one hexagon represents an area approximately 1/10th of a square kilometer. The hex bin approach is designed as equally sized and scalable geometric bins for summary, display, and comprehension of large datasets."[105]

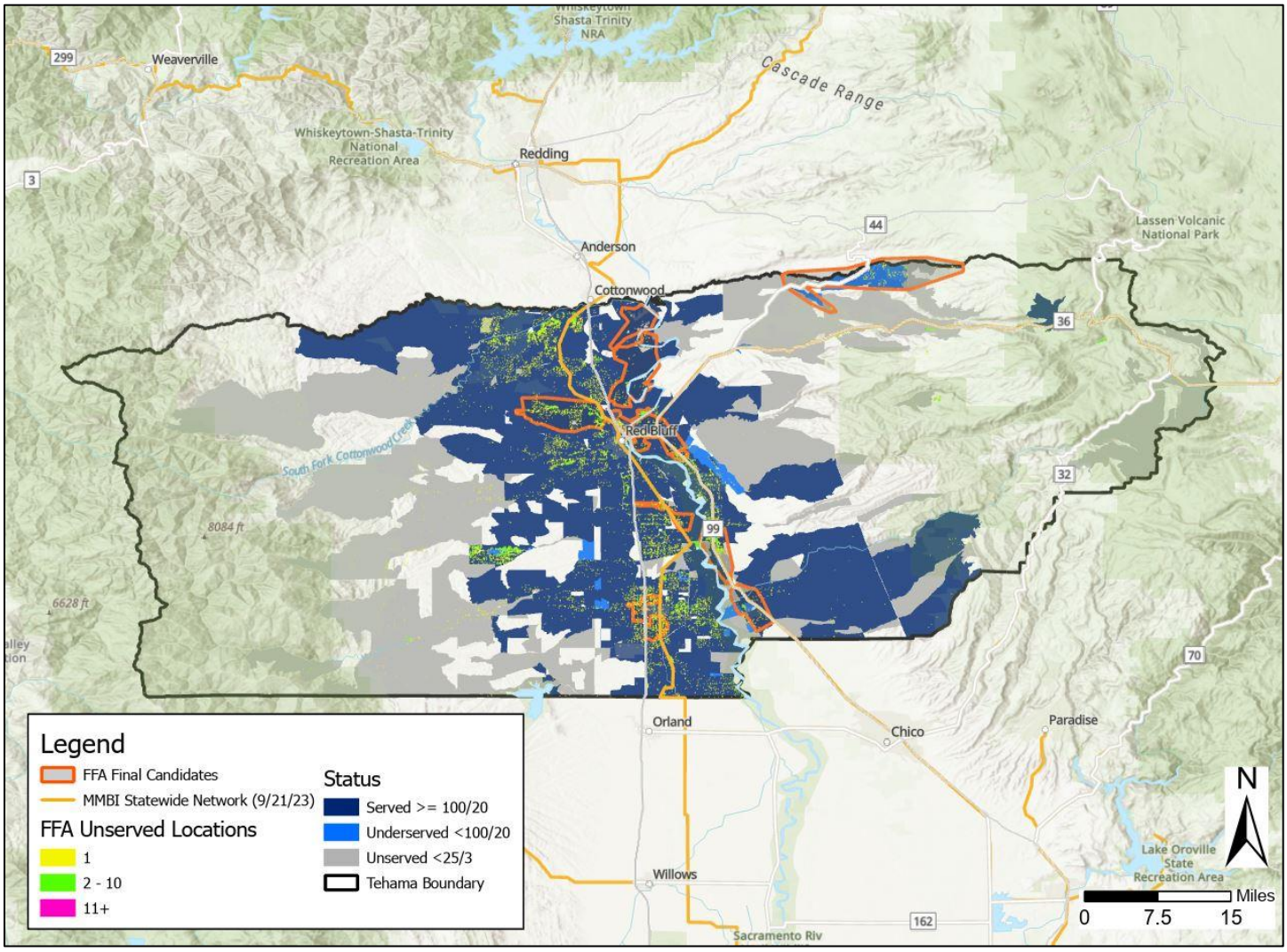
In essence, eligible locations were any address point that did not receive cable service having compatibility with a DOCSIS 3.0 or better modem, or fiber service. So, any address receiving an inferior wireline connection or any terrestrial fixed wireless broadband service. More info about the CPUC Federal Funding Account (FFA) program can be seen in Section 6.

The map below integrates many of these aforementioned datasets to illustrate the proposed project areas in Tehama and depict these CPUC-provided hexbins as points whose colors reflect the quantity of unserved locations within the hexbin. This data can serve as the baseline for prioritizing the remaining areas of need in the county.

[104] CPUC, "California Broadband Investment Model," p. 2, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/broadband-implementation-for-california/ffa-webpages/ca-broadband-investment-model_04212023.pdf, accessed September 2023.

[105] "Applicant Tool Data Dictionary," California Public Utilities Commission, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/broadband-implementation-for-california/ffa-webpages/applicant-tool-data-dictionary-052423.xlsx (accessed September 2023).

Figure 31: County-Selected Priority Areas, with Final FFA applied for Areas and GSN/CDT State Middle Mile



Unserved areas are color-coded to reflect the number of eligible locations in that area. Points containing two to ten FFA eligible unserved locations are green; areas with more than 11 are magenta, and areas with only one FFA unserved passing are yellow. The former illustrates clusters for more concentrated areas that can be appealing to ISPs for completely new expansion, while the latter shows both remote passings that require long drops, low density passings, or potentially BDC mapping errors.

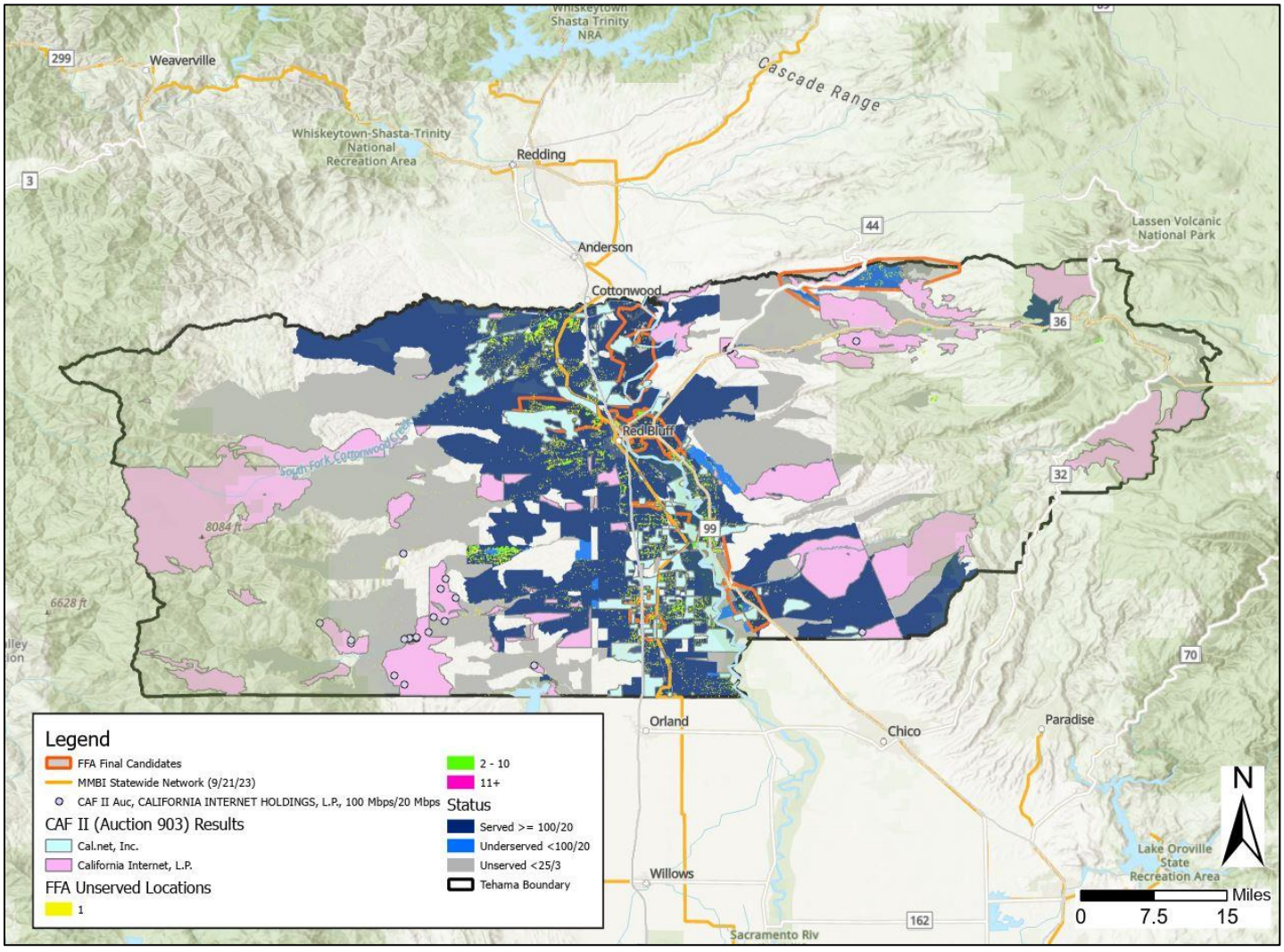
Additionally, because two serviceability datasets are presented here, different information can be gleaned from their combinations. Primarily, the FFA points may highlight partially unserved census blocks, illustrating the tendency for census block-level reporting to obfuscate these individual locations. When high density FFA-eligible clusters are found in areas in lighter blue shade (designated “Served < 100/20”), the area is likely to rely primarily on fixed wireless service or legacy cable infrastructure. In the dark blue, ”Served >= 100/20” areas can also be subject to these technologies but at a higher service standard, due to their proximity to PoPs, suffering from overstating of speeds from wireless providers, or cherry picking from cable operators. The latter is well poised for incumbent expansion, especially with access to the new state middle mile routes. The limitations of both of these technologies, discussed in Section 2, make these dense clusters into prime targets for modern wireline infrastructure deployments.

The incorporated areas have high middle mile traffic and close proximity to central offices, lit equipment, and in most cases, adequate service offerings such as fiber access, so the strategy to reach dense unserved pockets in these cases revolve

around addressing *islanding*, where unserved locations are surrounded by otherwise served locations. In most of these instances, partnerships and subsidies should typically be sought to alleviate these issues by the incumbents themselves. The application areas submitted by GSCA and UTOPIA address major high-density areas that do not overlap with incorporated areas of the county, which leaves them opportunity to expand into the city or outward toward more rural pockets of need. Comcast and Charter can adopt this strategy to fill out the remaining areas of Red Bluff and Corning, respectively. AT&T also has the ability to modernize its existing widespread network to fiber and build out from those areas.

The application areas submitted by GSCA and UTOPIA address major high-density areas that leave them the opportunity to expand into the city or outward toward more rural pockets of need. UTOPIA is looking towards big portions of the county surrounding Red Bluff, Corning, Los Molinos, Gerber, Vina, and Manton. With an established presence, they will be able to fulfill their obligations in these areas and then move to expanding into the other high density areas if need that are close to their deployments. If this strategy is successful, they will have the largest fiber presence in the county. With the new fiber facilities in place, they could also more efficiently build to any clusters in need of wireline that are located close to the middle-mile. Reds Creek Road, Bowman Road, and communities along State Route 36 such as Paynes Creek, Mineral, Mill Creek, and St. Bernard, are prime candidates for this strategy.

Figure 32: County-Selected Priority Areas, with Final FFA applied for Areas and GSN/CDT State Middle Mile, including CAFII in Progress Census Blocks



This map is an iteration of the former, now showing areas where GeoLink's in-progress CAF II Auction deployment is taking place. The pink dots represent passings that have already been connected by this project. The remaining orange areas are census blocks that will eventually have access to fixed wireless service capable of 100/20 Mbps. These look to be some of the most difficult to serve portions of Tehama, being farther from I-5 and SR 36. Notably, Stagecoach Rd along Elder Creek in the west and locations near Round Mountain and Campbell Ridge will prove tough to navigate wireline deployments due to the terrain and low density of households in comparison to the length required to build. GeoLinks is planning on serving only Cambell Ridge, but fixed wireless will remain an important part of the county's strategy in connecting the least-served, due to the landscape and low-density of some remote areas. Thanks to the state middle-mile, a great deal of the county has the potential to be upgraded to a more capable fixed wireless service. It will provide high-bandwidth connections to tower sites, enabling future ready service to locations that can receive signal, or even more creative approaches, such as using 18GHz wireless backhaul to serve a PoP to be used for remote fiber deployments. However, where wirelines laterals can be funded, these should be prioritized.

Ultimately, expansions will be strategic decisions based on the identified needs of Tehama County, the funding opportunities for unserved and underserved locations, improved access to middle mile infrastructure, and each ISP's willingness to build in these areas. However, there is a fundamental tension at the core of this decision-making. Should the expansion strategy focus on achieving fiber connectivity to even the most remote locations, essentially focusing on near universal high-speed wireline connectivity as the region's long-term "endgame," or should developers simply focus on the "low-hanging fruit," performing the least costly upgrades and expansions to the most locations as quickly as possible?

This tension is reflected in several questions of priority. Should remote areas with the greatest need be targeted, or should clusters near new middle mile routes be prioritized because they will be less costly to connect? Does fixed wireless sufficiently solve remote locations' connectivity problems enough to shift focus toward upgrading more underserved locations to fiber, or should more costly wireline expansions to remote locations unserved by wireline still be prioritized, despite having access to fixed wireless services exceeding minimum broadband speed standards? All of these options have their merit. However, when examining the tradeoffs between these different strategies, funding opportunities will largely determine where providers, both new and existing, will focus their efforts.

And with each opportunity having their own guidelines, standards, limitations, and considerations, a firm understanding of the nuances of each is required to plan accordingly. Section 6 dives into these existing and upcoming funding programs in detail.

SECTION

06

BROADBAND FUNDING STRATEGIES

California's broadband funding landscape has improved dramatically since 2020, providing an unprecedented amount of funding to finally connect California's most remote or challenging unserved and underserved areas. Over the next few years, the California Public Utilities Commission (CPUC) will award approximately $4 billion to support broadband projects to connect households and businesses that lack access to reliable services offering speeds of at least 25/3 Mbps.[106] Combined with additional federal broadband funding opportunities, California counties and localities now have access to a wide range of funding options to address the digital divide.

With this abundance of deployment funding options, regional, county, and local governments now face two broadband planning challenges. First, these public entities may need to work with ISPs or qualified public partners to **develop grant-eligible broadband deployment projects** that will make the best use of funding opportunities to meet the specific connectivity needs of their communities. Second, as historically unserved areas are finally connected to high-speed broadband networks, these communities will face new digital equity challenges. Some people are unable to adopt broadband services for financial reasons, while others lack the digital devices or skills necessary to take full advantage of the internet. Public entities should **develop or support funding-eligible broadband adoption and digital skills programs** using new funding opportunities designed to help everyone experience the economic and quality-of-life benefits of modern broadband. The county and localities must work with local community anchor institutions (CAIs) to understand how they already have been addressing these connectivity challenges and how the range of funding programs can be used to improve these efforts.

While Section 8 will examine funding opportunities that support digital equity, this section will focus on programs that will shape future network deployments. The aim of this overview is to empower Tehama County and its localities to become involved in the planning and deployment process by working with interested ISPs and qualified public partners to facilitate better connectivity in their own communities. Critical considerations for public sector entities participating in these processes include:

1. An understanding of the level of effort required to submit a grant application to a broadband infrastructure funding program,
2. An understanding of coordination and partnership opportunities between public entities and ISPs or qualified public partners,
3. The range of available funding options, and how they relate to connectivity needs within Tehama County, as well as each program's eligible location criteria and requirements for matching funds,
4. The methods to ensure that unserved locations are eligible for funding by challenging broadband map inaccuracies,
5. The implementation of broadband deployment-friendly local permitting and policy environments that will reduce deployment costs and encourage ISP investment.

Subsection 6.1 ("Applying to a network deployment funding opportunity") provides an overview of the standard submission requirements for network deployment programs that prospective applicants should consider before preparing a proposal. This section also reviews the roles and responsibilities associated with network construction and operation to help public entities assess when coordination or a partnership between qualified local partners and either private or public Internet Service Providers (ISPs) may be in the project's best interest.

Subsection 6.2 ("Broadband deployment grant programs") then reviews the current, most applicable broadband deployment funding options available to Tehama County administered by either the CPUC or the federal government. Relevant CPUC

[106] The Last Mile Federal Funding Account, Broadband Infrastructure Account, and upcoming California Broadband Equity, Access, and Deployment (BEAD) program each consider different groups of technologies when defining "reliable" broadband at this speed. See Section 6.1 below.

opportunities include the Last Mile Federal Funding Account (FFA), Broadband Infrastructure Grant Account (BIA), and the upcoming Broadband Equity, Access, and Deployment (BEAD) Program.[107] As these three programs present the most logical future opportunities for Tehama County and its localities, this section explores approaches for maximizing each opportunity's impact. Discussion of additional federal funding programs, such as the United States Department of Agriculture (USDA) Rural Utility Service's (RUS) **ReConnect** program and the Universal Service Administrative Company's (USAC) **E-Rate Special Constructions Projects** program are included, as these opportunities may also play a role in a comprehensive solution to connect Tehama County.

However, as noted above, a grant award supporting network construction through an unconnected area is often only the first step to bringing an entire community online, and construction itself is not without its own challenges. Though a grant can help to make a project economically feasible, awardees may still need to issue debt in order to fulfill a program's matching funds requirement or, in the case of programs with a receipt reimbursement structure, supply necessary cash on-hand to support construction between award payments. As a network is constructed, individual houses may be too far from the street to be served by standard installation practices. Apartment complexes may not have sufficient in-building wiring to deliver suitable speeds to residents even if a high-speed network serves their building. Additionally, residents with limited experience online could need support learning to use the internet safely and to their benefit. Fortunately, programs offering funds to address these additional needs are increasingly common. Subsection 6.3 provides an overview of these deployment-based opportunities, while Section 8 discusses programs supporting achievement of digital equity goals.

Subsection 6.4 ("Mapping and challenge processes") will review how counties and localities can work to ensure that unserved locations are eligible for grant funding. Each of these last-mile funding programs requires that applicants rely upon broadband service availability information and maps from either the FCC or the State of California to demonstrate a given project falls within a grant program's criterion for eligible locations. However, not all locations are accurately classified as served on these maps. The county or a locality may attempt to reclassify locations to make them eligible for funding if it is able to gather sufficient evidence that those locations are not served. These challenge processes can be used to combat self-reported and overly optimistic ISP claims of service availability, reliability, or performance, particularly for service provided over aging DSL systems and wireless systems. The county or locality can implement a number of strategies that can gather this information to ensure residents connected by these subpar systems can be included in deployment planning during this unique and brief funding window.

Section 7 ("Fostering a healthy broadband deployment environment") will review how counties and localities can encourage ISPs to deploy networks to their historically underserved areas. Communities can choose to work closely with private ISPs to develop and support grant-eligible deployment projects by developing partnerships, or they may simply prefer to facilitate private investment by streamlining permitting, access to public rights-of-way, and other local administrative processes. Other states and localities across the nation have developed and adopted "Broadband-Ready Communities" policies and best practices to address local deployment policy issues, foster improved cooperation with ISPs, and potentially reduce local administrative costs as well.[108] This section will review policies and strategies that localities can adopt to improve cooperation and reduce the cost of network deployments.

[107] While NTIA administers the BEAD program at the national level, California and other states are responsible for developing and implementing programs to select subawards, who then construct networks conforming to the Infrastructure and Investment Jobs Act's statutory priorities.

[108] See, e.g., Next Century Cities, "Becoming Broadband Ready Toolkit," https://nextcenturycities.org/broadband-toolkit/, accessed September 19, 2023; Indiana Broadband Office, "Broadband Ready Communities," https://www.in.gov/indianabroadband/broadband-ready-communities-program/, accessed September 19, 2023; Georgia Department of Community Affairs, "Broadband Ready Community Designation," https://broadband.georgia.gov/general-information, accessed September 19, 2023.

6.1 Applying to a Network Deployment Funding Opportunity

Network deployment funding opportunities have become increasingly sophisticated over the past few years. Many require that applicants already have a project plan in place, with sufficient detail regarding how the network will be constructed, operated, maintained, with relevant partnership agreements already or near executed. This section provides prospective public-sector applicants an overview of necessary considerations to guide a network concept to a submission-ready project, such as:

- Developing an understanding of one's organizational capacity for network construction and operation
- Reviewing cooperation opportunities and partnership structures compatible with this capacity
- Creating and executing project plan and companion application submission plan

While preparing an application does require significant planning and effort, many programs request near-identical or similar materials. This similarity creates an advantage for well-organized applicants, who can develop a core set of materials relevant to most opportunities, reducing effort required to submit a particular application. The Appendix contains a review of the common elements of the most important funding programs, and other programs share many of these details.

While these planning requirements may occasionally seem daunting, qualified ISPs should have no problem developing these materials. Public entities should simply be aware of these requirements to ensure they can be involved when needed and help to shape certain decisions, particularly if they are contributing their own efforts and resources to project planning and deployment.

Additionally, in the event a project is not selected for funding, plans and materials can often be revised to meet another opportunities' requirements. Preparing grant applications should therefore be understood as an iterative process. Planning efforts and any coordination agreements or partnerships should be created with this flexibility in mind to minimize the burden of pivoting to future project iterations if needed.

6.1.1 Common Considerations for Deployment-Focused Funding Opportunities

Grant programs to fund network construction aim to maximize the number of households that will receive new or improved internet service. Typically, programs will limit locations eligible for funding to locations that do not receive a certain level of service, such as 25/3 Mbps or 100/20 Mbps in some instances. Many restrict the types of entities that can apply for funding or include certain ownership requirements and service obligations for the resulting network.

To improve the chances that an awarded project fulfills its intended purpose, grant programs typically require applicants to provide extensive materials demonstrating that a proposed network is well thought out, financially sustainable, and executable within a specified timeframe. Materials often include, but are not limited to, a network's high-level engineering and designs, financial projections, construction timelines, anticipated permits, and proof substantiating that an applicant has funds available to meet the program's matching funds requirement. Many opportunities also require proof that an applicant has resources to support activities between funding reimbursements, as is the case for the three California programs discussed later in this section. Funding programs also assess the financial standing of applicants and any partners to understand the risks that may come with an award, often by requesting historical and projected financial statements and

organization charts. Prospective applicants should expect to provide the following materials, at a minimum, when submitting proposals to grant programs funding network deployment:

Table 19: Standard last-mile application areas and materials

Applicant and/or partnership information	Organization charts	Historical financial statements
	Organization-wide financial projections	Partnership structure and supporting documentation (as applicable)
Proof of project necessity	Proof of project area level of service	Stakeholder letters of support
Project Budget	Detailed budgets aligned with network design	Proof of matching funds
Network Construction Plan	Network diagrams	Construction timeline
	Network routes and service area (.kmz or shapefiles)	Project and workforce plans
Network Operation	Project pro forma projections demonstrating sustainability	End customer service pricing
	Operations plan	Marketing plan

In addition to these materials, many programs require narrative descriptions of key items justifying the proposal. The majority of opportunities also require an affidavit or certification by an authorized signatory of the lead applicant to prevent frivolous applications or inaccurate claims. Further discussion of these standard application materials can be found in Appendix B.

6.1.2 Organizational Capacity and Partnership Considerations

It is no small endeavor to execute a project plan to build, own, and operate a network. Aside from the effort required to prepare an application with detailed mapping, network designs, and financial projections, the role of constructing and operating the network requires significant and ongoing commitment and resources. While public entities may be attracted to the idea of serving their communities, many may not have the organizational capacity to handle the broad range of responsibilities that come with these roles. Responsibilities commonly associated with last-mile network deployment include:

- Management of contractors and project implementation,
- Securing funds to meet program match requirements,
- Maintaining cash reserves to fund project implementation,
- Performing ongoing operations, maintenance, and upgrades,
- Attracting and retaining customers

Partnerships and cooperation strategies with the private sector and qualified public partners can help projects be realized without placing undue burden on public entities committed to serving their constituents. While such partnerships can take any form depending on each party's expertise, an increasingly common structure is that of public asset ownership with private operation. This structure can allow public entities the benefit of using the network for their internal operations, realizing revenue through leasing dark fiber stands, and the opportunity to influence end-user bandwidth and services in some circumstances through agreements with the ISP partner. On the other hand, the private partner gains new or improved access to a customer base and can easily scale up existing operations to support service provision to new end-users. Note that various elements of this model can be customized significantly and that other models that do not involve public ownership of any assets nevertheless share many considerations, making this model an excellent starting point to understand the range of possible public-private and public-public models.

■ Deployment Considerations for Public Ownership, Private Operation Partnership Model

Under this model, either the public entity or the ISP may produce high-level engineering and design and lead network construction, though ISPs typically fill this role, as most already have established relationships with contractors and vendors to purchase necessary materials and services. Either party may also hire a third-party contractor to perform some of these steps, overseeing this subcontractor's work and integrating it into the overall project. If the ISP partner oversees the design and manages construction, the public entity can still participate through asset contributions or processes that facilitate network deployment, such as access to poles, underground conduit, rights-of-way, and expedited permit approvals.[109] This arrangement places the risk of managing contractors and executing deployment within the project timeline on the ISP partner, who may be more experienced in this role.

Providing funds to meet a grant program's match requirement can fall to the private partner, the public entity, or both parties. However, these contributions can impact the relative influence each party has on project outcomes. For instance, if a public entity is providing a larger proportion of the match, it may use this leverage to influence which deployment routes and roads are chosen to be included in the project. For example, the public entity may require that the network reach additional locations that benefit the community if it provides a larger portion of matching funds. In contrast, if a private partner provides a larger portion of this match, it may not allow the public entity to retain ownership of the constructed assets. This latter option can be considered a distinct public-private partnership model, the **Public Investment in Private Infrastructure**, and still provides significant opportunity to shape the project but with less control over the infrastructure and services offered over it in the long-term.

Maintaining cash reserves on-hand to cover project implementation costs can be handled either by the private partner or public entity, though this is typically the responsibility of the party managing construction. As with the match, both parties may contribute, and the relative proportion of this contribution may give greater leverage over the project's service area and outcomes. However, risk associated with issuing debt or opportunity cost of the committing funds should be considered against the benefit this increased leverage may provide on other decisions and project design.

■ Ownership and Operations Considerations for Public Ownership, Private Operation Partnership Model

Under this model, public entities typically own underlying network assets, such as fiber and conduit, while private entities own network electronics and provide services to customers over the network. This approach is often beneficial because fiber and conduit require little upkeep and can be leased or shared with other organizations that serve the public's interest, such as fire

[109] For further discussion of broadband deployment-friendly policies localities can adopt to make their jurisdictions more attractive to private providers, see Section 7: Fostering a Healthy Broadband Deployment Environment.

stations, police stations, local utilities, or community centers.[110] In contrast to fiber and conduit, network electronics are typically upgraded every five to seven years to serve growing capacity demands, which ISPs are accustomed to anticipating. Additionally, ISPs may be more experienced in the areas of customer acquisition and retention, customer support, marketing, and billing.

■ Opportunities for Partnership Customization

While the roles described above are a common form of the public ownership, private operation partnership model, this arrangement can always be customized to fit the partners' abilities and goals. Public entities with experience managing their own utility systems may consider filling the role of customer-facing services, such as billing, service calls, and marketing. Public entities with network operations experience may feel comfortable augmenting current staff to maintain network electronics and provision end-user services themselves. Those with experience managing public works projects may consider leading project construction with existing offices and staff. Public organizations that adopt the responsibilities of ultimately owning and operating their own networks are simply referred to as public ISPs.

Conversely, some public entities may not feel suited to even own the underlying fiber and conduit and may prefer to limit their involvement in a project by not entering into any formal partnerships. Entities in this position can still have an impact on project outcomes by providing matching funds, letters of support, access to rights-of-way, or existing conduit along project routes. ISPs will be eager to collaborate with public entities, as demonstrating public support can increase a project's score for many funding opportunities, and access to public assets can reduce project costs. For example, right-of-way fees can sometimes be waived or donated, and a project can often count this contribution towards a project's matching funds requirement. Strategies and policies that contribute to this **Public Facilitation of Private Infrastructure** are discussed more at length in Section 7 and still play an important role in other partnership and coordination models as well.

■ Public-Public Partnership Strategies

Collaboration between two or more public entities can also result in successful network deployments. If another public entity (or entities) has demonstrated experience in some or all of the areas described above, then a formal partnership between the two could instead serve as the mechanism for securing the necessary resources, expertise, and capacity to carry out network deployment projects. These partnerships can form between two localities that share the goal of serving a continuous area within both jurisdictions, between a locality and a larger entity such as a county or regional economic development authority, or between a locality and a multi-region development initiative with network deployment goals, such as GSCA. Additionally, public entities who do not feel they have suitable expertise to manage a partnership with an ISP could instead seek to collaborate with a public partner with more experience in this area, who can manage this relationship on behalf of the public (or group of public) entities.

■ Navigating Application Submissions with a Partner

Preparing an application to a network deployment grant program requires effort, careful planning, and close collaboration between involved groups. The expertise required to perform high-level engineering and design, companion network designs and maps, detailed budgets, financial pro formas, and other materials often requires that project routes, partnerships, and operation details already be near-finalized at least a month before the submission deadline to leave time for preparing

[110] Public entities interested in this approach should consider whether they have the capacity to perform ongoing maintenance for fiber and conduit. If not, there should be consideration for shifting this responsibility to the ISP partner depending on the terms of the contractual agreement. Maintenance can also be performed by another third party.

narratives, collecting letters of support from stakeholders, or conducting any challenges to levels of service reported in the target project area that are believed to be overstated.

It is worthwhile to have a common understanding among partners as to the roles, responsibilities, and ownership structure for the resulting network before application preparation begins in earnest. A coordination agreement for the project (or a general agreement applicable across multiple future projects) is a common method to establish this understanding. Preparing this agreement can take significant time, as it involves legal teams from all parties working through terms and conditions related to the project. Beginning this process early is highly encouraged, as it reduces the risk that the parties will not reach an agreement before a program's submission deadline.

Another approach to allocating responsibilities between partners is to issue a Request for Proposal (RFP), dictating the respondents' obligations in the project scope itself. This method is often required to satisfy a locality's procurement rules and ensure that the best partner is chosen through a competitive process. The agreement resulting from this process can specify each partner's involvement in network deployment, ownership, and operations. While time consuming, the RFP approach will, under good conditions, provide the public entity with a range of private partners to evaluate, allowing for selection of the partner that best suits the public entity's goals.

Finally, preparing a grant application between partners, as with the network plan itself, must have clearly defined responsibilities for each party, department, or contractor involved. Close coordination is essential, as the specific requirements of each opportunity may warrant multiple iterations of materials and plans, particularly if the proposed project area is not yet finalized before the drafting of application materials begins.

6.2 Broadband Deployment Grant Programs

The range of broadband deployment funding options available over the next few years likely represents the greatest amount of public support for broadband funding that will ever be offered in California. With a developed understanding of the level of effort and expertise needed to produce a grant application for a broadband infrastructure project, localities within Tehama County interested in such opportunities should aim to stay informed of upcoming funding programs, their eligibility requirements, and target uses to plan projects and supporting activities accordingly.

6.2.1 California funding opportunities overview

Combined with California's middle mile network, the three major California grant programs will finally allow counties and localities, working in cooperation with ISPs or public partners, to address the most pressing broadband connectivity needs in their communities.

1. The **Federal Funding Account** program is providing $2 billion for broadband infrastructure, with $74,801,160 allocated specifically to projects in Tehama County. The program incorporates the $540.2 million in federal funding from ARPA's Capital Projects Fund and is currently available, with application rounds expected to open every six months. In coordination with the county, GSCA, the joint powers authority working with UTOPIA Fiber, filed a FFA application in September 2023 and requested $74,798,880 to connect 7,886 total locations to an open access last mile fiber network.

1. The **Broadband Infrastructure Account** program has been revised to complement this program, drawing from an annual funding pool of up to $150 million per year, based on annual fees collected from a surcharge on telecommunications

bills.[111] This program's application window is expected to open once a year in the spring, with the actual amount available varying based on demand.

2. The **California Broadband Equity, Access, and Deployment** (BEAD) program is expected to begin offering $1.86 billion in deployment support as early as the summer of 2024.[112] While this program's rules have not been finalized, the NTIA has placed a number of requirements on the program, including a rule that mandates all unserved locations across the state be prioritized for funding before the program can accept applications for primarily underserved locations.[113] As a result, this funding will be available to unserved locations (those without access to 25/3 Mbps service), but is unlikely to be available for underserved locations (those with access to 25/3 Mbps service but not 100/20 Mbps service).[114]

This incredible amount of funding is likely to be available over only the next few years, so counties and localities must be strategic about how they work with the GSCA and other partners to take advantage of each of these rare opportunities. The three programs' location eligibility considerations and application timing differ enough to require strategic planning. The funding programs also limit the overall grant amounts that can be requested, so no one funding program will meet all the connectivity needs of the county. As a result, each deployment project submitted to one of the grant programs should be carefully designed to:

- Comply with that grant's location eligibility requirements,
- Limit the size and cost of the project area to comply with the grant request limit, and
- Design the network's eligible service area to facilitate future expansions covered by other grants.

Generally, programs with more restrictive eligibility criteria should be used to focus on locations that can meet those restrictions, while more flexible projects should focus on areas otherwise ineligible or unlikely to be covered by more restrictive programs. The county or locality then can encourage or design each distinct project to take advantage of the strengths of the specific grant opportunity available at the time in order to best utilize the overall range of funding opportunities available to it over the next few years.

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[111] Note that this amount is to be distributed across the CASF account programs. CPUC, "Broadband Infrastructure Grant Account Program Requirements, Guidelines and Application Materials," Decision 22-11-023, Attachment 1, Updated May 25, 2023, p. A-3, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/broadband-infrastructure-grant-account---landing-page/decision-docs/d2211023attachment-1casf-guidelinesw-coverheader-lef-052523.pdf. In 2023, the CPUC is expected to award $24.9 million to 2022 Broadband Infrastructure Account grant awardees and has explained that future allocations will be based on each year's applications and funding trends from other application programs. CPUC, Decision Adopting Modifications to Broadband Public Housing Account, Broadband Adoption Account, and Rural and Urban Regional Broadband Consortia Account Program Rules; and Fiscal Year 2022-2023 Allocation of California Advanced Services Fund Budget," Rulemaking 20-08-021, Decision 22-05-029, pp. 67-68, May 19, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M479/K637/479637749.PDF.

[112] NTIA, "Biden-Harris Administration Announces More Than $1.8 Billion to California to Deploy High-Speed Internet Infrastructure," June 26, 2023, https://www.internetforall.gov/news-media/biden-harris-administration-announces-more-18-billion-california-deploy-high-speed; CPUC, "California Broadband Equity, Access, and Deployment (BEAD) Program," https://www.cpuc.ca.gov/beadprogram, accessed September 2023.

[113] The BEAD program defines an "unserved location" as any broadband-serviceable location that lacks access to reliable broadband service with a speed of at least 25/3 Mbps and latency of less than 100 milliseconds from any wireline or licensed fixed wireless provider. BEAD NOFO, p. 17. An "underserved location" is similarly defined but identifies locations with a maximum available service speed of at least 25/3 Mbps but less than 100/20 Mbps. Ibid., at 16.

[114] CPUC, State of California Five-Year Action Plan: Broadband Equity, Access, and Deployment (BEAD) Program, Final Initial Draft, July 13, 2023, p. 87, ("CA BEAD Five-Year Plan"), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M513/K977/513977116.PDF.

Table 20: Key Eligibility Considerations of California's Three Primary Last-Mile Grant Programs

Grant Program	Grant Availability Timing	Eligible Areas	Additional Location Considerations
Last-Mile Federal Funding Account (FFA)	First application cycle ended Sept. 29, 2023; each cycle expected to occur 6 months	Must lack access to 25/3 Mbps service from "reliable" wireline source	DSL and cable using DOCSIS 2.0 or below are presumed not "reliable."[115]
CASF Broadband Infrastructure Account (BIA)	Recent application cycle ended June 1, 2023[116]; expected to occur annually	Must lack access to 25/3 Mbps service from wireline or fixed wireless sources	Strong focus on low-income areas.[117]
Broadband Equity, Access, and Deployment Program (BEAD)	First application cycle expected to begin mid-2024 at the earliest; at least two application cycles expected	Likely restricted to locations that lack access to 25/3 Mbps service from "reliable" wireline or licensed fixed wireless	"Reliable" defined as "available with a high degree of certainty."[118]

■ California Federal Funding Account Program

The FFA was the first funding source to become available, which is why at least one major FFA project application has already been submitted in September of 2023 by GSCA to serve areas in Tehama County. This application proposed a last-mile deployment connecting an estimated 4,397 unserved locations. The State of California allocated $74,801,160 to Tehama County to be distributed through the FFA program, and this proposed build has requested $74,798,880. The network will provide the physical fiber connections to each home and allow residents to choose between multiple competing internet service providers to manage this connection. While routes for this initial proposed network were chosen to reach as many eligible locations as possible, they also lay a foundation to connect many more through additional projects and GSCA's own deployment plans. As a result, any other plans to cover the areas included in the GSCA's FFA proposal should wait until the CPUC makes its first-round funding decisions. They should also be made cautiously, because any other FFA proposals in the county are likely to compete with a revised GSCA submission if the project is not initially awarded. FFA-eligible locations and the GSCA application's proposed service areas are shown below.

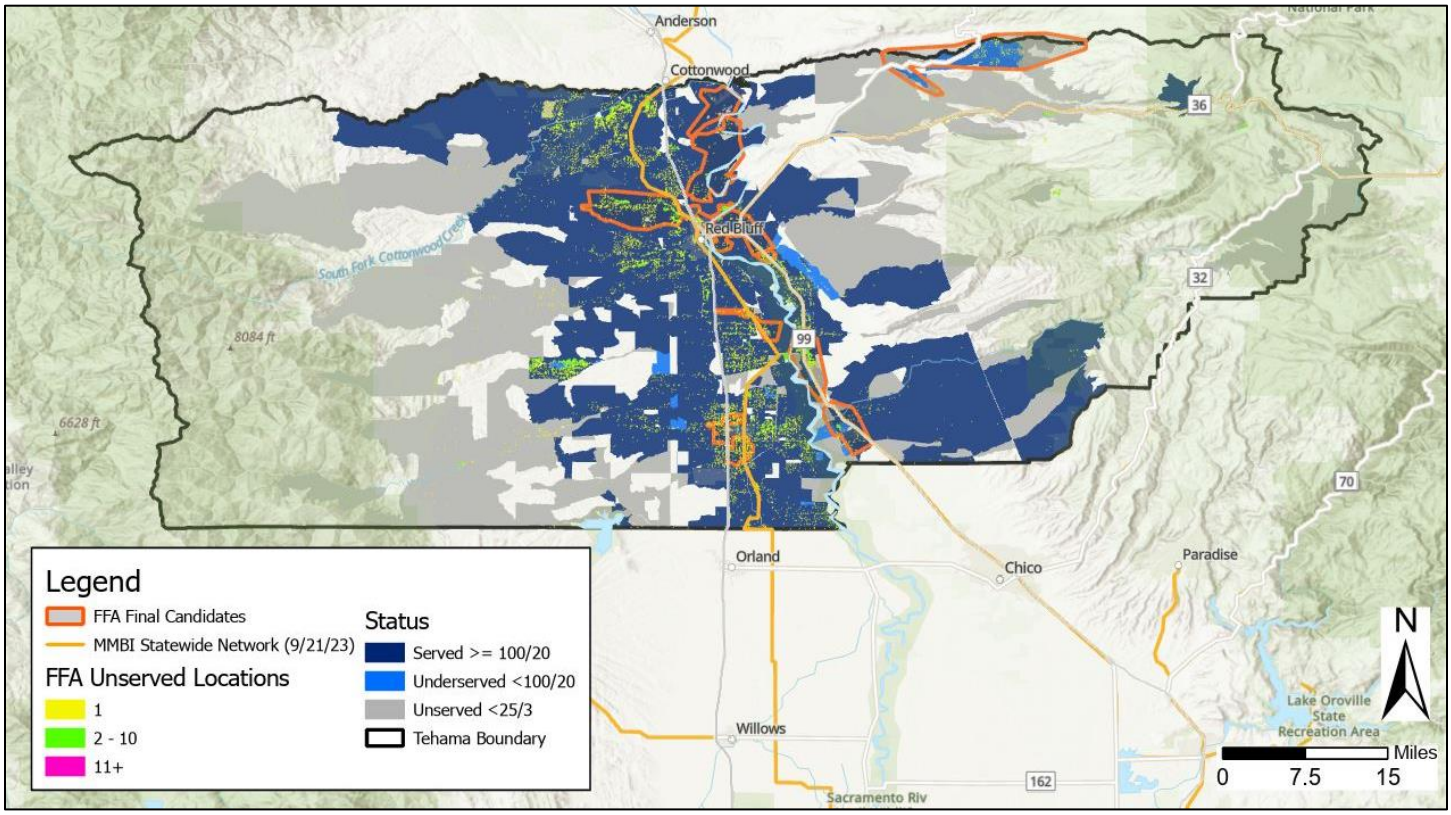
[115] CPUC, Federal Funding Account Program Rules and Guidelines, Order Instituting Rulemaking Regarding Broadband Infrastructure Deployment and to Support Service Providers in the State of California, Rulemaking 20-09-001, Decision 22-04-055, Appendix, April 21, 2022, pp. A-8, A-16, ("FFA Guidelines"), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M470/K481/470481278.PDF; CPUC, "Frequently Asked Questions(FAQs) – Federal Funding Account, Last Mile," April 2023, p. 3, https://www.cpuc.ca.gov/-/media/CPUC%20Website/Files/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Communications_-_Telecommunications_and_Broadband/FFA%20Webpage%202023-04/FFA%20FAQs%20V2.pdf.

[116] CPUC, "Second Postponement of the 2023 CASF Infrastructure Application Deadlines," April 18, 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/2023-letters/20230418-exec-dir-casf-infra-extension-deadline-letter.pdf.

[117] CASF, Broadband Infrastructure Grant Account Program Requirements, Guidelines and Application Materials, Order Instituting Rulemaking Regarding Revisions to the California Advanced Services Fund, Rulemaking 20-08-021, Decision 22-11-023, Attachment 1, p. A-10, updated May 31, 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/broadband-infrastructure-grant-account---landing-page/decision-docs/d2211023attachment-1casf-guidelinesw-coverheader053123.pdf.

[118] NTIA, Broadband Equity, Access, and Deployment Program Notice of Funding Opportunity, 15, May 12, 2022, ("BEAD NOFO"), https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf.

Figure 33: FFA-Eligible Locations, GSCA's September 2023 Submission to the Federal Funding Account Program, and BEAD-Defined Unserved and Underserved Census Blocks



The FFA Program does not require a matching funds commitment and is allocated at the county level, so applicants do not compete with other projects across the state.[119] This program is the only one of the three to classify locations served by either DSL or fixed wireless services at speeds at or above 25/3 Mbps as funding-eligible in the proposed deployment areas.[120] If an area is shown as served, but community testimonials, speed tests, and other network performance data collected suggest otherwise, CPUC may still consider the project area eligible for funding.[121] Additionally, the FFA awards additional points to projects that will serve disadvantaged communities, using demographic information provided by the CPUC and its own additional information sources.[122] As a result, this program offers the best opportunity to connect locations that would be less likely or outright ineligible to receive funding from the other programs due to levels of service reported in the area.[123] Many locations in the GSCA application took advantage of this distinction, leaving more locations eligible for the BEAD program's more stringent unserved eligibility requirement and increase the total funding pool available to the county.

[119] The Federal Funding Account program does not require a match. The program does award applicants with up to 10 points for providing up to a 50 percent match, but with applicants only competing against other project proposals within the same county, applicants do not have a strong incentive to offer matching funding for these scoring rewards.

[120] FFA FAQ, pp. 3, 5.

[121] FFA Guidelines, p. A-16.

[122] FFA Guidelines, p. A-7.

[123] However, a private ISP, without coordinating with the county or locality, can propose a relatively conservative extension of its network within the county and potentially beat out a more expansive project co-developed by another ISP and local governments.

The FFA program also puts certain location and cost limits on projects to be reviewed and approved without additional formal resolutions.[124] To receive the standard review, a project's grant request must not exceed $25 million, and the average cost per location cannot exceed $9,300 per location.[125] If the project exceeds either of these criteria, requests a waiver of one of the program requirements, or includes any locations also present in a competing FFA application, then a more detailed review and formal CPUC resolution will be required. Notably, the applicant may also include a limited number of served households in its proposed deployment area if necessary to make the project financially viable, but the CPUC has not provided a clear standard about how it will evaluate this request.[126] The GSCA project made this appeal to include served locations to ensure the network is economically viable and financially resilient.

The recent round of the CPUC's FFA grant program closed on September 29, 2023 and received 484 applications requesting more than $4.6 billion. An application was received for every county in the state. The CPUC received a total of eight applications for Tehama County, one from the Golden State Connect Authority, two from Comcast, and five from AT&T, three of which extend beyond the county's boundaries[127] At the time of this writing, applications are still being reviewed, and winners have not yet been announced. Detailed information about each application, including maps of proposed funded service areas, can be found here: https://broadbandportal.cpuc.ca.gov/s/objection-page

Table 21: Applications for Tehama County Submitted to the Federal Funding Account by September 29, 2023

Organization	Project Name	Amount Requested	Unserved Locations
AT&T	Butte – 1*	$10,000,000	2,347
AT&T	Glenn – 1*	$4,499,414	1,633
AT&T	Tehama – 1	$3,079,345	1,524
AT&T	Tehama - 1A*	$7,872,878	3,354
AT&T	Tehama - 1E	$27,825,000	2,568
Comcast	Tehama Glenn Stagecoach*	$55,333,035	3,518
Comcast	Tehama Hoag	$22,077,051	2,380
GSCA	GSCA Tehama County Broadband Network	$74,798,880	4,397

**Denotes a project that spans multiple counties*

Given the impact an award for this project would have on future network deployment efforts, further planning should wait until the CPUC announces its funding decisions. In the event GSCA does not receive an award, this project will likely require

[124] FFA Guidelines, p. A-23.

[125] FFA Guidelines, pp. A-23 to A-24.

[126] See FFA Guidelines, p. A-5, A-16. The FFA Rules reference the Treasury's Final Rule for the Coronavirus State and Local Fiscal Recovery Funds program: "Households and businesses with an identified need for additional broadband infrastructure investment do not have to be the only ones in the service area served by an eligible broadband infrastructure project. Indeed, serving these households and businesses may require a holistic approach that provides service to a wider area, for example, in order to make ongoing service of certain households or businesses within the service area economical." Ibid; 3 Department of the Treasury, Final Rule, Coronavirus State and Local Fiscal Recovery Funds, 31 C.F.R. Part 35, 87 FR 4338-4454 (January 27, 2022), https://www.federalregister.gov/documents/2022/01/27/2022-00292/coronavirus-state-and-local-fiscal-recovery-funds.

[127] California Public Utilities Commission (CPUC), Federal Funding Account Published Applications, https://broadbandportal.cpuc.ca.gov/s/objection-page, accessed November 2023.

revision if it is to be submitted to future rounds of FFA, as an awarded project within the county likely proposed to serve portions of GSCA's original project area.

■ CPUC's Broadband Infrastructure Account Program

While the California Advanced Services Fund (CASF) Broadband Infrastructure Account (BIA) is the next available funding opportunity, projects applying for this grant should be narrowly tailored to meet its more specific location eligibility and prioritization rules. Perhaps the most restrictive of the three primary last-mile funding programs, the BIA does not allow the inclusion of any location that receives at least 25/3 Mbps service from either a wireline or licensed fixed wireless ISP and does not permit any overbuilding. As with all three programs, service from satellite internet service providers, including low earth orbit providers such as Starlink, does not affect program eligibility. Compared to FFA's $2 billion in overall funding, the BIA offers substantially less funding, drawing from a funding pool of that in 2023 had $150 million shared with other CPUC programs. The location considerations are also more complex, impacting not only the eligible deployment area but the minimum match required along with the project's application score.

The program does not perform competitive scoring in the same way that most other grant programs do. Instead, it heavily prioritizes projects that will be used to connect areas with no service at all, followed by those unserved by speeds of even just 10/1 Mbps. After considering projects for these priority areas, remaining funds will be distributed according to the project area's median household income, with lower-income areas receiving preference.[128] To maximize chances of an award under BIA, projects should prioritize entirely unserved locations, followed by those without service of at least 10/1 Mbps. Project should also aim to include as many of the following match-reduction considerations as possible.

The CASF BIA program's match requirement varies between 0 and 40 percent, based on proposed project area's characteristics and current service level. Areas that are not served by a single facilities-based internet provider do not need to provide a match.[129] Otherwise, the project must provide up to 40 percent match, reduced by the income and other area considerations. Projects in low-income areas may reduce the match requirement by 40 percent.[130] Otherwise, each of the following criteria reduces the match amount required by 10 percent:

- Project will primarily rely on upgrading existing infrastructure to meet requirements,
- Project is in a "Broadband Consortium region" where more than 2 percent of locations do not yet have access to services offering at least 25/3 Mbps,
- Project's area satisfies at least three of the following criteria:
  - Is rural (as defined by U.S. Census Bureau),
  - Is an unincorporated community,

[128] CPUC, "Decision Adopting Modifications to California Advanced Services Fund Broadband Infrastructure Account, Attachment 1: Broadband Infrastructure Grant Account Program Requirements, Guidelines and Application Materials," R.20-08-021, p. A-6, November 17, 2022, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/broadband-infrastructure-grant-account---landing-page/decision-docs/d2211023attachment-1casf-guidelinesw-coverheader053123.pdf accessed Oct 18, 2023.

[129] Ibid., p. A-7.

[130] Low-income areas under this program are defined as any area where the American Community Survey (ACS) 5-year median household income is less than or equal to 80 percent of the statewide median income or Department of Housing and Community Development's list of state income limits. CASF BIA Guidelines, p. A-5. Participation in the Affordable Connectivity Plan (ACP), California LifeLine, or federal Lifeline is required to receive the full 40 percent reduction. Ibid.

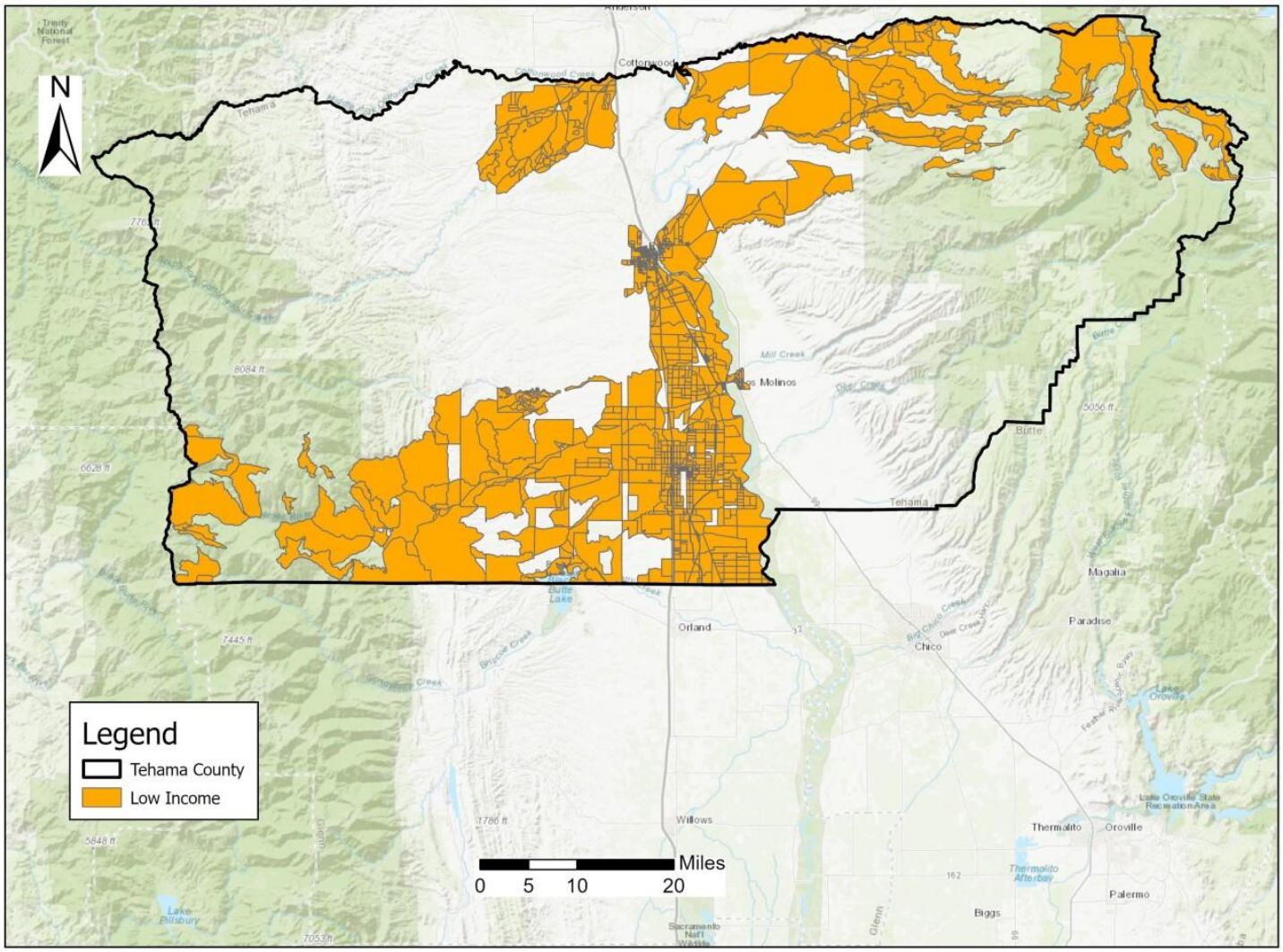
- Is an extreme or elevated fire threat area (as defined by the CPUC Fire-Threat Map),
- Is more than 10 miles away from nearest hospital,
- Is more than 10 miles away from nearest state or federal highway,
- Contains rugged or difficult terrain.

Despite available funding, BIA allows for a maximum average cost per location of up to $24,700 for projects seeking approval without a formal resolution, significantly higher than the FFA's per location maximum of $9,300.[131] These factors suggest BIA is intended to support projects in extremely unserved, hard-to-reach areas that do not anticipate network deployments under normal conditions. Given the program's emphasis on areas with extremely poor service, unique match requirement structure, and comparably high anticipated cost per location served, projects seeking funds from BIA should be designed to complement other network deployments by serving the most costly, rural, hard-to-reach locations other opportunities do not similarly prioritize.

To use this funding program effectively, a BIA-oriented project should focus on unserved locations in Census Block Groups with the lowest median incomes. These locations do not need to be contiguous; the project can identify areas as small as individual properties and combine them in one application, so long as the residents of each property are low-income households.[132] As a result, this program is a unique option for smaller project proposals that focus on expanding or upgrading existing networks to reach these economically disadvantaged areas. Low-income areas in Tehama County are shown below.

[131] CASF BIA Guidelines, p. A-31.
[132] CASF BIA Guidelines, pp. A-9 to A-10.

Figure 34: Low-income Areas for Consideration Under the Broadband Infrastructure Account Program



Tehama County has a reported 1,301 locations (4.8 percent) that do not yet receive any service meeting the 10/1 Mbps standard. Some of these hard-to-identify locations are somewhat scattered and will likely require access to the CostQuest address fabric to be identified. BIA projects can identify areas as small as individual properties and combine them in one application, so long as the residents of each property are low-income households. As a result, this program is a unique option for smaller project proposals across the county that focus on expanding or upgrading existing networks to reach economically disadvantaged areas. Localities can work with the ISPs serving nearby neighborhoods in each area to develop potential projects that could connect a number of small, non-contiguous areas to reach the lowest income unserved households prioritized by this program.

Including areas that may already receive 10/1 Mbps service but not 25/3 Mbps service, there are a few clusters in low-income census blocks that should be considered for the BIA program:

- A few clusters of unserved locations in low-income census blocks are located along Paskenta Road between the towns of Henleyville, Flournoy, and Paskenta. Access can be brought here from Corning Rd, which connects to the eponymous city where AT&T's DSL network and Comcast's cable network are located. Additionally, just southeast of this area, there may be another cluster of unserved locations on the northern side of Black Butte Lake, including the

Buckhorn Recreation Area, but this area may need to be accessed by a different fiber route, along Newville Road into Glenn County.

- Paynes Creek contains a number of unserved locations in low-income census blocks. These households are more dispersed along CA-36, including Dales to the west and a neighborhood in Ponderosa Way, to the east. A smaller concentration of unserved households is located to the south between Round Mountain and Middle Ridge. The state open-access middle mile network will run along these areas, and GSCA has submitted an FFA application to serve Manton slightly north of this area, putting it in an excellent position to consider this program.
- Further along CA-36, there are small clusters of unserved locations in low-income census blocks in the town of Mineral, extending along SR172 in the Mill Creek community, Morgan Summit Snowmobile Park, and further along in Deer Creek-St. Bernard. The state middle mile network extends through these communities and into Plumas County, so GSCA could propose to connect these areas, or alternatively, Frontier can look to replace its DSL service in Mineral by extending its existing fiber on the other side of the border in Stover Mountain.

The Broadband Equity, Access, and Deployment Program

The BEAD program will not be available until mid-2024 at the earliest.[133] The state's program rules have not been finalized yet, but the NTIA has required that states comply with a number of requirements that enable counties, localities, and ISPs to integrate the funding opportunity into their overall deployment strategies. The CPUC must ensure that BEAD funding is prioritized to cover all locations lacking 25/3 Mbps service from either a wireline or licensed fixed wireless ISPs (the BEAD program's definition of an "unserved" location) before funds can be used to connect "underserved" locations (locations that lack access to 100/20 Mbps service but receive 25/3 Mbps service). Unfortunately, the CPUC does not expect the amount of available funding to connect all unserved locations,[134] so Tehama County and interested partners should use BEAD funding to connect locations unserved by 25/3 Mbps that are not included in FFA-funded projects. The program is also likely to allow applicants to include a portion of served locations within their project applications, so long as these account for fewer than 20 percent of the project's total proposed locations.[135]

However, BEAD program's more lenient project area considerations come with a tradeoff. Applicants are generally expected to cover at least 25 percent of the project's total costs, and the program's scoring system is likely to favor both higher match amounts and lower average proposed costs per passing.[136] The NTIA has allowed for the possibility that projects in high-cost areas may be allowed to submit a lower matching amount or no matching amount at all. These areas are shown further below. The NTIA has also invited the CPUC to request a match reduction or waiver from the NTIA if a particular project demonstrates that "a match requirement could deter participation in the BEAD Program by small and non-traditional providers, in marginalized or low-income communities, or could threaten affordability (i.e., if an applicant must offset the cost of a substantial match through higher end user prices)."[137]

Fortunately, the BEAD program does provide some flexible ways to satisfy the match requirement. Funding from a number of other federal funding programs can be used as a matching contribution if the applicant is able to obtain them,[138] and

[133] CPUC, "California Broadband Equity, Access, and Deployment (BEAD) Program," https://www.cpuc.ca.gov/beadprogram, accessed September 2023.

[134] CPUC, State of California Five-Year Action Plan: Broadband Equity, Access, and Deployment (BEAD) Program, Final Initial Draft, July 13, 2023, p. 87, ("CA BEAD Five-Year Plan"), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M513/K977/513977116.PDF.

[135] BEAD NOFO.

[136] NTIA and U.S. Department of Commerce, "Broadband Equity, Access, and Deployment (BEAD) Program: Initial Proposal Guidance," pp. 40-41, July 2023, ("BEAD Initial Proposal Guidance"), https://broadbandusa.ntia.doc.gov/sites/default/files/2023-07/BEAD_Initial_Proposal_Guidance_Volumes_I_II.pdf; BEAD NOFO, pp. 20-21, 42-43.

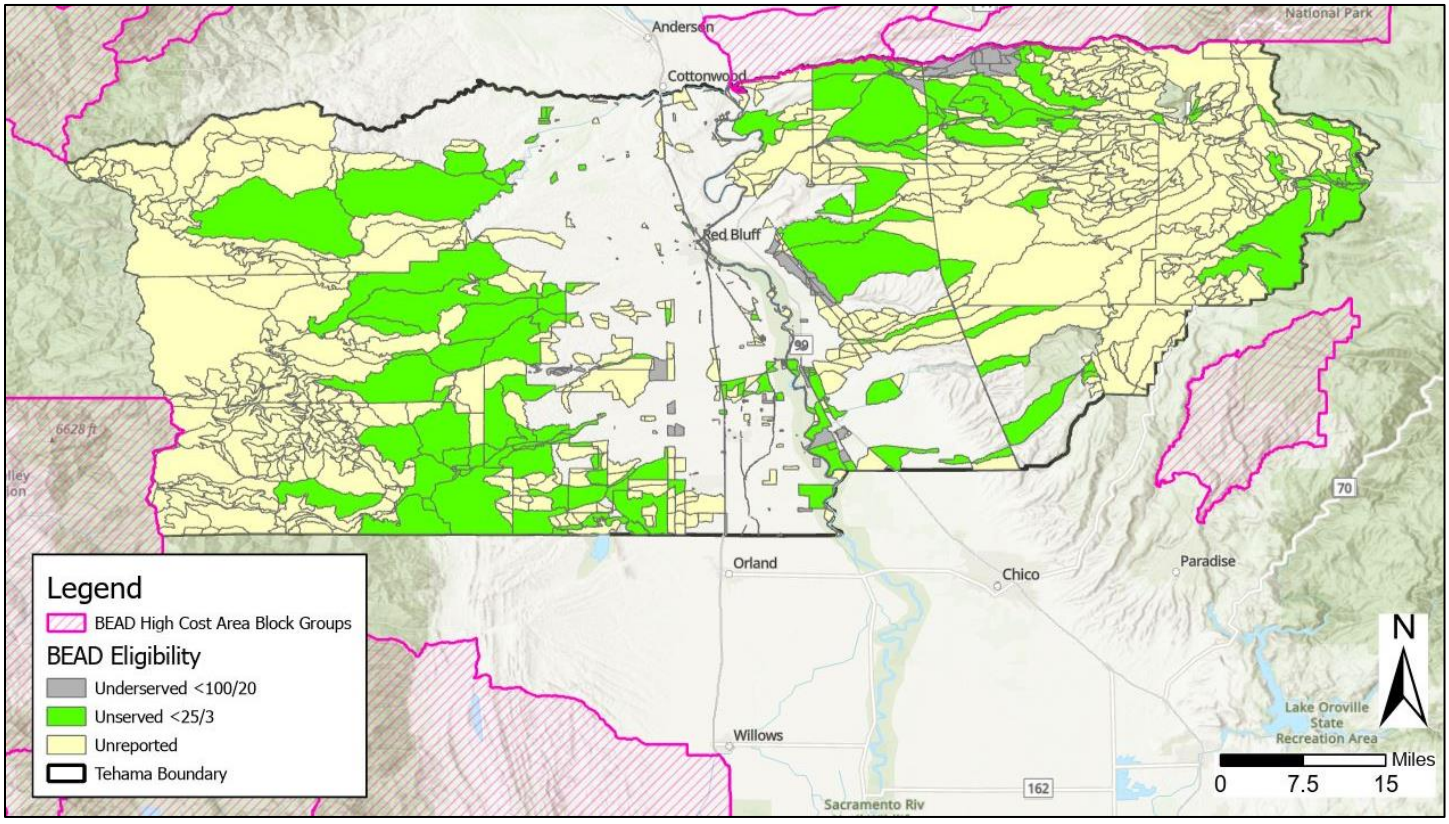
[137] BEAD NOFO, p. 20.

[138] BEAD NOFO, pp. 20-21.

California's Loan Loss Reserve Fund (discussed below) can be used by eligible organizations to help to obtain loans or other financing that could cover the matching requirement. NTIA's rules would allow applicants to offer in-kind contributions as match, such as employee service contributions, equipment, computer hardware and software, and waived fees or other valuable access rights related to rights-of-way, pole attachments, conduits, easements, or access to other types of infrastructure, if the CPUC chooses to allow that in the state's BEAD program.[139]

The BEAD Program's first application round will not begin until mid-2024 at the earliest.[140] By this time, the first and likely second rounds of the FFA program will have already established deployment commitments to a significant portion of unserved locations close to existing networks. As a result, project plans designed for the BEAD program should consider how these earlier funding opportunities are likely to extend the reach of FFA- and BIA-funded networks deeper into unserved areas and provide deployment opportunities to more remote locations. Maximizing funding under these programs will require careful planning, as many areas eligible for BEAD funding are also eligible for FFA and BIA. The figure below shows the areas in Tehama County that are currently eligible for BEAD funding, before additional deployment commitments are likely to revise this map.

Figure 35: Areas in Tehama County Likely Eligible under the BEAD Program



Fewer locations are anticipated to be eligible under BEAD than are eligible under FFA, which considers locations receiving 25/3 Mbps or above to be eligible if service is provided over DSL or fixed wireless. The BEAD program will not likely consider locations receiving 25/3 Mbps or above as unserved, regardless of the technology providing this service (aside from unlicensed fixed wireless or satellite). There are also blocks depicted that do not have BEAD data reported but could possibly

[139] BEAD NOFO, p. 22.

[140] CPUC, "California Broadband Equity, Access, and Deployment (BEAD) Program," https://www.cpuc.ca.gov/beadprogram, accessed September 2023.

contain eligible BSLs. Localities should recognize that the FFA offers better opportunities to connect or upgrade the services to locations currently receiving DSL or fixed wireless service, while BEAD funds can be used to expand networks in areas including some addresses known to be served, given the more lenient overbuild allowances.

A significant portion of BEAD-defined unserved locations are likely to be scattered in partially served census blocks, but there are a few clusters worth highlighting.

- All of the areas suggested for BIA consideration above should also be considered for the BEAD program. Comcast and AT&T should consider serving the unserved locations around Henleyville, Flournoy, and Paskenta, although Comcast is unlikely to be willing to deploy fiber as currently required by the BEAD program. The GSCA and other ISPs should consider the Paynes Creek and Mineral areas as well.
- A few unserved areas exist on both sides of the county where the Sacramento Valley grades to the mountains. In the west, about 20 miles northwest of Red Bluff, there are unserved locations clustered along State Route CA-36 at Baker Fire Station, then more scattered about 10 miles west. The closest available service is licensed fixed wireless from GeoLinks, but a bit closer to the interstate, AT&T DSL's network is nearby and connects to their fiber offering further north in Shasta, which could enable them to submit BEAD applications to bring this infrastructure to the north portion of the county and extend wireline service to these locations. GSCA has a committed FFA application between this area and Red Bluff, so if they are successful, they will also have a close enough fiber presence to connect these passings.
- Further south, unserved locations are clustered in the main clearing of Red Bank. Multiple locations are scattered throughout the mountains, following Coyler Springs Rd, then extend into Lowery and disperse again in Brushy Mountain. Ducor Telephone Company has available DSL service near Gleason Peak, but GSCA's proposed project area is equally nearby and would have better access to main roadways leading to these neighborhoods.

While the CPUC does not expect to have enough funding to support connectivity to all unserved locations,[141] there is a small chance that underserved locations may become available in a later funding round. The NTIA has recently released information about the areas that are considered "high cost," allowing projects covering them to offer a lower matching amount than the typical 25 percent requirement. The CPUC is yet to define the program's "Extremely High Cost Per Location Threshold," which requires the CPUC to identify the amount of subsidy needed per location that is so high, fiber deployments to that location should not be required.[142] Instead, areas with a funding need above this threshold become eligible for certain fixed wireless or satellite-based projects, provided they meet certain performance standards.[143] If the CPUC sets this value at a sufficiently low amount, a larger number of the California's most expensive unserved locations could be connected by these significantly less expensive technologies, which may free up enough funding to consider underserved locations.[144] CostQuest, the CPUC's mapping partner, estimated the following relationship between the number locations per square mile and the average cost per location.

[141] CA BEAD Five-Year Plan, p. 87.

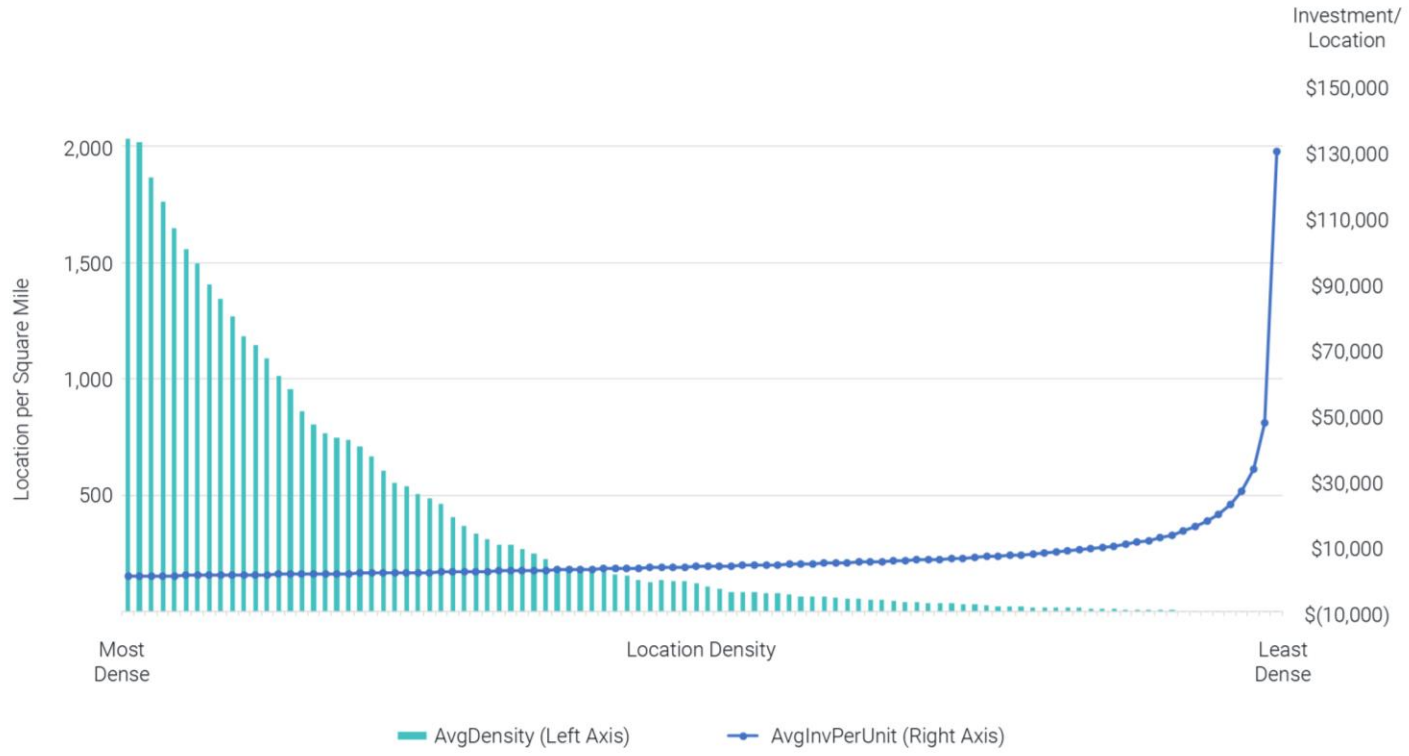
[142] BEAD NOFO

, p. 13. Notably, the CPUC has set the upper limit for the Broadband Infrastructure Account's average cost per location at $24,500, may hint at the eventual threshold it will choose. See CPUC, California Advanced Services Fund, Order Instituting Rulemaking Regarding Revisions, Decision 22-11-023, November 17, 2022, p. 38.

[143] See BEAD NOFO, pp. 13, 38-39.

[144] For example, in the 5-Year Action Plan, the CPUC expects the most expensive 12 percent of unserved and underserved locations across the state to cost an average of $40,000 per location, representing roughly half of the $9 billion in estimated total investment needed to connect the state. If the CPUC were to identify the Extremely High Cost Per Location Threshold as the cost per location that would separate the top 12 percent of locations from the other 88 percent, then the total cost for all location below this threshold would be $4.84 billion. If those 12 percent of locations could be connected via wireless systems for a fraction of the cost, the combined $3.86 billion between the FFA and the BEAD programs would likely be enough to connect all unserved locations, leaving some funding for underserved locations.

Figure 36: CostQuest Estimate of Investment Required Per Unserved Location by Location Density[145]



The CPUC estimates that the average cost to connect all but the 12 percent most costly locations to fiber-to-the-premises services to be approximately $5,700 per location,[146] requiring an estimated $4.84 billion in combined grant funding and industry investment.[147] In contrast, the most expensive 12 percent of locations would cost an average of $42,600 per location. This relationship between location density and cost per location is useful to understand which locations are likely to receive special consideration for fixed wireless deployments as well.

6.2.2 Federal Programs with Broadband Deployment Funding Options

Though the CPUC's Federal Funding Account, Broadband Infrastructure Account, and the California Broadband, Equity, Access, and Deployment program may offer the most compelling opportunities for network expansion in Tehama County, additional federal funding programs administered by the United States Department of Agriculture (USDA) and Universal Services Administrative Company (USAC) may also contribute to a comprehensive solution for local communities.

In 2021, the Infrastructure Investment and Jobs Act (IIJA) allocated $635 million to the USDA Rural Utility Service's (RUS) **ReConnect Program,** which offers several grant and/or loan-based funding options to support broadband deployments

[145] CostQuest Associates, California Broadband Investment Model Last Mile Funding Analysis, p. 15, April 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/broadband-implementation-for-california/ffa-webpages/ca-broadband-investment-model_04212023.pdf.

[146] CA BEAD Five-Year Plan, p. 87.

[147] CA BEAD Five-Year Plan, p. 87.

capable of at least 100/100 Mbps in rural areas.[148] The program is very competitive, so potential applicants should be very selective about how they choose their proposed deployment areas to achieve higher competitive application scores. The application process awards points for the proposed area's level of rurality, economic needs of the community, and the relative affordability of their low-cost broadband service options.[149] Additional scoring priority is given to local governments, non-profits and cooperatives, and Tribal Organizations.[150]

The program also adjusts the matching requirements and maximum allowed funding request to fit the proposed service location's characteristics.[151] If at least 90 percent of households in the proposed deployment area do not receive services at speeds of at least 25/3 Mbps, then the applicant can request the "90% unserved" option, which will avoid the standard 25 percent minimum matching requirement.

Otherwise, only 50 percent of the households in the proposed area need to be unserved at this speed, allowing applicants to construct a significant portion of their funded networks in already served areas.[152] Some areas meeting this criterion may nevertheless qualify to avoid the matching requirement as well. Special Area Grants are available for projects in persistent poverty areas, socially vulnerable communities, and Tribal Lands and do not require matching funds.[153] Table 21 provides a summary of these variations of the ReConnect program.

Table 22: USDA RUS ReConnect Program Funding Options

Funding Category*	Funding Type	Match	Maximum Request	Total Available***
More than 90% unserved	Grant	0%	$25,000,000	$200,000,000
Special Area Grant	Grant	0%	$25,000,000**	$350,000,000
Normal Area Grant	Grant	25%	$25,000,000**	$150,000,000
50%/50% Grant and Loan	Mixed	0%	$50,000,000	$150,000,000
100% Loan	Loan	0%	$50,000,000	$50,000,000

[148] Rural areas under this program are defined as areas that are "not located within:

a city, town, or incorporated area with a population of more than 20,000 inhabitants; or

an urbanized area contiguous and adjacent to a city or town that has a population of greater than 50,000 inhabitants as defined in the Agency Mapping Tool."

USDA Rural Utilities Service (RUS), "Rural E-Connectivity Program Application Guide for Fiscal Year 2022," pp. 6, 12-13, September 6, 2022, ("ReConnect Application Guide"), https://www.rd.usda.gov/files/ReConnect_Program_Application_Guide.pdf.

[149] Projects proposing PFSAs with population densities of 6 persons or less, or PFSAs located 100 miles from a city or town that has a population greater than 50,000 inhabitants will be awarded 25 points. ReConnect Application Guide, p. 23. Economic need is determined by evaluating the proposed area's county poverty percentage, using the United States Census Small Area Income and Poverty Estimates (SAIPE) integrated into the program's application mapping tool. Ibid.

[150] ReConnect Application Guide, pp. 24-25.

[151] The matching funds must be secured before the award can be fully accepted. ReConnect Application Guide, pp. 12, 26.

[152] ReConnect Application Guide, p. 13. Locations receiving service at or above 25/3 Mbps that were already supported by the RUS are not eligible. Ibid, at 13-14.

[153] To qualify for this funding category, a California project can qualify in three relevant ways:

At least 75 percent of the deployment area covers Persistent Poverty Counties, "defined as any county with 20 percent or more of its population living in poverty over the past 30 years" according to the ACS and the 1990 and 2000 decennial censuses;

The deployment area is a Socially Vulnerable Community, with a score of 0.75 or higher on the Center for Disease Control's Social Vulnerability Index;

The deployment area is on Tribal Lands, lands held in trust for Native Americans, protected Indiana Lands, or lands owned by a Tribal Government, and the Tribal Government is proposing to provide services. ReConnect Application Guide, p. 8.

*The ReConnect program refers to the normal area grant as the "100% Grant" category, but this description is somewhat misleading, because it suggests there is no match element. **This amount increases to $35,000,000 if the entire proposed deployment area is FAR Level 4. ***These amounts reflect the total amount available before the ReConnect – Round 4 funding cycle and are suggestive of the likely amounts and distribution of funding for future ReConnect funding cycles.[154]

Normal area grants are available for all other areas that do not meet the special area or 90 percent unserved requirements and require at least a 25 percent matching contribution. An applicant may also apply for the 50%/50% Loan and Grant or 100% Loan options, which offer a very low interest rates and a substantially larger maximum request.[155] The 100% Loan option can be used to acquire matching funding to most of the grant funding options offered by California. These options are less competitive, with the latter also reducing or removing several application requirements to encourage its use. Unlike the ReConnect grant programs, the 100% loan option is a "first come, first served" program, so applicants that act early in the cycle stand a better chance at success.

The ReConnect grant application process is among the most challenging, with a complex portal that requires manual entry of most GIS, budget, and financial information. Applicants must demonstrate the project's financial feasibility and sustainability by submitting detailed information about the services available in the area, the menu of ISP service offerings, expected adoption patterns, and all balance sheet information for the past five and next five years.[156] Thankfully, some pre-application costs, including expenses necessary to develop the project's network design, financial projections, and other application preparation efforts, are eligible for reimbursement if the applicant is successful.[157] Note that the ReConnect program has tended to update its rules for each funding round, so some of these details may change for ReConnect Round 5, which is expected to open in the fall of 2023.[158]

The USDA's **Community Connect Grant Program** offers up to $5 million to deploy broadband networks capable of at least 100/20 Mbps to a single, contiguous rural area that currently lacks access to fixed 25/3 Mbps service, provided that the project also include the improvement, expansion, construction, or acquisition of at least one community center that provide broadband accessibility to the public.[159] The cash matching requirement is only 15 percent, which makes it an appealing option for applicants without substantial financing resources.[160] The program's most recent funding cycle ended on June 20, 2023,[161] but the program is expected to be offered again in the future.

The program requires that the proposed project include at least 2 new computer access points and wireless access at the community center, which also must receive at least 2 years of free broadband service.[162] The program is more likely to select programs that demonstrate strong local community support, public safety connectivity needs, and the area's educational and health care challenges, particularly as they relate to distance learning and telehealth. The application also considers the

[154] "FAR Level 4 areas consist of rural areas that are—15 minutes or more from an urban area of 2,500-9,999 people; 30 minutes or more from an urban area of 10,000-24,999 people; 45 minutes or more from an urban area of 25,000-49,999 people; and 60 minutes or more from an urban area of 50,000 or more people." ReConnect Application Guide, p. 7.

[155] The loan program's interest rate is set at 2 percent, while the 50/50 Grant and Loan option's interest rate is set at the equivalent interest rate for U.S. Treasury securities. ReConnect Application Guide, pp. 8, 10.

[156] ReConnect Application Guide, p. 12.

[157] ReConnect Application Guide, pp. 14-15.

[158] See ReConnect Application Guide, p. 28.

[159] USDA RUS, "Community Connect Grant Program Application Guide-FY 2023," pp. 5, 7, 12, Match 20, 2023, ("Community Connect Application Guide"), https://www.rd.usda.gov/media/file/download/ccapplicationguidefy23.pdf.

[160] Community Connect Application Guide, pp. 12-13.

[161] Community Connect Application Guide, p. 4.

[162] Community Connect Application Guide, p. 10.

proposed deployment area's economic challenges, including low household income, unemployment data, and employment by sector, to better understand the deployment's potential economic impact.[163]

E-Rate Special Construction Projects: USAC allows eligible entities, such as schools and libraries to request funding from the E-Rate program to develop special construction projects that will deploy fiber connecting them to middle mile networks.[164] Eligible E-Rate entities can use the standard E-Rate procurement process (an RFP along with a form 470 posting) to choose a provider of Leased Lit Fiber, Leased Dark Fiber or Purchased "Self-Provisioning Fiber.[165] If an E-Rate-eligible entity positions the procurement correctly, an E-Rate-eligible service provider (a service provider with a SPIN/498 ID)[166] can also utilize additional fiber installed during the construction process to provide service to the community or communities in the vicinity.[167]

These projects can be combined with other deployments to reduce the overall cost of construction by taking advantage of "dig once" opportunities, reducing the cost of trenching incurred by the ISP or other parties. Eligible CAIs that do not yet receive symmetrical 1 Gbps services should strongly consider this option. Potential projects must show that the chosen special construction strategy will cost less over the life cycle of the proposed infrastructure than other options.

Figure 37: E-Rate special construction options and eligible costs[168]

Leased Lit Fiber	Leased Dark Fiber	Self-Provisioned Networks
■ Monthly recurring charges ■ Basic installation charges ■ Special construction charges ■ Network equipment	■ Recurring dark fiber lease or indefensible rights of use (IRU) payments ■ Maintenance and operations (M&O) charges ■ Basic installation charges ■ Special construction charges ■ Network equipment	■ Maintenance and operations (M&O) charges ■ Special construction charges ■ Network equipment

[163] Community Connect Application Guide, p. 23.

[164] Universal Service Administrative Company, "Fiber – Summary Overview," https://www.usac.org/e-rate/applicant-process/before-you-begin/fiber-summary-overview/, accessed September 2023.

[165] "Dark Fiber, Self-Provisioning Fiber and Special Construction," USAC, included in Pennsylvania E-rate Coordinator's cultivated ListServ, October 4, 2021, http://e-ratepa.org/wp-content/uploads/2020/10/4-4-Fiber-Eligibility-2021.pdf, accessed November 2023.

[166] USCA, "Obtain a Service Provider Identification Number (SPIN)," https://www.usac.org/e-rate/service-providers/step-1-obtain-a-spin/, accessed November 2023.

[167] FCC, Modernizing the E-rate Program for Schools and Libraries, WC Docket No. 13-184, Second Report and Order and Order on Reconsideration, December 19, 2014,

https://docs.fcc.gov/public/attachments/FCC-14-189A1.pdf

[168] Ibid.

6.1 Funding Opportunities that Complement Deployment Projects

A grant award supporting network construction is often one of many necessary steps to connecting a community. As deployment programs become increasingly common, companion programs that help awardees secure necessary financing or extend a network to individual, hard-to-reach locations have become available to remedy these potential hurdles.

6.3.1 Financing Programs

A few programs expand the range of financing strategies available to applicants of other projects, helping them to satisfy match requirements or reduce interest-related costs. The CPUC's **California Loan Loss Reserve Fund** will provide eligible organizations, including non-profits, electrical cooperatives, local and county governments, joint powers authorities, and other local or regional public entities, with the ability to obtain credit rating enhancements and provide support for timely debt payments.[169] This program has a total of $750 million to enable local governments and nonprofits to secure financing for broadband infrastructure.

The program prioritizes projects that will construct last-mile service that have received an award from another state or federal funding program. To assess the credit enhancement needed, the CPUC will rely on financial projections produced by either a third-party accredited municipal advisor or assessments from a credit rating agency.[170] To be eligible for this credit enhancement, projects must be completed in 36 months, and the resulting network must also be capable of delivering 100/100 Mbps to end-users, or 100/20 Mbps where the prior requirement is not feasible due to physical limitations, as is consistent with other last-mile funding opportunities administered by the CPUC.[171] While projects executed by public-private partnerships can receive support under the Loan Loss Reserve Fund, the resulting network must be owned by the public or non-profit partner to be eligible.[172]

A few federal programs, such as the USDA's **ReConnect** program (discussed above), offer loans with very low interest rates to construct broadband in eligible areas.[173] These loans can sometimes be used as matching funding in conjunction with another last-mile program, such as the upcoming BEAD program.[174] Under another program, the **OneRD Guarantee Loan Initiative** (formerly the "Business and Industry (B&I) Guaranteed Loan Program), the USDA can guarantee loans to a variety of organizational types to support broadband deployments in USDA-defined rural areas.[175] This program accepts applications year-round.[176] Additionally, the Treasury Department's **New Market Tax Credit** program encourages the creation of

[169] CPUC, "Broadband Loan Loss Reserve Fund Program Guidelines – Revised Staff Proposal," p. 10, June 21, 2023, ("Loan Loss Reserve Fund Guidelines Proposal"), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M511/K719/511719252.PDF; https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-implementation-for-california/loan-loss-reserve-fund.

[170] CPUC, "Broadband Loan Loss Reserve Fund Program Guidelines," p. 4, September 28, 2023, ("Loan Loss Reserve Fund Guidelines"), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M520/K495/520495866.PDF.

[171] Ibid., p. 6.

[172] Ibid., p. 11.

[173] CPUC, "Loan Loss Reserve Fund," https://www.usda.gov/reconnect/program-overview, accessed September 2023.

[174] BEAD NOFO, p. 21.

[175] This program defines a rural area as "Rural areas not in a city or town with a population of more than 50,000 inhabitants." USDA RUS, "Business & Industry Loan Guarantees," https://www.rd.usda.gov/programs-services/business-programs/business-industry-loan-guarantees#overview, accessed September 2023.

[176] Ibid.

Community Development Entities that can offer investors to receive tax credits in exchange for capital necessary for local projects operating in low-income communities.[177]

6.3.2 Wiring to/through Buildings

A majority of locations still unserved by fiber or cable technologies tend to be located several blocks or even miles away from the nearest fiber infrastructure. To become served, these locations need new fiber networks to be constructed along their roads, connecting the households that run along these streets. However, in some instances, these street-level "passings" are not enough. Some buildings remain unserved because they are far away from the wireline infrastructure that runs along the nearest street. To solve this "long drop" problem, the ISP or the building owner would have to spend thousands of dollars to deploy a line connecting the building to the network.

The State of California has developed the innovative **CASF Line Extension Program** to deal with this problem for low-income Californians. The program will provide up to $9,300 per qualified unserved household to connect the location to a nearby wireline network, and up to $500 for fixed wireless equipment and installation.[178] Households must demonstrate that they are enrolled in the California LifeLine or CARE Programs or may demonstrate that they otherwise meet the qualifying low-income threshold.[179] Notably, residents themselves can apply for this funding, or an ISP can apply on behalf of the household. Applications are accepted on an ongoing basis, allowing Californians to seek funding to connect their homes as soon as the need and presence of a nearby network are identified.

Publicly supported housing that suffers from poor, unreliable, or outdated wiring inside buildings will be eligible for the **CASF Broadband Public Housing Account Program**, which provides funding for the network engineering and designs, networking equipment, and labor necessary to install modern broadband equipment capable of supporting all units in the building.[180] This opportunity will reimburse up to 100 percent of costs associated with eligible rewiring projects.[181] As an added benefit, the ISP receiving the funding must offer free broadband service to residents.

6.2 Mapping and Challenge Processes

California's last-mile deployment grant programs discussed above rely on a combination of the FCC's new National Broadband Map and their own broadband mapping efforts to determine which locations are eligible for their programs. Both of these mapping programs have improved upon the earlier broadband availability mapping methods used throughout the 2010s. The FCC's prior mapping effort, the Form 477 broadband information program, identified only the speed ranges of advertised internet services available on each census block. An ISP could claim that an entire census block was served if it

[177] U.S. Department of the Treasury –Community Development Financial Institutions Fund, "New Market Tax Credits Program," https://www.cdfifund.gov/programs-training/programs/new-markets-tax-credit, accessed September 2023.

[178] CPUC, "CASF Broadband Infrastructure Grant Account –Line Extension Program Pilot Application Requirements and Guidelines," p. 2, April 2019, ("CPUC Line Extension Program Guidelines"), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/line-extension-program/lep-rules-appendix-extracted-from-d1904022.pdf.

[179] Ibid.

[180] CPUC, "Broadband Public Housing Account Revised Application Requirements and Guidelines," pp. 1-5, May 24, 2022, ("Broadband Public Housing Account Guidelines"), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-adoption-and-access/bpha/bpha-guidelines.pdf.

[181] Ibid.

could provide service to a single location within that block,[182] so unserved locations in partially served census blocks could not be identified for inclusion in grant programs.

Since mid-2022, the FCC's new Broadband Data Collection program has required ISPs to provide address-by-address service availability information twice a year. For each "broadband serviceable location" (BSL), ISPs provide information about the type of internet technology offered, the maximum advertised download and upload speeds available, and whether residential or business services are offered at the location.[183] California has aligned its service reporting requirements with this program, requesting that facilities-based ISPs submit this information to the CPUC directly.[184] The CPUC also requires that ISPs submit subscriber data as well,[185] which is used to provide additional validation that service is available at a location.

While the location-based information is a significant improvement over prior efforts, these two updated map programs still rely on ISP self-reports, which can be problematic. ISPs sometimes mischaracterize the services they provide to a location or even an entire area,[186] with a few ISP mischaracterizations even being explicitly attributed to restricting competitors' grant-based deployment efforts.[187] As a result, the two mapping programs have created opportunities to allow ISPs, localities, and sometimes other interested parties to submit mapping "challenges." Once filed, the ISP whose service claim is challenged is able to submit additional evidence to validate its original submission. The map's administrator, either the CPUC or the FCC, will then evaluate the competing claims, sometimes send out engineers to inspect the situation directly, and make a determination about the actual level of service.

While at least a few instances of mischaracterized services seem to result from anticompetitive intent, other mischaracterizations are more benign and harder to identify systematically. DSL-based service mischaracterizations are often the result of assuming that older copper-based telephone networks can still deliver consistent performance over aging infrastructure. Some ISPs have begun to remedy this issue by beginning to phase out their DSL services,[188] while others leave existing DSL customers with potentially unreliable service.

Fixed wireless services are similarly problematic. FCC requires that fixed wireless companies use wireless propagation modelling to ensure that their coverage claims reasonably match the potential reach of the technologies and frequencies used, but these methods do not necessarily account for all obstructions and issues that can hinder service availability or

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[182] ISPs could report connectivity to a census block if they could provide services to at least one household within that census tract "without an extraordinary commitment of resources" "within a service interval that is typical for that type of connection." FCC, "FCC Form 477 Local Telephone Competition and Broadband Reporting," December 6, 2016, p. 17, https://transition.fcc.gov/form477/477inst.pdf.

[183] FCC, "Data Specifications for Biannual Submission of Subscription, Availability, and Supporting Data," November 10, 2022, pp. 20-22.

[184] CPUC, "Broadband Data Submission Guidelines and Templates," https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-mapping-program/broadband-data-submission-guidelines-and-templates, accessed September 2023; CPUC, "Data Format for Fixed Broadband Deployment by Address," revised January 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/casf-infrastructure-and-market-analysis/broadband-data-collection-documents-and-templates/data-format-for-fixed-broadband-deployment-by-address-2023.pdf.

[185] CPUC, "Data Format for Fixed Broadband Deployment by Address."

[186] E.g., Jon Brodkin, "AT&T Gave FCC False Broadband-Coverage Data in Parts of 20 States," *Ars Technica*, April 17, 2020, https://arstechnica.com/tech-policy/2020/04/att-gave-fcc-false-broadband-coverage-data-in-parts-of-20-states/; Jon Brodkin, "After Defending False Data, Comcast Admits Another FCC Broadband Map Mistake," *Ars Technica*, February 23, 2023, https://arstechnica.com/tech-policy/2023/02/comcast-could-have-avoided-giving-false-map-data-to-fcc-by-checking-its-own-website/; Federal Trade Commission, "FTC Takes Action Against Frontier for Lying about Internet Speeds and Ripping Off Customers Who Paid High-Speed Prices for Slow Service," May 5, 2022, https://www.ftc.gov/news-events/news/press-releases/2022/05/ftc-takes-action-against-frontier-lying-about-internet-speeds-ripping-customers-who-paid-high-speed.

[187] Jon Brodkin, "ISP Admits Lying to FCC about Size of Network to Block Funding to Rivals," *Ars Technica*, February 2, 2023, https://arstechnica.com/tech-policy/2023/02/cable-company-tries-to-block-grants-to-rivals-by-lying-about-coverage-area/; Jon Brodkin, "Cable Company's Accidental Email to Rival Discusses Plan to Block Competition," *Ars Technica*, November 17, 2022, https://arstechnica.com/tech-policy/2022/11/cable-companys-accidental-email-to-rival-discusses-plan-to-block-competition/.

[188] E.g., Rob Pegoraro, "AT&T Shelving DSL May Leave Hundreds of Thousands Hanging by a Phone Line," *USA Today*, October 3, 2020, https://www.usatoday.com/story/tech/columnist/2020/10/03/att-dsl-internet-digital-subscriber-line-outdated/5880219002/; Farah Javed, "Verizon's Aging Copper Lines Leave Customers Hung Up With Frustration," *The City*, February 4, 2022, https://www.thecity.nyc/2022/2/3/22915176/verizon-copper-lines-customers-frustration.

reliability. In many otherwise unserved areas, mobile internet service providers can now claim that 5G and 4G-LTE-based fixed wireless services can provide reliable broadband with speeds of at least 25/3 Mbps, further complicating matters. Fixed wireless services are often even more difficult to challenge, because there is no physical infrastructure outside of each location for engineers to evaluate, removing one of the most effective challenge strategies available against wireline ISPs.

County and local governments must work with members of their communities and interested ISPs to understand the patterns of ISP service mischaracterizations and develop challenges to ensure that unserved and underserved locations in Tehama County can be identified and reclassified as eligible for the major influx of broadband funding over the next few years. This section will review the types of challenges, how they relate to the main funding programs, and what counties and localities can do to develop crowd-sourced information that can be used to submit challenges.

6.4.1 Overview of Challenge Processes

The FFA, BEAD program, and federal programs each have their own challenge processes, so potential applicants should be aware of which mapping source is used by each program and how service availability can be challenged. There are four general types of challenges:[189]

- **Service availability errors:** At least one service option detail, such as the advertised speed, technology (DSL, cable, fiber, etc.), or service type (residential or business), offered at the location does not match the service information presented on the map.
- **Service performance errors:** The actual speed or latency of the service does not reliably match the subscriber's service plan and conflicts with the service information presented on the map.
- **Location information error**: The information about the location, such as its address, position on the map, number of households at the location, or its status as a residence, business, or community anchor institution, does not match the location information presented on the map.
- **Enforceable commitment status error**: The location is either classified as included within a deployment project that is subject to an enforceable commitment, such as a grant agreement or reverse auction award, but is not, or the location is classified as not part of such an agreement but is marked as ineligible for this reason.

Not all of these challenge types are available under each program. For example, the FCC challenge process has not been adequately designed to handle actual service performance errors, while the BEAD program cannot consider location information errors. The NTIA required that state BEAD administrators have their own state-administered challenge processes to ensure that the states could provide additional challenge options not necessarily present in the FCC process.

Of the three main challenge processes, the FFA challenge process may be the most applicant-friendly, because a wider range of challenge information can be submitted as part of the application itself, and by default, challenged ISPs have a more limited time to respond.[190] The BEAD challenge process is more robust, with definite evidentiary requirements, and will occur during a specific time during the first half of 2024.[191] While the FCC's National Broadband Map challenge process still does not allow individuals to challenge actual service performance errors, this map is still used as the primary source to identify eligible deployment areas for federal agency programs, such as the USDA's ReConnect program and the BEAD program.

[189] See, e.g., NTIA and U.S. Department of Commerce, "BEAD Model Challenge Process," pp. 13-17, 2023, https://www.ntia.gov/sites/default/files/2023-09/bead-model-challenge-process.zip.

[190] FFA Guidelines, pp. A-15 to A-16, A-21 to A-23.

[191] NTIA and U.S. Department of Commerce, "BEAD Model Challenge Process."

6.4.2 Local Challenge Strategies

Localities have an important role to play to help ensure that all un- and underserved areas within their jurisdictions are eligible for grant funding. With two separate maps and at least three challenge processes, localities can sort through this complexity and serve as vital coordinators of community action, encouraging people within their jurisdictions to participate in the right efforts to fix erroneous service claims at their homes. Localities should adopt three core strategies.

Review the broadband maps closely: Localities should review the CPUC's map and FCC's National Broadband Map closely to check whether the ISPs' self-reported service areas seem to match with the experiences of their communities. Section 4 uses information from the FCC map, so close review of the materials in that section will help to guide this process. There are five distinct error patterns that this review may identify.

- **Missing locations:** While it is hard to discover individual missing locations, larger missing clusters, such as new residential communities, may not yet have been integrated into the National Broadband Fabric. ISPs have a strong incentive to add these areas to the fabric themselves, but localities should note the issue and consider submitting a bulk location challenge to the FCC, using their permitting information to verify the existence of new households.
- **Broadband signal-based issues**: While the areas served by each technology should be scrutinized, localities should look more closely at DSL and fixed wireless coverage to identify whether there are service issues related to weak or unreliable signals. DSL networks in some areas still use older infrastructure and wiring installed in the prior century. Without replacement, smaller sections of these networks can become unreliable somewhat sporadically, introducing reliability issues that are hard for the ISP to identify, track, and report to the FCC and CPUC. As a result, the ISP may reasonably believe that all locations are served, but consumers may have different experiences. Similarly, fixed wireless companies rely upon wireless propagation models to justify their service area claims, but some obstructions, such as trees, hills, and other buildings may hinder the signal from reaching all locations within the area predicted by the model.
- **Erroneous network location claims:** ISPs have a difficult task of interpreting a massive amount of network infrastructure and customer service information. When this information is converted to GIS data, errors may sometimes occur, and the ISP may claim that certain locations are or can be connected within 10 business days when they cannot. These errors may result in certain side streets or sections of longer rural roads being misclassified as served when the network may not actually be close enough to many locations.
- **"Long drops" – locations far from the nearest road:** As discussed in Section 6.2.3 above, some buildings remain unserved because they are far away from the wireline infrastructure that runs along the nearest street. Their driveways may be long, or they may be placed along dirt road easements onto which the ISP did not install infrastructure. In these situations, the ISP will often request several hundred or even thousands of dollars to perform the initial installation. The ISP may generate its service area claims by identifying the roads containing its infrastructure and assuming all passed addresses are serviceable. In many rural communities, this assumption will classify locations with long drops as served when they are not.
- **Wiring problems in apartments:** Older apartment buildings and other multi-tenant environments (MTEs)/Multiple Dwelling Units (MDUs) often rely on older wiring that may have originally been installed to provide basic telephone service. Service to some units may suffer from older cables. In many of these buildings, new wiring to connect the outside cables to each unit can be expensive to install, a problem that generally increases with each additional floor. ISPs that claim service to each building passed by their networks may claim these buildings are served when the internal wiring has not been installed or may not be aware of the condition of the internal wiring.

Encourage the right community actions: The locality should generally encourage everyone to look at the broadband maps if they are not happy with their broadband service options. However, depending upon the patterns of errors identified in the map, the locality may want to encourage members of its community to focus on specific efforts.

- **Promote participation in the FCC and CPUC challenge processes:** On their websites and at appropriate public events, localities can provide the public with information about the FCC and CPUC online map portals and encourage them to see what services are claimed to be available at their households. The locality can also explain the importance of these consumer challenges and how easy it is to submit information on those websites directly.
- **Listen to community issues:** The initial review of the broadband maps should be complemented by conversations with community broadband leaders and CAIs who may have more details about some of the ISPs' service claims and can promote participation in the FCC's and CPUC's consumer challenge processes. These discussions may identify some of the error patterns discussed above, which should guide any collective action.
- **Develop outreach strategies to participate in coordinated efforts:** Once the locality has identified an error pattern, it can reach out to households likely to be suffering from the same type of service mischaracterization. This more targeted participation strategy will provide the FCC or CPUC with multiple instances of the same problem within an area, which may encourage them to investigate the situation further and discover the extent of the mischaracterization beyond the individual challenges submitted to them.

Develop "bulk challenge" submissions: In some cases, the error pattern may encourage the locality to work with the community to develop a "bulk challenge" submission, which would contain information about the misclassification of many different locations across an area. These bulk challenges have a few added benefits. First, they implicitly allege that a pattern of mischaracterization is occurring, which may encourage additional investigations. Second, they allow the locality to create a more consistent data set identifying a reoccurring problem. Third, they serve as an additional opportunity for quality control, with crowdsourced information able to be requested with greater specificity and reviewed before submission to identify opportunities to improve the clarity of the data. While these bulk challenges are available to address most challenge claims, they are particularly useful in the following three contexts.

- **Speed testing efforts:** ISPs facing poor speed test results can often claim that the tests were performed over weak or slow Wi-Fi networks or were otherwise influenced by factors that muddle the results. A locality or other organization developing a bulk challenge filing can request that participants explain additional details about their testing circumstances, submit multiple testing outcomes across different times and days, or even require that some testing be performed over a direct wireline connection to the modem. These strategies reinforce the impact of bad speed test outcomes and foreclose some of the counterarguments that ISPs may make about their services.
- **Areas where ISP does not actually offer service on its website:** Once the locality has information about an ISP claiming to serve an area on the maps but not actually offering services to addresses in that area on its own website, it can develop data to demonstrate the pattern. It can request that residents send in screen captures the ISP's website showing both the address being checked and the services offered at that location, then have staff perform a similar check for services at neighboring addresses.
- **Areas without an ISP's claimed infrastructure:** Some service claims can best be refuted by sending a qualified broadband technician into an area and taking photos of the infrastructure available. In many cases, entire side streets marked as served can be demonstrated to be unserved if the technician can demonstrate there is no corresponding infrastructure.

More information about the types of challenges is provided below, along with additional information about how localities, and in some cases, other organizations can develop these bulk challenges.

6.4.3 FFA Challenges

Within the California Federal Funding Account application itself, the program allows applicants to revise location eligibility classifications by providing additional evidence that demonstrates the location has been misclassified as ineligible on the FFA's eligibility map. While applicants can challenge service availability errors, the program's list of suggested evidence primarily focuses on service performance errors, allowing applicants to submit[192]:

- Speed test data from the CalSPEED test or other platforms, such as Ookla
- Data contesting reliability of service
- Interviews and testimonial from the impacted community and other qualitative information
- Other available data, including federal or state-collected data

The program suggests that this data can be gathered in a crowdsourced manner, with individual users running speed tests and providing testimonials of their service experiences to a single organization to be organized and analyzed as a group.[193] The program also encourages individuals to submit their conflicting service information as feedback on the California Interactive Broadband Map directly.[194] The CPUC's official Federal Funding Account map includes a "Search and Give Feedback" tab on the top-left of the screen and the ability to provide feedback on individual location hexes, which allows individuals to provide information that contradicts the map's current service claims.[195] These comments "will be considered with any applications that include areas for which a comment was submitted. Comments will also be evaluated on an ongoing basis."[196]

Once the FFA applications are submitted and the proposed service areas are made public, ISPs may respond to these challenges and issue their response within 14 days.[197] Interestingly, the program's challenge response requirements are among the most vigorous and specific, requiring that the ISP submit documented evidence of the service area, such as permits, easements, pole attachments, and/or pictures of the infrastructure and may submit billing statements of customers in the area.[198] The ISP may also submit challenges identifying "a policy or statutory requirement that the application has contravened,"[199] which adds risk to application strategies that appeal to the CPUC for special consideration against its default rules.

6.4.4 BEAD Challenges

While the CPUC's BEAD challenge process has not been finalized, there is enough information about its likely design to allow localities to begin to plan their challenge strategies. As part of the CPUC's required BEAD Initial Proposal Submission, it must

[192] FFA Guidelines, pp. A-15 to A-16.

[193] See ibid.

[194] CPUC, "Broadband Public Feedback," https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-mapping-program/broadband-public-feedback, accessed September 2023.

[195] CPUC, "Federal Funding Account Public Map," https://federalfundingaccountmap.vetro.io/, accessed September 2023.

[196] FFA FAQ, p. 4; CPUC, "Federal Funding Account Public Map User Guide," p. 5, June 2023, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/communications-division/documents/broadband-implementation-for-california/priority-areas-webpage/public-map-user-guide.pdf.

[197] FFA Guidelines, p. A-21. The CPUC may extend this deadline as well. Ibid.

[198] FFA Guidelines, p. A-22.

[199] FFA Guidelines, pp. A-21 to A-22.

describe to the NTIA the process it intends to use to conduct its own challenge process to the FCC's mapping information.[200] The NTIA has provided states, such as California, with a "Model Challenge Process," which is designed to help them to comply with the long list of process requirements that NTIA has placed on it.

The Model Challenge Process identifies who may submit challenges and what challenges may be submitted, while suggesting submission timelines. As soon as the CPUC publishes the list of all unserved and underserved locations that it must provide to the NTIA, nonprofit organizations, units of local and tribal governments, and broadband service providers will have 30 days to submit their challenges.[201] Once submitted, the challenged ISPs will have 30 days to respond to the challenge, after which the CPUC has 30 days to evaluate the challenge and make a final determination. To request that a location's status be changed to "unserved" or "underserved," Challengers may submit the following challenge types:[202]

Table 23: BEAD Challenge Process Types

Challenge Type	Description	Evidence Examples
Availability	Service identified in data is not offered at the location	Website service offering screenshots; ISP message denying service, demonstrating failure to install service within 10 business days, or requesting excessive installation fee; pictures demonstrating no corresponding infrastructure
Technology	Technology identified in data is not offered or available	Manufacturer and model number of residential gateway (CPE) that demonstrates the service is delivered via a specific technology
Speed	Actual speed of the service tier falls below the unserved or underserved speed	Speed test performed by subscriber demonstrating performance below 25/3 or 100/20 Mbps; evidence of subscription to faster service plan
Latency	Round-trip latency of the service exceeds 100 ms	Speed test performed by subscriber demonstrating latency above 100 ms
Data cap	ISP mandates data cap of 600 GB per month or less	Screenshot or billing statement of ISP establishing impermissible data cap
Business service	Location is residential but is offered only business service	Website service offering screenshots
No enforceable commitment	Location is marked as covered by an enforceable commitment but is not	Evidence demonstrating that location is not included in corresponding funding program or otherwise rebutting the claim of deployment obligation

The Model Challenge Process also offers two optional sets of rules that states may adopt. The first provides a more detailed set of speed test requirements and a list of the different methods to perform a speed test, varying from a measurement made directly from the customer premises equipment to a typical consumer speed test conducted online near a Wi-Fi router.[203]

[200] NTIA, "Bead Challenge Process Policy, https://internet4all.gov/bead-challenge-process-policy, accessed September 2023.

[201] U.S. Department of Commerce and NTIA, "BEAD Model Challenge Process," 2023, p. 12, https://www.ntia.gov/sites/default/files/2023-09/bead-model-challenge-process.zip.

[202] Ibid, at pp. 13-17.

[203] Ibid, at pp. 18-20.

This optional set of rules requires that failing speed test outcomes occur on three separate days, which will hinder the ability for localities to use crowd-sourced data from their residents. These speed test outcomes also cannot occur more than 60 days before the start of the challenge period, requiring that crowd-sourced efforts occur within a very specific timeframe.

The second optional set of rules allows challengers to develop "Area Challenges," which will encourage them to use coordinated crowd-sourcing of data to submit the same challenge type from at least 6 locations within a census block group to obligate the ISP to demonstrate it actually does offer services meeting that claim across that area.[204] If the CPUC adopts this option, it will be a potent tool that will magnify the efforts of local coordination efforts, potentially allowing a locality and its community members to challenge entire areas of unreliable services instead of challenging only the statuses of individual locations. This option also provides apartments and other multiple dwelling units (MDUs) with the ability to challenge services across the building by gathering evidence demonstrating the challenge from at least 10 percent of units or 3 units, whichever is greater.

6.4.5 FCC Challenges

While the FFA and BEAD challenge processes will help ensure the eligibility of un- and underserved locations mischaracterized by ISPs for those programs, the FCC challenge process will be ongoing and will play a role in determining location eligibility in future federal broadband infrastructure grant programs. The challenge submission process is also available to individual consumers and provides a well-designed web interface that allows them to submit screengrabs, pictures, and other evidence directly. The FCC's process is the only way to challenge the location fabric as well, making it the essential route to correct location information. Individuals or organizations can submit information demonstrating that a broadband serviceable location (BSL):

- Has been omitted from the fabric
- Is not a BSL
- Features errors about the corresponding address, building type, and/or number of units
- Has the wrong location coordinates information

Individuals or organizations can also challenge availability claims under the following options:

- Provider does not offer the speed(s) reported to be available at this location
- The actual speeds of this service do not match its advertised speed
- Provider does not offer the technology reported to be available at this location
- Provider denied a request for service
- Provider failed to schedule a service installation within 10 business days of request
- Provider did not install the service at the agreed-upon time
- Provider requested more than the standard installation fee to connect service

[204] Ibid, at pp. 17-18.

Individual applicants are invited to upload evidence of these claims, such as screengrabs of the ISP's website containing both the resident's address and the services offered at the location or copies of messages sent by the ISP denying requests for services. Consumers are also invited to describe the situation and explain their evidence in an accompanying text box.

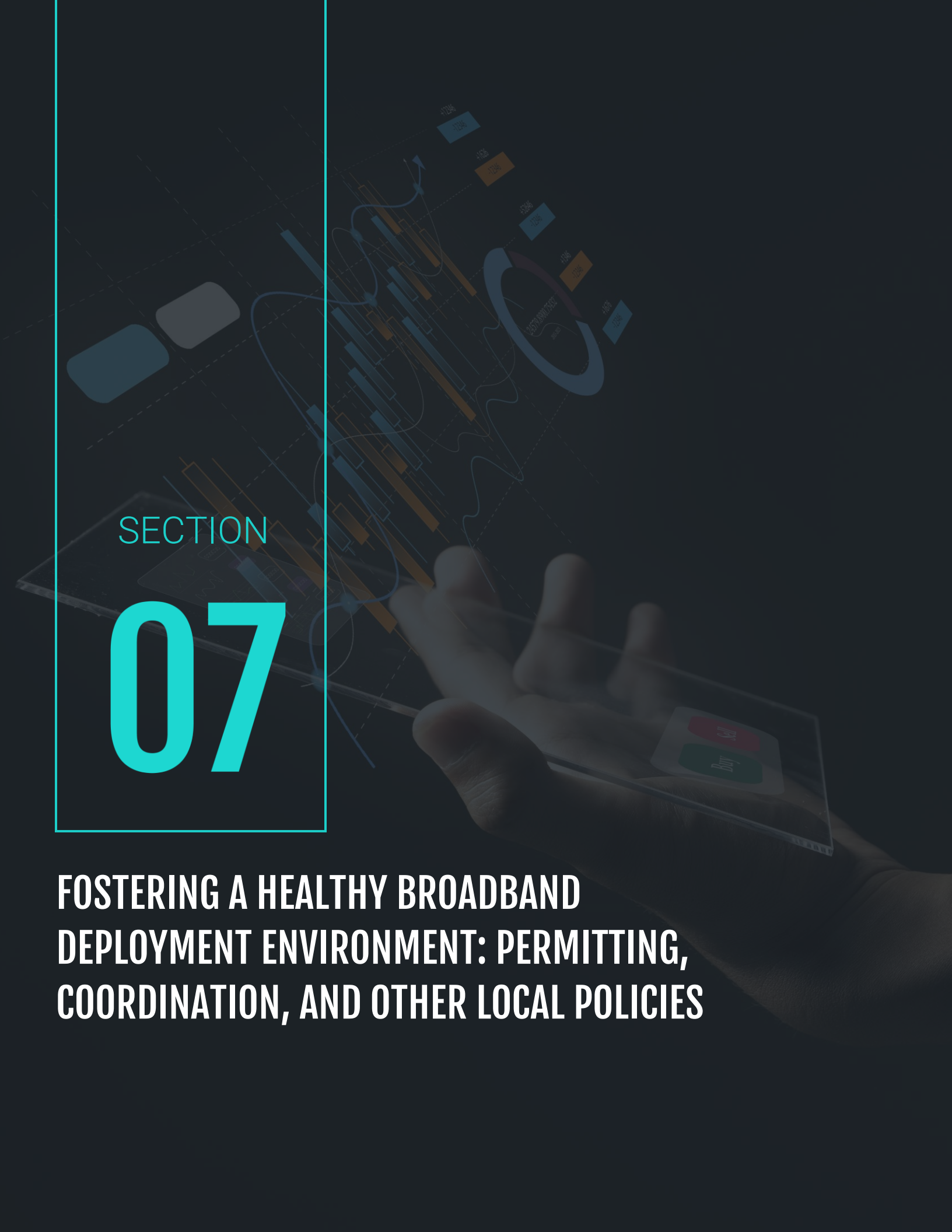
The FCC provides organizations with the opportunity to submit *bulk challenges* as well. There are several submission options, with the FCC inviting organizations to develop engineering evidence that evaluates the infrastructure in a given region or collecting crowdsourced information about consumers' service issues.[205] The crowdsourced information option generally requires that individuals provide the organization with much of the same information that is required by the FCC, so it may not be a particularly attractive option unless the organization has collected the information for another reason, such as to file a BEAD challenge.

Unfortunately, the FCC does not currently offer a way to challenge actual service speeds, making the BEAD challenge process's speed test option more important in this regard. Residents can submit customer complaints identifying that "[t]he actual speeds of this service does not match its advertised speed." Users submitting these actual performance claims are taken to a separate consumer complaints page that falls outside of the actual National Broadband Map challenge process page. Similarly, bulk challenges submitting speed test data to demonstrate that "performance of the fixed broadband service does not match its advertised speed" are categorized as a "Crowdsource Data" submission, not a formal challenge.[206] ISPs are under no obligation to respond, but the FCC explains that this speed test information "may be used by the FCC to identify instances or patterns of potentially inaccurate or incomplete data that warrant further investigation or review" by the FCC,[207] a process that has not been described in detail.

[205] See FFC, "Broadband Data Collection: Data Specifications for Bulk Fixed Availability Challenge and Crowdsource Data," pp. 1, 6-9, November 17, 2022, https://us-fcc.app.box.com/v/bdc-bulk-fixed-challenge-spec.

[206] FCC, "Broadband Data Collection: Data Specifications for Bulk Fixed Availability Challenge and Crowdsource Data," November 17, 2022, https://m.box.com/shared_item/https%3A%2F%2Fus-fcc.app.box.com%2Fv%2Fbdc-bulk-fixed-challenge-spec.

[207] FCC, "Differences between Bulk Fixed Availability Challenge Data and Crowdsource Data," November 17, 2022, https://help.bdc.fcc.gov/hc/en-us/articles/10390788241307-Differences-between-Bulk-Fixed-Availability-Challenge-Data-and-Crowdsource-Data.



SECTION

07

FOSTERING A HEALTHY BROADBAND DEPLOYMENT ENVIRONMENT: PERMITTING, COORDINATION, AND OTHER LOCAL POLICIES

Historically unserved and underserved areas tend to pose economic challenges that discourage ISPs from entering the market.[208] Last mile broadband funding programs help to improve the ISP's business case to deploy new infrastructure to these areas. However, with this support funding still limited, local government should strive to improve the economic appeal of serving these areas as much as possible.

Local governments cannot reduce higher deployment costs related to low population density or remote, problematic terrain. Still, they can adopt strategies to minimize other project costs and reduce the amount of ISP investment needed to offer new services. Some of these strategies require significant local effort or formal commitments between an ISP and the locality, with the latter contributing financial resources and access to its existing infrastructure. In exchange, the locality will be better positioned to ensure the ISP's network reaches unserved areas, offers more affordable pricing to customers, and better meets the community's needs.

In addition to these contributions, local governments can implement process improvements, policies, and best practices that do not require direct financial commitments or formal partnerships. These *Broadband Ready Community* strategies can often be done with little or no additional cost to the locality while reducing ISP deployment costs, fostering better coordination between ISPs and localities. These strategies can also reduce the administrative efforts of the locality itself.

When considering potential expansions, ISPs assess whether a locality has adopted these broadband-friendly policies. Adopting these policies therefore signals to the industry that the locality understands barriers to broadband investment and is willing to [improve its own processes] to meet the needs of an ISP partner. This level of readiness suggests the locality has the sophistication to competitively pursue state and federal funds, properly define the needs and bounds of cooperative efforts with ISPs and develop better deployment plans.

A few states, such as Colorado, Indiana, and Georgia, have analyzed these Broadband Ready Community strategies and created certification programs to help localities adopt them more easily.[209] Developed from local experimentation and experiences across the nation, these state certification programs use Broadband Readiness checklists to highlight the most important steps that localities can take to encourage new ISP investments. Accompanied by model ordinances, these clear requirements help communities determine whether they are poised to seek partners to design, deploy, and maintain broadband networks. The State of California has also developed advisory resources encouraging localities to improve their local permitting processes to facilitate network deployments by private ISPs.[210]

Overall, these policies can be classified into three categories[211]:

- **Improving access to information:** Local governments should make key broadband-related information about local infrastructure and public assets, permitting processes, projects, and related local strategies available online in an accessible, easy-to-use manner.

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[208] NTIA, "Economics of Broadband Networks: An Overview," p. 1, March 2022, https://broadbandusa.ntia.doc.gov/sites/default/files/2022-03/Economics%20of%20Broadband%20Networks%20PDF.pdf.

[209] Colorado Broadband Office, "Announcing the Broadband Ready Community Program," January 26, 2023, https://www.in.gov/indianabroadband/broadband-ready-communities-program/broadband-ready-certification/; Georgia Department of Community Affairs, "Broadband Community Application Information," https://broadband.georgia.gov/broadband-community-application-information, accessed September 2023.

[210] E.g., California Governor's Office of Business and Economic Development, California Department of Technology, California Public Utilities Commission, and California Emerging Technology Fund, "State of California Local Permitting Playbook," August 2022, ("State of California Local Permitting Playbook"), https://broadbandforall.cdt.ca.gov/wp-content/uploads/sites/19/2022/09/California-Local-Jurisdiction-Permitting-Playbook-1.pdf.

[211] These three general categories are non-exclusive. For example, one of the most common strategies, designating a single point of contact for all matters related to broadband development projects, improves all three categories. Local governmental organizations with a single point of contact will centralize information requests and coordination efforts while improving the locality's understanding about how permitting efforts are impacting the locality's overall deployment efforts.

- **Improving local governmental coordination**: Local governments should establish clear, efficient lines of communication between ISPs and the locality and between different local governmental subdivisions. Broadband issues appear in several departments, so local governments should strive toward interdepartmental coordination to handle deployment-related decision-making effectively. Local governmental organizations should also coordinate with their county, other localities, and among each other to implement strategies that facilitate regional network deployment.
- **Improving permitting and asset access processes**: Local governments should streamline permit application filing, permit review processes, and encourage coordination between different stakeholders using dig-once policies, one-touch make-ready policies, and improved leasing opportunities for fiber, conduit, facility space, and real estate.

After further discussion of the Broadband Ready Community strategies described above, this section will explore additional ways that localities can work with ISPs to encourage them to invest in unserved areas. From joint planning efforts to formal partnerships, localities can make significant contributions to deployment efforts. These contributions also allow the locality to encourage, or in some cases, require that an ISP adopt digital equity strategies or include specific areas in their deployment plans.

7.1 Improving Access to Information

To plan and complete network deployment projects, ISPs need access to a large amount of information about local broadband needs, current infrastructure, other deployment efforts, construction policies, and permitting processes. County and local governments often have access to much of this information but may not have made it easily accessible to interested ISPs. Some of this information may not have been collected or organized yet either, which would require interested ISPs to collect it themselves. Local governments are often in a better position to organize this information more efficiently and at a lower cost than an interested ISP. As a result, localities that adopt "access to information strategies" will help ISPs to better analyze location details, such as permitting and access rights, and can reduce an ISP's ultimate deployment planning costs.

Establish a dedicated broadband issues webpage on the local government's website: Depending upon how the locality handles permitting, mapping, and infrastructure development efforts, essential broadband deployment information can span many different local departments. An ISP may need to search throughout the locality's website to find the information it needs, and some information may not even be available online. A centralized broadband webpage can provide direct links to this information, documents, and online submission forms from multiple departments.

Other local governments with broadband issues webpages often dedicate the top section to consumer issues. This section is an opportunity to encourage residents to sign up for broadband service subsidy programs, such as the Affordable Connectivity Program (ACP) and Lifeline, and to provide information about local service providers' low-cost internet plans. The page can also be used to collect broadband service challenges as well, a process discussed in subsection 6.3.

Establish Geographic Information Systems (GIS) policies to support planning and construction efforts: Localities often have detailed mapping information about building addresses and locations, parcel designations, zoning, neighborhood boundaries, and other details. Localities typically also have mapping data about their own assets, including public real estate, facilities, rights-of-way, and any existing broadband assets, as well as access to information about light and utility poles, manholes and handholes, existing conduit, and underground utilities even if these assets are owned by a utility company. Through their permitting roles, localities may have access to information about private rights-of-way and easements, which can be substantially more costly for ISPs to discover themselves. Through its planning efforts, the locality may also have

developed details about unserved and underserved areas and related demographic information that can be invaluable when designing proposed service areas or applying to funding opportunities that require these details.

These GIS information sets can be essential for ISPs, allowing them to develop more detailed construction plans about their routes that can take into account more cost factors and funding considerations. A locality with well curated asset information can even encourage ISPs to consider leasing arrangements that will leverage current public assets to reduce project costs. Local governmental organizations should work to ensure that these information sets are available online in an accessible, easy-to-use manner.

Through its role handling local infrastructure issues, the locality may also be aware of certain challenges that could create problems or additional costs for ISPs entering the market. For example, some rights-of-way can become overly congested or are simply very costly to include in project construction. Many avoidable network design issues arise from a lack of knowledge of rights-of-way conditions, which can jeopardize project implementation. Localities can develop a congested rights-of-way policy, which can help to prioritize corridors in order of highest to lowest congestion to facilitate more efficient design decisions by guiding construction away from packed utility corridors whenever possible. Combined with GIS policies such as frequent maps updates for all public and utility rights-of-way, localities can aid ISP planning and coordination efforts significantly.

Revise internal record-keeping processes to facilitate information-sharing: Local governmental organizations often have access to essential information but may not have it organized in an easily accessible manner. For example, the State of California's "Local Permitting Playbook" describes the way that many localities have recorded their local fiber assets:

> Local government-owned fiber is often documented on paper maps, in computer-aided design (CAD) drawings, and with ad-hoc spreadsheets. First, when there are only a few routes and no real complexity, these techniques appear to suffice. However, after a few changes, re-routings, and additions, the de facto documentation is only in the memories of the fiber team. The result may be re-work, fiber damage, accidental service outages, wasted time and money, and lack in confidence in the community's own infrastructure. Lack of documentation has led some communities to doubt their own fiber assets to the point that they decline to use it for public safety purposes because of concerns regarding failure rate and reliability. These same communities decline to lease their fiber because of concerns that they could not meet contract terms for managing it or for uptime. [212]

A better asset management system that tracks information about fiber, conduit, and other local assets would avoid problems resulting from this record-keeping approach and would ensure that such assets could be better utilized by both the locality and interested parties looking to lease access to them. While this strategy may be costly upfront to implement, it is likely to reduce record-keeping costs in the long run and provide greater efficiency when these assets need to be repaired, upgraded, replaced, or utilized in new ways. Indeed, without a better asset management system, some future fiber uses may simply not be possible.

Establish efficient infrastructure information request policies: In many cases, such as the public fiber assets documentation problem identified above, the locality may not have the time or resources necessary to revise existing information into a more usable format. In these instances, the locality should use the locality's broadband issues webpage to encourage interested ISPs to reach out for more information about these deployment factors, then prioritize working with the ISP to analyze and refine the information into a more usable form needed by the ISP to create better deployment plans.

[212] State of California Local Permitting Playbook, p. 47.

Develop a permitting manual: The locality's broadband webpage should include information about a number of broadband consumer and ISP issues, but it may not be able to provide all details necessary to understand the permitting processes required by the locality. In these cases, the webpage can instead provide a link to a telecommunications permitting manual that reviews the rules, regulations, and permitting processes that ISPs must follow to conduct broadband constriction projects in the locality's jurisdiction. This manual should include permit cost and timeline expectations as well. If the locality has few rules and required permits or does not have the time and resources to create a manual, it should still organize information about these requirements in a single place for easy reference.

7.2 Improving Local Governmental Coordination

Once developed, the county or local government's broadband webpage should serve as a central point of passive information-sharing between interested ISPs and the locality. However, this website certainly cannot replace all the conversations needed between the ISP and local staff. ISPs must interact with staff from different departments, including the locality's attorneys, planning departments, public works and engineering, information technology, and GIS teams. When so many staff are involved, each person may not have the context of the overall broadband project and how each contributes to the locality's overall decision-making. As a result, localities without well-designed communication and coordination plans may quickly lose track of important information, provide inconsistent answers, and ultimately work against themselves.

To make matters more complex, representatives from the locality may also need to coordinate with other organizations that are outside of its control, such as local utilities. The locality must often serve as a point of contact between these organizations, particularly when all parties must submit permitting, attachments, or rights-of-way information to the locality. The locality should also coordinate with other local governmental organizations to understand how coordination between county and local governments can create broadband opportunities that would not otherwise be available to each individual organization.

In summary, the locality faces three on-going coordination challenges:

- Between the ISP and the locality's staff
- Among the locality's staff in different departments
- Between the locality's staff and other organizations

To streamline coordination as much as possible, localities should adopt the following three strategies.

Revise the locality's internal coordination strategy to address broadband issues: Considering the range of issues involved, a locality's broadband strategy planning and project coordination must involve input from several departments. Increasingly, a number of different local departments, including those that handle local economic development, community engagement, education, and local services, face significant broadband-related issues as well. These local services often depend upon reliable connectivity to ensure that their staff can provide public support.

To help all departments adequately address their broadband issues, localities should:

- Recognize how broadband issues impact each department
- Address broadband issues at top-level meetings among department heads

- Develop interdepartmental broadband plans that address:
    - The locality's overall broadband development and digital equity strategic plan
    - The locality's coordination strategies with other localities and essential third parties, such as utilities
    - Project coordination strategies between the locality and ISPs active in the area
- Design and empower a *broadband coordinator* role to execute these strategies

By integrating the needs and insights of each department, these strategies will better represent the locality's overall needs, ensuring that different departments are working together towards common goals.

Designate a single point of contact for coordination with outside organizations: Rather than requiring ISPs to reach out to multiple departments, localities should identify a single point of contact charged with quickly providing ISPs with information and other staff resources. Once initial contact is established, this broadband coordinator may allocate certain ongoing coordination responsibilities, such as permitting applications and GIS requests, to other staff as needed, while remaining responsible for overall staff utilization for broadband projects.

When the locality is more closely engaged with a particular ISP, this single point of contact should also oversee how deployment plans with the ISP are progressing and coordinate the locality's efforts to minimize planning and construction delays. This broadband coordinator should be empowered to work with ISPs to develop mutually agreeable approaches to design, planning, and construction that comply with local construction and permitting requirements as well.

This broadband coordinator will be more effective if she or he is also designated to represent the locality's interests with other organizations, such as utilities and state government, and to advocate proactively for the locality's broadband deployment and digital equity strategies. By placing this coordinator at the center of the locality's broadband efforts with other organizations, the locality can ensure that outside messaging and the locality's overall deployment plan will remain consistent and well informed across discussions with these external groups. This person can also establish relationships with ISPs in the region, which is a critical step toward forming partnerships that can significantly benefit the ISP and locality alike.

Develop and implement customized coordination strategies with ISPs committed to construction in the area: When a project is formally proposed, the locality should dedicate an official project coordinator to manage the locality's responsibilities for the duration of construction activities. Whether this project coordinator is the same person as the single point of contact described above, or merely reports to that designated point of contact, she or he can work closely with the ISP's project manager to review proposed plans and technical specifications, process permits, coordinate inspections, and identify and resolve unexpected issues. By working more directly with an ISP, this coordinator can also safeguard the locality's interests in both achieving improvements in broadband service and minimizing unnecessary impacts on other infrastructure and the neighborhoods themselves.

Companies undertaking major broadband infrastructure projects in the area should also be encouraged to create a general coordination agreement with the locality. This agreement has two basic goals. First, it should detail the locality's construction and permitting requirements, along with an explanation of the locality's responsibilities in administering them. Depending on what aspects are overseen by the locality, this list should identify any rules related to placement of facilities within the right-of-way, typical depths, permissible construction methods, restoration requirements, inspections, encroachment into streets, sidewalks, or other public property, traffic disruption and control, notification procedures, and mitigation measures.

Second, the agreement should allow the ISP and locality to identify any opportunities to modify submission and coordination processes to reduce the project's overall coordination costs and expedite deployment. Using the locality's default permitting

processes as a starting point, ISPs may suggest alternative ways that it can submit certain elements of its overall construction plans to comply with the locality's review in a more efficient manner. If the locality and ISP can come to an agreement about how the locality's review can occur, this more project-focused review process can reduce the amount of time and effort needed to fill out permitting documents.

7.3 Improving Permitting Processes, Local Deployment Policies, and Asset Access Practices

Localities have a vital role to play to ensure that all local construction meets reliability, safety, and accessibility standards while addressing the needs of the community.[213] Several types of broadband deployment locations, from utility poles to train crossings and highway junctions, involve the property interests of several different parties. Through its regulatory and permitting roles, the locality often helps coordinate and manage the rights and responsibilities of each involved party. They have five primary methods to accomplish these goals:

- **Construction rules and regulations:** These methods establish limitations and requirements that ISPs' projects must satisfy to ensure the community's interests are not harmed by construction. Most are not optional, though the locality may allow different approaches to satisfy the underlying policy purpose of certain requirements. These rules generally function without requiring that the locality provide notice to or communicate with construction companies, although the locality should make regulations as transparent and easily available as possible. Examples include a locality's rules about microtrenching, conduit installation, and the other project specifications verified through permitting processes.
- **Permitting processes:** These methods establish steps that an ISP must follow for authorization to perform certain construction activities, such as digging up roads, sidewalks, and other land, or to secure the right to place infrastructure on other property. Permit processes generally require that an ISP provide a specific set of information to the locality, who in turn reviews this information to verify that the proposed project complies with applicable construction rules and regulations. While a locality's permitting processes serve as the default method for submitting information, the locality may also consider allowing the ISP to work with staff directly if a project requires many permits that must be processed quickly. This close coordination approach can also reduce the burden permit submission and review places on both the ISP and the locality.
- **Coordination rules and policies:** These methods dictate the submission, communication, and coordination requirements an ISP's deployment plans must comply with to allow other parties the opportunity to place their own facilities alongside a network deployment, if reasonable. For example, a "dig once" policy will give other parties the chance to install their own infrastructure while the ground is open. Under this policy, an ISP must provide other parties with notice of the upcoming construction activities to facilitate this coordination. The goal of such policies is to minimize disruptions caused by construction.
- **Coordination agreements:** These methods allow the ISP and the locality to work together to streamline permitting, project planning, and other construction processes, adapting each of their default internal processes in a way that reduces time and effort for both parties. By committing to more customized coordination efforts, the locality can reduce the ISP's cost of expanding in the area.

[213] See State of California Local Permitting Playbook, p. 1.

- **Partnership agreements:** [214] The locality and ISP may develop agreements to exchange financial resources, ownership of assets, and/or service obligations with one another. The locality may agree to provide financing support and utility infrastructure to the ISP to encourage its market entry, or the locality may even decide that it wants to own the broadband network itself, with the ISP agreeing to manage the infrastructure and offer services to consumers.[215] The discussions leading up to a public-private partnership can give the locality the opportunity to negotiate additional commitments, such as the obligation to build out to all unserved locations in an area, offer low-cost broadband service plans to eligible households, or propose a discounted bulk service agreements to low-income housing in the area.

7.3.1 Construction Rules and Regulations

Depending upon the extent of the locality's authority over local construction, the scope of the locality's rules and regulations can differ dramatically. Larger localities with extensive regulations functionally require that construction experts analyze local rules and integrate compliance activities into an ISP's overall deployment plans. Smaller localities that do not fall into this category should instead focus on three factors:

Strive for regional consistency around construction rules and regulations: ISPs looking to expand into new areas are generally familiar with many of the construction rules and permitting practices of communities they already serve. In many cases, those communities have already worked with ISPs and gained insights into how their regulatory environment has impacted deployments, possibly modifying some rules to ease ISP entry. A locality can look to its neighbors to gain insights into how construction rules can be revised and can work with other localities to promote regional alignment around these policies and permitting practices, creating a more straightforward permitting process that may allow the ISP to use one set of filing methods to satisfy other local, regional, or state requirements.[216] This comparison may also highlight policies that could hinder market entry. Legacy policies and ordinances can inadvertently interfere with efficient construction and permitting or may even deter partnership formation.

Ensure that all construction rules and regulations are clear, reasonable, understandable, and available online: ISPs must spend time interpreting and incorporating local variations to construction rules into their deployment plans. Construction rules should be designed to establish clear standards while being sufficiently flexible to accommodate different build options. A rule should aim to "provide a person of ordinary intelligence fair notice of what is prohibited" while not being "so standardless that it authorizes or encourages seriously discriminatory enforcement."[217] The language used in regulatory and permitting practices should therefore provide clear guidance to ISPs and facilitate easy, consistent enforcement and permitting reviews by the locality.

Determine the locality's policies about underground construction methods and microtrenching: ISPs must make a number of decisions about where to use aerial placement of cabling on poles and where to perform underground construction. Aerial deployments are cheaper to construct, but they depend on the availability of suitable utility or light poles and may require that

[214] These partnerships may also be between different public entities, such as a county or locality and a California Joint Powers Authority.

[215] Note that this topic can be very complex, so this report will focus on the coordination and cost-reduction aspects of these partnerships. For more information about their business structuring aspects, see US Ignite and Altman Solon, "Broadband Models for Unserved and Underserved Communities," July 2020, https://www.us-ignite.org/wp-content/uploads/2020/07/USIgnite_Altman-Solon_Whitepaper-on-Broadband-Models_FINAL_7-9-2020.pdf, and a series of three public-private partnership whitepapers published by the Benton Institute for Broadband & Society, available at: https://www.benton.org/publications.

[216] See State of California Local Permitting Playbook, p. 12.

[217] Institute for Constitutional Advocacy and Protection at Georgetown Law School, "Local Authorities," *Protests & Public Safety: A Guide for Cities & Citizens*, Fall 2017, https://constitutionalprotestguide.org/local-authorities/.

the ISP pay to use this space. Pole attachment fees are generally annual, adding to a network's ongoing costs as well. In contrast, underground installations are substantially more expensive, requiring that the ISP dig a trench deep enough to place its conduit and fiber and install access points at regular intervals. However, underground construction is often necessary to ensure that the installed infrastructure is well protected against the elements, wildfires, and tampering. If fiber optic assets must be buried for protection and network preservation, the locality should create placement policies that ensure the fiber will be protected underground.

Microtrenching is the practice of cutting narrow channels into rights-of-way. These channels are typically a few inches wide and vary in depth but are seldom as deep as trenching for other infrastructure, such as electrical or water networks. This method is a much more cost-effective way to install conduit and fiber optics compared to the traditional methods of excavation and road restoration, because these much smaller cuts into road surfaces or other land require less effort and cost to remediate the work site. Locations that adopt microtrenching policies will encourage ISPs to build fiber optic infrastructure at lower costs and faster time frames. However, this practice is not without its disadvantages. Microtrenching may not bury infrastructure deep enough to insulate it against fires or some forms of accidental tampering, making it a poor fit to fire-prone areas or areas where rights-of-way are regularly dug up or experience other stresses. Localities should consider these factors when designing rules about what areas could be eligible for this cost-saving technique.

7.3.2 Permitting Processes

Localities generally oversee permitting processes related to construction, rights-of-way and access. Most permitting regulations specify a set of circumstances under which permits must be granted or denied, while the process used to ensure compliances with these regulations establishes the way that the ISP must submit information for review by the locality. Both the process and the regulations themselves are opportunities for transparency; municipalities should create clear, documented pathways through the process and explanations about how the evaluator will decide whether requirements are met. If the locality does not present this level of clarity or if the process itself seems to be a logistical burden, ISPs could be deterred from considering expanding in the area. Localities can improve their permitting processes by adopting the following strategies:

- Ensure that each permitting process has been properly updated to consider broadband deployment issues and reviewed by staff who understand telecommunications factors,
- Allow applicants to submit required permitting documentation digitally,
- Provide permitting process timelines and update applicants about their permit requests when the review reaches any milestones,
- Provide examples of permit planning and design standards, such as right-of-way diagrams, trench construction and pavement restoration, and pole attachments to improve ISPs' submission quality and better demonstrate standards,[218]
- Regularly revisit permitting rules and processes to improve alignment with federal, state, and other local requirements.[219]

[218] State of California Local Permitting Playbook, p. 2.

[219] For examples of rights-of-way rules, see FCC Broadband Deployment Advisory Committee Model Code for Municipalities Working Group, "Rights-of-Way Model Code for Municipalities," https://www.fcc.gov/sites/default/files/bdac-07-2627-2018-model-code-for-municipalities-approved-rec.pdf, accessed September 2023.

7.3.3 Coordination Rules and Policies Best Practices

Establish a "Dig Once" policy to promote conduit and fiber optic cable construction: Underground construction is often necessary to ensure that the installed infrastructure is well protected against the elements, wildfires, and tampering. However, trench digging is very costly, so whenever digging occurs, the locality should encourage as many parties as possible to take advantage of the opportunity to install infrastructure underground. Depending upon the specific rules adopted by the locality, a "dig once" policy requires that any organization conducting certain types of underground construction provide opportunities for:

- Additional conduit and/or facilities to be included to ensure that other organizations can benefit from better underground access, or
- Other organizations to install infrastructure in the trench while it is available (also known as a "joint trench" policy[220]).

"Dig once" policies reduce costs and minimize construction impacts on pedestrian and auto traffic by reducing the number and scale of excavations needed to install telecommunication infrastructure in rights-of-way. This coordination requirement also opens up a number of additional opportunities for the locality and other telecommunications and utility companies. For example, the locality may decide to add additional conduit or its own fiber during the build, paying for the additional costs involved. It may then lease access or offer indefeasible rights of use (IRU) agreements, serving as both a means to encourage additional entry and a revenue-generating opportunity to cover the upkeep of other local telecommunications systems. Conduit placement should be considered even if the locality does not necessarily have a current use for it. This way, when the conduit is needed for telecommunication infrastructure in the future, it is already in place and available for use or lease. Excess conduit reduces future installation costs by eliminating the need for additional trenching.

Localities should implement open trench notification processes as well. When a civil works project within the jurisdiction opens a trench, a list of pre-approved entities are notified of the opportunity to install conduit and cabling in that trench. Generally, this process will provide ISPs with the ability to install conduit and cabling at a significantly reduced cost if the trench is dug for other reasons, such as underground water, wastewater, gas, or other utility repairs and maintenance or new utility and municipal infrastructure projects. The locality should maintain a public list of all broadband providers that would like to receive notice of other trenching projects. To be eligible to receive an open trench notification, a provider must request that the locality include them on this list. The locality should provide notification of an upcoming open trench project on a non-exclusive, competitively neutral basis to broadband providers.

Provide Early Notification of Trenching Moratoriums: Trenching moratoriums are often used to protect newly paved roads or other recently completed infrastructure projects from trenching that would significantly undermine the quality and longevity of these improvements. Five-year trenching moratoriums can be particularly burdensome to ISPs planning gradual expansions or that are relatively new entrants to the market. If provided notice of a possible moratorium, providers may choose to install underground infrastructure that they might not immediately utilize in certain areas where a paving moratorium is about to go into effect. A provider may not need the infrastructure in place for some time, but the moratorium would foreclose the opportunity to perform installations and upgrades later. Providing regional ISPs with notice of a possible trench moratorium will encourage them to consider making a cheaper investment in conduit deployment if they anticipate eventual network expansion in the area.

[220] E.g., City of South San Francisco, "Ordinance amending Section 13.04 of the South San Francisco Municipal Code, adding Section adding Chapter 13.40 of the South San Francisco Municipal Code pertaining to open trench notification and telecommunication infrastructure improvements," January 9, 2019, https://www.ssf.net/home/showpublisheddocument/15880/636951776359530000; https://www.ssf.net/departments/public-works/engineering-division/dig-once-policy.

Establish a One-Touch Make-Ready Policy: Typically, when a provider requests permission to attach new cabling to utility poles, it begins the "make-ready" process. Providers requesting such permission should already have a pole attachment agreement in place with the pole owner(s), but each new attachment triggers a process that requires utility poles be inspected to determine what work is needed to make each pole ready to receive a new attachment. Often, other cables may need to be physically moved to create sufficient vertical clearances necessary to comply with national safety standards.[221] Each owner of existing attached cabling is typically required to assess their infrastructure on the poles and move their own cabling infrastructure. Numerous owners mean numerous separate visits to the same utility poles to perform essentially the same task.

A one-touch make-ready replaces this process with a more streamlined one, where a single contractor (or small group of contractors) pre-approved by the pole owner(s) and the attachment owners can perform all the work necessary to complete the make-ready work needed for new attachments.[222] This approach reduce costs and time necessary to complete the process.

Leverage Municipal Assets: Localities should encourage interested ISPs to leverage their public assets. A locality's existing conduit, fiber, rights-of-way, and facilities all present direct opportunities for broadband network developers to reduce their deployment costs, while potentially offering additional benefits to the locality itself. If the locality has an intragovernmental network running between local buildings, the conduit can be used to expand services quickly in areas passed by it, often into smaller town centers. A town's light and utility poles also may provide opportunities to run aerial cable or even install 5G small cell transmitters.[223] Key electronics facilities can be placed on or in locality properties, and the locality can offer its rights-of-way at reduced or no cost to encourage deployment without providing additional investment.

To facilitate ISP use of locality assets, the locality can create a template lease agreement. The template should include lease rates that prioritize broadband deployment over revenue generation and should allow for modifications to accommodate specific needs. By negotiating specific terms with the ISP, the locality can also ensure that the ISP will protect the locality's interests in these assets, potentially including ISP maintenance and additional operations requirements that can reduce the locality's costs in managing these assets.

However, to fully leverage municipal assets, the locality first must understand exactly what assets it has and be able to provide that information to interested ISPs. Not having this understanding and inventory can lead to less than full utilization, because the assets and potential uses would be too unclear to facilitate this type of mutually beneficial coordination.

Ensure Competition in Multiple Tenant Environments: In February of 2022, the Federal Communications Commission (FCC) issued a Report and Order and Declaratory Ruling in the matter of improving competitive broadband access to residential and commercial multiple tenant environments (MTE).[224] The Order contains several provisions, but it specifically prohibits certain revenue-sharing agreements and exclusive marketing arrangements between landlords and two types of companies: telecommunications carriers and covered multichannel video programming distributors (MVPD), which are cable and satellite television providers. In the Order, the FCC declined to extend these prohibitions to providers that solely offer internet service.

[221] State of California Local Permitting Playbook, p. VI.

[222] This practice generally applies only to make-ready work performed in the communications space on utility poles and not on any make ready-work that may be required in the upper, high-voltage power space.

[223] Even if the locality does not own the utility poles, it may own the land on which the poles are located, potentially giving it the ability to develop some policies governing its use, such as a One Touch Make Ready policy.

[224] FCC, Report and Order and Declaratory Ruling, Improving Competitive Broadband Access to Multiple Tenant Environments, GN Docket No. 17-142, February 15, 2022, https://docs.fcc.gov/public/attachments/FCC-22-12A1.pdf.

In the Order, the FCC specifically prohibits telecom providers and property owners from entering into agreements for exclusive or graduated revenue sharing. The FCC stated that these types of revenue-share agreements are particularly harmful to competition and amount to de facto exclusive access agreements.[225]

While the FCC did not prohibit exclusive marketing arrangements in the Order, it did require the disclosure of such arrangements. In the Order, the FCC requires providers to disclose the existence of exclusive marketing arrangements they have with MTE owners, requiring that such disclosure "must be included on all written marketing material directed at tenants or prospective tenants of an MTE subject to the arrangement and must explain in clear, conspicuous, legible, and visible language that the provider has the right to exclusively market its communications services to tenants in the MTE, that such a right does not suggest that the provider is the only entity that can provide communications services to tenants in the MTE, and that service from an alternative provider may be available."[226]

While the FCC's ruling in the Order is in effect, the issue of de facto exclusive access arrangements, including access to existing inside wiring within MTEs, has been problematic even in the presence of FCC rulemaking. Localities should:

- Extend the prohibition on revenue-share agreements and graduated revenue-share agreements to providers that solely offer internet service,
- Prohibit exclusive marketing agreements between MTE owners and providers,
- Introduce MTE access requirements that will ensure other ISPs can access MTE facilities and install competitive networks for residents who want them.

7.3.4 Encourage Coordination Agreements

Localities should provide ISPs proposing major broadband infrastructure projects with the option of entering into a more comprehensive development agreement that would streamline the permitting process once a project is underway. Existing franchisees who are undertaking major projects to extend or upgrade infrastructure that involves work in the right-of-way should also have the option of entering into such agreements. Construction permitting should be consolidated and streamlined by allowing the developer to submit plans and receive permits for larger, multi-block areas as the designs become available. The typical size of the areas submitted for review should be established in the development agreement, but areas containing up to 800-1000 premises would not be unreasonable. Required plans should be limited to one-dimensional (overhead) plans that indicate the placement of the proposed facility within the right-of-way and the method of construction.

Where local conditions require deviation from approved installation methods, localities should consider exceptions on a case-by-case basis, but may require greater supporting documentation before approval of needed permits.

While localities should identify expected construction methods, these should not be the exclusive methods permitted. Other methods may be appropriate due to local conditions, such as local underground obstructions or a lack of space in the right-of-way corridor or utility easement. As a matter of overall policy, the locality should state its willingness to work with developers to identify appropriate and cost-effective methods to allow access to any serviceable premises, based on a balance of the following factors:

[225] Ibid.
[226] Ibid.

- Minimizing the cost to install facilities serving premises within the locality to the extent practical,
- Minimizing the duration and disruption of work carried out within the right-of-way by using construction techniques less disruptive than traditional trenching,
- Minimizing accelerated depreciation of the right-of-way (deterioration of the roadway), considering the effectiveness of proposed restoration methods.

Such an agreement would include more information about the method(s) of construction that broadband providers intend to use in their project. The agreement should include, for example, cross-section plans for these methods and descriptions of situations in which they may be used, as well as allowable deviations from the norm. These agreements should describe the typical requirements for site restoration, traffic management, notification, and protection. They should also establish procedures for submitting final designs and as-built documentation, both as detailed drawings and GIS files.

SECTION

08

DIGITAL INCLUSION CONSIDERATIONS AND STRATEGIES

As near universal broadband access is steadily being achieved through last mile funding programs, other aspects of the digital divide are becoming more pronounced. To ensure that all members of the community benefit from the opportunities provided by broadband, services must not only be available, but also affordable. The affordability of the service itself is not the only financial barrier that low-income non-adopters face either. Many families struggle to afford quality digital devices for each member, and instead are often forced to share a couple of decent devices or rely on outdated ones. To make matters more challenging, households that have long been on the other side of the digital divide have had fewer opportunities to develop digital skills. With these issues in mind, localities developing their overall digital equity strategies should focus on three main areas:

- Broadband adoption
- Device adoption
- Digital skills development

Addressing each of these issues can be a challenge because it is often difficult to reach out to the people most in need of assistance. Localities must work to understand who in their communities needs this support, which community anchor institutions (CAIs) have been working to help them already, and what they can do to support and expand upon these existing digital equity efforts.

Section 3 analyzed many aspects of the digital divide in Tehama County. This information plays a vital part in understanding the county's needs. Building upon that analysis, this section will first briefly present some affordability and adoption research to identify baseline adoption and pricing trends in the United States. The provided metrics can be used to develop more reasonable estimates for the sizes of different groups in need, which can play a role in designing digital equity program funding applications in the future.

Next, broadband service subsidy programs, including the Affordable Connectivity Program (ACP), the federal Lifeline program and California Lifeline, will be reviewed. Combined, these valuable programs make broadband service both at home and on mobile devices more affordable, but most people who are eligible for them are not enrolled. Localities should support CAIs that facilitate enrollment in these programs by promoting awareness and providing sign-up assistance.

Finally, this section will discuss what localities can do to prepare for the next wave of major digital equity program support funding. Recent federal legislation has made available significant funding for affordability and digital equity programs, funding that will largely flow through the National Telecommunications and Information Administration (NTIA) and California Department of Technology (CDoT). The NTIA has required digital equity funding recipients to submit their State Digital Equity Plans by no later than November 30, 2023,[227] so while digital equity planners are aware of the NTIA's general rules regarding how California can disburse this funding, the State's plan has not been submitted at this time. Nevertheless, the general rules suggest what range of programs that localities, CAIs, and non-profit organizations should consider developing or expanding to help everyone to experience the economic and quality-of-life benefits of modern broadband.

[227] Gabriel Petek, *The 2023-24 Budget: Broadband Infrastructure*, March 2023, p. 10, https://lao.ca.gov/reports/2023/4747/Broadband-Infrastructure-032023.pdf.

8.1 Affordability and Adoption

Home broadband services have become essential for nearly all American households. When broadband is available, nearly all households will purchase it if they can afford to do so. Pew Research Center's 2021 survey found that 93 percent of adults nationwide say they use the internet.[228] However, only 77 percent of adults nationwide said they have broadband service at home.[229] In other words, nearly one in five people who use the internet did not have high-speed home internet service at the time the survey was conducted. This gap between internet usage and high-speed service adoption has gradually continued to shrink, thanks to major federal and state funding efforts and the hard work of digital equity advocates across the nation, but the journey toward universal adoption is far from over. Digital equity advocates cannot take their progress for granted either. One recent survey found that approximately half of all households with annual incomes of $50,000 or less "live near the precipice of disconnection."[230]

This subsection will review and provide quantitative estimates of this gap, including the portion of the population that struggles to adopt service for financial reasons, those that have broadband access through only their mobile devices, and those that would struggle to pay for home broadband service unless it was free. These figures can be used to estimate the portions of home broadband non-adopters that could be reached with additional digital equity efforts, such as Affordable Connectivity Program (ACP) outreach and digital device handout and discount programs.

There are many reasons people may not purchase home internet services. Some simply do not have access to good broadband options. When research firm MoffettNathanson considered the impact of wired internet availability on service adoption, it found that that 87.4 percent of households with an available wired broadband connection actively subscribe to such service.[231] Among those without home broadband service, 25 percent "say they do not have a home subscription because broadband service is not available where they live or not available at an acceptable speed."[232] Pew found that only 72 percent of adults in rural communities subscribe to home broadband service, 7 percentage points less than adults in suburban areas.[233] This rural adoption gap is largely the result of differences in the availability of adequate service, but it also suggests that un-and underserved rural areas may be facing a larger digital skills gap as well, because households without home broadband have long lacked the same opportunities to develop online skills as the rest of the country.

In areas where broadband service is available and plentiful, household income levels explain a significant portion of the gap between internet use and home subscribership. Pew found that 92 percent of adults in households earning $75,000 or more

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[228] Pew, "Internet/Broadband Fact Sheet," April 7, 2021, https://www.pewresearch.org/internet/fact-sheet/internet-broadband/.

[229] Pew, "Internet/Broadband Fact Sheet," April 7, 2021, https://www.pewresearch.org/internet/fact-sheet/internet-broadband/. The 2020 ACS found that 83 percent of households subscribe to wireline internet services, such as cable, fiber, and DSL. FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, December 30, 2022, p. 118, citing U.S. Census Bureau, American Community Survey, 2020 ACS 1-Year Estimates—Public Use Microdata Sample.

[230] John B. Horrigan and EveryoneOn, "Affordability and the Digital Divide: A National Survey of Low- and Lower-Income Households," December 2021, p. 5, https://tinyurl.com/HorriganAffordabilityReport.

[231] MoffettNathanson also found that an estimated 81.5 percent of households subscribe to wired broadband, which is noticeably higher than Pew's estimate. Alan Weissberger, "Broadband Access Subscriber Growth," *IEEE Communications Society Technology Blog*, January 4, 2023, https://techblog.comsoc.org/category/broadband-access-subscriber-growth/. MoffettNathanson's method differed; it analyzed households from the perspective of occupied housing.

[232] Andrew Perrin, "Mobile Technology and Home Broadband 2021," Pew Research Center, June 3, 2021, https://pewresearch-org-preprod.go-vip.co/internet/2021/06/03/mobile-technology-and-home-broadband-2021/.

[233] Emily A. Vogels, "Some Digital Divides Persist Between Rural, Urban and Suburban America," Pew Research Center, August 19, 2021, https://www.pewresearch.org/fact-tank/2021/08/19/some-digital-divides-persist-between-rural-urban-and-suburban-america/.

per year have broadband internet at home, but only 57 percent of households with an annual household income below $30,000 purchase the service.[234]

Digital device ownership is key to service adoption as well; researchers have identified a high correlation between owning a computer and obtaining home broadband services. One survey found that 90 percent of households have a laptop or desktop at home, and 96 percent of those households subscribe to home internet service.[235] Households without a laptop or desktop account for 58 percent of households that do not subscribe to home internet services.[236] When households can afford only a home connection or mobile service, most choose the latter. An estimated 27 percent of adults in households earning less than $30,000 annually are smartphone-only, while 13 percent in households with incomes of $30,000 to $74,999 and only 6 percent in households earning at least $75,000 rely exclusively on their smartphones.[237]

Simply put, many Americans are very sensitive to broadband pricing. In a nationally representative survey of 2,565 adult U.S. residents conducted by Consumer Reports in 2021, nearly a third of U.S. consumers who did not have broadband said the reason is because "it costs too much."[238] Another survey found that 45 percent of people without home broadband identify that the monthly cost of a subscription is too expensive.[239] Approximately 37 percent identified that the cost of a computer was a factor as well.[240]

Low-income households are particularly sensitive to home broadband service pricing. The Benton Institute for Broadband and Society's John Horrigan found that 40 percent of households with annual incomes of $50,000 or less say they cannot afford to pay anything for a home internet subscription.[241] Another 22 percent can afford to pay only about $25 per month.[242] Other research has concluded that prices above $10 to $15 per month are a challenge for low-income households to afford.[243] While many low-income households may choose smartphone service over home broadband service, not all household can afford smartphone service either. One survey found that about 24 percent of adults with household incomes below $30,000 a year say they don't own a smartphone.[244] Home computer costs play a role as well, with 41 percent of adults in the same income range reporting they don't have a desktop or laptop computer.[245]

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[234] Andrew Perrin, "Mobile Technology and Home Broadband 2021," Pew Research Center, June 3, 2021, https://pewresearch-org-preprod.go-vip.co/internet/2021/06/03/mobile-technology-and-home-broadband-2021/.

[235] Sean Buckley, "Looking Forward to Broadband in 2023," *Broadband Communities Magazine*, January/February 2023, https://www.bbcmag.com/broadband-applications/looking-forward-to-broadband-in-2023, citing Leichtman Research Group (licensed research).

[236] Ibid.

[237] Andrew Perrin, "Mobile Technology and Home Broadband 2021," Pew Research Center, June 3, 2021, https://pewresearch-org-preprod.go-vip.co/internet/2021/06/03/mobile-technology-and-home-broadband-2021/.

[238] Jonathan Schwantes, "Broadband Pricing: What Consumer Reports Learned from 22,000 Internet Bills," *Consumer Reports*, p. 9, November 17, 2022, citing Survey Report, "BROADBAND: A Nationally Representative Multi-Mode Survey," *Consumer Reports*, p. 3, July 2021, https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Broadband_June_2021.

[239] Andrew Perrin, "Mobile Technology and Home Broadband 2021," Pew Research Center, June 3, 2021, https://pewresearch-org-preprod.go-vip.co/internet/2021/06/03/mobile-technology-and-home-broadband-2021/.

[240] Ibid.

[241] John B. Horrigan and EveryoneOn, "Affordability and the Digital Divide: A National Survey of Low- and Lower-Income Households," December 2021, p. 5, https://tinyurl.com/HorriganAffordabilityReport.

[242] Ibid.

[243] Jonathan Sallet, "Broadband for America's Future: A Vision for the 2020s," Benton Institute for Broadband and Society, October 2019, 65-66, https://www.benton.org/publications/broadband-policy2020s; Colin Rhinesmith, Bianca Reisdorf, and Madison Bishop, (2019) "The Ability to Pay for Broadband," Communication Research and Practice 5, 2 (2019): 128; Colin Rhinesmith, "Digital Inclusion and Meaningful Broadband Adoption Initiatives," Benton Foundation, January 2016, 16, https://www.benton.org/sites/default/files/broadbandinclusion.pdf.

[244] Emily A. Vogels, "Digital divide persists even as Americans with lower incomes make gains in tech adoption," Pew Research Center, June 22, 2021, https://www.pewresearch.org/fact-tank/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/.

[245] Ibid.

These adoption patterns occur as a result of the specific range of home service prices available to each household. Overall, researchers have a sense of the range of prices consumers pay, but more detailed information is rare and often proprietary. A Consumer Reports study found that "among the 18,359 consumer bills on which an internet price could be identified, the median cost of high-speed internet service was $74.99 per month," with about half paying between $60 and $90 per month.[246]

Research into specific ISP pricing patterns is notoriously difficult. ISPs often use pricing strategies that differ by location, discount strategies that regularly change, and include occasional hidden fees. Each service pricing research effort must make simplifying assumptions to present the data, so the actual prices paid by consumers can differ significantly.

The Federal Communications Commission (FCC) analyzed the advertised rates for stand-alone internet plans in a limited number of markets on the websites of the top 11 fixed broadband providers in the United States, as shown in the chart below.[247] As the FCC noted, "in many cases these plans are not available throughout the provider's service area."[248] Additionally, the stated prices provided by ISPs do not necessarily reflect long-term pricing. The FCC study identified that, of the six providers offering discounts, the average discount was approximately 29 percent.[249] Consumers who are unable to switch to different ISPs may not be able to obtain new service discounts, so the real prices paid by consumers who have few ISP choices for adequate broadband services are often higher than prices paid by consumers in more competitive markets.

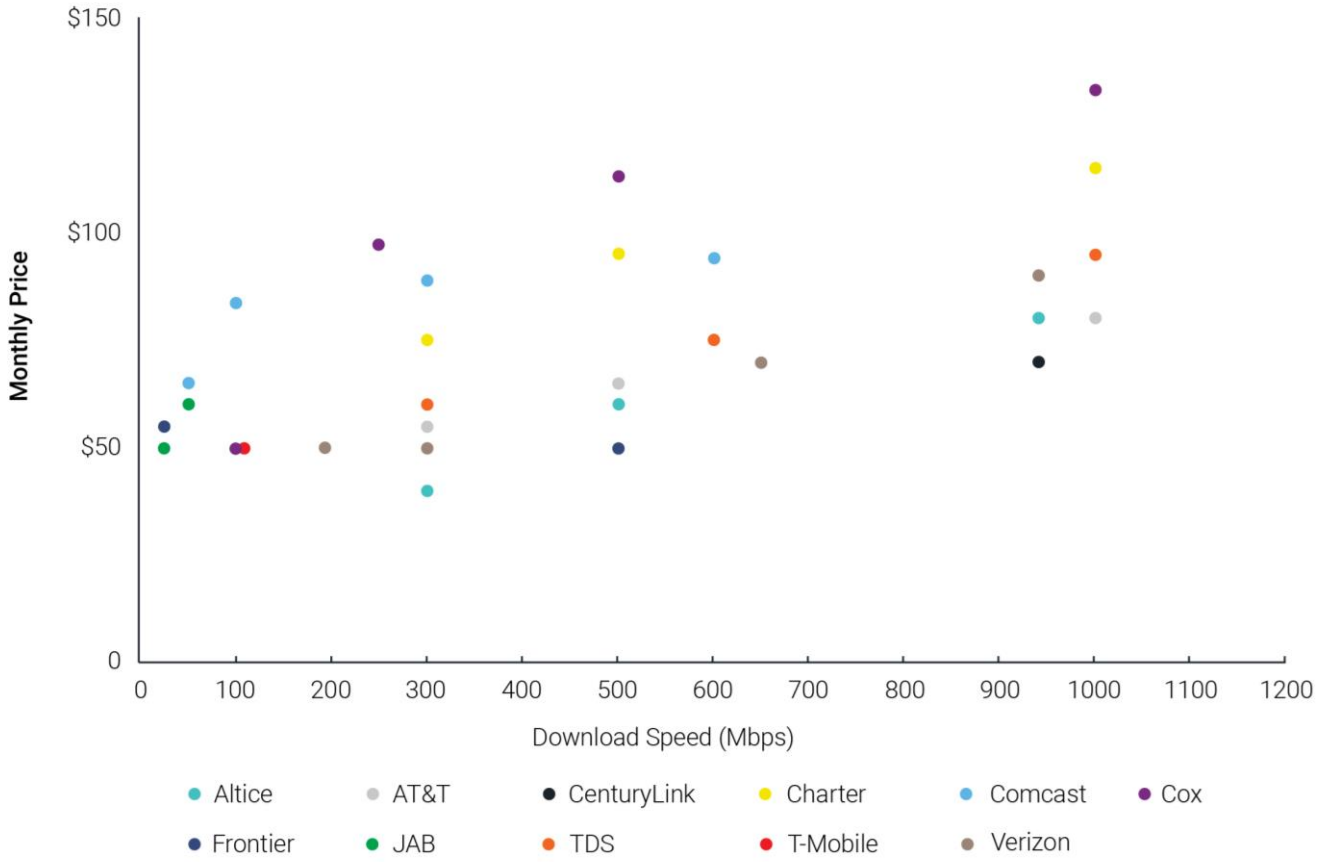
[246] Jonathan Schwantes, "Broadband Pricing: What Consumer Reports Learned from 22,000 Internet Bills, *Consumer Reports*, p. 3, November 17, 2022. Of the bills reviewed, 7,206 were bundled with other services but with internet service portions that couple be separated, while 2,827 bills were for bundled services that could not be used to identify the internet portion of the cost and were removed from the sample to reach this figure. Ibid, 16-17. This price range incorporated a number of additional costs on top of the stated price for the service and reflected the amount that consumers actually pay. Combined, short-term promotional discounts, paperless billing discounts, and credit card-based discounted in total typically ranged from $10 to $50 per month. Equipment charges were between $6 and $18 per month if they were included, and individual fees tied directly to internet service typically ranged from $2.49 to $9.95 per month. Ibid, at p. 4.

[247] FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, p. 29, December 30, 2022. The top 11 fixed broadband providers in the United States were Altice, AT&T, Lumen Technologies (CenturyLink), Charter, Comcast, Cox, Frontier, JAB Wireless, TDS, T-Mobile, and Verizon. Ibid. Using this method, the FCC's reported prices included the paperless billing or credit card-based payment discounts but not short-term promotional discounts, device fees, or additional company-imposed fees. Ibid.

[248] FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, p. 29, December 30, 2022.

[249] FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, p. 30, December 30, 2022.

Figure 38: Monthly Price for Internet-Only Plans[250]



While the FCC's research does not necessarily reflect the pricing in all markets, it does illustrate an important pattern. The price ranges offered by broadband service providers are somewhat similar, regardless of the technology providing the service or the actual service speeds. In other words, companies such as Frontier and AT&T may offer the same range of prices for DSL service in DSL-only areas as it does fiber service, despite the fiber service offering speeds significantly faster than what DSL can offer.

Focusing on the $50 price point, the chart above shows that the download speeds offered for $50 per month range from 25 Mbps to 500 Mbps. For example, Frontier offers both 25 Mbps and 500 Mbps service for $50, depending upon the availability of DSL or fiber technologies.[251] This pricing phenomenon has been referred to as "tier flattening," "in which consumers who have access only to the oldest and slowest internet infrastructure are forced to pay as much or nearly as much for inferior service as those served by newer, faster infrastructure."[252]

[250] FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, p. 30, December 30, 2022.
[251] FCC, "2022 Communications Marketplace Report," GN Docket No. 22-203, pp. 33-34, December 30, 2022.
[252] Jonathan Schwantes, "Broadband Pricing: What Consumer Reports Learned from 22,000 Internet Bills, Consumer Reports, p. 19, November 17, 2022.

Table 24: AT&T Internet Costs

AT&T Internet Costs by Package, Non-discounted prices of internet-only bills			
Package	**Bill Count**	**Mean Price**	**Median Price**
Internet 10	12	$51	$55
Internet 12	23	$58	$63
Internet 18	43	$64	$65
Internet 24	56	$68	$70
Internet 25	73	$60	$60
Internet 45	25	$74	$80
Internet 50	109	$66	$68
Internet 100	89	$63	$60
Internet 300	124	$67	$65
Internet 1000	579	$78	$80

Package names refer to the advertised download speed offered by the option. This is a convenience sample; no statistical inference can be drawn.[253]

The above table demonstrates this tier-flatting phenomenon from a single provider offering DSL in some markets and fiber in others. This pricing research reflects that the cost of the lowest-tier DSL, cable, and fiber services packages in many markets all tend to start at between $50 and $65. The ACP provides a $30 per month subsidy, so unless an ISP offers a qualified low-income plan at a lower price point, the ACP can reduce the cost of this basic plan to between $20 and $35 per month, before any additional fees. Recalling that about a quarter of households with annual incomes of $50,000 or below say they can afford to pay only about $25 per month, the ACP subsidy helps these people adopt broadband when they would not have been able to otherwise. However, unless the ISP offers a special low-income plan for $30 per month (before the ACP subsidy), these services remain out of reach of an estimated 40 percent of households in this low-income category.

Affordability requirements and incentives have been integrated into some of the last mile funding programs to encourage adoption. In the application process, the California Public Utilities Commission's (CPUC) Federal Funding Account (FFA) requires that ISPs submit their menus of service options and corresponding pricing, while committing to not increase those prices for five years.[254] The program awards an additional 10 points to ISPs that commit to not increase prices for an additional five years and provides 20 points to ISPs that offer a low-cost broadband plan at 50/20 Mbps for $40 a month, with free installation and modem.[255] The program also obligates funding recipients to participate in the ACP, so this optional but highly encouraged service cost of $40 per month could drop to $10, making it affordable for nearly all residents in an FFA project's service area.[256]

The Broadband Equity, Access, and Deployment (BEAD) program also strongly prioritizes affordability considerations, requiring that states treat the applicant's stated cost of symmetrical 1 Gbps services as one of the grant program's primary scoring criteria.[257] Funding recipients must also offer at least one low-cost broadband service option to low-income

[253] Jonathan Schwantes, "Broadband Pricing: What Consumer Reports Learned from 22,000 Internet Bills, Consumer Reports, p. 19, November 17, 2022.
[254] FFA Guidelines, p. A-18.
[255] FFA Guidelines, p. A-7.
[256] FFA Guidelines, p. A-7.
[257] BEAD NOFO, p. 43.

families.[258] With the provided example, the NTIA suggests that states require this plan to cost $30 per month, "inclusive of all taxes, fees, and charges."[259] With funding recipients also required to participate in ACP, this qualified service option for low-income families would be free, subject to each eligible household's willingness to sign up for the ACP.

8.2 Service Subsidy Programs

The Affordable Connectivity Program

The Affordable Connectivity Program (ACP) was authorized through the Infrastructure Investment and Jobs Act (IIJA) and is administered by the Federal Communications Commission (FCC) to continue the previously-funded Emergency Broadband Benefit (EBB) program. The ACP provides a monthly internet access discount of up to $30 to eligible households and up to $75 per month on tribal lands.[260] In addition, these same households can receive a one-time discount of up to $100 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. Households that meet at least one of the following criteria are eligible for the ACP:

- Household income at or below 200 percent of the federal poverty line;
- 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:
  - Free and Reduced-Price School Lunch Program or School Breakfast Program, including at U.S. Department of Agriculture (USDA) Community Eligibility Provision schools;
  - SNAP;
  - Medicaid;
  - Federal Housing Assistance, including:
    - Housing Choice Voucher (HCV) Program (Section 8 Vouchers).
    - Project-Based Rental Assistance (PBRA)/Section 202/ Section 811;
    - Public Housing;
    - Affordable Housing Programs for American Indians, Alaska Natives or Native Hawaiians.
  - Supplemental Security Income (SSI);
  - WIC;
  - Veterans Pension or Survivor Benefits.

The ACP's funding is set to run out in the next year or two without additional efforts by Congress, putting its long-term stability in doubt. The FCC offered the second round of the Affordable Connectivity Outreach Grant Program this past summer, providing a total of up to $10 million in funding support to programs designed to increase ACP adoption among eligible

[258] BEAD NOFO, p. 67.
[259] BEAD NOFO, p. 67.
[260] FCC, "Affordable Connectivity Program," https://www.fcc.gov/acp, accessed September 2023.

households.[261] Along with the ACP's inclusion in major last mile funding programs, these efforts strongly suggest that federal policymakers believe the ACP will receive more funding after the initial $14.2 billion allocation is exhausted.

In October 2023 the White House requested an additional $6 billion for the ACP, but at the time of this writing congress has yet to consider the request.

■ Federal Lifeline and California LifeLine Programs

The Universal Service Administrative Company (USAC) administers a program that offers up to $9.25 per month to reduce the cost of qualifying internet and phone services for eligible households.[262] In California, this program has been modified and supplemented with additional benefits provided by the state.[263] The program provides up to $17.90 per month for qualifying mobile or home phone services and relief from a number of additional service fees and taxes, but it does not allow the subsidy to be used for home wireline broadband service.[264] Nevertheless, it remains an important part of broadband adoption promotional strategies. More than a quarter of households with annual earnings at or less than $30,000 are estimated to be smartphone-only.[265] If those households can reduce their smartphone bills by more than $200 per year, these savings can be used to cover the cost of home internet services. When combined with the ACP, qualifying households can reduce their combined home and mobile internet costs by nearly $50 per month.

Similar to the ACP, households can qualify for this combined state and federal program in two primary ways. The income-based qualification method is presented in the figure below. Applicants must submit evidence of their annual income to the California LifeLine Administrator through either an online or paper application and must renew their eligibility status by updating this information annually.

Table 25: California LifeLine Income-Based Qualification Requirement

Household Size	Annual Income Limits
1-2	$32,500
3	$37,700
4	$45,900
Each Additional Member	$8,200
Effective June 1, 2023 to May 31, 2024	

[261] FCC, "Affordable Connectivity Outreach Grant Program – Round 2 Notice of Funding Opportunity," p. 5, 2023, https://www.fcc.gov/sites/default/files/FY_2023_ACP_Outreach_Grant_Program_NCOP_NOFO_Round_2_vF.pdf. The deadline for submissions was June 30, 2023. Ibid. at p. 11.

[262] USAC, "Lifeline – Get Started," https://www.lifelinesupport.org/get-started/, accessed September 2023.

[263] CPUC, "Program Guidelines: Is California LifeLine Right for You?," https://www.californialifeline.com/en/eligibility_requirements, accessed September 2023.

[264] CPUC, "California LifeLine Eligibility, https://www.cpuc.ca.gov/consumer-support/financial-assistance-savings-and-discounts/lifeline/california-lifeline-eligibility#qualify, accessed September 2023.

[265] Andrew Perrin, "Mobile Technology and Home Broadband 2021," Pew Research Center, June 3, 2021, https://pewresearch-org-preprod.go-vip.co/internet/2021/06/03/mobile-technology-and-home-broadband-2021/.

Alternatively, applicants can provide evidence that they participate in any of the following programs to qualify for the subsidy:

- Medicaid/Medi-Cal
- Low Income Home Energy Assistance Program (LIHEAP)
- Supplemental Security Income (SSI)
- Federal Public Housing Assistance or Section 8
- CalFresh, Food Stamps or Supplemental Nutrition Assistance Program (SNAP)
- Women, Infants and Children Program (WIC)
- National School Lunch Program (NSL)
- Temporary Assistance for Needy Families (TANF)
    - California Work Opportunity and Responsibility to Kids (CalWORKs)
    - Stanislaus County Work Opportunity and Responsibility to Kids (StanWORKs)
    - Welfare-to-Work (WTW)
    - Greater Avenues for Independence (GAIN)
- Tribal TANF
- Bureau of Indian Affairs General Assistance
- Head Start Income Eligible (Tribal Only)
- Food Distribution Program on Indian Reservations
- Federal Veterans and Survivors Pension Benefit Program

8.3 Reviewing and Assisting with CAI Efforts

- **Conduct outreach with Community Anchor Institutions (CAIs) and community broadband leaders**

In many communities, the digital divide is among the most important issues that social service-oriented organizations must address, because most other social programs either depend on or strongly benefit from online connectivity among participants. Employment and workforce development programs must encourage those seeking work to acquire connectivity, because it is vital to search for and apply to job openings, use online skills development opportunities, and discover the other online resources provided by the programs themselves. Similarly, people receiving assistance from programs related to healthcare, continuing education, elder care, income assistance, and other social service areas benefit significantly from online connectivity and are often unable to utilize full support opportunities without it. As a result, governmental organizations and CAIs offering these programs tend to be very aware of the digital divide and how it impacts the efficacy of their own programs.

A locality's digital inclusion efforts should begin by reaching out to these organizations to better understand local digital equity problems and how they impact these other social support areas. These outreach efforts should serve as a basis to develop more long-term relationships between social service organizations and the locality itself, because a locality can evaluate how efforts to improve adoption and digital skills can help other social programs and can support coordination between these organizations to create a more cohesive overall digital inclusion strategy.

Some of these organizations likely will be addressing the digital divide more directly. With their mission to connect people to information and learning opportunities, libraries play a significant role in helping people access the internet. Library leadership will typically have a good sense of the types of digital divide issues that their staff assist with every day and can provide information about the list of broadband accessibility and digital skills development opportunities offered at their local branches. Schools also typically have information about the portions of their students that struggle with home connectivity.

- **Develop or support ACP and California LifeLine adoption awareness programs**

Many localities, non-profits, and CAIs have created programs to help ensure qualified households sign up for the ACP. These outreach programs are often successful in enrolling qualified households in the ACP monthly subsidy program. While some CAIs have developed significant programs that provide eligible households with direct assistance throughout the enrollment process, others have focused primarily on spreading awareness and providing signup information. These campaigns can be large or small in scope, so organizations with few resources can still contribute to awareness if they are interested in doing so.

The FCC has provided a toolkit for CAIs, local governments, and trusted community organizations to raise awareness about the ACP.[266] This toolkit contains consumer handouts, flyers, explanations for newsletter distribution, audio PSAs, and even pre-designed social media posts that localities and CAIs can immediately use to spread awareness of the program. Community anchor institutions should be encouraged to look at these materials and include them in their communications strategies. A few organizations, such as EducationSuperHighway, will provide individuals with signup assistance directly without a fee.[267] Organizations promoting awareness should encourage people to use these additional resources.

[266] FCC, "ACP Consumer Outreach Toolkit," https://www.fcc.gov/acp-consumer-outreach-toolkit, accessed September 2023.

[267] EducationSuperHighway, "Affordable Home Internet. Made Easy." https://www.educationsuperhighway.org/acpbenefit/, accessed October 2023.

SECTION

09

WHAT IS A SMART COMMUNITY?

9.1 Defining a Smart Community

Many rural counties, suburban areas, and towns and cities are on the cusp of rapid change precipitated by a demand for digital services and the new technologies, such as high-speed broadband internet, that enable them. How can a community make informed decisions about its future, improve the efficiency of local government services, and meet the actual needs of its residents and businesses? While there is no one-size-fits-all definition for Smart Communities, they're generally recognized as digitally connected communities that utilize technology and data to improve the quality of life for all residents. Each community must go through a thoughtful planning process, informed by stakeholder input, to create a vision for the future that's backed by policy guidance and implementation plans.

9.1.1 Foundational Elements of Smart Communities

The following Foundational Elements are used to guide the development of Smart Community plans and selection of technology and strategies to address community needs and issues.

- **People Focused/Community Driven:** The needs and challenges of residents, businesses, and visitors are the primary focus for adopting new technology and innovation.
- **Co-Created:** Residents, businesses, and government participate in the decision-making process, including the identification of challenges and opportunities.
- **Healthy:** Smart Communities promote active lifestyles that improve physical and mental health.
- **Equitable:** A Smart Community is a compassionate community that works to enhance vulnerable and disadvantaged populations, reducing gaps to access and opportunity.
- **Sustainable:** A Smart Community seeks a balance between environmental protection, social equity, and economic development priorities.
- **Resilient:** A Smart Community maintains continuity of governance and business during chronic and acute stressors, including climate and severe weather impacts.
- **Data-Informed**: A Smart Community collects and analyzes data to provide better and more efficient digital and physical services for all.
- **Solution Oriented:** A Smart Community matches the right technological and innovative solutions to identified and established community issues and challenges.
- **Transparent:** A Smart Community discloses what data it collects and how it is used. The public understands how decisions are made.
- **Interconnected:** A Smart Community is connected digitally by information technology and physically through urban planning and mobility solutions.

9.1.2 Benefits of Smart Communities

The Smart Communities approach for Tehama County will identify technologies and innovation that address current issues and prepare for the future. By prioritizing sustainability, resiliency, and equity, Tehama County can leverage technology and data to improve the quality of life for all residents while minimizing its impact on the environment. This can include implementing renewable energy sources, green buildings, and efficient transportation systems as well as promoting equitable access to resources and services such as affordable housing, transportation, and healthcare. Additionally, a smart community can be prepared to respond to natural disasters and other challenges by implementing emergency preparedness plans and investing in resilient infrastructure. Overall, the Smart Community Application Plan can help Tehama County become a more livable, sustainable, and resilient place for all its residents.

9.2 Tehama County's Existing Conditions

Tehama County is located in northern California and has a population of around 65,245 people.[268] Agriculture is the main economic driver of the county, and it's home to the prominent Shasta University in Red Bluff. Trade of goods has been the biggest economic driver; with the Sacramento River and now Interstate 5 as potential trade routes. According to the Justice 40 Initiative criteria, 100 percent of the census tracks in the county are disadvantaged communities.

9.2.1 Climate, Hazards, and Other Issues

VHB reviewed publicly available information, including the county website, strategic plan, data provided by Tilson, and surveys conducted during the Broadband study to identify existing community issues and challenges.

VHB reviewed the CalEnviroScreen[269] tool, a mapping tool created by the California Office of Environmental Health Hazard Assessment, to identify census tracts that are most affected by sources of pollution, and where people are often especially vulnerable to pollution's effects. CalEnviroScreen uses environmental, health, and socioeconomic information to produce scores for every census tract in the state. An area with a high score is one that experiences a much higher pollution burden than areas with low scores. The CalEnviroScreen[270] Score for Tehama County is 49.9/100; primary hazards to the community are exposure to pesticides, ozone, and unsafe drinking water—all of which result from impaired water bodies, solid waste hazards, and groundwater threats. Primary community health risks include vulnerability to asthma and cardiovascular disease. The factors contributing to socioeconomic vulnerability are poverty, unemployment, and education attainment.

- **Digital Equity**

According to the California All Middle Mile Broadband Initiative, many residents struggle with internet and broadband access due to the county's diverse geography and the mix of demographics between rural and urban areas.[271] While urban centers such as Tehama, Red Bluff, Corning, and Los Molinos have existing open access broadband networks with higher speeds and reliability, rural areas in the eastern and western parts of the county have no broadband services available. These rural areas

268 US Census Bureau Tehama County
269 About CalEnviroScreen | OEHHA
270 CalEnviroScreen 4.0 Data Dashboard (arcgis.com)
271 California All Middle Mile Broadband Initiative

include Lake California, Dales, Mineral, Paskenta, and Rancho Tehama.[272] This lack of availability is particularly problematic for rural and remote communities residing in areas surrounded by forests and natural resources, limiting their access to emergency protocols, online content, and modern internet applications.

■ Transportation

The mean travel time to work in Tehama County is 22.0 minutes.[273] According to the Regional Transportation Plan 2019, the daily vehicle miles traveled (VMT) for the cities of Red Bluff, Corning, and Tehama shows a decrease between 5 percent and 25 percent between 2010 and 2016, while the county daily VMT has increased by 7 percent during the same period. This indicates that in-town driving has decreased but commuting has increased between communities within and outside Tehama County. This corelates to commute patterns that show 55 percent of county residents travel to the surrounding counties of Shasta, Butte, Sacramento, and Glenn for work. In rural areas, personal vehicles are the primary transportation mode and most travel to work is characterized by single-occupancy drivers (80 percent) or carpooling (10 percent). The remaining 10 percent is split between walking, public transport, taxicab, and bicycle.[274] The TRAX (Tehama Rural Area Express, fixed route) and the ParaTRAX (ADA only complimentary service in greater Red Bluff area) provide mobility to the communities of Red Bluff, Corning, Tehama, Los Molinos, and the greater unincorporated area of the county. METS, Medical Transportation Service, is a long-established public/private partnership in Tehama County. A commercial bus service is also available and offers fixed routes, interregional and cross-county transportation.[275]

■ Agriculture

Agriculture has been the backbone of Tehama County's economy. The favorable geographical location of the county in the Sacramento valley along with availability of water, fertile soils, and climatic conditions have contributed to stable production.[276] However, according to the 2009 General Plan, agricultural lands in the county have faced land use conflicts from non-agricultural development pressures. Additionally, most of the agricultural use, including cropland, orchards, and grazing, depends on availability of irrigated water from surface and groundwater sources. Even though the demand for agricultural water is expected to remain stable, water quality is a pressing issue due to erosion and run-off from agriculture.

■ Emergency Preparedness

According to the Emergency Operations Plan, the top three climate threats identified for the county are wildland fire, flood, and severe weather. Additionally, there is a risk of dam failure, hazardous material release, and volcanoes.[277] The county is currently experiencing a cycle of extreme heat, drought, and fire that is exacerbated by climate change. While wildfires are a natural occurrence in California, their frequency, size, and impact have increased due to longer wildfire seasons. The county also lacks proper access to wildlands for use, maintenance, and emergencies—thus limiting fire safety and mitigation measures. Furthermore, areas along the Sacramento River and tributary corridors, which includes the urban centers of Red Bluff and Tehama, are vulnerable to flooding. Another potential hazard is dam failure, which can cause inundation in significant portions of the county, including the Red Bluff Diversion Dam on Sacramento River, Black Butte Dam on Stoney

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272 GoldenStateNet Project 02 | Plumas, Tehama

273 2009 Tehama County General Plan

274 2019 Tehama County Regional Transportation Plan

275 2009 Tehama County General Plan

276 2009 Tehama County General Plan

277 Emergency Operations Plan 2023

Creek, and Shasta Dam (in Shasta County). The urban centers of Red Bluff and Tehama are vulnerable to inundation due to dam failures because of their location in the Sacramento Rover corridor.[278]

In the year 2020, the predominant source of electricity production was hydropower, followed closely by solar and natural gas. Electricity consumption has been steadily rising since 2020, with July and August being peak months of consumption. Tehama County ranks seventh out of the 58 counties in wind power generation in California and has a total yield of 1,732 megawatts from wind power. The county also produced 13,336 megawatts of electricity from solar.[279]

9.2.2 Community Plans and Initiatives

Through a review of publicly available data, VHB has observed that the following smart community technologies are already in use within the county.

- **Broadband**

Tehama County is adopting numerous strategies from the Broadband Strategic Plan to improve internet and broadband access. The county is part of the GoldenStateNet Project 02, which plans to build upon the existing open access broadband network by the California Public Utilities Commission (CPCU) and increase access to broadband in the western portion of the county along Highway 36. This project is notable for the potential opportunity of a joint build to construct fiber broadband paths.[280] The Middle Mile Broadband line is also proposed to be built along main transit corridors in the county, which will strengthen its existing open access broadband network.[281] Additionally, the county is actively searching for opportunities to install broadband infrastructure with public and private construction projects.

- **Transportation**

The county has a growing system of active transportation infrastructure such as multi-use trails and bike lanes. The urban center of Corning has prepared a bicycle/pedestrian plan funded by the California Transportation planning grant. As discussed in Existing Conditions, Tehama County's public transit includes a range of services for public use as well as specialized services for disabled and elderly. All public transit buses are provisioned with bike racks and wheelchair lifts.[282] The county also has EV charging stations along the major transit corridor of Interstate 5 in the urban centers of Corning and Red Bluff.

- **Energy**

While documentation on energy planning is limited in Tehama County, the 2009 Tehama County General Plan[283] features a combination of strategies focused on achieving greater sustainability through energy conservation measures. This includes achieving energy conservation in construction of new development, adoption of energy saving technologies such as LED lighting and renewable energy sources, encouraging the use of "EPA Energy Star" certified appliances and equipment, and providing incentives for energy efficiency for buildings and facilities. Municipalities within the county, such as Tehama City,

[278] 2009 Tehama County General Plan

[279] Find Energy

[280] GoldenStateNet Project 02 | Plumas, Tehama

[281] California All Middle Mile Broadband Initiative

[282] 2019 Tehama County Regional Transportation Plan

[283] https://www.co.tehama.ca.us/wp-content/uploads/2021/12/Tehama-County-General-Plan.pdf

have also adopted energy conservation measures in their general plans. The City of Tehama General Plan includes opportunities for energy conservation that include building partnerships with utilities to assist households in conserving energy and lowering electric and gas utility rates for low-income households.[284]

9.3 Initial Smart Community Strategies

The introduction of additional high-speed broadband connectivity will enhance the ability of Tehama County to deploy smart community technologies that provide more efficient public services and enhance sustainability, resilience, equity, and quality of life for residents and businesses.

The smart community technologies that are potentially applicable to rural California counties are organized into 5 Pillar Focus Areas:

- Digital Community Infrastructure
- Climate Adaptation, Hazard Monitoring and Resilience
- Connected Public Infrastructure
- Smart Transportation Operations
- Smart Agriculture and Food Systems

Pillar focus areas help guide the development and implementation of initiatives and projects that aim to improve various aspects of community life through the use of technology and innovation.

Each Pillar focus area contains several strategies to address community needs, such as sustainability, resilience, and equity, through the integration of smart community technologies and processes. A strategy is a broad plan or approach that outlines goals and objectives, as well as the actions and resources needed to achieve them. It's a high-level plan that provides direction and guidance for an organization or project.

9.3.1 Digital Community Infrastructure

Digital community infrastructure refers to the use of digital technologies and platforms to support community development and engagement. This includes the use of social media, online forums, and other digital tools to connect community members and facilitate communication and collaboration. Digital community infrastructure also includes the development of digital services and resources, such as online education and healthcare platforms, to improve access to essential services. The goal of digital community infrastructure is to create a more connected and inclusive community that can leverage digital technologies to improve quality of life and promote social and economic development.

Local government can improve digital services by investing in technology infrastructure, such as high-speed internet and digital devices, to ensure that all residents have access to digital services. They can also develop user-friendly digital platforms and applications that are accessible to all residents, including those with disabilities or limited digital literacy. Local government can also provide training and support to residents to help them navigate and use digital services effectively. Additionally, local government can engage with residents to gather feedback and input on digital services and use this

[284] https://www.dropbox.com/s/avt09rfyzckdi9m/Tehama_GP2045_Rev202212.pdf?dl=0

information to continuously improve and update digital offerings. Finally, local government can collaborate with other organizations, such as nonprofits and private-sector companies, to improve digital services.

Strategy

- Improve Digital Access and Equity
- Promote Digital Governance to Improve Communication Between Government and Citizens
- Use GIS and Digital Twin Technologies for Geospatial Analysis and Modeling

9.3.2 Climate Adaptation, Hazard Monitoring, and Resilience

Climate adaptation and resilience refer to the ability of a system or community to withstand and recover from the impacts of climate change. This includes the development of strategies to mitigate the effects of extreme weather events, sea level rise, and other climate-related hazards. Climate adaptation and resilience also involve the integration of climate considerations into planning and decision-making processes, such as land use planning and infrastructure development. The goal of climate adaptation and resilience is to reduce vulnerability to climate change and ensure the long-term sustainability and well-being of communities and ecosystems.

Climate hazard monitoring refers to the ongoing monitoring and assessment of climate-related hazards, such as extreme weather events, sea level rise, and changes in temperature and precipitation patterns. This involves the collection and analysis of data on climate conditions and trends, as well as the identification of potential risks and vulnerabilities associated with these hazards. Climate hazard monitoring is important for informing climate adaptation and resilience strategies as well as for supporting disaster preparedness and response efforts. By monitoring climate hazards, communities and organizations can better understand and prepare for the impacts of climate change and take proactive measures to reduce their vulnerability and increase their resilience.

The 22 counties in this study are some of the nation's most climate-vulnerable. Being primarily inland, the greatest climate risks are droughts, wildfires, inland flooding from cloudburst events, extreme heat, earthquakes, and landslides. These events impact communities in numerous ways, from droughts damaging regional agricultural economies to wildfires and landslides devastating homes. Many of these climate hazard events are now costing both the state and the nation billions of dollars each year.

Strategy

- Create Digital Model to Identify Climate Risks, Vulnerable Communities, and Critical Infrastructure
- Use Weather Monitoring & Analysis to Predict and Prepare for Climate Hazards
- Expand Wildfire Detection and Monitoring Systems to Improve Safety
- Expand Flood and Landslide Monitoring Systems to Improve Safety

9.3.3 Connected Public Infrastructure

Connected public infrastructure refers to the integration of various technologies and systems to create a network of interconnected infrastructure. This includes the use of sensors, cameras, and other devices to collect data on traffic patterns, energy usage, and other infrastructure-related information. This data is then analyzed and used to optimize performance, improve safety, and reduce costs. Connected infrastructure also includes the use of communication technologies to enable real-time monitoring and control of infrastructure systems, such as traffic lights and energy grids. The goal of connected infrastructure is to create a more efficient, sustainable, and resilient infrastructure system that can adapt to changing needs and challenges.

Strategy

- Use Smart Water Systems to Optimize Conservation Efforts
- Expand Use of Clean and Renewable Energy Systems to Reduce Carbon Emissions

9.3.4 Smart Transportation Operations

Smart transportation operations refers to the use of advanced technologies and data analytics to optimize existing transportation systems and increase efficiency. It involves the integration of various technologies such as sensors, GPS, and artificial intelligence to collect and analyze data on traffic patterns, vehicle performance, and passenger behavior. This data is then used to make informed decisions on route planning, traffic management, and vehicle maintenance. Smart transportation operations also include the use of connected vehicles and infrastructure to improve safety and reduce congestion. The goal of smart transportation operations is to improve mobility, reduce travel time, and minimize environmental impact while ensuring safe and reliable transportation for all.

Smart transportation operations include an emphasis on decarbonized mobility, or the transition from fossil fuel-based transportation to low-carbon or zero-emission modes of transportation. This includes the use of electric vehicles, hydrogen fuel cell vehicles, and other forms of alternative fuels. Decarbonized mobility also involves the development of sustainable transportation infrastructure, including charging stations and hydrogen refueling stations, to support the widespread adoption of low-carbon transportation. The goal of decarbonized mobility is to reduce greenhouse gas emissions from the transportation sector, which is a major contributor to climate change, while ensuring sustainable and efficient transportation for all.

Strategy

- Use Intelligent Transportation Systems (ITS) to Optimize Operations of Existing Transportation Networks
- Provide On-Demand Mobility as a Service (MaaS) to Enhance Trip Planning and Mobility
- Provide Digital Wayfinding to Reduce Traffic Congestion and Provide Public Safety Alerts
- Provide Smart Parking Solutions to Optimize Availability and Increase Revenue
- Deploy Charging and Fueling Infrastructure to Support Zero Emissions Vehicles (ZEV) and Electric Vehicles (EV)
- Deploy Microtransit Solutions to Provide Increased Transportation Options and Reduce Traffic Congestion

9.3.5 Smart Agriculture & Food Systems

Smart agriculture is the use of advanced technologies and data analytics to optimize agricultural production and increase efficiency. It involves the integration of various technologies, such as sensors, drones, GPS, and artificial intelligence, to collect and analyze data on soil conditions, weather patterns, crop growth, and livestock health. This data is then used to make informed decisions on crop management, irrigation, fertilization, and pest control. Smart agriculture also includes precision farming techniques that reduce waste and improve yields by enabling farmers to apply inputs only where they are needed. The goal of smart agriculture is to increase productivity, reduce costs, and minimize environmental impact while ensuring sustainable food production.

Strategy

- Use Soil Sensors to Optimize Irrigation, Fertilization, and Tillage
- Use Smart Irrigation Systems to Provide the Optimal Amount of Water for each Crop
- Use Aerial Drones to Monitor Crop Health, Irrigation, Spraying, and Planting, Soil and Field, Plant Counting, and Yield
- Use Smart Greenhouses to Create a Self-Sustaining Microclimate for Crop Production

9.4 Prioritized Strategies

VHB reviewed the Climate, Natural Hazards, and other Issues identified in Section 2 to evaluate which Smart Community strategies are most appropriate for the identified needs of Tehama County. This evaluation also considers the issues identified in County plan documents, survey results (where applicable), and technologies already in use by the county.

The Prioritized Strategies for Tehama County are as follows:

- Expand Wildfire Detection and Monitoring Systems to Improve Safety
- Expand Flood and Landslide Monitoring Systems to Improve Safety
- Use Weather Monitoring & Analysis to Predict and Prepare for Climate Hazards
- Use Smart Water Systems to Optimize Conservation Efforts
- Deploy Charging and Fueling Infrastructure to Support Zero Emissions Vehicles (ZEVs) and Electric Vehicles (EVs)

9.4.1 Strategy: Expand Wildfire Detection and Monitoring Systems to Improve Safety

■ **Description**

In the wake of increasing climatic changes and environmental challenges, the strategy for expanding wildfire detection and climate monitoring systems in rural California is aimed at proactively identifying and mitigating potential wildfire threats. Utilizing a fusion of advanced technologies such as satellite imaging, drones, ground sensors, AI predictive analytics, and robust communication infrastructures, this comprehensive approach offers real-time surveillance, accurate data collection, and swift response mechanisms for both wildfires and significant climatic shifts.

The importance of this strategy cannot be overstated. Rural California, with its expansive woodlands and dry terrains, has historically been vulnerable to devastating wildfires, which endanger lives, destroy homes, and decimate ecosystems. The economic and environmental repercussions of these events have ripple effects that are felt locally and nationally. Moreover, as climate change exacerbates weather extremes, monitoring shifts in the environment becomes crucial to predicting and preparing for these volatile events. Thus, by investing in and advancing these monitoring systems, we not only safeguard our communities and natural landscapes but also equip ourselves with the tools and knowledge necessary to combat the unpredictable challenges of a changing climate.

Applications and Use Cases

- **Computer Vision-Based Wildfire Monitoring Systems:** A vital component in modern wildfire detection and monitoring systems, Wildfire lookout cameras offer continuous, real-time surveillance of vulnerable landscapes. Equipped with high-definition, pan-tilt-zoom capabilities, these cameras are strategically placed at elevated vantage points to maximize their field of view, often covering dozens of miles in all directions. Utilizing advanced image recognition algorithms, they can automatically detect signs of smoke or fire and alert relevant authorities within seconds, thereby significantly reducing the time between the onset of a wildfire and the initiation of emergency response measures and aiding in the protection of lives, property, and natural ecosystems.
- **Emissions-Based Wildfire Monitoring Systems:** Wildfire emissions sensors are cutting-edge devices specifically engineered to monitor air quality and detect pollution levels associated with wildfires. Strategically deployed in fire-prone regions, these sensors are capable of measuring a range of pollutants, including particulate matter, carbon monoxide, and volatile organic compounds, and provide real-time data that is crucial for assessing the environmental and health impacts of wildfires. Integrated with advanced analytics and communication systems, these sensors not only alert emergency services and local communities to deteriorating air quality but also contribute valuable information for research and policy making. By continuously tracking and analyzing wildfire-induced emissions, these sensors offer an indispensable tool for mitigating both the immediate and long-term impacts of wildfires on air quality and public health.
- **Automated Wildfire Emergency Notification System:** The automated wildfire emergency notification system is a state-of-the-art alerting mechanism designed to provide immediate warnings to first responders and local communities when a potential wildfire threat is detected. Using real-time data from a network of cameras, sensors, and satellite imaging, this system employs advanced algorithms to accurately identify the early signs of wildfires. Upon detection, it automatically triggers a cascade of alerts via multiple platforms—such as text messages, emails, and dedicated apps—to ensure rapid dissemination of critical information. By significantly narrowing the time window between the onset of a fire and the initiation of emergency response actions, the automated wildfire emergency notification system plays a pivotal role in safeguarding lives, property, and natural resources, while allowing for more effective coordination among various agencies involved in wildfire management.
- **Drone and Unmanned Aerial Vehicles:** Unmanned aerial vehicle (UAV) deployment for investigating and monitoring potential and active wildfires represents a transformative approach to wildfire management. These UAVs can quickly and safely cover expansive and often rugged terrains that are difficult for human surveyors to access. Offering high-resolution imaging, thermal cameras, and smoke detection sensors, they provide real-time data that is invaluable for both the early identification of potential fire zones and the tracking of active wildfires. Integrated with predictive analytics and communication networks, the UAVs can instantly relay critical information to emergency services, facilitating timely and effective response strategies. By serving as agile, high-tech scouts in the sky, UAVs help protect communities and conserve natural ecosystems by enhancing situational awareness and operational capabilities in wildfire management.

- **Real Time Wildfire Tracking Systems:** Emergency response resource allocation, based on real-time fire location and severity data, revolutionizes the traditional approach to wildfire management by dynamically optimizing the deployment of firefighters, equipment, and other critical resources. Utilizing a data-driven model fed by an array of inputs—including satellite imagery, ground sensors, UAV footage, and weather forecasts—this system employs advanced analytics to assess the evolving nature and risk of active or potential fires. Based on this real-time analysis, the system then automates or advises the allocation of available resources, ensuring that they are directed where they are needed most. By providing a responsive, adaptive, and highly efficient method for marshaling resources, this approach substantially enhances the effectiveness of wildfire response efforts, ultimately saving lives, protecting property, and minimizing environmental damage.
- **Connected Infrastructure Systems:** Infrastructure systems linked to wildfire monitoring are designed to safeguard essential utilities by providing real-time alerts to utility companies, enabling the immediate shutdown of power lines and gas lines in areas at risk from an active wildfire. These integrated systems utilize data streams from a variety of sources, such as satellite imagery, ground sensors, and predictive analytics, to identify zones where fires are likely to spread. Upon detection of an emerging threat, the system triggers automated or manual protocols to temporarily disable vulnerable utility lines, thereby preventing them from serving as additional ignition sources or suffering damages. This multi-layered, responsive approach allows for a more coordinated and effective emergency response, enhancing both public safety and infrastructure resilience by reducing the risk of wildfire-induced utility failures and catastrophic events.
- **Online Public Wildfire Tracking Application:** Public Facing Web Applications offer a real-time, interactive platform to provide communities with critical information on wildfire locations, air quality, and designated safe zones. Sourced from a network of ground sensors, satellite imagery, and other monitoring systems, these applications serve as a centralized hub for data visualization and situational awareness. With user-friendly interfaces and geolocation features, they enable residents to easily track fire movements, assess air quality levels, and identify the nearest safe havens in the event of an emergency. By offering timely and accurate updates, these web applications empower individuals to make informed decisions for their safety and well-being while also facilitating more effective communication and coordination among residents, community organizations, and emergency services. In situations where timely information can make all the difference, these public-facing platforms are indispensable tools for community resilience against wildfires.
- **Real-Time Evacuation Protocols:** Evacuation Protocols based on real-time monitoring of wildfires represent a groundbreaking approach to public safety. These protocols ensure that residents receive timely warnings and access to the safest and fastest evacuation routes away from danger zones by using a dynamic system that continuously ingests data from an array of sources, such as ground sensors, satellite imagery, and UAV footage. Advanced algorithms analyze this real-time information to identify emerging threats and dynamically update evacuation plans. Residents receive immediate alerts via multiple communication channels, including text messages, phone calls, and apps, which provide warnings and turn-by-turn directions to the nearest safe locations. These smart evacuation protocols minimize the time between threat detection and community action, substantially increasing the odds of a successful and orderly evacuation.
- **Post-Fire Recovery Assessment:** Assess post-fire rehabilitation systems utilize advanced monitoring technologies to evaluate the damage wrought by wildfires on properties, the environment, and infrastructure. These systems employ a combination of satellite imagery, UAVs equipped with high-resolution and thermal cameras, and ground sensors to generate a comprehensive picture of affected areas. This data is then processed through specialized analytics software to quantify the extent of the devastation, from scorched landscapes and ruined buildings to compromised roads and utility networks. The detailed assessments help prioritize the most critical needs for restoring communities and natural habitats. Moreover, the collected data can be archived and studied to improve

future fire mitigation strategies. By providing precise, real-time insights into the aftermath of wildfires, Assess post-fire rehabilitation systems play a pivotal role in facilitating effective and efficient recovery efforts.

- **Wildfire Frequency Trend Analysis and Risk Modeling:** Wildfire frequency trend analysis and risk modeling systems are designed to synthesize a multitude of data points, including historical wildfire incidents, weather patterns, and land use, to better inform future wildfire mitigation efforts in the Wildland-Urban Interface (WUI) as well as in land management, climate adaptation planning, and insurance adjustments. The systems use machine learning algorithms and big data analytics to provide predictive models that identify areas of increased fire risk and estimate the likely frequency and intensity of future events. By isolating key variables and their interdependencies, these models serve as a robust basis for a range of applications, from guiding controlled burns and zoning regulations to influencing insurance premiums and climate resilience measures. As climate change intensifies the threats posed by wildfires, these advanced analytical tools safeguard communities and natural ecosystems alike by helping to proactively plan and inform decision-making.

Benefits

- **Early Detection and Rapid Response:** Live monitoring for wildfires allows for early detection and rapid response efforts to prevent wildfires.
- **Faster Wildfire Response Times:** Faster response times can result in putting out wildfires before they get out of control.
- **Disaster Reconnaissance:** Utilizing UAV for wildfire reconnaissance can quickly give emergency responders valuable information that mitigate wildfire damage and save lives.
- **Real-Time Tracking:** During an extreme wildfire event, first responders can accurately track the location, speed, and intensity of a wildfire and respond accordingly.
- **Enhanced Public Communication:** Robust communication saves lives during wildfire events.
- **Rapid Recovery and Adaptation:** The ability to determine areas that are frequently at risk from wildfires provides responders with information to guide the recovery process.

Metrics and Key Performance Indicators

- **Wildfire Detection Accuracy:** The accuracy of wildfire detection systems in identifying and locating wildfires in rural areas. This can be expressed as a percentage of correct detections compared to false alarms.
- **Response Time:** The time it takes for emergency services to respond to a detected wildfire. A shorter response time can minimize damage and save lives.
- **Evacuation Efficiency:** An evaluation of how quickly and efficiently residents in affected areas are evacuated during wildfire events. This can be measured in terms of evacuation completion time and the percentage of the population successfully evacuated.
- **Air Quality Index (AQI):** A measure of the AQI in urban areas affected by wildfires. High AQI levels can have health implications for urban residents, so maintaining good air quality is vital.
- **Infrastructure Resilience:** The resilience of critical infrastructure (e.g., power lines, water supply) to wildfire events. Metrics might include the percentage of infrastructure that remains functional during a wildfire and the time it takes to restore services.
- **Community Preparedness:** The level of preparedness of urban communities for wildfires. This can include the percentage of households with emergency kits, evacuation plans, and awareness of evacuation routes.

- **Emergency Communication Reliability:** The reliability of communication systems during wildfire events, such as cell networks and emergency alert systems.

Risks

- **Cost Overruns:** Developing and maintaining advanced monitoring systems can be expensive. There's a risk of budget overruns if the initial cost estimates are not accurate or if ongoing maintenance costs are underestimated.
- **Technological Challenges:** The integration of various technologies such as satellite imaging, drones, AI, and communication infrastructure can be complex. Technical failures or compatibility issues between these systems can disrupt monitoring efforts.
- **Data Privacy and Security:** Collecting and storing sensitive data related to wildfire detection and climate monitoring raises concerns about data privacy and security. Unauthorized access and data breaches could compromise citizen privacy and critical information.
- **False Alarms:** Overly sensitive detection systems may generate frequent false alarms, which can strain emergency response resources and lead to complacency among the public.
- **Public Resistance:** Some communities may resist the installation of monitoring infrastructure due to concerns about privacy, aesthetics, or perceived health risks such as those associated with cell towers.
- **Data Quality and Reliability:** Ensuring that the data collected by monitoring systems is accurate and reliable is crucial. Inaccurate data can lead to incorrect assessments of wildfire risks and climate trends.
- **Infrastructure Vulnerability:** The infrastructure supporting these monitoring systems may themselves be vulnerable to natural disasters such as wildfires or extreme weather events, potentially causing service disruptions.
- **Community Engagement:** Engaging with local communities is essential to gaining their support for these systems. Resistance or lack of cooperation from residents can hinder implementation and effectiveness.
- **Changing Climate Patterns:** Climate change can lead to shifts in wildfire behavior and patterns, making it challenging to predict and respond to these events accurately.
- **Resource Allocation:** Allocating resources to wildfire detection and climate monitoring may divert funds from other important planning initiatives. Misallocation can impact the overall effectiveness of the system and , potentially impact overall community development.
- **Interagency Coordination:** Coordinating efforts among various agencies responsible for wildfire response and climate monitoring can be complex and require effective collaboration.

Potential Partnerships

- **State and Local Government Agencies:** Agencies such as CAL Fire, local fire departments, the California Office of Emergency Services (CalOES), and the California Department of Fish and Wildlife (CDFW) aid in comprehensive wildfire management.
- **Federal Agencies:** Federal agencies, such as the United States Forest Service (USFS), National Oceanic and Atmospheric Administration (NOAA), Federal Emergency Management Agency (FEMA), and the National Interagency Fire Center (NIFC), can provide access to federal resources, funding, and expertise.
- **Nonprofit Organizations:** Nonprofit organizations such as the Sierra Club, The Nature Conservancy, and the National Wildfire Foundation, can aid in wildfire prevention, conservation, and climate action.

- **Academic Institutions:** Academic institutions such as the University of California system, Stanford University, and the National Center for Atmospheric Research (NCAR) can leverage their research capabilities in climate monitoring and wildfire prediction.
- **Technology Companies:** Technology companies, such as SpaceX for satellite imaging, DJI for drone technology, IBM for AI predictive analytics, and Verizon for communication infrastructure can utilize specialized capabilities in their respective fields.
- **Community Groups:** Local community groups, including the California Fire Safe Council and local Neighborhood Watch programs, can engage communities in preparedness efforts.
- **Utility Companies:** Utility companies such as PG&E, Southern California Edison, and San Diego Gas & Electric can enhance the resilience of critical infrastructure to wildfires.
- **Environmental and Conservation Organizations:** Organizations such as the Audubon Society, Environmental Defense Fund, and Earthjustice can enhance environmental protection and sustainable land management practices.
- **Emergency Services and First Responders:** Organizations such as the California Professional Firefighters and the California Highway Patrol can foster more effective response coordination.
- **Private Sector and Business Community:** Local businesses and industries, including the California Chamber of Commerce, can help with disaster planning and recovery support.
- **Community Leaders and Elected Officials:** Elected officials such as California's governor, senators, and congressional representatives can encourage their advocation for funding and policy support.
- **Grassroots Organizations:** Grassroots organizations, such as 350.org and local climate action groups, can mobilize community support.
- **Telecommunication Providers:** Telecommunication companies such as AT&T and T-Mobile can ensure robust communication infrastructure for timely alerts.
- **Weather Forecasting Services:** Weather forecasting services such as The Weather Channel and local meteorologists can help integrate accurate weather data into monitoring systems.
- **Insurance Companies:** Insurance providers such as State Farm and Allstate have an interest in reducing wildfire-related losses. They support risk assessment and mitigation strategies to reduce wildfire-related losses and minimize insurance claims.

Case Studies

The following case studies from Cal Fire's Sonoma-Lake-Napa unit, Sonoma County, and Australia serve as examples for rural California communities interested in deploying wildfire detection and monitoring systems. These success stories offer adaptable strategies that can be tailored to meet local needs.

Cal Fire's Sonoma-Lake-Napa unit, in collaboration with the ALERTCalifornia system at UC San Diego, is among six regional units testing the use of fire lookout cameras with artificial intelligence to speed responses.[285] The Sonoma-Lake-Napa unit covers six counties, including Colusa, Solano and Yolo counties. According to Cal Fire, the sensors are designed to detect wildfires "within minutes, often during their early smoldering phase, greatly reducing the risk of spreading or becoming larger or more catastrophic." They also monitor forest microclimates; temperature; humidity; and air pressure in dark, dense areas of the forest where remote, rugged terrain limits connectivity. The statewide system now boasts 1,032 high-definition

285 Cal Fire Tests AI Tech in Wildfire Detection System (govtech.com)

cameras strategically deployed around California—199 of them sponsored by Cal Fire. The cameras feature pan-tilt and zoom capabilities and near-infrared night vision, with the ability to provide 24-hour surveillance and 360-degree sweeps every two minutes, monitor the same peaks and ridge tops from different perspectives, and train the cameras on specific points to monitor unfolding events. The devices can view up to 60 miles during a clear day and up to 120 miles during a clear night. Cal Fire has invested $20.3 million in the system, with a commitment to provide at least $3.5 million more in the coming year.

Sonoma County recently partnered with the software company Alchera to deploy Firescout, an AI smoke detection solution.[286] This comprehensive system uses a network of strategically positioned fire watch cameras powered by advanced AI algorithms to detect smoke in its earliest stages. Firescout is on 24/7, and its optimized real-time alerting mechanism enables rapid notifications to emergency responders and local authorities. Beyond detection, it provides precise information about smoke plume location and characteristics, facilitating resource allocation and evacuation planning. This proactive approach exemplifies Sonoma County's commitment to safeguarding lives and properties in the face of California's persistent wildfire threat and showcases the pivotal role of technology in modern emergency management.

Australia's comprehensive FireWatch system[287] integrates a multitude of sources—including weather data, satellite imagery, and fire behavior modeling—to provide data to the public via an online map that displays real-time information about current wildfires. Firefighters and emergency services also rely on the data it provides about previous wildfires. During the devastating 2019-2020 bushfire season in Australia, FireWatch emerged as a critical asset; it tracked fire movements, predicted fire behavior, and played a central role in coordinating firefighting efforts and ensuring public safety during evacuations.[288]

■ Estimated Costs

A comprehensive approach must be taken when estimating the costs for implementing wildfire monitoring and detection systems. First, a community must identify the specific technologies and components required, such as satellite imagery, ground sensors, drones, communication infrastructure, and data analytics software. The scale of coverage, including the area to be monitored and the density of monitoring points, should be considered. Next, it's necessary to assess ongoing operational costs, including data processing, maintenance, and personnel. Additionally, the cost of system integration, training for personnel, and contingency planning should be factored in. Collaboration with experts in the field will help generate accurate cost projections and allow for consideration of potential scalability and expansion. It's crucial to account for both initial setup costs and long-term operational expenses when estimating the budget for such systems.

Funding for wildfire monitoring and detection systems can come from both in-state and national sources. California can allocate resources through its budget for emergency management and wildfire prevention. Funding may also be available through agencies such as Cal Fire, the California Department of Forestry and Fire Protection, and the California Office of Emergency Services. At the national level, the Federal Emergency Management Agency (FEMA) can provide grants for wildfire mitigation and preparedness. Collaborative initiatives with federal agencies such as the United States Forest Service (USFS) and partnerships with private sector companies involved in technology and environmental monitoring can also secure funding. Additionally, California can explore federal disaster relief funds for post-fire rehabilitation efforts, making it essential to establish strong intergovernmental relationships to effectively access these resources.

286 Staying Alert: California wildfire prevention with artificial intelligence - ABC7 San Francisco (abc7news.com)
287 https://firewatchaustralia.com/the-firewatch-system/
288 https://myfirewatch.landgate.wa.gov.au/

9.4.2 Strategy: Expand Flood and Landslide Monitoring Systems to Improve Safety

Description

In the diverse terrains of rural California, the strategy for enhancing flood and landslide monitoring blends advanced technological tools and community engagement. Central to this initiative is detecting early signs of soil movement or rising water levels through the deployment of ground-based sensors along riverbanks, slopes, and other vulnerable areas. Satellite imaging, combined with real-time meteorological data, can track heavy rainfall events and their potential to trigger landslides or floods. Further enriching these data streams with AI-powered analytics allows for predictive modeling, which can identify high-risk zones before any visible signs emerge. Additionally, engaging local communities through training and digital platforms ensures swift dissemination of alerts and promotes community-led monitoring efforts.

The implementation of such a robust monitoring strategy is crucial for several reasons. Rural areas, often characterized by less dense infrastructure and vast open landscapes, can experience rapid and devastating impacts from flash floods and landslides—resulting in loss of life, property damage, and significant economic setbacks. Given the changing climate, with erratic rainfall patterns and increasing instances of extreme weather events, the unpredictability of these hazards is on the rise. Proactively monitoring and predicting these events can significantly reduce response times, allowing residents to evacuate or take necessary precautions. Flood and landslide monitoring systems ensure the safety of the communities and minimize economic losses, making it an indispensable investment for the future safety and sustainability of rural California.

Applications and Use Cases

- Early Detection Systems: Early detection systems seamlessly integrate a multitude of data sources—including real-time weather data, riverbed and stormwater infrastructure flood sensors, and soil saturation measurements—enabling early detection of impending floods or landslides. Analysis of these data can be used to precisely forecast and issue real-time alerts, allowing communities to take swift and informed action to protect lives and property. Early detection systems are instrumental in bolstering disaster resilience, minimizing damage, and ensuring the safety and preparedness of vulnerable regions in the face of increasingly unpredictable weather patterns and natural hazards.
- Water Systems Monitoring: Water systems monitoring employs an advanced sensor network to continuously track water levels and assess water quality in critical waterbodies and reservoirs. Using real-time data to provide invaluable insights into the health and integrity of aquatic ecosystems, water monitoring systems play a pivotal role in safeguarding water resources by ensuring a sustainable supply of clean water and proactively identifying and addressing issues such as contamination or overuse. Their ability to provide early warnings and inform decision-makers about critical changes in water systems make these monitoring systems essential to preserving the ecological balance and meeting the water needs of communities and industries alike.
- Preventative Detection Systems: Preventative detection systems employ a sophisticated network of sensors capable of assessing environmental conditions and terrain stability in order to accurately gauge the likelihood of floods or landslides. Furthermore, they provide critical insights into identifying vulnerable populations who may be at risk. By leveraging real-time data and predictive analytics, these systems can save lives and minimize property damage by empowering communities and authorities to proactively plan and execute targeted interventions. Their capacity to forecast natural disasters and pinpoint those in harm's way makes them an indispensable tool in modern disaster management and community safety.
- Flood and Landslide Notification System: A flood and landslide notification system is a pivotal component of disaster response and public safety. Designed to rapidly disseminate to both first responders and the general public real-time alerts that are tailored to the specific level of danger posed by floods and landslides, these systems utilize

a combination of meteorological data, ground-based sensors, and predictive models to assess the severity of impending hazards. Whether it's issuing evacuation orders, road closures, or precautionary measures, these notifications play a critical role in minimizing risks associated with natural disasters. In doing so, they enhance overall disaster preparedness, ensure swift and informed responses, and safeguard property and lives in vulnerable communities.

- Evacuation Planning: Enhancing evacuation planning, in conjunction with the effective use of flood and landslide monitoring data, is pivotal to ensuring the safety and effectiveness of evacuation efforts. Real-time data on inundation areas and landslide paths allows authorities to plan evacuation routes that more precisely steer clear of high-risk zones and respond to the evolving conditions of a disaster event, ensuring the safety of evacuees and first responders. It also enables the efficient allocation of resources and the establishment of designated evacuation centers. Integrating flood and landslide monitoring data into evacuation planning is a proactive measure that saves lives and enhances the overall resilience of communities.
- Climate-Adaptive Water Resource Management: Climate-adaptive water resource management provides a forward-looking approach to mitigating flood risks while efficiently managing water resources. Monitoring data from various sources, including real-time weather data and water level sensors, allows for dynamic and data-informed decision-making in reservoir management and ensures that water levels are carefully controlled to minimize flood risk during heavy rainfall events. This adaptive approach safeguards communities from flooding and promotes sustainable water resource use. By synchronizing water releases with climate patterns, it optimizes water supply for various needs while simultaneously reducing the vulnerability of downstream areas to flood hazards. Integrating monitoring data into water resource management is essential in the face of changing climate dynamics, offering both resilience and resource efficiency for the benefit of communities and ecosystems alike.
- Ecological Impacts of Flooding and Landslides: Utilizing monitoring systems to assess the ecological impacts of flooding and landslides is vital for the preservation of vulnerable species and habitats. These systems provide valuable insights into the immediate threats posed by natural disasters and the subsequent opportunities for protection and restoration. By analyzing data from ground-based sensors, satellite imagery, and post-disaster surveys, they can identify areas where ecosystems may be at risk or where habitat restoration is needed. This information enables conservationists and authorities to develop targeted plans for safeguarding vulnerable species, restoring damaged habitats, and implementing mitigation measures to reduce future risks. Integrating monitoring data into ecological impact assessments fosters a more comprehensive and proactive approach to preserving biodiversity and ecological resilience in the face of natural disasters.
- Enhance Design and Deployment of Green Infrastructure: Using monitoring system data to enhance the design and deployment of green infrastructure and low-impact development (LID) systems is a progressive approach to mitigating the impacts of extreme precipitation events. By leveraging location and frequency data from monitoring systems, planners and engineers can make informed decisions about where to strategically implement green infrastructure and LID systems. This approach can reduce the risk of flooding and erosion by ensuring that sustainable stormwater management solutions are deployed in areas most vulnerable to extreme precipitation. By optimizing the allocation of resources and investments in green infrastructure projects, this strategy promotes a more resilient and sustainable urban environment. The integration of monitoring system data into infrastructure planning enhances the capacity to adapt to changing weather patterns and minimize the negative impacts of heavy rainfall on communities and ecosystems.

Benefits

- Enhanced Public Safety: Monitoring systems provide early detection—giving communities time to safely evacuate, take protective measures, and reduce risk of injury of loss of life.

- Optimized Emergency Response Resource Allocation: Authorities that are able to prioritize and deploy resources based on areas that are predicted to be the most affected can ensure timely and efficient responses.
- Infrastructure Protection: Local authorities and utility companies can take preventative measures, such as reinforcing structures or redirecting water flows, to protect key infrastructure from damage.
- Economic Saving: Early warning signs and preparations reduce the impact of disasters, saving in post-disaster recovery costs. This can result in reduced downtime for local businesses and greater economic stability.
- Nature-Based Planning and Design: Predictive data on flood and landslide-prone areas can allow for better land use decisions, ensuring safer and more resilient community design.
- Holistic Water Management: Real-time monitoring of river and rainfall patterns allows for better water resource management, potentially aiding in drought mitigation through ensuring appropriate reservoir levels.

Metrics and Key Performance Indicators

- Sensor Deployment Coverage: Measuring the percentage of vulnerable areas covered by ground-based sensors ensures comprehensive monitoring.
- Data Collection Frequency: Tracking how often data is collected from monitoring sensors ensures real-time or near-real-time monitoring capabilities.
- Early Warning Lead Time: The average lead time the monitoring system provides for issuing flood or landslide warnings to authorities and the public.
- Data Accuracy: Assess the accuracy of data collected by monitoring sensors ensures the reliability of early warnings.
- Response Time: The time it takes for emergency responders to react to alerts generated by the monitoring system.
- False Alarm Rate: Calculating the frequency of false alarms generated by the monitoring system minimizes unnecessary panic and resource allocation.
- Risk Zone Identification: The percentage of high-risk zones accurately identified by the monitoring system.
- Emergency Preparedness: The preparedness level of local authorities and communities can be assessed and improved through drills, training, and readiness assessments.
- Cost Efficiency: The cost-effectiveness of the monitoring system in terms of its ability to prevent damages and save lives compared to its operational expenses.
- Data Sharing and Integration: The extent to which monitoring data is shared and integrated with other relevant agencies and systems, such as weather forecasts or emergency response systems.
- Reduction in Casualties and Damages: The actual reduction in casualties, property damages, and economic losses attributed to the early warning and monitoring system.
- Infrastructure Resilience: The resilience of critical infrastructure, such as bridges and roads, to floods and landslides, based on monitoring data.
- Environmental Impact: The impact of monitoring efforts on the preservation of ecosystems and vulnerable species affected by floods and landslides.
- Public Awareness and Education: The effectiveness of public awareness campaigns and educational programs related to flood and landslide risks.

- Frequency of Monitoring System Updates: How often the monitoring system is updated with new technologies and improved capabilities to stay current with evolving risks.

Risks

- Financial Constraints: Funding for the installation, maintenance, and operation of monitoring systems can be limited. Budget constraints may hinder the expansion and sustainability of monitoring efforts.
- Data Privacy and Security: Collecting and sharing real-time data can raise concerns about data privacy and security. Unauthorized access and data breaches could compromise sensitive information.
- Technical Failures: Monitoring sensors and equipment may experience technical failures. Gaps in data collection or inaccurate information can be mitigated with regular maintenance and redundancy measures.
- False Alarms: Overly sensitive monitoring systems may generate frequent false alarms, which can strain emergency response resources and lead to complacency among the public.
- Public Resistance: Some communities may resist the installation of monitoring equipment due to concerns about property values, aesthetics, or perceived intrusiveness.
- Limited Coverage: Achieving complete coverage of all vulnerable areas can be challenging, especially in remote or geographically complex regions.
- Data Interpretation: Accurate interpretation of monitoring data, and the ability to distinguish between regular fluctuations and impending disasters, is essential to avoid unnecessary panic or evacuation.
- Infrastructure Vulnerability: The infrastructure supporting these monitoring systems may themselves be vulnerable to damage during extreme events, potentially disrupting data collection and communication.
- Climate Change Uncertainty: Climate change can alter precipitation patterns and increase the frequency and intensity of extreme weather events, making it challenging to accurately predict future risks.
- Resource Allocation: Allocating resources to wildfire detection and climate monitoring may divert funds from other important planning initiatives. Misallocation can impact the overall effectiveness of the system and potentially impact overall community development.
- Data Integration Challenges: Integrating data from various sources, such as weather forecasts, river gauges, and landslide sensors, can be technically complex and require ongoing coordination.
- Operational Maintenance: Regular maintenance and calibration of monitoring equipment are necessary to ensure the accuracy and reliability of data, which can be resource intensive.

Potential Partnerships

Addressing the complex challenges associated with expanding flood and landslide monitoring systems often requires collaboration with various partners. The following includes potential partners for rural California communities:

- State and Local Government Agencies: In California, collaboration with state and federal agencies such as the California Department of Water Resources and FEMA has led to the development of comprehensive flood monitoring systems. For example, the California Data Exchange Center (CDEC) is a state-operated system that collects, manages, and disseminates hydrologic and meteorological data to support flood monitoring and emergency response.

- Environmental Organizations: Collaborations with NGOs such as The Nature Conservancy and the Sierra Club can integrate ecosystem protection into flood monitoring. Their involvement can help balance environmental conservation with disaster resilience efforts, such as the restoration of floodplains and wetlands.
- Academic Institutions: California's universities, including the University of California, Berkeley, and Stanford University, conduct research on flood monitoring technology and risk assessment. Their expertise can contribute to the development of advanced monitoring systems and data analysis techniques.
- Technology Companies: California-based tech companies such as IBM and startups such as IoT America have partnered with government agencies to provide the technical infrastructure and software solutions required for flood monitoring. These collaborations can bring cutting-edge technology to a community's disaster resilience efforts.
- Community Groups: Involving California's community-based organizations, such as the Red Cross and local grassroots groups, can engage residents in preparedness efforts. These efforts are crucial for enhancing public awareness and participation.
- Weather Forecasting Agencies: The National Weather Service (NWS) and its local offices collaborate with California's emergency management agencies to improve the accuracy of weather forecasts and warnings. This partnership can ensure that real-time weather data is integrated into flood monitoring systems.
- Infrastructure and Utility Companies: Utilities such as PG&E and Southern California Edison are key partners in ensuring the resilience of critical infrastructure during floods. Their cooperation includes monitoring power grids and addressing potential vulnerabilities.
- Insurance Companies: Insurance providers such as State Farm have an interest in reducing flood-related losses. They support initiatives that enhance flood monitoring and mitigation to minimize insurance claims and protect policyholders.
- Nonprofit Organizations: California-based nonprofits such as the California Disaster Airlift Response Team (CalDART) are deeply connected to their communities. They can assist in disaster communication, outreach, and logistics.
- Emergency Responders: California's emergency response agencies, including the California Office of Emergency Services and local fire departments, can collaborate with developing flood response plans, coordinating rescue efforts, and ensuring public safety.
- Land Use and Urban Planning Departments: Local planning departments can work with flood monitoring systems to integrate real-time data into land use and development plans, helping create resilient, flood-resistant urban environments.
- Transportation Authorities: Agencies such as Caltrans can manage transportation infrastructure during flood events. Monitoring these systems aids in making informed decisions regarding road closures and detours, ensuring public safety.
- Regional and Local Authorities: Collaboration with county and municipal governments is essential for aligning policies, sharing resources, and coordinating flood response efforts at the local level.
- Data and GIS Experts: California's data and GIS experts contribute their skills to integrate monitoring data and create informative visualizations, making complex data accessible for decision-makers.
- Media and Communication Partners: California's media outlets and communication experts play a crucial role in disseminating timely flood warnings and safety information to the public, contributing to effective disaster communication.

Effective partnerships can enhance the capacity to expand and maintain flood and landslide monitoring systems while promoting community engagement and resilience. The choice of partners will depend on the specific goals and needs of the monitoring initiative and the local context.

■ Case Studies

The following case studies from Colorado, Washington State, and Monterey County serve as an example to rural California communities interested in deploying wildfire detection and monitoring systems. These success stories offer adaptable strategies that can be tailored to meet local needs.

Colorado has a history of flash floods, particularly in areas affected by wildfires. To address this risk, the Colorado Hazard Mapping Program (CHAMP), led by the Colorado Water Conservation Board, focuses on mapping flood and landslide hazards. Using advanced technologies such as LiDAR, aerial imagery, and ground-based field surveys, this program identifies high-risk areas within the state. However, it goes beyond mapping to play a pivotal role in guiding land use planning and enhancing emergency preparedness measures. By providing actionable data and insights, it equips stakeholders with the tools to make informed decisions, safeguard communities, and reduce the impacts of natural disasters.[289]

In the Pacific Northwest, an area known for its steep terrain and susceptibility to landslides, various agencies in Washington state have developed a landslide warning system. This system utilizes monitoring data and GIS Models to assess slope stability and promptly issue alerts when landslide risks are elevated, particularly after heavy rainfall. In addition, the system monitors where landslides occur and are reported, making the data available through its Geographic Information Portal. This proactive approach to monitoring has proven invaluable to protecting communities in the region.[290]

Monterey County, California, has been prone to both wildfires and flooding, which has led its Water Resources Agency to implement an early warning system. The ALERT Flood Warning System utilizes a network of sensors to monitor real-time environmental conditions including rainfall, river levels, and the potential for debris flows. Data from the system is monitored by staff via both a desktop and mobile web-based interface. The system also ensures redundancy through using an ALERT radio backbone, providing access to reliable real-time hydrologic data in even the worst storm conditions. What sets this initiative apart is its ability to swiftly issue alerts to both residents and emergency responders when the threat of flooding or landslides escalates. These timely notifications empower communities to take decisive actions, including evacuations, and enable emergency responders to mobilize quickly. This bridging of technology and disaster response serves as a lifeline for safeguarding lives and minimizing the impact of natural disasters in a state frequently at risk.[291]

■ Estimated Costs

The estimated cost of a flood monitoring system is subject to various factors, including the system's scope and coverage area; the choice of technology and sensors; data communication infrastructure, processing, and analytics; integration with existing infrastructure, maintenance and operational expenses; alerting and communication systems; user interface development; environmental conditions; regulatory compliance; and scalability requirements. Costs can range from tens of thousands of dollars for small-scale local systems to millions of dollars or more for larger regional or national systems with advanced technology and extensive coverage. To determine an accurate estimate, organizations planning flood monitoring systems should conduct a thorough needs assessment and cost analysis tailored to their specific objectives and project parameters.

289 https://bouldercounty.gov/transportation/floodplain-mapping/colorado-hazard-mapping-program-champ/

290 https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/landslides#find-mapped-landslides

291 https://www.co.monterey.ca.us/government/government-links/water-resources-agency/programs/flood-warning-alert/alert-flood-warning-system

In California, state and federal grants are crucial funding sources for flood monitoring systems and related projects. The California state government, through agencies such as the California Department of Water Resources and the California Governor's Office of Emergency Services, provides grants and funding opportunities for flood monitoring and disaster resilience initiatives.[292] Additionally, federal agencies such as FEMA offer competitive grant programs for which municipalities, organizations, and communities in California can apply to support their flood monitoring efforts.[293] These grants play a vital role in financing the development and maintenance of flood monitoring systems in the state, contributing to enhanced disaster preparedness and response. Securing such grants typically requires a comprehensive application process—demonstrating the project's alignment with state and federal priorities, potential impact on public safety, and adherence to specific program requirements and guidelines.

9.4.3 Strategy: Use Weather Monitoring & Analysis to Predict and Prepare for Climate Hazards

■ Description

The strategy for deploying weather monitoring and analysis systems in rural California is centered on harnessing state-of-the-art technologies to predict and prepare for climate hazard events. By integrating advanced meteorological sensors, satellite data, and AI-powered predictive analytics, this approach aims to gather real-time climate data and generate accurate forecasts tailored to the unique terrains and microclimates of rural areas[294]. This comprehensive system could map out daily weather patterns and identify early signs of extreme events such as droughts to flash floods, allowing for timely alerts and proactive response measures.

The significance of this strategy is multi-fold—rural California's diverse topography, ranging from arid deserts to fertile valleys, makes it especially susceptible to a myriad of climate hazards that can have catastrophic impacts on agriculture, infrastructure, and livelihoods; and, as global warming intensifies, the frequency and severity of these events are poised to rise, making the ability to predict and preemptively act upon them a critical need[295]. With this system in place, local communities could better brace themselves against the onslaught of adverse weather, thereby safeguarding their homes, crops, and economies. Furthermore, it ensures a safer and more sustainable future for rural Californians by committing to a broader to understanding of, and mitigating the challenges posed by, a rapidly changing climate.

Key to having more advanced and frequent weather monitoring arrays is in their ability to monitor developing microclimates and identify the immediate risk and likelihood of microbursts, during which several months' worth of precipitation can fall in just a few hours.

■ Applications and Use Cases

- **Extreme Heat Monitoring and Alert System**: As climate change exacerbates the frequency, length, and intensity of temperatures in excess of 90 degrees, monitoring heat and humidity is vital for public health. Timely extreme heat alerts are essential for communities to activate cooling centers and ensure citizen safety. This technology also offers economic and infrastructure benefits beyond public health. For example, utility companies can use it to help prevent brownouts by anticipating and managing energy demand spikes caused by the sudden need for cooling. The

292 https://www.caloes.ca.gov/
293 https://www.fema.gov/grants/mitigation/flood-mitigation-assistance
294 https://archive.eol.ucar.edu/projects/hydrometnet/california/
295 https://wildlife.ca.gov/Science-Institute/Climate-Biodiversity-Monitoring

integration of climate monitoring technology with smart grid systems opens up possibilities for automation and more efficient energy management.

- **Extreme Precipitation and Drought Monitoring and Notification System**: Precise monitoring of precipitation rates plays a pivotal role in safeguarding communities against the impacts of extreme weather events, particularly in a state such as California that has diverse climatic regions. The ability to anticipate droughts and prepare for potential inland flooding is paramount in an era of increasingly complex and unpredictable weather patterns driven by climate change. Monitoring precipitation involves tracking rainfall to identify when significant storms or cloudbursts might generate excessive stormwater that has the potential to overwhelm both municipal stormwater infrastructure and natural drainage systems and lead to flash flooding. Fortunately, California benefits from an array of hourly weather and precipitation data sources—including state and federal surface meteorological weather stations, radar, and satellite monitoring systems. These datasets are seamlessly integrated into the California Data Exchange Center, serving as a crucial data integrator that enhances preparedness and resilience by focusing on providing hydrological information tailored to each of the state's distinct hydrologic regions.
- **Storms and Severe Wind**: Monitoring storms and severe wind events is of paramount importance to protect communities from a wide range of hazards, including falling trees, structural damage, and threats to lives. These events can result in significant property damage, vehicular accidents, and immediate danger to residents. Moreover, severe winds have the potential to disrupt utility infrastructure, leading to power outages and water supply disruptions that can persist for extended periods. With the ongoing rise in ocean and water temperatures due to climate change, there's a growing expectation of increased frequency, intensity, and range of extreme wind events, underscoring the necessity for continuous monitoring and accurate forecasting.
- Wind patterns also play a pivotal role in the context of wildfires by amplifying their danger. Strong winds not only make wildfires more potent and deadly, they also fuel the rapid spread of flames and embers across nearby forests and homes. A comprehensive understanding of real-time wind patterns is indispensable for preventing, mitigating, and combatting wildfire events, emphasizing the interconnectedness of weather monitoring and wildfire management in safeguarding communities and ecosystems.
- **Air Quality & Emissions**: Monitoring air quality is an undertaking with far-reaching implications for both climate resilience and public health. Beyond its significance in assessing the risk of climate hazards such as wildfires, continuous air quality monitoring provides insights into communities' vulnerability to air pollution, a pervasive threat that can have detrimental effects on public well-being. Air quality data allows municipalities to track the presence of harmful pollutants and fine particulate matter, enabling early warnings and informed decision-making during wildfire events and providing for targeted interventions to reduce emissions and enhance air quality. These monitoring tactics help safeguard communities and advance the broader goals of climate resilience and public health protection.
- **Carbon Emissions**: Monitoring greenhouse gas (GHG) emissions is of paramount importance in the fight against climate change. The tracking of carbon emissions, a major component of GHGs, is essential for understanding and mitigating their impact on the environment. Advanced methods, such as remote sensing from satellites, have become invaluable tools for collecting comprehensive data on these emissions. Continuously monitoring GHG emissions provides insights into the sources and trends of carbon pollution, allowing for the development of targeted strategies to reduce emissions and combat climate change. Ongoing efforts to track and manage carbon emissions represents a critical step in the commitment to a more sustainable and resilient future for our planet.

Benefits

- **Early Warning and Preparedness**: These systems provide early warnings of extreme weather events, allowing communities to prepare and take preventive measures for hurricanes, tornadoes, floods, and heatwaves.

- **Improved Safety**: Accurate weather forecasts help individuals and organizations make informed decisions to ensure safety during adverse weather conditions, thus reducing the risk of accidents and injuries.
- **Agricultural Planning**: Farmers can increase crop yields and minimizing losses due to weather-related factors by using weather data to optimize planting, irrigation, and harvesting schedules,.
- **Energy Management**: Utilities can better manage energy resources by anticipating fluctuations in demand caused by weather variations, leading to more efficient and reliable energy distribution.
- **Infrastructure Resilience**: Weather monitoring helps design and maintain infrastructure that can withstand extreme weather conditions, thus reducing damage and repair costs.
- **Environmental Protection**: Monitoring systems aid in the conservation of natural resources and ecosystems by tracking air quality, pollution levels, and climate-related changes.
- **Transportation**: Weather forecasts improve road safety and air travel by allowing for better planning and preparation for adverse conditions, thus reducing accidents and disruptions.
- **Disaster Response**: Accurate weather data is crucial for emergency services and disaster management to provide timely responses and more effective evacuation and relief efforts.
- **Research and Climate Studies**: Meteorological data contributes to climate research, helping scientists understand long-term climate trends and make predictions about climate change impacts.
- **Economic Benefits**: Weather monitoring supports industries such as insurance, retail, and tourism by enabling them to make informed decisions and reduce financial losses caused by weather-related events.
- **Health Protection**: Air quality monitoring helps protect public health by providing information on pollutants and airborne allergens, allowing vulnerable populations to take precautions.
- **Water Resource Management**: Monitoring systems aid in water resource management, drought prediction, and flood control by tracking rainfall and water levels in rivers and reservoirs.

Metrics and Key Performance Indicators

- **Accuracy of Weather Forecasts**: An evaluation of how well the system predicts weather conditions by comparing forecasts to observed conditions.
- **Lead Time for Extreme Weather Alerts**: The time between issuing alerts and the actual occurrence of extreme weather events.
- **Data Availability and Reliability**: The consistency and uptime of weather monitoring instruments and data sources.
- **Response Time to Weather-Related Emergencies**: How quickly emergency services and organizations respond to extreme weather events for public safety.
- **Resource Allocation Efficiency**: A determination of how efficiently resources are distributed during weather-related incidents.
- **Number of False Alarms**: The frequency of false alarms in extreme weather warnings.
- **Cost Effectiveness**: The economic efficiency of the system in relation to the accuracy of forecasts.
- **Air Quality Assessment**: A measure of the air quality, including pollutant levels and the Air Quality Index (AQI).
- **Energy Demand Forecasting**: The system's accuracy in predicting energy demand during extreme weather events for utilities and energy providers.

- **Customer Satisfaction**: User and stakeholder satisfaction with the timeliness and accuracy of weather information and services.
- **Climate Data Trends**: Long-term climate data, such as temperature changes and precipitation patterns.

Risks

- **Data Accuracy and Reliability**: Inaccurate or unreliable data can lead to incorrect forecasts and warnings, which may erode public trust and pose risks during extreme weather events.
- **Data Privacy and Security**: Weather monitoring systems often collect and transmit sensitive data. Cybersecurity threats can compromise citizen privacy and the integrity of this information.
- **Infrastructure Vulnerability**: Interruptions in data collection can occur due to the vulnerability of physical infrastructure to natural disasters, vandalism, or technical failures.
- **Budget Constraints**: Funding limitations can hinder the maintenance and expansion of monitoring systems, potentially impacting their effectiveness and coverage.
- **Outdated Technology**: Reliance on outdated technology can reduce the accuracy and capabilities of monitoring systems, particularly when newer technology is available.
- **Communication Gaps**: Poor communication between meteorological agencies and emergency responders can result in delayed responses to weather-related emergencies.
- **Over-Reliance on Technology**: Excessive reliance on technology can lead to complacency in human decision-making, causing errors in response to rapidly changing weather conditions.
- **Environmental Impact**: The energy consumption and environmental footprint of monitoring systems, especially large-scale data centers, can contribute to environmental degradation.
- **False Alarms**: Frequent false alarms can cause complacency among the public that leads to a disregard for genuine warnings.
- **Resource Allocation**: Limited resources may be diverted from other important areas if too much emphasis is placed on expanding and maintaining weather monitoring systems.
- **International Cooperation**: Weather patterns transcend national borders, making international cooperation vital for comprehensive monitoring and effective responses to global weather-related challenges.
- **Disaster Response** Planning: Overreliance on advanced warning systems may lead to inadequate disaster response planning, based on the assumption that early warnings will always be available.
- **Climate Change Adaptation**: Monitoring systems must adapt to changing climate patterns, which can be challenging due to the uncertainty associated with climate change impacts.
- **Public Awareness and Education**: Lack of awareness and education about weather risks and preparedness measures can undermine the effectiveness of monitoring systems.

Potential Partnerships

- **Government Agencies**: Collaboration with national meteorological and environmental agencies can strengthen data sharing, enhance forecasting capabilities, and improve response coordination during extreme weather events.
- **International Organizations**: Partnerships with international organizations such as the World Meteorological Organization (WMO) facilitate the exchange of weather data and expertise, enabling a global approach to climate monitoring and disaster preparedness.

- **Academic Institutions**: Collaborations with universities and research institutions can foster innovation, advance climate research, and develop cutting-edge forecasting models and technologies.
- **Private Sector and Technology Companies**: Partnering with technology companies can provide access to advanced monitoring equipment, data analytics tools, and artificial intelligence solutions for improved weather prediction and analysis.
- **Utility Companies**: Collaboration with utility companies can help manage energy demand during extreme weather events, ensuring a stable power supply and grid resilience.
- **Non-Governmental Organizations (NGOs)**: NGOs focused on disaster relief and climate resilience can work alongside weather monitoring agencies to enhance preparedness, response, and recovery efforts.
- **Emergency Services**: Close partnerships with emergency services, including police, fire departments, and medical services, can lead to more efficient and coordinated responses to weather-related emergencies.
- **Agricultural Organizations**: Collaboration with agricultural associations and cooperatives can assist in providing farmers with accurate weather forecasts and climate-related guidance for crop management.
- **Community Groups**: Engaging with community organizations and local leaders can help raise awareness, improve community preparedness, and establish communication networks during weather emergencies.
- **Environmental Conservation Groups**: Partnerships with environmental organizations can focus on monitoring air quality, tracking pollution, and mitigating the environmental impacts of extreme weather events.
- **Private Weather Services**: Collaboration with private weather services can complement public efforts, offering additional data sources and expertise for more comprehensive weather monitoring.
- **Infrastructure Developers**: Collaboration with infrastructure development companies can lead to the incorporation of weather-resilient designs and materials in critical infrastructure projects.
- **Transportation Authorities**: Partnerships with transportation agencies can enhance road safety during extreme weather, with real-time weather data informing road maintenance and traffic management.
- **Insurance Companies**: Insurance providers can benefit from weather data for risk assessment and premium pricing, leading to more accurate coverage and reduced financial losses.
- **Startups and Innovators**: Engaging with startups and innovators in the fields of climate technology and data analytics can foster creativity and accelerate the adoption of new weather monitoring solutions.

Case Studies

Rural California communities interested in deploying weather monitoring and analysis systems can look to the following case studies from Colorado, Arizona, the NOAA and USGS, and other local health departments in partnership with the CDC. These success stories offer adaptable strategies that can be tailored to meet local needs.

Colorado has implemented an effective flood warning system that goes beyond traditional flood monitoring. Relying on a combination of weather radar and rain gauge data to monitor rainfall intensity and identify potential cloudbursts in real-time, the primary focus of this system is on detecting intense rainfall events such as cloudbursts and issuing timely flood warnings to communities downstream. This proactive approach is instrumental in mitigating the risk of flash floods—a significant concern in the state due to its varied topography and susceptibility to sudden and intense rainfall. By leveraging advanced technology to continuously monitor precipitation patterns, Colorado's flood warning system provides early warnings that enable communities to take precautionary measures and evacuate vulnerable areas, ultimately mitigating the devastating impacts of cloudburst-induced flash floods and protecting property and lives. Flood information is made available to the public

through the Colorado Flood Threat Bulletin, a combination web map and notification tool that communicates flood threats throughout the state.

Arizona's Department of Water Resources employs a comprehensive drought monitoring system that combines weather data, groundwater levels, and reservoir levels to assess drought severity across the state. With a hazard mitigation focus, this system informs water resource management decisions and drought contingency planning. By managing water resources effectively during dry spells, it mitigates the risk of water shortages and agricultural impacts.

Several U.S. cities, often in partnership with the Centers for Disease Control and Prevention (CDC), conduct real-time monitoring of extreme heat events and urban heat islands. This monitoring system plays a crucial role in hazard mitigation by informing cities about heatwave risks and urban heat islands. Consequently, cities can implement cooling strategies such as cooling centers, public awareness campaigns, and urban infrastructure enhancements to effectively mitigate the health risks associated with extreme heat.

The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) collaborate on extensive sea-level rise monitoring along U.S. coastlines. This monitoring system contributes significantly to hazard mitigation by continuously tracking sea-level changes and coastal erosion. It empowers coastal communities to make informed decisions and plan for resilient infrastructure, coastal defenses, and managed retreat strategies. By doing so, it effectively mitigates the impacts of sea-level rise and storm surges, safeguarding vulnerable coastal areas.

■ Estimated Costs

Estimating costs for developing a weather monitoring system involves a comprehensive assessment of various components. First, hardware expenses must be considered, including the procurement of weather stations, sensors, radar systems, satellites, and data loggers. Software development costs entail designing user interfaces, data processing algorithms, and predictive modeling. Infrastructure expenses encompass the construction of monitoring stations, data centers, and communication networks. Ongoing operational costs, such as maintenance, staff salaries, data storage, and transmission, should also be factored in. Additionally, research and development expenses for enhancing forecasting accuracy and system resilience are crucial.

Furthermore, there is a choice between developing a custom system, tailored to specific needs, or working with out-of-the-box solutions. The latter can include commercially available weather monitoring platforms such as IBM's Weather Insight[296] or utilizing open-source and publicly available data, such as from the U.S. National Weather Service and National Oceanic and Atmospheric Administration, for collection and analysis. Finally, contingency funds to address unforeseen challenges, and technology upgrades to stay current with evolving weather monitoring technologies, must be included.

9.4.4 Strategy: Use Smart Water Systems to Optimize Conservation Efforts

■ Description

Smart water systems help ensure sustainable water use for all by utilizing advanced technologies and data analytics to optimize water management and increase efficiency. Sensors that are outfitted with digital communications systems enable remote monitoring, live data analysis, and real-time decision making. Advanced metering infrastructure, including smart

[296] https://www.ibm.com/products/environmental-intelligence-suite?utm_content=SRCWW&p1=Search&p4=43700072984281831&p5=p&gclid=Cj0KCQjwj5mpBhDJARIsAOVjBdoWD39gN352kO9w1A6gzJFVpuurZnViYCL8Gum-G-MyX1WR0zDInK8aAhccEALw_wcB&gclsrc=aw.ds

meters sending wireless signals in real time, can be used to improve water accounting and reduce waste.[297] Implementing enhanced pressure and flow management strategies and monitoring distribution networks for infrastructure maturity can prolong the lifespan of a piping network.[298] Modern data analysis tools can also facilitate the use of more comprehensive historical and real-time data to make informed management decisions.[299]

Applications and Use Cases

- **Drought Detection**: Smart drought detection systems combine an array of data sources, including weather, soil moisture levels, and vegetation health, to predict and assess the magnitude and severity of droughts. Real-time data from sensor networks in the ground are integrated with satellite imagery collected through remote sensing to analyze and identify indicators of drought.[300] AI can also predict drought events based on historical and real-time data. Precise drought detection and accurate forecasts can enable more proactive drought management and minimize the economic, social, and environmental impacts of drought events.
- **Groundwater Monitoring**: Groundwater is one of two main sources of water in California and becomes especially important during droughts.[301] Smart sensors can be used to monitor both groundwater levels and quality, transmitting data to a central database or cloud platform in real time. Advanced models and machine learning can be used to identify patterns, trends, and anomalies in the data—thus enabling the detection of changes in groundwater levels, quality, and usage. Smart groundwater monitoring systems can allow for timely intervention and management actions by generating real-time alerts when abnormal conditions are detected.
- **Smart Irrigation**: Smart irrigation systems use sensors to monitor soil moisture levels and weather conditions, allowing for precise and efficient watering of plants and crops. Compared to standard clock-based irrigation controllers, smart irrigation systems significantly reduce outdoor water waste.[302]
- **Potable Water**: Water quality monitoring systems use sensors to continuously monitor water quality parameters such as pH, turbidity, and dissolved oxygen levels. They provide real-time data to ensure the safety and quality of drinking water. Real-time monitoring accelerates failure detection and reduces the response times needed to mitigate disruptions.[303]
- **Wastewater Reuse**: Smart wastewater treatment systems use real-time monitoring, automation, and optimization algorithms to improve the efficiency of wastewater treatment processes. The treatment process typically involves multi-barrier treatment trains, throughout which quality assurance can be enhanced with smart instrumentation and real-time verification.303 Smart wastewater reuse can help reduce energy consumption, enhance treatment performance, and minimize environmental impacts.

297 California drought: 'Smart' water meters coming to San Jose, other Bay Area cities (techxplore.com)

298 Utilizing Smart Water Networks to Manage Pressure and Flow for Reduction of Water Loss and Pipe Breaks | The Water Research Foundation (waterrf.org)

299 wsec-2016-tr-002-iws-smart-start---final.pdf (wef.org)

300 Remote Sensing | Free Full-Text | Integrated Drought Monitoring and Evaluation through Multi-Sensor Satellite-Based Statistical Simulation (mdpi.com)

301 Groundwater: Understanding and Managing this Vital Resource (arcgis.com)

302 Weather-Based Irrigation Controllers | US EPA

303 Intelligent Water Systems (waterrf.org)

Benefits

1. **Improved Efficiency**: Smart water systems enable more efficient water distribution, usage, and treatment by using real-time data and insights. Providing users with the tools to track water consumption more precisely, smart water systems encourage conservation and reduce water consumption.
2. **Enhanced Reliability**: Smart sensors and advanced analytics improve failure detection, reducing leaks and damage throughout the system. This enhances temporal reliability by minimizing disruptions to service that may be required for maintenance and repair. Continuous monitoring of water quality parameters ensures the safety and quality of drinking water by enabling early detection of abnormalities and timely intervention.
3. **Cost Savings**: By optimizing water usage, reducing water loss, and improving maintenance practices, smart water systems can lead to cost savings for water utilities, businesses, and consumers. Intelligent algorithms can be used to help reduce costs by modeling different operational scenarios.306

- **Environmental Sustainability**: Smart water systems contribute to environmental sustainability by promoting efficient water use, reducing energy consumption in water treatment processes, lessening reliance on bottled water, and minimizing the impact on ecosystems and natural water sources.

Metrics and Key Performance Indicators

- **Reduction in Water Consumption**: The reduction in gallons of water used can indicate the savings yielded by usage of smart water systems.
- **Reduction in Operational Costs**: Operational cost savings can indicate improved efficiency and cost-effectiveness achieved through the smart water system.[304]
- **Water Quality Compliance Rate**: Monitoring and assessing key water quality parameters such as pH, turbidity, chlorine levels, and microbial contaminants can help measure the effectiveness of smart water treatment and management practices.[305]
- **Response Time to Incidents**: Response times to incidents such as leaks, water quality issues, or equipment failures can serve as an indicator for service disruptions and incident management efficiency.

Risks

- **Water Security**: Collecting and storing sensitive data raises concerns about data privacy and security. Public health is more directly at risk if the control system is compromised due to cybersecurity risks. Unauthorized access and data breaches could compromise citizen privacy and critical information.[306]
- **Workforce Impacts**: Increased automation may eliminate the need for utility employees, including those responsible for manual meter reading, and data-interpretation workforce retraining would be needed.303.

Potential Partnerships

Collaborating with various partners can help ensure successful implementation of smart water systems in rural California. The following includes some potential partners and stakeholders:

304 2017-08-01digitalutilityfuture.pdf (nacwa.org)
305 Utility Benchmarking Definitions (awwa.org)
306 wsec-2016-tr-002-iws-smart-start---final.pdf (wef.org)

- **Groundwater Sustainability Agencies**: The passage of the Sustainable Groundwater Management Act (SGMA) in 2014 required the formation of Groundwater Sustainability Agencies (GSAs) in high and medium priority basins to help protect groundwater resources for the long term. Implementation of smart groundwater monitoring systems may benefit from collaboration with GSAs as well as Sustainable Groundwater Management grants available through the California Department of Water Resources (DWR).
- **Federal Agencies**: WaterSense, a program sponsored by the U.S. Environmental Protection Agency (EPA), aims to promote water-efficient products, services, and practices. WaterSense-labeled controllers meet EPA specifications and could be used to implement smart irrigation systems.[307]
- **State and Local Government Agencies**: The State Water Board's Safe and Affordable Funding for Equity and Resilience (SAFER) drinking water program may also serve as a source of funding for smart water system upgrades for potable water.[308]

Case Studies

The following case studies from Riverside County, Sonoma County, Marin County, and the University of California, Los Angeles (UCLA) serve as examples for rural California communities interested in deploying smart water systems. These success stories offer adaptable strategies that can be tailored to meet local needs.

The Western Municipal Water District in Riverside County, California utilizes a Supervisory Control and Data Acquisition (SCADA) system, with unified communication channels and remote access to its assets and data to manage the district's water system more efficiently.[309] A Wide Area Network (WAN) project is underway to upgrade and expand the SCADA telemetry network and enhance the security and reliability of the water system. The project involves the installation of new and upgraded radio and microwave hardware at four potable reservoirs in the water system and will increase operational efficiency by allowing staff to view system metrics such as flow rates, pressures, chemical dosing, and energy consumption.

In 2012, Ross Valley Sanitary District (RVSD) in Marin County, California implemented a computerized maintenance management system (CMMS) which allowed the county to catalog its assets, digitize field maps, institute CCTV inspections, and develop a comprehensive risk-based asset management program.[310] RVSD utilizes numerous Autodesk software solutions to achieve an intelligent digital workflow, with real-time mapping and reporting, custom-configurable dashboards to monitor KPI metrics, advanced risk analysis, and streamlined work management based on historical and current information stored its database. Amidst several major failures in 2013, the California Regional Water Quality Control Board issued RVSD a Cease-and-Desist Order (CDO), but by implementing the CMMS, RVSD was able to recover and exceed the CDO requirements. From 2016 to 2019, sanitary sewer overflows were reduced by half, and advanced hydraulic modeling enabled by extensive capacity and condition assessment reduced the overflows due to capacity by 88 percent during the same time period.[311]

UCLA has developed a high-tech system for smart water treatment in Monterey County's Salinas Valley.[312] The pilot program is run remotely from Los Angeles and provides a test case for providing clean drinking water to rural communities isolated from municipal water systems. UCLA's smart system is smaller and cheaper than conventional solutions and removes common contaminants from groundwater using reverse osmosis. Operated using mobile devices, the system utilizes an

307 WaterSense Labeled Controllers | US EPA

308 About the SAFER Program | California State Water Resources Control Board

309 SCADA Master Plan - Wide Area Network Implementation, Phase 1 for Water System Efficiency (usbr.gov)

310 From Cease and Desist to Solid Asset Management in California - SWAN Forum (swan-forum.com)

311 Ross Valley Sanitary District: from cease and desist to solid asset management - One Water Blog (autodesk.com)

312 Could Virtual Networks Solve Drinking Water Woes for California's Isolated, Disadvantaged Communities? - Water Education Foundation

assortment of wireless water meters, sensors, and digital alarms to track and relay real-time water usage and quality data to remote experts via an online dashboard.[313] Three smart systems were implemented between 2020 and 2022, and the systems have combined to produce more than 1 million gallons of potable water, reducing the need for bottled water supplies.

■ **Estimated Costs**

The cost of implementing a smart water system varies depending on the scale and complexity of the system, the number of sensors deployed, the level of automation desired, and the data analytics capabilities. Costs may include the purchase and installation of sensors, data collection systems, communication infrastructure, and data analytics software. Additionally, ongoing maintenance and operational costs should be considered.

Individual smart irrigation controllers can cost between $250 and $2,500, depending on the type, and sensors for soil moisture, precipitation, and wind can range from $80 to $200. [314] Systemwide installation of smart water equipment can cost on the order of millions of dollars. The cost of replacing analog water meters with smart meter technology ranges from $20 million to $100 million, depending on the number of water meters in the system.297 $2 million has been budgeted for the WMWD SCADA Master Plan Implementation.[315] The UCLA Water Treatment Project was supported by a $2.5 million grant from the California State Water Resources Control Board, and the monthly operational cost for the system is estimated to be about $40 per residential unit.313 Software such as that used by RVSD for water system management costs on the order of tens of thousands of dollars per year.[316]

9.4.5 Strategy: Deploy Charging and Fueling Infrastructure to Support Zero Emissions Vehicles and Electric Vehicles

■ **Description**

ZEVs and EVs are a transformative advancement in transportation technology. Since these vehicles operate without tailpipe emissions, they contribute to a significant reduction in air pollution and greenhouse gas emissions. EVs utilize advanced battery technology to store and provide power to an electric motor, enabling smooth and quiet acceleration. By harnessing electricity from renewable sources, ZEVs and EVs offer a sustainable and environmentally friendly alternative to traditional internal combustion engine vehicles. With a growing emphasis on sustainability and combating climate change, electric vehicles play a pivotal role in the transition towards cleaner, more eco-conscious transportation solutions.

■ **Applications and Use Cases**

The implementation of EV charging stations contributes significantly to the reduction of carbon emissions by encouraging residents to switch to electric vehicles, leading to a smaller carbon footprint.

Charging stations serve as a fundamental part of the Internet of Things (IoT) infrastructure in smart cities, allowing for better energy management and distribution. Ability to link these stations to smart grids for efficient power supply, real-time monitoring, and returning excess power to the grid. Comprehensive data from these stations enables local governments to analyze usage patterns for strategic planning and decision-making.

313 UCLA Engineers Build Water Treatment System for Disadvantaged Communities | UCLA Samueli School of Engineering
314 Smart Irrigation Technology: Controllers and Sensors | Oklahoma State University (okstate.edu)
315 Capital-Improvement-and-Facilities-Plan-for-2020-to-2025 (wmwd.com)
316 Autodesk InfoWorks WS Pro | Get Prices & Buy InfoWorks Software

Deployment of these systems typically consists of a partnership with a providing company. Third party providers may also develop additional analytical metrics that can be used in further decision making.

- **Benefits**
  - **Usefulness to Residents**: Local administrators that channel investments into electric vehicle charging infrastructure help foster and facilitate the adoption of EVs, thus enhancing their city's allure for residents. Such initiatives are an investment in the well-being and overall quality of life for citizens, cultivating an environment conducive to the health and prosperity of current and forthcoming generations. This not only generates cost savings for residents but can also direct those funds toward city-wide recreational pursuits—which, in turn, contributes to increased tax revenues and city benefits.
  - **Analytical Capabilities**: Leveraging automotive data aids local governments, traffic infrastructure planners, and charging station providers, in strategically placing charging infrastructure. Information such as location, timestamp, state of charge, ignition status, odometer readings, distance traveled, vehicle model, temperature, and battery capacity can be analyzed to discern driving patterns and identify driver clusters during various timeframes. These vehicle-derived insights empower municipalities to design a well-distributed network of EV charging stations.
  - **Economic Development**: Considering the existing range constraints, EV drivers tend to be particularly aware of charging station availability along their routes and strategically plan their stops. The substantial time investment, even with the use of fast charging infrastructure, might encourage EV drivers to optimize their refueling breaks by integrating them with other activities such as shopping, dining, and exploring local attractions such as parks and even casinos. Maintaining a link to the larger EV charging network benefits local residents and visitors by contributing to the economic growth of local businesses and generating revenue through these combined experiences.[317]

- **Metrics and Key Performance Indicators**
  - **Number of Charging Stations**: The total number of operational EV charging stations across the county. This is a direct indicator of accessibility for electric vehicle users.
  - **Usage Rate**: The frequency with which charging stations are used. This can indicate how often residents and visitors are using electric vehicles and the need for further stations.
  - **Energy Consumption**: The total amount of energy consumed by the charging stations. This can provide insights into peak usage times and energy demand, aiding in planning for energy management.
  - **Charging Time**: Average duration of a charging session. Shorter charging times could indicate more efficient charging technology or vehicles.
  - **Downtime**: The amount of time charging stations are out of service. Lower downtime equates to higher reliability and service quality.
  - **GHG Emissions Reduction**: The amount of greenhouse gas emissions reduced by using electric vehicles instead of fossil-fuel-powered vehicles. This helps quantify the environmental impact of the shift to electric vehicles.
  - **Customer Satisfaction**: Feedback from users about their experience with the charging stations. This can be gathered through surveys or online reviews and can provide insights into areas for improvement.

317 https://www.transportation.gov/rural/ev/toolkit/ev-benefits-and-challenges/community-benefits#:~:text=BEVs%20run%20with%20zero%20tailpipe,businesses%20and%20provide%20health%20benefits

- **Economic Impact**: Tracking the increase in local economic activity due to the implementation of charging stations, such as growth in tourism or electric micromobility businesses.
- **Number of EVs in the county**: Tracking the growth in the number of electric vehicles registered in the county can give an indication of the adoption rate and success of the initiative.
- **Vehicle-to-Grid**: In cases where vehicles or charging stations can give unused power back to the grid, measuring this energy can indicate the efficiency of this system. [318]

Risks

- **Upfront Costs**: The initial investment of establishing an EV infrastructure network is substantial, and it may be geographically infeasible to provide an extensive EV network.
- **Infrastructure Vulnerability**: Maintaining EV infrastructure is also at the mercy of the natural elements, and particularly dangerous or powerful storms can wreck the electrical or utility systems needed to support the existing network.[319]

Potential Partnerships

Potential partnerships may include cooperative relationships with EV infrastructure providers or individual EV automobile companies. The following includes some potential partners and stakeholders:

- **Utility Companies**: To build and maintain EV infrastructure, cooperative agreements with local energy companies and developers of charging stations could provide analytical insights into usage. Additional cooperation may include cost- and energy-sharing agreements.[320]
- **Public/Private Partnerships**: Private automobile manufacturers may also partner with infrastructure developers, particularly those automobile makers looking to enter the EV market against established, privately developed infrastructure companies such as Tesla.[321] Relationships between smaller EV automobile makers and private infrastructure providers may benefit the community by opening the door to new enhanced opportunities. Regardless, committing to public-private partnerships may aid municipalities in achieving ZEV/EV-related goals.

Case Studies

The following case studies from California cities serve as examples for rural California communities interested in deploying ZEV and EV infrastructure projects. These success stories offer adaptable strategies that can be tailored to meet local needs.

Los Angeles has been a leading U.S. city in the implementation of EV charging stations, with programs such as Charge Up LA! that offer rebates for home and commercial charging equipment installation. The city's Department of Water and Power (LADWP) has a goal to install 10,000 public charging stations by 2022. LA also integrates EVs into their public transit and city fleet, contributing to a reduction in the city's carbon emissions.

The Bay Area is known for its tech-savvy population and its commitment to sustainability, making it a natural fit for EV adoption. The city offers incentives for EV purchases and has implemented a significant number of charging stations in public

318 https://otonomo.io/blog/why-municipalities-should-invest-in-electric-vehicle-charging-infrastructure-today/#:~:text=Electric%20Vehicle%20Advantages&text=They%20emit%20no%20direct%20emissions,accompanies%20their%20charging%20and%20running

319 https://www.transportation.gov/rural/ev/toolkit/ev-benefits-and-challenges/challenges-and-evolving-solutions

320 https://evchargingsummit.com/blog/ev-partnerships/

321 https://www.axios.com/2023/07/26/electric-car-charging-network

parking facilities and at workplaces. The Bay Area Air Quality Management District's Charge! Program offers grants to public agencies and businesses to install charging stations.

Sonoma County in Northern California has been proactive in establishing EV charging infrastructure in suburban and rural areas. With a blend of urban centers, suburban communities, and rural areas, Sonoma provides a great case study. It launched the Sonoma County EV Charging Station Program, providing incentives for the installation of charging stations in public areas, workplaces, and multi-unit dwellings. This comprehensive approach helped make EVs a feasible option for a larger population.

Rural Humbolt County in northern California has made significant strides in installing EV charging stations, despite its rural nature. The Redwood Coast Energy Authority has been working, with local and state partners, to increase the number of EV charging stations throughout the county. This has included installations at key locations, such as local businesses and tourist destinations, in an effort to make EV ownership more convenient for residents and visitors.

Monterey Bay has implemented an extensive network of charging stations throughout the region. With its largely suburban and rural makeup, the Monterey Bay community has benefited from the Monterey Bay Electric Vehicle Incentive Program (MBeVIP) that provides incentives for the purchase or lease of new EVs.

The San Joaquin Valley, including Fresno County, has been a focus for clean transportation initiatives due to its air quality challenges. The Charge Up! program, managed by the San Joaquin Valley Air Pollution Control District, provides funding to businesses, public agencies, and property owners who install publicly accessible charging stations.

Placer County, a rural/suburban area in the Sierra Nevada, has seen increased installation of charging stations. This effort has been bolstered by the Placer County Air Pollution Control District, which provides incentives for the installation of EV charging stations.

Green Raiteros, an electric vehicle (EV) ride-sharing initiative, has emerged as a beacon of mobility justice in Huron. The community-organized initiative uses a fleet of EVs to provide free transportation to low-income and elderly residents for medical appointments. Born from a lack of public transit and environmental concern, the program now boasts 30 strategically placed charging stations around the city, transforming Huron into an example of how rural communities can overcome transportation barriers while reducing carbon emissions.

■ Estimated Costs

Infrastructure costs associated with deploying EV systems include actual physical charging systems as well as associated electrical engineering. Charging stations are developed on levels, and the cost may fluctuate with the different levels. Level One chargers cost between $300 to $1,500, Level Two chargers cost between $400 to $6,500, and DC Fast Chargers cost between $10,000 to $40,000.[322] Installation costs can range anywhere from $2,000 to $60,000.[323]

9.5 Goal, Objectives, and Policies

A Smart Community plan is anchored by goals, objectives and policies that describe the intended outcomes. A goal is a broad statement that describes what a community wishes to achieve, providing direction and vision for the plan. An objective provides detailed guidance on how to implement the goal, and typically includes measurable targets. A policy is a specific

322 https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf
323 https://www.icf.com/insights/transportation/electric-vehicle-charging-infrastructure-costs

action to step that is taken to implement the goal and objectives. The suggested goal, objectives, and policies presented below are intended to implement the prioritized Smart Community strategies identified in the previous section.

Goal: Tehama County shall integrate smart community technology to promote resilient development, conserve its natural resources, ensure safety, and enhance the quality of life of its residents.

Objective: Increase wildfire monitoring coverage by 30 percent by implementing additional fire detection systems and expanding the network of surveillance cameras.

Policies:

- Develop a centralized database to collect, analyze, and disseminate real-time wildfire monitoring data. The Tehama County Fire Department (TCFD) can act as a lead supported by Cal-Fire, city-level fire mitigation agencies and the U.S. Forest Service.
- Establish protocols and agreements for data sharing and collaboration between surveillance camera operators, fire departments, and emergency management agencies.
- Mandate the installation of fire detection systems, such as early warning sensors and satellite-based monitoring systems in wildland-urban interface (WUI) areas.
- Develop a comprehensive plan to expand the network of fire detection systems in Tehama County, focusing on buffer zones and strategic roads near wildland-urban interface to detect early warning signs and aid with emergency evacuations.

Objective: Reduce flood-related damages and losses through expanding flood monitoring systems**.**

Policies:

- Identify critical areas along the Sacramento River and its tributaries to install flood and weather sensors to enable early detection of impending floods to minimize damage to life and ensure safety during flooding events.
- Identify areas vulnerable to flooding based on data collected by on-ground sensors, satellite imagery and post-disaster surveys to discourage new development on areas likely to flood.
- On flood-prone parcels encourage design and deployment of green infrastructure and low impact development systems. Using the data from monitoring systems the county can make informed decisions on strategic location for green infrastructure strategies to mitigate extreme precipitation events.
- Develop a monitoring system to access the impacts of flooding on vulnerable species and habitats along the Sacramento River and its tributaries through surveillance cameras and satellite imagery. The monitoring systems can provide insights into post-flood landscape changes due to erosion, changes in vegetation patterns and adaptation capacity of wildlife species to these changes.

Objective: Enhance resiliency to extreme heat events through heat adaptation strategies and smart alert systems.

Policies:

- Integrate climate monitoring technology for early detection of extreme weather events such as heat waves.
- Identify locations for cooling centers throughout the county in partnership with public and private stakeholders.
- Create an emergency alert system to notify residents about hot days with information on location and capacity of cooling centers.
- Create educational programs and awareness on importance of cooling centers during hot days. This could help in management of energy demand spikes caused by sudden need for cooling and prevent brownouts.

Objective: Enhance water conservation and water quality of surface and groundwater through smart water systems and monitoring**.**

Policies:

- Employing smart technology such as artificial intelligence to predict drought events based on historical and real-time data to enable proactive drought management and minimize the economic, social, and environmental impacts.
- Providing incentives and grants to domestic well owners for installing smart groundwater monitoring systems to monitor the water levels, trends, patterns and usage of groundwater and springs.
- Mandate the installation of smart water meters and monitoring program for all new developments and existing development retrofitted with smart water systems to track system success and improve efficiency.
- Develop smart wastewater treatment systems to monitor water quality of wastewater being reused to irrigate open spaces and landscaped areas in urban and rural centers of the county. This will also ensure that groundwater quality is maintained and reduce the chance of contamination due to run-off.

Objective: Expand the existing network of electric vehicles charging stations throughout the county, to ensure access and promote just transition to electric vehicles**.**

Policies:

- Create a comprehensive plan to expand charging station network along major transit routes in collaboration with CALTrans and private sector partners.
- Collaborate with universities in the county urban centers to set up public electric charging points.
- Conduct a feasibility study to identify optimal locations for charging stations, considering factors such as population density, local transit routes, and community needs.
- Collaborate with electric utility companies, government agencies, and private sector partners to secure funding and resources for the installation and maintenance of charging infrastructure.
- Collaborate with local renewable energy providers to develop innovative solutions for integrating ZEV technology with clean energy generation.
- Establish partnerships with energy storage companies to explore the potential of using electric vehicle batteries for grid stabilization and energy storage purposes.

9.6 Implementation and Funding Sources

In order to effectively implement the prioritized Smart Community strategies, it's recommended that Tehama County prepare a Smart Community Plan. This will serve as a roadmap to guide the integration of Smart Community strategies and technologies into existing County policies and processes.

9.6.1 Community Engagement

Smart Community plans should be co-created with residents, businesses, and other members of the community. It's recommended that the county engage the public in a collaborative visioning process to identify community needs that may not have been addressed in this document, or to confirm that the identified needs are indeed most important. This could

consist of stakeholder focus group meetings, public workshops, online surveys, and other means of civic engagement and public participation. The county should strive to be inclusive and equitable, making accommodations for Justice 40 communities, persons who do not speak English as a first language, and other underserved communities. Next, the county and community members should collaboratively determine if the recommended prioritized Smart Community strategies in this document are the most relevant for current and anticipated needs and include additional strategies as appropriate. Once the county has the confirmed list of prioritized Smart Community strategies, it can move on to the Project Development phase.

9.6.2 Project Development

The prioritized Smart Community Strategies presented in this report are high-level "concepts of exploration" that describe a wide range of use cases. For each identified strategy, the county should perform benefit-cost analysis and identify a responsible department or partner agency, potential cost-sharing partnerships, risks, and any alignment with County policies and planned projects. Specific implementation cost estimates will be developed at this time, potentially for one or more pilot projects. Projects should then be included in annual or five-year capital improvement program (CIP) budgeting processes. Where applicable, the county should seek grant funding (described further below) or explore the potential for public-private partnership (P3) funding.

9.6.3 Smart Communities Plan and Documentation

Finally, it is important for the county to formally adopt (by resolution or ordinance) the recommended goal, objectives, and policies into its strategic planning or regulatory documents (General Plan, Strategic Plan, etc.). This establishes the public policy, purpose, and need for project implementation. The plan should be reviewed and amended periodically to adjust for changing policies and laws, additional climate hazards, changes in technology, and other factors.

9.6.4 Funding Sources

- **Wildfire Detection and Monitoring Systems**
  - FEMA's Assistance to Firefighters Grant Program (AFG): Assistance to Firefighters Grants Program | FEMA.gov
  - CAL FIRE's Fire Prevention Grants Program: CAL FIRE Wildfire Prevention Grants Program FY 2022-2023 - California Grants Portal
  - Bureau of Land Management's Wildland Fire Management Assistance Program: Community Wildfire Assistance | Bureau of Land Management (blm.gov)
  - Community Wildfire Defense Grant Program | US Forest Service (usda.gov)
  - California Climate Investments Fire Prevention Grant Program: Fire Prevention Program — California Climate Investments
  - 2023 Wildfire Resilience Forest Stewardship Grants https://www.grants.ca.gov/grants/2023-wildfire-resilience-forest-stewardship-grants/
  - Climate Adaptation and Resiliency - https://www.grants.ca.gov/grants/climate-adaptation-and-resiliency/
  - Regional Climate Collaboratives Program Round 2 - https://www.grants.ca.gov/grants/regional-climate-collaboratives-program-round-2/

- **Flood and Landslide Monitoring**
  - Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance (HMA) Grant: https://www.fema.gov/grants/mitigation
  - Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) Program: https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection
- **Smart Water Systems**
  - U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Conservation Innovation Grants (CIG): https://www.nrcs.usda.gov/programs-initiatives/cig-conservation-innovation-grants
  - Bureau of Reclamation WaterSMART Grants: https://www.usbr.gov/watersmart/weeg/
- **Weather Monitoring Systems**
  - FEMA Building Resilient Infrastructure and Communities (BRIC) Grant: BRIC program provides funding to states, local communities, tribes, and territories that are working on hazard mitigation projects that reduce the risk from flooding, extreme heat, and other extreme weather events.
  - Environmental Protection Agency: Environmental Justice Small Grants Program
  - National Oceanic and Atmospheric Administration (NOAA): Modeling, Analysis, Predictions, and Projections (MAPP) Program
- **Zero Emissions Vehicles (ZEVs) and Electric Vehicles (EVs)**
  - California's National Electric Vehicle Infrastructure (NEVI) Plan was adopted in August 2022[324]. The state will receive approximately $383M for charging infrastructure along Alternative Fuel Corridors (AFCs) over a five year period. This funding will be administered by CalTrans in accordance with the adopted NEVI Plan.
  - As a local government, Tehama County is eligible to apply for the Charging and Fueling Infrastructure (CFI) discretionary grant program. This $2.5B fund has two separate programs (corridors and communities) and is intended to fill in the gaps that are not covered by the AFCs designated in the NEVI plan. The CFI program prioritizes underserved and disadvantaged communities, including rural areas and low- and moderate-income neighborhoods. A Notice of Funding Opportunity (NOFO) will be posted on Grants.gov on an intermittent basis over a five year period
  - California Electric Vehicle Infrastructure Project (CALeVIP) 2.0 https://www.energy.ca.gov/programs-and-topics/programs/california-electric-vehicle-infrastructure-project-calevip-20

324 https://www.energy.ca.gov/programs-and-topics/programs/national-electric-vehicle-infrastructure-program-nevi

SECTION

10

RECOMMENDATIONS AND NEXT STEPS

10.1 Recommendations

Tilson was engaged to research the telecommunications industry landscape in Tehama County, including the locations of existing fiber optic cable and other assets, the service areas and service offerings – by technology – of retail Internet service providers (ISPs) in the county, the locations of premises lacking access to adequate broadband service, and available funding for broadband infrastructure. These findings then informed custom recommendations to support Tehama County's pursuit of network deployment. We focus on four sets of recommendations below:

1. **Identifying and developing broadband infrastructure projects:** The county should continue to support its partnership with Golden State Connect Authority's (GSCA) planned open-access last mile network, while localities should consider working with either the GSCA or nearby existing providers to improve connectivity in unserved and underserved areas. More detailed recommendations discuss next steps to develop these options.
2. **Developing a better broadband deployment environment:** Local policies can have a significant impact on both the cost and time required to deploy new networks or expand existing service areas. These recommendations identify opportunities to reduce broadband deployment costs and can be implemented regardless of whether community broadband leaders choose to develop formal partnerships, coordinate with interested ISPs, or simply improve permitting and infrastructure access policies. Localities have limited time and resources to revise local policies, so our recommendations focus on coordinating with interested ISPs to streamline permitting and information-sharing practices that matter most to those ISPs.
3. **Developing broadband project funding strategies:** Using the information about each funding source provided above, these recommendations focus on the next steps to acquire funding for projects to connect eligible unserved and underserved areas, with focus placed on the three most likely sources of funding. Using designs, cost models, and other strategic plans created before filing the FFA application, the GSCA is in an excellent position to develop additional project proposals to acquire funding from the BEAD and BIA programs. Recommendations also consider the next steps that localities can follow to help interested ISPs to acquire grant funding.
4. **Developing smart community strategies:** The introduction of additional high speed broadband connectivity will enhance the ability of Tehama County to deploy smart community technologies that provide more efficient public services and enhance sustainability, resilience, equity, and quality of life for residents and businesses. VHB reviewed Tehama County's climate, natural hazards, and other issues to evaluate which smart community strategies are most appropriate for those identified needs.

Each of these topics will be reviewed in turn, with a set of recommendations followed by next steps that will allow Tehama County to implement them. We note that some of the recommendations are already in the process of being implemented, while others will require additional planning efforts and coordination between different stakeholders. As a result, the next steps will often be used to elaborate on certain recommendations more than others.

10.2 Identifying and Developing Broadband Infrastructure Projects

The incredible amount of funding to be offered over the next few years has generated excitement among most ISPs. Many had slowed down their expansion efforts over the past several years, so this period is likely the last major expansionary push toward unserved and underserved locations that had simply not been economically viable to connect without significant public financial support. As FFA and BEAD funding help to establish near universal service throughout a significant majority of communities, most ISPs' only service expansion options afterward are likely to be in areas already receiving some form of service. As a result, most ISPs are very interested in using this funding as much as possible to expand and upgrade their networks while these last markets unserved by high-speed broadband are still open.

Localities interested in connecting unserved and underserved locations then are in a very favorable position. ISPs are already developing funding-eligible projects, and if localities can assist with these efforts, ISPs will be interested in any support they can provide to acquire funding or reduce the cost of their deployments. Localities that understand the current market conditions and service areas of each ISP will be equipped to identify which ISPs are most likely to work with them and develop coordination or partnership opportunities. In turn, localities can help to shape the proposed project areas, ensuring that as many unserved households as possible are included in these efforts.

Section 4 reviewed ISPs' current service areas by technology and speeds available and any existing deployment commitments resulting from recent grant awards. Section 5 presented available network assets across Tehama County. These reviews have resulted in three sets of broadband project development recommendations:

- Deployment planning and strategy recommendations for GSCA's open-access last mile network
- A list of suggested project areas that will be eligible for one or more grant programs
- Steps that localities can use to develop relationships with ISPs and ensure that their unserved and underserved constituents are connected

GSCA's open-access last mile network: In connection with this program and a related project, Tilson developed a high-level network design, cost estimate, and other planning materials for a potential Golden State Connect Authority (GSCA) network to connect locations across the county. Section 5 reviewed the process used to generate these materials, which have been submitted to Golden State Finance Authority (GSFA). They were also used in collaboration with the GSFA and county representatives to select the priority areas used in the California Federal Funding Account application submitted in September 2023, along with future plans for both additional funding eligible GSCA projects and competitive expansions. By offering competitive, open-access last mile services to connected locations, this new market entrant will have a significant impact on Tehama County's broadband market, adding a vital potential partner for localities looking to improve service options in their communities. Tilson recommends that all other localities consider this potential partner when developing any broadband deployment plans.

Nevertheless, this Broadband Strategic Plan has adopted an ISP-neutral approach to evaluating potential broadband projects. Section 4's review of current service areas and specific ISP factors also identified a list of top expansion and upgrade opportunities across the county. Combined with a review of factors influencing these opportunities, this section also identifies which existing ISPs may be the most likely to expand into these unserved and underserved areas, based on their existing networks, changes to middle mile network availability, and other market trends. Due to the proprietary strategic value of GSCA's internal expansion plans developed on an adjacent project, this organization has not been prominently featured in

these expansion strategies, but localities should also consider them among the top ISPs to partner with to develop new deployments.

Residents of Tehama County can experience three very different broadband markets. The first group can receive high-speed cable service from either Comcast or Charter. Comcast generally serves the Corning area, reaches 2,464 locations, and has submitted an application to the CPUC's Federal Funding Account (FFA) program to expand to more. Charter primarily serves the Red Bluff and Lake California areas, connecting 9,169 locations, and has reported that it has begun connecting some households to fiber as well, representing the only home fiber service available in the county. Households receiving these services can experience the benefits of broadband shared by the vast majority of households across the rest of the county.

The second group of residents must rely upon a mixture of DSL and fixed wireless options.[325] Unfortunately, the FCC reports that only 604 locations can receive DSL services providing at least 25/3 Mbps, so a majority of these locations cannot actually receive broadband via DSL. Ducor Telephone Company and Frontier report to provide DSL connectivity to 760 and 169 locations, respectively. In the populous regions of the county through the Sacramento Valley, AT&T has offered DSL to 11,395 locations as well, but has announced that it will no longer be taking on new DSL subscribers as it retires its DSL networks. Instead, AT&T has applied to the FFA program to replace major portions of its network with fiber.

The second group's fixed wireless options are often faster than DSL. A reported 75 percent of households across the county can receive fixed wireless services of 100/20 Mbps or more, with 33.4 percent of households able to receive only this level of performance via fixed wireless options. The largest fixed wireless provider is DigitalPath, which uses a more traditional wireless network to reach 23,524 residences. T-Mobile, AT&T and Verizon provide a mix of mobile and fixed wireless services with their networks, claiming to reach 14,020, 781, and 56 households, respectively.

The third group of residents have very poor internet service options. The 1,301 locations (4.8 percent) are reported to not even receive 10/1 Mbps services from either wireless or wireline networks but may still have some form of connectivity. About 219 households across the county can receive slower wireless service, and 5,640 are claimed to able to receive a slower DSL service than 10/1 Mbps. These locations must be prioritized to receive improved connectivity.

Suggested project areas:

- Comcast and Charter can explore expanding services in and around their existing service areas of Red Bluff and Corning, respectively. The new state open-access middle mile network through these areas will provide more essential data bandwidth for backhaul necessary to support high-speed broadband networks to these locations while reducing costs to construct last mile networks to new customers. Comcast submitted an FFA application that target areas around Corning, across the Sacramento River in Los Molinos, and up to Table Mountain.
- AT&T has a large network of old DSL infrastructure in parts of the county and is looking to replace it with fiber, as indicated from their FFA applications. This strategy should be encouraged, as it will fill out most of the pockets in need along Interstate 5.
- Several unserved and underserved communities, such as Paynes Creek, Mineral, Mill Creek, and St. Bernard, are along the state's planned open-access middle mile route. Existing incumbents or new entrants will soon be able to build wireline networks into these areas at reduced cost. In particular, the northeastern portion of the county along State Route 36 should be prioritized to receive better wireline connectivity.

[325] We note that a few other providers claim to offer services to a very small number of residential locations. TPx Communications claims to offer DSL to 9 locations, while GeoLinks and King Street Wireless claim to serve a total of 5 locations with their wireless services.

- The GSCA has submitted applications for multiple fiber projects in the county to address pockets of eligible unserved locations along the state's planned middle mile route. If these projects are awarded, they will introduce open-access last mile fiber service into areas around Corning, north of Red Bluff, including Bend and Blunt, Proberta-Flores-Gerber, and communities along State Highway 99E, such as Vina and Los Molinos. Once their presence is established, this new entrant is likely to expand into other areas of need, so localities should consider this potential partner in addition to the existing ISPs.
- The most remote locations may still need to be connected via fixed wireless networks. The BEAD program did not classify any part of the county as a high-cost area, so fixed wireless options will not be able to receive funding unless certain areas remain unserved after the initial BEAD application period. Wireless companies will need to monitor the BEAD application areas to identify whether some locations will remain unserved after the BEAD funding is distributed.

These top suggestions are not exhaustive but should serve as a starting point for community broadband leaders to understand their options. The broadband marketplace can be very dynamic, with large ISPs often privately developing regional and local strategies that can shift priorities away from traditional expansion opportunities in this county. Similarly, broadband deployment project requests for proposals (RFPs) can receive unexpectedly strong offers from some ISPs or no answer from the best-positioned broadband providers. Localities must use available market information, evaluate the RFP answers, and adjust their options accordingly.

Steps that localities should use to develop relationships with ISPs: With the need for adaptability in mind, this report recommends that localities that are not already working with ISPs begin the process of reaching out to nearby providers and developing relationships with them that can lead to broadband deployment projects designed to reach unserved and underserved locations. Tilson recommends that:

- As many unserved locations are in close proximity to an existing broadband network, localities should work in conjunction with those nearby service providers to expand their existing networks, provided the level of service of those network extensions is appropriate and qualifies for state grant funding. Localities should informally reach out to nearby ISPs to establish lines of communication and gauge their interest in expanding their services areas within the community.
- Once the locality has established this baseline level of information from ISPs, it should issue an RFP for a public-private or public-public partnership if a partner has not already been selected. The locality may choose to propose contributing matching funds for the broadband infrastructure deployment and that matching funds also be contributed by the private partner(s). Any shortfall in available funding can then be pursued from the state's competitive grant programs.
- The locality should concentrate on expanding broadband access using wireline technologies. Currently available funding favors wireline technologies, such as fiber optic cable, and should be spent to deploy wireline infrastructure as widely as possible.
- When suggesting the terms of the partnership or coordination agreement, the locality should likely focus on the "public facilitation of private infrastructure" model discussed in Section 6.1 and offer to the ISP any opportunities to use existing assets, including access to public land necessary for the network deployment, and an enhanced level of coordination and local effort when handling access to poles, underground conduit, rights-of-way, and permit approvals. With nearly all localities having little experience owning, operating or maintaining broadband infrastructure, the locality should require that the ISP generally operate, maintain, and upgrade the network as appropriate. The specific roles and responsibilities of the public private partnership members should be negotiated and codified.

10.3 Developing a Better Broadband Deployment Environment

Localities can implement process improvements, policies, and best practices that do not require direct financial commitments or formal partnerships. These *Broadband Ready Community* strategies can often be done with little or no additional cost to the locality while reducing ISP deployment costs, fostering better coordination between ISPs and localities. These strategies can also reduce the administrative efforts of the locality itself. While Section 7 contains additional suggestions, Tilson highlights the following recommendations:

- **Adopt policies to improve access to information**

To plan and complete network deployment projects, ISPs need access to a large amount of information about local broadband needs, current infrastructure, other deployment efforts, construction policies, and permitting processes. County and local governments often have access to much of this information but may not have made it easily accessible to interested ISPs. Local governments are often in a better position to organize this information more efficiently and at a lower cost than an interested ISP. As a result, localities that adopt "access to information strategies" will help ISPs to better analyze location details, such as permitting and access rights, and can reduce an ISP's ultimate deployment planning costs.

- Localities should establish a dedicated broadband issues webpage on the local government's website. A centralized broadband webpage can provide direct links to information on permitting, mapping, and infrastructure development efforts. This site is an opportunity to encourage residents to sign up for broadband service subsidy programs, such as the Affordable Connectivity Program (ACP) and Lifeline, and to provide information about local service providers' low-cost internet plans.
- Localities should develop a permitting manual that reviews the rules, regulations, and permitting processes that ISPs must follow to conduct broadband constriction projects in the locality's jurisdiction. This manual should include permit cost, timeline expectations and clarify acceptable underground construction techniques and practices.
- Localities should revise internal record-keeping processes to improve information-sharing and facilitate ISPs' use of existing assets, such as fiber, conduit, and attachment or placement rights. While this strategy may be costly upfront to implement, it is likely to reduce record-keeping costs in the long run and provide greater efficiency when these assets need to be repaired, upgraded, replaced, or utilized in new ways.

- **Adopt policies to improve local government coordination**

To facilitate ISP deployments, localities must coordinate with the ISPs themselves and often other organizations, such as local utilities. ISPs must also often work with locality staff from different departments that handle permitting, infrastructure planning, and even IT and GIS staff. As a result, unprepared localities may face significant challenges coordinating both internal and external communications.

- Localities should designate a single point of contact for coordination with outside organizations. This broadband coordinator may allocate certain ongoing coordination responsibilities, such as permitting applications and GIS requests, to other staff as needed, while remaining responsible for overall staff utilization for broadband projects.
- Localities should ensure that their internal coordination strategy can address broadband issues. Localities must recognize how broadband issues impact each department and develop interdepartmental broadband plans that

address the locality's broadband development and digital equity strategic plan, coordination with other localities and essential third parties, and between the locality and ISPs active in the area.

■ Adopt permitting process to streamline deployments

Localities generally oversee permitting processes related to construction, rights-of-way and access. Most permitting regulations specify a set of circumstances under which permits must be granted or denied, while the process used to ensure compliances with these regulations establishes the way that the ISP must submit information for review by the locality. Broadband Ready Communities have generally begun to place time limits on permitting reviews and cost limits of permitting fees, while a wider range of best practices covered in Section 7 discuss further streamlined permitting processes. Tilson suggests that:

- Localities should adopt a core set of best practices relating to permitting, including:
  - Ensure that each permitting process has been properly updated to consider broadband deployment issues and reviewed by staff who understand telecommunications factors
  - Allow applicants to submit required permitting documentation digitally
  - Provide permitting process timelines and update applicants about their permit requests when the review reaches any milestones
  - Provide examples of permit planning and design standards, such as right-of-way diagrams, trench construction and pavement restoration, and pole attachments to improve ISPs' submission quality and better demonstrate standards
  - Regularly revisit permitting rules and processes to improve alignment with federal, state, and other local requirements.
- Localities should establish a "Dig Once" policy to promote conduit and fiber optic cable construction. These policies require that any organization conducting certain types of underground construction provide opportunities for additional conduit and/or facilities to be included to ensure that other organizations can benefit from better underground access or for other organizations to install infrastructure in the trench while it is available (also known as a "joint trench" policy).
- Localities should establish a "One-Touch Make-Ready" policy, where a single contractor (or small group of contractors) pre-approved by the pole owner(s) and the attachment owners can perform all the work necessary to complete the make-ready work needed for new attachments. This approach reduces costs and time necessary to complete the process.
- Localities should enable ISPs to leverage municipal assets. A locality's existing conduit, fiber, rights-of-way, and facilities all present direct opportunities for broadband network developers to reduce their deployment costs, while potentially offering additional benefits to the locality itself. To facilitate ISP use of locality assets, the locality can create a template lease agreement, which should include lease rates that prioritize broadband deployment over revenue generation and should allow for modifications to accommodate specific needs.

■ Utilize other, more formalized examples of Broadband Ready Community strategies to support revision efforts

A few states, such as Colorado, Indiana, and Georgia, have analyzed these Broadband Ready Community strategies and created certification programs to help localities adopt them more easily. Localities looking to improve their permitting practices can use these examples to support some of their revisions when presenting their proposals to local government representatives.

- Indiana's program focuses on the appointment of a single point of contact for all broadband development project issues, supporting electronic submission of all forms, applications, and documentation required for a broadband development project, and shorter deadlines for all permit reviews and inspections. The program also forbids the use of application review fees or discrimination against any ISPs. Information about this program is available at: https://www.in.gov/indianabroadband/broadband-ready-communities-program/broadband-ready-certification/
- Georgia's program offers a model ordinance that similarly establishes a single point of contact for all broadband development project issues while setting short permit application review deadlines and restricting application fees to $100 or less. Information about this program is available at: https://broadband.georgia.gov/broadband-community-application-information
- Colorado's program offers more detailed materials, including a checklist that covers a number of additional local policy areas, coordination efforts, and additional resources that provide links to other checklists. This approach requires that localities complete a set of tasks, such as identifying local broadband champions, developing a local broadband team, engaging with the local community, reaching out to local ISPs, conducting a local asset inventory, and ultimately developing a project communication plan that will ensure all stakeholders are engaged as the locality works with an interested ISP to develop, fund, and construct a broadband network. This more step-by-step approach applies many of the recommendations made in Section 7 and can be used as a useful tool to guide local policy efforts. Information about this program is available at: https://broadband.colorado.gov/funding/advance-colorado-broadband-grant-program/broadband-ready-community-program

10.4 Developing Broadband Project Funding Strategies

In this report, Tilson dedicated considerable time to describing current and upcoming funding opportunities for broadband infrastructure. This is intentional and is to emphasize the magnitude and importance of these funding opportunities. The coronavirus pandemic has brought about three significant pieces of federal legislation, the CARES Act, ARPA, and the IIJA, each of which provides significant funding for broadband infrastructure to connect unserved locations. While CARES Act funding is largely spent, ARPA and IIJA broadband infrastructure funding will flow through the states to be distributed by state broadband offices through competitive grant programs. The CPUC will administer the distribution of these funds in California.

The current and upcoming funding for both broadband infrastructure and affordability, which will flow from 2022 to 2028, represents a watershed event in broadband funding opportunities. This period will go down in history as by far the most significant funding opportunities of their kind. Robust participation in these funding opportunities, and robust preparation and planning for participation in these funding opportunities, cannot be recommended highly enough for the county.

A review of funding options and related factors has been presented in multiple parts. Section 6.2 evaluated the possible federal and state funding sources that could aid Tehama County's efforts to connecting unserved and underserved households and businesses. Section 6.1 reviewed how localities can work with ISPs to develop grant-eligible broadband projects and share the financial commitments across those funding sources, the ISP, and even the locality itself. This section, along with Section 7, also reviewed strategies that the locality can use to reduce the cost of the deployment itself or leverage the locality's existing resources and contribute them to the project, even serving at a portion of the matching requirement. This combination of possible federal and state funding sources, private ISP investments, and local cost-reducing efforts or financial contributions should be used as a toolkit of funding options that can be combined flexibly to facilitate deployments in areas long deemed economically unviable if funded by ISP investments alone.

Ultimately, this report focuses on the three primary funding options, the California Federal Funding Account (FFA), the Broadband Equity, Access, and Deployment (BEAD) program, and the California Broadband Infrastructure Account (BIA). To use these and other funding opportunities, Tilson recommends that the county and other relevant stakeholders:

- **Use the challenge processes to ensure that all unserved and underserved locations are eligible for funding**

California's last-mile deployment grant programs discussed above rely on a combination of the FCC's new National Broadband Map and the CPUC's own broadband mapping efforts to determine which locations are eligible for funding. While these maps are a significant improvement over prior efforts, they still rely on ISP to report their own service areas, which can sometimes mischaracterize the services they provide to a location or even an entire area. County and local governments must work with members of their communities and interested ISPs to understand the patterns of ISP service mischaracterizations and develop challenges to ensure that unserved and underserved locations in Tehama County can be identified and reclassified as eligible for the major influx of broadband funding over the next few years.

- Tehama County should participate in a forthcoming challenge process required under the IIJA BEAD program to correct inaccuracies in federal broadband availability mapping data and identify additional locations that may be eligible for funding. Only units of local government, Internet Service Providers (ISPs), non-profits and tribal governments are permitted to participate in this challenge process, members of the public cannot.
- Localities should encourage members of their communities to participate in the individual challenge process options provided by the FCC and California maps.
- Localities that have been working with ISPs to develop projects targeting specific areas can work with people in those areas and just beyond them to ensure that the maps accurately reflect current levels of service. The locality can develop a strategy to collect data specifically in areas under dispute to ensure that locals provide the required evidence to file successful challenges and can even employ broadband engineers to evaluate the physical plant used to provide (or not provide) claimed services in an area. This targeted strategy will enable the locality to focus its limited resources to make the most impact on areas that are more likely to be included in projects already in planning and development.

- **Monitor the evaluation of the first round of Federal Funding Account submissions and adjust when announcements are made**

The State of California allocated $74,801,160 to Tehama County to be distributed through the FFA program. On behalf of the county, GSCA, the joint powers authority working with UTOPIA Fiber, filed a FFA application in September 2023 to connect 4,397 unserved locations to an open-access last mile fiber network. The proposed project requested $74,798,880 to build this network, which will provide the physical fiber connections to each home and allow residents to choose between multiple competing online service providers to manage this connection. This innovative new entrant hopes to use these locations as a starting point to expand services both deeper into unserved and underserved areas and into served areas to introduce competition.If the project is awarded, the county and GSCA will begin the deployment process and should adjust their subsequent deployment plans and funding requests accordingly. Similarly, the areas included in this successful application will be considered served for the purposes of other funding programs, so localities looking for a partner near the funded areas should strongly consider collaboration with GSCA.

The recent round of the CPUC's FFA grant program closed on September 29, 2023 and received 484 applications requesting more than $4.6 billion. An application was received for every county in the state. The CPUC received a total of eight applications for Tehama County, one from the Golden State Connect Authority and two from Comcast, and five from AT&T, three of which extend beyond the county's boundaries At the time of this writing, applications are still being reviewed, and winners have not yet been announced. Detailed information about each application, including maps of proposed funded service areas, can be found here:

https://broadbandportal.cpuc.ca.gov/s/objection-page

- If the GSCA project is awarded, the county and GSCA will begin the deployment process and should adjust their subsequent deployment plans and funding requests accordingly. Similarly, the areas included in this successful application will be considered served for the purposes of other funding programs, so localities looking for a partner near the funded areas should strongly consider collaboration with GSCA.
- If the GSCA project is not awarded, the CPUC will provide feedback about any issues they encountered and will encourage the project to be revised accordingly. Depending upon whether other projects are awarded funding in the county, this project may be revised and resubmitted.

■ **Develop eligible projects for the BEAD Grant Program**

A significant portion of BEAD-defined unserved locations are likely to be scattered in partially served census blocks, but there are a few clusters worth highlighting:

- All of the areas suggested for BIA consideration above should also be considered for the BEAD program. Comcast and AT&T should consider serving the unserved locations around Henleyville, Flournoy, and Paskenta, although Comcast is unlikely to be willing to deploy fiber as currently required by the BEAD program. The GSCA and other ISPs should consider the Paynes Creek and Mineral areas as well.
- A few unserved areas exist on both sides of the county where the Sacramento Valley grades to the mountains. In the west, about 20 miles northwest of Red Bluff, there are unserved locations clustered along State Route CA-36 at Baker Fire Station, then more scattered about 10 miles west. The closest available service is licensed fixed wireless from GeoLinks, but a bit closer to the interstate, AT&T DSL's network is nearby and connects to their fiber offering further north in Shasta, which could enable them to submit BEAD applications to bring this infrastructure to the north portion of the county and extend wireline service to these locations. GSCA has a committed FFA application between this area and Red Bluff, so if they are successful, they will also have a close enough fiber presence to connect these passings.
- Further south, unserved locations are clustered in the main clearing of Red Bank. Multiple locations are scattered throughout the mountains, following Coyler Springs Rd, then extend into Lowery and disperse again in Brushy Mountain. Ducor Telephone Company has available DSL service near Gleason Peak, but GSCA's proposed project area is equally nearby and would have better access to main roadways leading to these neighborhoods.

Section 6 also reviews how counties and localities can work to ensure that unserved locations are eligible for grant funding. These funding programs require applicants to rely upon broadband service maps from either the FCC or the State of California, but not all locations are accurately classified on these maps. Local governments, ISPs, non-profits, and in some cases, the residents themselves may attempt to reclassify locations to make them eligible for funding if sufficient evidence is gathered to demonstrate that a location is not served. Local governments can implement a number of strategies to gather this information and ensure residents with unreliable or slower services can be included in deployment planning during this unique and brief funding window.

Additional opportunities will likely exist in partially served census blocks scattered across the county. In order to identify these locations, the county and other localities should acquire a CostQuest data license that will allow them to access individual location service information necessary to spot these locations and include them in projects submitted to the BEAD program.

■ **Develop targeted projects that can best utilize the Broadband Infrastructure Account**

This program focuses on identifying locations that are either unserved at speeds of 10/1 Mbps or are low-income locations without access to 25/3 Mbps service. The program also allows for smaller applications including fewer locations, allowing

applicants to target the most eligible households and create projects that can connect locations across a wider area. While there are a few clusters of areas that are very likely to be prioritized, many projects using this funding source will have to be developed using location-specific service availability and demographic data.

Tehama County has a reported 1,301 locations (4.8 percent) that do not yet receive any service meeting the 10/1 Mbps standard. Some of these hard-to-identify locations are somewhat scattered and will likely require access to the CostQuest address fabric to be identified. BIA projects can identify areas as small as individual properties and combine them in one application, so long as the residents of each property are low-income households. As a result, this program is a unique option for smaller project proposals across the county that focus on expanding or upgrading existing networks to reach economically disadvantaged areas. Localities can work with the ISPs serving nearby neighborhoods in each area to develop potential projects that could connect a number of small, non-contiguous areas to reach the lowest income unserved households prioritized by this program. Including areas that may already receive 10/1 Mbps service but not 25/3 Mbps service, there are a few clusters in low-income census blocks that should be considered for the BIA program:

- A few clusters of unserved locations in low-income census blocks are located along Paskenta Road between the towns of Henleyville, Flournoy, and Paskenta. Access can be brought here from Corning Rd, which connects to the eponymous city where AT&T's DSL network and Comcast's cable network are located. Additionally, just southeast of this area, there may be another cluster of unserved locations on the northern side of Black Butte Lake, including the Buckhorn Recreation Area, but this area may need to be accessed by a different fiber route, along Newville Road into Glenn County.
- Paynes Creek contains a number of unserved locations in low-income census blocks. These households are more dispersed along CA-36, including Dales to the west and a neighborhood in Ponderosa Way, to the east. A smaller concentration of unserved households is located to the south between Round Mountain and Middle Ridge. The state open-access middle mile network will run along these areas, and GSCA has submitted an FFA application to serve Manton slightly north of this area, putting it in an excellent position to consider this program.
- Further along CA-36, there are small clusters of unserved locations in low-income census blocks in the town of Mineral, extending along SR172 in the Mill Creek community, Morgan Summit Snowmobile Park, and further along in Deer Creek-St. Bernard. The state middle mile network extends through these communities and into Plumas County, so GSCA could propose to connect these areas, or alternatively, Frontier can look to replace its DSL service in Mineral by extending its existing fiber on the other side of the border in Stover Mountain.

As with the BEAD program, additional planning efforts will require that localities acquire the CostQuest data license that will allow them to access individual location service information. Localities should combine this information with demographic information covered in Section 6.2 in order to identify the strongest candidate locations for funding, and work with nearby ISPs to extend service to these locations.

- **Utilize California's Loan Loss Reserve Fund program to reduce the financing costs necessary to build broadband projects that will result in public ownership of network assets**

This program will enable eligible entities to obtain a wider range of financing options with better borrowing terms, thereby increasing the viability of many projects that will require more time to cover initial investment costs. However, this program also includes certain ownership requirements that restrict its use to projects that will result in non-private infrastructure ownership. This distinction will make local partnerships with special eligible entities, such as joint powers authorities, more appealing, but private ISPs may still consider certain public-private partnerships that would comply with this ownership requirement as well.

10.5 Developing Smart Community Strategies

The benefits of broadband access to individual households and businesses are well-documented, but some benefits can occur only when connectivity is used to allow multiple organizations or entire communities to coordinate with one another. Digitally connected communities improve the quality of life for all residents by leveraging both new and existing technologies and the data they gather to enable new ways of addressing community needs, such as transportation, energy, agriculture, natural resource management, and emergency responsiveness. Section 9 reviews a diverse range of applications for smart systems, but we focus on the most impactful suggestions here. To develop smart community systems more generally, Tilson and VHB recommend that localities develop an overall smart community plan using a core set of steps.

■ Develop a smart community plan

The county and major localities all can benefit from digital technologies, but their opportunities and resources will obviously differ. For example, localities can increasingly use data-driven methods to control public utility infrastructure such as local water drainage systems and transportation infrastructure such as stoplight grids to manage traffic flows at peak times. In contrast, the county will likely focus on issues like fire management systems. Despite these different applications, all localities should generally follow the same steps:

- Localities should identify their current digital information and coordination systems and evaluate how this data could contribute to other organizations or different use cases.
- Localities should engage the public in a collaborative visioning process to identify community needs, using the topics and strategies presented in this report as a starting point to understand what strategies should be prioritized. This engagement process could consist of stakeholder focus group meetings, public workshops, online surveys, and other means of civic engagement and public participation.
- For each priority, the locality should perform benefit-cost analysis and identify a responsible department or partner agency, potential cost-sharing partnerships, risks, and any alignment with county policies and planned projects. Specific implementation cost estimates can be developed at this time, potentially for one or more pilot projects.
- Localities should use smart community plans that contain recommended goals, objectives, and policies to acquire feedback from key stakeholders and the community at large, then refine them into formal resolutions, ordinances, or special projects that can see these plans put into action.

In terms of specific community needs, Tilson and VHB recommend the following:

■ Expand wildfire and flood detection and monitoring systems to improve safety

Local, state, and federal organizations already monitor a number of environmental conditions and factors. However, to improve their efficacy, these different organizations are currently undergoing a data-driven evolution that aims to share information in real time, improve risk assessment models, and develop processes and strategies that are more responsive to current conditions. These improvements require both coordination between these organizations and their information management systems and, increasingly, the involvement of key community members to expand data-gathering capabilities and facilitate more localized monitoring. While Section 9 contains additional suggestions, Tilson and VHB highlight the following recommendations:

- The county should work with essential partners involved at other levels of government and key non-governmental organizations (NGOs). To coordinate fire monitoring and prevention strategies, the California Office of Emergency Services (CalOES), the California Department of Fish and Wildlife (CDFW), United States Forest Service (USFS),

National Oceanic and Atmospheric Administration (NOAA), Federal Emergency Management Agency (FEMA), and the National Interagency Fire Center (NIFC) can all contribute to a comprehensive wildfire management strategy. Similarly, the California Department of Water Resources and FEMA, the California Data Exchange Center (CDEC), and some of the aforementioned agencies can contribute to a flood detection and water management policy strategy.

- To improve the ability to evaluate trends and more problematic areas, the county should work toward using a single system that can draw from data its partners and any privately-owned devices that could aid in the monitoring process on the local level.
- Localities should prioritize the use of smart infrastructure technologies, such as smart levees, flood gates, and stormwater management systems that can automatically respond to changing environmental conditions.
- The county should use ongoing efforts to improve its monitoring systems to revisit and revise emergency response plans, using the system's increased predictive and real-time capabilities to create more localized or adaptive strategies.

■ Deploy charging and fueling infrastructure to support zero emissions vehicles (ZEV) and Electric Vehicles (EV)

Zero emissions vehicles (ZEV) and electric vehicles (EV) are a transformative advancement in transportation technology. On a local level, these transportation options can generate cost savings for residents who adopt them while reducing the county's dependence on and demand for gasoline. Their presence along key roads across the county can also improve cross-county travel, bringing in more visitors and promoting local tourism. While Section 9 contains additional suggestions, Tilson and VHB highlight the following recommendations:

- The county should adopt an initiative to deploy charging and fueling infrastructure to support zero emissions vehicles (ZEV) and electric vehicles (EV).
- Localities should reach out to organizations that provide EV infrastructure to develop initial cost and feasibility information.
- Localities should conduct feasibility studies to identify optimal locations for charging stations, considering factors such as population density, transportation routes, and community needs.
- Localities should work toward developing cooperative agreements with local energy companies to support these systems.
- Using the funding suggestions presented in Section 9.5, the county and local governments should work together to develop scalable deployment plans that leverage additional funding from outside the county to improve the region's transportation options. This strategy will require collaboration between electric utility companies, government agencies, and private sector partners to secure funding and resources for the installation and maintenance of charging infrastructure.

■ Use Smart Water and Irrigation Systems to optimize conservation efforts

Smart water systems help ensure sustainable water use for all by utilizing advanced technologies and data analytics to optimize water management and increase efficiency. Sensors that are outfitted with digital communications systems enable remote monitoring, live data analysis, and real-time decision making. Advanced metering infrastructure, including smart meters sending wireless signals in real time, can be used to improve water accounting and reduce waste. Implementing enhanced pressure and flow management strategies and monitoring distribution networks for infrastructure maturity can prolong the lifespan of a piping network. Modern data analysis tools can also facilitate the use of more comprehensive

historical and real-time data to make informed management decisions. While Section 9 contains additional suggestions, Tilson and VHB highlight the following recommendations:

- The county should develop smart drought detection, groundwater, and wastewater management systems that use real-time monitoring, automation, and optimization algorithms to improve the efficiency of overall water supply management methods.
- The county should promote the use of smart soil sensors and irrigation systems, which use sensors to monitor soil moisture levels and weather conditions and allow for more precise and efficient watering of plants and crops.
- The county should work with Groundwater Sustainability Agencies (GSAs) in high and medium priority basins to help protect groundwater resources for the long term. Implementation of smart groundwater monitoring systems may benefit from collaboration with GSAs as well as Sustainable Groundwater Management grants available through the California Department of Water Resources (DWR). The State Water Board's Safe and Affordable Funding for Equity and Resilience (SAFER) drinking water program may also serve as a source of funding for smart water system upgrades for potable water.

10.6 Next Steps

Many of the recommendations above have been presented in a sequential manner, with certain topics, such as the public-private partnership formation process or the development of a smart community plan, already presented as a series of steps and considerations that will need to be made to accomplish those overall projects. However, with so little time available before key broadband funding processes begin, the county and other localities must prioritize certain recommendations over others now and in the near future. These next steps will be divided into the following four time periods:

- **January to March of 2024:** During this period, additional mapping updates will be released by the FCC and the CPUC, which will serve as the underlying basis to determine location eligibility information. The BEAD challenge process may begin as early as the end of this period as well, requiring that localities prioritize all efforts to ensure that these maps accurately reflect unserved and underserved locations that should be included in broadband project proposals. The CPUC may also issue awards for the first round of FFA funding, which will either solidify GSCA plans or require updates before the next FFA funding cycle.
- **April to August of 2024:** The BEAD challenge process period will close during this period, which will solidify the final map used to determine BEAD-eligible unserved and underserved locations throughout the county. The initial BEAD application round may begin toward the end of this period as well, so localities and ISPs should be prepared to submit their project plans and application materials. The third FFA application window is also expected to open and close during this period, providing what is likely to be the last opportunity to utilize any funding allocated specifically to Tehama County under this program.
- **September to December of 2024:** The initial BEAD application round is more likely to be conducted during this period, so ISPs and their local partners should be prepared to submit eligible projects that focus primarily on unserved locations. Localities that have worked to develop local policy revisions strategies also should begin to implement them during this period, setting the stage for any recently funded projects that will need to benefit from the cost- and time-saving efficiencies they enable.
- **2025 and beyond:** If the BEAD program does not exhaust its available funding during the initial application round, there will be another submission opportunity that will focus on projects to any remaining unserved locations that were

not connected during the prior round. The program may also have funding available to consider underserved locations, so ISPs and their partners can refine their deployment plans accordingly.

However, the focus of the county and other localities will increasingly shift toward two areas: deployment monitoring and smart community efforts. Whether the locality formally partnered with an ISP or merely coordinated with one, the locality should monitor deployment progress closely to understand how service availability is improving and comply with any reporting requirements it may have committed to. With fewer local efforts devoted to deployment planning, localities should also devote more attention to developing and implementing smart community strategies.

- **January to March of 2024**
  - **Each locality should designate its primary point of contact for broadband projects, if it has not already done so:** Of all the local policy best practices advocated by experts and broadband ready community programs implemented in other states, this recommendation is made most consistently. This person will serve as the central source of broadband information to the ISPs and have an opportunity to understand ISP priorities, which will facilitate all other planning and coordination efforts.
  - **Localities should reach out to nearby ISPs that may be willing to expand or upgrade services in their areas:** Localities should establish lines of communication with local ISPs to identity their levels of interest in deployment efforts, any local policy concerns they may have, and their willingness to coordinate or partner with the locality. This information will be used for all subsequent planning efforts, and the relationships developed here will ensure that any formal RFPs are received and considered by each ISP in a timely manner.
  - **Localities should monitor mapping updates closely:** This period will see updates made to the FCC and CPUC broadband maps, which will serve as the basis for the BEAD challenge process. These updates have the potential to reveal recent expansion and upgrade efforts made by ISPs after their last service area submissions, which have been used in this report. As a result, any of the locations identified as unserved and underserved and the resulting deployment suggestions developed in this report may change, requiring that localities adopt their strategies accordingly.
  - **Each locality should acquire the appropriate CostQuest location information licensing agreement:** Some of the remaining unserved and underserved locations are found in partially served census blocks, so maps that aggregate information about available services on the census block-level can hinder the inclusion of these scattered eligible locations. Localities can contact CostQuest and acquire a free license to access location-based information about their jurisdictions that will enable a GIS team to identify these locations and include them in planning efforts and grant applications. This process will also require that the locality submit certain information to the FCC, but these efforts are minimal, and the strategic planning benefits are significant.
  - **Localities should begin to conduct community outreach on broadband needs and issues, if it has not already done so:** While mapping and service-level information generally establish eligible service areas for funding programs, each locality can benefit from active community engagement in a number of ways. Community broadband leaders and other interested parties can identify areas with services that may fall short of the information presented on the broadband maps. This information should be used to identify areas that may need to be included in the challenge process. Active engagement will also allow the locality to learn about other aspects of the digital divide in their communities, along with any existing digital inclusion efforts and additional needs still not being met. The relationships established during these outreach efforts will also allow the locality to cultivate local buy-in for local deployment efforts, which can increase the rate at which locals adopt recently deployed services and improve economic viability accordingly.

- **Localities should develop and implement their challenge process strategies:** With the BEAD challenge process occurring so soon, localities must immediately review service availability maps closely, identify any areas that are likely mischaracterized, and implement data-collection strategies that can harness well-coordinated crowdsourcing of evidence necessary for successful challenges. Section 6.4 reviews top strategies that localities can use to develop and implement these coordinated efforts.
- **Localities should review their local policies and begin to identify improvement opportunities:** Using the top recommendations listed above and the more in-depth discussion provided in Section 7, localities should review their current policies and identify improvement opportunities. This process should begin immediately, because localities need ample time to identify the list of potential changes, evaluate benefits and costs of refining and implementing each change, and ultimately adopt them.
- **Localities should begin to consider possible smart community strategies that they may want to implement:** While smart community strategies planning is not as pressing as the development of ISP and community relationships, challenge process information-gathering, or deployment planning in the short term, localities should still begin to think about the range of recommendations identified above and in Section 9.

April to August of 2024

- **The county and GSCA should continue their efforts to acquire funding for the open-access last mile network:** In the prior period or early in this period, the CPUC is likely to announce awardees from the first round of FFA funding. If GSCA's project has been awarded funding, the organization will begin to implement its deployment plan and develop BEAD-eligible projects that can rely on these new service areas. If the project is not selected for funding, GSCA can revise the application and resubmit it, and adjust its potential BEAD application strategy accordingly.
- **Localities should develop deployment plans for their priority areas:** During this period, the BEAD challenge process will have finalized the broadband service maps used to identify BEAD-eligible unserved and underserved locations. Localities should refine their list of priority locations, using this new information and the CostQuest-sourced location data to create more detailed deployment plans.
- **Localities should work with local ISPs to connect unserved locations using the BIA program:** This funding option can offer a lower matching requirement than the BEAD program, so localities seeking to maximize funding should use the CostQuest-sourced location data and relevant demographic data to identify high-priority low-income locations that can be connected through this program.
- **Localities should release their RFPs and begin the partnership or coordination process with the best candidate ISPs:** After developing lines of communication and a general understanding of interest from each ISP in the prior period, the locality can develop an RFP that can allow each ISP to submit a formal proposal that includes all the details the locality should consider to identify its best partnership opportunity. If the locality has already refined its deployment priority plans, these priority areas can be included as either required or suggested areas for any project proposals.
- **Localities should create drafts of revised local policies that will facilitate deployments:** To ensure that these policy revisions are in place before ISPs begin to deploy their networks, this period should be used to develop revised policies, then distribute them to stakeholders for feedback and refinement opportunities.
- **Localities should conduct community outreach about smart community strategies:** Building upon prior broadband community engagement efforts, this period can be used to gauge community interest in the different smart community strategies presented in Section 9 and possibly to discover other needs that can be met through the coordinated use of digital technologies.

- **Localities should contact the most relevant state and federal agencies and companies that could contribute to smart community strategies:** As the locality conducts its initial feasibility review of its smart community strategy options, it should reach out to key organizations that can provide it with more information about what data can be sourced and other factors key to the planning process.

September to December of 2024

- **Localities should work with interested ISPs to develop and likely submit deployment projects to the BEAD program:** The prior period focused on the solidifying project service areas and partnership or coordination details. This period will require that additional project details be finalized, which may require significant time and effort to refine certain project elements if the locality has chosen to partner with an ISP more formally.
- **Localities should adopt revised local policies that will facilitate deployments:** After drafting revisions, acquiring stakeholder input, and refining proposed policies accordingly, this period should be used to formally adopt the policies and begin implementing them.
- **Localities should develop a draft of their overall smart community plan:** To ensure that the information-gathering efforts occurring in the prior period yield results, localities should set the goal of releasing a draft of their smart community plan. This document should include outlines for initiatives to implement each of the recommendations above, along with more detailed proposals of key pilot projects selected as the starting points for these overall strategies.

2025 and beyond

- **Localities should develop and implement deployment monitoring programs:** If the locality formally partnered with an ISP and co-developed project received a grant award, the locality may be obligated to conduct detailed monitoring of project progress and financial expenditures that must be submitted regularly to the CPUC. This obligation will depend upon the partnership structure, so localities should consider this responsibility when establishing a partnership agreement.

  However, even if the locality is not obligated to monitor deployment progress at this level of detail, it should still coordinate with the ISP to understand when locations will be able to receive service and keep local communities informed of these timelines.
- **Localities should consider developing additional BEAD project proposals with interested ISPs:** If unserved areas do not receive acceptable project proposals, the BEAD program will likely open up an additional submission round that will focus primarily on ensuring these locations are connected. The BEAD program may also have enough funding available after the first round to enable applicants to include underserved areas, so ISPs and their partners should closely monitor the BEAD application review process and plan accordingly.
- **Localities should monitor additional broadband program developments and changes:** With so much funding available and so many different rules used to direct funding allocations, it is very difficult to predict what sort of emergent problems may arise throughout the next year. These funding programs may have to modify certain rules to address such problems, and localities should pay close attention to any changes, because they may impact deployment opportunities significantly.
- **Localities should implement smart community pilot projects, refine their smart community plans, and develop additional projects to take advantage of improved broadband access and new technologies:** With most funding to be awarded over a brief two-year window, localities that have devoted significant efforts toward deployment programs will finally be free to shift their efforts toward other broadband-related priorities. Localities should be able to develop

their smart community capabilities more gradually, using the initial pilot projects as a starting point to expand the locality's smart community efforts into other areas.

SECTION

11

APPENDICES AND GLOSSARY

Appendix A: Business Survey Results and Analysis

Tilson conducted a survey of businesses located throughout the counties participating in this study to collect data on their experiences with internet services. Participants representing a wide variety of businesses responded, ranging from small home ventures and fast-food establishments to larger organizations, such as hospitals and hotels. The survey received a total of 184 responses across 16 counties, as shown below in Table 26:

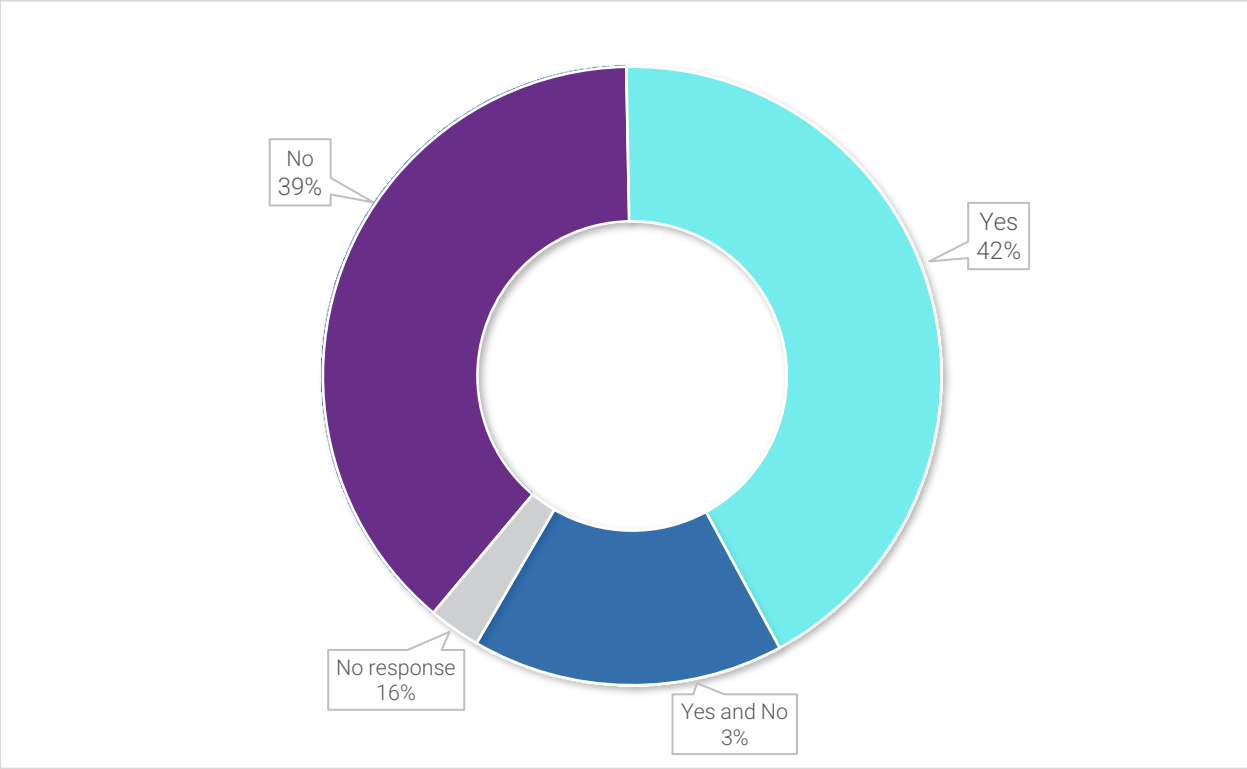
Table 26: Count of Business Survey Participants, by County

County	Count of Survey Participants in County
Tehama	30
Mariposa	26
Butte	23
Calaveras	23
Inyo	15
Plumas	14
Lassen	14
Modoc	11
Sierra	6
Colusa	5
Tuolumne	5
Napa	4
Glenn	3
Shasta	2
Amador	2
Nevada	1
Total	**184**

The survey included a variety of questions intended to capture participants' current internet service (both monthly cost and subscription speeds, in Mbps), experience with this service (performance and/or reliability, the service's suitability, and satisfaction with customer service), and anticipated future bandwidth needs. The survey also collected information on conditions that may impact the actual performance experienced by the business, irrespective of external network conditions, such as the age of the business's network equipment and the state of their building's internal wiring.

Figure 39 below summarizes participant responses to the most fundamental question regarding internet service: whether or not it is sufficient for their business's needs.

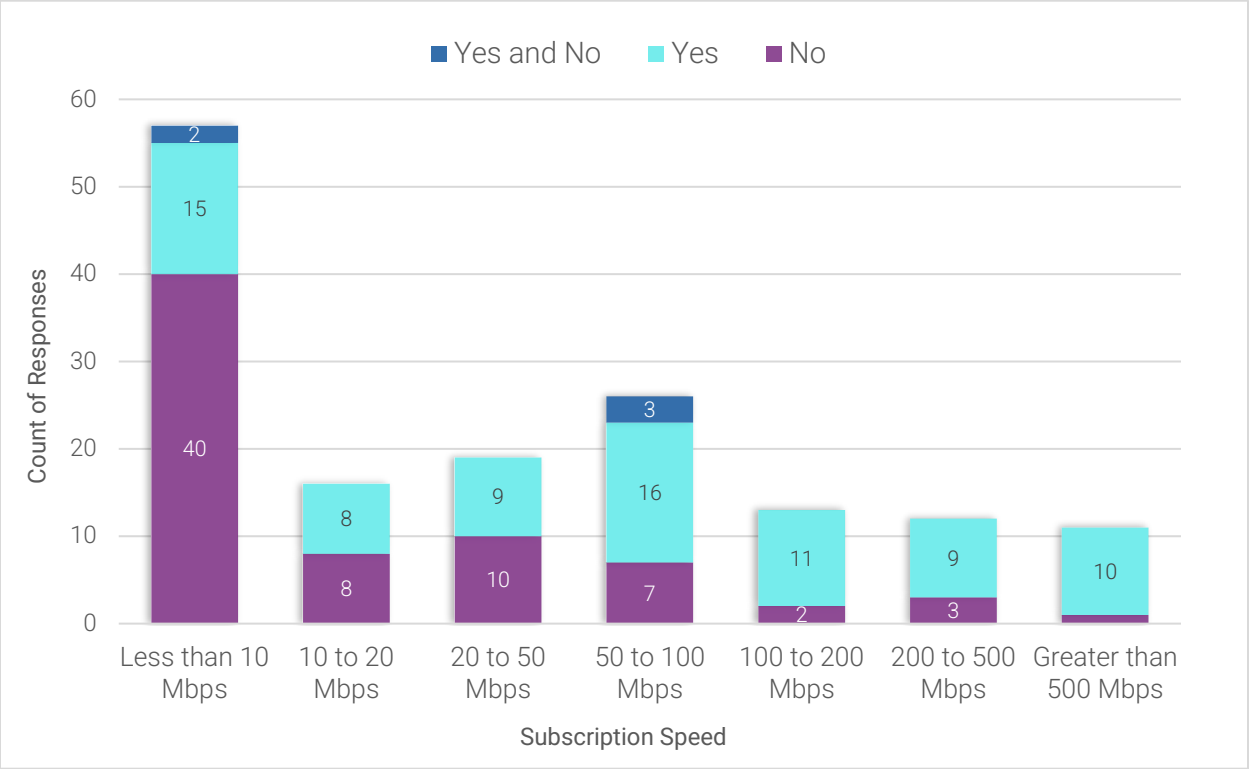
Figure 39: Summary of Responses to the Question "Is your internet sufficient for your business needs?"



Of the 184 participants, a slightly greater proportion indicated their internet was sufficient for their businesses' needs (42 percent), as compared to those who did not feel their service was sufficient (39 percent). A small group (3 percent) felt their service was sufficient in some ways, but insufficient in others. The remaining 16 percent of participants did not respond to the question.

As expected, participants' impressions of their internet service's adequacy was somewhat related to the speed of internet service purchased, with businesses receiving slower subscription speeds more likely to identify that their services was not sufficient.

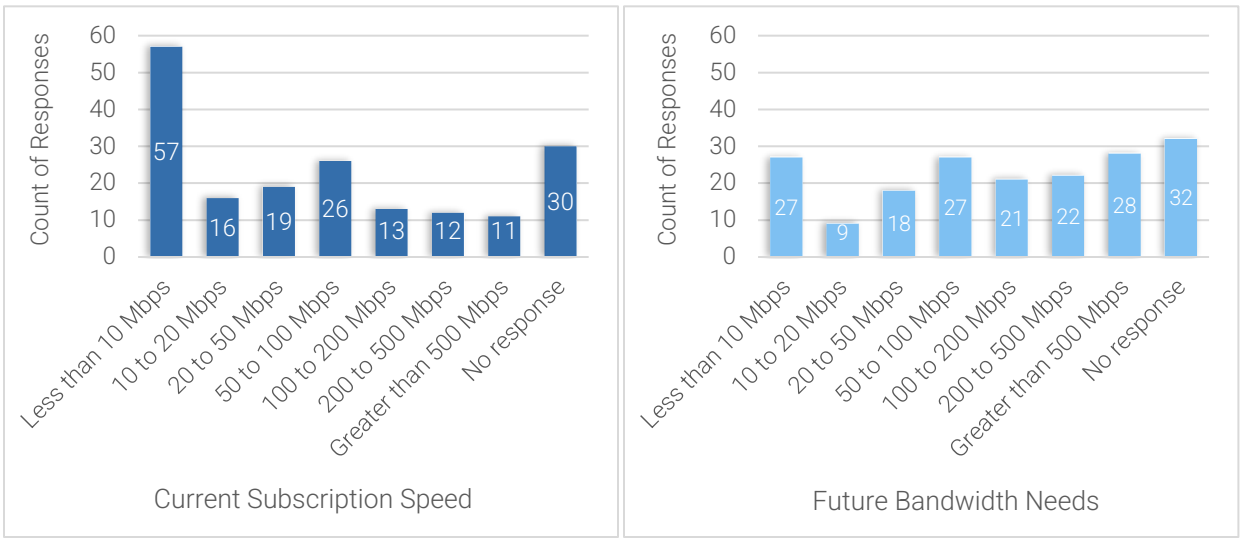
Figure 40: Summary of Responses to the Question "Is your internet sufficient for your business needs?" by Subscription Speed



Notably, this survey had a disproportionately high number of respondents who indicated their business relies on internet service of less than 10 Mbps (57), reflecting their likely stronger interest in participating. A larger proportion of this group also indicated their internet service was not sufficient for their business's needs (70 percent), greater than for those subscribing to higher-speed services. As the amount of bandwidth purchased increases, the proportion of survey participants who stated their internet service meets their business's needs generally increased as well, but even with downloads of 50, 100, or 200 Mbps, some businesses identified that they needed better service.

Participants were also asked to estimate their business's future bandwidth needs. Figure 41 below compares the range of participants' current subscription speeds against the range of participants' estimated future bandwidth needs.

Figure 41: Current Internet Speed vs. Future Bandwidth Needs

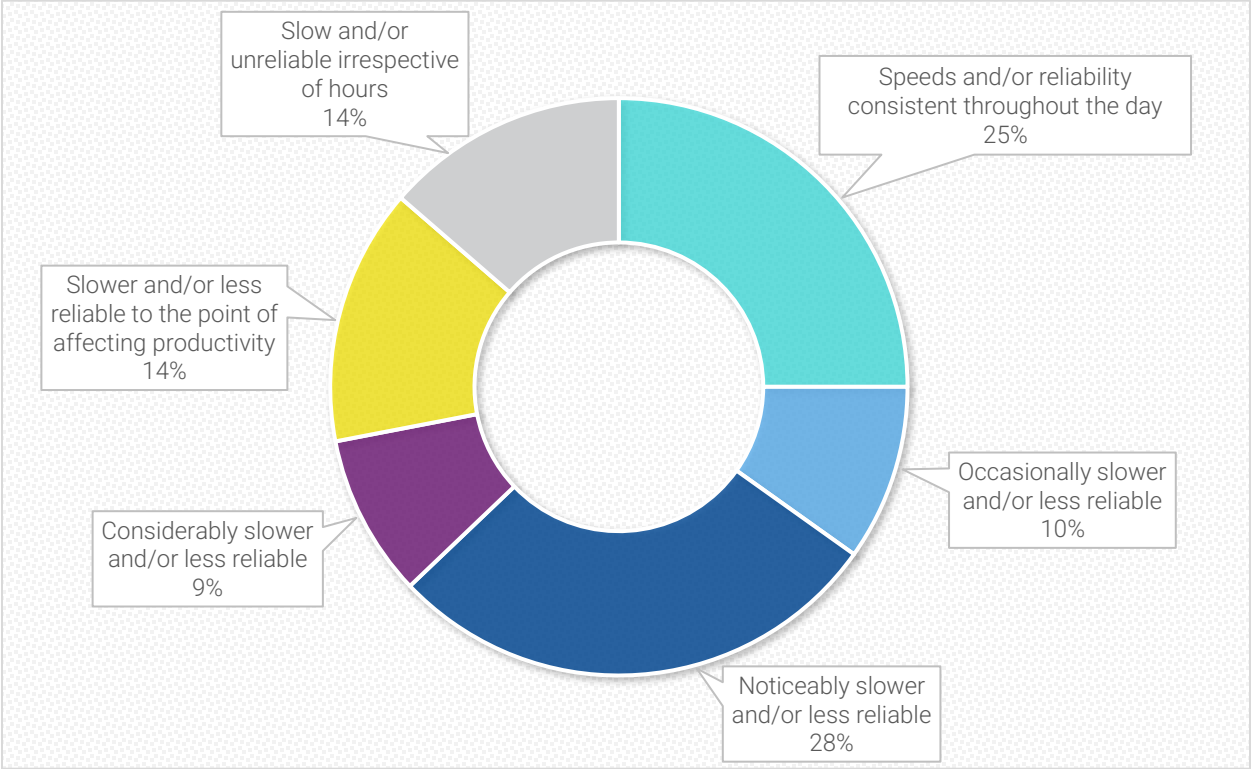


Unsurprisingly, the number of businesses expecting to have their needs met by less than 10 Mbps or between 10 and 20 Mbps dropped significantly, reflecting the extent to which businesses receiving only those levels of service would want faster service options. The number of participants who felt internet service of less than 10 Mbps would be sufficient for their business's future needs fell by approximately 50 percent, the largest decrease among all groups.

The data strongly demonstrates an increased demand for higher-speed services, particularly at speeds of at least 100 Mbps or more. Nearly a quarter of businesses identified that they would need access to speeds of at least 200 Mbps. The group of participants who felt 200 to 500 Mbps would meet future needs is 83 percent greater than those currently purchasing this level of service. Service capable of delivering greater than 500 Mbps increased the most, representing a portion nearly 2.5 times the number of respondents already receiving this option.

Participants were then asked to describe their business internet service's performance and reliability during peak usage hours to understand how increased user demand may affect these areas. Figure 42 below summarizes participant responses to the question, "During peak hours, how would you rate your network congestion and reliability?" Answers provided by this open-ended question have been translated to the following answers, shown in Figure 42, based on (1) whether they identified that speeds were consistent, then (2) whether they identified the issue occurred irrespective of hours, then (3) whether the answer mentioned a reduction in productivity or work, then (4) by the intensity of the remaining answers.

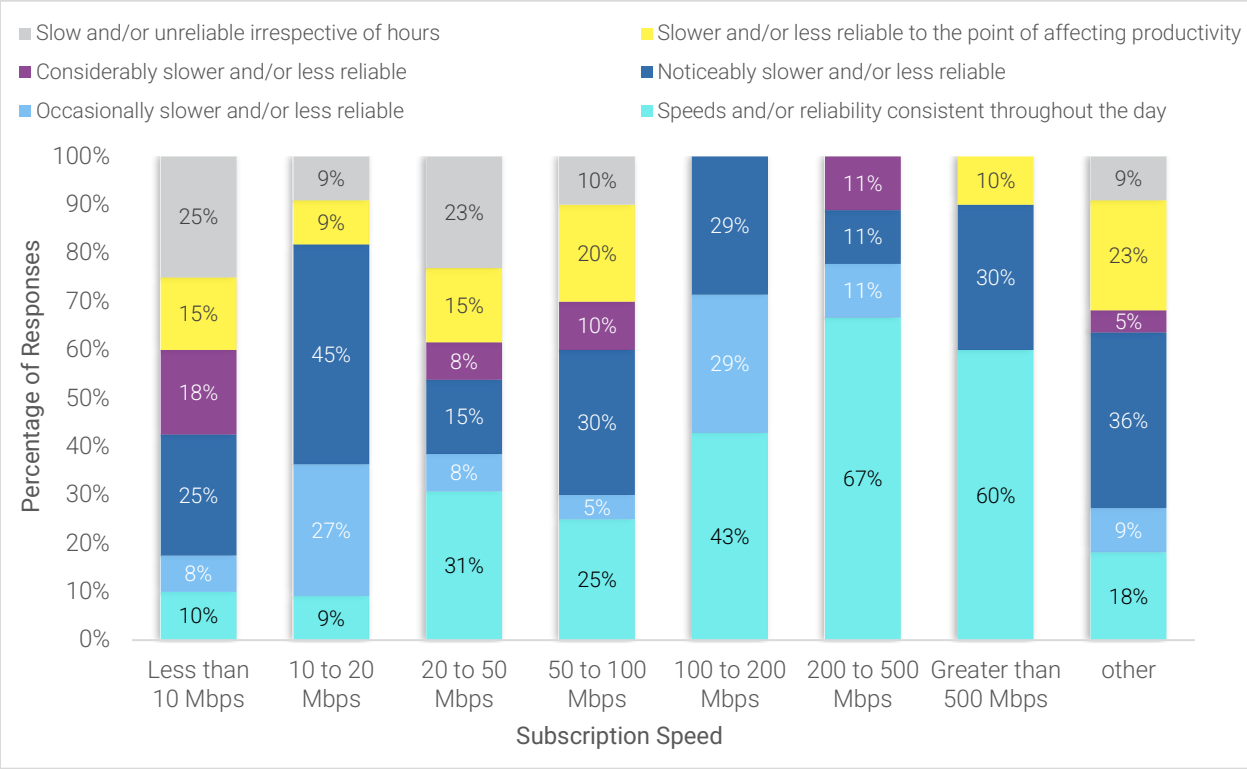
Figure 42: Summary of Responses to the Question "During peak hours, how would you rate your network congestion and reliability?"



Three-quarters of respondents identified that they are at least occasionally impacted by slower internet speeds during peak hours. Concerningly, more than half (51 percent) answered that their services were noticeably or considerably slower or less reliable or problematic to the point of impacting productivity. Another 14 percent focused on the issue of occurring any time of day. The data collected by this question suggests that, while a quarter of participants experience consistent speeds and reliability throughout the day, many more face slower and less reliable service as network congestion increases during peak hours.

A greater proportion of participants whose businesses subscribe to lower service tiers experience degradation during peak usage hours when compared to their counterparts who purchase higher tiers. Figure 43 below summarizes this comparison.

Figure 43: Summary of Responses to the Question "During peak hours, how would you rate your network congestion and reliability?" by Subscription Speed



Just 10 percent of those subscribing to service less than 10 Mbps report experiencing consistent speeds and reliability throughout the day. This ratio is similarly low for the group subscribing to service between 10 and 20 Mbps (9 percent). In general, those purchasing higher service tiers tend to report more consistent speeds and reliability throughout the day, though some participants in these groups still suffer from service degradation during peak usage hours. Notably, no participants subscribing to speeds at or above 100 Mbps indicated their service was slow and/or unreliable irrespective of hours, in contrast to those subscribing to lower-tier services.

Participants were asked to specify the ISP their business purchases internet services from. Table 27 below provides a count of participants by the internet service provider they patronize and the county their business is located in.

Table 27: Count of Participant's Internet Service Providers, by County

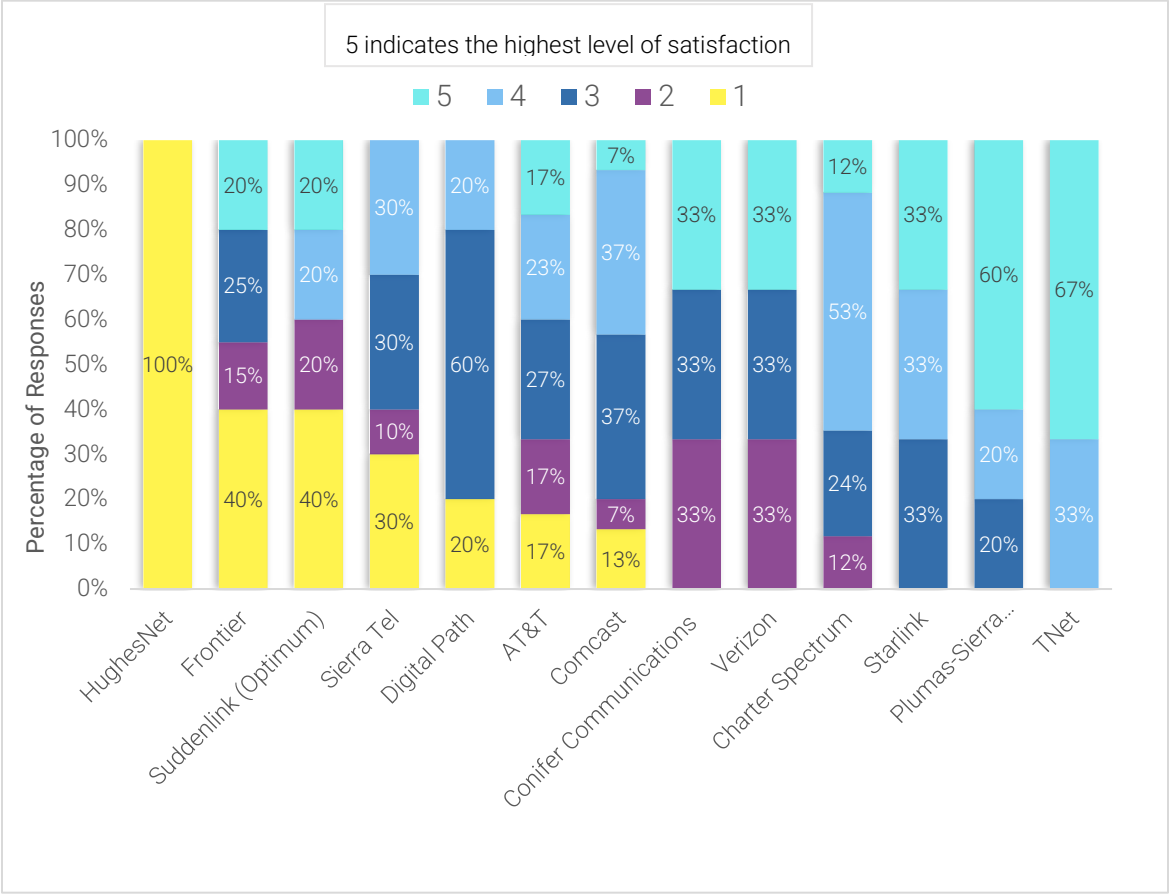
Provider (Count of Participant Subscribers)	Participant County	Count of Participants
Comcast (30)	Butte	8
	Calaveras	14
	Colusa	1
	Napa	3
	Tehama	1
	Toulumne	3
AT&T (30)	Amador	1
	Butte	10
	Calaveras	2

	Glenn	2
	Mariposa	2
	Plumas	1
	Sierra	3
	Tehama	7
	Tuolumne	2
Frontier (20)	Colusa	1
	Inyo	4
	Lassen	8
	Modoc	4
	Plumas	3
Sierra Tel (20)	Mariposa	19
	Nevada	1
Charter Spectrum (17)	Tehama	17
Plumas-Sierra Telecommunications (5)	Lassen	1
	Plumas	4
Suddenlink (Optimum) (5)	Inyo	5
Digital Path (5)	Plumas	2
	Tehama	3
Starlink (3)	Lassen	1
	Mariposa	1
	Modoc	1
TNet (3)	Modoc	3
Conifer Communications (3)	Calaveras	1
	Mariposa	2
HughesNet (3)	Calaveras	1
	Plumas	1
	Sierra	1
Verizon (3)	Butte	2
	Tehama	1
Succeed.Net (2)	Colusa	2
Schat Communications (2)	Inyo	2
Shasta Beam (2)	Shasta	1
	Tehama	1
Cal.net (2)	Calaveras	2
Hospitality WiFi	Inyo	1
SV.Net	Modoc	1
SONIC	Napa	1
Unwired Broadband	Mariposa	1
T-Mobile	Calaveras	1
Stream IT	Glenn	1
ViaSat	Sierra	1
Caltel Connections	Calaveras	1

Volcano Telephone Company	Amador	1
ColusaNET	Colusa	1
Zito Media	Plumas	1
Silver Rapid	Calaveras	1
Smarter Broadband	Sierra	1
Other Responses		
2 Providers (10)	Butte	2
	Inyo	2
	Lassen	2
	Modoc	2
	Plumas	1
	Shasta	1
3+ providers (3)	Butte	1
	Lassen	2
None or N/A (2)	Inyo	1
	Mariposa	1
Unknown	Plumas	1

Participants were asked to indicate satisfaction with their provider's level of service and customer support on a scale from one to five, with one corresponding to the lowest satisfaction and five to the highest. Figure 44 below summarizes these responses, though the graph excludes ISPs with less than three answers to this question.

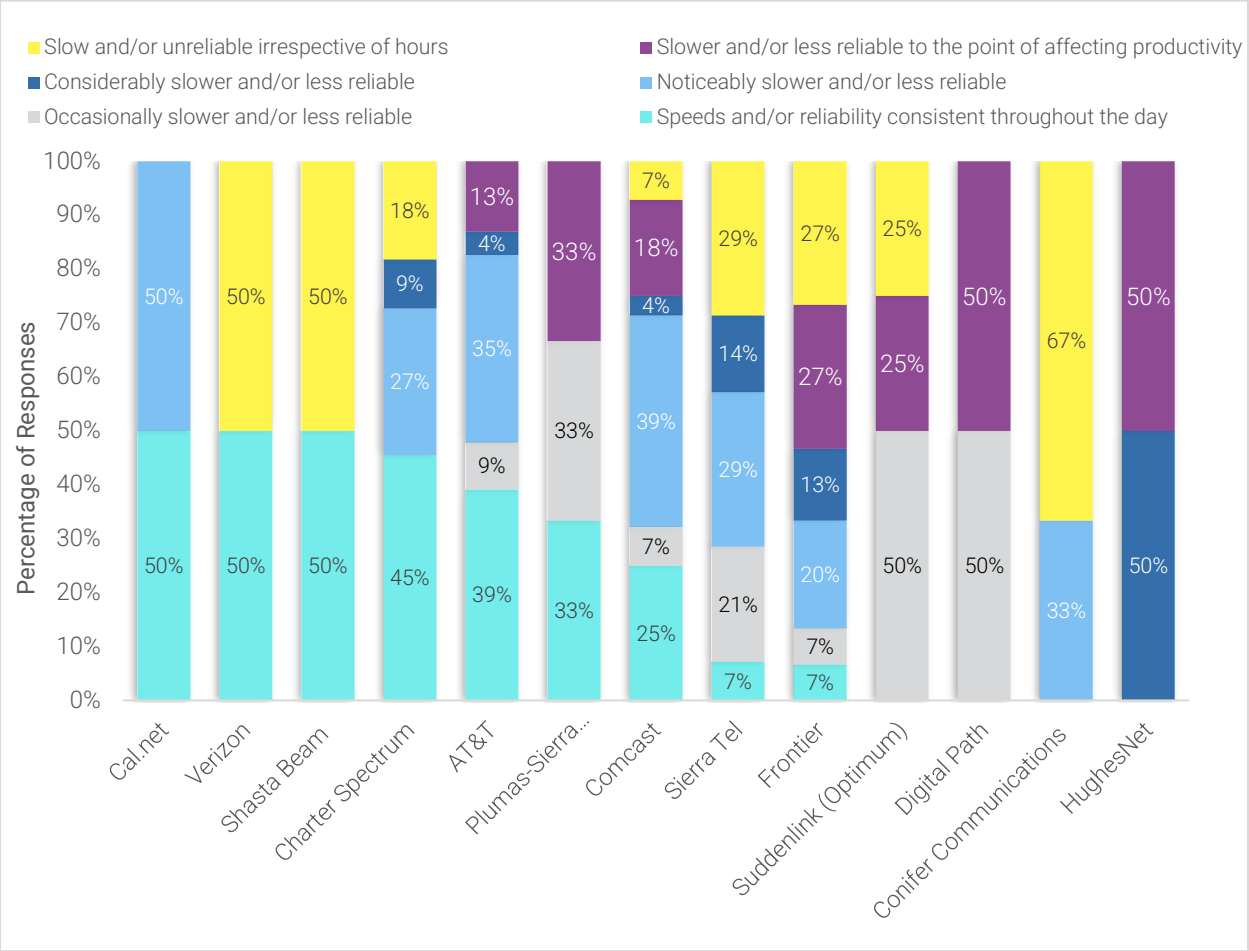
Figure 44: Satisfaction with Level of Service and Customer Support, by Provider



Providers on the left-hand side have a higher ratio of responses indicating lower satisfaction with their level of service and customer support. The responses collected may disproportionately represent the opinions of less satisfied customers, who may have felt more compelled to participate in the survey, given the opportunity to voice their concerns.

The bias created by unhappy customers' tendency to complete surveys should also be applied to Figure 45 below, which summarizes participants' experience during peak hours by the provider their business purchases service from. Figure 45 excludes providers who received only one response to this question.

Figure 45: Summary of Responses to the Question "During peak hours, how would you rate your network congestion and reliability?" by Provider

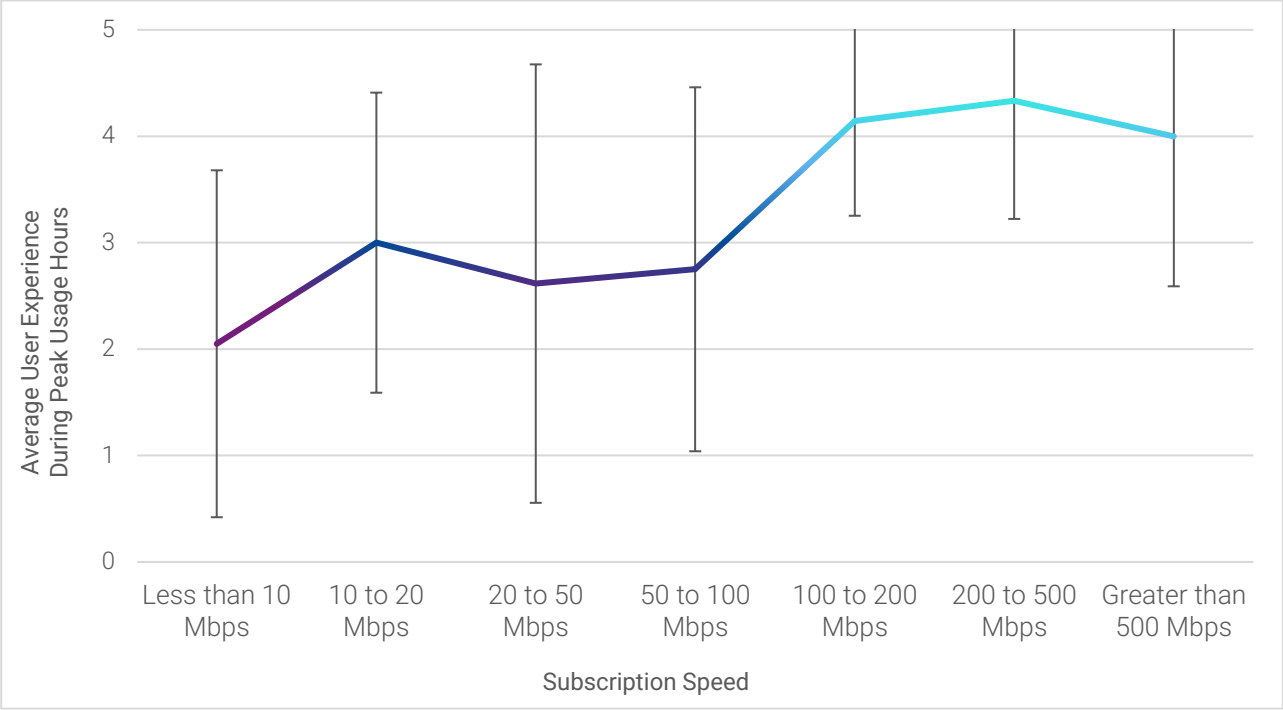


In contrast to Figure 45, providers shown on the left-hand side demonstrate higher ratios of participants who felt their service was consistent throughout the day. However, it should be noted that network performance and reliability vary significantly among participants served by the same provider. Verizon and Shasta Beam are stark examples of this, with 50 percent of subscribers reporting consistent reliability and speeds throughout the day, while the remaining 50 percent experience slow, unreliable service irrespective of the time of day.

This phenomenon is likely due in part to the different subscription speeds that participants purchase from the same provider. Experience during peak hours is poorer on average for those subscribing to lower-tier service offerings. No one subscriber is guaranteed to receive the maximum speeds advertised for the internet service they purchase. As a network becomes more congested, end-user's experienced data transfer rate, referred to as throughput, decreases. This can leave subscribers to lower-tier offerings more vulnerable to more severe service degradation during peak usage hours when compared to their counterparts who purchase more bandwidth.

Figure 46 below summarizes the relationship between the participant's subscription speed and average experience during peak usage hours.[326]

Figure 46: Numeric-coded Average of Responses to the Question "During peak hours, how would you rate your network congestion and reliability?" by Subscription Speed

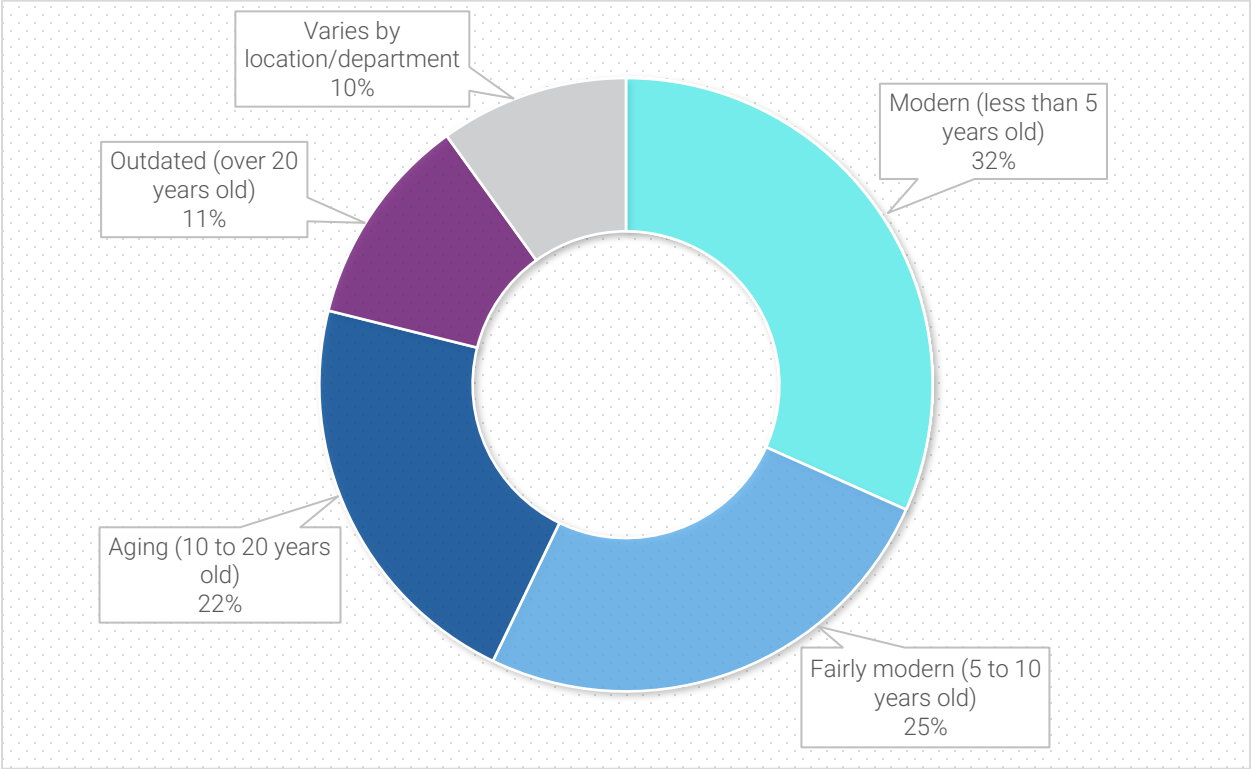


As demonstrated by the relationship shown above, respondents who subscribe to lower-tier service offerings have a poorer average experience during peak usage hours than those who subscribe to higher service tiers. While a portion of this trend is likely due to the relationship between bandwidth purchased and experienced throughput during periods of network congestion, the technology delivering service may contribute. Fixed wireless and DSL networks often face greater service degradation during peak usage hours and offer less bandwidth to end-users. Such technologies require subscribers within a geographic area to share these networks' limited resources, which are inherently less than in hybrid fiber-coax or entirely fiber networks.

Lastly, participants were asked to estimate the age of their business location's internal network equipment and in-building wiring, which can impact end-user speeds irrespective of external network performance. Figure 47 below provides a summary of these responses.

[326] The average of respondents' experience using their internet subscription during peak usage hours was calculated by coding the original qualitative responses to the question as follows: 0: Slow and/or unreliable irrespective of hours; 1: Slower and/or less reliable to the point of affecting productivity; 2: Considerably slower and/or less reliable; 3: Noticeably slower and/or less reliable; 4: Occasionally slower and/or less reliable; 5: Speeds and/or reliability consistent throughout the day.

Figure 47: Summary of Responses to the Question "What best describes your current building infrastructure (age and quality of wiring and network equipment)?"



A significant portion of responses indicate their business's in-building wiring and network equipment is less than 10 years old (57 percent). Those with aging or outdated wiring and equipment account for approximately one-third of responses (33 percent). This data suggests that some businesses may not be able to take full advantage of internet services available to them, as aging network equipment and in-building wiring may be unable to support these higher speeds.

Appendix B: Overview of Previous Funding and Possible Funded Areas

Below is a summary of federal funding programs that have funded projects in the past, some of which may still be in the deployment stage. The FCC maintains a map of areas funded by federal programs that can be found here:[327]

https://fundingmap.fcc.gov/home

FCC Model-based support – Non-competitive subsidy funding provided to regulated carriers to serve "High-Cost" locations:

Connect America Fund Phase II Model-Based Support (CAF II) utilized a predetermined cost-based model to allocate monthly payments to "price cap carriers" tasked with expanding broadband service to specific fixed locations in eligible areas. The targeted service speed was set at a minimum of 10 megabits per second downstream and one megabit per second upstream (10/1 Mbps). The initial CAF Phase II Model support term spanned from 2015 to 2020. Subsequently, all participating carriers opted for an optional seventh year of support in 2021. These carriers were required to finalize their deployment and adhere to interim deployment milestones by the end of 2021.[328]

Alternative Connect America Cost Model (ACAM) allocated predetermined monthly payments based on a cost model to "rate of return" carriers. These payments aimed to facilitate broadband expansion to specific fixed locations in eligible areas. The revised ACAM enhanced model-based support for existing ACAM carriers will require deployment of 100/20 Mbps service. The original ACAM support term, available to carriers that opted for the original ACAM program (excluding Revised ACAM), spanned from 2017 to 2026. ACAM carriers were required to complete their deployment by the end of 2026 while adhering to interim deployment milestones. In contrast, the Revised ACAM support term extends from 2019 to 2028, with Revised ACAM carriers having until the end of 2028 to complete their deployment while meeting interim milestones. The CAF Map encompassed locations funded by both the original ACAM program and Revised ACAM.[329]

Alternative Connect America Cost Model (ACAM II) or Revised ACAM, entailed predetermined monthly payments based on a cost model for "rate of return" carriers who voluntarily opted to transition from CAF BLS funding to model-based support. The ACAM II support term ranged from 2017 to 2028, granting ACAM II carriers until the end of 2028 to finalize their deployment and adhere to interim deployment milestones.[330]

Connect America Fund Broadband Loop Support (CAF BLS) provided support based on carrier costs and financial data to "rate of return" carriers. This support aimed to expand broadband access to specific fixed locations in eligible areas. The CAF BLS deployment term spanned from 2019 to 2023, with carriers required to complete deployment by the conclusion of 2023. It's important to note that not all existing CAF BLS locations are represented on the map, as CAF BLS carriers do not report locations deployed before May 25, 2016.[331]

[327] https://fundingmap.fcc.gov/home

[328] https://www.usac.org/high-cost/funds/cafphaseii/#:~:text=Connect%20America%20Fund%20(CAF)%20Phase,Mbps)%20to%20a%20specific%20number

[329] https://www.usac.org/high-cost/funds/acam/

[330] https://www.usac.org/high-cost/funds/revised-acam/

[331] https://www.usac.org/high-cost/funds/caf-broadband-loop-support/

Rural Broadband Experiments (RBE) offered predetermined monthly payments to telecommunications carriers that successfully secured bids to deploy broadband in unserved "price cap" areas, particularly those in rural regions with the highest deployment costs. The RBE support term covered the period from 2015 to 2025, with RBE carriers obligated to meet interim and final deployment milestones on an ongoing basis.[332]

Competitive Grant Programs:

FCC:

Connect America Fund Phase II Auction (CAF II Auc.) provided monthly payments to entities that won bids in a competitive reverse auction held in 2018. The goal was to extend broadband coverage to areas where the incumbent price cap carrier had declined CAF II Model based funding, as well as other price cap areas with high deployment costs. Payments under the CAF II Auction began in 2019, with support terms extending over 10 years. CAF II Auction carriers had until the conclusion of 2025 to complete their deployment while meeting interim deployment milestones.[333]

Rural Digital Opportunity Fund (RDOF) provided set monthly payments to entities that successfully secured bids in a 2020 competitive reverse auction. These funds were allocated to expand broadband coverage in specific areas lacking service at speeds of at least 25 megabits per second downstream and 3 megabits per second upstream (25/3 Mbps). RDOF payments commenced in 2021 on a rolling basis, and support terms extended over 10 years. RDOF recipients were granted up to eight years to complete their deployment while adhering to interim deployment milestones.[334]

NTIA:

Broadband Infrastructure Program (BIP) is a $288 million broadband deployment program directed to partnerships between a state, or one or more political subdivisions of a state, and providers of fixed broadband service to support broadband infrastructure deployment to areas lacking broadband, especially rural areas. Funded service must be at least 100/20 Mbps.[335]

Tribal Broadband Connectivity Program (TBCP) is a $3 billion program directed to tribal governments to be used for broadband deployment on tribal lands, as well as for telehealth, distance learning, broadband affordability, and digital inclusion. Funded service must be at least 100/20 Mbps.[336]

USDA:

Community Connect Grant Program provides grants to eligible applicants that will provide, on a "community -oriented connectivity" basis, broadband service that fosters economic growth and delivers enhanced educational, health care, and public safety benefits. Eligible service areas must be contiguous and funded service must be at least 100/20 Mbps.[337]

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[332] https://www.fcc.gov/general/rural-broadband-experiments

[333] https://www.fcc.gov/auction/903

[334] https://www.fcc.gov/auction/904

[335] https://broadbandusa.ntia.doc.gov/broadband-infrastructure-program

[336] https://broadbandusa.ntia.doc.gov/funding-programs/tribal-broadband-connectivity

[337] https://www.rd.usda.gov/community-connect

Rural Econnectivity Program (ReConnect) offers loans, grants, and loan-grant combinations to facilitate broadband deployment in areas of rural America that currently do not have sufficient access to broadband. Proposed funded service areas can be non-contiguous and funded service must be at least 100/20 Mbps.[338]

US Department of Treasury:
Capital Projects Fund (CPF) was enabled by ARPA and is currently being distributed through the FAA program by the CPUC. With upcoming announcements of FAA program winning applications, CPF awarded areas will start to appear on the FCC's Funding Summary map. Funded service must be at least 100/20 Mbps and scalable to 100/100 Mbps.[339]

[338] https://www.usda.gov/reconnect

[339] https://home.treasury.gov/policy-issues/coronavirus/assistance-for-state-local-and-tribal-governments/capital-projects-fund

Appendix C: Further Detail on Materials for California Last-mile Network Funding Opportunities

All applications require a list of information about the applicant, including details about how the organization is structured and who the organization's key leaders are. Applicants must also submit information about the financial health of the organization, including audited financial statements from recent years and, in some cases, companywide financial projections in addition to modeling the project's performance.[340]

The programs require that the applicants explain the proposed network using a combination of Geographic Information Systems (GIS) information about the project's location, network diagrams, and written explanations that describe its technical attributes. The required engineering information is relatively similar, but the specific mapping information may differ across each program. For example, the Federal Funding Account requires that applicants identify their proposed deployment areas within the program's application platform, which then generates information about current service availability and location eligibility characteristics, additional demographic information, and other location-based factors. In the case of the BEAD program, it is unclear whether applicants will be required to generate this information themselves.

Project designers must also create a number of documents that identify the project's costs and when they will occur. Detailed project budgets must identify the inventory of equipment and materials used in the network design, all labor necessary to construct the network, and permitting costs, along with any eligible ancillary costs related to the project. Applicants must also explain when each of these costs will occur by providing a deployment plan timeline and a related capital investment schedule.

Applicants must explain how they will cover both the project's required matching contribution and on-going costs before they can be reimbursed by the grant program. In addition to explaining the project's funding sources, applicants must also provide the projected business plan for the project area. This plan includes the menu of service options and their prices to consumers and businesses, expected adoption rates, and an analysis of the project area's on-going operational and maintenance costs and is used to understand the network's financial sustainability and profitability.

[340] FFA Guidelines, p. A-20.

Appendix D: California's Three Primary Last-Mile Funding Programs: Considerations for Prospective Applicants

■ Who Can Apply?

California's three primary last-mile programs have all integrated a number of grant program best practices that states, and federal agencies have developed over the past decade. 341 Each of the three programs will accept applications from a wide range of organization types, including facilities-based broadband providers, non-profits, cooperatives, and all local governmental agencies, such as county or local governments, special utility districts and joint powers authorities, and tribal governments.342 This flexibility not only facilitates construction to historically unserved areas using a wider range of funding sources and deployment approaches, but it also encourages local governmental agencies to coordinate with ISPs or participate themselves. Additionally, the Federal Funding Account program rewards additional scoring to projects proposed by, owned, operated by, or affiliated with local governments, non-profits, or cooperatives.[343]

■ What Technologies can be Deployed?

To "ensure that the network built by the project can easily scale speeds over time to meet the evolving connectivity needs of households and businesses," the BEAD program goes a step further and explicitly requires that all projects in areas that do not meet the state's "Extremely High Cost Per Location Threshold" must provide "service via end-to-end fiber-optic facilities to each end-user premises." [344]

■ Digital Inclusion Considerations

Digital inclusion considerations have also been incorporated into these grant programs as well. All three require that funding recipients commit to provide at least some services at prices at or below what they propose in their applications for five or more years.[345] The FFA requires that ISPs participate in the Affordable Connectivity Program and awards additional points to ISPs that will extend their pricing commitment from the required five years to a period of ten years, will offer services eligible for California and federal Lifeline subsidies, and/or will offer a low-cost plan offering 50/20 Mbps service for $40 per month.[346] The programs also have adopted rules that favor low-income areas, so project planners should look closely at the income characteristics of proposed service areas to identify which locations should be prioritized for inclusion.[347]

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[341] See, e.g., Ryland Sherman et al, *Putting State Broadband Funds to Work: Best Practices in State Rural Broadband Grant Programs*, Benton Institute for Broadband & Society, June 2021, https://www.benton.org/sites/default/files/state-funds-final.pdf.

[342] Cal. Gov. Code § 54951 (2023), identifying the categories of governmental organizations considered to be local agencies; CASF BIA Guidelines, p. A-8, providing an example list of relevant local California agency types, and A-10; FFA Guidelines, pp. A-8 to A-9; BEAD NOFO, p. 37. The CASF BIA identifies that the CPUC uses the NTIA's definition of a facilities-based broadband service provider, "which is generally defined as any entity providing internet access service or middle mile transport, over its own fixed or wireless facilities to residence, businesses, or other institution." CASF BIA Guidelines, p. A-10. The CASF BIA will also accept applications from Wireless carriers registered with the CPUC (i.e., hold a Wireless Identification Registration (WIR). CASF BIA Guidelines, p. A-10. The NTIA's BEAD program has the broadest criteria, requiring that California accept applications from private companies more generally and not use scoring criteria that would unreasonably favor one organizational type over the other. BEAD NOFO, p. 37; BEAD Initial Proposal Guidance, p. 39.

[343] FFA Guidelines, p. A-6.

[344] BEAD NOFO, p. 14.

[345] CASF BIA Guidelines, p. A-14; FFA Guidelines, pp. A-11, A-18; BEAD NOFO, pp. 66-67, requiring that low-cost broadband service options be available for "the useful life of the network assets."

[346] FFA Guidelines, pp. A-6 to A-7, A-12.

[347] See, e.g., CASF BIA Guidelines, pp. A-5 to A-7; FFA Guidelines, pp. A-6 to A-7; BEAD NOFO, p. 41.

Eligible Costs

CASF BIA and FFA cover a fairly similar range of eligible project costs. They both cover costs directly related to the deployment of infrastructure and upgrades to critical existing infrastructure. They also cover "costs to lease access to property or for Internet backhaul services for a period not to exceed five years."[348]

The BEAD program's range of eligible costs are likely to be more expansive. NTIA's guidance identified that in addition to construction, improvement, and acquisition costs necessary to serve the proposed locations, the program can fund long-term leases such as fiber indefeasible right-of-use agreements, without the five-year limitation featured in the other programs. The BEAD program can also fund installation of internet wiring or Wi-Fi infrastructure within apartment buildings and other eligible multi-family residences.[349] The program is likely to also include costs related to design, permitting, and other work necessary for environmental, historical, and cultural reviews, cybersecurity training and implementation, subject matter expertise and consulting, and other labor costs necessary to manage the project.[350]

Reimbursement-Based Structure Considerations

These grant programs offer funding on a reimbursement basis. Projects offered these grants must organize all recent eligible project expenditures and submit them to the grant's administrating agency, the CPUC.[1] These submissions will be evaluated, and once approved, the CPUC will reimburse the awardee for the eligible costs. This submission process then requires that grant awardees have access to enough cash on hand to cover project costs until it can submit and receive its reimbursement.

Each of the programs has its own reimbursement rules. The FFA allows reimbursement requests to be submitted only at specific intervals, after 10%, 35%, 60%, 85%, and 100% of the project's total projected budget has been expended.[351] These fixed intervals create a large demand for cash on hand. For example, a project with the maximum standard FFA grant allocation of $25 million would expend $6.25 million between the 10% to 35% and the 35% to 60% reimbursement periods. While such a project organizes its funding request, submits it, and waits for its reimbursement, the project will continue to cover on-going costs, which can raise its short-term capital demands to $7.5 million or more. Projects may need to seek financing to cover these short-term costs.

[348] CASF BIA Guidelines, p. A-15.

[349] BEAD NOFO, p. 39.

[350] BEAD NOFO, p. 39.

[351] FFA Guidelines, p. A-27.

Appendix E: Summary of Federal Funding Opportunities

Below is a comprehensive list of the various grant funding opportunities created by the three recent pandemic-related infrastructure bills (ARPA/IIJA/Consolidated Appropriations Act Federal Broadband Programs Survey[352]), which represent the overwhelming majority of broadband infrastructure funding available currently.

Table 28: Broadband Equity, Access And Deployment Program ("BEAD") (IIJA)

Program name	Broadband Equity, Access and Deployment Program (BEAD)
Legislation creating or expanding the program	Infrastructure Investment and Jobs Act (IIJA)
At a high level, what does the program fund?	Eligible uses include: deploying infrastructure to un/underserved areas; providing affordable devices; mapping and planning; installing/providing wifi for multifamily residential buildings; and other projects determined by NTIA. Deployment must: first prioritize areas where 80% residents lack 25/3, then areas where 80% lack 100/20; offer 100/20 speeds; provide a low-cost option; and not exclude municipal and cooperative providers. Subgrants should use 25% matching funds, but in-kind or CARES/ARPA funds are acceptable.
Which organization determines which projects get funded?	Block grants to states (or administering agency selected by governor), territories, and tribes. Funds may be subgranted.
How much money is available in the program?	$42,450,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Formula allocation
What kinds of organizations are eligible and/or preferred for funding?	Block grants to states (or administering agency selected by governor), territories, and tribes. Funds may be subgranted.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Notice of Funding Opportunity (NOFO) likely by end of May 2022. Funding likely available in 2023 and after FCC releases new maps.

[352]https://muninetworks.org/sites/www.muninetworks.org/files/Federal%20Broadband%20Funding%20Guide%20%28Common%20Sense%20Media%29.pdf

Will the funding be available in a single tranche or multiple tranches, and when?	Multiple tranches. After NOFO is released, states can submit letters of intent to participate in BEAD and receive $5 million for planning if they request it. If submitting request for planning funds, state must submit a 5-year action plan. Once FCC DATA Maps are published identifying unserved vs. served areas, NTIA will calculate state's allocation. State then will submit an **Initial Proposal** to receive the first 20% of its allocation. State must then launch challenge process to provide ISPs and others opportunity to identify whether unserved/underserved areas have been misidentified. To receive remainder of allocation, States must subsequently submit a **Final Proposal,** which must include a proposal for a Low-Cost Broadband Service option. Timeframes for all steps likely to be included in NOFO to be released in May 2022.
Are there any key performance metrics known?	Deployment must: first prioritize areas where 80% residents lack 25/3, then areas where 80% lack 100/20; offer 100/20 speeds.
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	No.

Table 29: State Digital Equity Capacity Grant Program (IIJA)

Program name	State Digital Equity Capacity Grant Program
Legislation creating or expanding the program	IIJA
At a high level, what does the program fund?	This program consists of two subprograms: one $60 million program to support the development of state digital equity plans, and a second $1.4 billion program to fund the implementation of those plans. To be eligible for the second program, a state must have its digital equity plan be approved by the NTIA. These plans must include: measurable objectives for promoting internet adoption in vulnerable populations; assessments of plan's impact on state goals for the economy, workforce, education, health, and civil society; and identification of and collaboration with stakeholders.

Which organization determines which projects get funded?	States or administering agencies selected by governor, territories, and tribes. Funds may be subgranted.
How much money is available in the program?	$1,500,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Formula Allocation
What kinds of organizations are eligible and/or preferred for funding?	The State, a political subdivision, agency, State instrumentality, Indian Tribe located in State, a non-profit entity providing services in the State (which is not a school), a community anchor institution, a state agency, among others.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	$60m for planning available in FY2022. $1.4 b available between FY 2022-2026. States have 5 years to spend awards.
Will the funding be available in a single tranche or multiple tranches, and when?	Planning Grant Applications and State Capacity Grant Applications to be accepted not later than 60 days after notice of funding availability is released. (HR 3684—788, 789)
Are there any key performance metrics known?	No
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	No

Table 30: Digital Equity Competitive Grant Program (IIJA)

Program name	Digital Equity Competitive Grant Program
Legislation creating or expanding the program	IIJA
At a high level, what does the program fund?	Eligible uses include: digital inclusion activities; digital navigators; workforce training programs; low-cost devices; and deployment of public broadband. NTIA will prioritize projects that: expand access and adoption among vulnerable populations; represent geographically diverse regions; and do not duplicate other programs.

Which organization determines which projects get funded?	NTIA/Dept. of Commerce
How much money is available in the program?	$1,250,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive Grant
What kinds of organizations are eligible and/or preferred for funding?	Public entities, private companies, nonprofits, cooperatives, Indian Tribes, Alaska Native Entities. State entities that receive State Digital Equity Capacity grants are ineligible.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Post May NTIA NOFA, Assistant Secretary of Commerce begins awarding State Capacity Grants (see above). Within 30 days of this, the Asst. Secretary shall establish the Digital Equity Competitive Grant Program (HR 3684—1039-1040) (IIJA § 60305)
Will the funding be available in a single tranche or multiple tranches, and when?	$250m available per year FY 2022-2026. Awardees will submit annual evaluation reports. Grants must be spent within four years.
Are there any key performance metrics known?	No
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	No

Table 31: Middle Mile Grants Program (IIJA)

Program name	Middle Mile Grants Program
Legislation creating or expanding the program	IIJA
At a high level, what does the program fund?	Funds middle mile projects that reduce the cost of connecting un/underserved areas and/or promote resiliency by creating redundant network connections. Priority is given to projects that: adopt fiscally sustainable strategies; offer non-discriminatory interconnection to last-mile providers; collaborate with partners that will provide financially sustainable last-mile service; utilize other

	forms of support (e.g., waived permitting fees); and benefit national security and the DoD.
Which organization determines which projects get funded?	NTIA/ Dept. of Commerce
How much money is available in the program?	$1,000,000,000 (Amount of middle mile grant to eligible entity may not exceed 70% of total project cost)
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive grant
What kinds of organizations are eligible and/or preferred for funding?	States, political subdivisions of states, Tribal gov'ts, technology companies, electric utilities, cooperatives, telecommunications companies, nonprofits, Native entities (tribes, Alaskan Native Corporations), EDA's
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	NOFO likely by end of May 2022. Funds available until Sep. 30, 2026
Will the funding be available in a single tranche or multiple tranches, and when?	Unknown
Are there any key performance metrics known?	If eligible entity is proposing to use middle mile grant for build infrastructure to connect community anchor institutions via fiber optic technology, minimum speeds delivered must be not less than 1 gigabit per second for downloads; and 1 gigabit per second for uploads to an anchor institution. (HR 3684—808-809)
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	No—the statute allows for terrestrial or fixed wireless middle mile infrastructure as well as fiber optic.

*The California Department of Technology was awarded $73 million from this program in 2023.

Table 32: Affordable Connectivity Program (IIJA)

Program name	Affordable Connectivity Program (*Formerly Emergency Broadband Benefit Program--extended and modified by IIJA)
Legislation creating or expanding the program	IIJA (*Continued and Modified from the Consolidated Appropriations Act of 2021)
At a high level, what does the program fund?	Makes the Emergency Broadband Benefit permanent and renames it to the "Affordable Connectivity Program." Decreases the benefit amount from $50/mo to $30/mo and changes some eligibility criteria. Participating ISPs must: promote the benefit; allow the benefit to be applied to any service offering; notify subscribers of the transition; and implement new consumer protections. The benefit provides a discount of up to $30 per month toward internet service for eligible households and up to $75 per month for households on qualifying Tribal lands. Eligible households can also receive a one-time discount of up to $100 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 Affordable Connectivity Program is limited to one monthly service discount and one device discount per household.
Which organization determines which projects get funded?	FCC
How much money is available in the program?	$14,200,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	N/A, Consumer subsidy

What kinds of organizations are eligible and/or preferred for funding?	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 certain assistance programs, such as SNAP, Medicaid, Federal Public Housing Assistance, SSI, WIC, or Lifeline; Participates in Tribal specific programs, such as Bureau of Indian Affairs General Assistance, Tribal TANF, or Food Distribution Program on Indian Reservations; Participates in the National 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 provider's existing low-income internet program. (Source: https://www.fcc.gov/acp)
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Currently enrolling
Will the funding be available in a single tranche or multiple tranches, and when?	N/A (Monthly payment benefit)
Are there any key performance metrics known?	N/A
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	N/A

Table 33: Coronavirus Capital Projects Fund (ARPA)

Program name	Coronavirus Capital Projects Fund
Legislation creating or expanding the program	American Rescue Plan Act (ARPA)
At a high level, what does the program fund?	Block grants to states; each state will get at least $100 million. Eligible uses include: deploying infrastructure to areas that lack reliable wireline speeds of 100/20 and/or where service is unaffordable for a majority of residents; fostering adoption with low/no cost devices, free wi-fi, digital literacy training, and tech support; and building or improving community anchor institutions to enable public internet access. Deployment projects should: offer a low-cost option; accept ACP/Lifeline; deliver 100/100 where possible; and prioritize last mile connections. Treasury encourages use of public, nonprofit, and cooperative networks. No matching requirements.
Which organization determines which projects get funded?	Block grants to states from Treasury (or an administering agency selected by governor), territories, and tribes. Funds may be subgranted.
How much money is available in the program?	$10,000,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Formula Allocation
What kinds of organizations are eligible and/or preferred for funding?	Capital Projects Fund Recipients may award funds to Subrecipients, such as other levels or units of government (e.g., municipalities or counties), non-profits, or private entities. For example, for Broadband Infrastructure Projects, Subrecipients may include co-operatives, electric utilities, and other entities that build or operate broadband networks, including networks that are owned, operated by or affiliated with local governments. (Per Guidance For the Coronavirus CPF, https://home.treasury.gov/system/files/136/Capital-Projects-Fund-Guidance-States-Territories-and-Freely-Associated-States.pdf)

What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	For eligible Recipients: Request funding from Sep. 24 – Dec. 27, 2021 (Tribes Oct. 1 – June 1, 2022). Submit grant plan by Sept. 24, 2022. Funds must be expended by Dec. 31, 2026.
Will the funding be available in a single tranche or multiple tranches, and when?	After Treasury approves an applicant's Grant Plan in whole or in part, Treasury will inform the Recipient of the schedule for payments to the Recipient for purposes of the approved portions of the plan. The amounts, timing, and conditions of such payments will be determined by Treasury in its sole discretion.
Are there any key performance metrics known?	The construction and deployment of broadband infrastructure projects ("Broadband Infrastructure Projects") are eligible for funding under the Capital Projects Fund program if the infrastructure is designed to deliver, upon project completion, service that reliably meets or exceeds symmetrical download and upload speeds of 100 Mbps. If it would be impracticable, because of geography, topography, or excessive cost, for a Broadband Infrastructure Project to be designed to deliver services at such a speed, the Project must be designed so that it reliably meets or exceeds 100 Mbps download speeds and between 20 Mbps and 100 Mbps upload speeds and be scalable to a minimum of 100 Mbps symmetrical for download and upload speeds. Treasury encourages Recipients to focus on projects that will achieve last-mile connections. (https://home.treasury.gov/system/files/136/Capital-Projects-Fund-Guidance-States-Territories-and-Freely-Associated-States.pdf)
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	Recipients are encouraged to prioritize investments in fiber-optic infrastructure where feasible, as such advanced technology better supports future needs. (https://home.treasury.gov/system/files/136/Cap

	ital-Projects-Fund-Guidance-States-Territories-and-Freely-Associated-States.pdf)

Table 34: Coronavirus State And Local Fiscal Recovery Fund (ARPA)

Program name	Coronavirus State and Local Fiscal Recovery Fund (SLFRF)
Legislation creating or expanding the program	ARPA
At a high level, what does the program fund?	Block grants to state/county/city governments for general COVID-19 relief from Treasury, but recipients may use funds on broadband infrastructure, digital literacy training, and other programs that promote access to the internet. Projects should: prioritize areas with an identified need for additional broadband infrastructure investment; prioritize last mile connections; deliver speeds of 100/100 and use fiber technology wherever feasible; offer low-cost service options; and encourage public, nonprofit, and cooperative service providers. RDOF and other grant areas are eligible for funding.
Which organization determines which projects get funded?	Block grants to states, territories, tribes, metropolitan cities, and counties. Funds may be subgranted.
How much money is available in the program?	$350,000,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Formula Allocation
What kinds of organizations are eligible and/or preferred for funding?	States, territories, tribes, metropolitan cities, and counties. Funds may be subgranted.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Treasury is accepting submissions. Eligible expenses should be incurred by Dec. 31, 2024. Projects should be completed by Dec. 31, 2026.
Will the funding be available in a single tranche or multiple tranches, and when?	Two Tranches: Local governments will receive funds in two tranches, with 50% provided beginning in May 2021 and the balance delivered approximately 12 months later. States that have

	experienced a net increase in the unemployment rate of more than 2 percentage points from February 2020 to the latest available data as of the date of certification will receive their full allocation of funds in a single payment; other states will receive funds in two equal tranches. Governments of U.S. territories will receive a single payment. Tribal governments will receive two payments, with the first payment available in May and the second payment, based on employment data, to be delivered in June 2021. (https://home.treasury.gov/policy-issues/coronavirus/assistance-for-state-local-and-tribal-governments/state-and-local-fiscal-recovery-funds)
Are there any key performance metrics known?	Confirm that the project is designed to, upon completion, reliably meet or exceed symmetrical 100 Mbps download and upload speeds. If the project is not designed to reliably meet or exceed symmetrical 100 Mbps download and upload speeds, explain why not, and confirm that the project is designed to, upon completion, meet or exceed 100 Mbps download speed and between at least 20 Mbps and 100 Mbps upload speed, and be scalable to a minimum of 100 Mbps download speed and 100 Mbps upload speed.
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	Use of fiber technology wherever feasible; focus on last mile connections, either directly or by ensuring middle-mile projects support new/improved last-mile service. (SLFRF Final Rule, p. 297)

Table 35: Emergency Connectivity Fund (ARPA)

Program name	Emergency Connectivity Fund (ECF)
Legislation creating or expanding the program	ARPA
At a high level, what does the program fund?	Intended to support remote education. Eligible schools and libraries apply to be reimbursed for costs associated with providing devices, hotspots,

	and internet service (including service to student homes) between July 1, 2021 and June 30, 2022 (future funding rounds may expand this window). *Spending on infrastructure is allowed only where infrastructure not otherwise available.
Which organization determines which projects get funded?	FCC
How much money is available in the program?	$7,170,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive grant
What kinds of organizations are eligible and/or preferred for funding?	Schools, libraries, consortia that qualify for E-Rate and/or the Libraries Services and Technology Act.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	The first two application windows have closed. A third window may be announced for the remaining approximately $1 billion.
Will the funding be available in a single tranche or multiple tranches, and when?	Single tranche
Are there any key performance metrics known?	None
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	No

Table 36: Homeowner Assistance Fund (ARPA)

Program name	Homeowner Assistance Fund
Legislation creating or expanding the program	ARPA
At a high level, what does the program fund?	Intended to help mid and low-income homeowners who have experienced financial hardship after January 21, 2020. Each state receives a formula-determined allocation and may use it to help homeowners with eligible expenses. May be used to help homeowners pay for internet service.

Which organization determines which projects get funded?	States, territories, and Tribes
How much money is available in the program?	$9,900,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Formula Allocation
What kinds of organizations are eligible and/or preferred for funding?	Mid- and low-income homeowners who have experienced financial hardship after January 21, 2020
Will the funding be available in a single tranche or multiple tranches, and when?	Unknown
Are there any key performance metrics known?	N/A
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	N/A

Table 37: Elementary & Secondary School Emergency Relief (ARPA)

Program name	Elementary & Secondary School Emergency Relief (ESSER III)
Legislation creating or expanding the program	ARPA
At a high level, what does the program fund?	Intended to help educational agencies and school districts operate safely and address the impact of the pandemic. Funding distributed to state educational agencies (SEAs) via formula, and SEAs provide subgrants to local educational agencies (LEAs). Funds may be used on hardware, software, and connectivity for students.
Which organization determines which projects get funded?	State educational agencies (SEAs) and then subgrants to local educational agencies (LEAs).
How much money is available in the program?	$122,700,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Title I Formula

What kinds of organizations are eligible and/or preferred for funding?	State educational agencies (SEAs) and then subgrants to local educational agencies (LEAs).
Will the funding be available in a single tranche or multiple tranches, and when?	Single tranche
Are there any key performance metrics known?	N/A
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	N/A

Table 38: Broadband Infrastructure Grant Program (CAA21)

Program name	Broadband Infrastructure Grant Program
Legislation creating or expanding the program	Consolidated Appropriations Act 2021 (CAA21)
At a high level, what does the program fund?	Grants for broadband infrastructure in predominantly rural areas with less than 25/3 and in which no entity is receiving federal or state funding to build infrastructure.
Which organization determines which projects get funded?	NTIA
How much money is available in the program?	$288,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive Grant
What kinds of organizations are eligible and/or preferred for funding?	Partnerships between governments and fixed broadband providers, including public, nonprofit, and cooperative providers
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Not currently accepting applications. Awards pending.
Will the funding be available in a single tranche or multiple tranches, and when?	Single tranche
Are there any key performance metrics known?	Minimum service not less than 25/3 Mbps; preference for projects providing at least 100/20

	Mbps, but this 100/200 speed preference is lower priority than providing service to the greatest number of households in a rural area that are cost-effective. (Public Law 116-260, Dec. 27, 2020)
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	Technology neutral, but infrastructure must be fixed.

Table 39: ReConnect Grant Program

Program name	ReConnect Grant Program
Legislation creating or expanding the program	Consolidated Appropriations Acts of 2018 and 2020; Coronavirus Aid Relief, and Economic Security Act (CARES) extended funding.
At a high level, what does the program fund?	Eligible projects must serve areas that lack speeds of 100/20 and provide service of 100/100 to every location in its service area. Projects will be prioritized if they: target low-density and/or low-income rural areas that lack speeds of 25/3; offer low-cost service options; agree to strong labor standards; are submitted by a local or tribal government, nonprofit, or cooperative. ReConnect offers multiple types of awards, including 100% funded grants, 75% grants, loan/grant combinations, and loans. RDOF and other grant areas are eligible for funding.
Which organization determines which projects get funded?	USDA Rural Utilities Service
How much money is available in the program?	$2,000,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive grant
What kinds of organizations are eligible and/or preferred for funding?	Private companies, cooperatives, nonprofits, state and local governments, tribes, territories
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Applications were accepted until March 2022.

Will the funding be available in a single tranche or multiple tranches, and when?	Single tranche
Are there any key performance metrics known?	To be eligible for ReConnect Program funding, an applicant must serve an area without broadband service at speeds of 100 megabits per second (Mbps) (download) and 20 Mbps (upload) and commit to building facilities capable of providing broadband service at speeds of 100 Mbps (download and upload) to every location in its proposed service area.
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	Technology neutral but see speed requirements above.

Table 40: Good Jobs Challenge (ARPA)

Program name	Good Jobs Challenge
Legislation creating or expanding the program	ARPA
At a high level, what does the program fund?	Grants for projects that bring together employers and workforce trainers to develop and implement programs that train workers in the digital skills that lead to good-paying jobs. EDA prioritizes projects that reach historically underserved populations.
Which organization determines which projects get funded?	Economic Development Authority (EDA)
How much money is available in the program?	$500,000,000
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Competitive Grant
What kinds of organizations are eligible and/or preferred for funding?	State, local, and tribal governments, nonprofits, and educational institutions.
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Applications were accepted until February 2022.

Will the funding be available in a single tranche or multiple tranches, and when?	Unknown
Are there any key performance metrics known?	N/A
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	N/A

Table 41: Lifeline (FCC/USAC)

Program name	Lifeline
Legislation creating or expanding the program	
At a high level, what does the program fund?	Monthly subsidy to help low-income consumers afford telephone and broadband bills. Provides $5.25/mo for telephone or $9.25 /mo for broadband (and up to $34.25 for those living on Tribal lands). Only one benefit allowed per household. Program funded by the Universal Service Fund (USF).
Which organization determines which projects get funded?	ISP's through FCC. Consumers apply by contacting their ISP.
How much money is available in the program?	N/A
Is it allocated competitively nationwide, or is there a formula allocation to states or localities?	Consumer Subsidy
What kinds of organizations are eligible and/or preferred for funding?	Consumers and Participating ISP's
What is the timeframe in which we expect funding to become available, to the extent known, and are there any application deadlines that are already known?	Ongoing
Will the funding be available in a single tranche or multiple tranches, and when?	N/A
Are there any key performance metrics known?	N/A
Are any technologies favored (like fiber) or disfavored (like fixed wireless or satellite)?	N/A

Glossary

5G: In telecommunications, 5G is the fifth-generation technology standard for broadband cellular networks, which cellular phone companies began deploying in 2019. Hardware based on the 5G standard can also be used for fixed wireless networks.

Access: Broadband access is the ability of individuals or organizations to connect to the high-speed broadband network using a computer or other digital device. Access requires available network service connectivity at a specific location with the required speed. Access requires that the potential subscriber has availability.

Access Point (AP): The term Access Point generally refers to a wireless access point mounted to a vertical asset such as a communications tower or rooftop and provides wireless service (mobile or fixed) to multiple end users.

ACP (Affordability Connectivity Program): The Affordable Connectivity Program (ACP) provides eligible households with a discount on broadband service and connected devices.

ADSL (Asymmetrical Digital Subscriber Line): A form of Internet service communications technology that uses existing telephone wires and delivers constantly accessible data transmissions over copper telephone lines. ADSL is a common brand of DSL and has download speeds between 2 and 6 Mbps and upload speeds reaching 512 Kbps.

Availability: Broadband availability is the presence of a high-speed broadband network within the potential subscriber's location. Availability does not require subscriber adoption.

Artificial Intelligence (AI): Artificial intelligence is the intelligence of machines or software, as opposed to the intelligence of humans or animals.

Asymmetrical: Upload and download speeds of retail internet access services often differ with the download speed being far greater than the upload speed. The term asymmetrical refers to this difference between these two speed measurements.

Backbone: A major high-speed transmission line that strategically links smaller high-speed Internet networks across the globe.

Backhaul: The portion of a broadband network in which the local access or end user point is linked to the main Internet network.

Bandwidth: The capability of telecommunications and Internet networks to transmit data and signals.

Bit: The smallest unit of digital information

Byte: Equal to 8 bits

Bps: Bits per second

Kbps: Kilobits per second (1000 bits per second)

Mbps: Megabits per second (1 million bits per second)

Gbps: Gigabits per second (1 billion bits per second)

Tbps: Terabits per second (1 trillion bits per second)

Bond: A fixed-income security in which a borrower borrows money from an investor for a specified period of time at a fixed or variable interest rate.

Broadband: The term broadband commonly refers to high-speed Internet access that is always on and faster than traditional dial-up access. Broadband includes several high-speed transmission technologies, such as fiber, wireless, satellite, digital

subscriber line, and cable. For the Federal Communications Commission (FCC), broadband capability requires consumers to have access to actual download speeds of at least 25 Mbps and actual upload speeds of at least 3 Mbps.

Broadband Adoption: The use of broadband in places where it is available, measured as the percentage of households that use broadband in such areas. Link to Digital Inclusion definition.

Burstable: Authorizes a connection to exceed its specified speed, normally up to a set maximum capacity for a period of time.

Citizens Broadband Radio (CBRS): CBRS is a 150 MHz broadcast band of the 3.5GHz band in the US. In January 2020, the FCC authorized full use of the DBRS and for wireless service providers. Under the new rules, wireless carriers using DBRS may deploy 5G mobile networks without having to acquire spectrum licenses.

Central Office: A telecommunication company's building where consumers' phone lines are attached to equipment that connects a consumer to other consumers in that central office or other central offices across the globe.

Competitive Local Exchange Carrier (CLEC): A CLEC (Competitive Local Exchange Carrier) is a local voice service carrier that establishes local network interconnection with ILECs (Incumbent Local Exchange Carriers) and/or other LECs to enable local exchange telecommunications services.

Community Anchor Institutions: Schools, libraries, medical and healthcare providers, public safety entities, institutes of higher education and other community support organizations that provide outreach, access, equipment and support services to facilitate greater use of broadband service by the entire population and local governments.

Dark Fiber: Fiber that is in place but not being used for broadband services. ("non-lit" fiber, also see "Lit Fiber").

Digital Divide: The gap between those of a populace that have access to the Internet and other communications technologies and those that have limited or no access.

Digital Equity: Recognizes that digital access and skills are now required for full participation in many aspects of society and the economy. Digital Equity links Digital Inclusion to social justice and highlights that a lack of access and/or skills can further isolate individuals and communities from a broad range of opportunities.

Digital Inclusion: Implies that individuals and communities have access to robust broadband connections; Internet enabled devices that meet their needs; and the skills to explore, create and collaborate in the digital world.

Digital Literacy: The ability to leverage current technologies, such as smartphones and laptops, and Internet access to perform research, create content, and interact with the world.

Digital Skills: Any skills related to operating digital devices or taking advantage of digital resources.

Data Over Cable System Interface Specification (DOCSIS): The international telecommunications standard for cable signaling data and spectrum sharing.

Digital Subscriber Line (DSL): A form of technology that utilizes a two-wire copper telephone line to allow users to simultaneously connect to and operate the Internet and the telephone network without disrupting either connection.

Digital Subscriber Line Access Multiplexer (DSLAM): A DSLAM is the piece of hardware used by internet service providers to provide DSL service to multiple end users. The farther an end user is from the DSLAM the weaker the signal strength will be at their location and the slower the internet access speeds will be.

Fiber (Also referred to as Fiber Strand): A flexible hair-thin glass or plastic strand that is capable of transmitting large amounts of data at high transfer rates as pulses or waves of light.

Fiber to the Home or Fiber to the Premise (FTTH or FTTP): The delivery and connection of fiber optics directly to a home or building.

Fixed Wireless Broadband Access: The use of wireless devices/systems in connecting two fixed locations, such as offices or homes. The connections occur through the air, rather than through fiber, resulting in a less expensive alternative to a fiber connection.

Gigabit Passive Optical Network (GPON): A gigabit passive optical network (GPON) is a fiber optic telecommunications technology for delivering broadband network access to end user customers. Its architecture is a point-to-multipoint design in which a dedicated optical fiber unit in the central office serves multiple endpoints at the customer premise.

Grant: A legal instrument reflecting a relationship between a government agency and a recipient. The main purpose of the relationship is to dispense money or resources in order to accomplish a public purpose. No substantial involvement is anticipated by the government agency during the recipient's completion of the activity.

Internet Service Provider (ISP): A company that provides users (individuals or businesses) with access (a connection) to the Internet and related services.

Interconnection: The linking of numerous telecommunications networks to exchange user traffic.

Jitter: The deviation of a periodic signal, or the variation in time delay between when a signal is transmitted and when it's received over a network connection.

Last Mile: The technology and process of connecting the end customer's home or business to the local network provider.

Latency: Refers to the delay that happens between when a user takes an action on a network or web application and when they get a response. Another latency definition is the total time, or "round trip" needed for a packet of data to travel.

Lit Fiber: An active fiber optic cable capable of transmitting data.

Local Area Network (LAN): A group of network devices that are on a high-speed connection and typically within the same building or location.

Long Haul Fiber: Fiber cable that traverses great distances such as transcontinental and undersea cables.

Long Term Evolution (LTE): A 4G wireless broadband technology that provides speeds up to 100 Mbps download and 30 Mbps upload.

Make-Ready: The process of preparing a utility pole for a new cable (including fiber optic) attachment. Typically involves making a request to the pole owner and paying for any work required to ensure the new attachment meets all engineering and safety requirements.

Microtrenching: The process of digging a small trench, about one to two inches wide and as deep as two feet, often in existing road pavement, with a specialized machine for the purpose of installing conduits for fiber optic cables. Microtrenching is faster, cheaper, and less disruptive than traditional underground utility construction which involves saw-cutting the top layer of pavement, jack-hammering the material, and excavating down to the desired depth, often about thirty to thirty-six inches.

Middle Mile: The connection between a local network, also called a "last mile" connection, and the backbone Internet network.

Network Infrastructure: The hardware and software components of a network that provide network connectivity and allow the network to function.

Open Access Network (OAN): Networks that offer wholesale access to network infrastructure or services provided on fair and reasonable terms with some degree of transparency and nondiscrimination. Last mile open access networks have multiple retail ISPs in competition with one another using the same network.

Overbuild: Overbuild is a term used to describe building something on top of something else, which is some cases is deemed not necessary or overly elaborate and/or expensive.

Point of Presence (POP): The particular place or facility where local Internet service providers connect to other networks. Distance from the Point of Presence can affect service availability and pricing.

Point to Multipoint: A common network architecture for outdoor wireless networks to connect multiple locations to one single central location.

Rate of Return Telephone Company: Rate of return regulation is a form of price setting regulation where governments determine the fair price which is allowed to be charged by a monopoly. It is meant to protect customers from being charged higher prices due to the monopoly's power while still allowing the monopoly to cover its costs and earn a fair return for its owners.

Rights-of-Way (ROW): ROW are legal rights to pass through property owned by another. ROW are frequently used to secure access to land for digging trenches, deploying fiber, constructing towers and deploying equipment on existing towers and utility poles.

Service Area: The entire area within which a service provider either offers or intends to offer broadband service.

Small Cell: low-powered cellular radio access nodes that operate in licensed and unlicensed spectrum that have a range of 10 meters to a few kilometers. They are "small" compared to a mobile macrocell, partly because they have a shorter range and partly because they typically handle fewer concurrent calls or sessions. As wireless carriers seek to 'densify' existing wireless networks to provide for the data capacity demands of "5G"; small cells are currently viewed as a solution to allow re-using the same frequencies and as an important method of increasing cellular network capacity, quality and resilience with a growing focus using LTE Advanced.

Subscriber Module (SM): Refers to the customer premise equipment located at end users' premises to receive service from a fixed wireless network.

Switch Port: The physical opening where a cable (fiber or copper) connects to a piece of networking equipment such as a switch or a router. Switch ports are most commonly Ethernet ports. For copper cables this can be an RJ45 Ethernet port and for fiber cables this can be a SFP Ethernet port.

Symmetrical: Upload and download speeds of retail internet access services often differ with the download speed being far greater than the upload speed. More modern technology such as FTTP allows for both the download and upload speeds to be equal. The term symmetrical refers to when these two speed measurements are equal.

Symmetrical DSL (SDSL): A technology that permits the transfer of data over copper telephone lines. The transmission bandwidth for uploads and downloads is equal.

Telemedicine: The use of high-speed, high-capacity Internet to support long-distance healthcare services, patient and provider education and enhanced healthcare administration.

Tier 1 Internet Network: A network of Internet providers that form a superhighway that allows users access to every other network on the Internet.

Underserved: Locations or areas that have internet service at speeds higher than those that are defined as unserved, but lower than the State of Federal definition of broadband. The current definition for broadband is wireline service of <25Mbps/3Mbps.

Unserved: Locations and areas that lack internet service at the State or Federal definition of broadband. The current definition for broadband is wireline service of <25Mbps/3Mbps.

Voice over Internet Protocol (VoIP): A technology that allows users to send and receive voice calls using an Internet connection instead of a phone line.

Wireless Fidelity (WiFi): A technology that uses radio transmissions to enable electronic devices to connect to a wireless local area network (LAN).

Wireless Internet Service Provider (WISP): An ISP that provides service through a wireless network.

TILSON

Address

- 16 Middle St. 4th Floor
  Portland, ME 04101

Phone

- +1 (207) 735-7198

Contact

- **Bill Trimble**
  Feasibility Manager
  wtrimble@tilsontech.com