Lake County Master Broadband Plan

Telecommunications Infrastructure

Upstate California Connect Consortium

CSU Chico, Geographical Information Center

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1 Contents

2 Executive Summary

The following Master Broadband Plan for Lake County aims to provide a comprehensive assessment of the current landscape of broadband services for residential and business customers, as well as recommendations for improving broadband coverage and service speeds, developing and implementing local government policies that can ease and support broadband infrastructure deployments, and improving broadband service adoption.

The broadband assessment includes both wireline and fixed wireless services offered by Internet service providers (ISPs) and uses publicly available data from the California Public Utilities Commission (CPUC) and its California Broadband Interactive Map. The assessment includes detailed footprints and available downstream speeds reported by each ISP, and CPUC methods used to provide feedback or validation of such reported speeds. Current levels of aggregated broadband service adoption (subscribership) are presented along with current Internet service pricing.

The recommendations for improving coverage and speeds, based on current ISPs' coverage and technology characteristics, focus on upgrading, expanding, or launching broadband networks and services to reach areas of interest (i.e., unserved residential and business areas) in Lake County. This section presents two potential funding sources to carry out broadband infrastructure deployments, the California Advanced Services Fund (CASF) program and the USDA Reconnect Program, along with maps of eligible areas for these grants. To define potential project areas for these grants, this section also present a collaborative approach based on local partner or stakeholder input.

The recommendations for developing and implementing local policies focus on reducing technical and economic barriers for new broadband infrastructure deployments (i.e., dig-once policy and conduit standard development), making publicly owned assets available, and streamlining the permit and authorization process in public right-of-way. This section also recommends updating the County General Plan and incorporating a Telecommunications Element in order to include specific goals, policies, and actions that can support and promote broadband infrastructure and services expansion.

Finally, the recommendations for improving broadband adoption include forming partnerships with existing organizations and programs to establish credibility and identifying best practices for outreach, implementation, follow-through, and success.

3 Introduction

The County of Lake is a rural county in Northern California, and is roughly 100 miles north of the Bay Area (Figure 1), with a 2015 population of 64,665 residents across two incorporated cities, numerous smaller census-designated places (CDPs) and other rural communities. Lake County is centered around Clear Lake, the largest natural lake entirely within California. Lake County has a large agricultural community, and is home to many vineyards and wineries. Major agricultural commodities include grapes, pears, and walnuts[1]. Lake County was founded on May 20, 1861. The county seat, Lakeport, was incorporated April 30, 1888.

Lake County has a wide variety of industries, some of which include Adobe Creek Orchards, and Calpine, which is the United States' largest producer of natural gas and geothermal electricity and operates three geothermal power plants in Lake County; when taken together these plants account for roughly 10 percent of the renewable electricity generated in California. There are also many historic and natural attractions such as Clear Lake State Park, Anderson Marsh State Historic Park, and the Historic Courthouse Museum.

Figure 1. County of Lake in California

The County of Lake also faces some challenges. The county tends to fare lower than the California average in terms of income, poverty, and educational attainment indicators. In 2017, the median household income in Lake County was $36,132, 43 percent lower than California's median income of

[1] County of Lake website: http://www.co.Lake.ca.us/

$63,783. The county also faces a high level of poverty, with 20.7 percent of residents considered impoverished compared to only 14.3 percent statewide. Whereas 32 percent of all California citizens aged 25 and over hold four-year college degrees or higher, only 16.2 percent of this age group in Lake County holds four-year degrees.

Section 3.1 Broadband Importance and Applications in Rural Northern California describes different approaches where broadband can help to improve the aforementioned indicators in Lake County. The following subsection presents definitions of broadband adopted by the California Public Utility Commission (CPUC) and the Federal Communications Commission (FCC).

3.1 Broadband Importance and Applications in Rural Northern California

Education

High-speed access is integral in connecting teachers to students, parents and educational resources. The rural digital divide diminishes access to educational opportunities, resources and sources of academic and professional support[2]. Without adequate high-speed connectivity, rural schools and students are challenged to obtain skills and information needed for success. Teachers and administrators also benefit from the capabilities associated with access to high-speed Internet service. Many rural school teachers and administrators cite connectivity limitations as the primary obstacle to effectively using technology in the classroom[3]. Additionally, students may lack broadband (or any) connectivity at home, putting them at a disadvantage when completing assignments that require online access and interaction. As more bandwidth intensive material moves online—such as educational videos, interactive learning tools, and video conferencing tools for teachers—connection speed is quickly becoming a major issue for rural educators[4]. By eliminating these barriers through expanded access, schools can provide curriculums that are currently unavailable due to limited resources or lack of subject-matter experts. Four of the forty-four schools located in Lake County are currently unserved by California's K–12 High-Speed Network[5]; with speeds of 10 Mbps download or below, and with two schools having less than 2 Mbps download.

Health Care

The health care sector is emerging as a heavy user of telecommunications services. Improved imaging techniques produce large data files and moving these files between providers requires substantial capacity. A location that does not have the telecommunications capacity for efficiently uploading and downloading large imaging files may find health care providers deciding either not to locate there or limiting the services provided there[6]. Telehealth is a care delivery mode that can provide access to specialists for treatment of multiple conditions. It can provide more effective and efficient health care delivery by connecting physicians with physicians and patients with physicians[7]. The evidence for technologies that lower costs, connect remote populations, and expand the reach of urban-centered medical expertise is strong. Access to reliable, sufficient and affordable broadband is increasingly

[2] Howley, C., Kim, K., & Kane, S. (2012, June). Broadband and Rural Education: An Examination of the Challenges, Opportunities, and Support Structures that Impact Broadband and Rural Education.
[3] Ibid.
[4] Ibid.
[5] K12HSN Datalink – Listing by District. https://datalink.k12hsn.org/listing/11. Accessed: 2/7/18.
[6] Kuttner, H. (2012). Broadband for Rural America: Economic Impacts and Economic Opportunities. Broadband for Rural America: Economic IEconomic Summit on the Future of Rural Telecommunications. Washington, DC.
[7] Kvedar, J. C. (2014, February). Connected Health: A Review of Technologies and Strategies to Improve Patient Care with Telemedicine and Telehealth. Health Affairs, 33(2), 194-199.

important to providing high-quality health care, and it has become an essential infrastructural need for all hospitals and health systems[8]. The California Telehealth Network (CTN) offers two primary services: a secure, private health care network with subsidies for monthly costs and CTN Connect, which provides web-based videoconferencing. Lake County does not currently participate in the California Telehealth Network (CTN)[9].

Agriculture

Rural broadband planning has historically excluded the importance of fast, reliable Internet access for agricultural areas. The rise of "precision agriculture" combined with increasing interest in the use of "telematics" and "big data" for agriculture, raises the question of how available broadband connectivity is for U.S. farms[10]. Simply defined, precision agriculture is the application of information technology to farm-level production operations and management decision-making. Precision agriculture also offers opportunities for improved farming efficiency, food safety and enhanced environmental sustainability[11]. Broadband is increasingly becoming the backbone for innovative technological tools farms and ranchers use to maintain greater control over crop and livestock production, processing, distribution, and storage resulting in greater efficiencies, lower prices, safer growing conditions, safer foods and reduced environmental and ecological impact. Little information is available about the adoption of precision agriculture technologies in Lake County. A UC Cooperative Extension Office is located in Lakeport and can provide information to growers on use of the technologies.

Manufacturing

According to the National Association of Manufacturers, manufacturers leverage the Internet to compete in global markets, deploy new technologies, connect their workforce and customers, reduce costs, cut waste, enhance the environment and create safer, more reliable products[12]. Manufacturing establishments in rural areas are involved in a variety of sectors: value-added food production, natural resource processing, infrastructure management and clean-energy facilities. For these industries, adequate broadband service has been documented as necessary for food supply chain management, mining safety and transportation and logistics[13]. No program currently tracks broadband-enabled manufacturing.

Economic Development

Broadband availability is positively related to employment growth. This relationship is stronger in areas with lower population density consistent with the theory that smaller or more isolated areas may benefit more from high-speed connections, giving businesses in these areas access to larger markets[14].

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[8] Rural Health Information Hub. (2017). *Retrieved from https://www.ruralhealthinfo.org/topics/health-information-technology. Retrieved from https://www.ruralhealthinfo.org/.*

[9] California Telehealth Network - Participating Sites. https://www.caltelehealth.org/participating-sites Accessed February 21, 2018.

[10] Whitacre, B., Gallardo, R., & Strover, S. (2014, June). Broadband's contribution to economic growth in rural areas - Moving towards a causal relationship.

[11] Aubert, B., Schroeder, A., & Grimaudo, J. (2012). IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology.

[12] National Association of Manufacturers. (2017). Retrieved from www.man.org.

[13] Xu, L., Wu, H., & Shancang, L. (2014, November). Internet of Things in Industries: A Survey. IEEE Transactions on Industrial Informatics, 10(4).

[14] Kolko, J. (2010). *Does Broadband Boost Local Economic Development.* Public Policy Institute of California, San Francisco. Retrieved from http://www.ppic.org/content/pubs/report/r_110jkr.PDF

Moving from no broadband providers to one to three providers (the FCC categorizes instances of 1 to 3 providers as a single statistic in its reporting) was associated with an increase in employment growth of roughly 6.4 percent between 1999 and 2006[15]. Available broadband speed is also a factor in economic growth. Research shows that offering the minimum broadband service to all businesses and residents is not enough to close the rural digital divide. Poverty levels are about 2 to 6 percentage points lower in rural counties with high download speeds compared to otherwise similar counties[16]. There is a causal relationship between broadband adoption in rural areas (defined as county-level adoption rates >60 percent) and higher levels of median household income growth and reduced unemployment when compared with similar counties that do not meet the threshold[17].

Workforce Development

Broadband increases learning opportunities in rural communities through online education. Distance, online, and hybrid instruction provide access to learning for individuals who cannot always be physically present in a traditional classroom setting or who may not be available at the specific times classes are being offered. According to the Pew Research Center[18], 54 percent of Americans go online to look for job-related information and 45 percent have applied for a job online. Employers need broadband to access online training and classes to improve their employees' skills. Many businesses do not have the budgets to send employees to professional development or are too small to send an employee away from operations. Bringing professional development in-house eliminates those challenges. In a fall, 2015 assessment of the geographic distribution of CSU, Chico distance and online education students, two students out of 191 were located in Lake County (Lakeport and Cobb). The ZIP Code of the student located in Lakeport was mapped as 97 percent likely to be served at, what was then, the state standard of 6 Mbps download/2 Mbps upload and 94 percent likely to be served at the federal standard of 25 Mbps download/3 Mbps upload, while the ZIP Code of the student in Cobb was mapped as 59 percent likely to be served at, what was then, the state standard of 6 Mbps download/2 Mbps upload and 50 percent likely to be served at the federal standard of 25 Mbps download/3 Mbps upload. The speed at which the actual students' homes were served is unknown.

Tribal Communities

American Community Survey data shows that residents of tribal lands often lack basic infrastructure and telecommunications services. Tribal lands are among the most underserved areas in terms of broadband service, often due to remote and challenging terrain, low incomes, lack of expertise with telecommunications and barriers associated with bureaucratic government programs (U.S. Government Accountability Office, 2016)[19] (Morran, 2016). As a result, the economic, educational and communication benefits associated with broadband are largely absent for most people living on tribal lands (Broadband for Tribal, n.d.).

Emergency Services

Scarcity of broadband capacity in rural areas limits emergency services' communication capacity and response capability. Cutting-edge technologies are critical for public safety communications allowing

[15] Ibid.

[16] Whitacre, B., Mark, T., & Griffin, T. (2014). How COnnected are Our Farms. Choices: The Magazine of Food, Farm, and Resources Issues.

[17] Ibid.

[18] Pew Research Center Internet & Technology. (2015). *Retrieved from www.pewinternet.org/2015/11/19/1-the-internet-and-job-seeking/*

[19] https://www.gao.gov/

first responders to send and receive critical voice, video and data to save lives, reduce injuries, prevent crime and terror and notify community members about emergencies and disasters. Rural geographies are in need of integrated and interoperable systems to increase capacity, security and accessibility among emergency responders. The current anchor institutions database for Lake County shows twenty-two public safety locations in Lake County. The Upstate Broadband Consortium is currently working to confirm and update the locations of public safety facilities and their access to broadband for its counties. AT&T Mobility has been awarded a federal contract to deploy FirstNet, a public safety broadband network.

3.2 Broadband Definition (Federal and State) and California Coverage Goal

The term "broadband" commonly refers to high-speed Internet access that is always on and faster than traditional dial-up access (56 kbps). In this subsection, we present federal and state definitions of broadband and statistics of served, underserved and unserved areas based on these definitions.

The Federal Communications Commission (FCC) defines advanced telecommunications capability (broadband) primarily in terms of downstream and upstream speeds, as this is a particularly useful metric for analyzing the deployment of these services. In the 2015 Broadband Progress Report[20], the FCC updated the definition of broadband to 25 Mbps downstream and 3 Mbps upstream (previously defined as 4 Mbps downstream and 1 Mbps upstream). In 2017, the California legislature changed the definition of unserved areas to areas where broadband is offered at slower speeds than 6 Mbps downstream and 1 Mbps upstream[21]. For more details on broadband service benchmarks see ***Section 9.1 Appendix A - Broadband Service Benchmarks***.

According to the FCC's 2016 Broadband Progress Report[22], nationwide there is a population of 33,981,660 (10 percent of the total population) without access to fixed broadband at current FCC broadband speed rates (25 Mbps downstream/3 Mbps upstream). Based on residence area, 10,551,623 residents without access are located in urban areas, and 23,430,037 are located in rural areas, accounting for 4 percent and 39 percent of the urban and rural population, respectively. At the state level, there is a population of around 2 million people (5 percent of the state population) without access to fixed broadband services at FCC speed rates. Breaking down this population by residence area, 920,182 of these residents are in urban areas (2 percent of urban population) and 1,096,984 are in rural areas (61 percent of rural population). Regarding tribal lands in California, 29,052 people (51 percent of the population) have no access to fixed broadband. This report also shows that only 37 percent of the United States', and 43 percent of California's populations have adopted broadband.

The California Public Utilities Commission's (CPUC) latest broadband service availability data[23], as of December 2017 and released on December 2018, provided statistics regarding recent availability for wireline (DSL, cable modem and fiber-to-the-home), and fixed wireless broadband services. Table 1 and Table 2 show the broadband availability by technology in California based on the CPUC's definitions of

[20] Federal Communications Commission (FCC). (2015, January). *2015 Broadband Progress Report.* Retrieved June 2017, from https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-10A1.pdf

[21] California Legislative Information (CALEG). (2017, October). AB-1665 Telecommunications: California Advanced Services Fund. Retrieved Dec 2017, from https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB1665.

[22] Federal Communications Commission (FCC). (2016, January). *2016 Broadband Progress Report.* Retrieved June 2017, from https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf

[23] California Public Utilities Commission (CPUC). *California Broadband Validation Methods: Round 2017.* Data as of Dec. 31st, 2016.

served (at least 6 Mbps downstream and 1 Mbps upstream), unserved (less than 6 Mbps downstream or 1 Mbps upstream), and no service (no availability or no available data) areas. The State of California's goal is to provide access to 98 percent of California households[24].

Table 1. California Households Served by Broadband Technology 2017 (CPUC 2018)

	Total Households	Served Households		Unserved Households with Slow Service		Unserved Households with No Service	
Wireline	13,113,840	12,505,598	95.4%	115,598	0.9%	492,645	3.8%
Fixed Wireless	13,113,840	450,718	3.4%	32,519	0.2%	12,630,604	96.3%
Combined	13,113,840	12,649,624	96.5%	92,128	0.7%	372,088	2.8%

Table 2. California Rural and Urban Households Served by Technology 2017 (CPUC 2018)

	Statewide Households Served	Urban Households Served	Rural Households Served
Wireline	95.4 %	97.7%	53.6%
Fixed Wireless	3.4%	1.9%	30.8%
Combined	96.5 %	97.8%	72.5%

DIGITAL DIVIDE INDEX

The Digital Divide Index (DDI) is a measurement of technological equality in access to and adoption of broadband that provides metrics by census tract and county. A higher DDI indicates an area that suffers more severely from the digital divide. Table 3 provides the overall DDI, along with some of the underlying statistics for Lake County, with Sacramento and Santa Clara counties provided for comparison[25]. Lake County exhibits a higher DDI than the other two counties, along with a higher percentage of population without access to the FCC's broadband speed, and lower advertised speed offers. This table also shows lower levels of broadband penetration (connections) in Lake County.

Table 3. 2015 Digital Divide Index Data

2015 Digital Divide Index Data			
	Lake	Sacramento	Santa Clara
Overall Digital Divide Index	52	33	26
Per. of pop. with no access to fixed broadband (25/3)*	16	2	0
Avg. advertised fixed download speed	25	36	46
Avg. advertised fixed upload speed	4	9	13
Fixed residential connections per 1,000 homes (10/1)**	40.0–59.9%	60.0–79.9%	60.0–79.9%

*25 Mbps download/3 Mbps upload is the criterion access to broadband.
**10 Mbps download/1 Mbps upload is the speed for which adoption is assessed.

[24] Pub. Util. Code section 281(b)(1) states; "The goal of the program is, no later than December 31, 2015, to approve funding for infrastructure projects that will provide broadband access to no less than 98 percent of California households."
[25] 2015 Digital Divide Index. Starkville, MS: MSU Extension Service Intelligent Community Institute. http://ici.msucares.com/sites/ici.msucares.com/files/2015_ddi.pdf Accessed 2/7/18.

3.3 Broadband Demand Drivers

This subsection presents applications that, in recent years, have driven up broadband demand both in terms of customer and speed demands. There is an increasing reliance on broadband to perform multiple functions, and instances of consumers within a single household routinely using multiple applications simultaneously. According to the FFC's 2015 Broadband Progress Report[26], the following applications are the main drivers for broadband demand:

- **Video services:** Video services provide a wide range of options including video streaming, video on demand (VoD), IP TV, video games and video conferencing. According to the 2014 Sandvine Report, real-time entertainment such as video streaming is responsible for over 67 percent of downstream bytes during peak periods[27]. Table 4 shows downstream speeds for video services recommended by three technology companies. Based on 2014 consumer statistics, approximately 77 percent of households in the United States have at least one high-definition television (HDTV) set, and about 46 percent of all households have multiple HDTVs.[28] Video conferencing is also facing increasing levels of usage, such as for telemedicine and distance education.

Table 4. Recommended downstream speeds for video services

Service	Downstream	Recommendation
HD video	5 Mbps	Netflix
Ultra HD quality video	25 Mbps	Netflix
720p video	6 Mbps	Apple
1080p HD video	8 Mbps	Apple
HD video	5 Mbps	DISH

- **Data services:** According to the 2014 Sandvine report, web-browsing is responsible for approximately 10 percent of downstream data traffic during peak period Internet use. Data transfer is another application that is growing in demand and is commonly used in telecommuting. Downstream speeds impact the time websites take to fully load, and the time files take to transfer from servers to user's devices.
- **Voice services:** Voice services have been replacing traditional telephone service by allowing users to make phone calls using broadband connections; also called VoIP technology. According to the 2014 FCC Local Competition Report, residential VoIP subscribers increased from 19.7 million in December 2008 to 37.7 million in December 2013.[29] VoIP applications require a minimum of 100 kbps downstream and upstream speeds to enable real-time voice communications.

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[26] Federal Communications Commission (FCC). (2015, February 4). *2015 Broadband Progress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment*. Federal Communications Commission Hearing, Washington, D.C., *FCC 15-10,* 21-25.

[27] Sandvine Intelligent Broadband Networks, Global Internet Phenomena Report, 2H 2014 at 5 (2014), https://www.sandvine.com/downloads/general/global-internet-phenomena/2014/2h-2014-global-internetphenomena-report.pdf (2014 Sandvine Report).

[28] See Press Release, Leichtman Research Group, The Majority of TV Sets Used in U.S. Households are Now HDTVs, 4K Ultra HDTV in Early Stages of Development (Mar. 7, 2014), http://www.leichtmanresearch.com/press/030714release.html.

[29] Industry Analysis and Technology Division, Wireline Competition Bureau, Local Telephone Competition: Status as of December 31, 2013 at 14 (Oct. 2014), http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1016/DOC-329975A1.pdf.

- **Social networking and cloud applications:** Social networking applications have increased in demand and, as of 2015, approximately 73 percent of adults online use a social networking site of some kind[30]. Cloud computing has also risen in demand due to its capability to allow users to store and access data and information (photos, music, emails, documents, etc.) over the Internet.
- **Machine-to-machine applications:** Machine-to-machine applications include smart meters, video surveillance, health care monitoring, transportation and package/asset tracking. In 2013, Cisco Systems reported that 33 percent of IP traffic originated with non-PC devices, but predicted that by 2018 the non-PC share of total IP traffic would grow to 57 percent.

This section provided broadband definitions and current context, both nation and statewide, to assist with understanding the importance of expanding broadband infrastructure deployments and adoption programs in the County of Lake, and its cities and rural communities. The importance relies on the broadband capability to expand the reach of programs in the fields of education, health care, agriculture, manufacturing, economic and workforce development, tribal communities, and emergency services, among others. This section also presented demand drivers for broadband services, including video, data, voice, social networking, cloud, and machine-to-machine application. The following section presents the current broadband landscape in Lake County based on CPUC's broadband service availability data.

[30] Maeve Duggan & Aaron Smith, Social Media Update 2013, Pew Res. Internet Project (Dec. 30, 2013), http://www.pewinternet.org/2013/12/30/social-media-update-2013/.

4 Current Broadband Landscape in the County of Lake

This section provides a comprehensive assessment of the broadband landscape in the County of Lake including both wireline and fixed wireless services offered by Internet service providers (ISPs) for residential and business customers. The assessment uses publicly available broadband availability data from the California Public Utilities Commission (CPUC) and its California Broadband Interactive Map[31]. It includes detailed footprints and available downstream speeds reported by each ISP, along with CPUC methods used to provide feedback or validation of such reported speeds (i.e., CalSPEED and CPUC Public Feedback Form). The assessment also presents aggregated broadband service adoption levels (subscribership), Internet service pricing, and availability of high-capacity middle-mile infrastructure.

4.1 Broadband Services Availability (Served, Underserved and Unserved Areas)

This subsection presents the advertised broadband service availability in the County of Lake, based on the CPUC's broadband availability data as of December 2017 (released on December 2018). The advertised service availability data are collected by the CPUC from a majority of broadband service providers in the State. Most of the broadband availability is provided by last-mile broadband service providers[32]. Coverage data for wireline and fixed wireless providers are reported at the census block level. The data are mapped and validated for accuracy using CPUC's broadband validation methods[33]. For this report, broadband availability data plots are generated from the California Interactive Broadband Map[34].

Broadband service availability for Lakeport and Clearlake is available in ***Sections 9.3 Appendix C: Lakeport Broadband Availability*** and ***9.4 Appendix D: Clearlake Broadband Availability***.

Table 5 shows the major residential and business Internet service providers in the County of Lake and the technology used to provide services, from DSL, cable and fiber optics, to terrestrial fixed wireless.

Table 5. Technology offerings by Internet service provider in Lake County

Internet Service Provider	Service Type	Technologies Offered
Allstream Business US Inc.	Business Only	• Other Copper Wireline
AT&T California	Residential & Business	• Asymmetric xDSL • ADSL2, ADSL2+
DigitalPath, Inc.	Residential & Business	• Terrestrial Fixed Wireless
EarthLink Business, LLC	Business Only	• Asymmetric xDSL
Level 3	Business Only	• Other Copper Wireline • Fiber to the end user
MCI	Business Only	• Other Copper Wireline
Mediacom California LLC	Residential Only	• Cable Modem DOCSIS 3.0 • Cable Modem DOCSIS 3.1
North Coast Internet	Residential & Business	• Terrestrial Fixed Wireless

[31] CPUC's California Interactive Broadband Map: http://www.broadbandmap.ca.gov/

[32] For a detailed description of last-mile broadband technologies see ***Appendix B: Middle-, Second- and Last-Mile Broadband Technologies***.

[33] California Public Utilities Commission (CPUC). *California Broadband Validation Methods: Round 2017.* Data as of Dec. 31st, 2016.

[34] CPUC's California Interactive Broadband Map available in http://www.broadbandmap.ca.gov/.

US TelePacific Corp.	Business Only	• Other Copper Wireline • Fiber to the end user
Valley Internet	Residential & Business	• Terrestrial Fixed Wireless

4.1.1 Wireline and Fixed Wireless Service Availability

Wireline Service Availability

Figure 2 shows wireline served areas and downstream speeds in Lake County as of December 2017. For more details on the technical capabilities and limitations of wired technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.*** Figure 2 shows that the highest available downstream speeds (1–2 Gbps) are mostly located around Clear Lake as well as in the communities of Hidden Valley Lake and Middletown in the southern part of the county (purple areas). Speeds of 10 to 25 (green areas) can be found in the community of Cobb and the surrounding areas, as well as in the community of Nice. Other areas with downstream speeds lower than 10 Mbps (brown, light-brown, and yellow areas) are scattered throughout the county, with the largest areas located south of Lakeport and Kelseyville, as well as in the southeast of the county.

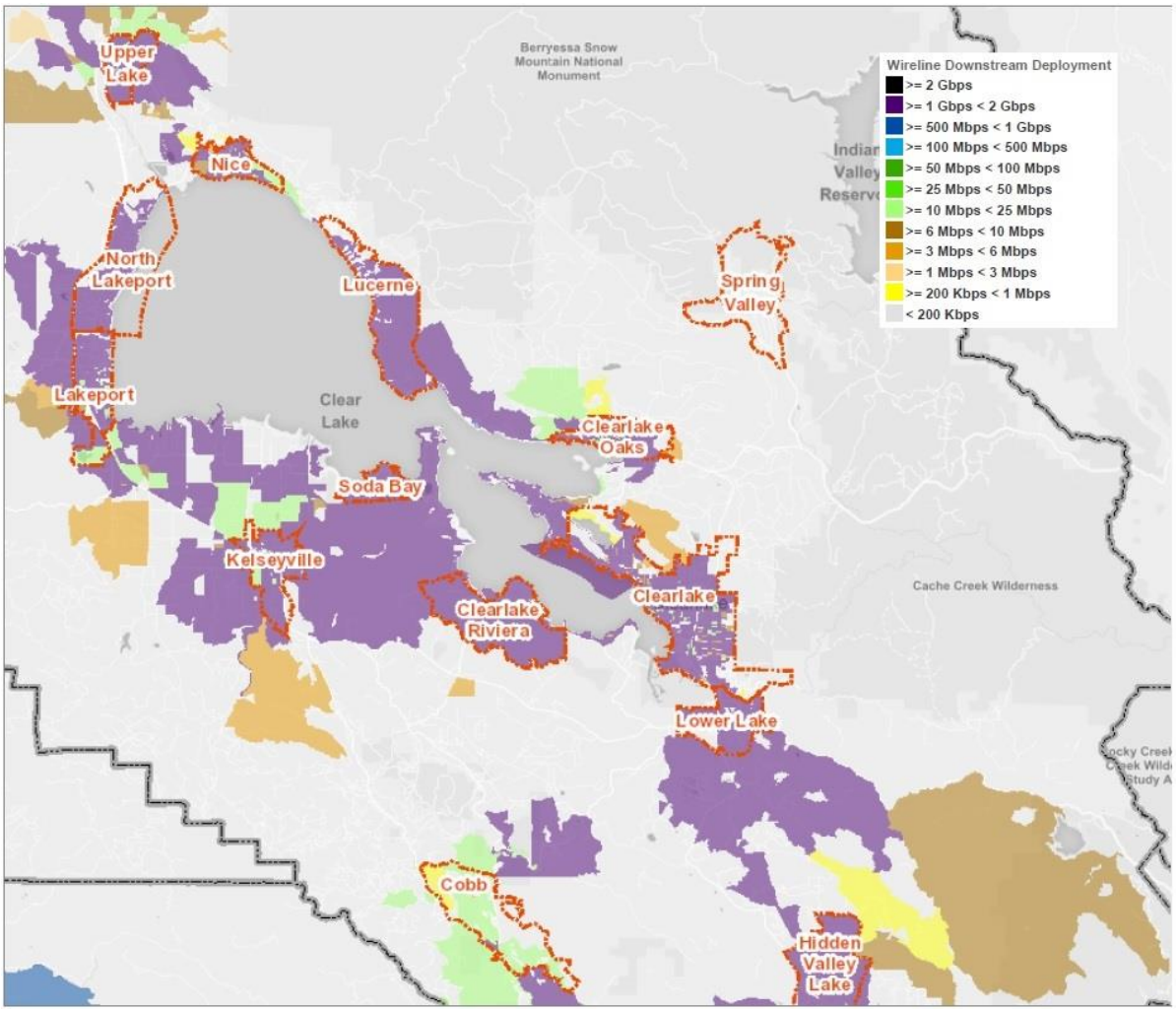

Figure 2. Wireline served status (December 2017) in Lake County under CPUC standard

Fixed Wireless Service Availability

Figure 3 shows the fixed wireless downstream speeds of Lake County as of December 2017. Depending on the location of towers, access points or base stations, and line-of-sight (no visible obstructions) to customer premises, fixed wireless service can cover wide areas, and in this case, most of the valley in the County of Lake. However, accurate coverage is difficult to estimate due to environmental factors such as trees, buildings and topography, each of which can affect availability of the fixed wireless service. The coverage shown represents best efforts to visualize terrestrial fixed wireless coverage. For more details on the technical capabilities and limitations of fixed wireless technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.***

Figure 3 shows that wireless downstream speeds of 10-50 Mbps (green and light-green areas) can be found scattered throughout Lake County. Fairly large portions of North Lakeport, Lucerne, Spring Valley, and Clearlake Riviera have wireless service, while only small portions of Lakeport, Cobb, Middletown, Hidden Valley Lake, Lower Lake, and Clearlake currently have fixed wireless service. Several unincorporated areas in the south and west of the county also have fixed wireless access with speeds of 10 to 50 Mbps, while a few smaller areas in the northwest and southeast have speeds of only 6 to 10 Mbps (brown areas).

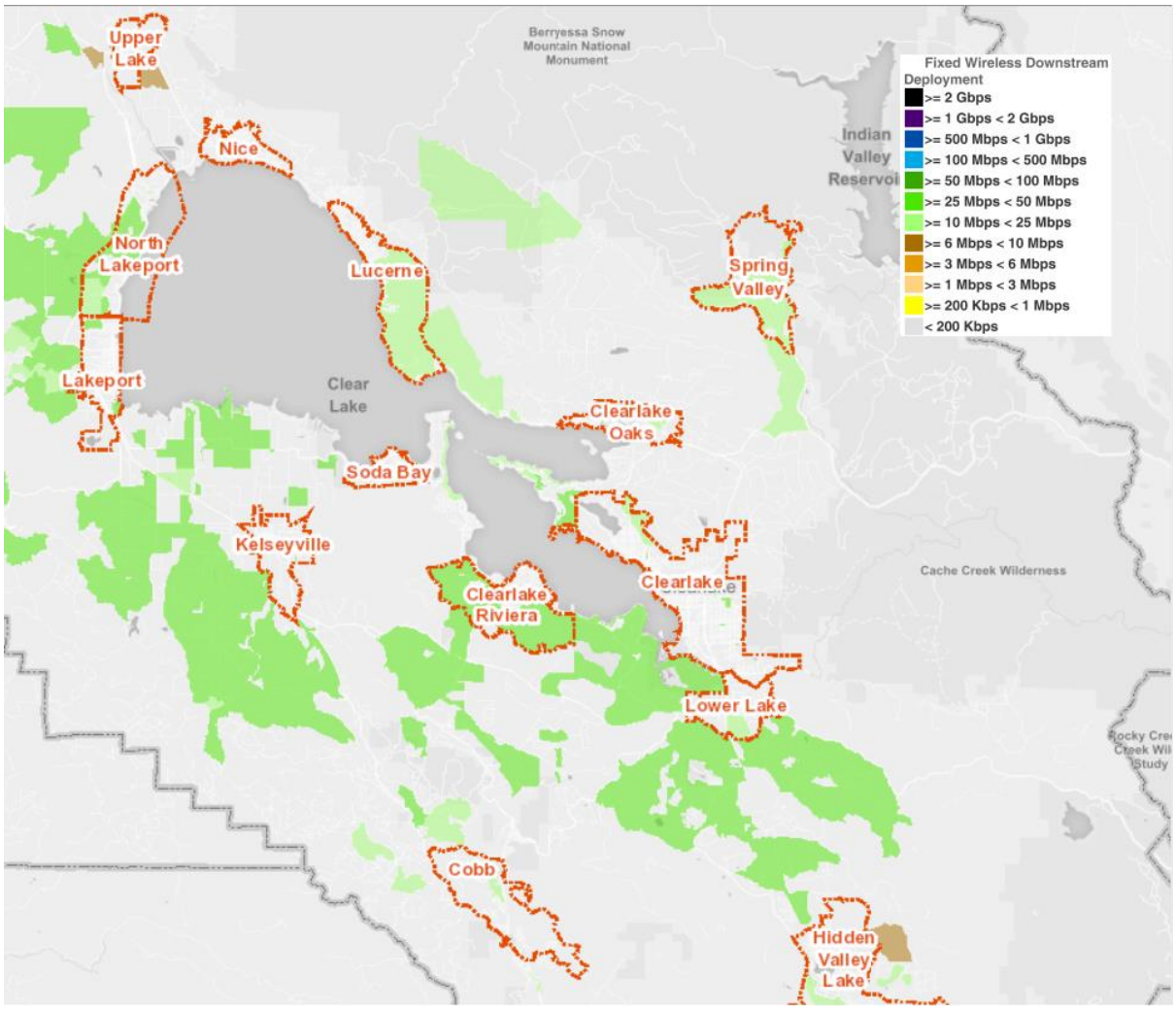

Figure 3. Fixed wireless served status in Lake County (December 2017) under CPUC standard

Table shows the reported broadband coverage under the CPUC standard (6 Mbps/1 Mbps) of the major residential Internet service providers (wireline and fixed wireless) in Lake County by housing units, population, and census blocks. Of the wireline providers, Mediacom serves the most housing units and population, 74.6 percent and 76.2 percent, respectively. AT&T also has fairly extensive coverage in the county, but with ubiquitous downstream speeds of 1 Mbps or less, AT&T's broadband offerings do not meet the CPUC's standard for served status. Of the fixed wireless providers, DigitalPath and Valley Internet serve the most housing units and population, 19.7 percent and 8.9 percent, and 18.6 percent and 9.6 percent, respectively. North Coast Internet also provides fixed wireless broadband in Lake County, serving 5.9 percent of housing units and 6 percent of the county's population.

Table 6. Main Internet service providers coverage (December 2017) under the CPUC standard (6 Mbps downstream and 1 Mbps upstream)

	Housing Units		Population		Census Blocks	
	Served	**Unserved**	**Served**	**Unserved**	**Served**	**Unserved**
Residential Wireline Provider						
AT&T California	0 (0%)	34560 (100%)	0 (0%)	65081 (100%)	0 (0%)	5164 (100%)
Mediacom California LLC	25793 (74.6%)	8767 (25.4%)	49584 (76.2%)	15497 (23.8%)	1104 (21.4%)	4060 (78.6%)
Residential Fixed Wireless Provider						
DigitalPath, Inc	6801 (19.7%)	27759 (80.3%)	12084 (18.6%)	52997 (81.4%)	500 (9.7%)	4664 (90.3%)
North Coast Internet	2054 (5.9%)	32506 (94.1%)	3882 (6%)	61199 (94%)	136 (2.6%)	5028 (97.4%)
Valley Internet	3082 (8.9%)	31478 (91.1%)	6244 (9.6%)	58837 (90.4%)	367 (7.1%)	4797 (92.9%)

4.1.2 Advertised Download Speed Availability by ISP

AT&T California

AT&T offers residential and business services in Lake County using a mix of asymmetric xDSL, ADSL2 and ADLS2+ technologies. Figure 4 shows broadband speeds offered by AT&T (as of December 2017) with ADSL2 and ADSL2+ technologies. AT&T offers speeds of 10 to 25 Mbps (light-green areas) throughout most of Lakeport, Nice, Clearlake, Upper Lake, Clearlake Oaks, and Kelseyville. Similar speeds are offered in roughly fifty percent of Cobb and Hidden Valley Lake. AT&T also serves the southern portion of North Lakeport with speeds that vary from 200 Kbps to 25 Mbps (green, brown, light-brown, and yellow areas. AT&T also offers varying speeds up to 25 Mbps in several unincorporated regions in the south and west of the county.

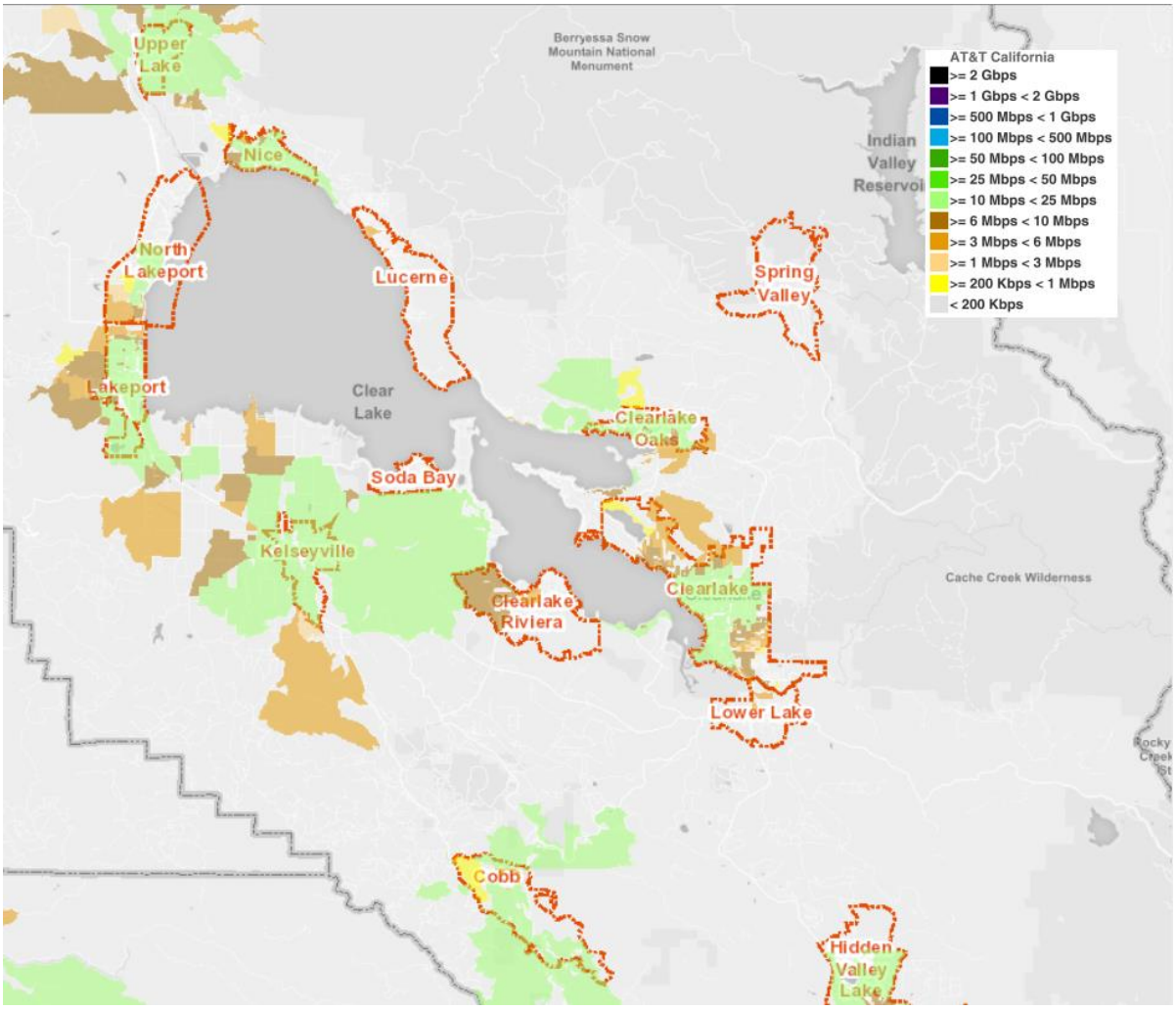

Figure 4. Broadband service speed offered by AT&T California in Lake County (December 2017)

Mediacom California

Mediacom offers cable Internet service to residential and business customers. Figure 5 shows speeds offered by Mediacom in Lake County (December 2017). Mediacom advertised 1 to less than 2 Gbps download speeds (purple areas) in areas within and surrounding Clearlake, Lower Lake, Clearlake Oaks, Lucerne, Nice, Upper Lake, Lakeport, North Lakeport, Soda Bay, Kelseyville, Clearlake Riviera, Hidden Valley Lake, Middletown and a small area within Cobb.

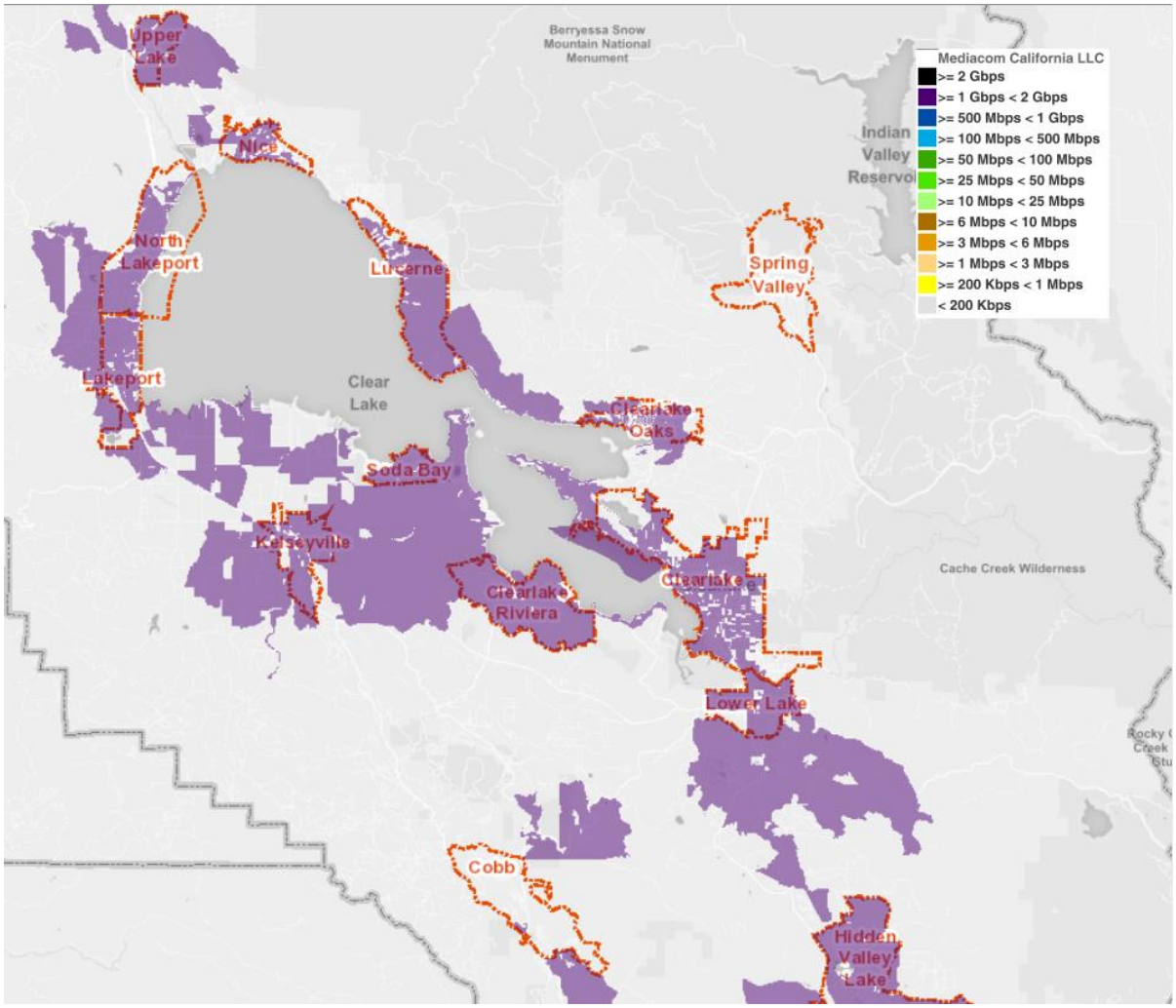

Figure 5. Broadband service speed offered by Mediacom in Lake County (December 2017)

Valley Internet

Valley Internet offers Internet service to residential and business customers. Figure 6 shows speeds offered by Valley Internet in Lake County (December 2017). Valley Internet advertised 25 to less than 50 Mbps download speeds (green areas) in portions of Lakeport, North Lakeport, Clearlake, Clearlake Rivera, and surrounding areas. With speeds over 25 Mbps, these areas are considered served under both CPUC and FCC standards. Valley Internet also advertised speeds ranging from 6 to less than 25 Mbps (light-green and brown areas) in portions of Lucerne, Hidden Valley Lake, and Upper Lake.

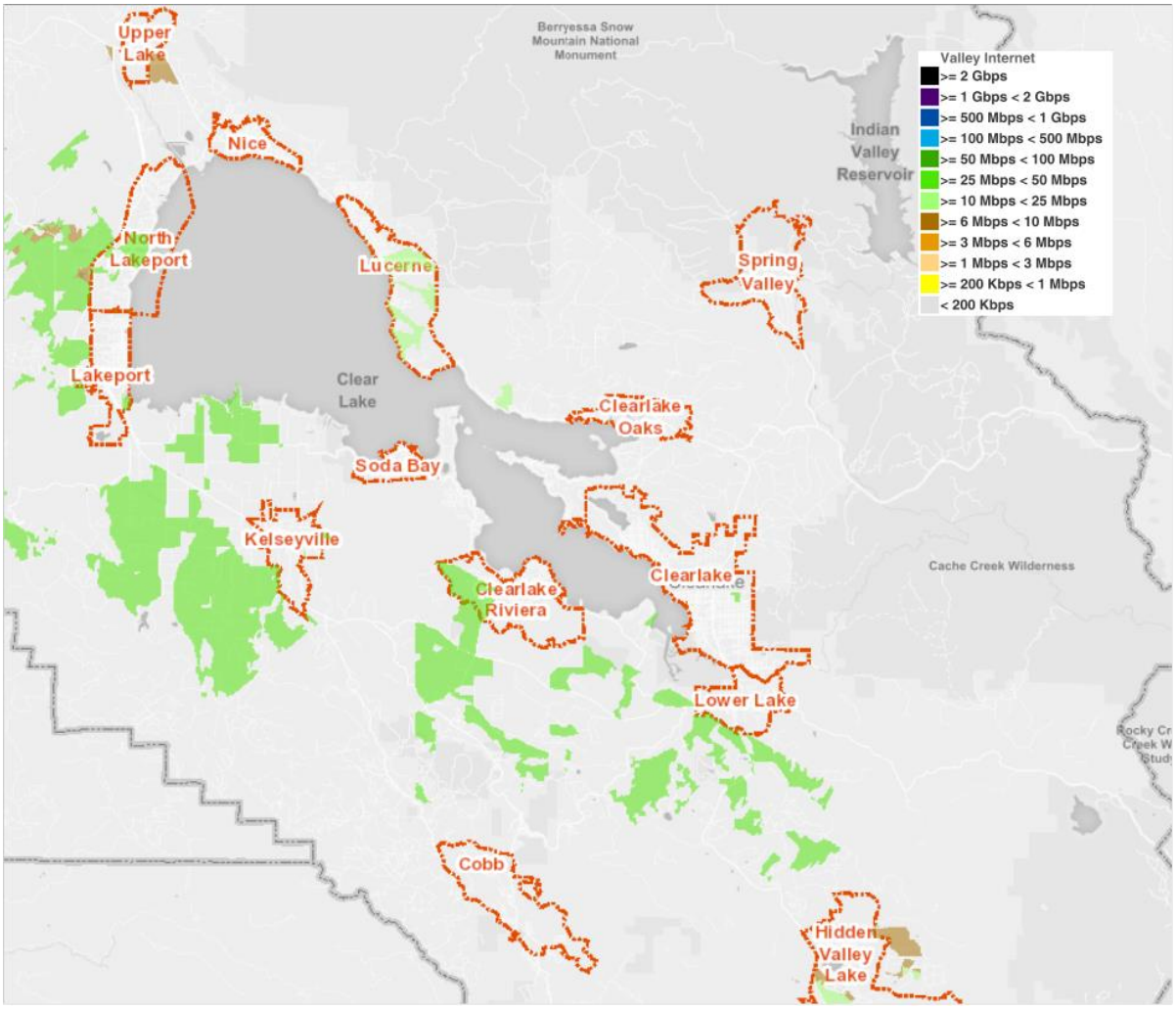

Figure 6. Residential broadband service speed offered by Valley Internet in Lake County (December 2017)

DigitalPath

DigitalPath offers broadband service to residential and business customers through a terrestrial fixed wireless network. Figure 7 shows speeds offered by DigitalPath in Lake County (December 2017). Accurate coverage of fixed wireless providers is difficult to estimate due to environmental factors such as trees, buildings and topography, which can affect availability of fixed wireless service. The coverage shown represents best efforts to visualize DigitalPath's coverage. This provider offers downstream speeds of 10 to less than 25 Mbps (light-green areas) in portions of Clearlake, Clearlake Oaks, North Lakeport, Lower Lake, Cobb, and throughout most of Lucerne.

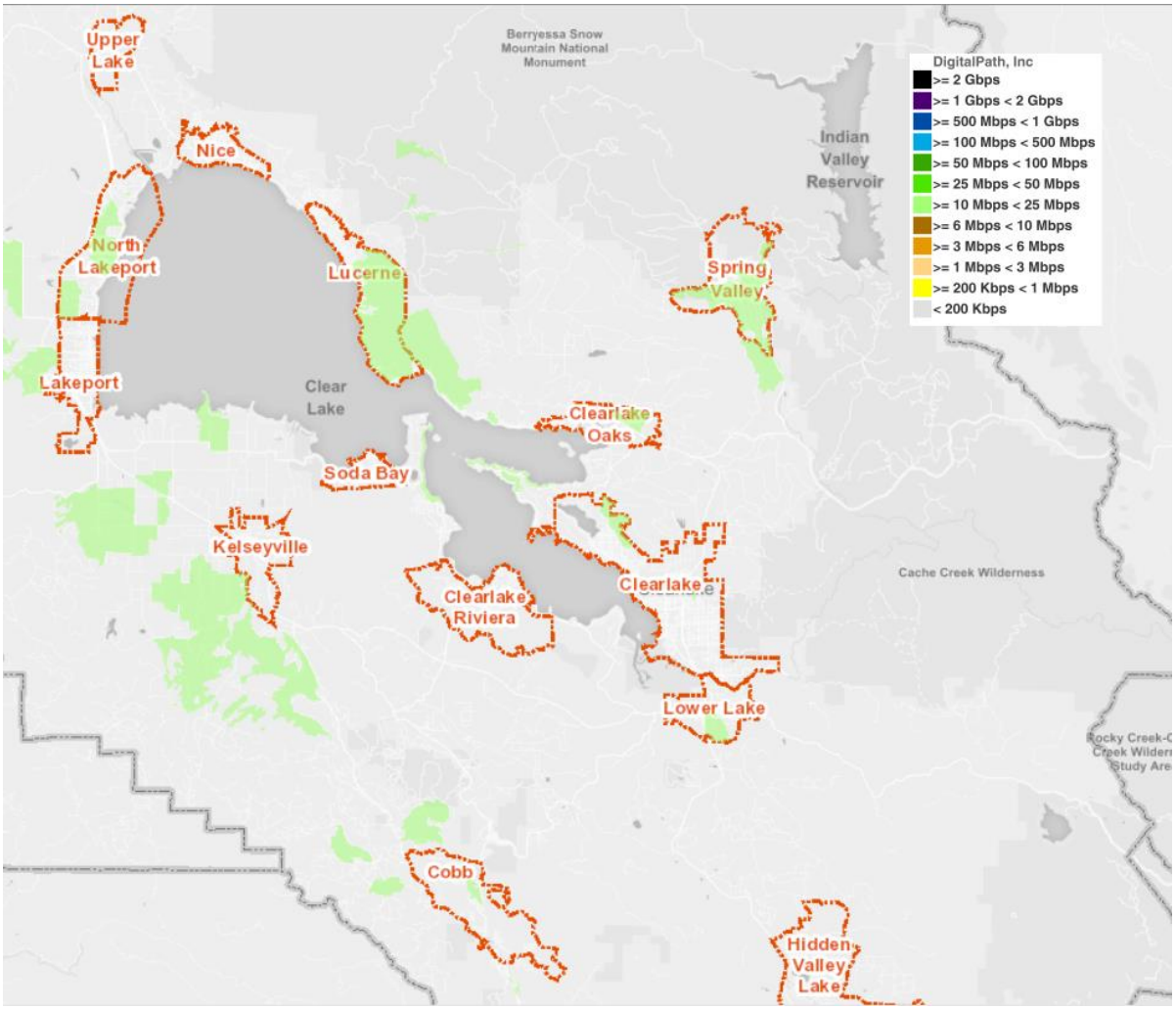

Figure 7. Broadband service speed offered by DigitalPath in Lake County (December 2017).

North Coast Internet

North Coast Internet offers broadband service to business and residential customers in Lake County through a terrestrial fixed wireless network. Figure 8 shows broadband service speeds provided by North Coast Internet of 25 to less than 50 Mbps (green areas) in parts of Clearlake Riviera, Lakeport, North Lakeport, and in several unincorporated areas near Lakeport, North Lakeport, and Kelseyville.

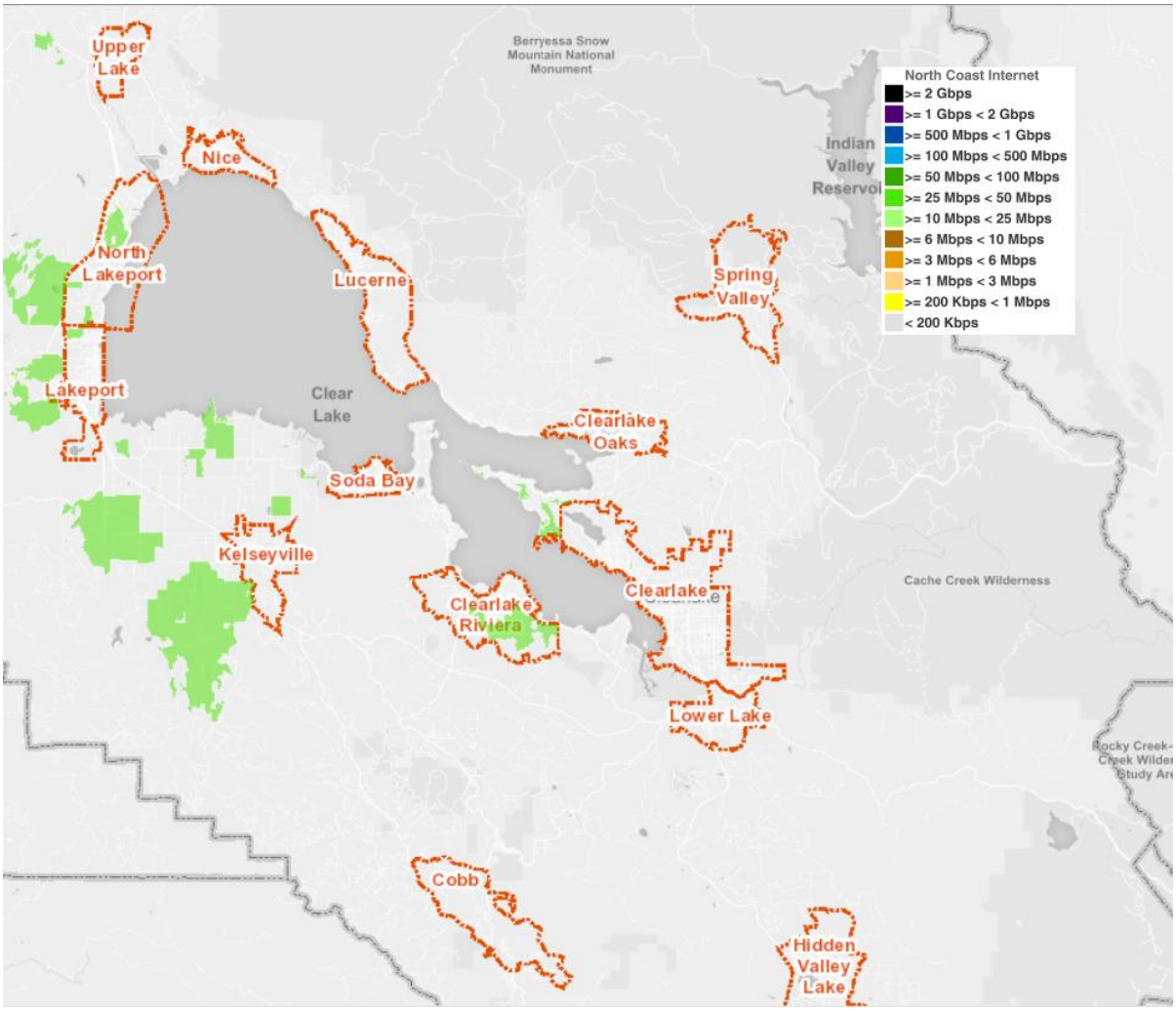

Figure 8. North Coast Internet broadband service coverage in Lake County (December 2017).

Level 3 Communications

Level 3 offers copper wireline and fiber-optic service to business customers in Lake County, shown in Figure 9. Level 3 reports fiber-optic connections of more than 2 Gbps in an unincorporated area to the east of Clearlake Oaks (black areas).

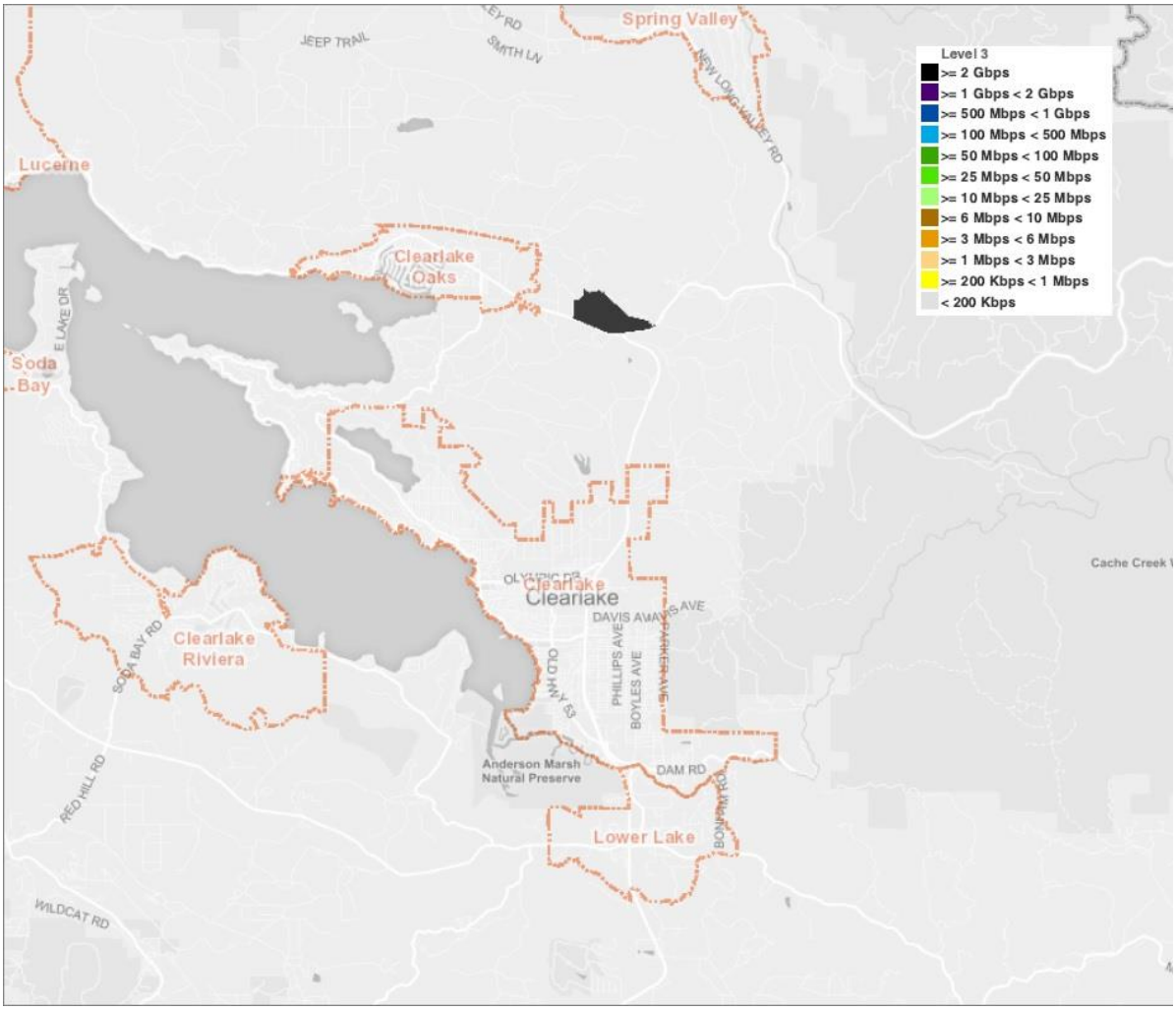

Figure 9. Level 3's business-class broadband service coverage in Lake County (December 2017)

Earthlink Business

Earthlink is a business-class only broadband service provider and uses asymmetric xDSL, copper wireline and cable modem technologies. This provider offers speeds of 1 to less than 3 Mbps (light-brown areas) in areas within Lakeport and Clearlake, shown in Figure 10.

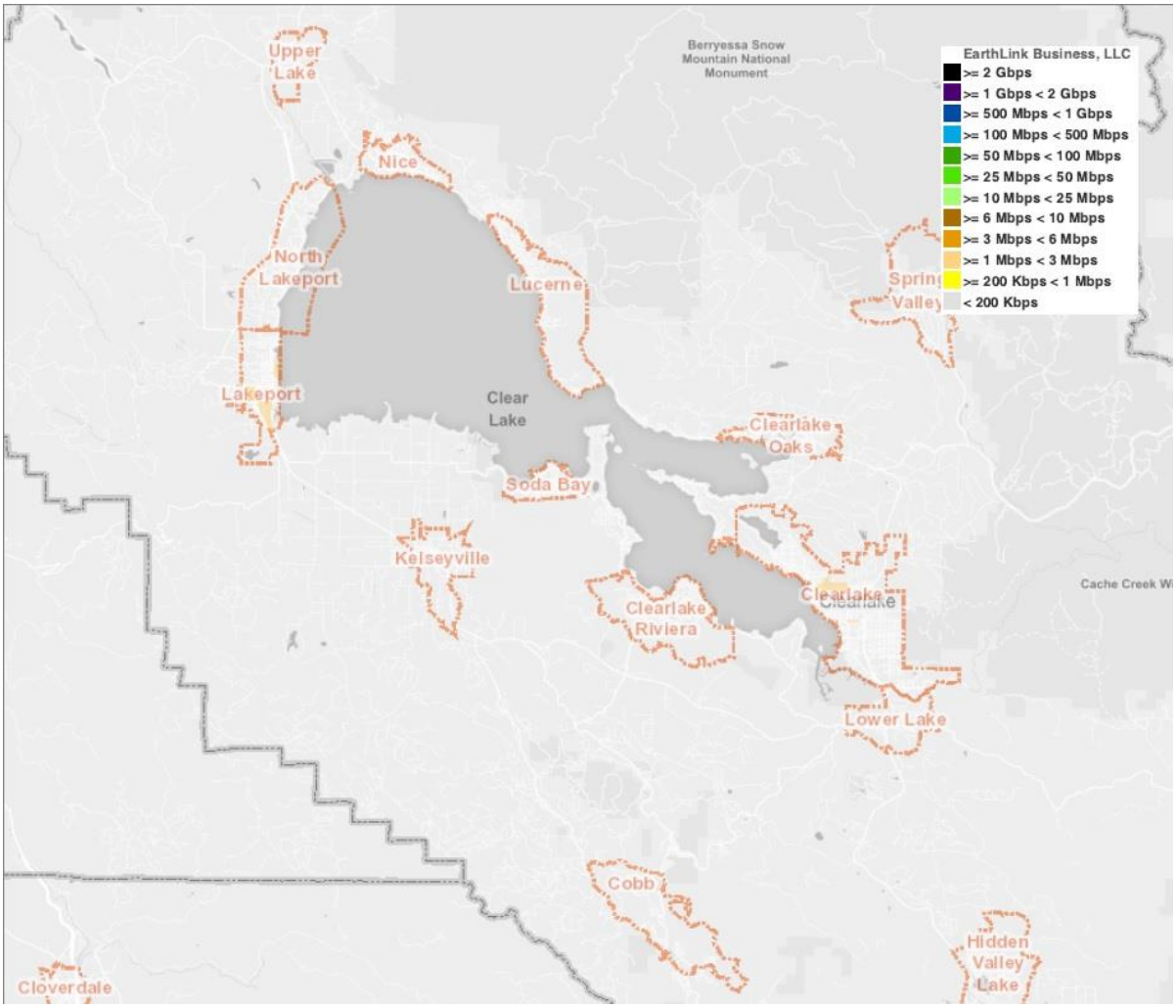

Figure 10. Broadband service speed offered by Earthlink in Lake County (December 2017).

U.S. TelePacific

U.S. TelePacific is a business broadband service provider, which offers fiber-to-the-end-user and copper wireline connectivity. This provider serves businesses in three areas within Lakeport with speeds of 100 to less than 500 Mbps (blue areas) and 50 to less than 100 Mbps (dark-green areas). Figure 11 shows business-class broadband service provided by U.S. TelePacific.

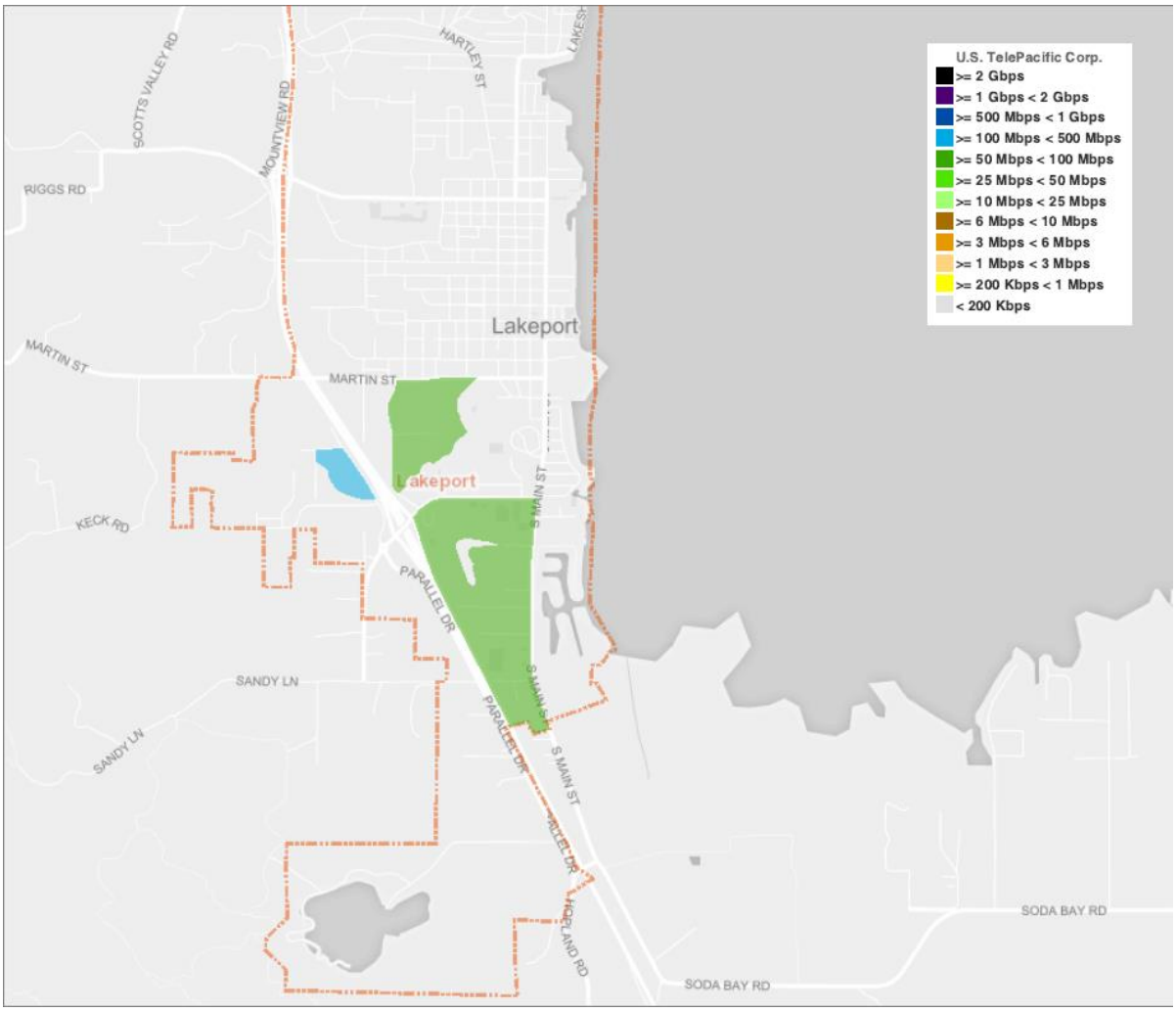

Figure 11. Broadband service speed offered by U.S. TelePacific in Lake County (December 2017).

MCI

MCI is a business-class broadband service provider. Based on CPUC data, MCI uses copper wireline technology. This provider offers speeds of 1 to less than 3 Mbps service (light-brown area) in an area within Clearlake, shown in Figure 12.

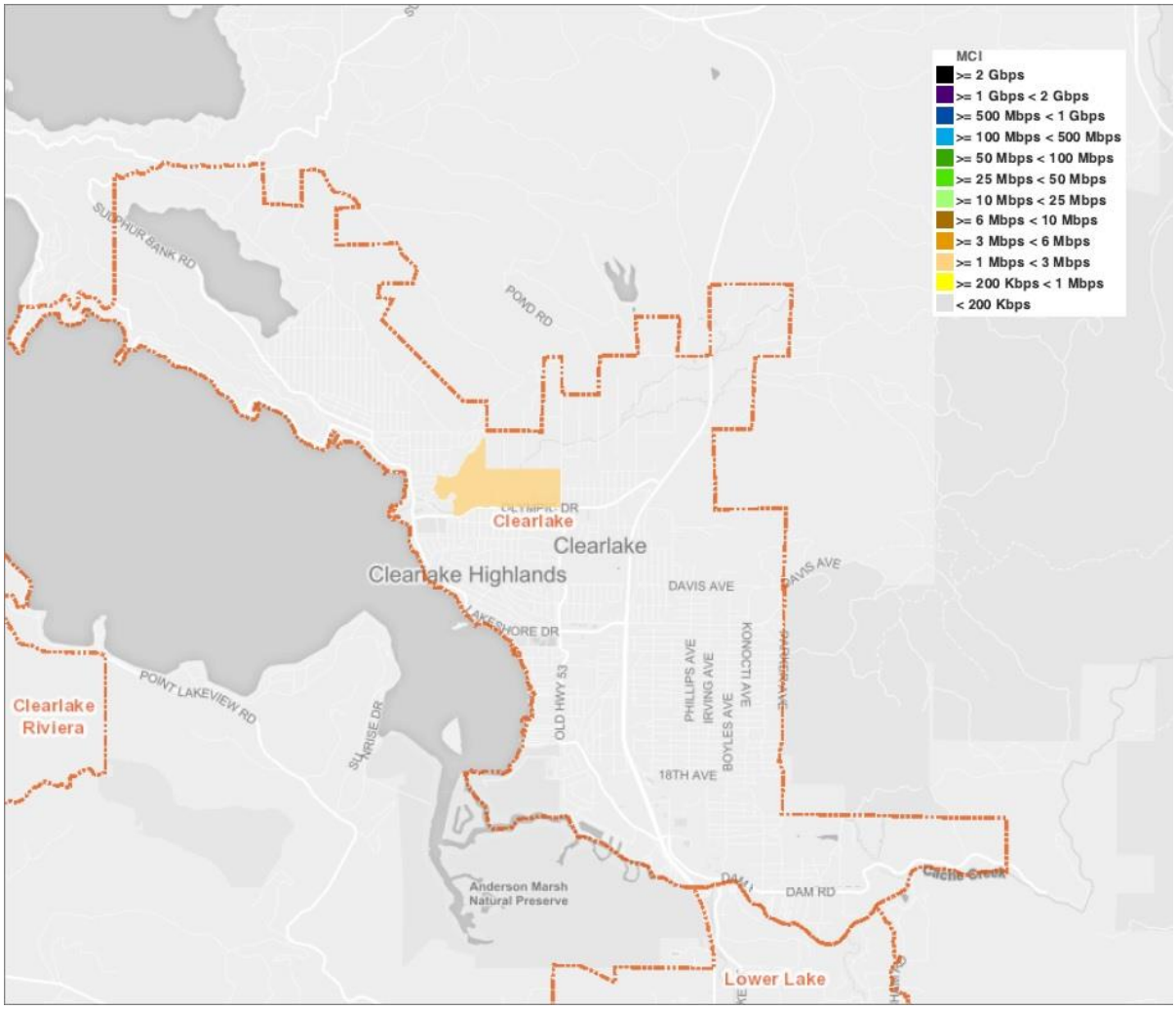

Figure 12. Broadband service speed offered by MCI in Lake County (December 2017).

4.1.3 Measured Broadband Service and Download Speed Availability

The CPUC encourages Internet service customers to provide feedback (validation) of the coverage and speeds reported by ISPs in order to improve the accuracy of broadband availability data in California. The CPUC has made available the following methods[35] to provide such feedback:

- CalSPEED application for mobile and desktop
- Online survey
- Public Feedback Form (hard copy survey)

The CalSPEED application is a professional-level broadband testing tool that allows conducting performance testing of both fixed and mobile broadband services. This application was developed at California State University, Monterey Bay and is used by the CPUC for measuring and validating broadband coverage from any broadband subscriber location. CalSPEED can be downloaded from www.calspeed.org.

[35] CPUC Broadband Availability Public Feedback: https://www.cpuc.ca.gov/Broadband_Availability_and_Public_Feedback/

The broadband testing results are displayed in the user device and then sent to a CPUC server for displaying on the California Broadband Availability Map[36]. CalSPEED measures broadband performance parameters, such as downstream and upstream speeds, latency, and jitter (see detailed definitions in ***Section 9.1 Appendix A - Broadband Service Benchmarks***). Results of CalSPEED can be used to validate broadband service availability in a specific geographic region and update the served or unserved (slow service or no service) status.

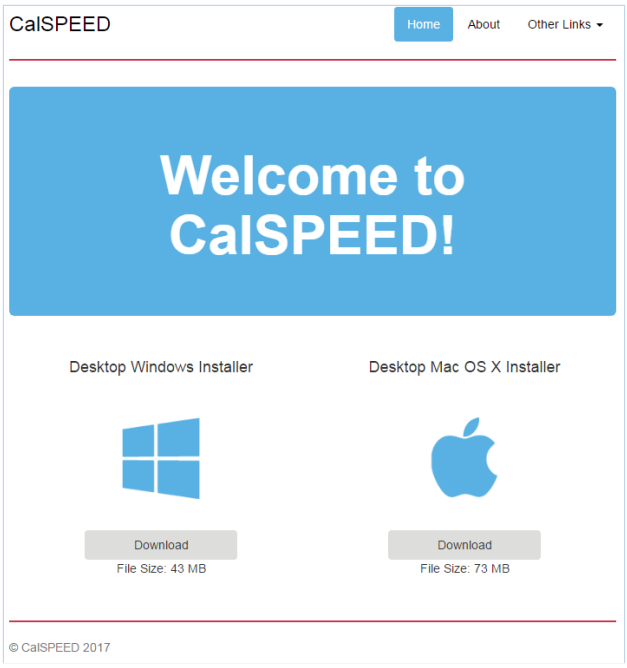

Figure 13. CalSPEED desktop versions available in www.calspeed.org

Figure 14 shows current CalSPEED results for fixed broadband services in Lake County (as of June 2018). Clearlake has seven measurement points showing speeds ranging from 1 to less than 50 Mbps. Lakeport has 6 points showing speeds ranging from 6 to less than 50 Mbps. Clearlake Riviera, Kelseyville, Soda Bay, and North Lakeport have three points, Hidden Valley Lake has two points, Upper Lake, Nice, Clearlake Oaks, Middletown, and Cobb each have one point, and there are another nine points across Lake County. The speed test results in Clearlake Riviera, Kelseyville, North Lakeport and other areas show speeds ranging from <200 kbps to <50 Mbps. The current number of measurements (forty-two points) does not yet allow for proper validation of broadband availability in the county. More measurement points are required to assess levels of broadband availability for wireline and fixed wireless broadband providers.

Other methods, developed and made available by the CPUC, for coverage and speed validation are the CPUC Public Feedback Form Survey and Online Survey. Links for both surveys can be found at the following link: https://www.cpuc.ca.gov/Broadband_Availability_and_Public_Feedback/.

[36] California Public Utility Commission (CPUC). Broadband Availability Map. http://www.broadbandmap.ca.gov/.

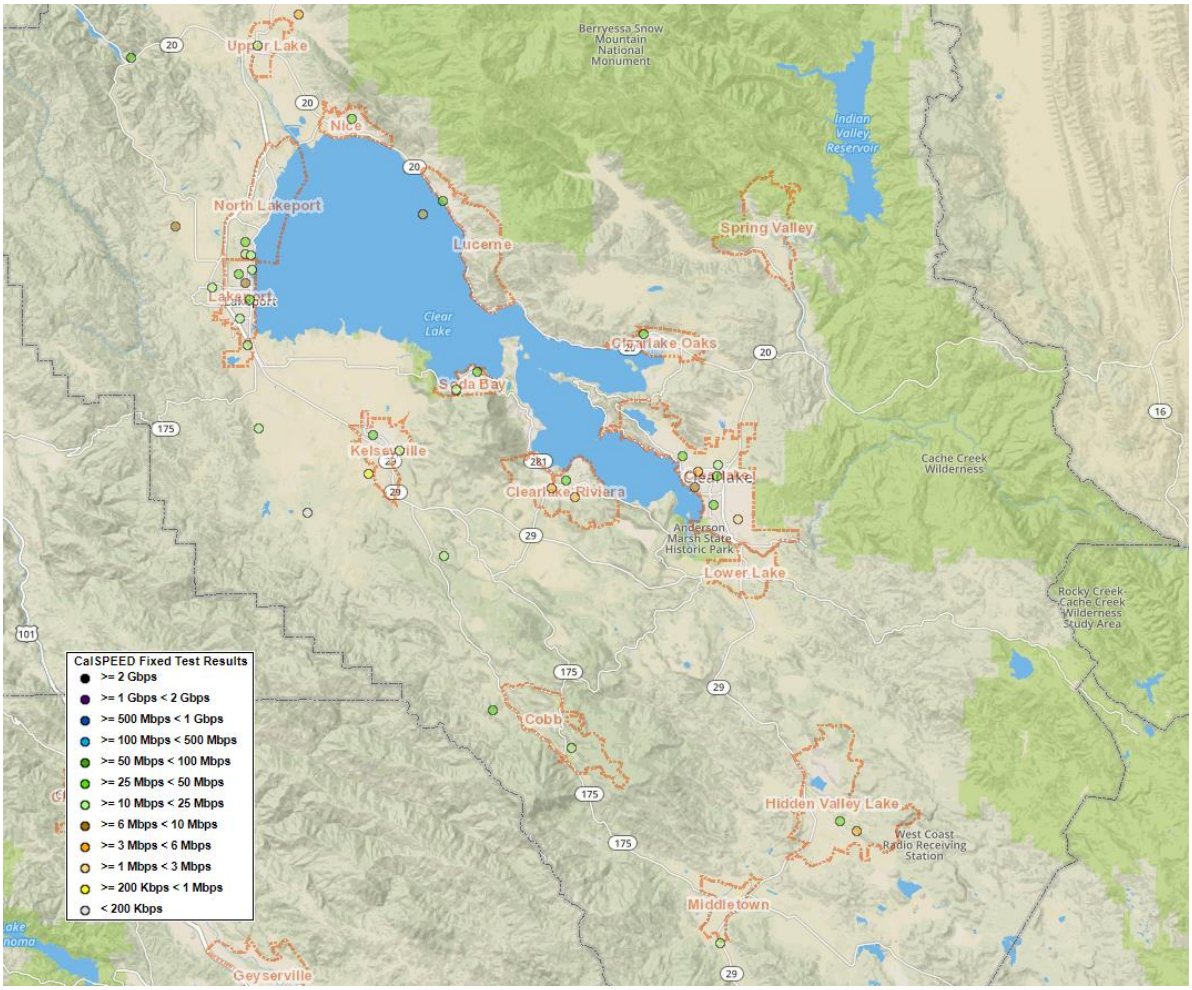

Figure 14. CalSPEED fixed test results for the County of Lake

4.2 Broadband Services Adoption

Residential broadband adoption is defined as the number of consumer broadband subscriptions divided by the total number of households within a defined geographic unit. Data regarding broadband subscriptions are confidential but the CPUC does publish a limited set of broadband adoption statistics by census tract. Figure 15 shows adoption rates in Lake County. The CPUC withholds data from some parts of the county (no colored areas) to protect confidentiality of the individual service providers, due to one service provider having over 80 percent of the area's subscriptions, or an area having fewer than three service providers, in accordance with guidelines developed by the United States Department of Commerce.

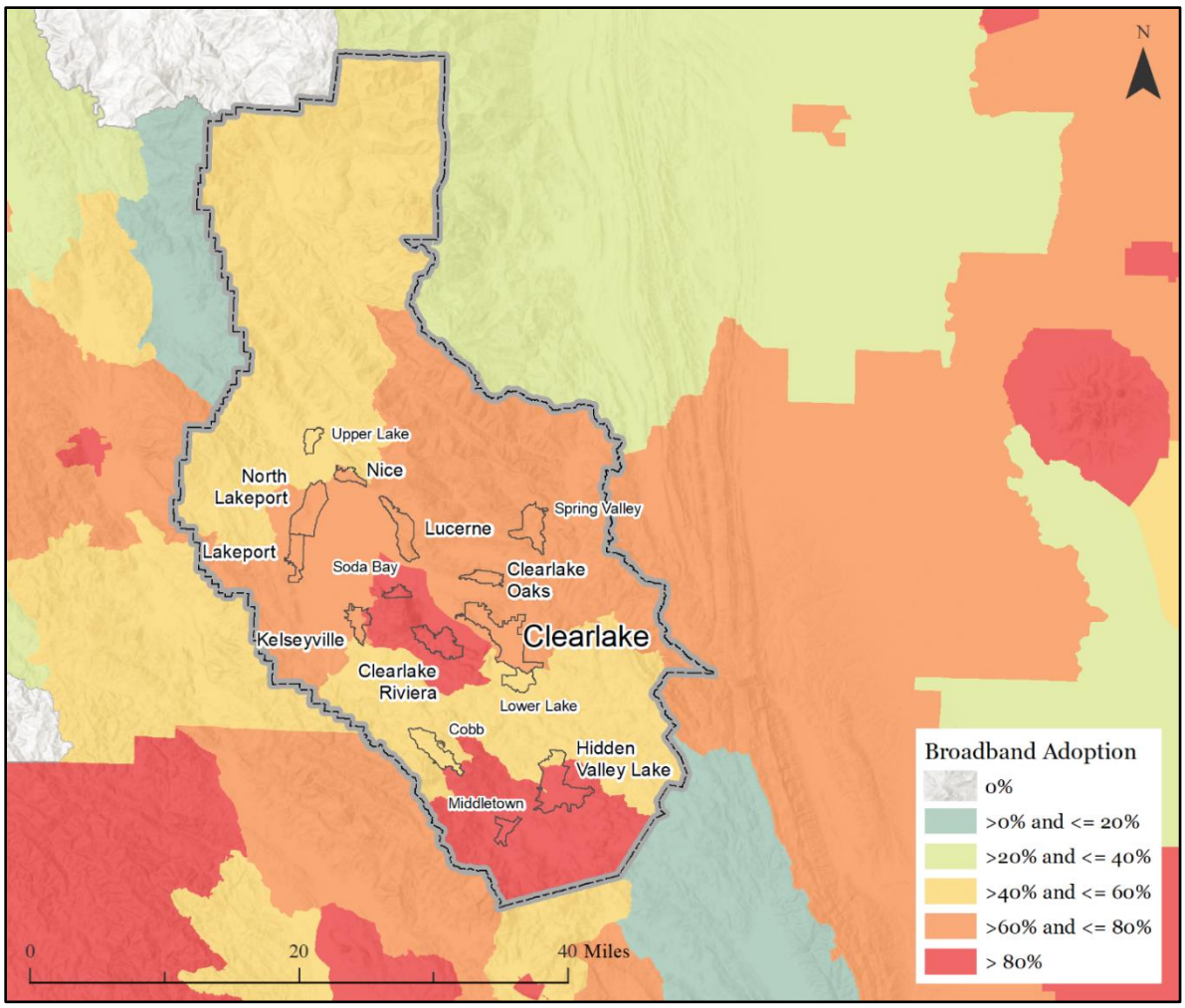

Figure 15. Broadband adoption rates in Lake County

Broadband adoption rates in the County of Lake range from 40 percent to >80 percent. The highest adoption rates of >80 percent are in Middletown, Soda Bay, Clearlake Riviera, and in and around Hidden Valley Lake. The rest of the county has adoption rates of 40 percent to 80 percent.

4.3 Broadband Service Pricing and Speed Offer

Figure 16 shows broadband service pricing in the County of Lake from October 2017. The figure presents downstream broadband speed offers and price per Mbps[37] (as a standardized pricing unit) for residential service ISPs such as AT&T, 101 Netlink, Mediacom, DigitalPath, North Coast Internet, and Internet Free Planet. Repeated ISP labels are due to offering multiple speed tiers in the county.

[37] The price per Mbps is calculated by dividing monthly Internet plan price by downstream speed in Mbps offered in such plan.

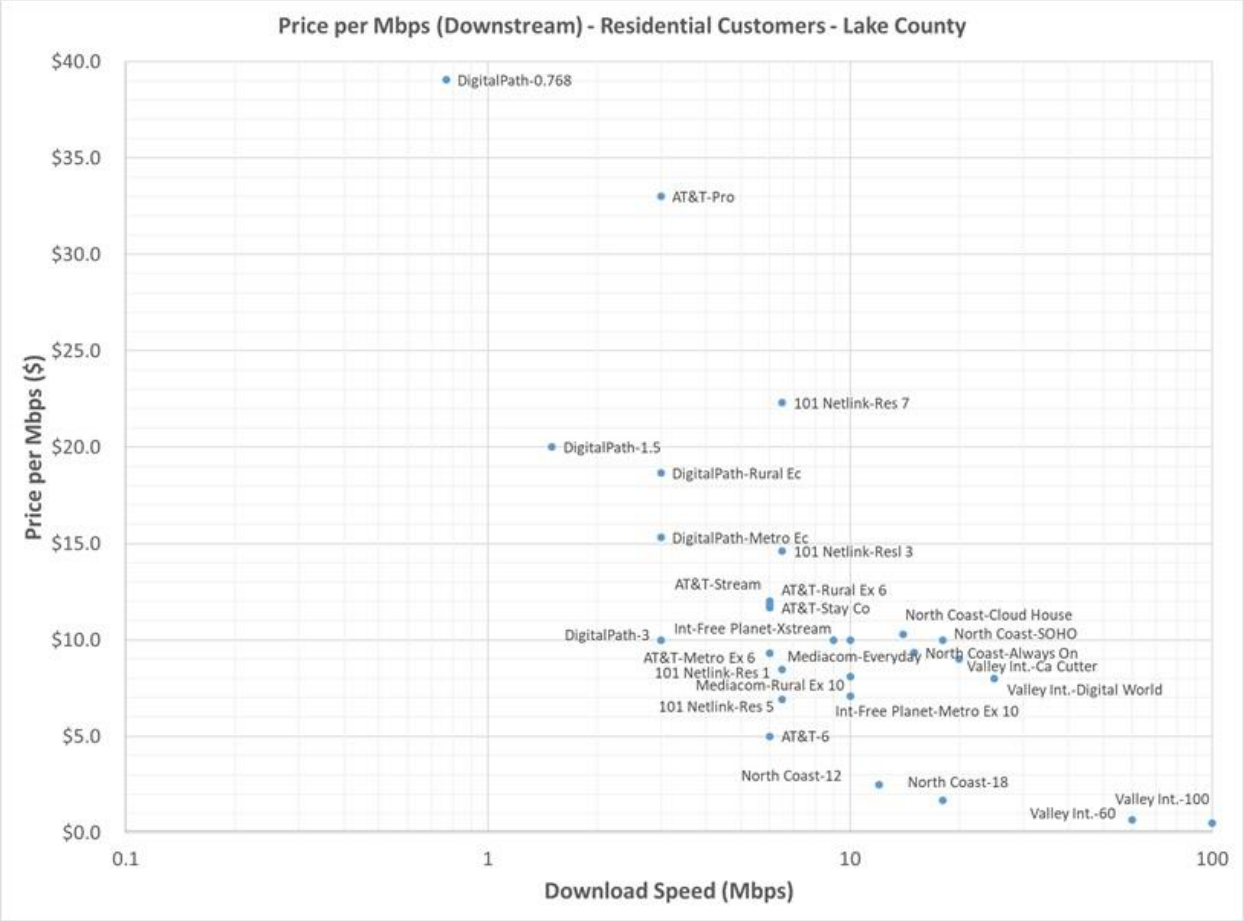

Figure 16. Broadband service pricing (speed offer and cost per Mbps) in Lake County (Sept 2017)

The following summarizes pricing trends broken down by downstream speed:

1. For downstream speeds of 768 kbps to 3 Mbps, price per Mbps ranges from $10 to $39.1.
2. For a downstream speed of 6 Mbps (CPUC) to 6.5 Mbps, price per Mbps ranges from $5 to $22.3.
3. For downstream speeds of 10 Mbps to 25 Mbps, price per Mbps ranges from $1.7 to $10.3.
4. For downstream speeds of 60 Mbps to 100 Mbps, price per Mbps ranges from $0.5 to $0.7.

These figures and pricing trends indicate the following:

1. Most residential plans in Lake County offer downstream speeds at or below 10 Mbps.
2. Price per Mbps decreases as downstream speed offers increase, which indicates that broadband technologies providing higher speeds have an overall better service pricing.

4.4 Middle-Mile Service Availability

This subsection presents middle-mile infrastructure (fiber-optic-based backbones) available in the County of Lake. The middle-mile segment provides high-speed and high-capacity transport and transmission of data communications from an aggregation point (i.e., central office, cable headend or wireless switching station) to an Internet point of presence (POP). Availability, affordability and access to middle-mile infrastructure are critical for planning of last-mile broadband infrastructure projects, and

providing either wireline or fixed wireless services to residential and business customers. For a detailed description on middle-mile broadband technologies see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies***.

It is important to note that fiber-optic carriers usually do not provide or report information of their fiber-optic routes. The route information presented in this subsection was collected over the past few years from unofficial discussions with ISP's personnel and local government staff with knowledge of fiber-optic deployments in the county. The Upstate California Connect Consortium is currently working with ISPs and the CPUC to update and validate fiber-optic routes in rural Northern California.

Figure 17 shows the middle-mile infrastructure (fiber-optic-based backbones) in Lake County offered by AT&T and Level 3. AT&T's backbone passes through the county north of Clear Lake and through the community of Upper Lake. Level 3 has a backbone that travels along the northeast shores of Clear Lake through the communities of Upper Lake, Nice, Lucerne, and Clearlake Oaks. Potential last-mile projects located along or near these backbones may negotiate agreements for accessing their high-speed and high-capacity fiber-optics.

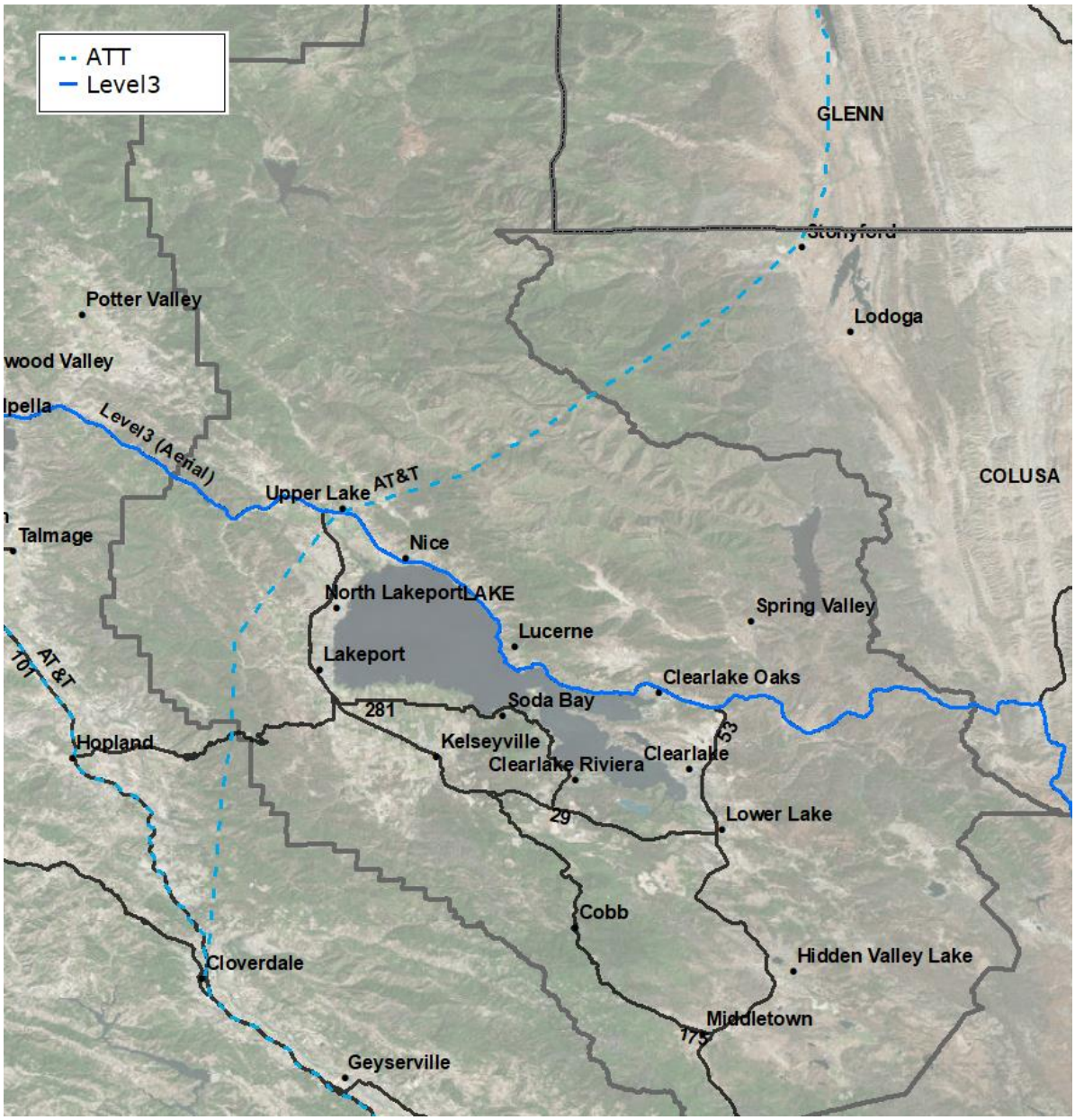

Figure 17. Middle-mile infrastructure reported in Lake County

5 Broadband Service Coverage and Infrastructure Expansion Recommendations

This section presents recommendations for expanding, upgrading or launching broadband service in Lake County. Based on CPUC broadband availability data, subsection ***5.1 Eligible Areas for Federal and State Broadband Infrastructure Grants*** presents eligible areas for broadband infrastructure grants for two funding sources, the CPUC California Advanced Services Fund (CASF) and USDA Reconnect Program. Subsection ***5.2 Local Partner Input and Priority Areas Selection for Broadband Projects*** describes critical input from local governments, ISPs, and community based organizations to define priority areas for broadband infrastructure projects. After defining priority areas for projects, the next step is assessing potential funding sources including ISP's private investment, ISPs applying to State or Federal grants, or establishing public-private partnerships between local government and ISPs. Finally, subsection ***5.3 Partnership with Caltrans Projects along State Highways*** presents the current state regulatory framework which allows for partnerships to install broadband infrastructure along Caltrans projects in State highways.

5.1 Eligible Areas for Federal and State Broadband Infrastructure Grants

5.1.1 Eligible Areas for CPUC CASF Broadband Infrastructure Grants

AB 1665, approved by the Governor on October 2017, extends the date of the California Advanced Services Fund (CASF) goal (deploying broadband Internet service at speeds of 6/1Mbps to 98 percent of household in each consortium region) from 2015 to 2022 and authorizes the CPUC to collect an additional $300 million to the CASF Broadband Infrastructure Grant Account[38]. On December 2018, the CPUC approved the new rules for the Infrastructure Grant Account (Proceeding R1210012). As per the new rules, the CPUC is allowed to fund all or a portion of a project, on a case-by-case basis. To determine the funding level (ranging from 60% to 100%) for a project, the Commission will consider the following factors:

- **Baseline (60%):** Areas served at speeds below 6 Mbps downstream and 1 Mbps upstream.
- Areas with only dial-up or no Internet connectivity (up to +40%)
- Low-income service (median household income no greater than $50,200) (up to +40%)
- Location and accessibility of the area meeting two of the following five characteristics (up to +10%):
  1. Rugged or difficult terrain (e.g., mountains, desert, national or state forest);
  2. Unincorporated community;
  3. More than 10 miles from the nearest hospital;
  4. More than 10 miles from the nearest state or federal highway; and/or
  5. Rural census block, as defined by the U.S. Census Bureau.
- Existence of communication facilities that may be upgraded to deploy broadband (up to +10%)
- Project makes a significant contribution to achieving the program goal (up to +10%)

Eligible applicants for the CASF Infrastructure Account grant includes:

- Entities with a Certificate of Public Convenience and Necessity (CPCN) that qualify as a "telephone corporation" as defined under Public Utilities (Pub. Util.) Code section 234;

[38] CPUC Decision 18-12-018 Appendix 1 – Broadband Infrastructure Account Requirements Guidelines and Application Materials.
http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M250/K330/250330089.PDF

- Wireless carriers who are registered with the Commission (i.e., hold a Wireless Identification Registration (WIR))—wireless carriers need not obtain a CPCN to qualify for CASF funding;
- Non-telephone corporations that are facilities-based broadband service providers—the Commission uses the NTIA 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;
- A local governmental agency if no other eligible entity applied.

Figure 18 shows eligible areas in Lake County for the 2019 CASF infrastructure grants application cycle. Under the current CASF program, grant cycles run until 2022. This assessment of eligible areas is based on 2018 CPUC broadband availability data (as of Dec 2017)[39]. This figure shows eligible areas at the baseline funding level of 60% (red areas), and 100% (orange, yellow, and green areas). The latter for dial-up only, low income, or a combination of both types of areas.

5.1.2 Eligible Areas for USDA Reconnect Program

The USDA ReConnect Program[40] is a pilot program that offers federal financing and funding options in the form of loans ($200M), grants ($200M), and loan/grant combinations ($200M) to facilitate broadband deployment in areas that don't currently have sufficient access to broadband (10 Mbps/1 Mbps). This pilot program allows applicants to deploy broadband infrastructure to provide high-speed Internet e-Connectivity to as many rural premises as possible, including homes, community facilities for health care and public safety, schools, libraries, farms, ranches, factories, and other production sites.

For a geographic area to be eligible to receive funds from this pilot program, it must meet two criteria[41]:

1. **It must be rural:** Service areas are not located in a city, town, or incorporate area that has a population greater than 20,000 or an urbanized area adjacent to a city or town with a population greater than 50,000 people. Eligible areas must be completely contained within a rural area or composed of multiple rural areas.
2. **Most households must currently have insufficient Internet service:** At least 90 percent of households in the proposed area must not have sufficient access to broadband service (fixed terrestrial broadband service at 10 Mbps downstream and 1 Mbps upstream).

Eligible applicants for the USDA Reconnect Program must be able to supply retail broadband to customers. Applicant include:

- Cooperatives, non-profits, or mutual associations
- For-profit corporations or limited liability companies
- States, local governments, or any agency, subdivision, instrumentality, or political subdivision thereof
- A territory or possession of the U.S.
- An Indian tribe

Figure 19 shows eligible areas in Lake County for USDA Reconnect Program grants for the 2019 application cycle. Further funding cycles are expected in 2020 and coming years.

[39] Eligible areas for the 2020 application cycle and forward will be based on latest releases of CPUC broadband availability data. i.e., 2019 data release (as of Dec 2018) and forward.

[40] U.S. Department of Agriculture – ReConnect Loan and Grant Program. https://www.usda.gov/reconnect

[41] Additionally, no part of the proposed area may overlap with the service area of a company that has received a broadband loan from the Rural Utilities Service (RUS) as defined in this Funding Opportunity Announcement (FOA).

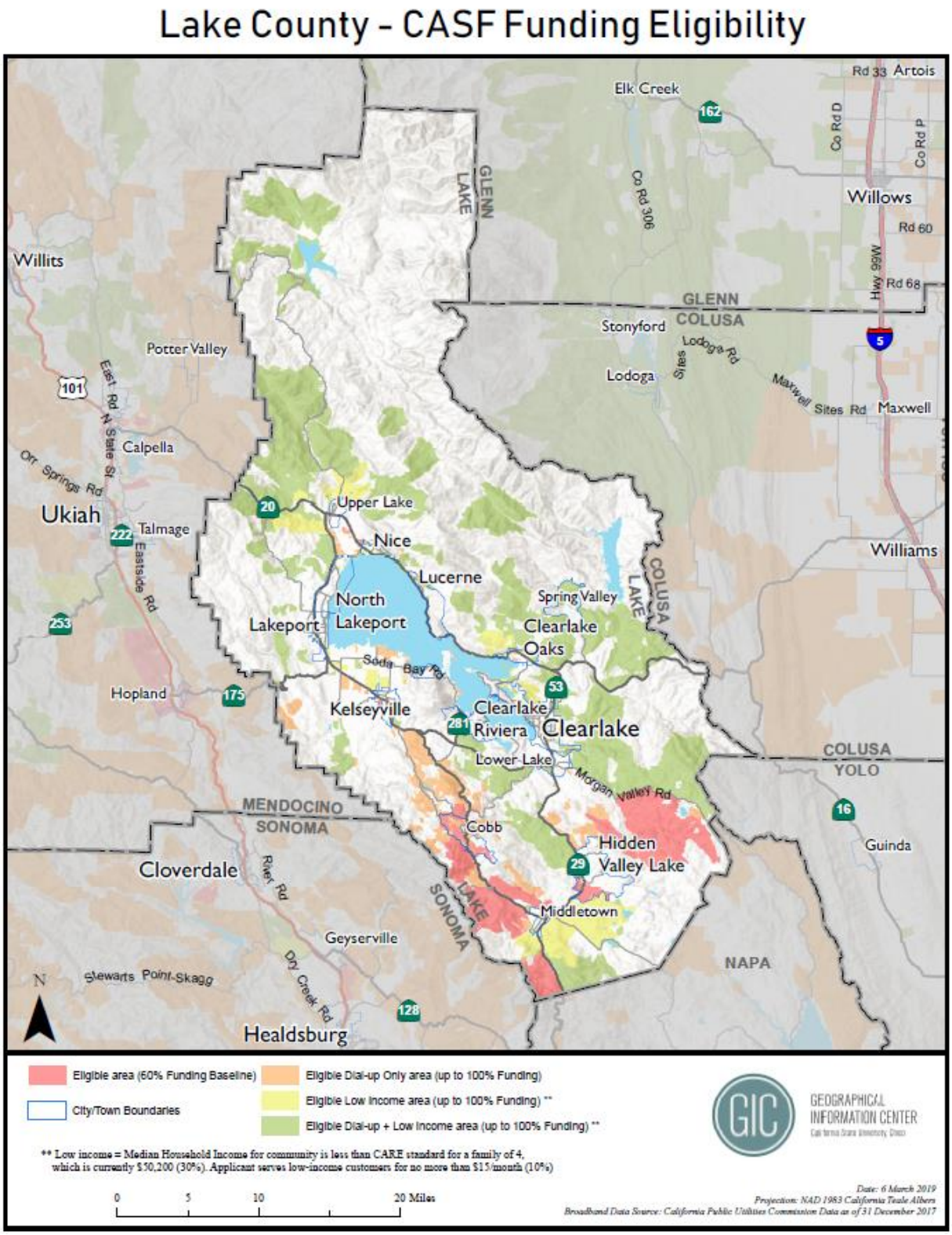

Figure 18. Eligible areas in Lake County for CPUC CASF infrastructure grants.

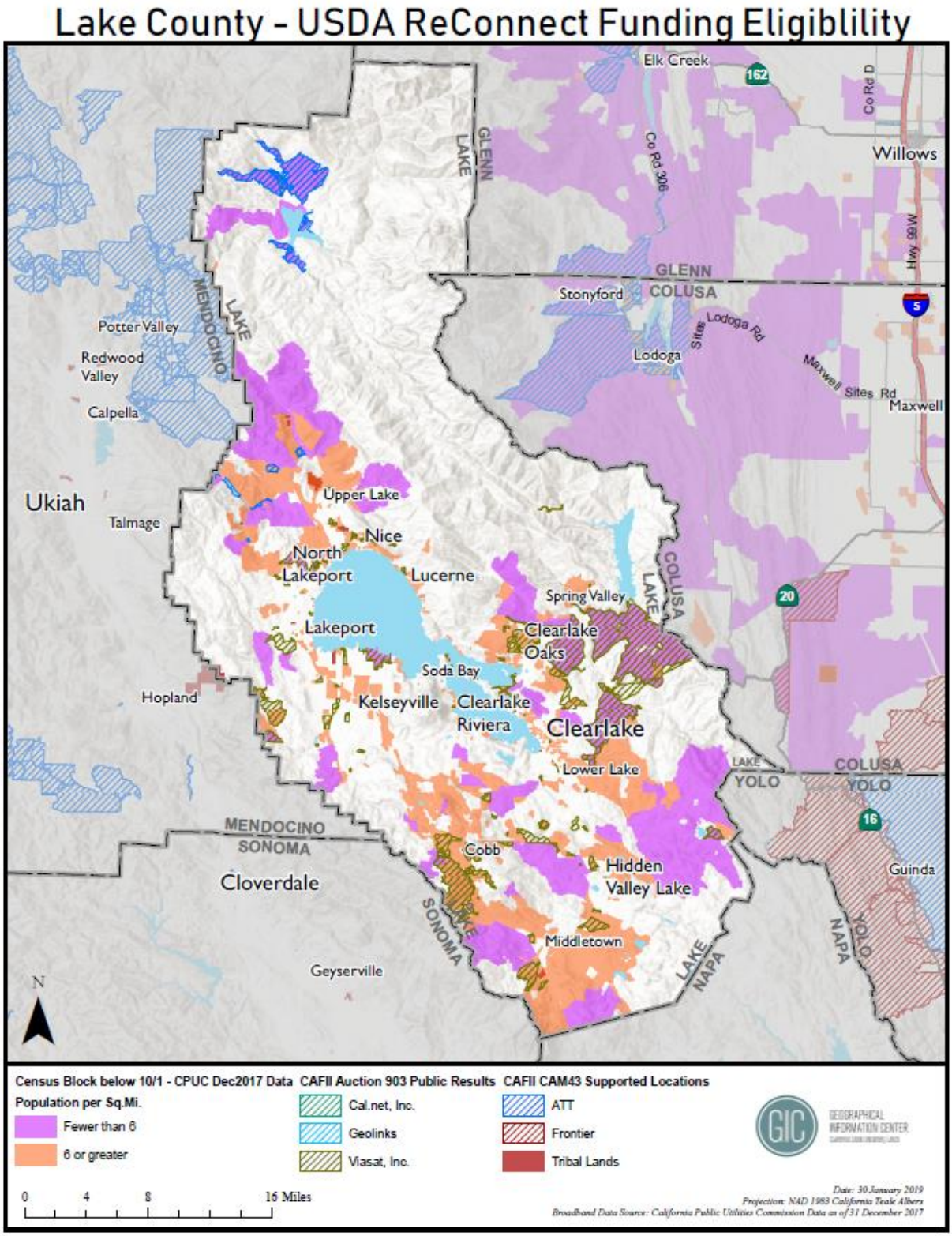

Figure 19. Eligible areas in Lake County for USDA Reconnect Program grants.

5.2 Local Partner Input and Priority Areas Selection for Broadband Projects

5.2.1 Input from Local Partners to Identify Broadband Needs

The input from local partners is critical to identify and quantify potential project areas for broadband expansion or upgrades. Local partners have the ability to work closely with the community and have firsthand knowledge of broadband related needs, or can support efforts to gather information of such needs (i.e., conducting surveys, forum, or workshops). Critical local partners in Lake County include but are not limited to:

- Lake County local government
- Lakeport local government
- Clearlake local government
- Lake County Economic Development Corporation
- Lake County Office of Education
- Lake County Business Associations
- Lake County Chamber of Commerce
- Lake County Association of Realtors
- Lake County Winegrape Commission
- Lake County Winery Association
- Lake County Tribal Nations
- Lake County community action organizations
- Lake County family service providers
- Lake County Family Resource Center
- Cobb Area Council
- City of Clearlake Chamber of Commerce
- Lucerne Area Revitalization Association
- Mendocino College Lake Center
- New Paradigm College
- North Coast Opportunities
- Redwood Community Services
- Woodland Community College Lake Campus

The input from local partners should be quantified and aggregated in order to identify broadband needs and priority geographic areas for broadband deployments. These areas might include but are not limited to:

- Unserved residential areas
- Unserved or underserved business and industrial areas
- Unserved or underserved community based organizations
- Unserved or underserved community anchor institutions

After identifying priority geographic areas for broadband deployments, these areas need to be entered and plotted in digital maps (i.e., using GIS software, Google Earth or other mapping tool). These digital maps and files will allow to incorporate these priority geographic areas in a comprehensive analysis which will also include CPUC's broadband availability data, among other geospatial data.

5.2.2 Economic Development Strategy for Lake County – Dr. Eyler's Report

Between June and October of 2017, five community forums were held in Lakeport and Clearlake. The forum topics included economic development themes such as what draws businesses to Lake County, what is missing to help businesses grow, what improvements Lake County can make to attract businesses, and what is missing to help businesses stay in the county. Many of the answers centered on the need to include broadband infrastructure and utility improvements for businesses to stay and grow and that broadband infrastructure is lacking as a component of general infrastructure altogether. The clear indication from these forums is the fact that broadband technology is important in supporting local business needs and that it is a necessary component to attract and retain local businesses. [42] Much of the data collected from these forums allow for a look into the perceptions and attitudes of local business owners and community members. The findings from these forums were included in Dr. Eyler's report: *Economic Development Strategy for Lake County*.

In Dr. Eyler's report, several recommendations were made regarding the types of broadband service that would benefit Lake County, funding opportunities, and specific comments relating to Lakeport and Clearlake. The first recommendation that Dr. Eyler laid out was that Lake County should consider incorporating broadband and wireless Internet strategies. As outlined in the recommendations, funding opportunities should be pursued through government agencies such as the USDA. This report also mentions broadband infrastructure improvement as a short-term goal. Regarding this recommendation, it needs to be noted that Lake County should seek funding opportunities that are available within the short term and that the county should be proactive in applying for such funding in the short-term. The previous subsection on this Master Broadband Plan covers two potential funding sources for broadband deployments, the USDA Reconnect Program and CASF Infrastructure Grants.

In regard to the Cities of Lakeport and Clearlake, the report highlighted that the lack of broadband infrastructure in these communities is a significant weakness and threat to the vitality and success of these communities. [43] Lastly, the report mentions broadband as a metric to watch in order to monitor the vitality and quality of life of the region.[44] To monitor this metric, data are available at the census block level from the California Public Utilities Commission.

The local partner and community input gathered during these five forums and the recommendations presented in Dr. Eyler's report demonstrate the importance of gathering local input to identify common issues and challenges, and strategizing potential solutions in the short and long term.

Using a similar approach, the Upstate California Connect Consortium is currently holding meetings and working together with some of the local partners listed above in order to gather input on specific geographical areas in need of broadband expansion or upgrades, including but not limited to unserved residential areas, unserved or underserved business and industrial areas, and unconnected community based organizations and community anchor institutions, among others.

[42] Eyler, Robert. "Lake County Economic Development Strategy: Planning Process and Community Forums." 2017.
[43] Eyler, Robert. "Lake County Economic Development Strategy: Economic Development Planning Efforts and CEDS in Progress." 2017.
[44] Eyler, Robert. "Lake County Economic Development Strategy: Metrics to Watch." 2017.

5.2.3 Priority Areas Selection for Broadband Deployments

The priority areas selection process for broadband deployment includes using the identified priority geographic areas, CPUC broadband availability data, census data, among other relevant input. For the case of carrying out broadband deployments using grants (or subsidies), input of eligible areas for Federal or State broadband infrastructure grants need to be included in the selection process. This selection process might include criteria such as the following:

- Location of a priority area
- Eligibility for State or Federal Grants, and highest possible funding level
- Existing nearby broadband coverage and infrastructure
- Population and household density
- The number of businesses, anchor institutions (i.e., local government buildings, health care centers, education facilities, etc.), and public safety locations
- Median household income

The next step is to make this information available to ISPs interested in carrying out broadband deployments in these areas using private funding, federal or state subsidies, or through public-private partnerships.

5.2.4 Broadband Technology Options for Broadband Deployments

For the potential project areas, options for expanding, upgrading or launching broadband service might include using wired or fixed wireless technologies.

Wireline broadband includes digital subscriber line (DSL), cable modem and fiber-to-the-home. These technologies are primarily deployed in urban and suburban areas, and in some cases DSL can also reach rural areas. Deployment and coverage limitations of these technologies include access to right-of-way or poles, and high costs associated to rolling underground lines or aerial deployments. Presented below are options, based on ISPs' wireline technologies, to improve current coverage and speed levels of broadband service:

- **Upgrade copper infrastructure and service:** The copper infrastructure, also called public service telephone network (PSTN), enables xDSL, ADSL2, ADSL2+, and VDSL broadband services. PSTN upgrades allow coverage expansion; however, depending on the infrastructure status (i.e., equipment condition, copper lines and distance), speed upgrades may only be able to reach up to a few Mbps or, in the best case scenario, only up to couple tens of Mbps.

- **Expansion of cable network infrastructure and service:** Cable technology currently offers among the highest downstream speeds (up to 500 Mbps or Gbps). Expanding its footprint can make these high speeds available to more customers.

- **Launching fiber-to-the-building (FTTB) or fiber-to-the-home (FTTH) services:** These services are currently unavailable in Lake County; however, they could be launched in specific profitable market areas offering gigabit speeds.

Upgrading PSTN, expanding cable or launching FTTB/H would require deploying infrastructure like underground conduit or aerial cabling, cabinets, energy systems, networking equipment, etc. Table 6 shows estimated broadband deployment costs from projects previously funded by the CPUC California

Advanced Services Fund (CASF). The table shows the average cost per household based on wireline (DSL and FTTH) CASF projects, including minimum and maximum cost ranges per household.

Table 6. Average costs per household of CASF infrastructure grant awards by project type[45]: upgrades using existing infrastructure and new fiber-to-the-home build.

Project	Technology	Speed	Weighted Average Cost per HH ($)	Min. Cost per HH ($)	Max. Cost per HH ($)
Upgrades Using Existing Infrastructure (Both ILECs and non-ILEC providers)	ADSL2+, VDSL	25Mbps/1.5Mbps	$1,080	$894	$2,446
Upgrades Using Existing Infrastructure (Both ILECs and non-ILEC providers)	FTTH	50Mbps/50Mbps 1Gbps/1Gbps	$1,119	$1,013	$1,183
New Fiber-To-The-Home Build (Predominantly aerial installations)	FTTH	1Gbps/1Gbps	$16,005	$11,505	$25,753

Fixed wireless broadband technologies include 802.11 Wi-Fi standard (unlicensed spectrum), LTE (unlicensed, lightly licensed, and licensed spectrum), and TVWS (unlicensed spectrum on a secondary basis) among other technology options (proprietary FDD or TDD OFDM-based solutions). These technologies are primarily deployed in areas where wireline technologies have incomplete coverage, such as some suburban and most rural areas. Deployment and coverage limitations of these technologies come from obstructions (terrain/vegetation) between the antenna at the customer premises and the access point or base station located at a pole or tower.

Fixed wireless technologies are the most feasible and viable technology solutions to expand current coverage of broadband service to unserved rural areas under harsh geographical conditions (i.e., mountains, hills or forests). Table 7 uses estimated broadband deployment costs for fixed wireless from the CPUC California Advanced Services Fund (CASF). This table shows the average, minimum and maximum costs per household based on CASF projects using fixed wireless.

Table 7. Average costs per household of CASF infrastructure grant awards[46]: fixed wireless.

Project	Average Total Project Cost per HH ($)	Range Min. Cost per HH ($)	Range Max. Cost per HH ($)
Fixed Wireless Deployments	$1,285	$960	$1,645

Each wireless technology has intrinsic characteristics that directly impact upfront and maintenance costs, such as operation frequency, propagation through vegetation and obstacles, capacity per base station/access point (BS/AP), and available spectrum, among others. For example, TVWS, which operates at the lowest band (470MHz-698MHz) among these technology options, has better propagation

[45] From Supporting Materials for May 25 (page 75) Communications Division Staff Workshop on CASF Reform ftp://ftp.cpuc.ca.gov/Telco/CASF/Reports%20and%20Audits/CASF%20Workshop%20May%2025th.pdf. Additionally, cost information was also gathered directly from the CPUC resolutions mentioned on page 75.

[46] From Supporting Materials for May 25 (page 72) Communications Division Staff Workshop on CASF Reform ftp://ftp.cpuc.ca.gov/Telco/CASF/Reports%20and%20Audits/CASF%20Workshop%20May%2025th.pdf

and achieves larger coverage from one site than 900MHz, 2.4GHz, and 5.8GHz. However, based on capacity, Wi-Fi 2.4GHz and 5.8GHz and fixed LTE provide higher speeds per BS/AP, and as a result, can offer higher speeds per customer. Thus, to determine the best technology fit for a specific scenario, further technical and cost assessments would be required.

For the case of business and industrial customers, since these customers require higher levels of speed, reliability, resilience and quality of service than residential customers, technologies used to provide business-class broadband service mostly include cable, fiber optics and high-throughput fixed wireless. Middle-mile carriers must be able to provide fiber-optic service. Fixed wireless providers must be able to provide high-throughput point-to-point radio links. The best technology fit for business and industrial customers will depend on specific broadband needs and requirements, and the associated costs of such services. However, due to the high-speed capacity and reliability of the fiber-optic service it is the preferred choice for business- and industrial-class customers. Although, in some cases, deploying a dedicated fiber line to a business located a few miles from the middle-mile route or carrier facilities can result in expenses in the range of tens of thousands of dollars.

For either of the above technology options (DSL, fiber optics, cable or fixed wireless), local governments can help to create incentives and promote upgrading, expansion, or launching broadband services by making it easier and less expensive to deploy broadband infrastructure. **Section 6 Policy Recommendations to Support Broadband Infrastructure Deployment** describe policies which can help to achieve this goal.

5.3 Partnership with Caltrans Projects along State Highways

An approach that can help to identify potential cost-effective broadband projects in Lake County is to partner with the California Department of Transportation (Caltrans) in order to coordinate installation of broadband infrastructure along Caltrans projects in State highways. These projects can be carried out especially in areas that are currently unserved or underserved by ISPs. This subsection presents the current framework that can allow for this coordination and collaboration.

California Governor's Executive Order S-23-06 (PDF) Twenty-First Century Government[47] directed the establishment of the California Broadband Task Force, of which the California Department of Transportation (Caltrans) is a member, in order to bring together public and private stakeholders to better facilitate broadband installation, identify opportunities for increased broadband adoption, and enable access to and deployment of new advanced communication technologies.

California Assembly Bill 154948 (Wood, Chapter 505, Statutes of 2016) requires that Caltrans, during the planning phase of specified Caltrans-led highway construction projects, notify broadband deployment companies and organizations on its website of transportation projects that involve construction methods suitable for the installation of broadband. Upon notification from Caltrans, companies or organizations working on broadband deployment may collaborate with Caltrans to install a broadband conduit as part of a project. The bill also requires Caltrans, in consultation with Broadband

[47] http://www.cetfund.org/files/executive_order_s2306_20061128.pdf
[48] Assembly Bill No. 1549. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1549

Stakeholders, to develop guidelines[49] to facilitate the installation of broadband conduit on State highway right-of-way on or before January 1, 2018.

There are two methods by which broadband stakeholders may work with Caltrans in order to deploy conduit inside the State highway right-of-way, through a Stand-Alone Encroachment Permit Project or a Planned Transportation Partnering Project. In both cases, broadband stakeholders must complete Encroachment Permits in order to proceed. If broadband stakeholders prefer to complete the planning, design, and installation of their conduit alone and using contractors of their choice, they may apply for a Stand-Alone Encroachment Permit.

If broadband stakeholders would prefer to work more closely with Caltrans during the planning, design, and installation of their conduit, they may apply for a Planned Transportation Partnering Project. Broadband Stakeholders in Lake County may find information regarding current Caltrans projects here: https://dot.ca.gov/caltrans-near-me/district-1/d1-projects. Stakeholders must contact and coordinate with the Caltrans district single point of contact to determine if the Caltrans planned project of their choice involves construction methods that suit broadband conduit installation. As a part of the partnering process, conduit planning, design, and construction are to be completed by Caltrans chosen contractor.

[49] Caltrans, User Guide: Incorporating Wired Broadband Facility on State Highway Right-of-Way (2018). https://dot.ca.gov/-/media/dot-media/documents/wired-broadband-facility-user-guide-1st-ed-signed.pdf

6 Policy Recommendations to Support Broadband Infrastructure Deployment

This section presents policy recommendations for supporting and promoting broadband infrastructure and services expansion and upgrades in Lake County, which can help to create additional incentives (on top of Federal or State grants) for ISPs to carry out broadband projects. The proposed local policies focus on reducing technical and economic barriers for new broadband infrastructure deployments (i.e., dig-once policy and conduit standard development), making publicly owned assets available, and streamlining the permit and authorization process in public right-of-way. This section also recommends updating the County General Plan and incorporating a Telecommunications Element in order to include specific goals, policies, and actions that can support broadband expansion.

6.1 Policy Issues and Considerations

6.1.1 Ease for Broadband Infrastructure Deployments

Local governments should promote and support expansion of high-capacity middle-mile (fiber-optic backbone) and high-speed last-mile (wireline and wireless) networks to reach residential, business and industrial broadband customers in both urban and rural areas. The County of Lake, and its cities and rural communities can reach out to ISPs to provide ubiquitous, reliable and high-speed broadband Internet access. For that purpose, permit and authorization processes should provide detailed guidance and timely responses to requests for broadband infrastructure deployments and installation of telecommunications equipment. Additionally, the county, cities and rural communities can implement policies aimed to reduce barriers and streamline permit processes for broadband infrastructure deployments and facilities upgrades. It is also important to find a balance between proper land use designations and growing needs for broadband services in the county, as optimal locations for wireline and/or wireless network infrastructure may be in areas unassigned to telecommunications infrastructure deployments.

6.1.2 Priority Areas for Broadband Infrastructure Deployments

Lake County, its cities and rural communities should identify priority areas for broadband deployments based on local needs (i.e., for residential, business and industrial services) and/or low attention from ISPs. Local governments should work with public entities, non-government organizations, and business associations, among other interested parties, to identify priority areas and develop strategies for addressing broadband needs. In the case of residential broadband services, needs may include broadband services like work-related applications for distance education, telehealth applications, high-quality entertainment and Internet-of-things applications. High-speed and high-quality services are paramount for local businesses to thrive in the growing digital economy. High-quality broadband provides access to a variety of competitive suppliers regardless of geographical location, as well as automated logistics and coordination systems across production and distribution processes, advertising to nationwide and global markets, and direct communication between companies and customers. The identified priority areas may be unserved areas or areas where very high speeds are needed for businesses and where such needs should accommodate growth over the next decade.

6.1.3 Partnerships for Broadband Infrastructure Projects

Local governments should support ISPs to expand broadband infrastructure through development of a comprehensive data set of available broadband-related city-owned assets (called a broadband asset inventory), and providing this information to the public through an online map viewer. The assets can include towers or tall buildings that may be used to deploy wireless infrastructure, rights-of-way to run underground conduit and fiber-optic cables. Local governments should also evaluate options for establishing partnerships with one or more ISPs to support the deployment of infrastructure in order to provide cutting-edge residential, business and industrial broadband services. Public/private partnerships can help ISPs reduce capital expenditures when government entities own infrastructure constructed with grant funds, which is then leased to private for-profit ISPs for operation. Developing technologies can facilitate consumer choice among ISPs in such a framework. The county and cities can support deployment of the last-mile element (to reach final customers) using high-speed broadband technologies which may include but are not limited to fiber optics, cable, Wi-Fi, LTE, TVWS, 4G and 5G mobile wireless, millimeter-wave. New deployments should also accommodate future expansion of infrastructure for growing broadband customer and speed demands, changes in technology and future utility providers. Partnerships can also be established with public utilities (i.e., PG&E) and state organizations (i.e., Caltrans) to find efficiencies and synergies when deploying infrastructure in public right-of-way (PROW). For example, developing a partnership with PG&E to explore options for ISPs to lease space on electric poles to run aerial fiber-optic cables, and working with Caltrans to deploy conduit as part of coming highway and road projects.

6.1.4 Promote Broadband Services Adoption to Foster Economic Development

Local governments within Lake County should collaborate with community partners to promote broadband adoption wherever it is available. Broadband adoption can be defined as a residential subscription to high-speed Internet, but can go beyond that definition to include digital inclusion, which also incorporates the skills and equipment necessary to fully utilize such connections. Elements of a broad-based adoption program include low-cost subscriptions, digital literacy training and low-cost computers[50]. Adoption provides customers for ISPs deploying in rural areas and supports education, health care, agriculture, manufacturing, economic and workforce development, tribal communities, and emergency services.

6.2 Policies for Promoting and Improving Telecommunications Infrastructure

This subsection presents a summary of recommended policies that can guide use of municipal resources and promote expansion of modern broadband Internet services. These policies support expansion and upgrading of broadband infrastructure and services in Lake County, its cities and rural communities by reducing infrastructure deployment costs and permitting delays for private ISPs. They also promote cooperation between public works departments, public utilities and ISP's broadband infrastructure projects to find synergies and achieve cost efficiencies. For example, enabling coordination among public utilities carrying out excavation projects and ISPs seeking to deploy underground conduit and fiber, or allowing ISPs access to and leasing public assets for expanding broadband coverage would promote the reduction of upfront deployments costs, which would be a strong incentive for ISPs to expand service. These policies are based on best practices from cities and counties in California (i.e., City of

[50] Rhinesmith, Colin. "Digital Inclusion and Meaningful Broadband Adoption Initiatives." Evanston, IL: Benton Foundation, January 2016. benton.org/broadband-inclusion-adoption-report. Accessed 5/15/18

Morgan Hill[51] and County of Santa Cruz[52]). Additionally, some of these recommendations are based on policies and ordinances of other counties and cities such as the City of San Jose and City and County of San Francisco.

6.2.1 Dig-once Policy

Depending on the approach taken regarding dig-once policies, they can help local governments and utility companies to work together to maximize access to excavation projects and open trenches in public right-of-way and to optimize resources for installation of conduit as part of county or city projects. A white paper by the Columbia Telecommunications Corporation (CTC) summarizes the range of approaches for dig-once policies[53]:

- Requiring an excavator who applies for a permit in the public right-of-way to notify utilities and other relevant entities (e.g., telecom companies and ISPs) about the excavation project and provide them with the opportunity to install infrastructure.
- Requiring an excavator to install empty conduit for future use (also called "shadow conduit" installation policy). Depending on the policy, the excavator or the jurisdiction can then lease that excess conduit capacity.
- Undertaking a longer-term process, coordinating multi-year plans with excavators.

During meetings with local government officials in the Northern California region, a common point of discussion was deciding when laying conduit was technically and financially feasible without interfering with timelines and operations on the main excavation project. Addressing this topic requires evaluating several factors and conducting a feasibility analysis covering the following points:

- Technical feasibility, maximizing available resources and reaching high-priority areas;
- Developing a technical specification for the dig-once conduit; and
- Developing an engineering cost model to estimate the incremental costs of the dig-once conduit.

6.2.2 Develop Conduit Specifications

Conduit specifications allow local governments, utility companies and ISPs to estimate costs of adding conduit in an excavation project in public rights-of-way, and carry out efficient planning and deployment of fiber optics on standard conduit deployments. These specifications can be developed and implemented in cities and would achieve higher efficiencies if adopted in a county or across an entire region. Conduit specifications include requirements and recommendations such as size, type and material of the conduit, conduit installation and placement in the trench parameters, depth and distance from utility infrastructure, vault installation parameters, and minimum distance between vaults or manholes,

[51] Tellus Venture Associates, Blum, S., *City of Morgan Hill 2035 General Plan – Telecommunications Infrastructure Final Report*. 12 September 2016. http://www.tellusventure.com/downloads/morgan_hill/morgan_hill_telecommunications_infrastructure_final_report_12sep2016.pdf

[52] California Broadband Council. (2014, January 15). *California Broadband Council-Overcome local barriers to deployment and adoption.* Retrieved from County of Santa Cruz-Recommended Actions to Expand Broadband: http://broadbandcouncil.ca.gov/uploadedFiles/Content/News/Santa%20Cruz%20County%20Broadband%20Update.1-28-2014.pdf

[53] Columbia Telecommunications Corporation. (2017, April). *ctc technology & energy.* Retrieved from Technical Guide to Dig-Once Policies: http://www.ctcnet.us/wp-content/uploads/2017/04/CTC-White-Paper-Dig-Once-20170414.pdf

among others. These specifications must be reviewed by public works departments to assess feasibility and practicality of such installations in specific geographic areas.

6.2.3 Master Lease Agreement

The purpose of this lease agreement is to reduce processing time and the complexity of leasing a local government's broadband-related assets. A lease agreement allows for the installation, operation and maintenance of ISPs' telecommunications equipment on city-owned assets. To maximize effectiveness of a master lease agreement, the local government needs an up-to-date inventory of assets, which might include land, public rights-of-way, conduit, buildings, utility poles, light standards, towers, and any other property on which wireless or wireline broadband infrastructure could be located. For example, base stations can be installed atop municipal buildings or towers, and/or fiber-optic cable can be rolled out in underground conduit or utility poles. This inventory should be publicly available for ISPs to review so they can assess the assets they may want to lease, based on their broadband deployment planning. The agreement should include fee structures, agreement duration, renewal terms, access and responsibilities of the parties, and co-location rights, among other legal requirements.

6.2.4 Streamline Application Process and Permit Fees

Streamlining processes to deploy broadband infrastructure allows faster expansion of broadband infrastructure and services. Additionally, charging at-cost permit fees might contribute to a competitive broadband service pricing in the region. In the context of rural Northern California, with its lower population densities, geographically spread out households and, in some cases, harsh geography, broadband deployment and operation are more expensive than in urban areas. This results in higher broadband prices and lower speed offers. Some ISPs in the Northern California region identified county and/or city asset leases and permit fees as significant operating expense drivers. Some options to address these issues include charging discretionary planning permits at cost and removing requirements for broadband infrastructure within the public right-of-way to obtain a discretionary land use permit. Other identified issues to address include land use regulations and land use permits for certain broadband facilities (i.e. cabinets, racks, wireless facilities) within public right-of-way.

6.3 Sample Telecommunications Element for County or City General Plans

This sample Telecommunications Element for a General Plan presents goals, policies and actions that can guide use of municipal resources and develop internal municipal processes to promote expansion of broadband infrastructure and services in the local jurisdiction.

GOALS, POLICIES, AND ACTIONS

Goal T-1: **Promote broadband-based services to increase county operational efficiency**
Goal T-2: **Promote efficient expansion of broadband infrastructure to provide high-speed broadband Internet service**

- **Goal T-1: Promote Broadband-Based Services to Increase County Operational Efficiency**
  - **Policy T-1.1 (Promote Deployment of Broadband Services in Public Facilities) –** Promote deployment of broadband services to provide broadband-based municipal services.
    - **Action T-1.1.1 –** Promote inclusion of broadband facilities in all public buildings, major transportation projects and all public works projects.
  - **Policy T-1.2 (Develop Standards) –** Develop standards for preparing future construction and development of broadband facilities and services.
    - **Action T-1.2.1 –** Develop broadband building and wiring standards to support broadband in new construction and buildings.
    - **Action T-1.2.2 –** Develop broadband requirements for new public, commercial, residential and industrial projects.
  - **Policy T-1.3 (Online Municipal Services) –** Promote and make all municipal services available online.
    - **Action T-1.3.1 –** Enable all municipal services in the county's portal.
- **Goal T-2: Promote Efficient Expansion of Broadband Infrastructure to Provide High-Speed Broadband Internet Service**
  - **Policy T-2.1 (Develop a Strategic Broadband Plan) –** Develop a strategic plan for supporting expansion of high-speed broadband infrastructure and services for residential, business and industrial customers and anchor institutions.
    - **Action T-2.1.1 –** Work with public entities, non-government organizations, and business associations, among other interested parties, to asses priority areas for broadband expansion and/or upgrades and broadband related needs of residential, business and industrial customers and community anchor institutions (education, public services, public safety, and health care).
    - **Action T-2.1.2 –** Based on the priority areas and broadband needs assessments, develop a master plan to address them including objectives, strategies, partners, resources, and timelines, among other important planning elements.
  - **Policy T-2.2 (Dig-Once Policy) –** Promote collaboration among public works departments, utility companies and Internet service providers to find project planning synergies to optimize resources for installation of conduit and/or fiber optics as part of county projects.
    - **Action T-2.2.1 –** Develop and implement a local dig-once ordinance by assessing the potential role of local governments and different dig-once policy approaches (i.e., open trench, shadow conduit, excess capacity utilization, etc.).
    - **Action T-2.2.2 –** Develop standards for deploying conduit and lateral connections. This will allow cost estimation of adding conduit in an excavation project in public

rights-of-way, and efficient planning and deployment of fiber on standard conduit deployments.

- **Policy T-2.3 (Access to Public Assets and Develop a Master Lease) –** Assess feasibility of allowing ISPs to lease public assets (public rights-of-way, land, buildings, ducts, conduit, poles, towers, etc.) for deployment, upgrade and/or expansion of broadband networks.
  - **Action T-2.3.1 –** Develop an up-to-date inventory of broadband related county-owned assets and community anchor institutions which might include land, public rights-of-way, conduit, buildings, utility poles, light standards, towers, and any other property.
  - **Action T-2.3.2 –** Make the asset inventory available in geographic information system (GIS) format and make it publicly available through an online map viewer and data tables.
  - **Action T-2.3.3 –** Develop and implement a master lease aimed to reduce processing time and complexity for leasing county or city broadband-related assets. The agreement must include standard terms such as fee structures, agreement duration, renewal terms, access and responsibilities of the parties, and co-location rights, among other legal requirements.
  - **Action T-2.3.4 –** Develop specific procedures to grant access and/or leasing assets in a fair and transparent manner to all interested ISPs.
- **Policy T-2.4 (Streamline Permit and Authorization Processes) –** Ensure transparent and fair permit and authorization processes for all ISPs. Streamline process to deploy broadband infrastructure to allow faster and timely expansion of broadband infrastructure and services in the county.
  - **Action T-2.4.1 –** Review and assess current municipal permit and authorization application processes for deployment of broadband infrastructure, including requirements, steps, timelines, and costs associated with the applications.
  - **Action T-2.4.2 –** Update permit and authorization processes when, based on the assessment, efficiencies and faster processes can be achieved.
  - **Action T-2.4.3 –** Require digital plan files in GIS format for all upcoming works in PROWs and new developments (i.e., utilities, developers, contractors and others).
- **Policy T-2.5 (Assess Partnerships for Infrastructure Deployments) –** Assess the establishment of strategic partnerships with ISPs to support infrastructure and broadband services expansion.
  - **Action T-2.5.1 –** Assess the potential role of the county as partner to support broadband service expansion.
  - **Action T-2.5.2 –** Explore partnerships with state agencies (i.e., Caltrans) to achieve interagency coordination.
- **Policy T-2.6 (Develop a Database of Upcoming Public Infrastructure Projects) –** Generate a database of upcoming public infrastructure projects (i.e., water, sewer, roads, paving, etc.) in public rights-of-way, including location, routes and estimated timelines.

- **Action T-2.6.1 –** Identify and track upcoming public infrastructure projects and generate a database.
- **Action T-2.6.2 –** Make the upcoming public infrastructure project database available in geographic information system (GIS) format through an online map viewer.

- **Policy T-2.7 (Promote Validation of Broadband Service Availability and Speed) –** Promote crowd validation of broadband service availability and speed for anchor institution, residential, business and industrial broadband services.
  - **Action T-2.7.1 –** Promote downloading and using the CalSPEED (or similar professional tools) for validating broadband service coverage and speed of broadband services.

7 Recommendations to Improve Broadband Service Adoption

While broadband access is critical, adoption of broadband services is equally as important. Many community residents in Lake County, its cities and rural communities need assistance finding low-cost Internet service, obtaining a computer and learning pertinent skills to navigate the online world successfully. Efforts to meet these needs will help the region to combat the inequitable distribution of broadband to rural areas, referred to as the "digital divide." The digital divide is often more broadly defined as the discrepancy between the availability of technology among socioeconomic or racial/ethnic groups. The divide limits rural residents' access to education, workforce training, health care and civic engagement.

Providing equipment and training opportunities will allow users to effectively understand and learn how broadband can improve their ability to conduct business, excel in school, manage their finances, participate in telehealth, apply for jobs, receive vocational training and function effectively in a digital world. These skills are critical to educational and career success and are accessible to more advantaged families but can be out of reach for disadvantaged communities due to socioeconomic challenges (e.g., educational background, time impacts of multiple jobs and long commutes).

Communities and organizations seeking to connect users with equipment and access to curriculums should establish partnerships with existing organizations and programs to establish credibility and identify best practices for outreach, implementation, follow-through and success.

Broadband also transforms the way small businesses operate, communicate with employees, and interact with customers. Broadband is an important tool for achieving strategic goals, improving competitiveness and efficiency, reaching customers, and interacting with vendors. Businesses use broadband connections to improve efficiency and productivity, both in their internal processes and their interactions with customers. The capability of and opportunities provide by broadband can translate into profits and producer surplus to businesses with a portion of the gains being passed to consumers.

Many businesses throughout the region do not have access to the speeds necessary to conduct day-to-day business. Because of this limited capacity, many smaller businesses are unaware of the growth potential that is attainable if they had better broadband. Economic development organizations, workforce agencies and chambers of commerce are examples of groups that can provide training and information to business owners to increase adoption and plan for growth and sustainability.

8 Conclusion

This Master Broadband Plan for Lake County aimed to provide the following:

- A comprehensive assessment of the current landscape of fixed broadband services for residential and business customers
- Recommendations for upgrading, expanding and launching broadband infrastructure and services
- Recommendations for developing and implementing local government policies that support broadband infrastructure deployments
- Recommendations for improving broadband adoption through establishing partnerships with existing organizations and programs.

The recommendations for improving broadband service coverage and infrastructure expansion for residential and business customers include assessing existing Federal or State grants (funding) to carry out broadband deployments, including the California Advanced Services Fund (CASF) and the USDA Reconnect Program. These existing subsidies will greatly help to accelerate broadband infrastructure expansion, in addition to ISP's private investment. In some cases, public-private partnerships can also be a model to explore for local governments. The next step is to work with local partners and broadband stakeholders to gather input on broadband needs and priority geographical areas for broadband expansion and upgrades. These needs be quantified and mapped in order to carry out a comprehensive analysis ranking potential projects; which later need to be summarized in project profiles to be shared with ISPs interested in carrying out these projects.

The recommendations for improving broadband infrastructure focused on upgrading DSL infrastructure, expanding cable model service, and launching FTTH/B service. This section presented estimated deployment costs using deployment cost data from past projects funded by the CPUC California Advanced Services Fund (CASF). Depending on actual conditions and specific geographic areas, actual deployment costs may differ for these cost estimations per household. These cost estimations are provided as a first step toward assessing potential alternatives for expanding broadband service to unserved areas and other geographic areas of interest in Lake County.

Common technologies used to provide broadband to business-class customers include cable, fiber optics and high-throughput fixed wireless. Middle-mile carriers must be able to provide fiber-optic service. Fixed wireless providers must be able to provide high-throughput point-to-point radio links. The best technology fit for business and industrial customers will depend on specific broadband needs and requirements and associated costs of such services.

The Upstate California Connect Consortium is actively working with Internet Service Providers (ISPs), local governments in the County of Lake, its cities and rural communities to evaluate a broad range of alternatives to expand broadband infrastructure and services in the county for residential, local government, business and industrial customers. These alternatives include, but are not limited to, the California Advanced Service Fund (CASF), U.S. Department of Agriculture (USDA), Economic Development Administration (EDA), Corporation for Education Network Initiatives in California (CENIC), and California Telehealth Network (CTN), among others.

The recommendations for developing and implementing local policies focused on reducing barriers for new broadband infrastructure deployments and streamline permit and authorization process in public right of ways. The main policies include the following: a dig-once policy, technical conduit specifications, and master lease agreements. Additionally, it is recommended that cities and the county

streamline application processes and permit fees. Finally, a sample of a Local Government General Plan-Telecommunications Element is also presented as a reference.

The recommendations for improving broadband adoption included establishing partnerships with existing organizations and programs to establish credibility and identify best practices for outreach, implementation, follow-through and success. Additionally, economic development organizations, workforce agencies and chambers of commerce were examples of groups that can provide training and information to business owners to increase adoption and to plan for growth and sustainability.

Finally, this plan also recommended launching a CalSPEED and CPUC Public Feedback Form campaign for residential and business customers to download and use this application and form to validate actual broadband service coverage and speeds provided by ISPs. The Upstate California Connect Consortium is currently working with Lake County and its communities on deploying CalSPEED to businesses and residences.

9 Appendices

9.1 Appendix A - Broadband Service Benchmarks

9.1.1 Downstream/Upstream Broadband Speeds (Mbps)

The FCC defines broadband (advanced telecommunications capability) primarily in terms of downstream and upstream speeds of 25 Mbps and 3 Mbps[54], respectively. The CPUC also uses speed as a metric to evaluate broadband service coverage, defining underserved areas as areas where broadband is offered at slower speeds than 6 Mbps downstream and 1 Mbps upstream[55].

9.1.2 Supplemental Benchmark Metrics

The FCC currently does not adopt non-speed performance metrics in their broadband progress reports (although it recognizes the importance of low latency and high consistency in providing advanced telecomm capability) due to a current lack of comprehensive data on factors other than speed. The following are supplemental broadband benchmarks described in the FCC's 2016 Broadband Progress Report, which in the future will help evaluating quality-of-service in a more comprehensive manner.

Latency (ms)

Latency is defined as a measurement of the time it takes a data packet to travel through the network. It significantly impacts the performance of interactive, real-time applications, including VoIP, online gaming, videoconferencing, and VPN platforms.

Consistency

Consistency has the potential to significantly impact whether a service delivers broadband to consumers with meaningful access to interactive advanced services including VoIP, telemedicine, and online education applications using high-quality voice, data, graphics, and video telecommunications.

Packet Loss

The Measuring Broadband America program denotes a packet as lost if the latency exceeds 3 seconds or if the packet is never received. Packet losses might affect the perceived quality of phone calls or video conferencing.

9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies

This subsection describes current and new broadband technologies used by ISPs for middle-, second- and last-mile broadband networks. For this report, the definitions of middle-, second- and last-mile network segments follow the basic network structure from the FCC's Broadband Availability Gap Paper[56] (Figure 20). Based on an initial assessment of last-mile broadband networks and providers in the

[54] Federal Communications Commission (FCC). (2016, January). *2016 Broadband Progress Report.* Retrieved June 2017, from https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf

[55] California Public Utility Commission (CPUC). (2012, May). *Forth Annual DIVCA Report.* Retrieved June 2017, from http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Communications__Telecommunications_and_Broadband/Service_Provider_Information/Video_Franchising/4thDIVCAReportforYearEndingDec2010.pdf

[56] Federal Communications Commission (FCC). (2010, April). *The Broadband Availability Gap - OBI Technical Paper NO.1.* Retrieved from https://transition.fcc.gov/national-broadband-plan/broadband-availability-gap-paper.pdf

County of Lake and regional Internet fiber-optic carriers, it is assumed that most broadband networks in the county consist only of middle- and last-mile network segments; therefore this study does not include the second-mile network segment. The second-mile segment is mostly used in the case of fixed wireless broadband services, which aggregate traffic from several sparsely located towers deployed in cascade configuration.

The middle-mile segment provides transport and transmission of data communications from an aggregation point (i.e., central office, cable headend or wireless switching station) to an Internet point of presence. The last-mile segment provides transport and transmission of data communications from a broadband modem provided by a local ISP to the first aggregation point in the network (i.e., remote terminal, wireless tower, or HFC node).

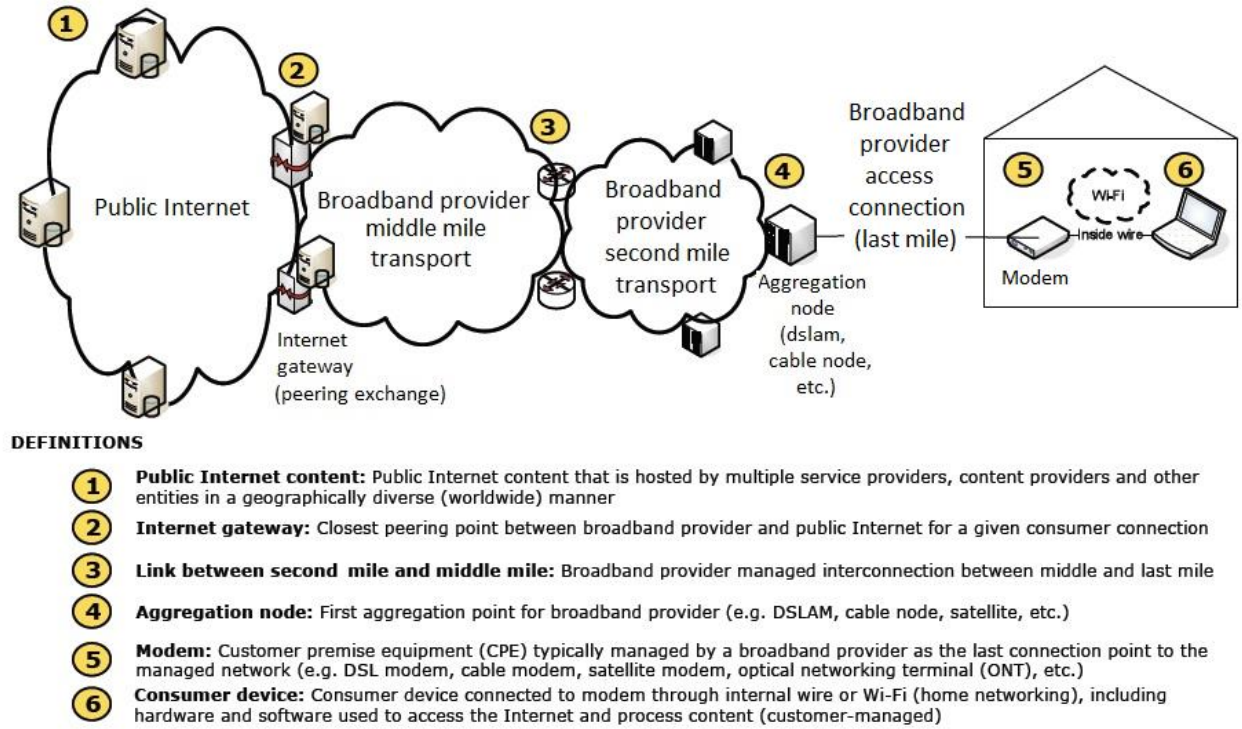

Figure 20. Basic network structure from the FCC's Broadband Availability Gap Paper

Commonly deployed middle-mile transport technologies include fiber optics, microwaves and satellite links. In 2010, the majority of central offices (approximately 95 percent) and nearly all cable nodes connected to the Internet through fiber-optic links. Once the transport requirement reaches 155 Mbps and above, the only effective transport mode is using a fiber-optic-based transmission backbone. Microwave and other terrestrial wireless technologies are well suited only when aggregated data is of a few hundred Mbps and relatively short middle-mile runs of 5 to 25 miles. However, microwave backhaul may be a critical transport component in the second-mile segment in the case of fixed wireless networks.

The following subsections describe most current technologies used for last-mile networks including wireline, wireless and mobile technologies. It also describes new and innovative technologies, including some that are still in the testing stage and are not commercially available yet.

9.2.1 Wireline Broadband

Wireline broadband includes digital subscriber line (DSL), cable modem and fiber-to-the-home. These technologies are primarily deployed in dense urban areas. Deployment and coverage limitations of these technologies include access to right-of-way and the high costs of rolling underground lines.

Digital Subscriber Line (DSL)

DSL is defined as broadband service provided over traditional copper telephone lines (without disrupting regular telephone calls) already installed in homes and businesses. According to the FCC's 2016 Broadband Progress Report[57], this technology is the second most common service type comprising roughly 29 percent of the fixed broadband market. DSL offers the following speeds[58]:

a) **DSL with loops of over 12,000 feet:** Uses ADSL2/ADSL2+ to provide rates of 6 Mbps downstream and 1 Mbps upstream. To provide faster speeds, DSL operators can bond loops (over 30 Mbps if sufficient number of copper loops are available) and continue to shorten loop lengths (see loops of 5,000 feet or 3,000 feet).
b) **DSL with loops of over 5,000 or 3,000 feet:** Typically uses VDSL2 to provide 35 Mbps downstream and 6 Mbps upstream over loops of 3,000 feet, and 20 Mbps downstream and 4 Mbps upstream over loops of 5,000 feet.

Limitations of this technology include speed sensitivity related to distance from central offices, lack of expansion of traditional telephone lines resulting in a lacking DSL footprint growth, and not providing higher data rates for growing speed demands of 50 Mbps, 100 Mbps and higher.

Cable Modem

Uses coaxial cables already installed by cable television operators to deliver video and sound. Cable modem can provide at least 1.5 Mbps and up to tens of Mbps and a few Gbps (cable networks upgraded to DOCSIS 3.1) downstream[59], and a few Mbps to 1 Gbps upstream. This technology provides the most common fixed broadband service in the United States accounting for around 59 percent of all fixed broadband customers. Benefits of this technology include large coverage areas for consistently fast speeds with low packet loss and latency. Limitations include low numbers of or single cable broadband providers in most areas.

Fiber Optics

Fiber-optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers of a few microns in size. Fiber-based service can provide downstream speeds of around 20 Mbps to a few Gbps and upstream speeds of around 5 Mbps to a few hundred Mbps. There are three basic types of FTTP deployments: point-to-point (P2P) networks, active Ethernet networks and

[57] Federal Communications Commission (FCC). (2016, January). *2016 Broadband Progress Report.* Retrieved June 2017, from https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf
[58] Federal Communications Commission (FCC). (2010, April). *The Broadband Availability Gap - OBI Technical Paper NO.1.* Retrieved from https://transition.fcc.gov/national-broadband-plan/broadband-availability-gap-paper.pdf
[59] Federal Communications Commission (FCC). (2010). *National Broadband Plan*. Retrieved from FCC-National Broadband Plan: https://www.fcc.gov/general/national-broadband-plan

passive optical networks (PON). PON makes up more than 94 percent of the residential FTTP (fiber-to-the-premises) deployments in the United States[60].

Benefits of fiber include consistently high speeds and transmitting across large distances without signal degradation. Limitations include the requirement of new infrastructure, in contrast to DSL and cable modems using already deployed telephone and cable television infrastructure.

9.2.2 Fixed Wireless Broadband

Fixed wireless broadband includes Wi-Fi, WiMAX and LTE. These technologies are primarily deployed in areas where wireline technologies do not have complete coverage, such as rural areas. Deployment and coverage limitations of these technologies include obstructions (i.e. terrain and/or vegetation) between the antenna at the customer premises and the access point or base station located on a pole or tower. These obstructions can prevent or disrupt communications in fixed wireless radio links by causing attenuation, scattering, diffraction and absorption of electromagnetic waves.

Wi-Fi

Wi-Fi (IEEE 802.11 Standard) operates in unlicensed bands (2.4 GHz and 5.8 GHz) and was originally designed for wireless local area networks (WLANs) to enable communication among devices and stations in a range from tens to a few hundred feet; however, in the last few years, equipment manufacturers developed Wi-Fi based long-range solutions able to span several miles of coverage. Wi-Fi can provide aggregated data rates of up to 600 Mbps[61] allowing it to provide downstream speeds of a few Mbps to tens of Mbps. Benefits of Wi-Fi include the low cost of access points (APs) and customer premise equipment (CPEs) due to large economies of scale achieved by this technology. Limitations include potential interference leading to signal degradation due to operating in a widely used, unlicensed spectrum.

WiMAX

WiMAX (IEEE 802.16 Standard) emerged as a high-capacity and long-range technology (up to 30 miles) for the provision of fixed and mobile broadband services to wireless metropolitan area networks (WMAN), and operates using licensed and the unlicensed bands. WiMAX was one of the technologies chosen by the ITU for providing IMT-Advanced services or 4G mobile services[62]. It achieves aggregated data rates up to 350 Mbps allowing it to provide speeds up to tens of Mbps downstream to customers. Limitations include low varieties of base stations (BSs) and CPEs due to most mobile operators and equipment manufactures shifting to LTE due to larger worldwide adoption of this technology for 4G mobile services.

LTE

Long-Term Evolution (LTE) was designed by the 3rd Generation Partnership Project (3GPP) for mobile communications in densely populated areas (see mobile broadband). LTE has also been used to

[60] Federal Communications Commission (FCC). (2010, April). *The Broadband Availability Gap - OBI Technical Paper NO.1.* Retrieved from https://transition.fcc.gov/national-broadband-plan/broadband-availability-gap-paper.pdf

[61] Institute of Electrical and Electronics Engineers (IEEE). (n.d.). IEEE Standards Association. (IEEE) Retrieved from http://standards.ieee.org/

[62] Institute of Electrical and Electronic Engineers (IEEE). (n.d.). *IEEE 802.16™: Broadband Wireless Metropolitan Area Networks (MANs)*. (IEEE Standards Association) Retrieved from http://standards.ieee.org/about/get/802/802.16.html

provide fixed broadband services in rural areas. LTE can achieve aggregated data rates up to 300 Mbps allowing it to provide speeds up to tens of Mbps downstream to customers. For benefits and limitations see LTE in the Mobile subsection.

9.2.3 Mobile Broadband

Mobile broadband includes packet-based data technologies such as 2G (GPRS, EDGE and CDMA2000), 3G (WCDMA, HSDPA, HSPA and CDMA2000 EV-DO), and 4G (LTE and WiMAX). Although evolution of these technologies has made mobile broadband services much more versatile and useful to consumers by providing mobility and portability, there are important differences between mobile and fixed broadband. Mobile transmissions, due to using wireless spectrum, operate under environmental factors that can impact consistent coverage and speeds. These technologies are primarily deployed in densely populated urban areas and, in a smaller scale, in rural areas. Coverage limitations of mobile broadband come from obstructions (i.e. terrain and/or vegetation) between base stations located on towers and mobile devices, and availability and access to the licensed spectrum.

Legacy Technologies (2G and 3G)

These mobile technologies include packet-based data services that evolved from the GSM and CDMA mobile technologies. For GSM, these technologies include: GPRS and EDGE (100–130 kbps data rates), UMTS or WDCMA (220–320 kbps), HSPA (several Mbps). For CDMA these technologies include: CDMA2000 (307 kbps), CDMA2000 EV-DO (3.1 Mbps). Limitations of these legacy technologies include low speeds in comparison to new-generation mobile broadband and wireline and fixed wireless broadband.

4G Long-Term Evolution (LTE)

Long-Term Evolution (LTE) was designed by the 3rd Generation Partnership Project (3GPP) for mobile communications in densely populated areas and can achieve aggregated data rates up to 300 Mbps allowing to provide speeds up to tens of Mbps downstream and a few Mbps upstream to customers. The 3GPP group has released several versions of the LTE standard, from the first release (Rel-8 in 2008) to LTE-Advanced (Rel-11)[63]. LTE was one of the technologies chosen by the ITU to provide IMT-Advanced services or 4G mobile services, and operates in the same bands as its predecessor GSM, in addition to other bands. The most common LTE bands range from 700 MHz to 3.8 GHz. Benefits of this technology include data rates in some cases comparable to wireline and fixed wireless broadband services and flexible network design allowing combination of macro- and microcell sites to cover demand needs of specific geographical areas. Limitations include the purchasing new devices that support LTE service and plans that might include data caps.

4G WiMAX

WiMAX was one of the technologies chosen by the ITU to provide IMT-Advanced services or 4G mobile services[64]. It achieves aggregated data rates up to 350 Mbps allowing speeds up to tens of Mbps downstream for customers. Limitations include low varieties of base stations (BSs) and CPEs due to most

[63] 3rd Generation Partnership Project (3GPP). *3GPP A Global Initiative*. (3rd Generation Partnership Project (3GPP)) Retrieved from http://www.3gpp.org/technologies/keywords-acronyms/98-lte

[64] Institute of Electrical and Electronic Engineers (IEEE). *IEEE 802.16™: Broadband Wireless Metropolitan Area Networks (MANs)*. (IEEE Standards Association) Retrieved from http://standards.ieee.org/about/get/802/802.16.html

mobile operators and equipment manufactures shifting to LTE due to larger worldwide adoption of this technology for 4G mobile services.

9.2.4 New Technologies for Middle- and Last-Mile

Millimeter-wave

Technology operating in millimeter waves is currently used for high-speed backhauling (point to point) to connect cell sites or access points in order to provide high-speed Internet[65]. There is assigned licensed and unlicensed spectrum for millimeter-wave technology. The unlicensed millimeter-wave spectrum operates in the 60 GHz band (57–66 GHz), offering 7 GHz of bandwidth, and the licensed millimeter-wave operates in the 71 to 76 GHz and 81 to 86 GHz, offering bandwidth from 10 to 80 MHz, although for shorter distances. Equipment working on these bands is affected by heavy atmospheric absorption, which limits range of operations, but also unwanted interference. Millimeter-wave can achieve up to 2.5 Gbps for a mile-long point-to-point radio link.

Unmanned Aircrafts

The initiative of using solar-powered unmanned aerial vehicles (UAVs), also known as drones, flying 12 miles above the ground to provide Internet service in unserved areas is currently led by Google and Facebook. In April 2014, Google acquired Titan Aerospace and started the Project SkyBender, which is currently testing drones using millimeter-wave technology to transmit at data rates higher than 4G LTE[66]. In March 2014, Facebook acquired Ascenta, a UK-based drone manufacturer, and is also currently testing solar-powered drones using free-space optics (high-powered laser beams) to achieve high-data-rate transmissions[67]. It is likely that both Google and Facebook will use these narrow-beam and high-frequency technologies (millimeter-wave and lasers) as high-capacity backhauls and other mobile and fixed wireless technologies (mentioned above) to connect final customers. The idea of using unmanned aerial vehicles (UAVs) or drones to deploy a backhaul network is innovative and promising, but it is still in a design and testing stage with no current commercial deployments.

Unmanned Super-Pressure Balloons

Delivering broadband services using super-pressure balloons travelling in the stratosphere is a Google X initiative known as the Project Loon. This project will allow customers in rural and remote areas to connect to the balloons' network (in the stratosphere 12 miles above the ground) and then to the Internet[68]. In the stratosphere, there are many layers of steady winds which vary in direction and speed. The balloons will travel to the needed location or route by rising or descending into a layer of wind blowing in the desired direction. To provide the broadband service, the signal from

[65] Dehos, C., Gonzalez, J., De Domenico, A., Ktenas, D., & Dussopt, L. (2014). Millimeter-Wave Access and Backhauling: The Solution to the Exponential Data Traffic Increase in 5G Mobile Communications Systems? IEEE Communications Magazine, 88--95.

[66] Heilman, D. (2016, February 1). *Google's SkyBender Drones Could Deliver 5G Internet*. (Sci-Tech Today) Retrieved June 2017, from http://www.sci-tech-today.com/story.xhtml?story_id=13100C1INE20

[67] Miners, Z. (2015, July 30). Meet Aquila, Facebook's unmanned Internet drone. (PCWorld) Retrieved June 2017, from http://www.pcworld.com/article/2955212/software-social/facebook-aims-to-launch-unmanned-drone-by-yearend.html

[68] X (Google X) - Project Loon. *Project Loon*. (X (Google X)) Retrieved from https://x.company/loon/

customer's devices connect to a balloon network in the stratosphere, and then down to the global Internet on Earth, just as satellite services work at much higher altitudes, using free space optical (lasers) for the backhaul and radio frequency equipment to access radio links. For the access radio links, the Loon project has conducted tests in rural areas in New Zealand, California and Brazil using both unlicensed ISM and licensed LTE bands. In 2014, the Loon project expressed interest in using LTE bands and working in partnership with operators and telecommunications companies due to the potential to achieve universal access targets mandated by countries in a cost-effective manner in the short-term, while fiber-optic backbone and terrestrial networks are being deployed in the long-term.

Gigabit Satellite

This type of broadband technology is currently offered by the company O3b[69] which stands for "Other 3 Billion". This company provides satellite communication backhaul service offering low latencies (less than 150 Mbps) and data rates comparable to fiber-optic technology. O3B has a constellation of 12 satellites with a ground period of 360 minutes using the Ka-band, providing a coverage of 45 degrees north/south latitudes. The satellites provide 10 beams per region (7 regions), totaling 70 remote beams for the entire constellation. The latency is less than 150 milliseconds due to the use of Medium Earth Orbit (MEO) satellites. The maximum available aggregated throughput per beam (over a single transponder) is 1.6 Gbps (800 Mbps x 2) and each beam provides coverage of 400 miles.

Television White Spaces (TV White Spaces)

White Spaces can be defined as part of the spectrum available for a radio communication application at a given time, in a given geographical area, on a non-interfering/non-protected basis with regard to primary and other services. The TV White Spaces technology (IEEE 802.11af and IEEE 802.22 Standards) operates in white spaces of the broadcast television spectrum (from 54 MHz to 862 MHz)[70]. It was designed for wireless local area networks (WLANs) with a range up to a few miles and wireless regional area networks (WRANs) with a range up to several tens of miles. TVWS can achieve aggregated data rates of a few tens of Mbps allowing it to provide downstream speeds of a few Mbps. The TVWS technology has the advantage of enhanced propagation features due to the use of frequencies bellow 1 GHz, allowing for the penetration of walls, vegetation, moderate hills and other obstacles.

9.3 Appendix C: Lakeport Broadband Availability

Wireline Service Availability

Figure 21 shows wireline served areas and downstream speeds in Lakeport as of December 2017. For more details on the technical capabilities and limitations of wired technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.*** Figure 21 shows that the highest available downstream speeds (1–2 Gbps) are mostly concentrated in the center of town (purple areas). Speeds of 10 to 25 (light-green areas) can be found in the southern portions of Lakeport as well as smaller scattered

[69] O3b Networks. O3b Networks - Our Technology. Retrieved June 2017, from https://www.o3bnetworks.com/announcement.php

[70] Pietrosemoli, E., & Zennaro, M. (2013). TV White Spaces - A pragmatic Approach. ICTP-The Abdus Salam International Centre forTheoretical Physics.

areas in the center of town. Downstream speeds lower than 10 Mbps (brown areas) are found in a small area in western edge of town. There are also small pockets in the northern edge and center of town that do not show any broadband service.

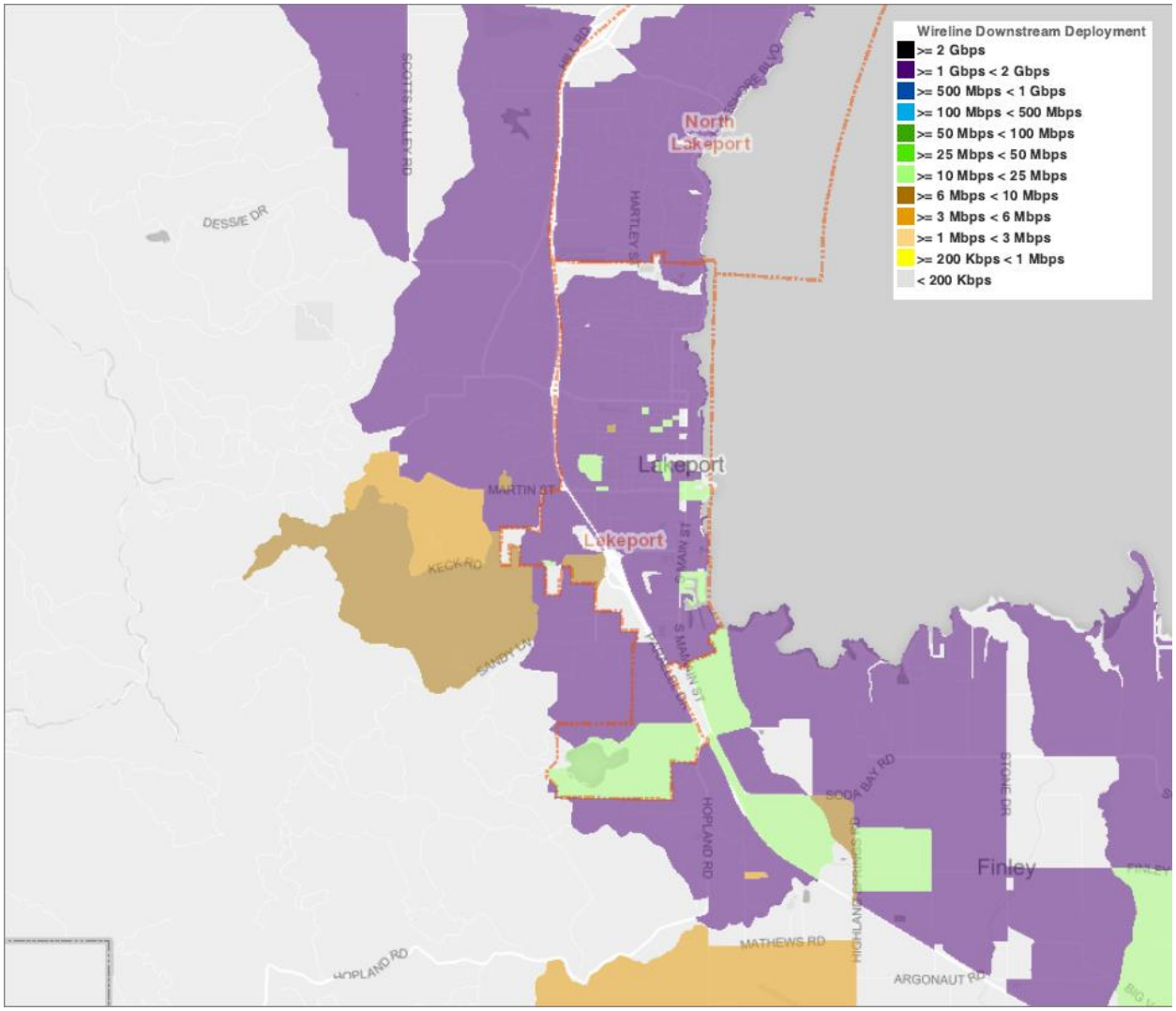

Figure 21. Wireline served status (December 2017) in Lakeport under CPUC standard

Fixed Wireless Service Availability

Figure 22 shows the fixed wireless downstream speeds of Lakeport as of December 2017. Depending on the location of towers, access points or base stations, and line-of-sight (no visible obstructions) to customer premises, fixed wireless service can cover wide areas, and in this case, most of the valley in the County of Lake. However, accurate coverage is difficult to estimate due to environmental factors such as trees, buildings and topography, each of which can affect availability of the fixed wireless service. The coverage shown represents best efforts to visualize terrestrial fixed wireless coverage. For more details on the technical capabilities and limitations of fixed wireless technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.***

Figure 22 shows that wireless downstream speeds of 25-50 Mbps (green areas) can be found in an area in the north of Lakeport, as well as in a small area in the southeast of town.

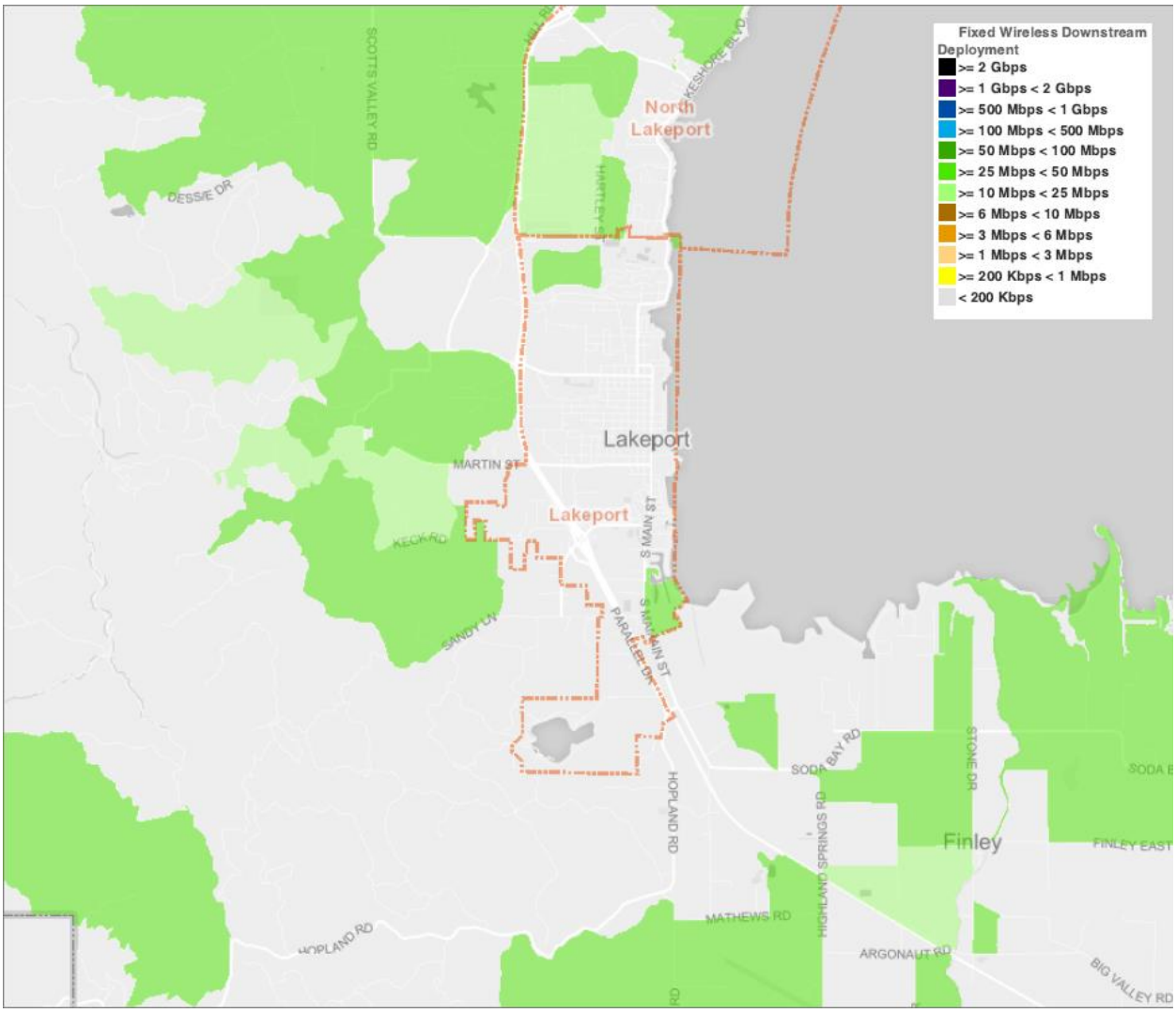

Figure 22. Fixed wireless served status in Lakeport (December 2017) under CPUC standard

AT&T California

AT&T offers residential and business services in Lakeport using a mix of asymmetric xDSL, ADSL2 and ADLS2+ technologies. Figure 23 shows broadband speeds offered by AT&T (as of December 2017) with ADSL2 and ADSL2+ technologies. AT&T offers speeds of 10 to 25 Mbps (light-green areas) throughout most of Lakeport; however, there are large areas in the north, west, and smaller areas scattered throughout the center of Lakeport with downstream speeds below 10 Mbps (dark-brown, brown, and light-brown areas).

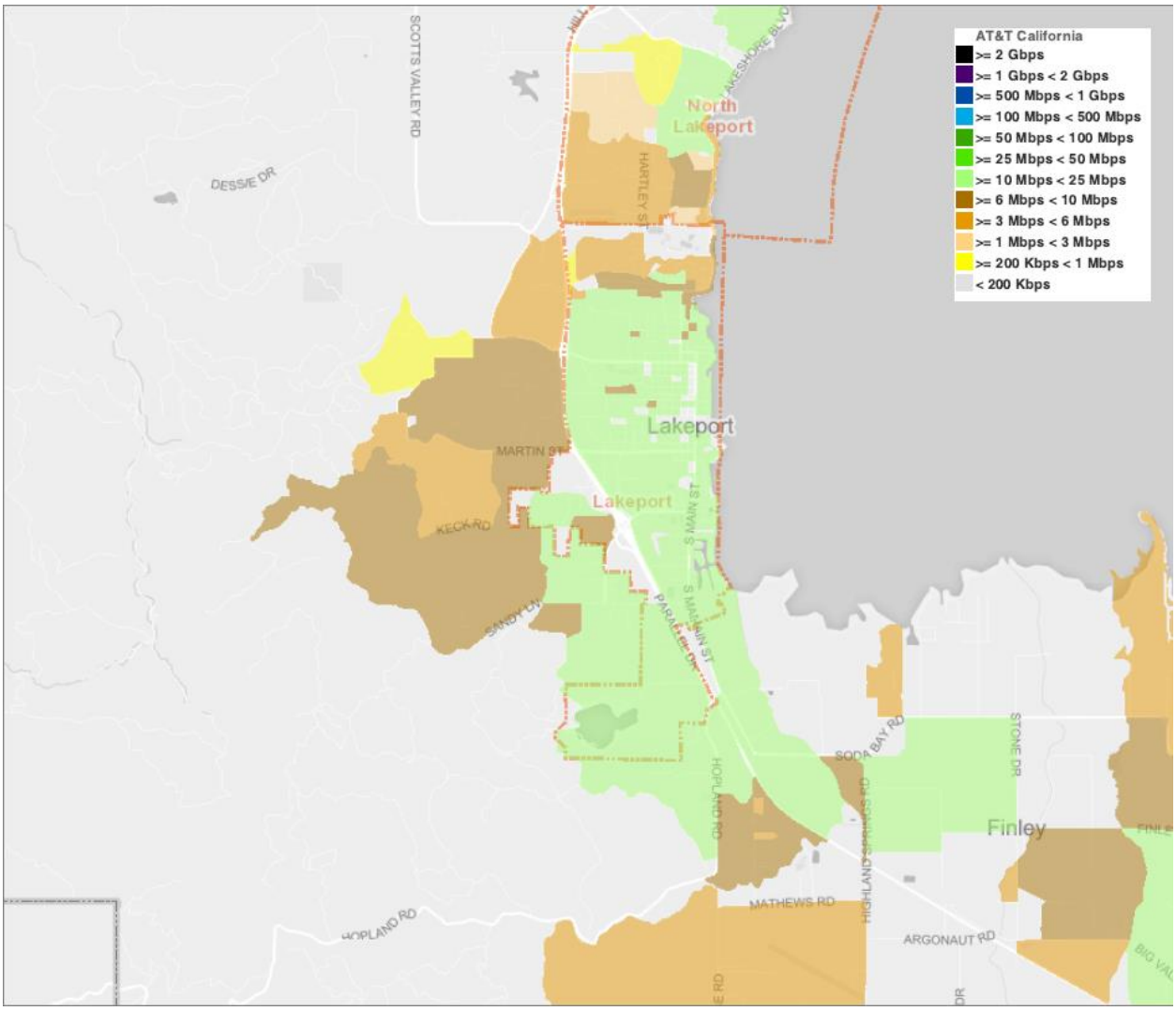

Figure 23. Broadband service speed offered by AT&T California in Lakeport (December 2017)

Mediacom California

Mediacom offers cable Internet service to residential and business customers. Figure 24 shows speeds offered by Mediacom in Lakeport (December 2017). Mediacom advertised 1 to less than 2 Gbps download speeds (purple areas) throughout much of Lakeport; however, there are scattered areas in the central and northern portions of town without service, as well as larger areas near the southern edge of town without service.

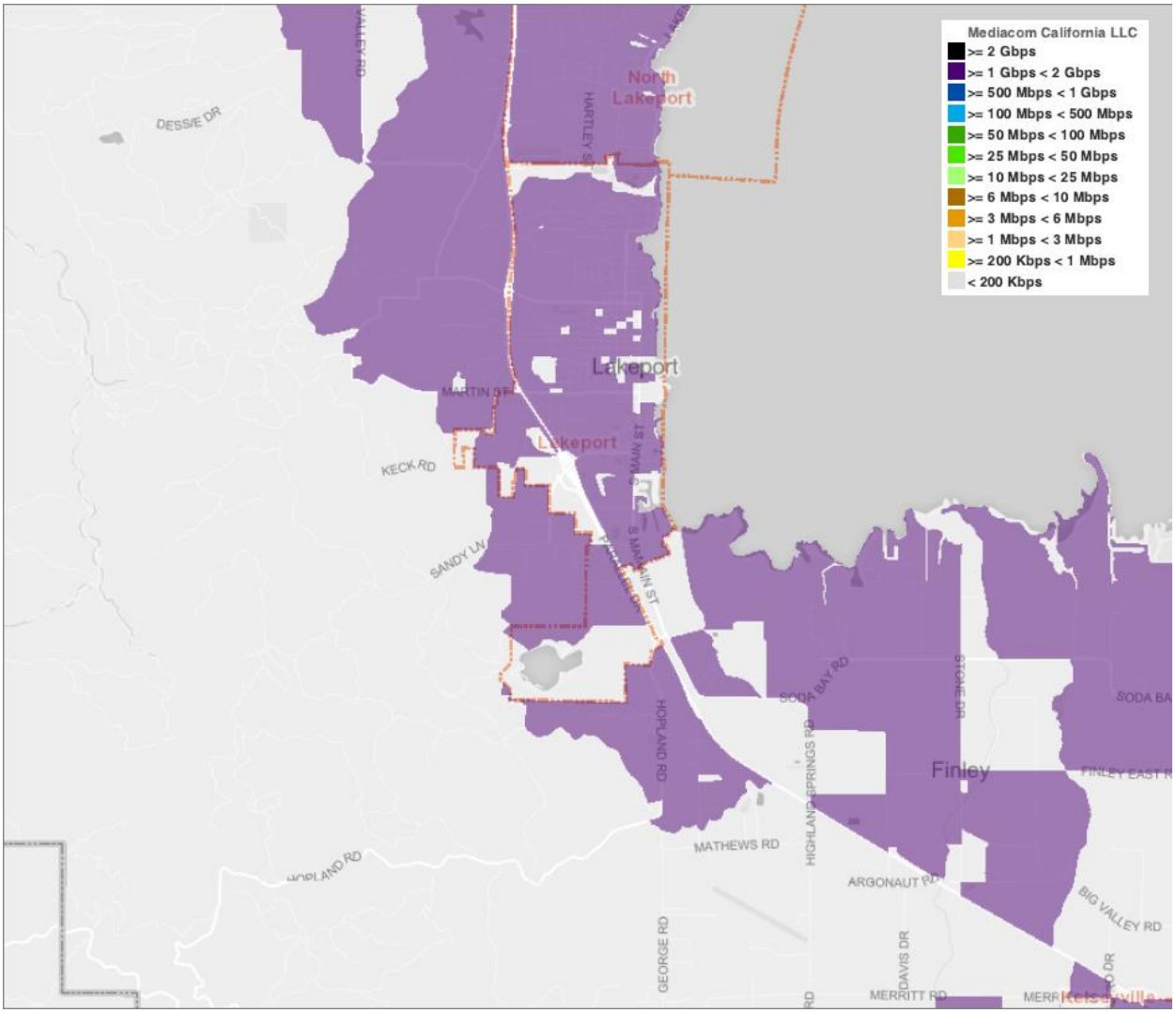

Figure 24. Broadband service speed offered by Mediacom in Lakeport (December 2017)

Valley Internet

Valley Internet offers Internet service to residential and business customers. Figure 25 shows speeds offered by Valley Internet in Lakeport (December 2017). Valley Internet advertised 25 to less than 50 Mbps download speeds (green areas) in the southeast corner of Lakeport, as well as a few very small areas near the northern edge of town.

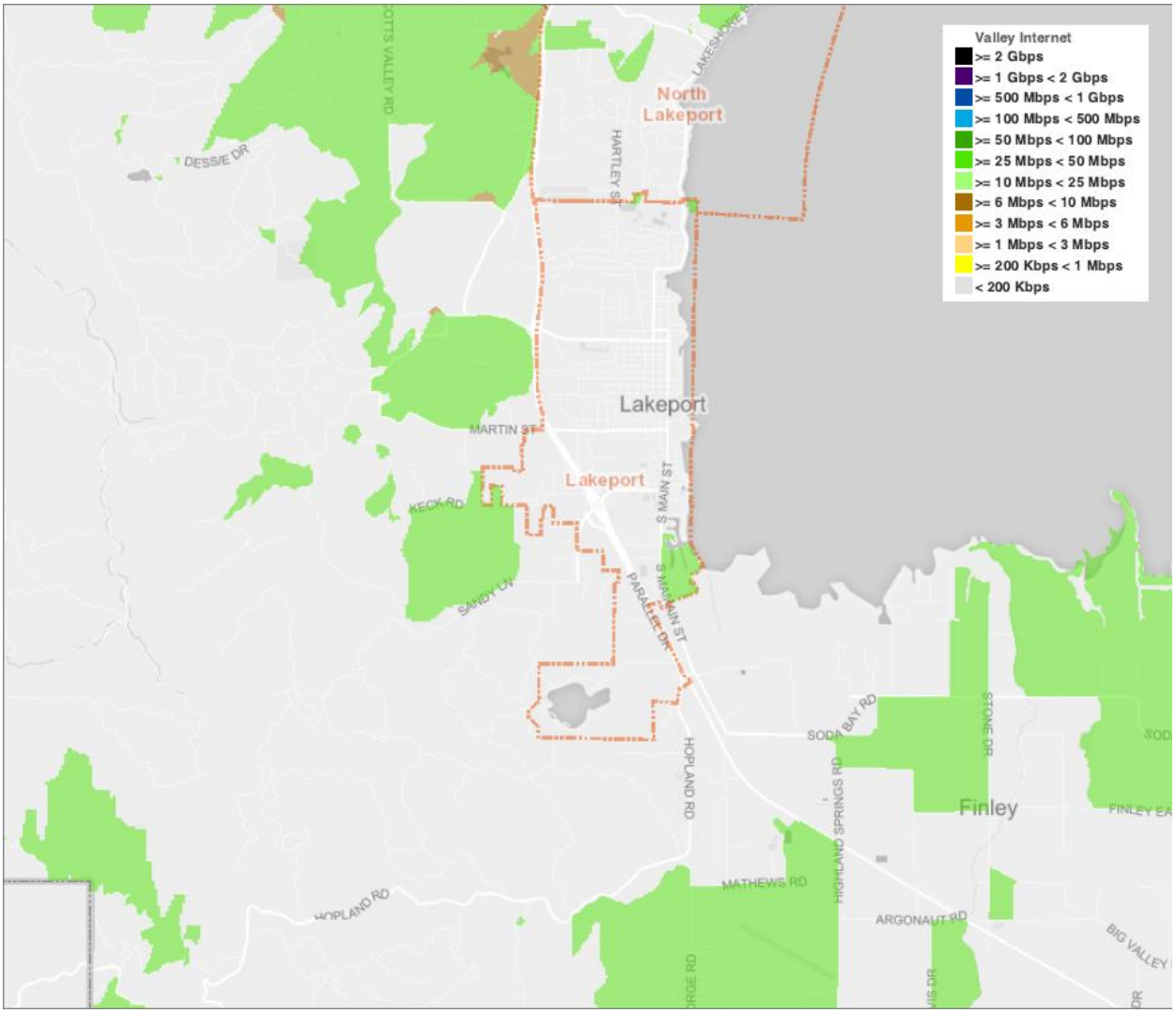

Figure 25. Broadband service speed offered by Valley Internet in Lakeport (December 2017)

DigitalPath

DigitalPath offers broadband service to residential and business customers through a terrestrial fixed wireless network. Figure 26 shows speeds offered by DigitalPath in Lake County (December 2017). DigitalPath does not currently provide service within the Lakeport city limits.

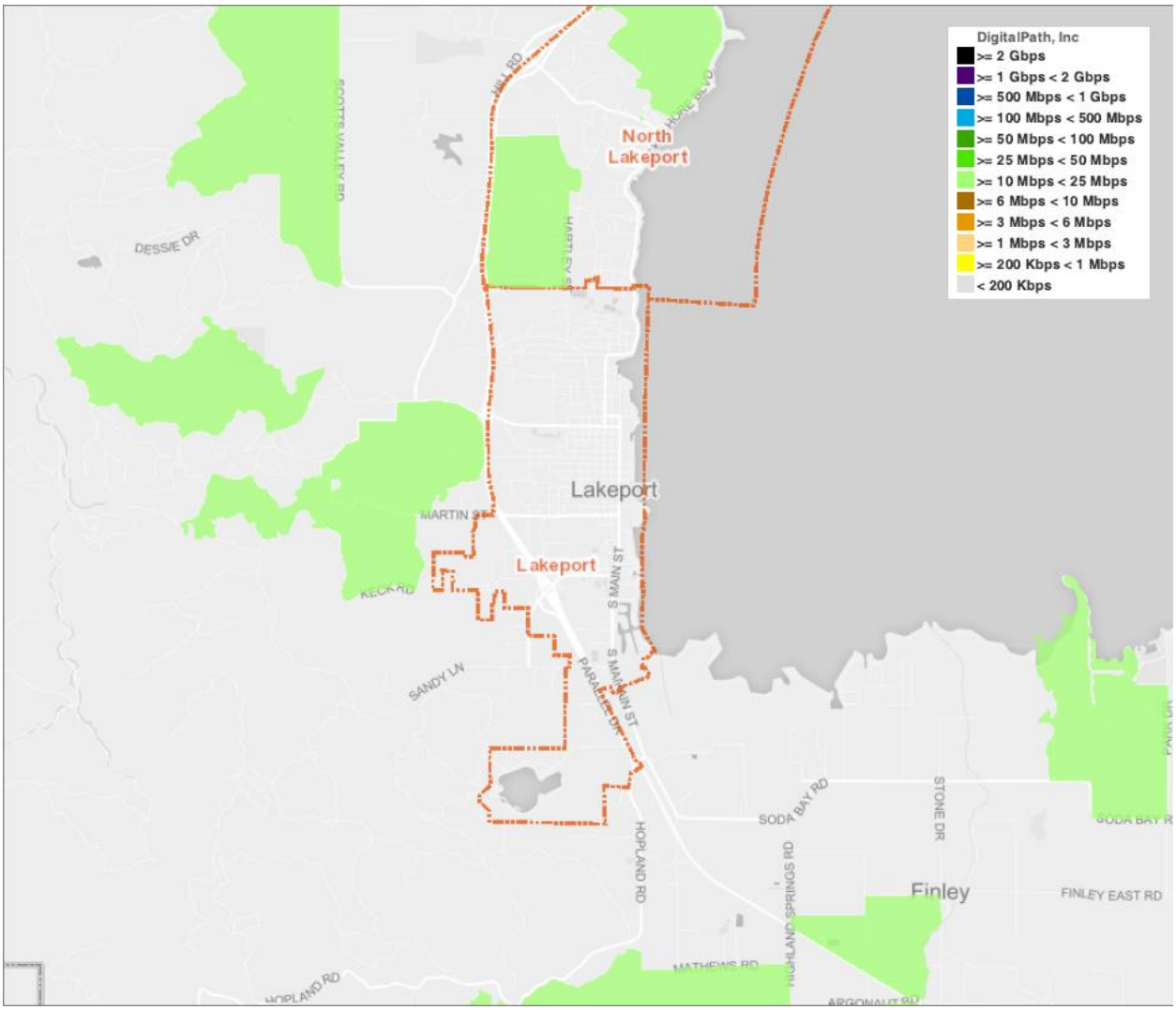

Figure 26. Broadband service speed offered by DigitalPath in Lakeport (December 2017).

North Coast Internet

North Coast Internet offers broadband service to business and residential customers in Lakeport through a terrestrial fixed wireless network. Figure 27 shows broadband service speeds provided by North Coast Internet of 25 to less than 50 Mbps (green areas) in an area in the northern portion of the Lakeport.

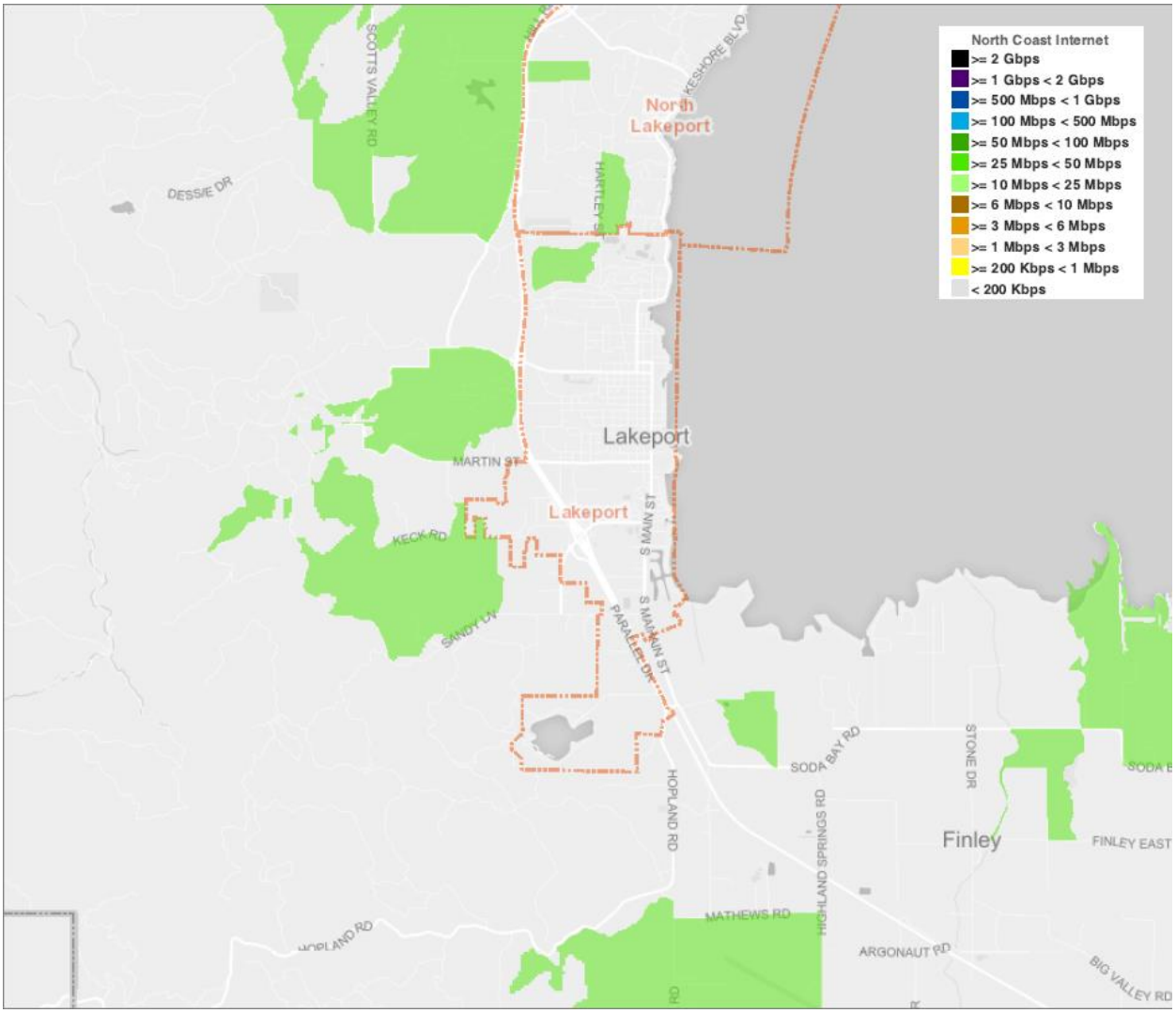

Figure 27. North Coast Internet broadband service coverage in Lakeport (December 2017).

Level 3 Communications

Level 3 offers copper wireline service to business customers in Lakeport, shown in Figure 28. Level 3 reports copper wireline connections of more than 25 to less than 50 Mbps (green areas) in the southeast corner of Lakeport.

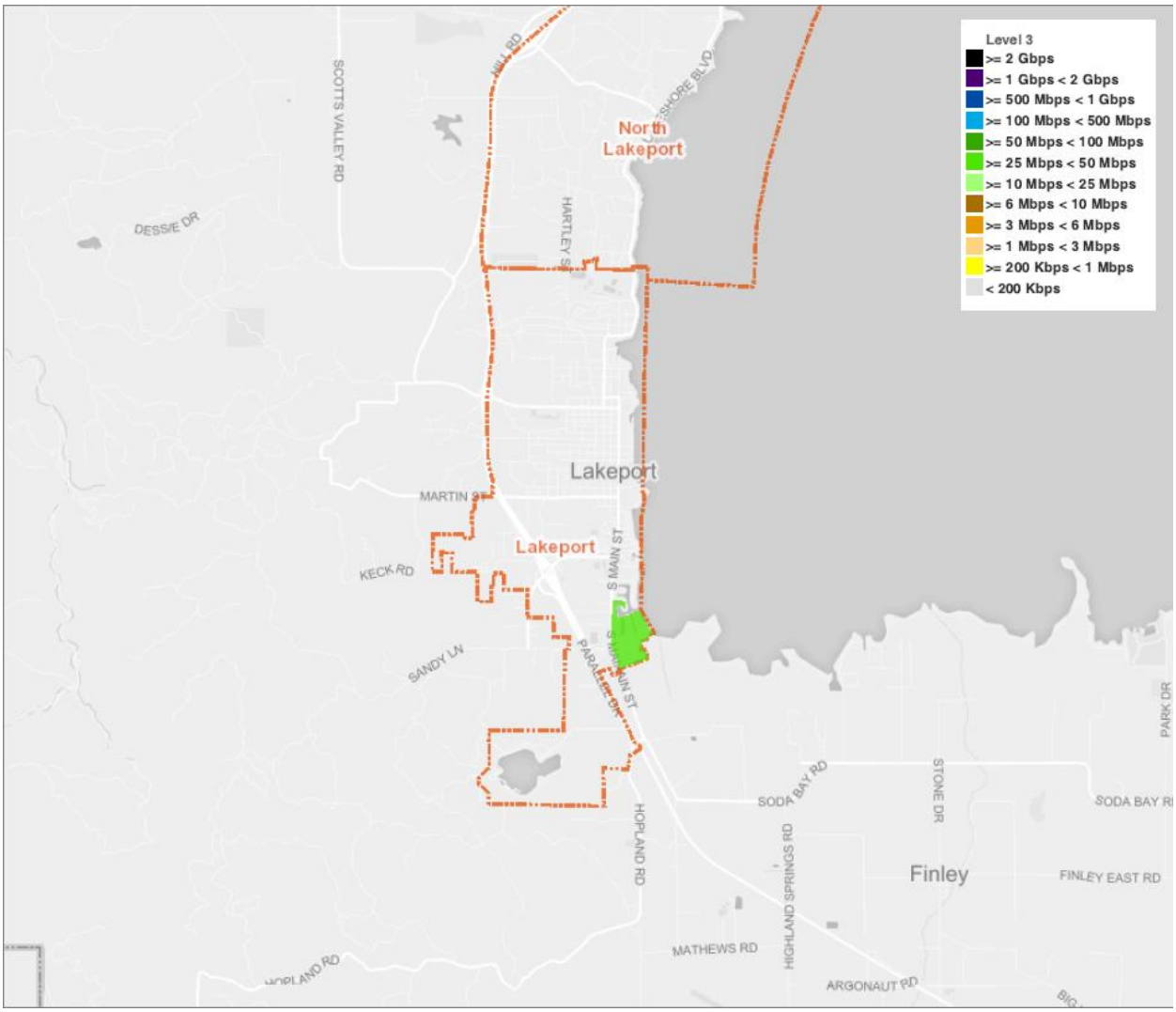

Figure 28. Level 3's business-class broadband service coverage in Lakeport (December 2017)

Earthlink Business

Earthlink is a business-class only broadband service provider and uses asymmetric xDSL, copper wireline and cable modem technologies. This provider offers speeds of 1 to less than 3 Mbps (light-brown areas) in portions of central and east Lakeport, shown in Figure 29.

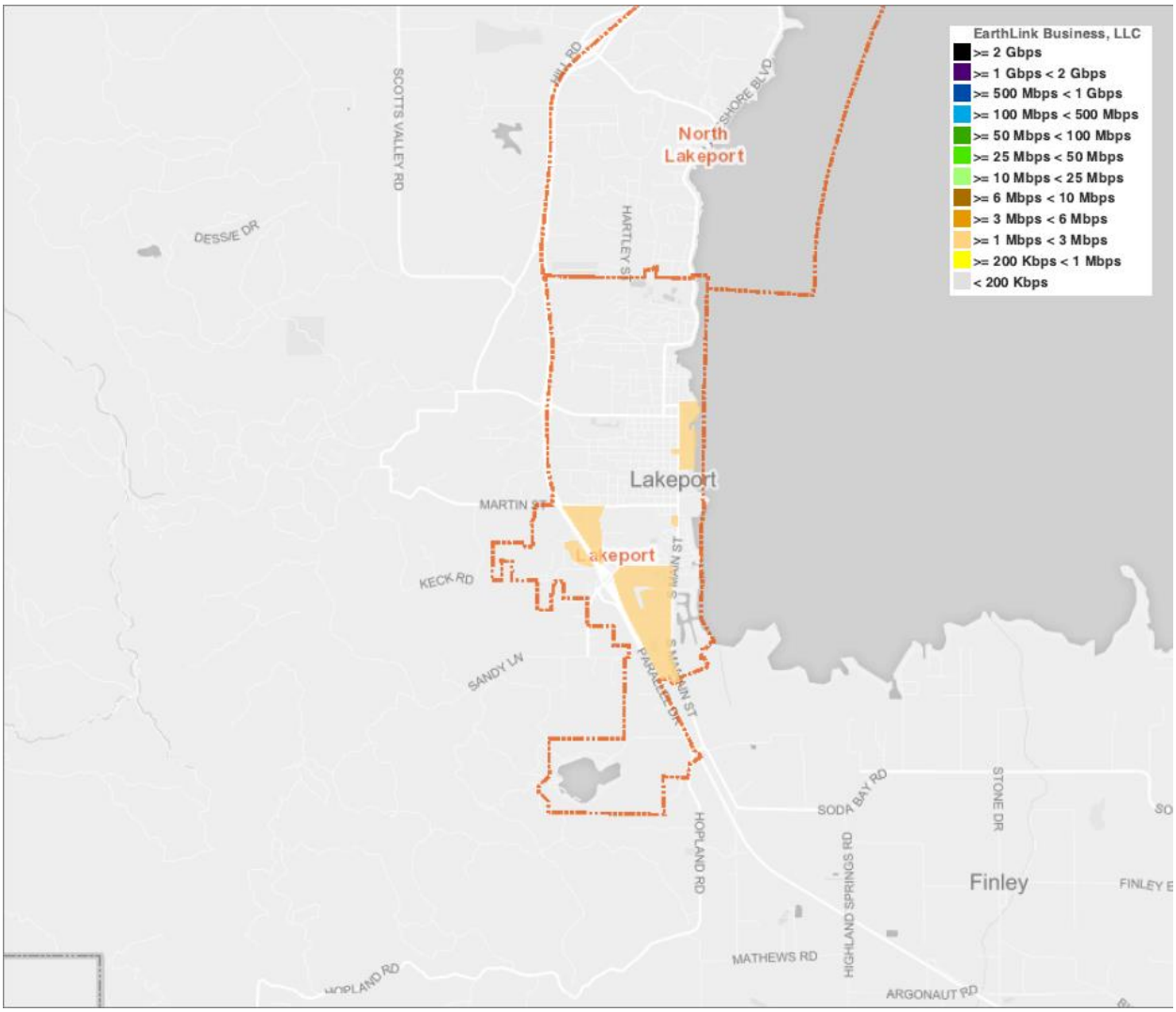

Figure 29. Broadband service speed offered by Earthlink in Lakeport (December 2017).

U.S. TelePacific

U.S. TelePacific is a business broadband service provider, which offers fiber-to-the-end-user and copper wireline connectivity. This provider serves businesses in three areas within Lakeport with speeds of 100 to less than 500 Mbps (blue areas) and 50 to less than 100 Mbps (dark-green areas). Figure 30 shows business-class broadband service provided by U.S. TelePacific.

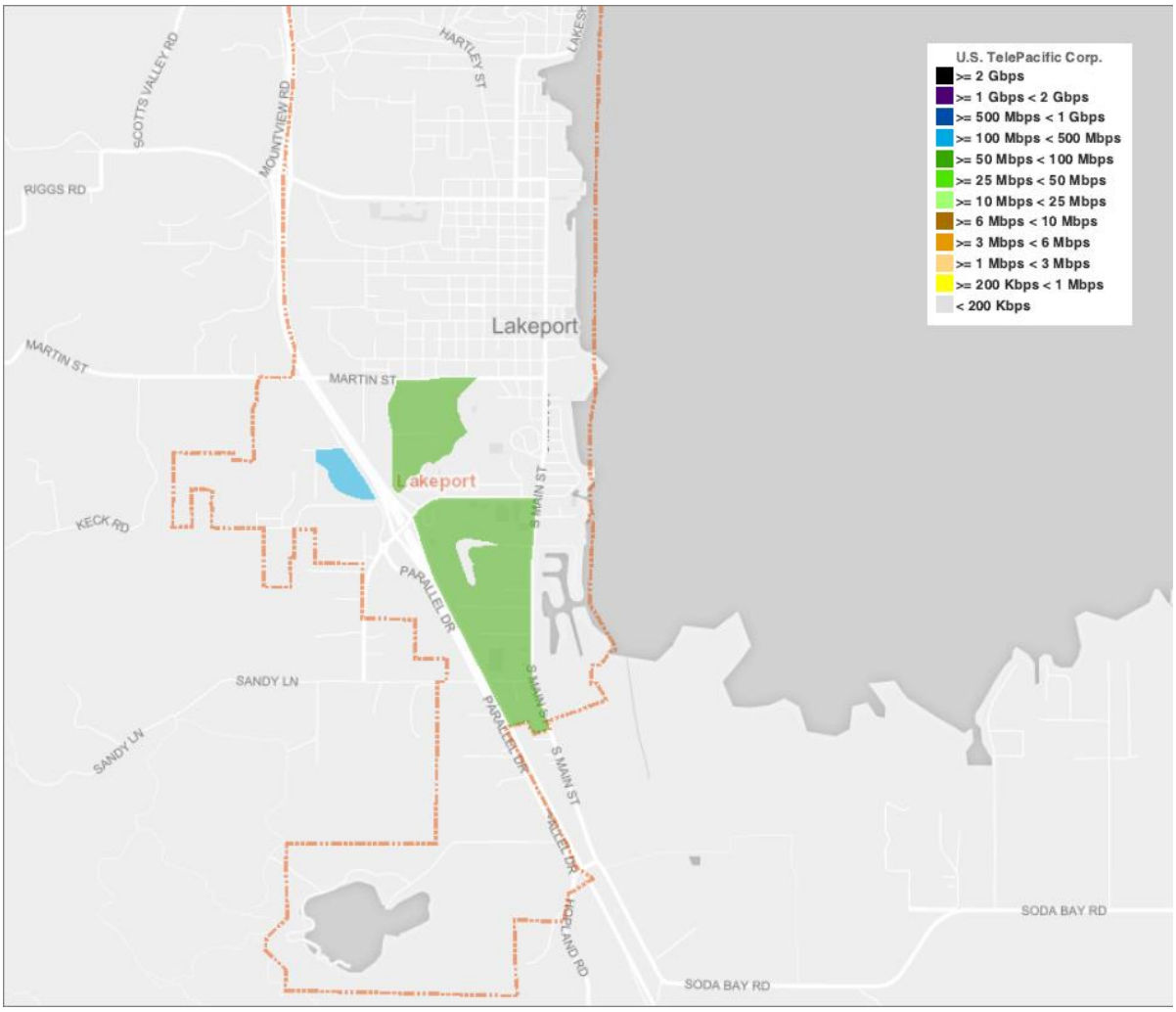

Figure 30. Broadband service speed offered by U.S. TelePacific in Lake County (December 2017).

MCI

MCI is a business-class broadband service provider. Based on CPUC data, MCI uses copper wireline technology. This provider offers speeds of 1 to less than 3 Mbps service (light-brown area) in an area of central Lakeport, shown in Figure 31.

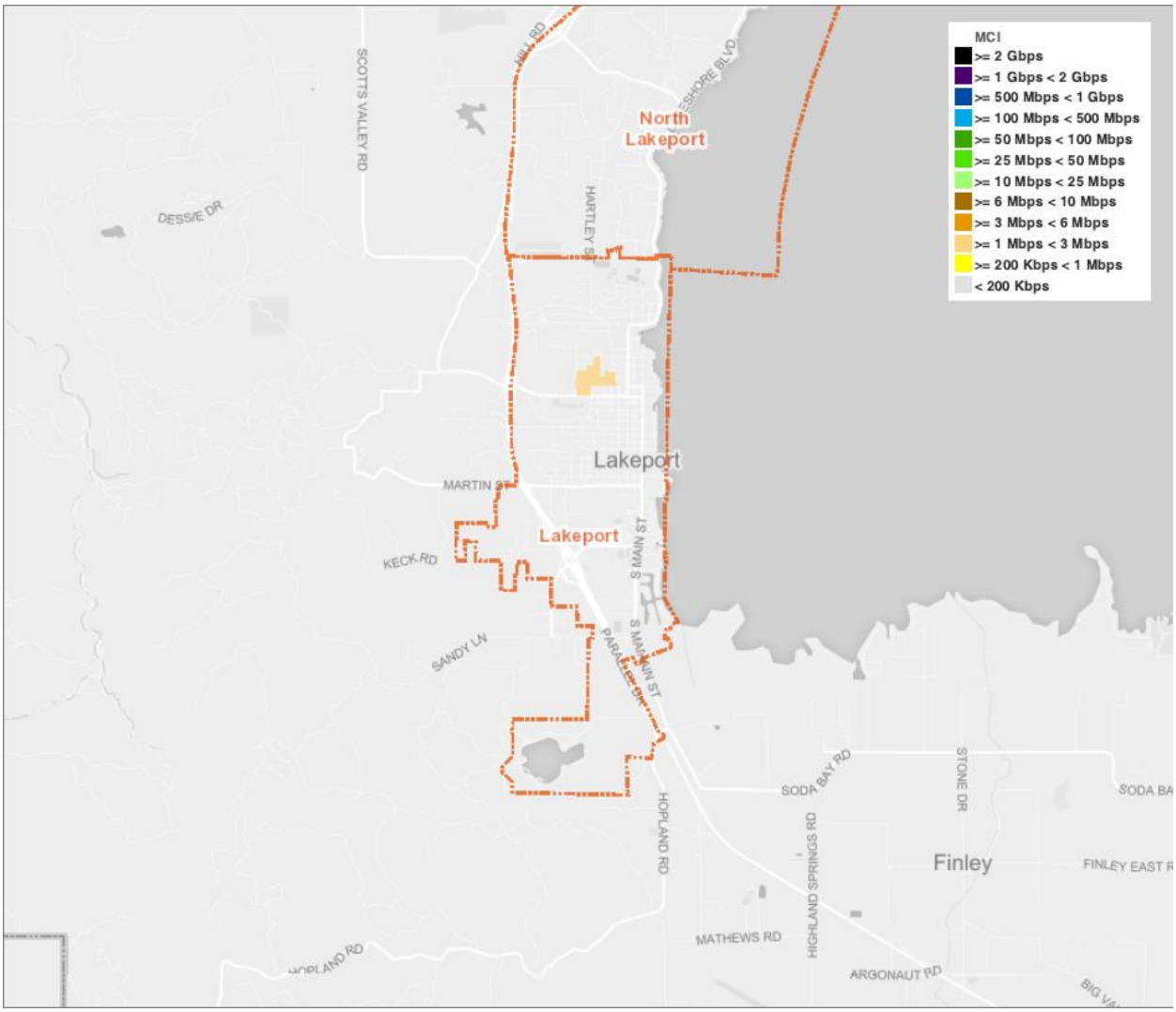

Figure 31. Broadband service speed offered by MCI in Lakeport (December 2017).

Allstream Business

Allstream is a business-class broadband service provider. Based on CPUC data, Allstream Business uses copper wireline technology. This provider offers speeds of 1 to less than 3 Mbps service (light-brown area) in an area of western Lakeport, shown in Figure 31.

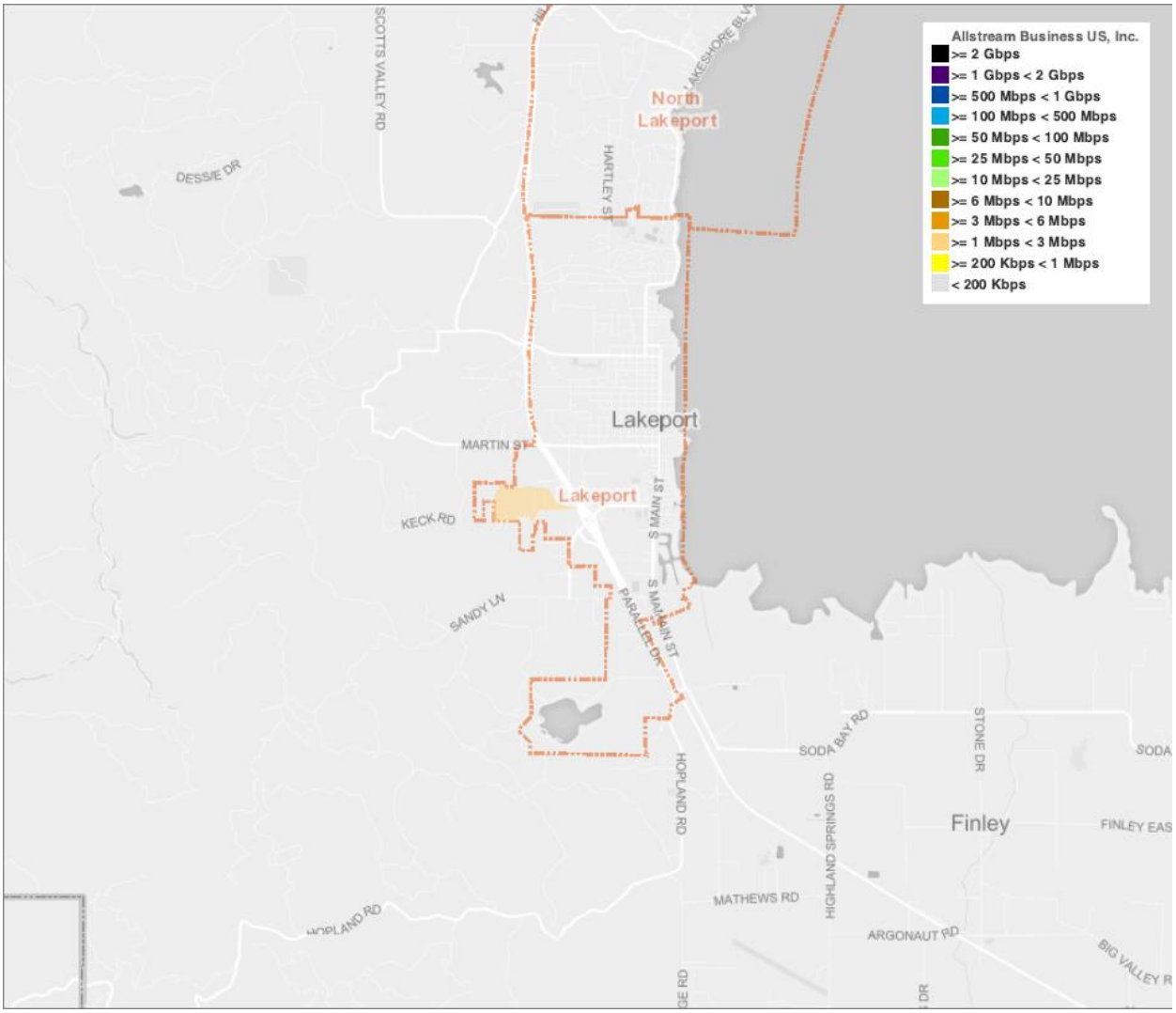

Figure 32. Broadband service speed offered by MCI in Lakeport (December 2017).

9.4 Appendix D: Clearlake Broadband Availability

Wireline Service Availability

Figure 33 shows wireline served areas and downstream speeds in Clearlake as of December 2017. For more details on the technical capabilities and limitations of wired technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.*** Figure 33 shows that the highest available downstream speeds (1–2 Gbps) are located through much of the center of Clearlake (purple areas). Scattered areas in the center of town have access to speeds of 10 to less than 25 Mbps (green areas). Other areas with downstream speeds lower than 10 Mbps (brown, light-brown, and yellow areas) are scattered throughout the city, but are more prominent near the northern and southern edges of town. There are also several scattered areas, as well as larger areas near the northern and eastern extremes of Clearlake that are currently without broadband service.

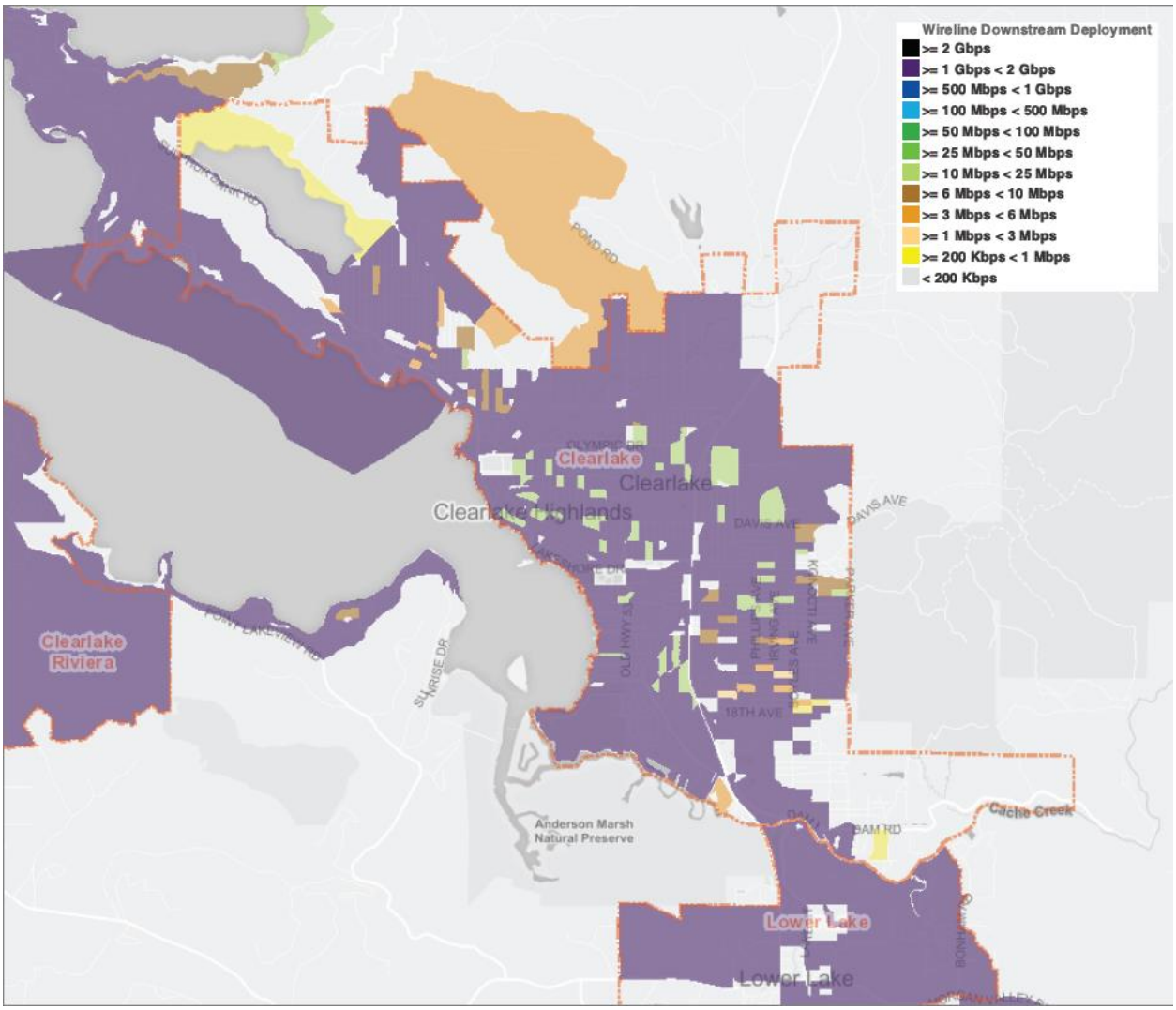

Figure 33. Wireline served status (December 2017) in Clearlake under CPUC standard

Fixed Wireless Service Availability

Figure 34 shows the fixed wireless downstream speeds of Lake County as of December 2017. Depending on the location of towers, access points or base stations, and line-of-sight (no visible obstructions) to customer premises, fixed wireless service can cover wide areas, and in this case, most of the valley in the County of Lake. However, accurate coverage is difficult to estimate due to environmental factors such as trees, buildings and topography, each of which can affect availability of the fixed wireless service. The coverage shown represents best efforts to visualize terrestrial fixed wireless coverage. For more details on the technical capabilities and limitations of fixed wireless technologies, see ***Section 9.2 Appendix B: Middle-, Second- and Last-Mile Broadband Technologies.***

Figure 34 shows that wireless downstream speeds of 10-50 Mbps (green and light-green areas) within a few scattered areas in Clearlake. A fairly large area in the northwest of Clearlake is currently served with speeds of 10 to less than 25 Mbps (light-green area), while several smaller areas in the center of Clearlake are served with speeds of 25 to less than 50 Mbps (green area).

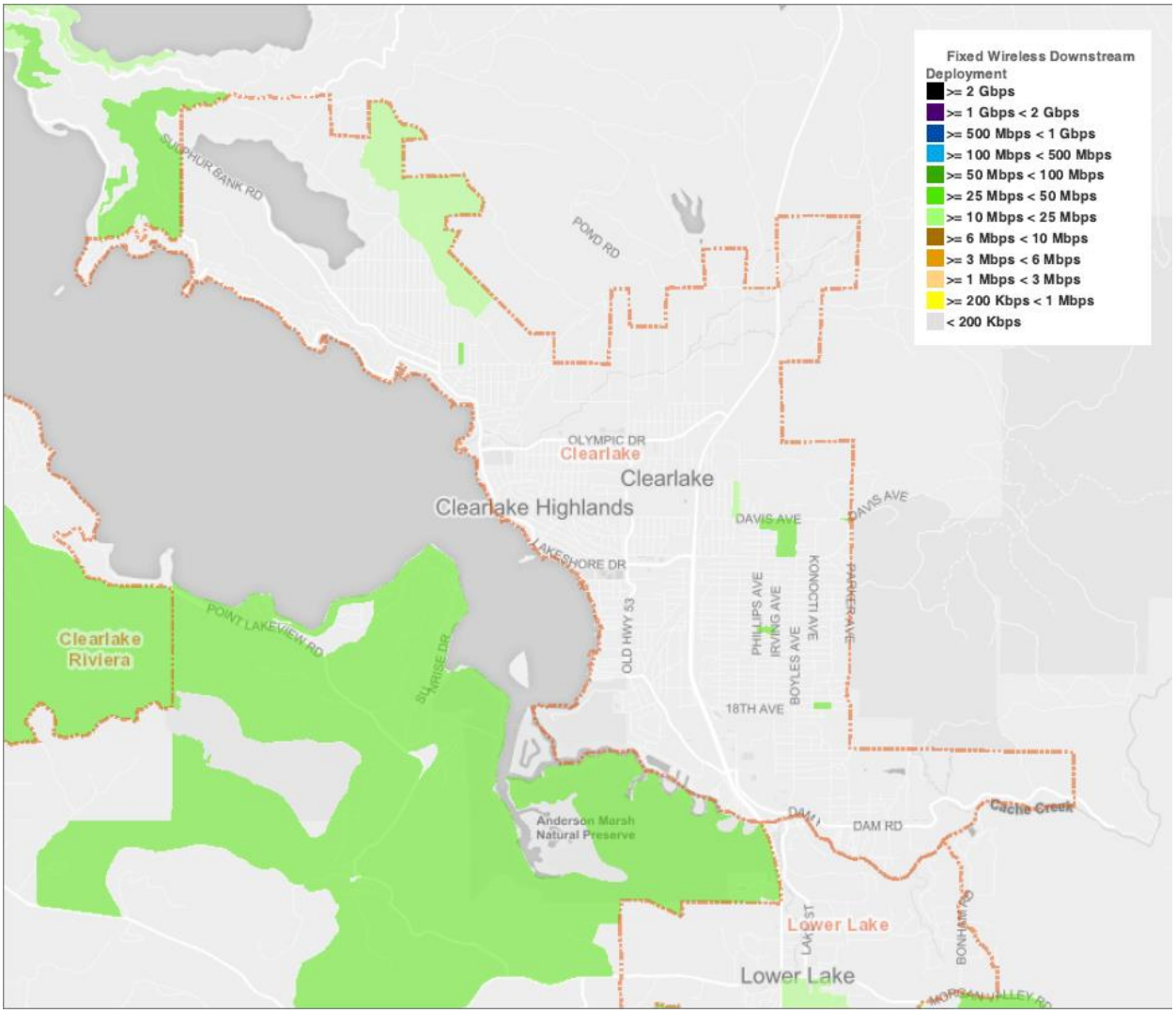

Figure 34. Fixed wireless served status in Clearlake (December 2017) under CPUC standard

AT&T California

AT&T offers residential and business services in Clearlake using a mix of asymmetric xDSL, ADSL2 and ADLS2+ technologies. Figure 35 shows broadband speeds offered by AT&T (as of December 2017) with ADSL2 and ADSL2+ technologies. AT&T offers speeds of 10 to 25 Mbps (light-green areas) in a large area in the center of Clearlake. As one moves further north or south away from the center of town, AT&T's speeds drop below 10 Mbps (dark-brown, brown, light-brown, and yellow areas).

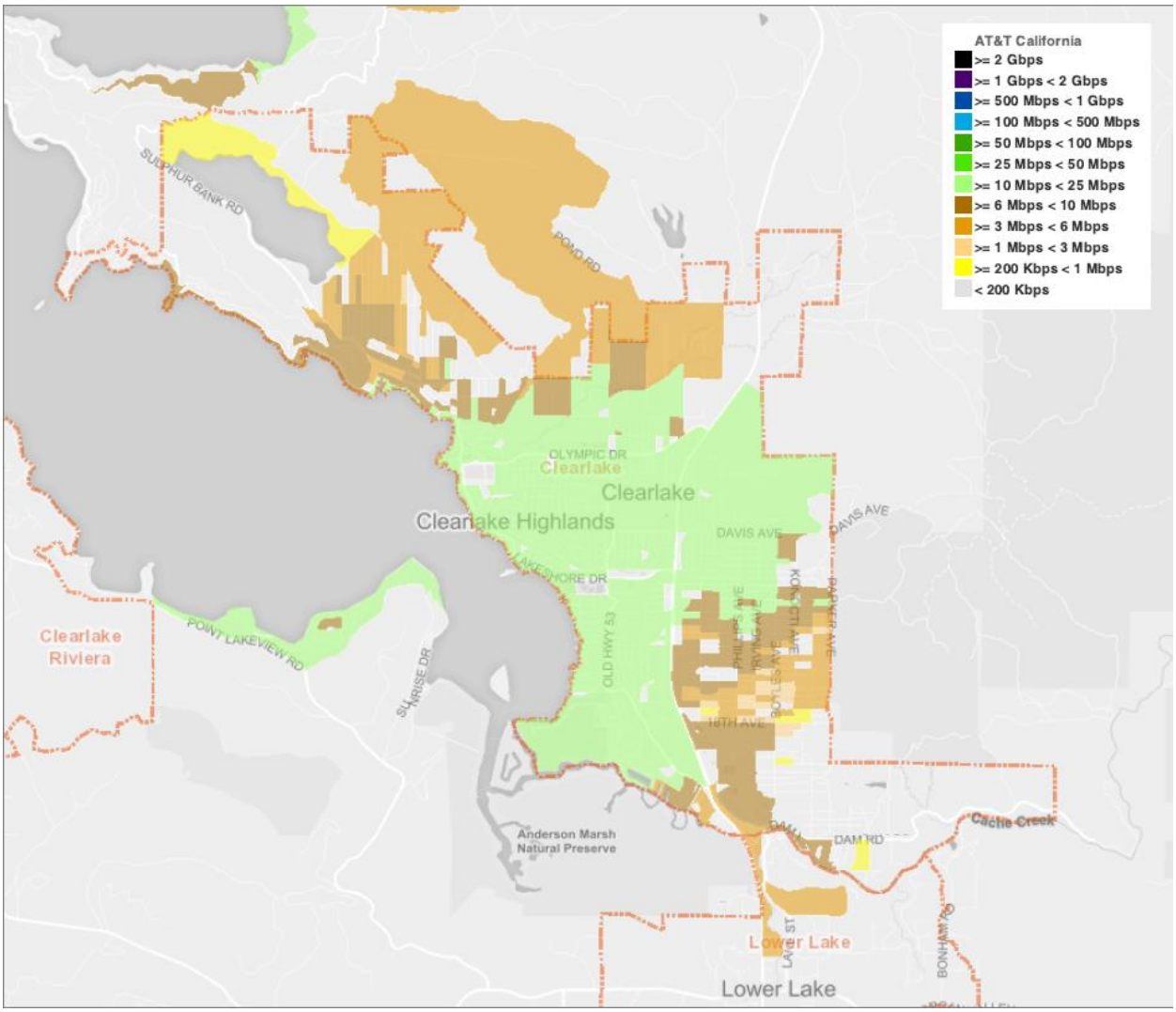

Figure 35. Broadband service speed offered by AT&T California in Clearlake (December 2017)

Mediacom California

Mediacom offers cable Internet service to residential and business customers. Figure 36 shows speeds offered by Mediacom in Clearlake (December 2017). Mediacom advertised 1 to less than 2 Gbps download speeds (purple areas) throughout most of Clearlake; however, there are large areas in the north and south, as well as scattered areas in the center of town that are currently not served by Mediacom.

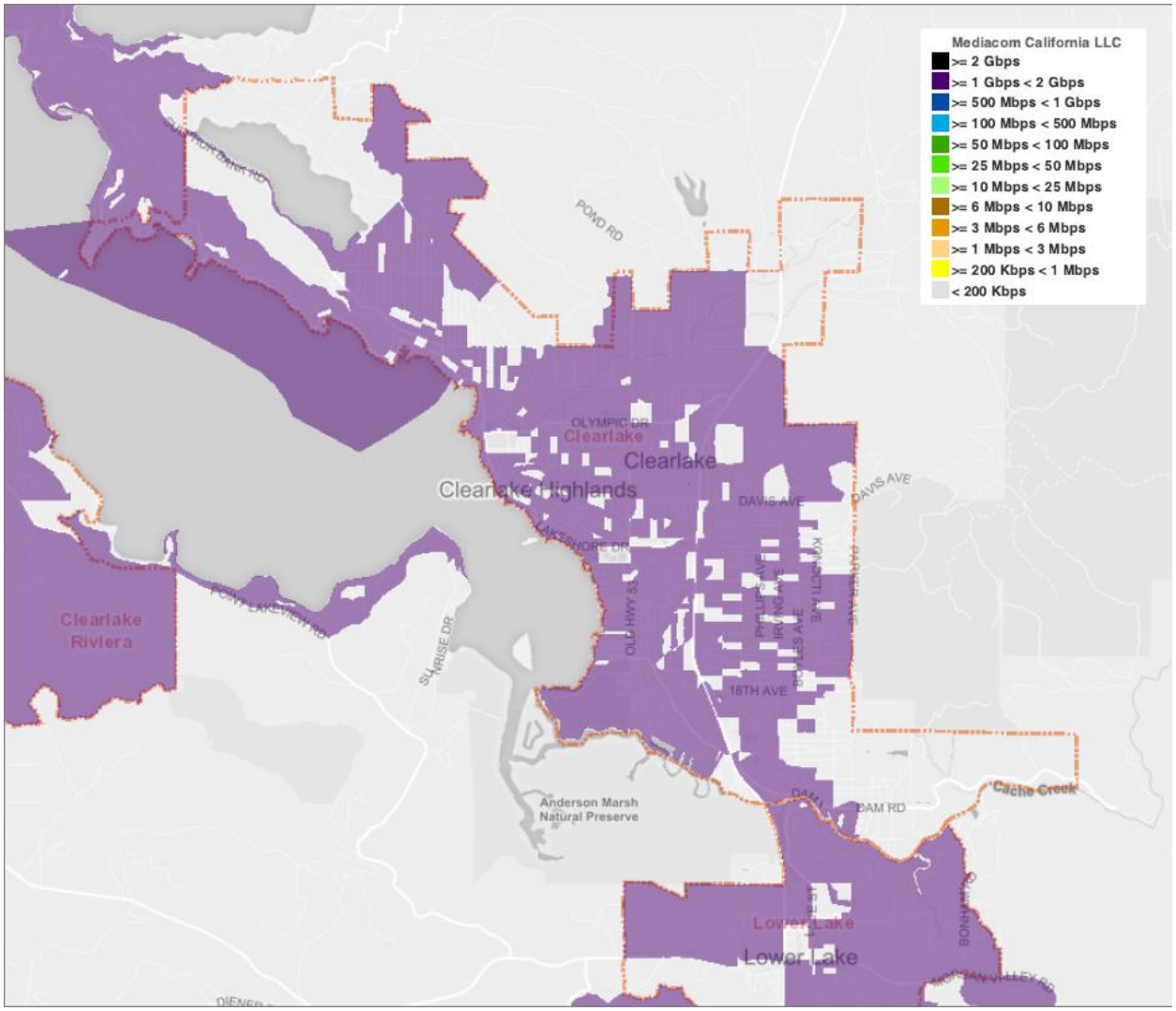

Figure 36. Broadband service speed offered by Mediacom in Clearlake (December 2017)

Valley Internet

Valley Internet offers Internet service to residential and business customers. Figure 37 shows speeds offered by Valley Internet in Clearlake (December 2017). Valley Internet advertised 25 to less than 50 Mbps download speeds (green area) in a small area in the center of town.

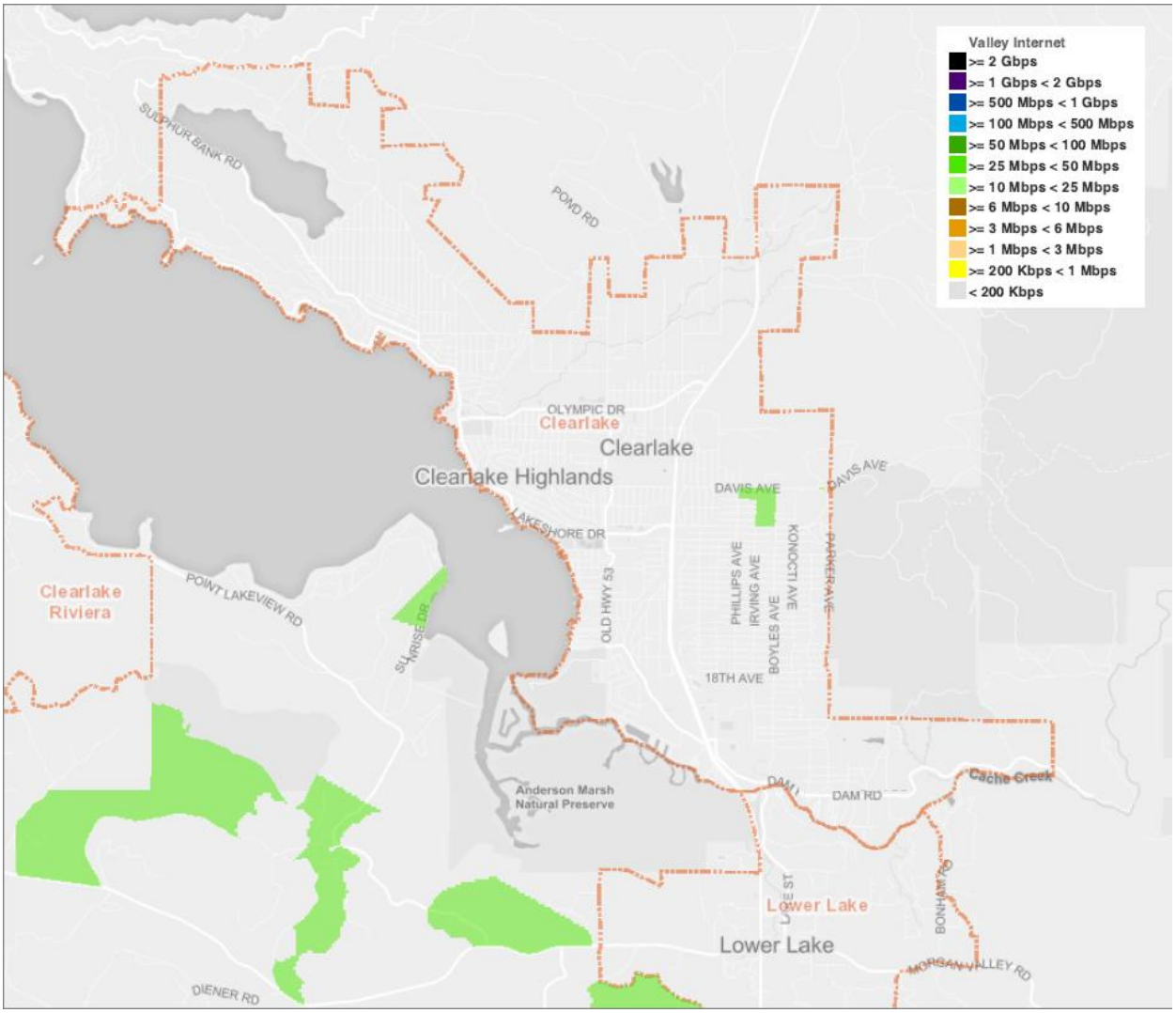

Figure 37. Residential broadband service speed offered by Valley Internet in Clearlake (December 2017)

DigitalPath

DigitalPath offers broadband service to residential and business customers through a terrestrial fixed wireless network. Figure 38 shows speeds offered by DigitalPath in Clearlake (December 2017). This provider offers downstream speeds of 10 to less than 25 Mbps (light-green areas) in an area in the northwest of Clearlake and in a small area in the center of town.

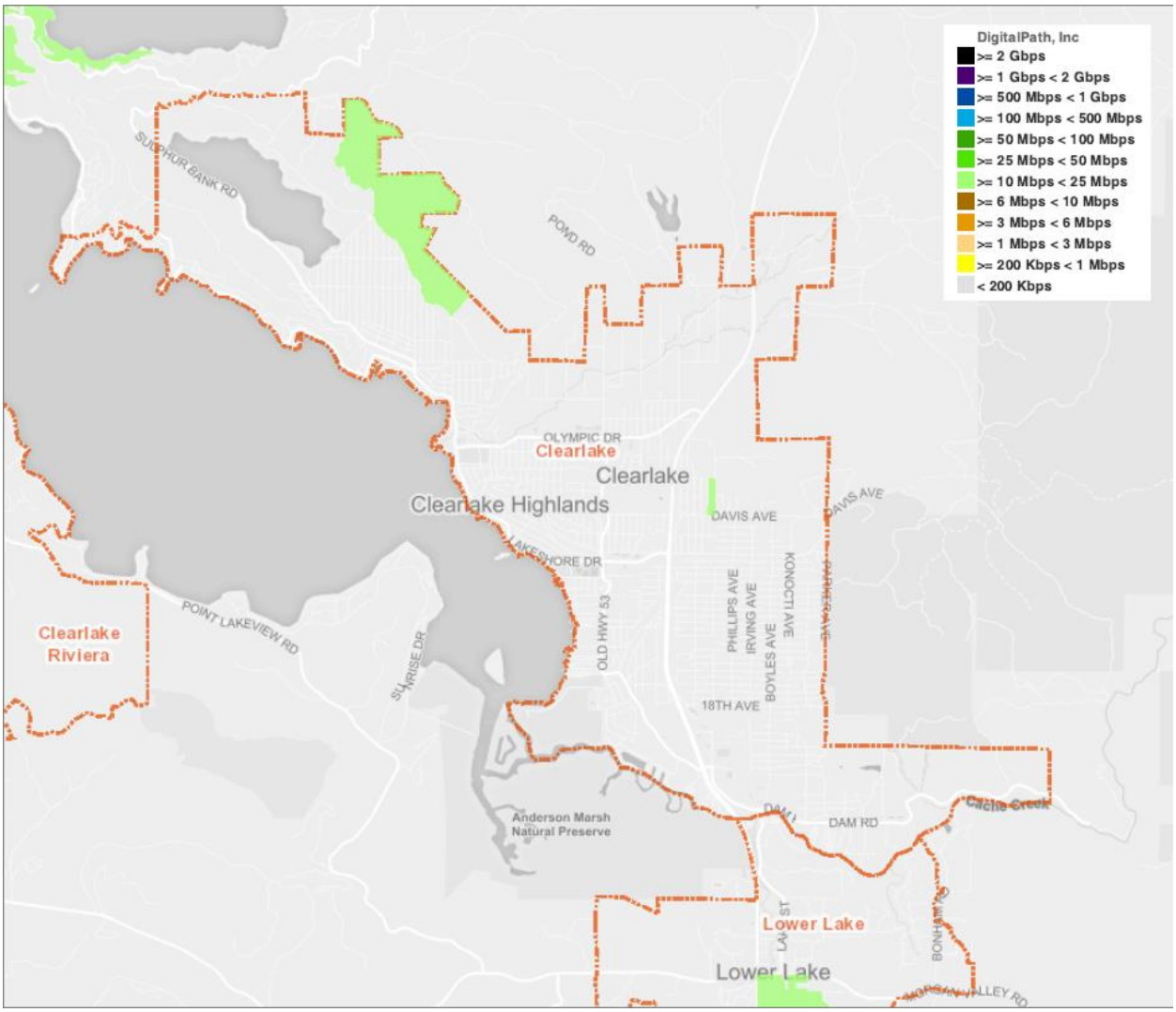

Figure 38. Broadband service speed offered by DigitalPath in Clearlake (December 2017).

North Coast Internet

North Coast Internet offers broadband service to business and residential customers in Clearlake through a terrestrial fixed wireless network. Figure 39 shows broadband service speeds provided by North Coast Internet of 25 to less than 50 Mbps (green areas) in number of small areas near the center of town and in the northeast.

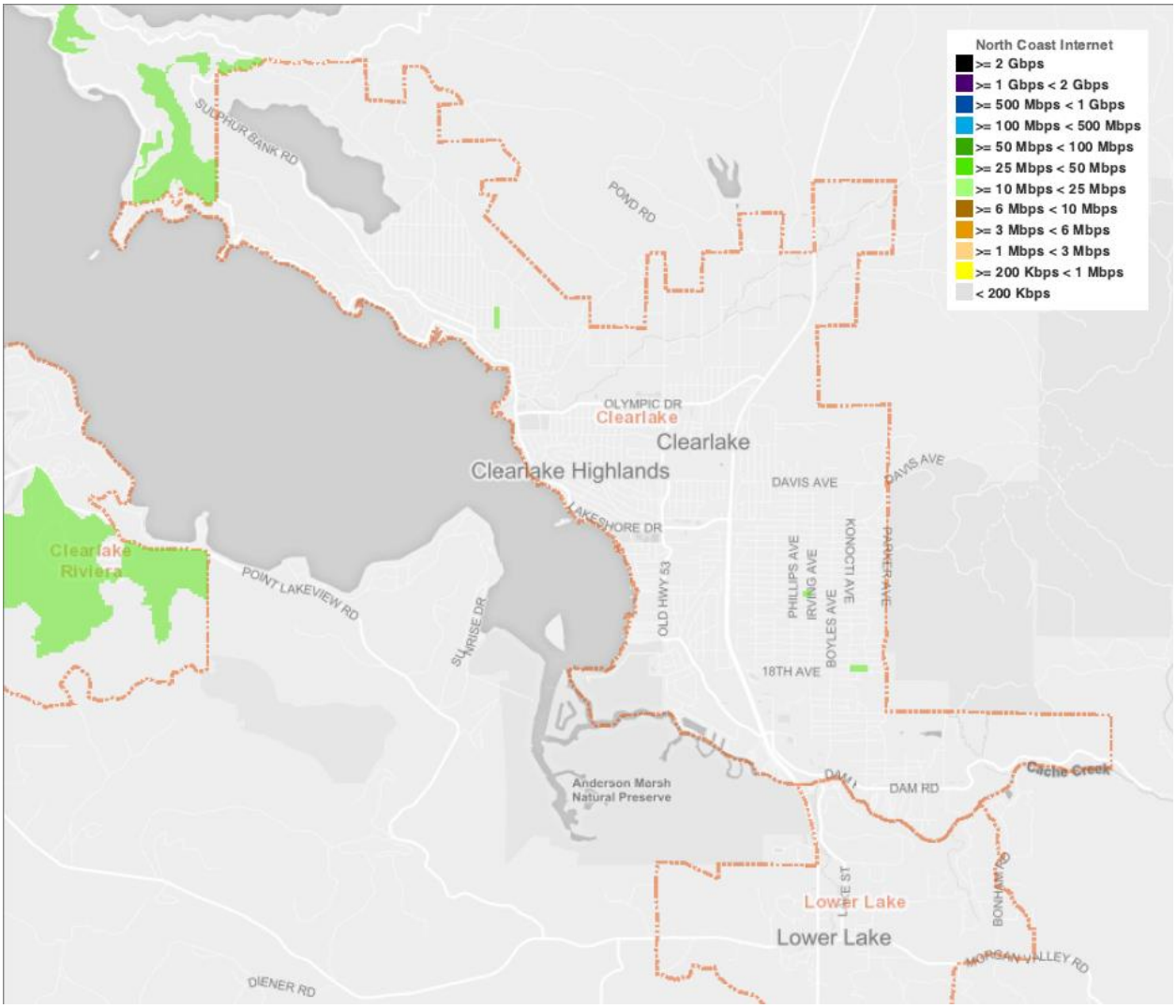

Figure 39. North Coast Internet broadband service coverage in Clearlake (December 2017).

Level 3 Communications

Level 3 offers copper wireline and fiber-optic service to business customers in Lake County, but does not currently provide service in Clearlake, shown in Figure 40.

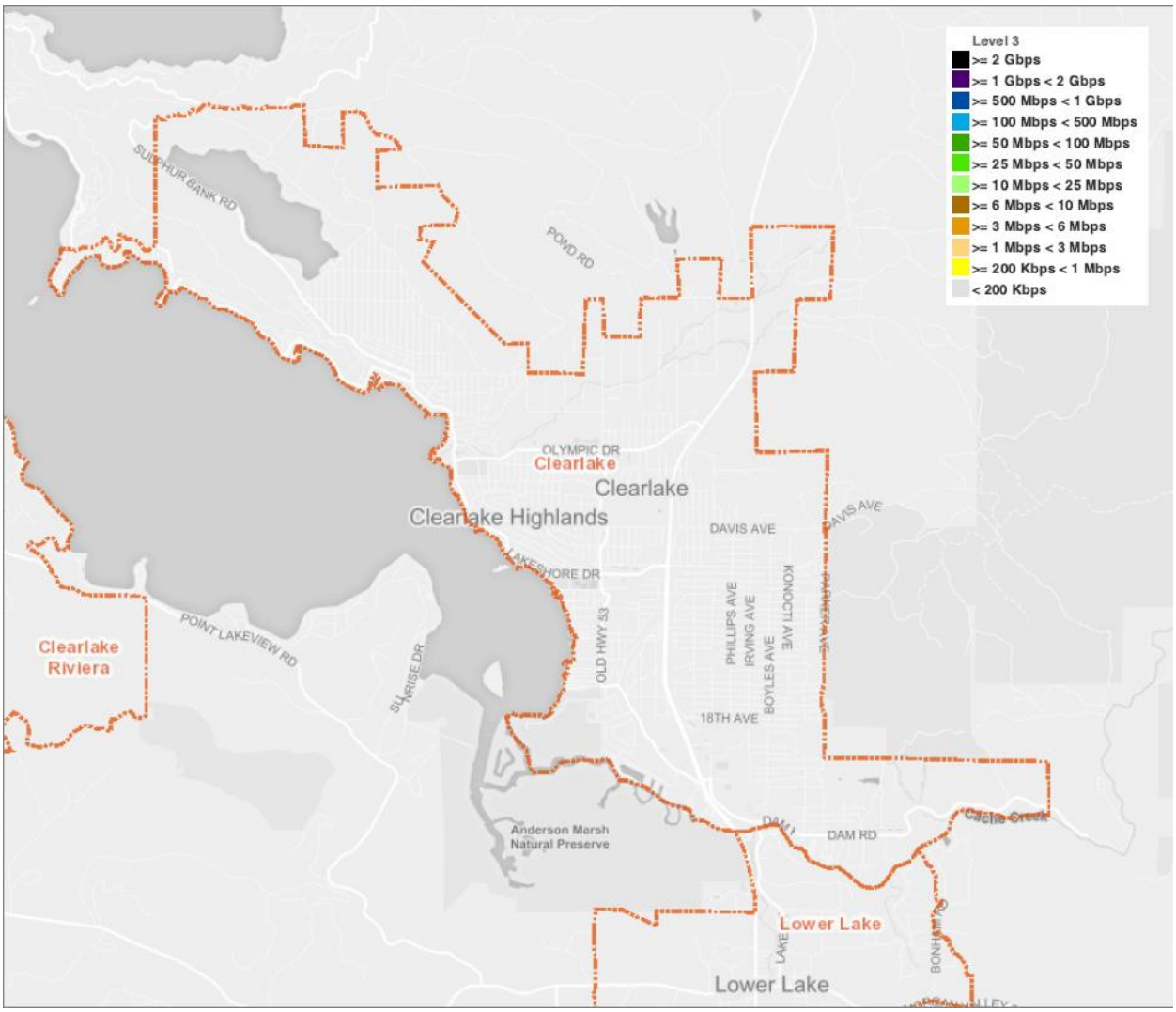

Figure 40. Level 3's business-class broadband service coverage in Clearlake (December 2017)

Earthlink Business

Earthlink is a business-class only broadband service provider and uses asymmetric xDSL, copper wireline and cable modem technologies. This provider offers speeds of 1 to less than 3 Mbps (light-brown areas) in two regions of central Clearlake, shown in Figure 41.

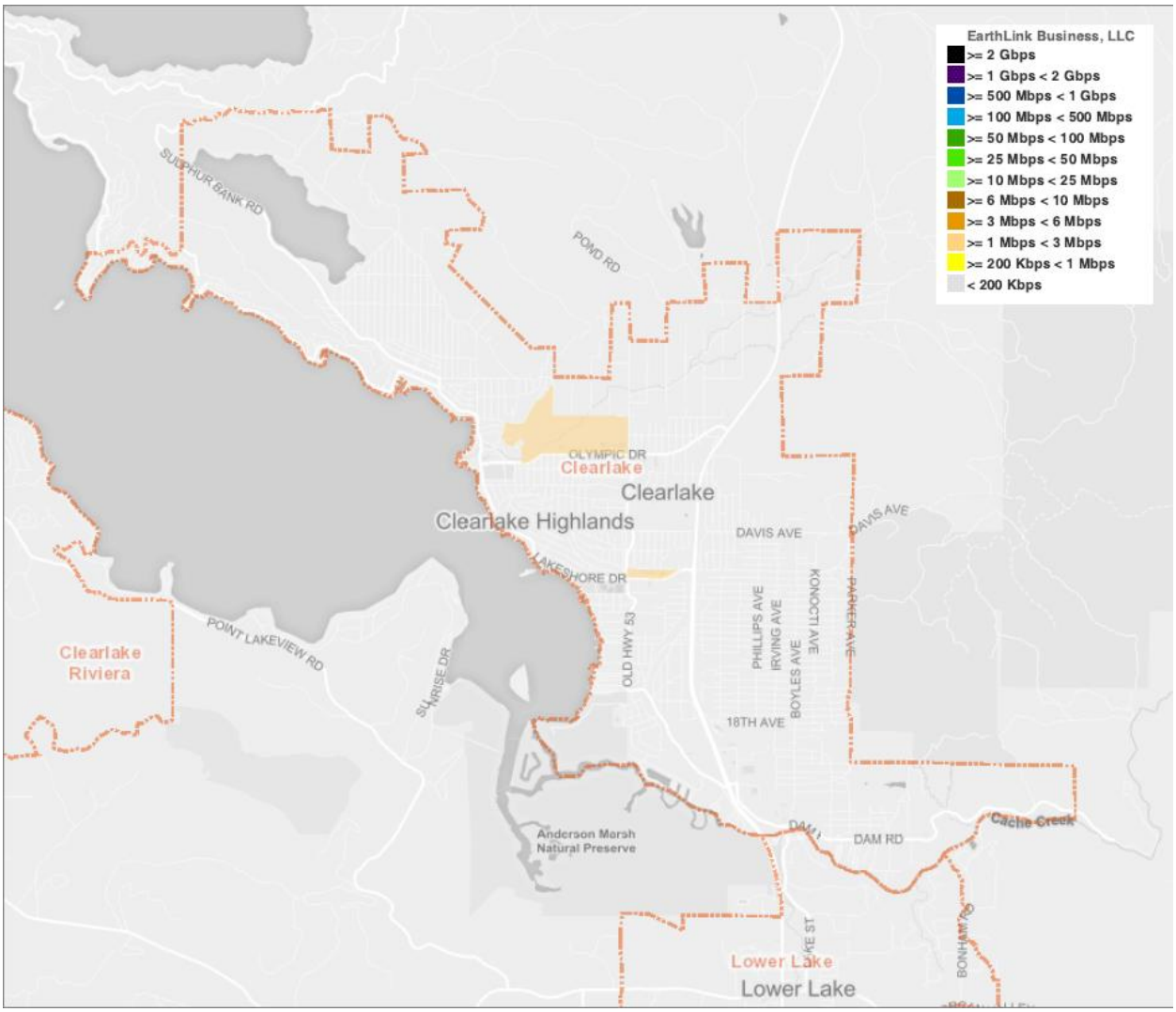

Figure 41. Broadband service speed offered by Earthlink in Clearlake (December 2017).

U.S. TelePacific

U.S. TelePacific is a business broadband service provider, which offers fiber-to-the-end-user and copper wireline connectivity. This provider serves businesses along the coast of Clear Lake and two small areas near the center of Clearlake with speeds ranging from 1 to less than 3 Mbps (light-brown areas). U.S. Telepacific also provides faster speeds of 3 to less than 6 Mbps in a larger area in the south of Clearlake (orange area). Figure 42 shows business-class broadband service provided by U.S. TelePacific.

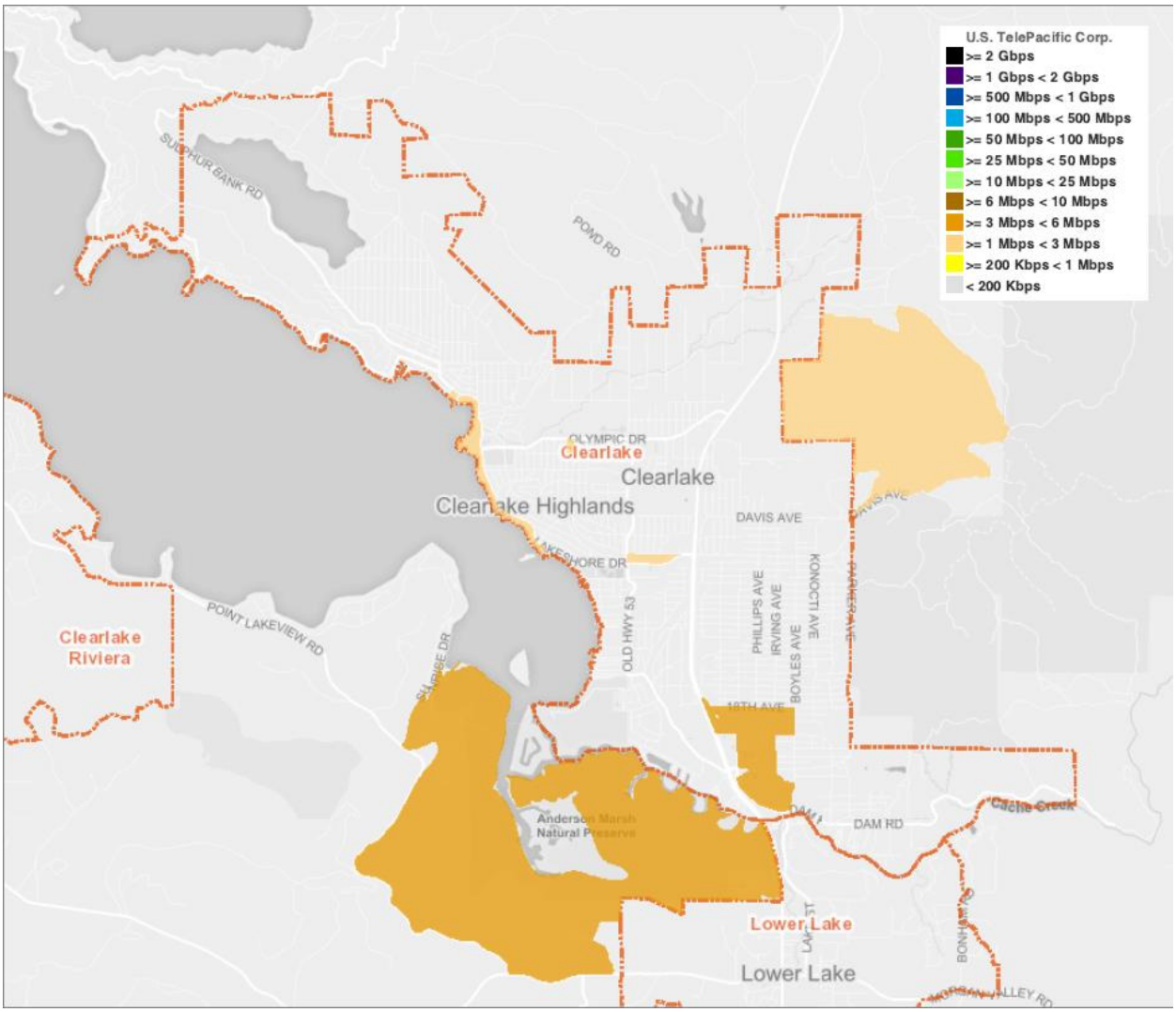

Figure 42. Broadband service speed offered by U.S. TelePacific in Lake County (December 2017).

MCI

MCI is a business-class broadband service provider. Based on CPUC data, MCI uses copper wireline technology. This provider offers speeds of 1 to less than 3 Mbps service (light-brown area) in an area within central Clearlake, shown in Figure 43.

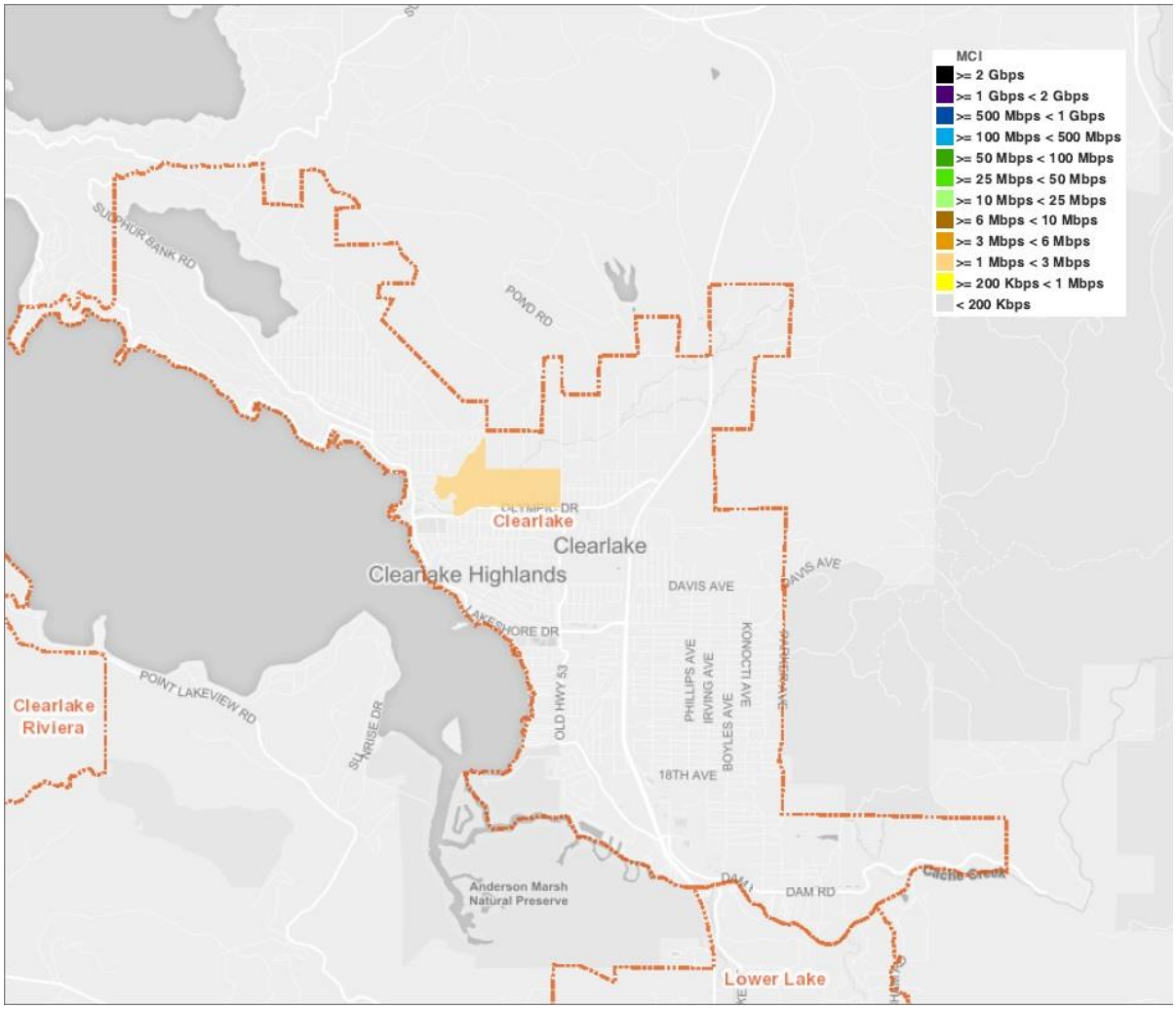

Figure 43. Broadband service speed offered by MCI in Clearlake (December 2017).

10 Glossary

25/3 Mbps: An Internet connection with a download speed of 25 megabits per second and an upload speed of 3 megabit per second. Also, the speed at which the FCC considers an Internet connection to be broadband.

6/1 Mbps: An Internet connection with a download speed of 6 megabits per second and an upload speed of 1 megabit per second. Also, the speed at which the State of California considers an Internet connection to be broadband.

ADSL2+: The next step up from standard ADSL that generally provides a faster Internet speeds. AT&T is currently the only ISP offering ADSL2+ in Lake County.

Asymmetric DSL: A DSL line where the upload speed is different from the download speed. Usually the download speed is much greater. Providers of asymmetric DSL include AT&T and Earthlink Business.

Backbone: A high-speed line or series of connections that forms a major pathway within a network.

Bandwidth: The capacity for data transfer of an electronic communications system.

bps: A measurement of how fast data is moved from one place to another via a network or Internet connection.

Broadband: High-speed Internet access that is always on and faster than the traditional dial-up access.

Broadband Assets: Government owned assets that may assist in the deployment of broadband infrastructure. Examples include towers or tall buildings that may be used to deploy wireless infrastructure and rights-of-way to run underground conduit and fiber-optic cables.

Cable Modem DOCSIS (Data Over Cable Service Interface Specification): An international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV system. Mediacom California is currently the only cable Internet provider in Lake County.

Cloud computing: The use of a network of remote servers hosted on the Internet to store, manage, and process data. An alternative to the established practice of storing and processing data on a dedicated server or computing machine.

Coverage: The geographical areas in which an ISP provides Internet connections.

CPUC: The California Public Utilities Commission. The CPUC regulates services and utilities, protects consumers, safeguards the environment, and assures Californians' access to safe and reliable utility infrastructure and services. The essential services regulated include electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies.

Digital Divide: A measurement of technological equality in access to and adoption of broadband that provides metrics by census tract and county.

Download: An act or instance of transferring something (such as data or files) from a usually large computer to the memory of another device (such as a smaller computer) over a network or Internet connection.

Downstream: Data sent from a network service provider to a customer via the Internet.

DSL (Digital Subscriber Line): A category of technologies that transmit digital data over telephone lines. Providers of DSL include AT&T and Earthlink Business.

FCC: The Federal Communications Commission. The Federal Communications Commission regulates interstate and international communications by radio, television, wire, satellite, and cable in all 50 states, the District of Columbia and U.S. territories. An independent U.S. government agency overseen by Congress, the Commission is the federal agency responsible for implementing and enforcing America's communications law and regulations.

Fiber-optic cable: A type of cable used for very high speed data transmission.

Fiber-to-the-premises/fiber-to-the-home (FTTP/FTTH): The installation and use of optical fiber from a central point directly to individual buildings such as residences, apartment buildings and businesses to provide high-speed Internet access.

Fixed broadband: High-speed data transmission to homes and businesses using technologies such as T1, cable, DSL and FiOS. The term excludes the cellular data market.

Fixed wireless: The operation of wireless communication devices or systems used to connect two fixed locations with a radio or other wireless link.

Gbps (gigabits per second): A measurement, in terms of gigabits, of how fast data is moved from one place to another via a network or Internet connection. A gigabit equals 1,000 megabits.

ILEC (Incumbent local exchange carrier): A local telephone company which held the regional monopoly on landline service before the market was opened to competitive local exchange carriers, or the corporate successor of such a firm.

Internet-of-things: The interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.

IPTV: The delivery of television content over Internet networks.

ISP (Internet Service Provider): An institution/business that provides access to the Internet. Examples of ISPs include AT&T, Netlink 101, Mediacom California, etc.

Kbps (kilobits per second): A measurement, in terms of kilobits, of how fast data is moved from one place to another via a network or Internet connection.

Last-mile: The last segment of the connection between a communication provider (e.g., telephone company central office, ISP) and the customer (usually residential, but sometimes commercial).

Latency: A measurement of the time it takes a data packet to travel through the network. It significantly impacts the performance of interactive, real-time applications, including VoIP, online gaming, videoconferencing, and VPN platforms.

Long-Term Evolution (LTE): A fourth generation (4G) mobile communications standard for the high-speed wireless Internet connection of mobile devices (smartphones, tablets, etc.)

Machine to machine: Direct communication between devices through network or Internet connections.

Mbps (megabits per second): A measurement, in terms of megabits, of how fast data is moved from one place to another via a network or Internet connection. A megabit equals 1,000 kilobits.

Middle-mile: The network infrastructure that connects last mile networks to other network service providers, major telecommunications carriers, and the greater internet.

No service: According to the CPUC standard, areas where broadband is offered at slower speeds than 6 Mbps downstream and 1 Mbps upstream.

OFDM (Orthogonal Frequency Division Multiplex): A form of transmission that uses a large number of close spaced carriers that are modulated with low rate data.

P2P: A network allowing two or more computers to communicate directly without having to use a router or other centralized server.

Packet Loss: The Measuring Broadband America program denotes a packet as lost if the latency exceeds 3 seconds or if the packet is never received. Packet losses might affect the perceived quality of phone calls or video conferencing.

Point of presence: An access point to the Internet and a physical location that houses servers, routers, etc. Also, an interconnection point within fiber-optic networks.

Public Right of Way (PROW): The right to cross property to go to and from another parcel. The right of way may be a specific grant of land or an "easement," which is a right to pass across another's land. The mere right to cross without a specific description is a "floating" easement. Some rights of way are for limited use such as repair of electric lines or for deliveries to the back door of a store.

Served: According to the CPUC standard, areas where broadband is offered at speeds of at least 6 Mbps downstream and 1 Mbps upstream. According to the FCC standard, areas where broadband is offered at speeds of at least 25 Mbps downstream and 3 Mbps upstream.

Telecommuting: Working from home through the use of the internet, email, and by telephone.

Telemedicine: The use of telecommunication and information technology to provide clinical health care from a distance.

Throughput: How much stuff you can send through a connection. Throughput is what people usually mean when they use the term "bandwidth" and it is usually measured in bits-per-second (bps) A full page of English text is about 16,000 bits. A common configuration of DSL allows downloads at speeds of up to 1.544 megabits (not megabytes) per second, and uploads at speeds of 128 kilobits per second.

TVWS (TV White Space): A form of wireless technology that takes advantage of unused TV channels between the active ones in the VHF and UHF spectrum to transmit data.

Unserved: According to the FCC standard, areas where broadband is offered at slower speeds than 25 Mbps downstream and 3 Mbps upstream.

Upload: To transfer (something, such as data or files) from a computer or other digital device to the memory of another device (such as a larger or remote computer) over a network or Internet connection.

Upstream: Data transferred from a customer to a server via the Internet.

USDA: The United States Department of Agriculture.

VDSL (Very-high-bit-rate digital subscriber line): A digital subscriber line technology that provides faster data transmission than asymmetric digital subscriber line. AT&T is currently the only ISP offering VDSL in Lake County.

Video on demand (VoD): A system in which viewers choose their own filmed entertainment, by means of a PC or interactive TV system, from a wide selection.

VoIP technology: A technology that allows you to make voice calls using a broadband Internet connection instead of a regular (or analog) phone line.