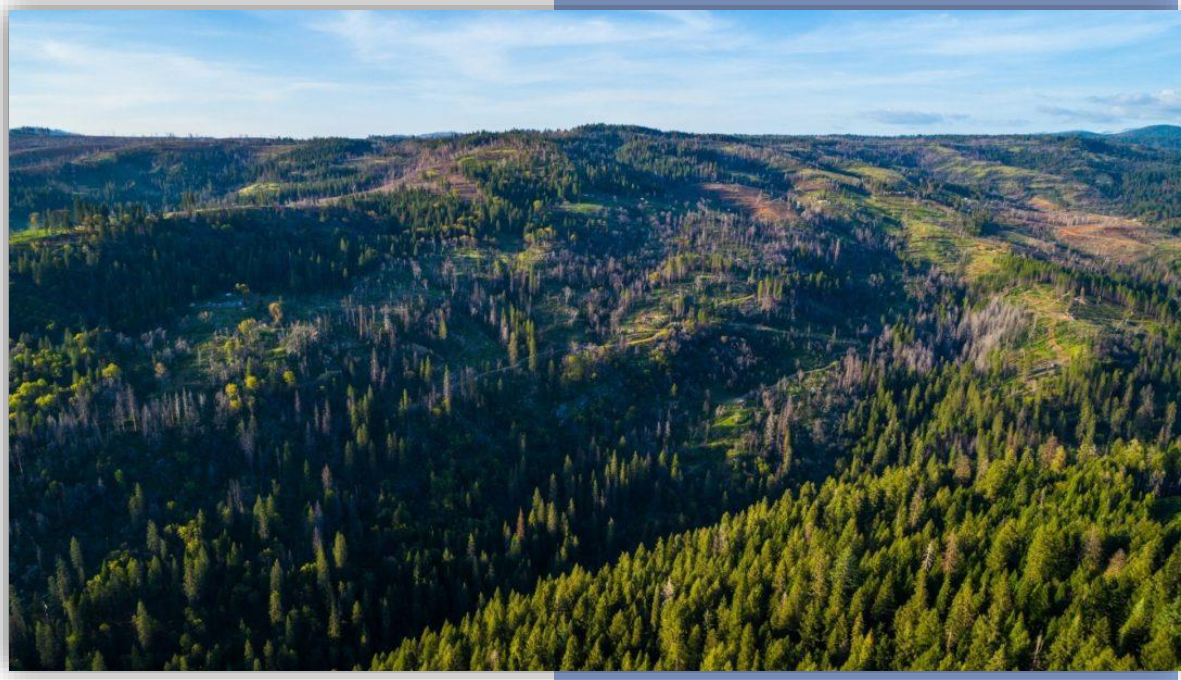
2021

Paradise Broadband Feasibility Study



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Acknowledgements

The North State Planning and Development Collective (the Collective) is the overarching nonprofit entity housing the Center for Economic Development (CED, est. 1986), the Geographical Information Center (GIC, est. 1988) and the Northeastern and Upstate California Connect Broadband Consortia. The Collective is an auxiliary 501(c)(3) organization of the Chico State Enterprises (formerly the CSU, Chico Research Foundation).

Project Background

In 2020, the Town of Paradise released a Request for Proposals (RFP) for agencies to produce a feasibility study examining the demand and viability of installing high-speed broadband infrastructure within the Town. The Geographical Information Center (GIC), at Chico State Enterprises submitted a proposal to the Town of Paradise that was approved by the city council in the summer of 2020. The goal of this feasibility study is to determine the demand for and cost of installing broadband infrastructure in the Town of Paradise. This study also aims to provide the basis for the Town's future Request for Information (RFI).

This report focuses on the demand within the Town of Paradise for high-speed broadband services. Included in this report are the results of the survey GIC staff administered to residents of Paradise as well as summary and analysis of these results. In addition, GIC staff prepared educational, public safety workforce (fire and police), population, and business projections for the Town of Paradise to provide insight into future demand for broadband services based on growth within those sectors that present greater demand for such services.

Town of Paradise

In the wake of the Camp Fire, the Town of Paradise faces numerous hurdles on its road to recovery. The full impact of the Camp Fire on the Town of Paradise will not be clear for some time, but many of the immediate challenges of rebuilding the Town are more evident. Among the most substantial obstacles facing the Town of Paradise are several concerning housing, health care, senior care, homelessness, and children and youth issues, including education (North State Community Foundation).

The Camp Fire resulted in a total loss of 14,600 housing units and more than 27% of the Butte County's mobile homes were lost as well (North State Community Foundation). The US Department of Health and Human Services has projected an increase in homelessness and a sharp increase in home prices in the region as a direct result of the Camp Fire. This is all despite an overall net population loss of 11,153 individuals in Butte County since the fire (U.S. Department of Housing and Urban Development's Office of Policy Development and Research). Additionally, the US Department of Health and Human Services also projected a loss of workforce across all industry sectors in the region, including a significant loss of its highly skilled workforce, as many of these residents moved out of the area after the Camp Fire.

Many of the issues faced by the Town of Paradise are endemic to Butte County as a whole. Additionally, several areas within Butte County meet shortage criteria for primary care and dental care, while all of Butte County faces mental health shortages (Butte County Public Health). In addition to the barriers to health care access in Butte County, the composition of the County's population also presents several health care challenges and specialized health care needs. Butte County has a significantly higher percentage of individuals between the ages of 18-64 with disabilities when compared to California as a whole. Individuals with disabilities often face many barriers to proper health care and "report having poorer overall health, less access to adequate health care, limited access to health insurance, skipping medical care because of cost, and engaging in risky health behaviors including smoking and physical inactivity" (Butte County Public Health). Butte County also has a greater percentage of individuals over the age of 65 than California as a whole, and almost twice the percentage of grandparents within Butte County are responsible for their grandchildren when compared to California as a whole. Additionally, homelessness in Butte County has been increasing since 2015 (Butte County Public Health), and Butte County faces "substantial substance abuse issues" (US Department of Health and Human Services). Additional Public Health and Environmental Health and Safety Issues identified by the US Department of Health and Human Services include increased disease communicability as a result of increased homelessness, increased housing density, and increased substance abuse, health care worker shortages, and potential health ramifications of poor air quality as a result of the fire. According to Butte Countywide Homeless Continuum of Car, 31% of homeless individuals in Chico are homeless due to Camp Fire and 80% of these individuals are unsheltered.

Executive Summary

This report seeks to provide the Town of Paradise with assistance determining the level of demand for broadband among its citizens and businesses. In preparing this report, GIC staff conducted literature review, mined existing databases, administered surveys to over 1,000 former and current residents of the Town of Paradise, and prepared educational, public safety workforce (fire and police), population, and business projections for the Town of Paradise through 2027. The results of these combined research efforts were aggregated, culled, and analyzed by GIC staff with a particular focus on indicators of broadband demand within the community. Based on the research presented in this document and the appendices that follow, GIC staff conclude that:

- Market demand for the high-speed broadband exists among Paradise's citizens and businesses.
- Development of high-speed broadband infrastructure within the Town of Paradise will provide long-term economic benefits to the Town and region.
- Demand for broadband services within the Town of Paradise will increase is the future.
- Paradise households with children who need the internet for school have a significant need for improved broadband services.
- Leverage Town assets for future broadband deployment and to promote provider competition to increase economic innovation.

Methodology

Survey Methodology

In summer of 2020, the Geographical Information Center (GIC) and the Center for Economic Development (CED) at CSU, Chico conducted a survey of current and former Paradise residents and businesses to assess the demand for high-speed broadband internet in the Town of Paradise. Outreach and advertisements were performed by the Town of Paradise. The survey was developed by GIC/CED staff. The survey captured 1,178 respondents. The survey contained a series of twenty-eight questions aimed at assessing the current state of internet service in Paradise and the demand for broadband.

Additionally, GIC/CED staff cross tabulated responses from multiple survey questions to determine correlations that might shed further light on not only the extent of demand for broadband services in the Town of Paradise, but also details regarding the type, source, and demographics of demand. During these cross tabulations, CED Staff focused on correlations between satisfaction/desire to upgrade service and multiple variables related to respondents' current internet service. In doing so, GIC/CED staff were able to determine the various conditions and scenarios in relation to internet service that led to respondents desiring upgraded service. It should be noted that while the sample size of the survey was relatively large, these cross tabulations filtered out non-relevant responses, reducing the practical sample size for particular comparisons. While this filtering has resulted in some data points not being statistically significant enough to establish strong correlations, these comparisons do offer an initial assessment of potential demand for high-speed broadband in the Town of Paradise.

The complete survey can be found in Appendix B.

Projection Methodology

A series of demographic projections were prepared by GIC/CED staff to assess the potential change in demand for broadband service among the populace of the Town of Paradise through 2027. Using historical data, GIC/CED staff were able to determine the likely rate of growth in school enrollment, public safety workforce, business, and population in the Town of Paradise. Projection methodologies for each sector were developed by GIC/CED staff after an extensive literature review of related projection methodologies. Projections were developed using data provided by the Town of Paradise and other public sources including the Census.

More detailed descriptions of the methodology of the projections prepared by GIC/CED within this report may be found in Appendix A.

Economic and Social Impacts of Broadband

When it comes to the effect broadband has on economic development, the literature on the subject is varied and somewhat inconsistent. There is a significant amount of literature claiming many positive impacts of broadband on economic development, while others question whether increased economic development spurs on the growth of broadband. Numerous studies claim that increased access to high-speed internet service positively impacts GDP, employment, income, productivity, and quality of life. Others have claimed that broadband increases the desirability of a city, which can increase migration to the city and bolstering the local workforce and serves as a significant draw for businesses. While it is mostly agreed upon that broadband access can help economic development, the exact effects of broadband on economic activity remain unclear.

The trouble with determining the exact impact of broadband on economic development stems from the plethora of variables that affect economic development and the lack of universally apt methods for measuring broadband access. Some metrics, like download speed, show little to no correlation with economic development, while others, such as broadband adoption, show correlation to some aspects of economic development and not others. In a study compiling 10 different broadband-related metrics at the county-level to see their impact on job productivity, researchers found that advertised speed variables had little to no impact on job productivity, while several other broadband-related variables showed significant influence over job productivity (Gallardo et. al., 2020). Though the significance of broadband's impact on local economies are still widely debated, one must also consider the many social welfare benefits of broadband as well. Broadband can greatly enhance emergency response times and preparedness, provide medical care to rural and remote areas, and provide residents with access to a wide range of online services. While there may not be a consensus regarding broadband's influence over economic development it remains worthwhile to examine the claims of positive relationships between broadband and economic development made by those investigating this relationship.

A 2009 study by the World Bank examined the impact of information and communication technologies (ICT), namely broadband, on GDP growth from 1980-2006 for 120 countries (Qiang et al.). The study found that broadband raises productivity and lowers costs when implemented and integrated into businesses effectively (Qiang et al.). The study also showed a correlation between a 1.21% increase in GDP growth for every 10% increase in broadband adoption in developed countries (Qiang et al.). When effectively and fully implemented, broadband helps to improve business processes, introduce new business models, drive innovation, and extend business links (Qiang et al.). Additionally, in the *World Development Report 2016: Digital Dividends* prepared by Michael Minges; the author reviewed a multitude of studies on the economic impact of broadband. Almost every study the author reviewed showed a positive correlation between broadband adoption and positive economic outcomes (Minges, 2016).

According to a study prepared by Dr. Raul Katz, Director of Business Strategy Research at the Columbia Institute for Tele-Information (CITI) at Columbia University, broadband has several positive effects on regional economies, including jobs created by the necessary construction of broadband networks, the adoption of broadband within firms, which leads to a substantial increase

in productivity, which in turn contributes to the growth of GDP, and increase in household income (Katz 2012).

A case study of the Actnow Programme in Cornwall (UK) prepared by Dr. Martin Fornefeld on behalf of the European Commission shows how ubiquitous regional broadband can positively affect the regional economy and quality of life. In 2005, the Actnow Programme administered a survey to regional businesses hoping to gain insight on the various impacts the Actnow had on local firms. Of the survey's 700 respondents, over seventy-five percent indicated that Actnow had resulted in lower telephone, mail, and printing costs and expressed an overall improvement to their business performance due to the availability of broadband. Eighty-one percent of respondents indicated that broadband was crucial for their business activities (Fornefeld, 2008).

Along with the more direct benefits to local businesses and residents, the Actnow Programme also helped to improve the overall image of Cornwall. The Actnow Programme helped to change the image of Cornwall from a rural region that was behind on the times, to an attractive region with innovative businesses. According to Actnow, approximately 4,300 broadband-related jobs have been created in Cornwall since 2002 (Fornefeld, 2008).

Leveraging Competition for an Innovative Economy

The Town of Paradise has a valuable asset in owning its underground conduit that can be utilized for broadband fiber deployment. The Town of Paradise has an opportunity to leverage this asset to promote competition among current and future internet providers. The lack of competition among broadband providers is a real and pressing issue. Over 70% of American households live in an area with either no choice in provider, or only one choice. Monopolies and duopolies create artificially high prices. This is reflected in the Office of Economic and Community Development's (OECD) data that ranks the U.S. as the country with the second highest broadband prices among developed nations in 2017. In markets with a limited number of providers, prices can easily be coordinated to maximize profit at the expense of the consumer. Highly concentrated and coordinated markets restrict the presence of new entrants (Sallet, 2019). High prices due to lack of provider choices are more likely to impact low-income, rural communities. On average, the bottom 10 percent of the least densely populated areas pays 37 percent more for residential wired broadband at 25/3 than those at the top 10 percent of the most dense areas. Data from a 2018 study from Harvard's Berkman Klein Center for Internet & Society found that the entry of an additional provider resulted in customer savings up to 50 percent (Sallet, 2019). Stronger competition would incentivize companies to improve services, lower prices, and be more consumer-friendly. The following people and communities are most likely to be impacted by limited competition:

- Middle-Class Households: BroadbandNow found that households in states with a median household income of less than $60,000 (approximately the national median) frequently pay more for the same 25/3 Mbps service than do households in states with a median household income of more than $60,000. Households in the lower-income states are 40 percent less likely to be obtaining that service for $60 per month or less.

- Rural America: BroadbandNow also found that the least dense 10 percent of areas defined by zip code pay an average of 37 percent more for residential wired broadband at 25/3 than those in the 10 percent most dense areas.313 And only 4 percent of rural households have the choice of more than two options for 100 Mbps broadband; that drops to 1 percent in tribal areas.
- People with Lower Incomes: Wealthier communities are approximately two to three times as likely to have more than two choices as communities with lower-than-average household incomes (Sallet, 2019).

The Town has an opportunity to develop high-performance broadband in its community and for surrounding areas and deliver the economic and social benefits for its residents and businesses. Local leaders, private industry, nonprofits, and government work together to identify community needs, local resources and assets and steps necessary to deploy broadband networks. The Town can adopt a package of economic-development incentives, redesign local administrative processes to streamline deployment logistics, or otherwise reduce barriers to entry. The ability for future providers to access the Town's conduit is important for new entrants. In addition to the accessible, built infrastructure, speeding and easing the process for approval of construction permits and providing accurate, easy to-use infrastructure maps and a streamlined application review process reduce the length and cost of deployments. Google's initial fiber deployment into Kansas City served as an early indication of how this cooperative process between a municipality and a new broadband provider could improve the economics of deployment (Sallet, 2019).

Consumers and communities benefit from more competition. Constricted broadband competition—without regard to its cause—therefore curbs the economic and social progress that broadband can help deliver.

Further economic benefits of broadband, including those related to specific industries, are discussed later in this document.

Survey Analysis and Summary

Of those respondents with children currently using the internet for schoolwork, 80.9 percent indicated that their current service does not completely meet their current needs. Additionally, of these same respondents, 63.8 percent indicated that they would be willing to pay more for upgraded internet service. Lastly, of those respondents with children in school who are interested in upgrading, 20 percent indicated that they would be willing to pay an additional $70 or more per month for upgraded internet service.

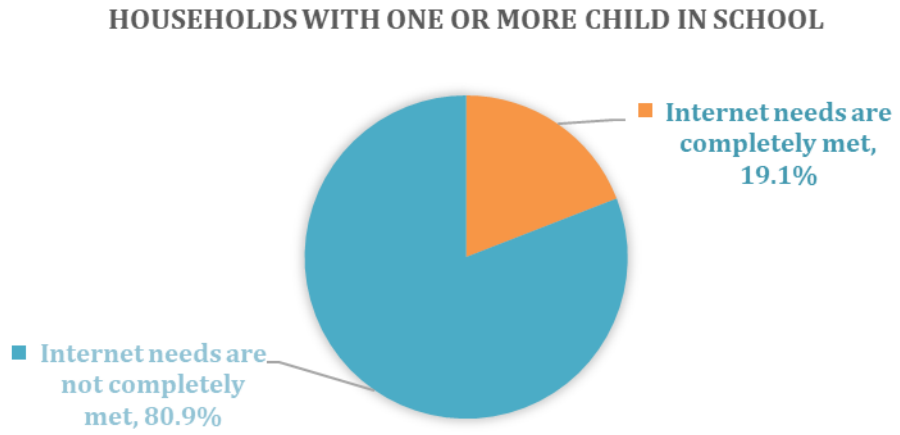

Figure 1. Chart showing the level of internet service satisfaction among households with one or more child in school.

Similarly to the previously discussed cross tabulation, CED staff examined survey data for relationships between those respondents with home-based businesses and satisfaction and interest in upgrading. 79.9 percent of respondents with home-based businesses indicated that their current internet service does not completely meet their needs; conversely, only 67.6 percent of those without home-based businesses expressed a lack of complete satisfaction with their service. This clearly illustrates the importance of fast and reliable broadband for home-based businesses in the Town of Paradise. Likewise, a greater percentage of those with home-based businesses (66%) indicated a willingness to pay for upgraded service when compared to those respondents without home-based businesses (51.8%).

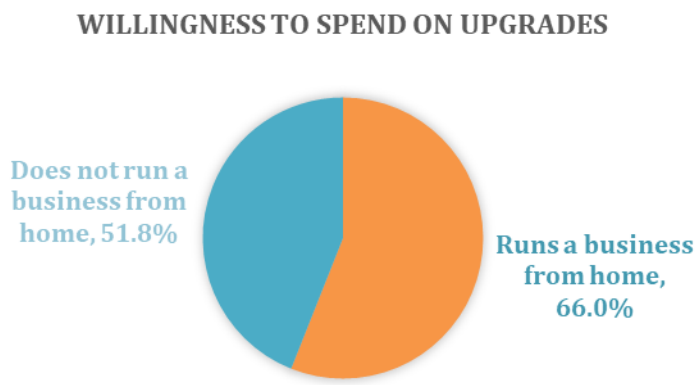

Figure 2. Chart showing respondents' willingness to spend on internet service upgrades based on whether or not the respondent runs a business from their home.

When compared to those without home-based businesses, a greater percentage of respondents running businesses from home were willing to pay more for upgraded service. 16.6 percent of respondents that run a home-based business were willing to pay an additional $70 or more for upgraded internet service.

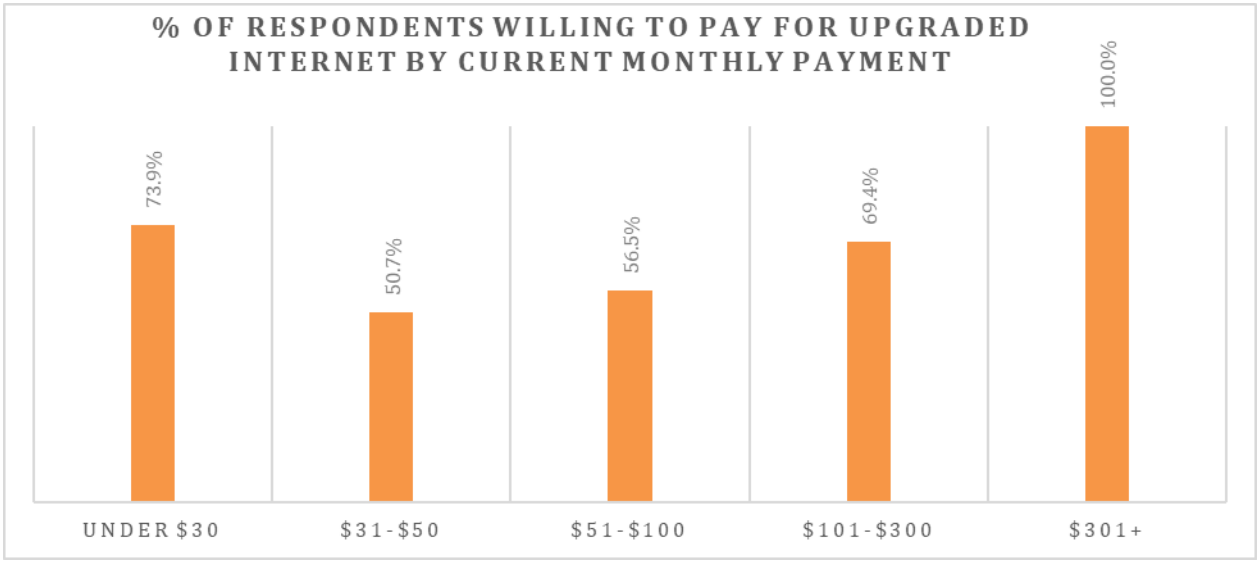

Figure 3. Chart showing the percentage of respondents willing to pay for upgraded internet service based on their current monthly payments.

CED staff also examined survey responses for relationships between the cost of respondents' current internet service and satisfaction and interest in upgrading. Interestingly, the extremes in terms of monthly internet costs showed the most interest in upgrading their service, with 73.9 percent of those spending under $30 per month and 100 percent of those paying over $300 per month expressing willingness to upgrade their internet service. A similar trend is found when comparing monthly bills and levels of satisfaction. Only 13 percent of those spending under $30 per month on their internet service felt their needs were met, while none of the respondents paying over $300 per month were completely satisfied with their service. The highest percentage of

satisfaction was found among those paying between $31 and $50 per month for their service with 32 percent of respondents indicating that they are completely satisfied with their internet service. When looking at current monthly cost and willingness to spend on upgrades, most respondents indicated that they would be willing to spend $31-$40 more per month for upgraded internet services.

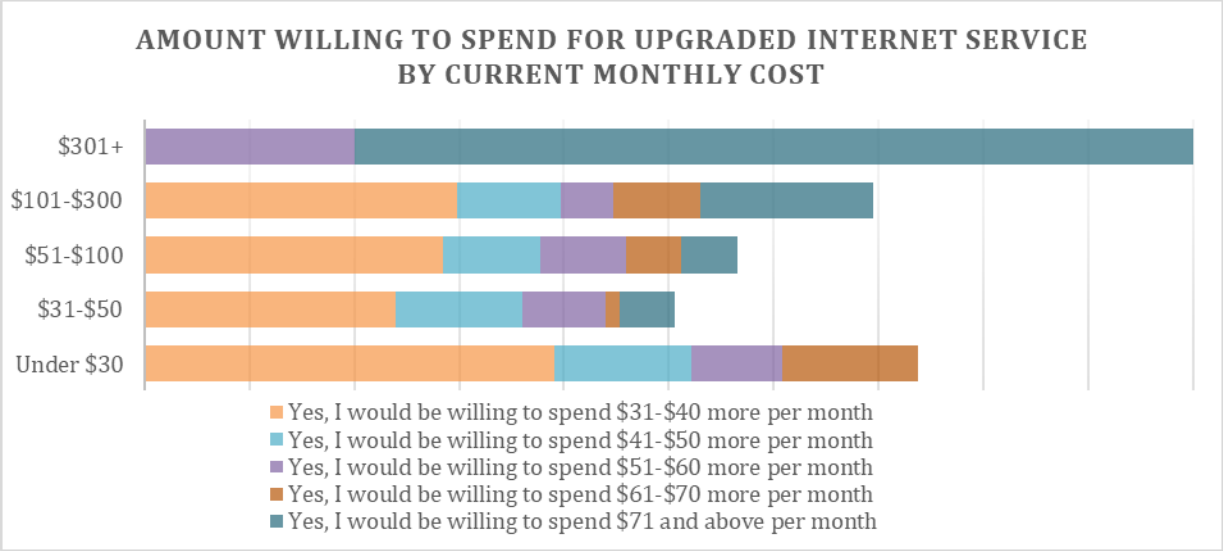

Figure 4. Chart the amount respondents are willing to pay for upgraded internet service and the amount they would be willing to pay for that service based on their current monthly payments.

CED staff also examined survey data for relationships between the type of technology currently providing respondents with internet service and their level of satisfaction. The highest rate of satisfaction was found among those with fiber connections with 40.5 percent indicating that they were completely satisfied with their service. The technology with second highest levels of satisfaction was cable with 26.1 percent of respondents indicating complete satisfaction with their internet service. All of the other technology types (fixed wireless, DSL, cellular, satellite) had a satisfaction rate of under 15 percent. Additionally, CED staff examined responses for relationships between technology type and the respondents' willingness to purchase upgraded internet service if made available. Over 80 percent of those with fixed wireless, cellular, satellite, or no internet service indicated an interest in upgrading their service while 57.2 percent of respondents with cable connections expressed interest in upgrading and 50 percent of those with fiber were interested in upgrading. Lastly, 42.9 percent of respondents with DSL indicated that they were interested in upgrading. While DSL represents the technology with the lowest percentage of respondents interested in upgrading, it should also be noted that this category of technology had the second lowest sample size with only seven respondents.

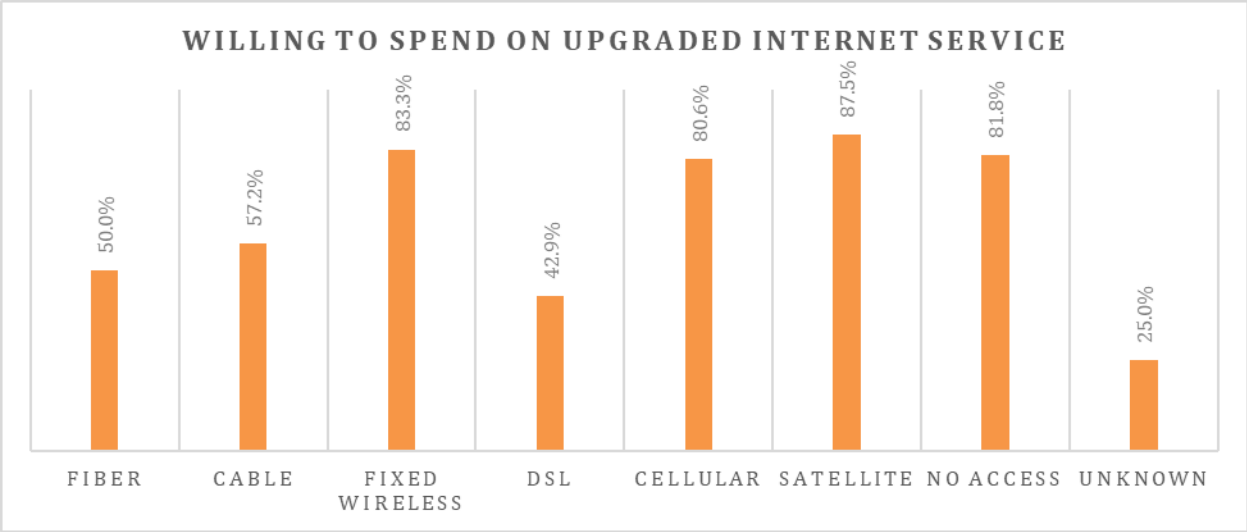

Figure 5. Chart showing the percentage of respondents willing to pay for upgraded internet service based on their current service technology.

Finally, CED staff examined the relationship between the amount of time respondents regularly spend on the internet and their interest in upgrading their internet service. Generally, respondents who regularly spend more time on the internet showed an increased interest in upgrading their internet service. 54.9 percent of respondents who spend four or fewer hours on the internet per day and 55.7 percent of respondents who spend five to nine hours on the internet per day showed interest in upgrading. 70.9 percent of respondents who spend ten to fourteen hours on the internet per day showed interest in upgrading, while 62.2 percent of those who spend more than fifteen hours on the internet per day expressed interest in upgrading.

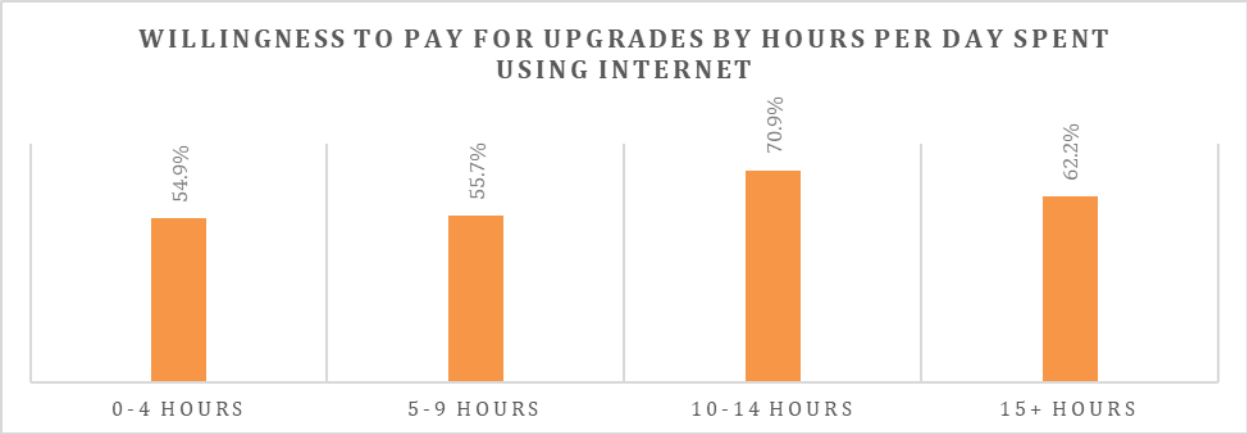

Figure 6. Chart showing the percentage of respondents willing to pay for upgraded internet service based on their current internet usage.

Projections

Residential/Population Projections

Population projections were prepared assuming an occupancy rate of 100 percent for the projected number of dwellings in Town of Paradise, which is based on the Paradise Sewer Project dwelling projections. Given that the town is in the process of rebuilding, CED staff worked under the assumption that homes were rebuilt with the express purpose of being filled, therefore giving an occupancy rate of or near 100 percent. The projected population numbers were determined by multiplying the average number of people per household (2.34), according to U.S. Census data, by the number of dwellings.

Table 1. 2020-2027 population projections for the Town of Paradise.

Year	Number of Dwellings	Projected Town Population
2020	2,201	5,150
2021	2,323	5,435
2022	2,451	5,736
2023	2,587	6,054
2024	2,731	6,391
2025	2,847	6,663
2026	2,969	6,947
2027	3,095	7,243

School Enrollment Projections

School enrollment projections show a slowly decreasing trend in school enrollment from the 2020-2021 academic year through 2023-2024 academic year. However, from 2024-2025 on, school enrollment begins to trend upward from the low of 1,709 projected enrolled students in the 2023-2024 academic year to a high of 1,875 in the 2026-2027 academic year (8.9 percent increase).

Table 2. 2020-2027 school enrollment projections for the Town of Paradise.

Grade	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
K	207	199	202	180	184	189	193
GR 1	121	173	166	169	151	154	158
GR 2	105	123	176	169	172	153	157
GR 3	102	107	125	179	172	175	156
GR 4	124	103	108	127	181	174	177
GR 5	110	123	101	106	125	179	171
GR 6	130	112	124	103	107	126	181
GR 7	84	130	111	123	102	107	126
GR 8	114	86	131	112	125	103	108
GR 9	123	107	80	123	105	117	97
GR 10	159	126	109	82	125	107	119
GR 11	174	159	126	109	81	125	107
GR 12	168	175	160	127	110	82	126
Total District Enrollment	**1,724**	**1,721**	**1,720**	**1,709**	**1,741**	**1,791**	**1,875**

Public Safety Workforce Projections

CED acquired 911 call data from Butte County that covered the Town of Paradise from 2011 to 2019, this data was used to calculate an annual average of 0.464 emergency calls per person. The annual average was multiplied by the projected population of Paradise through 2027 to determine the projected number of annual calls. The CED then used the projected number of annual calls to determine the number of patrol officers needed based on 2080 hours per year (5 days/week, 40 hours/week, and 52 weeks/year).

Table 3. 2020-2027 public safety workforce projections for the Town of Paradise.

Year	Projected Population	Projected 911 Calls	Projected # of Officers
2020	5,150	2,388.55	2.58
2021	5,435	2,520.47	2.72
2022	5,736	2,660.02	2.87
2023	6,054	2,807.65	3.03
2024	6,391	2,963.83	3.20
2025	6,663	3,090.02	3.33
2026	6,947	3,221.70	3.48
2027	7,243	3,359.13	3.62

Business Projections

CED staff were unable to determine a reliable growth pattern for the Town of Paradise due to the variability of Camp Fire effects and lack of available historical data. To attempt to overcome this limitation, CED staff prepared low-, standard-, and high-growth projections for business in

Paradise. A 2.4 percent rate of growth was used for calculating the low rate of growth projection, while the standard and high projections used growth rates of 5 percent and 7.2 percent, respectively.

Table 4. 2020-2027 business projections for the Town of Paradise.

Year	2.4% Low	5% Standard	7.2% High
2020	776	776	776
2021	795	815	832
2022	814	856	892
2023	833	898	956
2024	853	943	1,025
2025	874	990	1,099
2026	895	1,040	1,178
2027	916	1,092	1,262

Additionally, CED staff was able to obtain survey data, collected after the Camp Fire, from the Paradise Chamber of Commerce and Alliance for Workforce Development regarding business internet needs. It was determined that 14 percent of businesses surveyed lacked necessary internet connections. This ratio was applied to business projections through 2027 to attempt to capture the number of new businesses that would also be in need of suitable internet connections.

Table 5. 2020-2027 business broadband need projections for the Town of Paradise.

Year	2.4% Low	5% Standard	7.2% High
2020	108	108	108
2021	111	113	116
2022	113	119	124
2023	116	125	133
2024	119	131	143
2025	122	138	153
2026	125	145	164
2027	128	152	176

Health Care

Two questions about use of and demand for online health care services were added to the Paradise Needs Assessment. Of the 1,116 survey respondents, 66.6 percent indicated that they have used health care services online. Of the 370 respondents who had not used online health care services, 52.2 percent indicated they would be interested in using online health care services if they had better access to the internet. When considering all survey respondents, only 15.9 percent expressed having no interest in using online health care services. This data not only reveals that there is a significant demand for online health care services, but that there is also a sizable unmet demand for these services within the Town of Paradise that is compounded by unsatisfactory internet connectivity.

Smart City Assessment and Recommendations

According to the Smart Cities Council, the definition of "smart city" is still not universally agreed upon by professionals in the field due to the concept being relatively new. The Smart Cities Council defines smart city as "one that has digital technology embedded across all city functions" (Smart Cities Council). While this definition may be a bit exclusive, the individual methods employed by those cities that do meet this definition may guide other cities in how to move towards becoming a smart city. Though it may be difficult for some municipalities to embed digital technology in all city functions, cities may still increase operational efficiency by incrementally adopting cutting-edge broadband-based municipal services such as smart parking meters, smart traffic systems, digital information kiosks, smart energy-efficient lights, smart security and monitoring systems, among other services. Smart city services allow municipalities to provide services optimizing human resources and offering more detailed data on the provision and use of these automated services. Municipalities may assess the feasibility (including both technical and financial aspects) of implementing and adopting smart city services and establishing partnerships with internet service providers and technology companies to launch pilot projects in the city.

While the definition of "smart city" may be vague, clear examples of the types of systems used by such cities can be found by viewing case studies of successful smart city integration. New York City has implemented numerous smart city systems to assist with waste management, air quality control, water management, park management, and public transportation.

To assist with waste management NYC has deployed smart trashcans throughout the city that use wireless sensors to monitor trash levels, allowing for efficiently planned pick-up trips. These smart trashcans also contain their own solar-powered trash compactors, which allows the container to hold up to 500 percent more waste. NYC has also implemented smart city systems to assist with air quality control. Ninety monitoring stations throughout the city monitor air quality and report data in fifteen-minute intervals. These monitoring stations were able to determine a major source of air pollution in the City and sulfur dioxide emissions were reduced by over seventy percent between 2008 and 2019. Due to the City's massive amount of water consumption, the NYC Department of Environmental Protection deployed a large-scale Automated Water Reading (AMR) system that allows citizens to monitor their daily water usage. The AMR system eliminates the need to estimate bills, ensures accurate bills, allows for more accurate monitoring of citywide water consumptions, and is a less expensive way to read water meters when compared to conventional methods. In 2016, NYC launched a new pilot program, installing multi-purpose "smart" benches. These benches provide free mobile charging, but more importantly gather data for the NYC Parks Department on park use. The gathered information is used to assist in better park design, maintenance, and programming. To increase the speed of the City's bus lines, the Better Buses Action Plan was introduced with the goal of improving bus speeds by twenty-five percent over a year. As part of this plan, the City introduced Transit Signal Priority (TSP), a combination of hardware and software that enables traffic signals to sense incoming city buses. The system can then change the signals, giving priority to the city buses, increasing their average and helping them adhere to schedules. This technology has been installed in approximately 600 intersections, directly impacting twelve bus

routes. Additionally, the NYC Department of Transportation has installed over 750 high-speed cameras at intersections to assist with traffic enforcement.

In 2014, New York City initiated LinkNYC, a unique communications network that replaced the City's pay phones with kiosks called Links. The Links are equipped with free high-speed wireless internet, phones, a tablet featuring maps and city services, and charging stations for devices. There are currently over 2,200 Links in the City. LinkNYC is free to users and is funded entirely through advertising revenue. Lastly, through the use of LED lighting retrofits to existing municipal buildings and street lighting, New York City has been able to save over $800,000 dollars a year in energy savings.

While investment in new technologies and enhancements to existing infrastructure are necessary components of smart city development, such advancements also require "a willingness from the city authorities to embrace new ways of working, to make data publicly available where possible, to encourage new ideas and to stimulate the deployment of shared infrastructures such as wireless networks and fiber backhaul" (Toh 2019).

The Brookings Institution's Metropolitan Policy Program co-hosted a forum bringing together officials from cities throughout Europe, Canada and the United States to better understand the potential and practice for smart cities. While the concept of harnessing the aspects of smart cities to promote economic prosperity and innovation is exciting, there is still much work to be done to make smart city development the norm rather than the exception. The Town of Paradise is well-positioned to incorporate its ability to achieve smart city status in its current and future development plans. However, simply drafting a technology-focused economic vision is not enough.

A successful vision or plan will use technology to pursue three drivers for an economy that creates jobs, spurs investment, and provides greater economic and workforce development opportunities. The first is productivity and should support aggregate economic growth and promote efficiencies throughout the public and private sectors. As an example, this study identifies smart city attributes and opportunities for the Town to consider. The second is inclusivity and should support opportunity for all firms and citizens. As stated, broadband is equally important to the future economic success of households, businesses, education, workforce training, and remote access. The third is resiliency and must support more than a sustainable built environment. The rebuild of the Town will be more energy efficient by design. However, often city/town cores generate more aggregate carbon than other parts. Additionally, the community will still be susceptible to natural disasters and other long-term environmental concerns related to climate change. A smart city will understand its global responsibility to adopt sustainable policies and make environmentally-friendly investments (Tomer and Puentes, 2014).

Parks:

Smart parks use technology to improve park services, community health, safety, water and energy efficiency, and decrease long-term costs. Like many smart city improvements, smart park technology often requires substantial initial investment, but the long-term reduction in the costs of running and maintaining the parks make up for these initial capital investments. These cost reductions are achieved by technology assisting park management personnel in efficiently

maintaining and operating parks while conserving water and energy resources (Loukaitou-Sideris 2019).

The publication, "SMART Parks: A Toolkit," produced by the Luskin Center for Innovation at UCLA provides extensive and detailed descriptions of the technologies that can be implemented in SMART Parks. The Toolkit includes a wide variety of technologies to improve efficiency and operations in the areas of landscaping, irrigation, stormwater, hardscaping, activity spaces, urban furniture and amenities, lighting, and "digiscapes."

Technologies that can improve landscaping in Paradise parks include automatic lawn mowers, near infrared photography, green walls, air-pruning plant containers, and vibrating pollinators. Automatic lawn mowers are electric, reducing air pollution, carbon dioxide emissions, and energy costs. Additionally, automatic lawn mowers can reduce the cost of hands-on maintenance and landscaping. Near infrared photography is effective at measuring photosynthesis levels and thus plant health in large parks. Green walls include growing vegetation on any vertical wall or structure and increase planted areas, contribute to the park and ecosystem, offer cooling effects, and enhance visitor experience (Loukaitou-Sideris 2019). Air-pruning containers can be used to improve plant health and ability to withstand stress, while simultaneously reducing the need for repotting, resulting in reduced maintenance costs (Loukaitou-Sideris 2019). Lastly, vibrating pollinators can improve parks with edible food gardens by increasing yield and can be used as educational tools (Loukaitou-Sideris 2019).

Park irrigation in Paradise may be improved through such technologies as smart water controllers, low-pressure and rotating sprinklers, subsurface drip irrigation, smart water metering, and greywater recycling (Loukaitou-Sideris 2019). Smart water controllers can help manage and reduce water usage, as well as maintenance costs (Loukaitou-Sideris 2019). Low-pressure and rotating sprinklers can be installed without extensive infrastructure upgrades and can help conserve water. Subsurface irrigation can also greatly increase water efficiency, especially when paired with other smart irrigation technologies (Loukaitou-Sideris 2019). The amount and types of data smart water meters collect is dependent on the type of meter used. Less expensive systems collect data on water usage, while more expensive smart water meters can also detect leaks or other irrigation problems (Loukaitou-Sideris 2019). Lastly, greywater recycling, which uses wastewater as a replacement for potable water for irrigation, can extend the value of used water, enhance plant growth, and reduce overall water use in parks (Loukaitou-Sideris 2019).

There are several technologies that can assist Paradise park managers with stormwater management, such as engineered soils, real-time control and continuous monitoring and adaptive control (CMAC), rainwater harvesting, and underground storage basins (Loukaitou-Sideris 2019). Engineered soils can improve the treatment of pollutants and infiltration of water (Loukaitou-Sideris 2019). Real-Time Control and CMAC systems "can control the function of infrastructure based on weather predictions and real-time data to effectively utilize capacity, capture water, and remove pollutants" (Loukaitou-Sideris 2019). Rainwater capture systems can help manage stormwater and conserve water for irrigation (Loukaitou-Sideris 2019). Lastly, underground basins, when combined with rainwater capture and irrigation technologies can help manage floods and reduce water costs (Loukaitou-Sideris 2019).

Utilizing technology to capture, monitor and control water functions can also contribute to "regenerative firescaping". For example, orchards can provide ember traps provided that the tree spacings are offset from one row to the next Irrigated orchards increase moisture and decrease the intensity of an advancing fire front. Fruit and nut bearing trees are typically quite sappy and have high moisture content. Though they may be damaged or killed in the fire, orchards can provide a tremendous boost to structure survivability (7th Generation Design, 2019).

There are a number of technologies that can be used to improve the hardscaping of Paradise parks, including cross-laminated timber, pervious paving, piezoelectric energy-harvesting tiles, self-healing concrete, photocatalytic titanium dioxide coating, daylight fluorescent aggregate, and carbon upcycled concrete (Loukaitou-Sideris 2019). Cross-laminated timber can be used to replace standard wood, steel, and concrete materials, reducing carbon emissions and cost (Loukaitou-Sideris 2019). Permeable pavement can be used in place of traditional concrete or asphalt and allows water infiltration into the soil (Loukaitou-Sideris 2019). Piezoelectric tiles generate electricity from mechanical pressure and can be installed in highly trafficked areas to supplement park energy costs, while also collecting information on park visitors (Loukaitou-Sideris 2019). Self-healing concrete can be used to prevent and fix microcracks in traditional concrete, reducing maintenance costs and prolonging the lifespan of park hardscaping (Loukaitou-Sideris 2019). Photocatalytic titanium dioxide-coated surfaces are self-cleaning, kill bacteria and mold, and remove pollutants from the air (Loukaitou-Sideris 2019). Ultimately, Photocatalytic titanium dioxide-coated surfaces reduce water use and maintenance costs while also providing the health benefits associated with the removal of pollutants Photocatalytic titanium dioxide-coated surfaces. Daytime fluorescent aggregates can provide electricity-free illumination when used as a coating for surfaces and paths (Loukaitou-Sideris 2019). Lastly, carbon upcycled concrete can be used in place of traditional concrete, is nearly carbon neutral, and can be prefabricated using 3D-printing technology, reducing construction time and cost (Loukaitou-Sideris 2019).

There are also many technologies that can create more attractive and successful activity spaces in city parks, including interactive play structures, high-performance track surfaces, pool ozonation, energy-generating exercise equipment, and hard-surface testing equipment (Loukaitou-Sideris 2019). Interactive play structures can serve as educational tools, improve citizen health by promoting physical activity, and increase access to parks for children with disabilities (Loukaitou-Sideris 2019). High-performance track surfaces impart health benefits to park users by decreasing the strain on users' joints while also being weather-resistant, reducing long-term upkeep costs (Loukaitou-Sideris 2019). Pool ozonation can replace traditional chlorine-based pool cleaning methods, uses less water, and requires less maintenance than traditional methods (Loukaitou-Sideris 2019). Energy-generating exercise equipment can be used to provide power to other electronic amenities, like phone chargers, while also encouraging visitors to use the equipment (Loukaitou-Sideris 2019). Lastly, hard-surface impact testing equipment can be used to assess and improve park safety (Loukaitou-Sideris 2019).

Park furniture and amenities can also be improved by technologies, such as smart benches, solar shade structures, solar-powered trash compactors, smart water fountains, and automatic bicycle and pedestrian counters (Loukaitou-Sideris 2019). Smart benches can provide park visitors with

internet access, track park usage, and gather environmental data, resulting in more efficient park management (Loukaitou-Sideris 2019). Solar shade structures provide protection from the sun like traditional shade structures while also generating electricity and provide services, such as phone charging (Loukaitou-Sideris 2019). Solar-powered trash compactors can be installed in receptacles to enhance collection and prevent overflows, among other benefits (Loukaitou-Sideris 2019). Smart water fountains can save energy and reduce costs while also promoting public confidence in water quality (Loukaitou-Sideris 2019). Lastly, automatic bicycle and pedestrian counters can assist in park management by tracking the usage of parks (Loukaitou-Sideris 2019).

Park lighting can also be improved through smart technologies, such as motion-activated sensors, LED and fiber optic lighting, and off-grid light fixtures (Loukaitou-Sideris 2019). Motion-activated lights can increase park security while also using less energy than standard lighting. LED and fiber optic lighting can be used to minimize energy consumption while also enhancing park aesthetics (Loukaitou-Sideris 2019). Off-grid lighting with renewable energy sources can actually be cheaper to install than traditional lighting and reduces long-term energy costs (Loukaitou-Sideris 2019).

Parks can also be improved using "digiscapes," technologies that collect data on park use and visitors that can then be used to improve park services, access, safety, programming, and operations (Loukaitou-Sideris 2019). These technologies include Wi-Fi and geographic information systems and services, among others. Free public Wi-Fi has the potential to attract many more citizens to parks and can also provide reliable communication during emergencies or when cellular networks are down (Loukaitou-Sideris 2019). GIS mapping technology can be used to streamline and improve many park functions and assist in park management and planning (Loukaitou-Sideris 2019).

Waste Management:

Waste management is another aspect of municipal operations that the Town of Paradise may find benefits from smart technology improvements. Integrating smart technologies into Paradise's waste management system can help to improve efficiency, reduce costs, and enhance the beauty of public areas ("Smart City Waste Management" 2020). The various technologies that can improve waste management include Internet of Things (IoT) sensors, high-performance networks, management platforms, and data analytic software ("Smart City Waste Management" 2020). Smart waste management uses IoT technology, such as specialized sensors and wireless communication technology to provide waste management staff with detailed information regarding trash and recycling bins, including when they need to be emptied, when odor has become a problem, when bins have been tipped over, and the temperature inside the bins ("Smart City Waste Management" 2020). This information helps waste management staff perform their jobs more effectively and efficiently and can be used to improve the living conditions of residents ("A Smart Waste Management Solution . . ." 2020). Smart waste management systems require high-speed networks to transmit the data collected by IoT sensors, while waste management personnel require suitable management platforms and data analytics to receive and review this data effectively ("Smart City Waste Management" 2020).

The various benefits of using smart technologies to improve waste management include lower costs, reduced maintenance, cleaner public spaces, reduced traffic congestion and carbon emissions, and more effective management ("Smart City Waste Management" 2020). IoT sensors can eliminate unnecessary waste pick-ups, reducing operating and maintenance costs ("Smart Cities Readiness Guide" 2020). Fewer pick-ups also mean a longer lifespan for department vehicles and equipment ("Smart City Waste Management" 2020). With sensors that can detect and alert waste management staff of overflowing or malodorous trash bins cities can quickly address these issues before they become more problematic ("Smart City Waste Management" 2020). Fewer pick-ups also mean fewer garbage vehicles on the road causing traffic congestion and also reduces the amount of fuel used and thus carbon emissions released into the atmosphere ("Smart City Waste Management" 2020). Smart waste management technologies can also be used to monitor the extent to which Paradise residents participate in waste reduction programs and practices, such as recycling ("Smart Cities Readiness Guide" 2020). Smart technologies also help public works departments manage and communicate with the vendors employed to assist with garbage and recycling collection and processing ("Smart City Waste Management" 2020).

Emergency Management and Public Safety:

Smart city technologies can be utilized to increase the efficiency of emergency response and manage safety systems. Smart technologies integrated into buildings can actively communicate with nearby buildings and with emergency facilities in a constant network. This means that everything involved in the emergency response process, detectors, alarms, camera systems, traffic systems, call centers, and responders could be constantly monitored and synchronized to maximize coordination and virtually eliminate communication lag (Schwichtenberg).

Surveillance and Sensors

Traditionally, video monitoring is the primary method of citywide surveillance. Video surveillance has been a powerful tool for preventing and solving crimes in many cities by identifying perpetrators and suspects. While video surveillance remains an effective law enforcement tool, new technologies have also been implemented to assist local police in preventing and responding to potential criminal activity. In some cities, new types of sensors are being deployed, including sensors that can detect gunshots and locate their source using sophisticated audio techniques ("Guide to Fiber Optics and Premises Cabling").

Fire:

Internet of Things networks in smart cities create a wide-reaching network of low power sensors that can transmit various data from a large number of devices quickly over wide distances. Such a system has considerable potential for any emergency, but its application for fighting fires stands out. Smoke and temperature detectors can actively communicate with emergency workers and people in potential danger to ensure quick response times and efficient evacuations (Murphy and Tracy). A network of heat-resistant temperature sensors can also monitor growth patterns of spreading fires so that they can be combated more efficiently, potentially decreasing the damage

caused in these events (Goldstein). The status of detectors can also be constantly monitored, ensuring that they are all operating properly at any given time. IoT sensors on firefighters themselves can be used to communicate their location and vital statistics in real time and reduce the risk imposed on them, and the systems in place at the location of a fire, be it a high-rise or a forest, can help emergency workings in mapping and traversing otherwise unknown environments (Goldstein). Smart systems within buildings can also be used to eliminate the need for firefighter intervention at all using smart sprinkler systems that can localize spray in rooms where the fire is present while also monitoring the current status of that fire and communicating that information to those on the outside (Goldstein).

Air Quality:

Health complications due to poor air quality are common and kill millions of people around the world every year. In California, where air quality is notoriously poor, the use of smart technologies to monitor and communicate air quality information could be used to great effect in reducing a population's exposure to harmful air.

Air quality is not constant across regions and can experience considerable variation within the space of several city blocks. Therefore, the small number of sensors most cities utilize are not sufficient to gauge air quality (Samms). The implementation of a network of sensors can provide many benefits by communicating current air quality in real time to public and private individuals by neighborhood instead of by city and by identifying "hot spots" that are prone to poor air quality. The data these sensors gather can also be accumulated across months and years to gain a better understanding of how air quality affects local health.

A city has several options on how to implement air quality sensors. The first and most commonly used method is simply adding more sensors to static infrastructure such as buildings and utility poles. This technology allows for reliable and complex measurements that can track changes in air quality and composition instantaneously and across time. These static sensors tend to be expensive per unit primarily due to installation and maintenance costs, though the benefits could be increased if the sensors are utilized in a fire-monitoring network as well (Bousquet). Another option is to install much smaller and less expensive sensors onto mobile structures such as police vehicles, drones, or bicycles (Samms). These devices can then collect data across the entire city using fewer units; however, this method does not allow for constant measurement in individual areas like a static sensor (Bousquet). Pairing either of these sensor types with the mobile phones of residents can provide further understanding by recording where common foot travel takes place. If it appears to be the case the people are regularly being exposed to poor air quality, then mitigation efforts can be directed with greater focus (Samms). Another option that cities have used involves taking data from a smaller number of fixed sensors and using advanced modeling from environmental data companies to accurately predicted air quality in areas where there are no sensors (Samms).

Transportation and Traffic Management:

There are several smart technologies that can assist city staff with transportation and traffic management, including smart traffic signals, video and radar traffic monitoring, and creating a communications environment that facilitates future autonomous traffic using vehicle-to-vehicle and vehicle-to-infrastructure feedback. While autonomous vehicles have many advanced technologies allowing them to drive without user input, many engineers involved in developing smart cities suggest that these vehicles will be most effective and safer if they are able to communicate with smart city services such as smart traffic signals, traffic signs, information from video surveillance ("Guide to Fiber Optics and Premises Cabling").

Public Services

Smart city technologies can also be used to monitor and control public utilities. Smart technologies used to manage electricity, water, sewer, gas, etc. can make them more efficient and economical. Electrical grids can be improved with smart technologies to allow for the integration of alternative energy sources into traditional generation and distribution ("Guide to Fiber Optics and Premises Cabling").

Data Centers

To make full use of the plethora of available smart city technologies, the Town of Paradise may require a data center with sufficient storage, computing power, and communication capabilities to process, analyze, and transmit the data generated by the town's smart technologies. The data center could be a city facility, but it could also be a cloud service hosted in the city. Such a data center would require a high-speed and stable internet connection ("Guide to Fiber Optics and Premises Cabling").

Partnerships

Effective implementation of smart city technologies requires cooperation. While the services mentioned already exist in some cities, they are often privately owned and operated. Synergistic implementation of smart technologies as well as partnering efforts are highly recommended. For example, through proper partnering efforts and coordinated installations, streetlights could fulfill numerous functions, including providing lighting, video and/or radar for surveillance and traffic management, Wi-Fi for private and public use including vehicle communications, locations for small cell telecommunications, and weather and pollution monitoring (Guide to Fiber Optics and Premises Cabling").

Public Engagement and Privacy Concerns

For the implementation of smart city technologies to be successful, municipalities must engage with the community to make the benefits of these technologies clear, and to promote an atmosphere of transparency ("What's Fueling the Smart City Backlash?"). Citizens can often be wary of data collecting smart city technologies, as they fear these tools may invade their privacy (Stone).

Whether cameras used to deter and monitor crime or IoT sensors collecting data on resident activities, many citizens can be resistant to the installation of these devices (Stone). One method of alleviating these concerns is proper transparency and education regarding these technologies (Stone). Additionally, local governments should implement data privacy policies directly addressing the concerns of their citizenry regarding smart technologies (Oliveira, Oliver, and Ramalhinho).

London's congestion charging model is a prime example of smart city implementation that received significant public resistance and scrutiny, but was ultimately successful due to a detailed implementation strategy, and careful stakeholder management ("Congestion Charging . . ."). London's congestion charging model, intended to reduce congestion by bringing about a modal shift away from single passenger vehicles in central London ("Congestion Charging . . ."). The ultimate success of the plan was due to a detailed implementation strategy, and careful stakeholder management. The model was designed to reduce traffic congestion by charging a fee to single-passenger vehicles in central London using cameras and an Automatic Number Plate Recognition (ANPR) system ("Congestion Charging . . ."). City staff, including the mayor, developed a method of gaining support from stakeholders by engaging with them throughout the design of the model ("Congestion Charging . . ."). The mayor released a discussion paper titled, "Hearing London's Views," to nearly 400 key stakeholders in 2000 ("Congestion Charging . . ."). This was then followed by a second paper, "Transport Strategy," being released for public consultation. The second paper received approximately 8,000 responses ("Congestion Charging . . ."). By taking this transparent approach to the development and implementation of their plan, the City of London was able to modify the plan to both meet the cities goals while also addressing a host of public concerns ("Congestion Charging . . .")

Inventory of Internet Service Providers, Technologies, and Speeds

In this section, we have provided an inventory of broadband assets in the Town of Paradise. We have included an inventory of regional ISPs and their maximum advertised download speeds. Also included is the served status of Paradise residents, households, housing units, and census blocks. To provide visual reference for consumer broadband coverage in Paradise, a series of maps depicting coverage by ISP and technology type have been included. Additionally, an aggregate coverage map and map displaying the served status of areas within Paradise have been included.

Table 1 displays the served status of Paradise residents in terms of census blocks, households, housing units, and population. Currently, 1,538 of the 1,687 households in the Town of Paradise are currently served at adequate speeds based on the CPUC standard of 6 Mbps downstream and 1 Mbps upstream. Nearly 400 Paradise citizens are without adequate broadband service.

Table 6. Paradise served status under the CPUC standard of served, 6 Mbps download/1 Mbps upload.

Served Status 6 Down and 1 Up	Census Blocks	Households 2020	Housing Units 2020	Population 2020
Served	209	1,538	1,615	4,246
Unserved – Slow Service	3	4	4	12
Unserved	123	145	157	386
Paradise Totals	335	1,687	1,776	4,644

Table 2 displays the ISPs currently located in the Town of Paradise. There are currently six ISPs serving the Town of Paradise; however, two of these ISPs (MCI and TPx Communications) only provide business-class internet, and do not provide internet service to local consumers. The four remaining ISPs (AT&T, Comcast, Digital Path, and Shastabeam) provide internet service to Paradise residents using a variety of technologies, including Asymmetric xDSL, ADSL2, ADSL2+, fiber, cable, and terrestrial fixed wireless. AT&T currently offers the highest download speeds in Paradise of 1,000 Mbps or 1 Gbps through fiber technology. Comcast offers the second highest speeds of 986.5 Mbps through cable technology. Digital Path and Shastabeam offer internet service at considerably lower speeds of 25 and 20 Mbps, respectively. Comcast currently serves the largest number of census blocks (199) in Paradise, followed by AT&T (80), Digital Path (3), and Shastabeam (1).

Table 7. Inventory of internet service providers, service type, broadband technology, and maximum advertised download speed.

Provider	Service	Census Blocks	Technology Code	Technology Name	Maximum Advertised Download Speed (Mbps)
AT&T Service, Inc.	Consumer	26	10	Asymmetric xDSL	6
AT&T Service, Inc.	Consumer	21	11	ADSL2, ADSL2+	18
AT&T Service, Inc.	Consumer	80	50	Fiber to the end user	1000
AT&T Service, Inc.	Consumer	3	70	Terrestrial Fixed Wireless	10
Comcast	Consumer	199	43	Cable Modem DOCSIS 3.1	986.5
Digital Path, Inc.	Consumer	3	70	Terrestrial Fixed Wireless	25
Shastabeam	Consumer	1	70	Terrestrial Fixed Wireless	20
Comcast	Business	295	43	Cable Modem DOCSIS 3.1	Not provided
Digital Path, Inc.	Business	55	70	Terrestrial Fixed Wireless	25
MCI	Business	2	30	Other Copper Wireline	1.544
Shastabeam	Business	1	70	Terrestrial Fixed Wireless	20
TPx Communications	Business	2	30	Other Copper Wireline	10
TPx Communications	Business	1	50	Fiber to the end user	5

Fixed Consumer Broadband Maximum Advertised Downstream Speed

Figure 7 shows the maximum advertised download speeds of fixed wireline service in Paradise as of November 2020. The overwhelming majority of Paradise currently has advertised download speeds of 500 Mbps or greater. A large portion of these served sections of Paradise have advertised download speeds of 1 Gbps or greater. Smaller scattered areas throughout the town are without service while two small locations are served with speeds of 25-50 Mbps, and another with speeds of 6-10 Mbps.

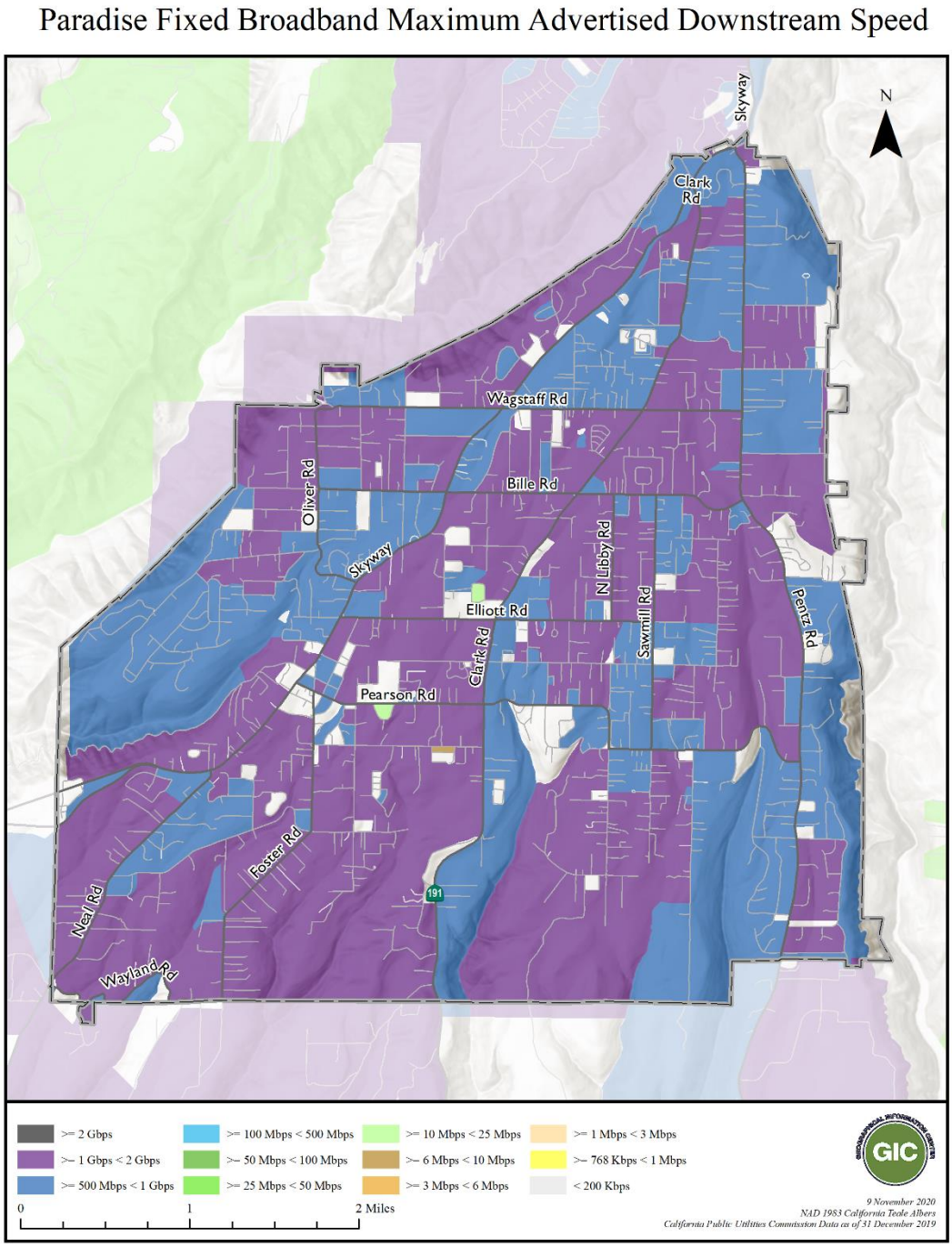

Figure 7. Fixed broadband maximum advertised downstream speeds in Paradise (November 2020)

Fixed Consumer Broadband Served Status

Figure 8 shows fixed broadband served status of consumers in Paradise as of November 2020. Served status was based on the California Public Utilities Commission's (CPUC) definition of served being download speeds of 6 Mbps and upload speeds of 1 Mbps. While most of Paradise is served, there are approximately fifty scattered small areas throughout the town that are currently unserved and three others that have slow service.

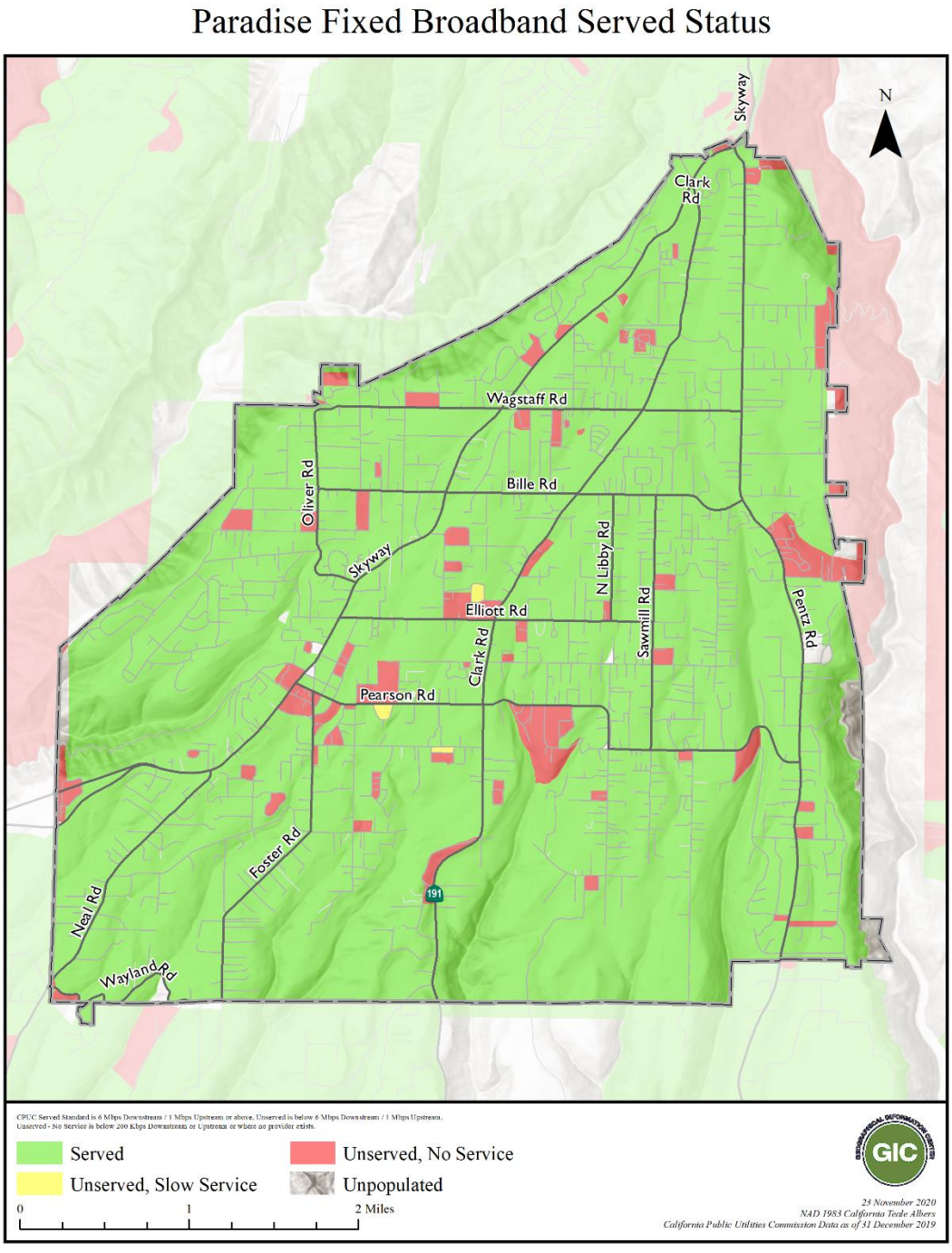

Figure 8. Fixed Consumer Broadband Served Status in Paradise (November 2020)

AT&T California

AT&T offers a mix of Asymmetric xDSL, ADSL2 and ADLS2+, fiber, and fixed wireless technologies to consumers in Paradise. Figure 9 shows broadband speeds offered through ADSL2 and ADSL2+ by AT&T in Paradise (November 2020). While some regions of Paradise are served with speeds of 10-25 Mbps, and others with slower speeds varying between 1 and 10 Mbps, the majority of Paradise remains unserved by AT&T's ADSL2 and ADSL2+ technologies.

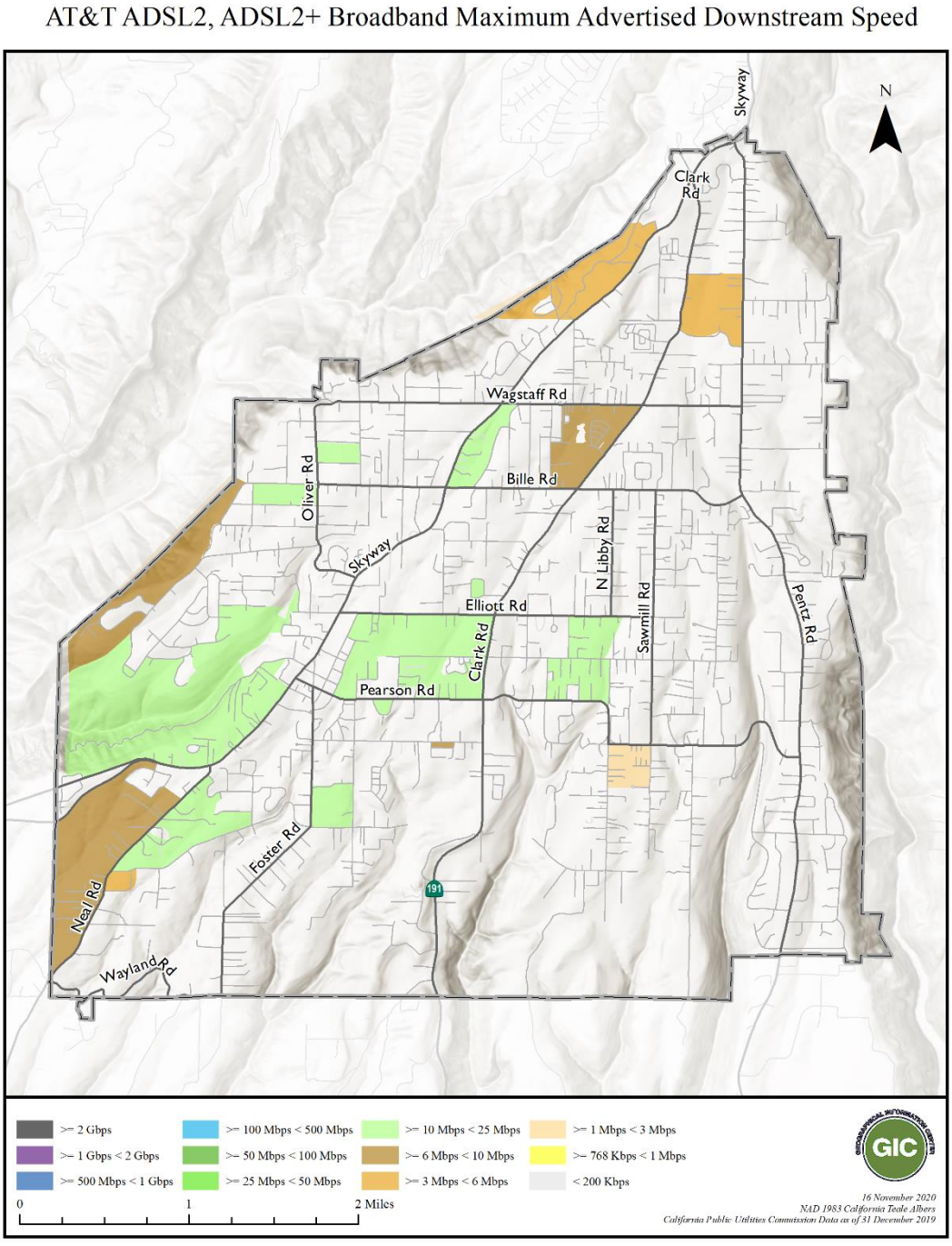

Figure 9. ADSL2, ADSL2+ consumer broadband maximum advertised download speed offered by AT&T California in Paradise (November 2020)

Figure 10 shows broadband speeds offered through Asymmetric xDSL by AT&T in Paradise (November 2020). Many scattered areas throughout Paradise receive service with download speeds varying between 3-10 Mbps; however, the majority of Paradise remains unserved by AT&T's Asymmetric xDSL. Additionally, some of the areas served at slower speeds by this technology may not meet the CPUC's definition of "served."

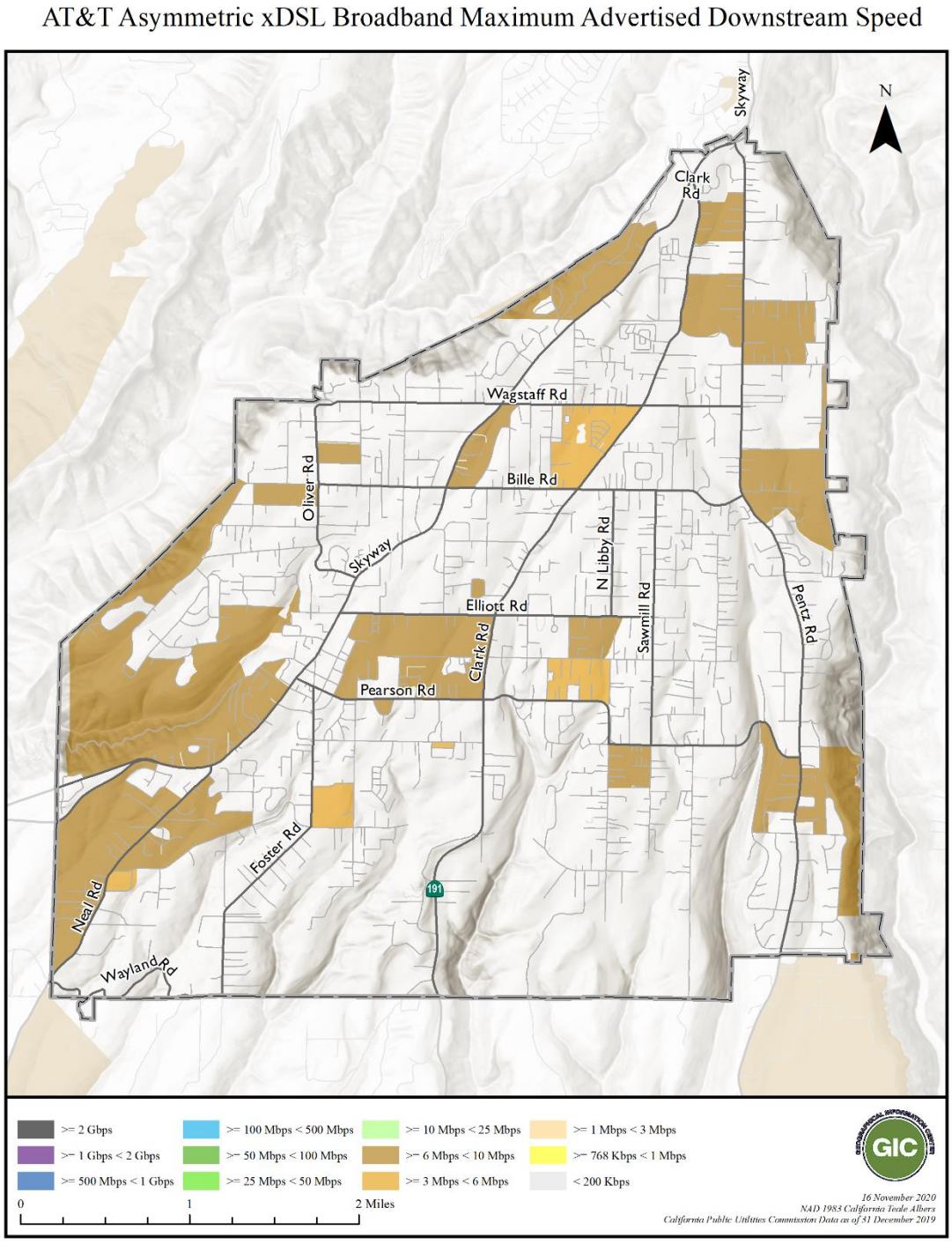

Figure 10. Asymmetric xDSL consumer broadband maximum advertised download speed offered by AT&T California in Paradise (November 2020)

Figure 11 shows broadband speeds offered through fiber by AT&T in Paradise (November 2020). Large portions of Paradise are currently served by AT&T's fiber to the end user technology with download speeds of 1-2 Gbps. While this service is available to much of Paradise, there are still large portions of the town that do not have access to AT&T's high-speed fiber to the end user service.

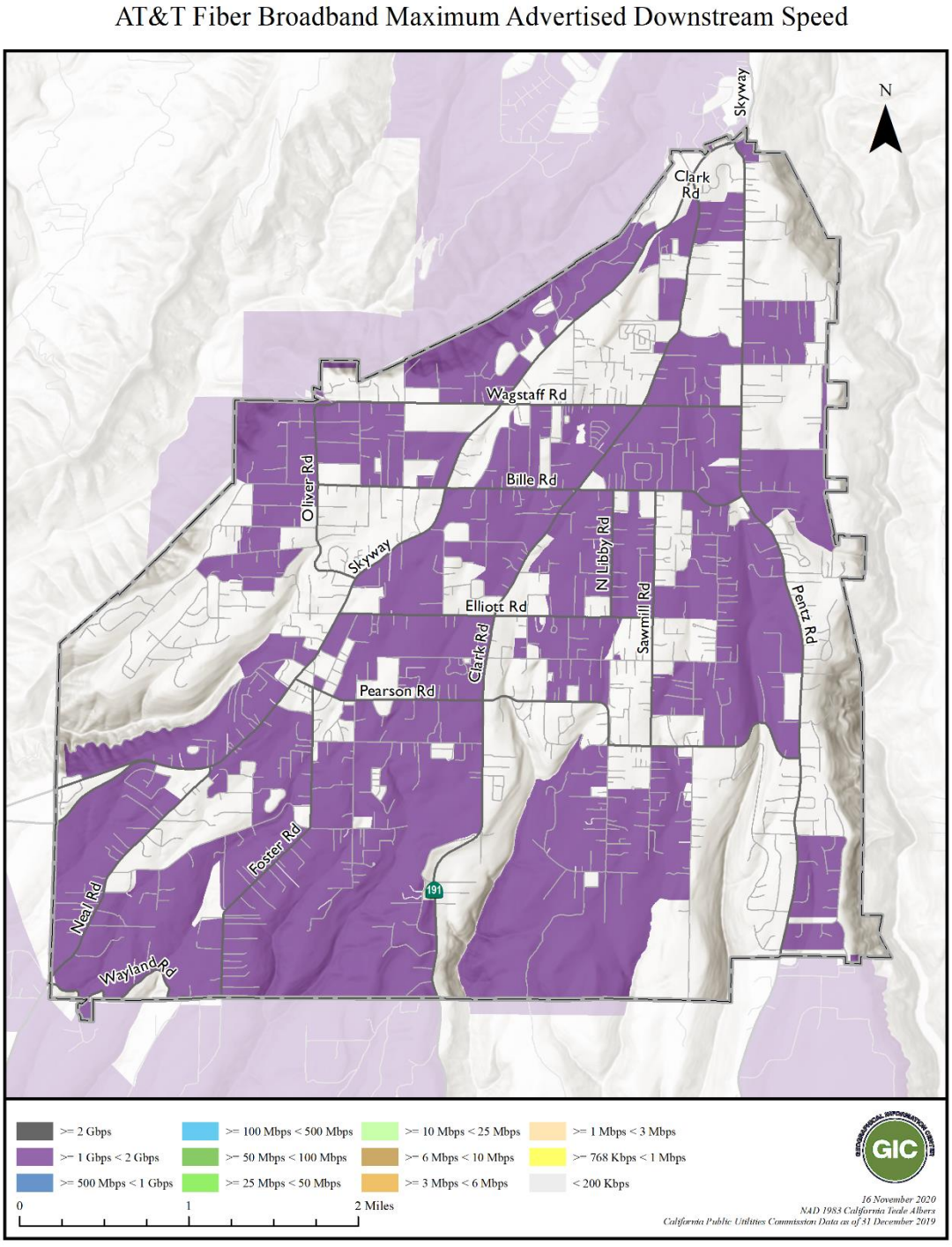

Figure 11. Fiber consumer broadband maximum advertised download speed offered by AT&T California in Paradise (November 2020)

Figure 12 shows broadband speeds offered through fixed wireless by AT&T in Paradise (November 2020). Only three moderately sized areas in southern Paradise are currently served by AT&T's fixed wireless service, the rest of Paradise does not have access to AT&T's fixed wireless service. Download speeds provided by this technology vary from 10-25 Mbps.

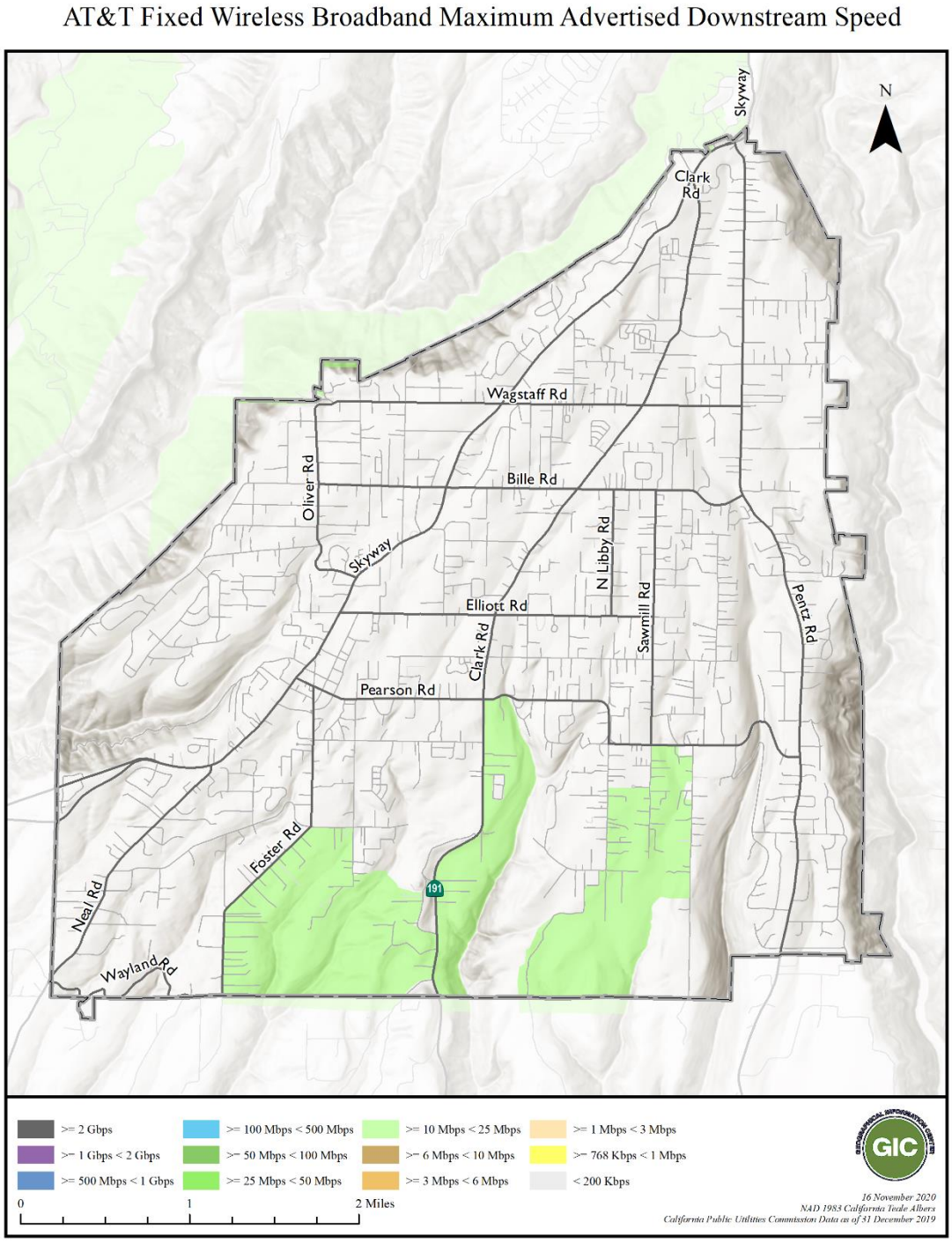

Figure 12. Fixed Wireless consumer broadband maximum advertised download speed offered by AT&T California in Paradise (November 2020)

Comcast

Comcast offers cable broadband services to consumers in Paradise. Figure 13 shows broadband speeds offered by Comcast in Paradise (November 2020). Comcast advertises download speeds of 500 Mbps-1 Gbps throughout the majority of Paradise. Though Comcast coverage is quite extensive, there remains many scattered areas throughout Paradise that remain unserved by Comcast.

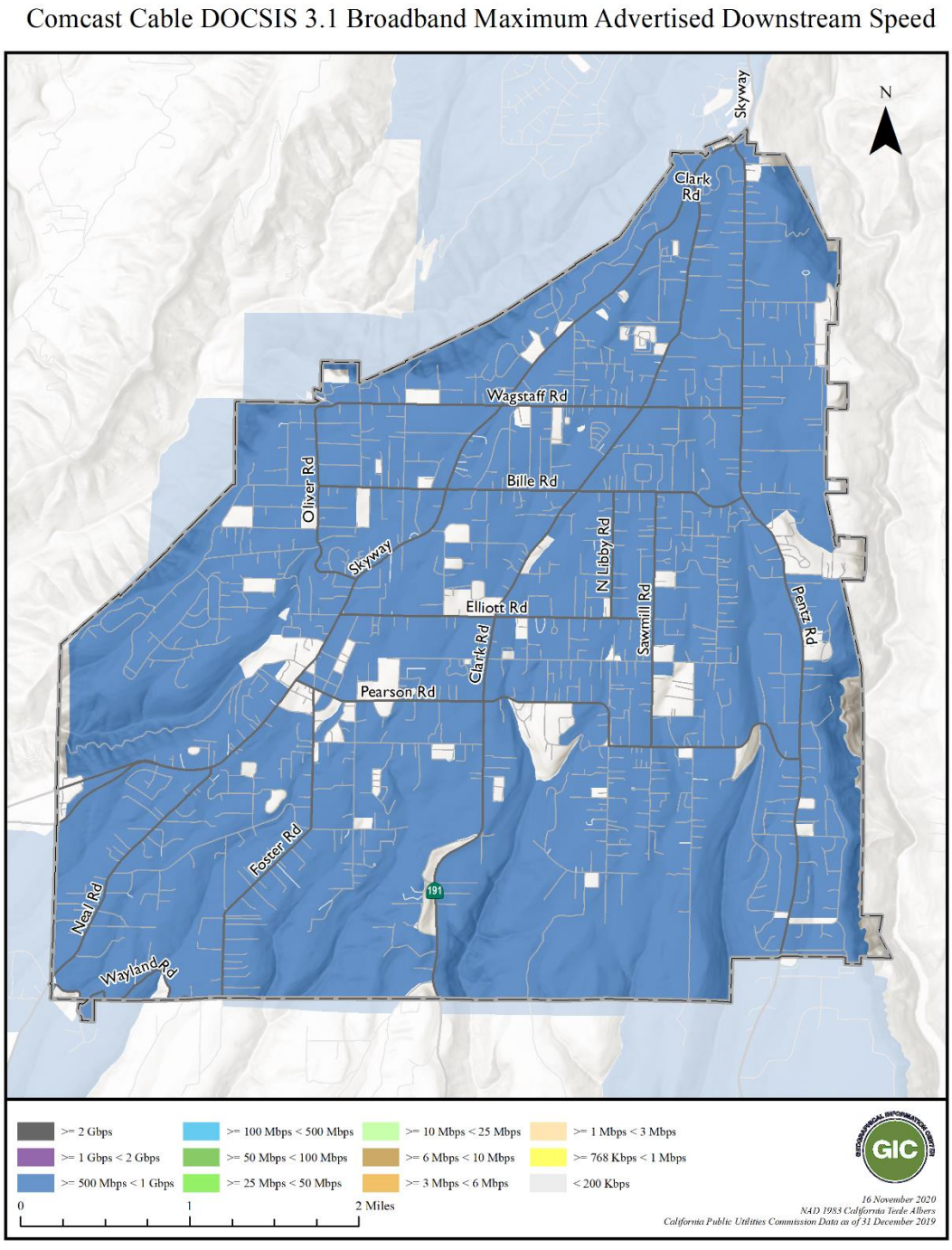

Figure 13. Cable consumer broadband maximum advertised download speed offered by Comcast California in Paradise (November 2020)

Digital Path

Digital Path is a wireless service provider that serves both business and residential customers in central and Northern California. Digital Path provides service to three moderately sized areas in Paradise (Figure 14) with advertised speeds of 10-25 Mbps in the north and 25-50 Mbps in the southern regions.

Digital Path Fixed Wireless Broadband Maximum Advertised Downstream Speed

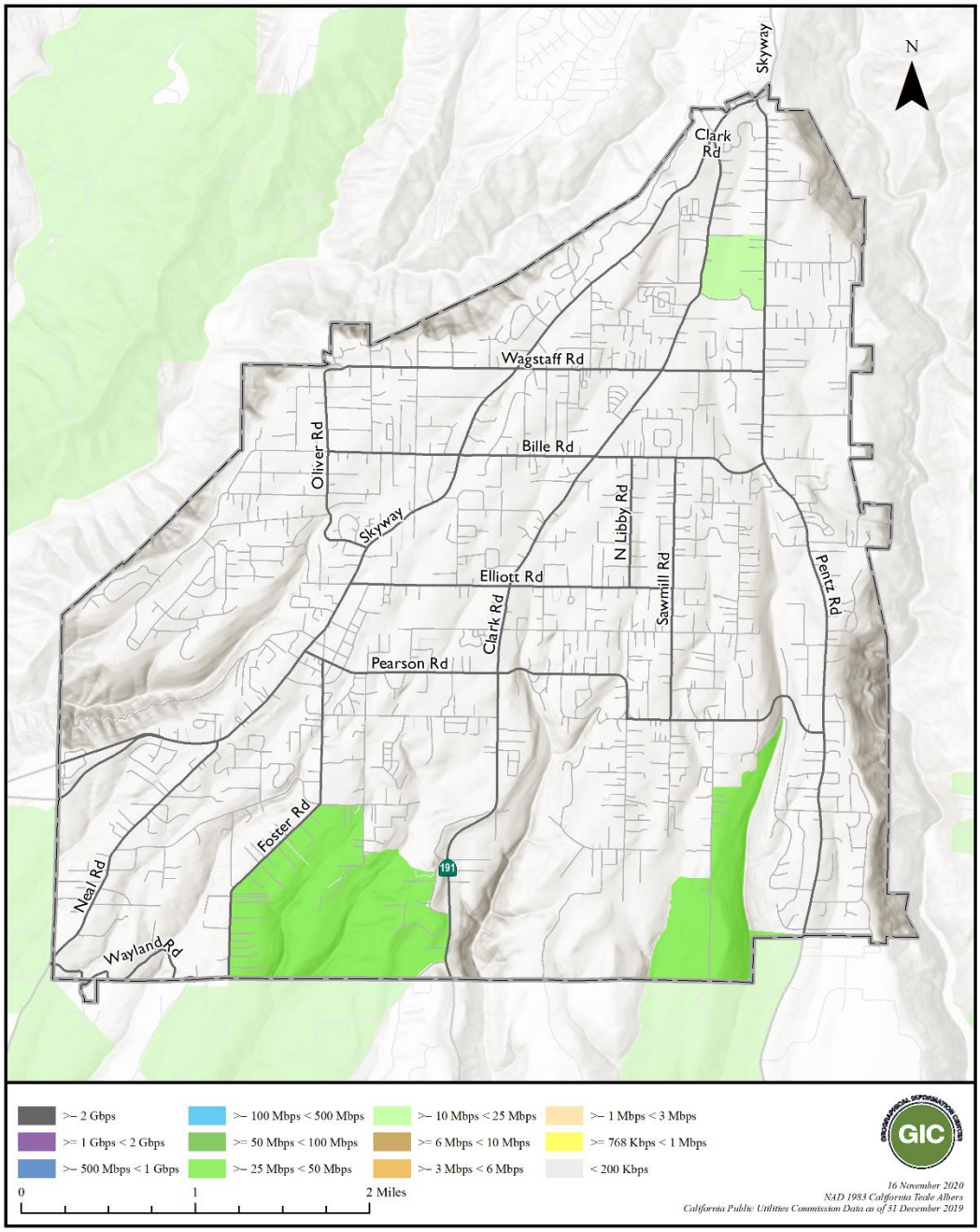

Figure 14. Fixed Wireless consumer broadband maximum advertised download speed offered by Digital Path California in Paradise (November 2020)

Shastabeam

Shastabeam offers broadband via fixed wireless technologies to consumers in Paradise. Figure 15 shows broadband speeds offered to consumers through Shastabeam in Paradise (November 2020). Shastabeam provides internet service with download speeds of 10-25 Mbps in a moderately sized region of southern Paradise.

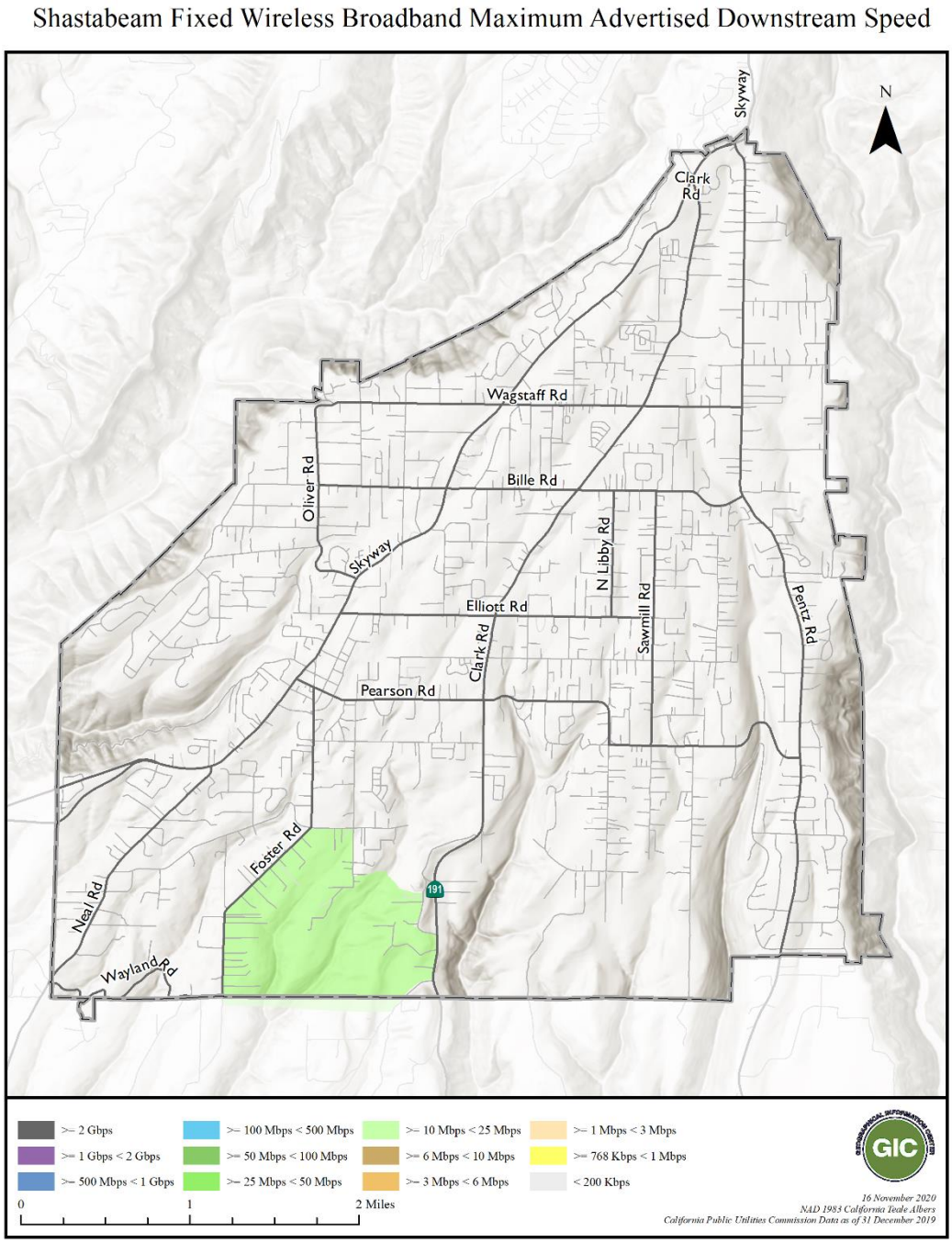

Figure 15. Fixed Wireless consumer broadband maximum advertised download speed offered by Shastabeam California in Paradise (November 2020

Inventory of Town-Owned Assets

Included below is a map of the Town of Paradise with Paradise-owned parcels clearly identified as such. Red represents parcels that are owned by the Town of Paradise.

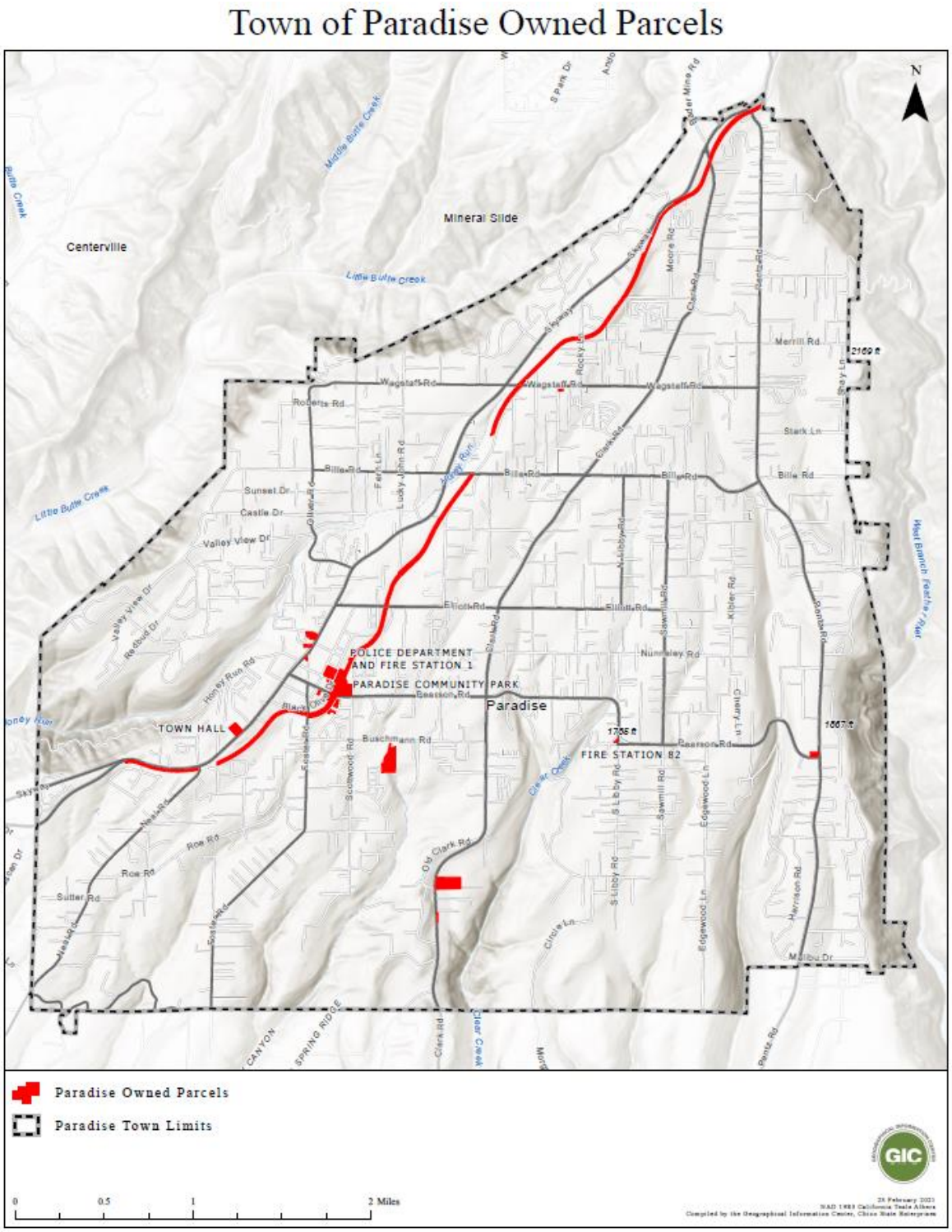

Figure 16. Map of Paradise-owned parcels.

Public Private Right of Way Assessment

Included below is a map of the Town of Paradise with private and public roads clearly identified as such. Red represents roads that are privately owned, while black represents public roads.

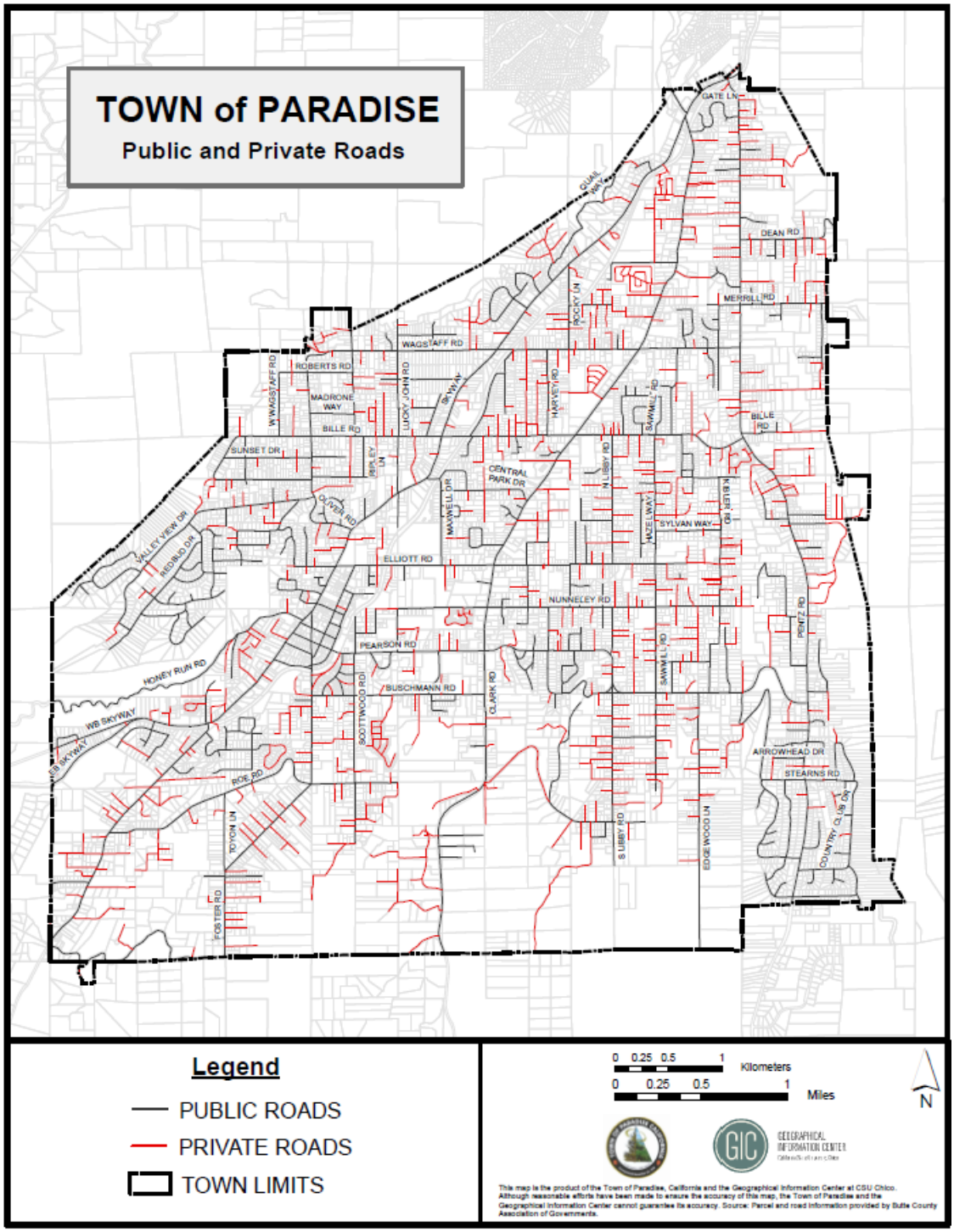

Figure 17. Map of public and private roads in the Town of Paradise.

High-level Fiber-Optic Network Design

Included below is a map of the Town of Paradise featuring a proposed network. Orange represents roads under which the proposed network could be installed.

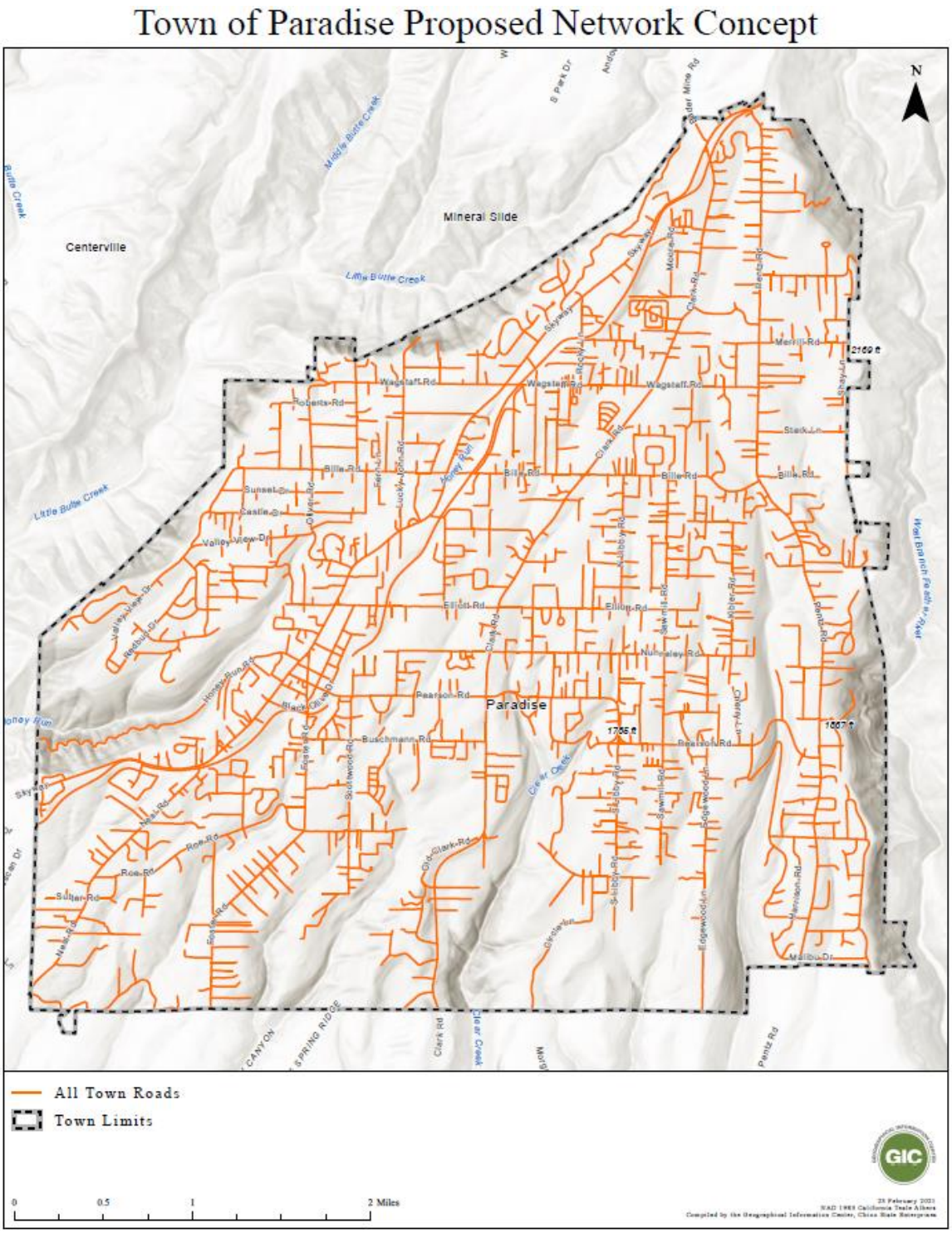

Figure 18. Map of the proposed network concept for the Town of Paradise.

Estimated Deployment, Operation, and Maintenance of the Fiber-Optic Network

Deliverables from sub-consultant forthcoming regarding cost sheets for three alternative networks: on premise, commercial/industrial, and/or town asset only.

Assessment of Partnership Approaches for Deployment, Operations, and Maintenance of the Fiber Optic Network

Deliverables reliant of outcomes forthcoming from sub-consultant.

Recommendations for Economic Development Opportunities Locally and Regionally

Industry Growth/Benefits of High-Speed Broadband

The growth of the internet has led to a rapid change in how the economy conducts itself: which industries have grown or shrunk, and where labor has migrated. Regions that have not kept pace with this change risk being left behind. Laid out below are the various ways the economy has changed with respect to growth in high-speed broadband in the previous years.

Some industries have seen wage and employment growth that is correlated with the rise in broadband internet. Due to different studies classifying industries differently, or using different metrics for conveying growth rates, it is difficult to identify with perfect accuracy the industries that experienced the greatest employment growth; however, we can garner a good, generalized idea. With relative consistency, the number of knowledge-based jobs and jobs in service industries grew alongside broadband internet (Stockinger, 2019). These include, among others, technical, internet, educational, financial, and managerial services (Atasoy, 2013, Kolko, 2012, & Crandall et al., 2007).

Most industries that saw employment growth also saw wage and output growth, though this was not universally the case. The technical services industry experienced an increase in employment while seeing a decrease in wage growth (Atasoy, 2013). The overwhelming majority of studies show that increases to broadband availability leads to an increase in overall wage growth. Most available studies look at industry growth, but some evidence of industry shrinkage attributable to broadband growth exists as well. The wholesale, transportation, health care, and administrative services industries had seen some drop in wage growth, employment growth, or both (Atasoy, 2013).

The cutting edge of industries' intersection with the internet can be seen in the growth of internet-connected technologies commonly referred to as the internet of Things. Many industries are adopting these technologies as the status quo. Some of the industries that are rapidly adopting and implementing new digital technologies include the healthcare industry, manufacturing, digital media/technology, transportation, retail, finance, and energy/utilities (Tel, 2019, "Which Industries will be most . . .," 2015, "The 6 Top Industries . . .," 2017, DeNisco-Rayome, 2017, Dvurechenski, 2019, Matthews, 2018).

Costs and Benefits of Undergrounding

There are many variables to consider when installing underground utility and communication lines as opposed to overhead lines. To assist Paradise personnel in their future determinations, CED staff have researched the various benefits and costs associated with transitioning overhead lines to underground or choosing to install new underground lines.

One of the first and most obvious benefits of undergrounding is improved aesthetics. Areas that are not cluttered with power lines are more attractive and increase social welfare (California Public Utilities Commission). The true value of this would be difficult to measure exactly but can be proxied by property value premiums in neighborhoods that lack overhead power lines. One study found that 31 percent of households in a middle-income suburban neighborhood were willing to pay

an $11,700 premium for property with underground utilities compared to similar properties with overhead utilities (McNair & Ableson, 2010). However, these benefits to property values may not be immediately realized, as overhead lines may not be removed immediately unless all services that might use the overhead lines (power, internet, cable television, etc.) are able to be undergrounded at once.

The most considerable benefit of undergrounding lines is the vastly reduced outage periods caused by vehicle collisions or storms when using overhead lines. These costs can be significant, with both consumers and utility suppliers incurring them, which can effectively double the initial cost-per-mile of basic overhead lines over the course of their lifespans (expected to be about 40 years) (Glass & Glass, 2019). Underground power lines also dramatically decrease the likelihood of wildfire, though other alternatives such as installing metal poles with new conductor coverings can be quite effective as well while also being far less expensive.

Price of installation is the greatest cost of undergrounding, and it is far greater than the cost of installing alternatives. There is no universal cost of installation, as it can vary greatly depending on the numerous unique factors that come with each location. However, even the lowest estimates exceed the cost of metal poles by a considerable margin, and some of the highest estimates run as much as 12 times the initial cost per mile. Ultimately, whether or not these costs are warranted is contingent on local need and their respective costs (California Public Utilities Commission). In urban and suburban regions prone to outages, the cost to utility providers and consumers from overhead lines could likely exceed the costs of undergrounding due to the increased frequency of maintenance costs and the number of affected consumers per mile of line. However, in more rural areas that are not prone to power outages, it may be incredibly difficult to justify the transition to underground lines considering the costs (Larson, 2016).

An additional, lesser cost to consider with underground lines is that when outages occur, though less frequently, it takes maintenance workers much longer to get the system back online. This is due to issues being much more difficult to identify and fix, given many components are hidden beneath the earth (California Public Utilities Commission).

Access to Broadband and a Younger Workforce

Young people are more likely to have internet services and interact in today's digital world. 78 percent of millennials (aged 23 to 38) say they subscribe to broadband service (Vogels, 2019). 80 percent of Americans aged 18 to 29 have broadband access compared with 43 percent of those aged 65 and older (U.S. Department of Housing and Urban Development's Office of Policy Development and Research). When millennials live in remote rural areas, they are more likely to reside in a county that has better digital access. Any community attempting to retain or attract millennials needs to address the digital divide (Gallardo et. al., 2018).

39 percent of millennials have indicated a preference for living in a small town over a big city in recent years. For attracting millennials, priorities for relocating are broadband and the ability to work remotely. 36 percent of people surveyed cited bad or limited internet access as the primary obstacle preventing them from moving to more rural areas, and 67 percent agreed that internet availability is affecting their decision to move somewhere rural (Cooke, 2020).

Access to Broadband and Families with Children in School

Parents with minor children at home are more likely than average to have broadband at home, by a 75-65 percent margin (Horrigan, 2010, p 7). Nine out of ten households with children under age 18 at home have internet access, and 74 percent have broadband at home (Horrigan, 2010). 15 percent of U.S. households with school-age children do not have high-speed internet connections at home. Survey findings have also shown that some teens are more likely to face digital hurdles when trying to complete their homework (Anderson and Perrin, 2018).

Home internet can reduce time and monetary costs of working by allowing individuals to work from home, reduce search frictions in the labor market by connecting potential employees to employers, and save users time in home production tasks like shopping and paying bills, freeing up time to engage in market work. The most significant impact on labor force participation due to high-speed internet usage is seen among college-educated women with children. High-speed internet also increases hours and employment rates among married women. Data on internet usage, telework, employment histories, and time use provide suggestive evidence that telework, and time saved in home production can explain the estimated change in labor supply for women (Dettling, Lisa J, 2015).

Internal Benefits of Coworking Spaces

People who use coworking spaces see their work as meaningful. They believe that they have more job control and autonomy. They also feel like part of a community. Connections are a big factor to why people pay to work in a communal space, as opposed to working from home or renting an office. Spending time away from a traditional office, in a coworking space, can spark new ideas and creativity (Spreitzer, 2015).

Coworking spaces can offer some promising characteristics. According to a survey of coworking space users produced by Swantje Robeleski and published in the International Journal of Environmental Research and Public Health, 71.9 percent of participants agreed or totally agreed that they can better concentrate at the coworking space. 81.3 percent agreed or totally agreed that their overall job satisfaction is higher. 92.2 percent agreed or totally agreed that they have more social interaction at work. 85.9 percent agreed or totally agreed that they can separate their personal life from work-life better. 41.3 percent agreed or totally agreed that the workplace is more ergonomic (e.g. office furniture, lighting, etc.). 71.9 percent agreed or totally agreed that they can concentrate better, and 89.1 percent agreed or totally agreed that they are more productive. 92.2 percent agreed or totally agreed that they had an easier time in regard to self-organization (Robelski et. al., 2019, page 13).

External Benefits of Coworking Spaces

By utilizing coworking office spaces, a business could save up to 75 percent in total costs (Starbuck and Nerdwallet, 2015). Coworking spaces are flexible, allowing the potential to deliver the best return for businesses now and into the future. There is less risk because businesses can adjust

their workspace according to what their business needs at the given time. Flexible workspaces can help companies reduce capital expenditures, stabilize expenses, and only pay for the space they need.

Coworking Spaces and Broadband

About half of Americans (48 percent) at the end of 2020 said that if they were able to live anywhere, they would choose a town or rural area rather than a city or suburb. (Saad, 2021). A significant factor influencing the shift away from large cities is the ability to work remotely. Broadband is a prerequisite for promoting a community as a remote work location (Drew, 2020). While 84 percent of remote workers work primarily from home, a recent survey revealed that 51 percent note coffee shops and coworking spaces as the second most common location from which they work. Remote workers sometimes need a change in scenery (Drew, 2020). To attract remote workers, common tactics include providing coworking spaces and building a community of remote workers (Qatalist Research Group, 2020). For coworking and alternative workspaces, this does not have to mean a formal coworking space. Small towns can start identifying and sharing alternative workspaces from within the community. Communities can get creative with their coworking spaces, including leveraging public libraries, businesses that are not using all their space, church fellowship halls, youth centers, or other pre-established spaces with regular vacancies (Qatalist Research Group, 2020).

To attract workers who can work anywhere, communities could take a more active role in placemaking aimed at remote workers by investing or supporting development of a coworking space to serve as a hub or catalyst for the remote working community to come together (Oliver et. al., 2016, page 12).

Grant Funding/Financing Opportunities

To assist the Town of Paradise in its planning and decision-making process, included in this section is an inventory of broadband-based funding opportunities. The inventory is limited to funding opportunities for which the Town of Paradise is most eligible. The inventory is presented in tables 8a-8c below. These tables include the name of the program, the agency that administers the funding, the most recent application dates and deadlines, funding range, funding priorities, type of funding, eligibility criteria, and web links to the appropriate website when available. Additionally, a more in-depth review of two particularly apt funding options, California Advanced Services Fund (CASF) Infrastructure Grants and USDA ReConnect Program grants and loans, have been provided.

Eligible Areas for CPUC CASF Broadband Infrastructure Grants

AB 1665, approved by the Governor on October 2017, extends the date of the CASF goal (deploying broadband internet service at speeds of 6/1 Mbps 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. In 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 include:

- 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;

- 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.

Eligible Areas for USDA Reconnect Program

The USDA ReConnect Program 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:

1. **It must be rural:** Service areas are not located in a city, town, or incorporated 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. Applicants include:

- Cooperatives, nonprofits, 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

The various details for the recommended funding opportunities have been split between three tables for improved legibility.

Table 8a. Inventory of potential broadband funding opportunities available to the Town of Paradise

Grant/Funding Program Name	Agency	Application Last Open	Application Last Due
FY 2019 Disaster Supplemental Notice of Funding Opportunity (NOFO) (Disaster Supplemental NOFO)	Economic Development Administration, US Department of Commerce	August 1 2019	There are no submission deadlines. Applications will be accepted on an ongoing basis.
FY 2020 EDA Public Works and Economic Adjustment Assistance Programs including CARES Act Funding	Economic Development Administration, US Department of Commerce	October 1 2019	April 15 2020
Reconnect and Loan Grant Program	US Department of Agriculture	January 1 2020	May 4 2020
CASF Infrastructure Grant	California Public Utilities Commission	April 1 2020	December 23 2020
Community Connect Grant Program	US Department of Agriculture		No application window
Telecommunications Infrastructure Loan Program	US Department of Agriculture	Applications accepted year round	September 21 2020
Community Development Block Grant	US Department of Housing and Urban Development's Community Planning and Development Office	Ongoing	Ongoing
Community Planning and Development - Section 108 Loan Guarantee	US Department of Housing and Urban Development's Community Planning and Development Office	Ongoing	Ongoing
Rural Development - Rural Broadband Access Loan and Loan Guarantee Program (Broadband Program)	US Department of Agriculture	Ongoing	Ongoing
Municipal bonds - General Obligation (GO) bonds	Local Agency (Town of Paradise)	Ongoing	Ongoing
Municipal bonds - Revenue bonds	Local Agency (Town of Paradise)	Ongoing	Ongoing

Table 8b. Inventory of potential broadband funding opportunities available to the Town of Paradise

Grant/Funding Program Name	Funding Range	Funding Priorities	Type of Funding
FY 2019 Disaster Supplemental Notice of Funding Opportunity (NOFO) (Disaster Supplemental NOFO)	587 Million	Planning, broadband infrastructure, digital skills training, smart cities, other	Grant
FY 2020 EDA Public Works and Economic Adjustment Assistance Programs including CARES Act Funding	Award ceiling: $30,000,000; award floor: $100,000	Planning, broadband infrastructure, digital skills training, smart cities, other	Grant
Reconnect and Loan Grant Program	Up to $200 million	Construction required to provide broadband service	Grant, Loan, or 50/50 Grant/Loan
CASF Infrastructure Grant	$300 million	Infrastructure grants for infrastructure projects that provide last-mile broadband access to households	Grant
Community Connect Grant Program	35,000,000	Broadband infrastructure and adoption	Grant
Telecommunications Infrastructure Loan Program	Minimum amount is 50,000	Construction, improvement, and expansion of facilities required to provide telephone and broadband service in eligible rural areas	Loan
Community Development Block Grant	FY2020 - 3,425,000,000 (funding amount)	Planning, broadband infrastructure, broadband adoption, digital skills training, public computer access	Grant
Community Planning and Development - Section 108 Loan Guarantee	$300,000,000 (funding amount)	Federal guaranteed loans large enough to pursue physical and economic revitalization projects. Broadband infrastructure, broadband adoption, digital skills training, public computer access, broadband financing.	Loan
Rural Development - Rural Broadband Access Loan and Loan Guarantee Program (Broadband Program)	FY 2020 $11,200,000; FY 2019 $29,851,000 (funding amount)	Broadband infrastructure and financing	Loan
Municipal bonds - General Obligation (GO) bonds		No funding priority - GO bonds are backed by the general revenue of the municipality	Municipal bond
Municipal bonds - Revenue bonds		No funding priority - revenue bonds are supported by a specific revenue source	Municipal bond

Table 8c. Inventory of potential broadband funding opportunities available to the Town of Paradise

Grant/Funding Program Name	Applicant Eligibility Criteria	Link
FY 2019 Disaster Supplemental Notice of Funding Opportunity (NOFO) (Disaster Supplemental NOFO)	City or township governments eligible. Grantees in communities impacted by natural disasters in 2018, and floods and tornadoes in 2019	https://www.grants.gov/web/grants/view-opportunity.html?oppId=321695
FY 2020 EDA Public Works and Economic Adjustment Assistance Programs including CARES Act Funding	City or township governments eligible. Projects supporting work for economic growth. For CARES Act Funding, the project would have to prevent, prepare for, and respond to coronavirus, or respond to economic injury as a result of the coronavirus.	https://www.grants.gov/web/grants/view-opportunity.html?oppId=321695
Reconnect and Loan Grant Program	Local governments are eligible, and eligible funding purposes are to fund the construction or improvement of land, buildings, and other facilities that are required to provide broadband service; to fund reasonable pre-application expenses, to fund the acquisition and improvement of an existing system that is providing insufficient broadband, and to fund terrestrial-based facilities that support the provision of satellite broadband service	https://www.usda.gov/reconnect/program-overview
CASF Infrastructure Grant	Local governmental agencies are eligible, to fund broadband infrastructure	https://www.cpuc.ca.gov/General.aspx?id=8246
Community Connect Grant Program	State and local units of government eligible, rural areas that lack existing broadband speed of at least 10 Mbps downstream and 1 Mbps upstream are eligible	https://www.rd.usda.gov/programs-services/community-connect-grants
Telecommunications Infrastructure Loan Program	State and local governmental entities	https://www.rd.usda.gov/programs-services/telecommunications-infrastructure-loans-loan-guarantees
Community Development Block Grant	Local governments are eligible	https://www.hudexchange.info/resource/4891/cdbg-broadband-infrastructure-faqs/
Community Planning and Development - Section 108 Loan Guarantee	Local governments are eligible	https://www.hudexchange.info/resource/4891/cdbg-broadband-infrastructure-faqs/
Rural Development - Rural Broadband Access Loan and Loan Guarantee Program (Broadband Program)	Local governments are eligible; at least 15% of households in the proposed area must not have access to broadband service	https://www.rd.usda.gov/programs-services/rural-broadband-access-loan-and-loan-guarantee
Municipal bonds - General Obligation (GO) bonds		
Municipal bonds - Revenue bonds		

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Appendices

Appendix A: Projection Methodology

School Enrollment Projections

To calculate the enrollment projections for Paradise Unified School District, the Grade Progression Ratio/Cohort Survival Rate methodology was used. In this approach, historical enrollment data was collected from all schools within the District for the 2010-'11 academic year through the 2019-'20 academic year. These enrollment numbers were then summed by grade level for each academic year to create district total enrollment by grade level. From this, a number called the Cohort Survival Rate (CSR) was then calculated by dividing the "current" school year/cohort by the "previous" school year/cohort. For example, to calculate the CSR for 2019-'20 12th grade, the district's 12th grade enrollment in 2019-'20 would be divided by the enrollment for 11th grade in 2018-'19.

To project kindergarten enrollment, a ratio was calculated for the number of live births to the number of kindergarten enrollments five years later (the assumption was made that all children are enrolled in kindergarten at 5 years old). Due to data availability, this ratio was constructed for kindergarten enrollments in years 2018-'19 and 2019-'20. These two ratios were then averaged, and then applied to the remaining years of live birth data for the area, resulting in kindergarten enrollment projections through the 2023-'24 school year. Kindergarten enrollment for the remaining three projected years (through 2026-'27 school year) were determined by using an average of the year to year (for years 2010-'11 through 2018-'19) percent change in kindergarten enrollment, which was roughly 2%. Therefore, kindergarten enrollment beyond the 2023-24 school year is projected to increase by roughly 2%.

After calculating the CSR for each grade level for each of the years of historic data, a measurement called the Grade Progression Ratio (GPR) was then calculated; this is done by taking the average of 5 years of CSR measurements for each cohort. For these projections, the 2014-'15 through 2018-'19 school years were used for the GPR calculations to avoid including the external shock of the Camp Fire on enrollment numbers in the 2019-'20 school year.

Projections for the enrollment period of 2020-'21 through 2026-'27 were then calculated using the found Grade Progression Ratios. The GPR for a cohort in question was multiplied by the previous year/cohort's projected enrollment. The total enrollments per year were summed across cohorts to provide a total for projected district enrollment.

It should be noted that while the Paradise Unified School District does have their own enrollment projections through the 2022-'23 academic year, their projections differ slightly from those found in this report. This is due to differences in methodology; while their projections seem to rely on predicting a 2% decrease in annual enrollment, the method described above calculates a trend that varies slightly from year to year.

Public Safety Workforce Projections

To project the public safety workforce for the Town of Paradise, a method was established using annual data for 9-1-1 calls. The first step was determining the historical number of calls that resulted in incidents requiring a police response, and then dividing this number by the annual population for the Town. By doing this for several years preceding the Camp Fire and then averaging this number per resident, a measure for the average annual number of 9-1-1 calls per person was established. This average per person was then multiplied by the annual projected population per year to determine the projected number of 9-1-1 calls that would merit a police response per year for the study period through 2027.

The projected number of annual calls was then used to calculate the number of patrol units that would need to be staffed to meet the public safety demands of Paradise. The projected annual number of calls was multiplied by .75 to account for the average length of time needed to respond to emergency calls (45 minutes is the widely accepted average). This was then multiplied by 3 to account for a buffer (time used on regular patrols and other preventative routines). This resulting number represents the total number of patrol units that would need to be staffed. The number of patrol units is then divided by 3,650 (accounting for 10 hours, 365 days per year) to show the number of annual hours worked by a basic patrol unit. To determine the projected number of officers needed to staff the department overall, the projected number of basic patrol units was multiplied by 1.75 (1.75 =3,650 (annual hours per basic patrol unit)/2,080 (annual hours per police officer); this represents officers working 5 days per week, 40 hours per week, for 52 weeks per year). These calculations were repeated for each projected year, using the year's respective projected population.

Residential/Population Projections

Because the number of residences in the Town of Paradise was so drastically changed as a result of the Camp Fire, common growth rate methodology did not seem feasible in predicting the population for Paradise. Therefore, the future population was projected using average household size and the projected number of residences in the Town of Paradise. The number of future residences was projected by the Geographical Information Center for the Paradise Sewer Project; average household size was obtained from 2018 5-year American Community Survey estimates. Population through 2027 for the Town of Paradise was calculated by multiplying the household size estimate with the projected number of residences for each year. It should be noted that occupancy was assumed to be 100 percent for Paradise, operating under the assumption that people would only rebuild their homes if they either had the intention to move back, or knew that they would be able to find a renter for their property. In addition, it should be noted that another assumption in this calculation is that each of these residences is a single-family dwelling.

Business Projections

To calculate the business presence in the Paradise area, use of preexisting business data and newly created raw survey data from the Paradise Ridge Chamber of Commerce was used. Ratios obtained from respondents to a survey of Paradise Ridge businesses in January of 2020 were correlated with pre-Camp Fire business numbers to project the baseline number of businesses in the

first year of the study period. An estimated number of businesses that existed pre-Camp Fire was provided by the Chamber (1,200 businesses).

For the remainder of the study period, a spread of possible new business formation rates was used to calculate possible growth of the business community in the Paradise area. An estimated number of businesses that existed pre-Camp Fire was provided by the Chamber (1,200 businesses). The business characteristics (i.e., full or part time employment and internet needs) were calculated based on their initial ratio to the number of businesses.

Ratios for the internet requirements of businesses was gleaned from a Butte County Business Recovery survey conducted on Paradise Ridge businesses.

Appendix B: Survey Questions

Question 1: What is the current ZIP Code for the city you are residing in?

Question 2: What is your current residency status in relation to the Town of Paradise?

Question 3: How many people in your household are using the internet on a daily basis?

Question 4: How many total children (under 18) live in your household?

Question 5: What grade level are the children (under 18) in your household? Please check all that apply.

Question 6: Do the children (under 18) in your household need access to the internet to complete their schoolwork?

Question 7: Of the people in your household, how many students are using the internet for schoolwork?

Question 8: Of the people in your household, how many people are currently or will be using the internet to work remotely/run a home-based business?

Question 9: On average, how many hours a day is your household spending (combined) on the internet?

Question 10: How many hours do you spend on the internet per session?

Question 11: Do the people in your household use health care services online?

Question 12: Would you consider using online health care services if you had better access to the internet?

Question 13: How many hours a day do you spend on the internet doing the following?

Question 14: How do you access the internet at home?

Question 15: Who is your home internet provider?

Question 16: What is/are the reason(s) that you do not have broadband internet access at your home?

Question 17: If you do not have access to the internet at home, do you have an alternate method for students residing within your home to access the internet?

Question 18: What type of device do you use to access the internet at home? Please check all that apply.

Question 19: How many internet-capable devices does your household own (e.g., desktops, laptops, smartphones, wearables, gaming devices, streaming media devices, etc.)? Only include devices that your household actively uses.

Question 20: To the best of knowledge, what is the advertised download speed of your current internet service plan?

Question 21: To the best of your knowledge, how much are you currently paying per month for internet access?

Question 22: Do you have a personal smartphone?

Question 23: Who is your service provider for your data plan?

Question 24: What is your data plan for your smartphone?

Question 25: Based on your current household needs, please indicate your level of satisfaction with your current internet connection.

Question 26: What are the primary reasons that your current internet connection does not meet some or all of your needs? Please check all that apply.

Question 27: Would you be interested in purchasing faster broadband services if available? How much more would you be willing to pay per month for such services?

Question 28: What is/are the primary reason(s) that you are not interested in purchasing an upgraded internet service? Please check all that apply.