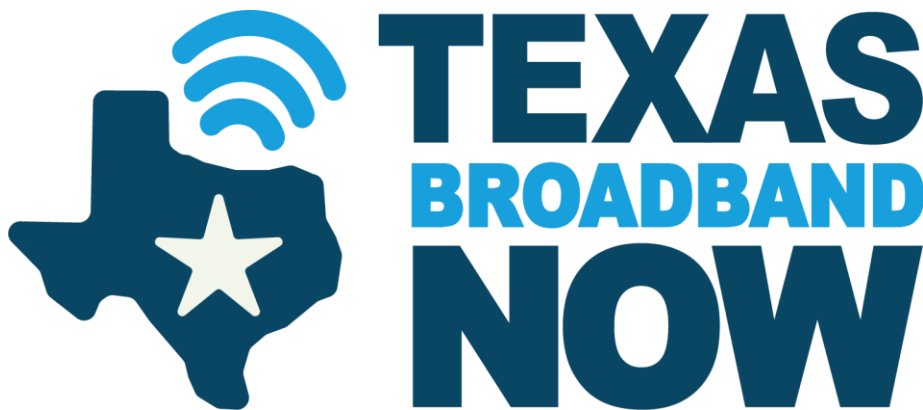


Broadband & Economic & Community Development in Texas



TXP, Inc.
1310 South 1st Street, #105
Austin, Texas 78704
(512) 328-8300
www.txp.com

Summary

The economy of rural Texas is changing. Once largely based on the extraction of commodities and small regional centers of commerce, the ability to connect to resources and markets remotely creates vast new opportunities for both residents and businesses. Underpinning these opportunities is the infrastructure that enables connection, which is high-speed internet capacity. Commonly referred to as “broadband,” high-speed internet access has so fully integrated into daily life in most urban areas, however, many communities have yet to realize the benefits, as the Comptroller’s Office estimates that 7 million Texans lack broadband access.

The statistical analysis quantifies the impact of making broadband available to those who currently do without. The findings indicate a highly significant relationship between level of economic outcomes (as measured by household income and per capita economic output) and economic growth (as measured by job growth over a five-year period), education (as measured by the share of the adult population with at least a high school, associates, and bachelor’s degree) and community health (as measured by the share of the adult population who self-report “good” or “excellent” health).

An illustration of the potential magnitude of this investment was then developed and suggests that greater rural access to broadband could easily yield an increase in personal income in Texas of **\$8.8 billion annually** (measured in \$2019). In Texas, wage & salaries accounted for 51 percent of total personal income in 2019; with an average annual wage of \$59,794 that year, that implies that this increased economic activity would create an additional **74,702 permanent jobs**. In addition, the State itself will gain. Over the period from 2017-21, State General Fund revenue averaged the equivalent of 6.4% of total Texas personal income; applying that ratio to the \$8.7 billion figure above implies the State will gain **\$556.9 million each year**, a handsome return on investment. However, these findings do not reflect universal access; if that were achieved, the annual impact across Texas could easily be several times what is reported here. This is especially true given the fact that the analysis does not include those within metropolitan areas who also lack adequate access. Based on the results here, it is likely that broadband access would raise average household incomes among those who currently lack it by **approximately \$10,000** (\$2019) as well.

The above having been said, as with almost all infrastructure categories, the economics of rural broadband deployment and operations cannot be addressed purely by market forces. Because of high capital and operating costs per potential customer, areas with low population density struggle to attract private investment in capital infrastructure. As a result, it is crucial that the public sector step forward to fill the gap and provide the means to fully access the capacity and benefits inherent in high-speed internet. Much like rural electrification, subsidized water purification, and farm-to-market roads, the benefits for smaller communities will be life-changing for residents themselves and Texas as a whole.

Overview

The economy of rural Texas is changing. Once largely based on the extraction of commodities (including ranching, agriculture, and oil & gas) and small regional centers of commerce, the ability to connect to resources and markets remotely has created vast new opportunities in e-commerce, professional services, manufacturing, and healthcare. Underpinning these opportunities is the infrastructure that enables connection, which is high-speed internet capacity. Commonly referred to as “broadband,” digital technology that yields high-speed internet access has integrated into daily life for those who have access, benefiting both rural businesses and residents. On the commercial side, businesses rely on broadband to generate sales, make purchases, and to conduct operations. On the social side, the capacity to connect to wider communities of interest that broadband provides has been transformative for many, while technology has further enabled unprecedented access to education and health care. Collectively, it is clear that broadband is as fundamental to the health and well-being of rural Texas as farm-to-market roads and provision of electricity were in previous centuries.

As a result of this recognition, communities seek to achieve the following economic and community development goals through their public-private collaborations:

- Create more jobs locally by making remote positions viable;
- Create an environment fertile for entrepreneurship;
- Support existing industries and enable the growth of new industries;
- Enable upskilling and reskilling through online resources, allowing residents to participate in workforce development on their own time, schedule, and budget;
- Grow the talent pipeline locally by connecting students to skills training, job opportunities, mentorship, and other resources;
- Allow local employers to attract and retain talent through work-from-home arrangements; and
- Facilitate access to further education and remote healthcare.

The following report is designed to provide insight into the potential impact of enhanced broadband implementation on indicators of local economic performance and community well-being across rural Texas. In order to provide context, areas of benefit are generally outlined, drawing from trade literature and experience elsewhere. This is followed by a statistical analysis that quantifies the relationship between broadband a range of economic and community variables, and an illustration of the economic gains (as measured by personal income and jobs) and public sector benefits (as measured by General Fund revenue to the State of Texas) that could ensue from increased implementation. The report’s conclusions form the final section.

A National and Texas Perspective

US Chamber: Unlocking the Digital Potential of Rural America

Unlocking the digital potential of rural America is vital to economic growth. Rural America comprises over 18 million households and over 37 million adults. While accounting for nearly 15 percent of the adult population and covering over 72 percent of the land, annual revenues of businesses located in rural areas make up less than 10 percent of the U.S. economy (approximately \$3.1 trillion). Due to lack of opportunities, a large portion of rural residents have been migrating to urban areas for new or better jobs. Currently, about 17.5 million rural adults (over 47%) are either unemployed or are not actively looking for jobs.

According to the US Chamber Technology Engagement Center, digital technology boosts sales by 55 percent and reduces purchasing costs for rural small businesses by 29 percent. About one-fifth of rural small business in American generate 80 percent-plus of their sales online, while a comparable number purchase more than 80 percent of their goods and services the same way. Almost half sell products/services online, over 58 percent have social media accounts, and about one-third engage in further online marketing. Operational tasks such as business banking, accounting, virtual meetings/conference calls, and cloud computing increasingly are also conducted online. Taken together, the potential benefits are substantial, as Table 1 indicates.

Table 1: National Impact of Greater Rural Broadband

	Actual Benefits in the Past 3 Years	Unrealized Benefits in the Past 3 Years	Potential Benefits in the Next 3 Years
Percentage change in 3- year revenue	17.2%	18.3%	20.8%
Additional sales per year	\$69.8 billion	\$74.4 billion	\$84.5 billion
Additional GDP per year	\$38.7 billion	\$41.3 billion	\$46.9 billion
Additional jobs	296,288	316,605	360,054
Additional wages paid per year	\$12.1 billion	\$13.0 billion	\$14.8 billion

Sources: *Unlocking the Digital Potential of America*. US Chamber Technology Engagement Center, 2019.

The Texas Comptroller's Office: Texas Broadband Plan 2022

The Texas Comptroller's Office is well aware of the need to extend and expand broadband. According to their most recent report:

U.S. Census Bureau data indicate almost 2.8 million Texas households and 7 million people lack broadband access. Twenty three percent of Texans are unable to attend online classes, see a healthcare provider from their living room, fill out a job application online, start a business or access online marketplaces from their kitchen table. These barriers negatively affect Texans' quality of life and limit economic opportunities for people and the state overall. Home access allows for the streaming of videos, social media and online gaming. Technology supports connection between families and friends. Access to broadband can allow people to "age in place," live in their hometowns and be and stay connected with loved ones. According to a 2016 Federal Reserve Bank of Dallas report, this problem disproportionately affects rural communities.

The report goes on to outline different facets where more widespread implementation of broadband could meaningfully influence Texans' lives.

Economic Growth

Broadband provides local communities, regions and nations with the opportunity to develop and expand businesses and institutions. It also improves productivity and profitability of businesses and allows them to compete in local, national and global markets. Broadband is essential to conduct business, even in so-called "lower-tech" industries, as it facilitates connection among suppliers, customers, collaborators and employees.

Digital technologies anchored by high-speed internet can help businesses generate revenues, expand their reach and participate in larger vendor networks.

Education

Students need to be technologically equipped for success in today's and tomorrow's workforce. Broadband can help them maintain an advantage in finding jobs and developing career skills. Broadband is essential for distance learning — from kindergarten to graduate school. Texas' rural leaders shared concerns about the existence of a "homework gap" and the subsequent lifelong implications for students and communities. Large percentages of rural and low-income students are unable to access the online resources needed to participate. In many areas, the student population relies on mobile internet service for homework. Many students are forced to sit in library parking lots after hours to complete homework on the library's Wi-Fi network.

Healthcare

Broadband enables remote access to clinical services for patients and provides improved, cost-effective access to healthcare. It also allows physicians to monitor patients through home health devices to avoid costly house calls as well as provide patients real-time feedback. Similarly, the use of online disease management services, electronic health

records, home monitoring and other applications can assist Texans who don't have easy face-to-face access to healthcare. Without sufficient broadband to support telehealth services, many rural hospitals and anchor institutions will be at a disadvantage serving Texans.

Public Safety & Emergency Management

Broadband, particularly wireless broadband, is increasingly indispensable to the interoperability of police, fire, health and other government services. This includes rapid disaster response systems, effective early-warning and public alert systems, disaster preparation programs, remote security monitoring and backup systems for public safety communications networks. As new technologies are implemented, such as digital e911 systems, sufficient wireless and wireline bandwidth is necessary to enable the sending of pictures and videos and video chats between a dispatch, first responders, and the public (e.g., through the Emergency Services IP Network or ESInet).

A lack of sufficient broadband limits training opportunities. For example, during outreach it was shared that volunteer firefighters and correctional officers often struggle to attend required online training programs.

Agriculture

Farmers depend on broadband. Autonomous machinery, data-driven irrigation sensors and web-enabled sales platforms are just a few of the tools of modern "precision" agriculture, which apply high-tech processes to improve the efficiency and effectiveness of planting, irrigation, nutrient and pest management, and harvesting. Precision agriculture can reduce fuel usage by 40 percent, decrease water usage by 20 to 50 percent, and reduce chemical applications by up to 80 percent. According to the U.S. Department of Agriculture, in 2019, 25 percent of Texas farms did not have internet access.

State & Local Government

Broadband service helps government agencies improve quality, lower costs and increase transparency by enhancing internal operations and making it easier for residents to interact with them online. Most state agencies have undergone or are undergoing modernization to automate processes and provide lower-cost and higher-quality services to citizens. For example, the *Texas by Texas* platform provides an easier, faster and more secure way for Texans to obtain driver license and vehicle registration renewals.

Measuring the Impact

Study Approach

The underlying concept behind the study approach is simple; compare analogous areas with varying levels of broadband access to see if broadband influences a range of community outcome measures. To quantify this relationship, data must be gathered that measures broadband and other variables that serve as proxies for economic and community outcomes. The American Community Survey (ACS) conducted annually by the Census Bureau is a wide-ranging source that provides detailed information at the county level across the United States. The most recent data available at this level was collected in 2019. While slightly dated (there are, for example, much more recent estimates on broadband penetration) using information from this source and this time-period has the advantage being consistent across variables, and not subject to the potentially distorting impacts of the COVID-19 pandemic. This data is augmented with information from the University of Wisconsin, the Texas Workforce Commission, and the Bureau of Economic Analysis (BEA).

To better isolate the impact of broadband, the number of counties included in the analysis was narrowed. Initially, all counties that are in metropolitan statistical areas (MSAs) were eliminated, for two reasons. First, the entire concept of MSAs is a recognition of that regional economies are not contained within municipal boundaries. Urban areas have more developed economies that include both “modern-economy” commercial activity that requires high-speed internet and a large consumer market that desires the same. Second, service-providers that serve larger regions are more likely to be able to extend service into smaller communities that are in relative proximity to their main market, as their costs of service extension will skew toward being marginal/incremental, making it less expensive to serve new clients than in stand-alone rural areas. In addition, “modern-economy” industries (which on average produce greater income/wealth) tend to be concentrated in urban areas. Eliminating metro area counties facilitates isolating the impact of relative access to broadband in comparable rural communities, a process enhanced by also eliminating non-MSA counties where the population is greater than 50,000 as of 2019. The result is a set of 163 counties (representing just over two-thirds of the counties in Texas) used in the analysis.

The economy, healthcare, and education are three main areas where broadband is seen to have significant community outcomes. The following tables provide specific data for the share of the households in each county with access to broadband, as well as the number of 1) population & households; 2) average household income; 3) median household income; 4) per capita economic activity (GAP); 5) five-year job growth; 6) share of adult (25+) population with at least a high school degree; 7) share of adult population with at least an associate’s degree; 8) share of adult population with at least a bachelor’s degree; and 9) share of adult population that reports “good” or “excellent” health.

Data Tables

Table 2: 2019 Population and Households for Selected Counties

County	Population	House	County	Population	House	County	Population	House
Andrews	18,879	5,649	Glasscock	1,439	435	Mitchell	19,962	2,419
Austin	29,972	11,569	Gonzales	20,948	7,465	Montague	20,654	7,969
Bailey	6,697	2,056	Gray	21,658	7,843	Moore	12,393	6,659
Baylor	3,518	1,621	Grimes	29,614	9,206	Morris	1,185	5,170
Bee	32,513	8,499	Hale	32,754	10,888	Motley	14,835	496
Blanco	12,269	4,665	Hall	2,939	1,252	Nolan	9,598	5,516
Borden	706	223	Hamilton	8,557	3,007	Ochiltree	29,320	3,391
Bosque	18,603	7,255	Hansford	5,279	1,859	Palo Pinto	23,187	10,334
Brewster	9,237	4,292	Hardeman	4,011	1,672	Panola	9,522	8,662
Briscoe	1,487	588	Hartley	5,443	1,691	Parmer	15,718	3,213
Brooks	6,964	2,475	Haskell	5,754	2,162	Pecos	6,508	4,868
Brown	37,633	14,614	Hemphill	3,777	1,356	Presidio	12,552	2,580
Burleson	18,514	6,931	Hill	37,006	13,094	Rains	3,833	4,321
Burnet	49,653	17,384	Hockley	22,921	8,071	Reagan	3,411	1,117
Calhoun	21,001	8,027	Hopkins	37,170	13,514	Real	11,995	1,254
Camp	13,060	4,460	Houston	22,835	8,234	Red River	15,949	5,143
Cass	29,879	11,962	Howard	36,540	11,354	Reeves	6,877	3,772
Castro	7,396	2,557	Hutchinson	20,677	7,074	Refugio	813	2,566
Childress	7,143	2,308	Irion	1,564	636	Roberts	10,401	329
Cochran	2,897	1,026	Jack	9,056	3,169	Runnels	10,507	3,891
Coke	3,323	1,625	Jackson	14,854	4,924	Sabine	8,248	4,524
Coleman	8,100	3,492	Jasper	35,375	13,725	San Augustine	29,301	3,712
Collingsworth	2,877	1,029	Jeff Davis	2,220	991	San Jacinto	6,039	10,143
Colorado	21,610	7,442	Jim Hogg	5,184	1,545	San Saba	2,761	2,134
Comanche	13,750	5,416	Jim Wells	40,452	12,924	Schleicher	16,662	1,036
Concho	2,827	876	Karnes	15,562	4,552	Scurry	3,300	6,115
Cooke	41,393	15,530	Kenedy	379	129	Shackelford	24,915	1,367
Cottle	1,363	703	Kent	786	286	Shelby	3,027	9,486
Crane	4,765	1,500	Kimble	4,396	1,967	Sherman	9,334	1,070
Crockett	3,513	1,394	King	283	90	Stephens	1,315	3,408
Culberson	2,149	668	Kinney	3,670	1,475	Sterling	1,348	405
Dallam	7,273	2,344	Kleberg	30,338	11,140	Stonewall	3,738	529
Dawson	12,974	4,430	Knox	3,683	1,394	Sutton	7,340	1,282
Deaf Smith	18,277	6,053	La Salle	7,500	19,995	Swisher	702	2,599
Delta	5,349	2,066	Lamar	49,905	4,706	Terrell	12,183	419
DeWitt	20,174	6,823	Lamb	12,710	7,823	Terry	1,487	4,101
Dickens	2,140	861	Lavaca	20,216	7,904	Throckmorton	32,926	713
Dimmit	9,925	3,178	Lee	17,397	6,159	Titus	14,883	11,064
Donley	3,308	1,344	Leon	17,493	6,837	Trinity	21,591	6,105
Duval	11,058	3,407	Limestone	23,340	8,292	Tyler	3,623	7,109
Eastland	18,388	7,017	Lipscomb	3,111	1,158	Upton	26,742	1,344
Edwards	1,923	787	Live Oak	12,324	3,854	Uvalde	49,028	8,921
Erath	43,224	14,263	Llano	21,958	9,031	Val Verde	12,097	16,388
Fannin	35,913	12,391	Loving	181	62	Ward	35,771	4,100
Fayette	25,547	9,033	Lynn	6,025	2,199	Washington	41,685	13,321
Fisher	3,784	1,676	Madison	14,427	3,151	Wharton	4,946	15,248
Floyd	5,672	2,184	Marion	9,960	4,205	Wheeler	12,552	2,060
Foard	1,135	509	Mason	4,344	1,722	Wilbarger	21,161	5,008
Franklin	10,821	3,960	Matagorda	36,725	1,668	Willacy	7,887	5,882
Freestone	19,874	6,736	McCulloch	7,823	16,647	Winkler	46,291	2,618
Frio	20,379	4,673	McMullen	721	229	Wood	8,702	16,716
Gaines	21,996	5,878	Menard	2,124	1,035	Yoakum	17,904	2,601
Garza	6,222	1,713	Milam	24,708	9,468	Young	14,172	7,491
Gillespie	26,960	10,820	Mills	4,840	1,752	Zapata	11,840	4,689
						Zavala	19,962	3,674

Sources: American Community Survey, TXP

Table 3: 2019 Access to Broadband and Average Household Income (AHI)

County	Broadband	Income	County	Broadband	Income	County	Broadband	Income
Andrews	89.1%	\$94,468	Glasscock	85.7%	\$100,166	Mitchell	72.4%	\$77,376
Austin	80.7%	\$79,591	Gonzales	77.2%	\$77,497	Montague	75.8%	\$72,551
Bailey	73.1%	\$67,987	Gray	76.8%	\$75,181	Moore	84.7%	\$66,733
Baylor	78.6%	\$57,449	Grimes	77.5%	\$81,315	Morris	81.1%	\$55,022
Bee	68.4%	\$62,450	Hale	75.9%	\$59,986	Motley	69.8%	\$65,417
Blanco	87.8%	\$97,625	Hall	70.2%	\$60,663	Nolan	74.9%	\$65,693
Borden	81.6%	\$98,135	Hamilton	74.3%	\$69,365	Ochiltree	81.2%	\$67,728
Bosque	74.8%	\$72,099	Hansford	75.6%	\$62,171	Palo Pinto	82.1%	\$72,854
Brewster	75.1%	\$61,876	Hardeman	70.8%	\$60,592	Panola	80.0%	\$68,947
Briscoe	70.1%	\$53,553	Hartley	85.1%	\$73,890	Parmer	75.6%	\$76,735
Brooks	64.2%	\$37,307	Haskell	72.0%	\$68,984	Pecos	70.4%	\$72,265
Brown	78.5%	\$67,938	Hemphill	81.0%	\$95,981	Presidio	62.9%	\$37,266
Burleson	76.4%	\$80,669	Hill	81.5%	\$70,949	Rains	78.4%	\$74,527
Burnet	83.9%	\$82,742	Hockley	76.8%	\$65,648	Reagan	76.3%	\$73,655
Calhoun	79.4%	\$71,336	Hopkins	82.6%	\$70,972	Real	63.4%	\$61,403
Camp	75.5%	\$63,245	Houston	67.3%	\$58,528	Red River	71.4%	\$52,872
Cass	75.4%	\$62,065	Howard	79.2%	\$73,584	Reeves	65.3%	\$70,017
Castro	73.5%	\$64,332	Hutchinson	83.2%	\$71,082	Refugio	72.8%	\$63,023
Childress	77.6%	\$65,265	Irion	65.9%	\$70,391	Roberts	80.5%	\$73,297
Cochran	71.8%	\$56,739	Jack	73.7%	\$67,142	Runnels	74.5%	\$61,649
Coke	73.5%	\$60,146	Jackson	76.4%	\$71,734	Sabine	78.3%	\$62,030
Coleman	76.0%	\$66,834	Jasper	73.6%	\$63,309	San Augustine	74.1%	\$52,268
Collingsworth	67.4%	\$66,445	Jeff Davis	63.2%	\$50,552	San Jacinto	78.2%	\$64,195
Colorado	73.3%	\$74,130	Jim Hogg	57.6%	\$50,163	San Saba	80.2%	\$64,287
Comanche	75.1%	\$65,366	Jim Wells	65.4%	\$64,473	Schleicher	63.9%	\$58,283
Concho	74.0%	\$68,447	Karnes	70.0%	\$85,714	Scurry	76.8%	\$67,720
Cooke	77.7%	\$83,239	Kenedy	50.4%	\$42,733	Shackelford	80.5%	\$66,206
Cottle	68.4%	\$55,903	Kent	79.0%	\$74,316	Shelby	72.6%	\$57,911
Crane	72.3%	\$76,800	Kimble	75.9%	\$81,624	Sherman	81.4%	\$97,461
Crockett	66.9%	\$54,200	King	92.2%	\$48,838	Stephens	76.7%	\$62,557
Culberson	54.8%	\$44,721	Kinney	59.3%	\$56,212	Sterling	89.1%	\$76,835
Dallam	76.8%	\$85,157	Kleberg	78.2%	\$61,532	Stonewall	83.4%	\$63,826
Dawson	77.4%	\$62,021	Knox	78.8%	\$62,069	Sutton	55.1%	\$68,118
Deaf Smith	79.0%	\$63,338	La Salle	70.0%	\$60,056	Swisher	74.8%	\$49,238
Delta	69.6%	\$70,079	Lamar	70.4%	\$56,084	Terrell	66.8%	\$50,663
DeWitt	67.9%	\$76,500	Lamb	82.1%	\$77,252	Terry	74.9%	\$62,622
Dickens	82.7%	\$60,390	Lavaca	78.5%	\$76,795	Throckmorton	76.9%	\$65,105
Dimmit	65.3%	\$49,232	Lee	79.5%	\$69,408	Titus	78.9%	\$63,918
Donley	67.0%	\$64,259	Leon	72.3%	\$71,055	Trinity	72.5%	\$62,398
Duval	65.7%	\$55,217	Limestone	66.6%	\$59,716	Tyler	73.3%	\$62,066
Eastland	72.3%	\$63,389	Lipscomb	86.3%	\$79,893	Upton	61.1%	\$67,263
Edwards	48.3%	\$58,715	Live Oak	63.8%	\$66,491	Uvalde	70.3%	\$60,347
Erath	86.7%	\$75,796	Llano	83.6%	\$96,019	Val Verde	67.1%	\$61,529
Fannin	74.7%	\$78,077	Loving	96.8%	\$73,574	Ward	76.8%	\$74,288
Fayette	65.4%	\$77,645	Lynn	79.4%	\$66,538	Washington	76.8%	\$83,164
Fisher	75.6%	\$67,102	Madison	83.7%	\$60,554	Wharton	76.6%	\$72,687
Floyd	73.6%	\$63,372	Marion	75.6%	\$72,954	Wheeler	77.1%	\$66,702
Foard	69.0%	\$62,365	Mason	72.0%	\$98,374	Wilbarger	70.2%	\$57,372
Franklin	84.4%	\$85,203	Matagorda	77.0%	\$83,443	Willacy	66.7%	\$52,956
Freestone	68.5%	\$70,865	McCulloch	65.4%	\$55,806	Winkler	79.0%	\$75,295
Frio	65.3%	\$68,141	McMullen	77.3%	\$96,335	Wood	80.2%	\$77,104
Gaines	80.3%	\$76,784	Menard	63.5%	\$56,752	Yoakum	83.6%	\$85,587
Garza	82.5%	\$60,304	Milam	73.1%	\$70,525	Young	79.7%	\$72,988
Gillespie	83.1%	\$84,771	Mills	76.5%	\$66,878	Zapata	61.8%	\$56,743
						Zavala	61.7%	\$48,127

Sources: American Community Survey, TXP

Table 4: 2019 Access to Broadband and Median Household Income (MHI)

County	Broadband	Income	County	Broadband	Income	County	Broadband	Income
Andrews	89.1%	\$75,147	Glasscock	85.7%	\$74,375	Mitchell	72.4%	\$44,939
Austin	80.7%	\$64,468	Gonzales	77.2%	\$58,210	Montague	75.8%	\$57,511
Bailey	73.1%	\$55,038	Gray	76.8%	\$54,679	Moore	84.7%	\$53,967
Baylor	78.6%	\$40,946	Grimes	77.5%	\$56,086	Morris	81.1%	\$43,995
Bee	68.4%	\$45,287	Hale	75.9%	\$47,500	Motley	69.8%	\$45,417
Blanco	87.8%	\$70,397	Hall	70.2%	\$40,197	Nolan	74.9%	\$43,692
Borden	81.6%	\$83,281	Hamilton	74.3%	\$46,893	Ochiltree	81.2%	\$53,431
Bosque	74.8%	\$57,337	Hansford	75.6%	\$46,507	Palo Pinto	82.1%	\$55,986
Brewster	75.1%	\$45,296	Hardeman	70.8%	\$47,188	Panola	80.0%	\$51,297
Briscoe	70.1%	\$37,875	Hartley	85.1%	\$53,722	Parmer	75.6%	\$58,558
Brooks	64.2%	\$25,058	Haskell	72.0%	\$48,955	Pecos	70.4%	\$53,879
Brown	78.5%	\$49,180	Hemphill	81.0%	\$59,605	Presidio	62.9%	\$22,716
Burleson	76.4%	\$60,058	Hill	81.5%	\$55,615	Rains	78.4%	\$52,612
Burnet	83.9%	\$59,919	Hockley	76.8%	\$47,010	Reagan	76.3%	\$61,659
Calhoun	79.4%	\$57,170	Hopkins	82.6%	\$54,600	Real	63.4%	\$38,659
Camp	75.5%	\$49,539	Houston	67.3%	\$40,838	Red River	71.4%	\$37,135
Cass	75.4%	\$47,539	Howard	79.2%	\$57,761	Reeves	65.3%	\$61,543
Castro	73.5%	\$49,900	Hutchinson	83.2%	\$57,921	Refugio	72.8%	\$51,054
Childress	77.6%	\$43,564	Irion	65.9%	\$53,778	Roberts	80.5%	\$61,964
Cochran	71.8%	\$41,000	Jack	73.7%	\$54,087	Runnels	74.5%	\$48,489
Coke	73.5%	\$45,072	Jackson	76.4%	\$58,243	Sabine	78.3%	\$38,917
Coleman	76.0%	\$46,948	Jasper	73.6%	\$42,756	San Augustine	74.1%	\$41,568
Collingsworth	67.4%	\$41,202	Jeff Davis	63.2%	\$47,657	San Jacinto	78.2%	\$44,566
Colorado	73.3%	\$52,663	Jim Hogg	57.6%	\$35,736	San Saba	80.2%	\$45,169
Comanche	75.1%	\$54,889	Jim Wells	65.4%	\$45,857	Schleicher	63.9%	\$45,250
Concho	74.0%	\$53,333	Karnes	70.0%	\$52,896	Scurry	76.8%	\$50,277
Cooke	77.7%	\$62,733	Kenedy	50.4%	\$40,083	Shackelford	80.5%	\$48,212
Cottle	68.4%	\$40,250	Kent	79.0%	\$61,706	Shelby	72.6%	\$41,170
Crane	72.3%	\$54,596	Kimble	75.9%	\$46,602	Sherman	81.4%	\$57,130
Crockett	66.9%	\$46,695	King	92.2%	\$39,286	Stephens	76.7%	\$44,940
Culberson	54.8%	\$34,853	Kinney	59.3%	\$39,972	Sterling	89.1%	\$53,194
Dallam	76.8%	\$58,956	Kleberg	78.2%	\$47,301	Stonewall	83.4%	\$58,309
Dawson	77.4%	\$40,469	Knox	78.8%	\$50,719	Sutton	55.1%	\$61,190
Deaf Smith	79.0%	\$49,790	La Salle	70.0%	\$48,036	Swisher	74.8%	\$36,337
Delta	69.6%	\$49,868	Lamar	70.4%	\$44,935	Terrell	66.8%	\$42,823
DeWitt	67.9%	\$53,815	Lamb	82.1%	\$64,808	Terry	74.9%	\$44,052
Dickens	82.7%	\$41,141	Lavaca	78.5%	\$54,211	Throckmorton	76.9%	\$41,875
Dimmit	65.3%	\$25,996	Lee	79.5%	\$56,696	Titus	78.9%	\$53,406
Donley	67.0%	\$51,875	Leon	72.3%	\$43,392	Trinity	72.5%	\$44,052
Duval	65.7%	\$45,349	Limestone	66.6%	\$45,781	Tyler	73.3%	\$47,865
Eastland	72.3%	\$41,559	Lipscomb	86.3%	\$63,182	Upton	61.1%	\$59,008
Edwards	48.3%	\$40,643	Live Oak	63.8%	\$50,212	Uvalde	70.3%	\$45,936
Erath	86.7%	\$55,383	Llano	83.6%	\$58,941	Val Verde	67.1%	\$47,675
Fannin	74.7%	\$57,898	Loving	96.8%	\$44,076	Ward	76.8%	\$61,915
Fayette	65.4%	\$62,872	Lynn	79.4%	\$46,163	Washington	76.8%	\$59,623
Fisher	75.6%	\$52,683	Madison	83.7%	\$48,618	Wharton	76.6%	\$51,770
Floyd	73.6%	\$52,714	Marion	75.6%	\$60,499	Wheeler	77.1%	\$49,036
Foard	69.0%	\$39,306	Mason	72.0%	\$70,000	Wilbarger	70.2%	\$45,121
Franklin	84.4%	\$59,632	Matagorda	77.0%	\$61,434	Willacy	66.7%	\$37,906
Freestone	68.5%	\$52,232	McCulloch	65.4%	\$41,385	Winkler	79.0%	\$63,585
Frio	65.3%	\$48,708	McMullen	77.3%	\$67,386	Wood	80.2%	\$56,749
Gaines	80.3%	\$62,994	Menard	63.5%	\$43,826	Yoakum	83.6%	\$69,004
Garza	82.5%	\$58,938	Milam	73.1%	\$48,253	Young	79.7%	\$52,158
Gillespie	83.1%	\$61,445	Mills	76.5%	\$50,198	Zapata	61.8%	\$32,945
						Zavala	61.7%	\$40,090

Sources: American Community Survey, TXP

Table 5: 2019 Access to Broadband and Per Capita Economic Activity (GAP - \$000s)

County	Broadband	GAP	County	Broadband	GAP	County	Broadband	GAP
Andrews	89.1%	\$88.45	Glasscock	85.7%	\$900.82	Mitchell	72.4%	\$33.14
Austin	80.7%	\$51.58	Gonzales	77.2%	\$77.09	Montague	75.8%	\$29.84
Bailey	73.1%	\$57.94	Gray	76.8%	\$44.21	Moore	84.7%	\$104.23
Baylor	78.6%	\$50.72	Grimes	77.5%	\$36.05	Morris	81.1%	\$44.11
Bee	68.4%	\$23.28	Hale	75.9%	\$39.87	Motley	69.8%	\$32.59
Blanco	87.8%	\$38.46	Hall	70.2%	\$29.98	Nolan	74.9%	\$66.38
Borden	81.6%	\$390.12	Hamilton	74.3%	\$36.11	Ochiltree	81.2%	\$69.05
Bosque	74.8%	\$35.27	Hansford	75.6%	\$73.97	Palo Pinto	82.1%	\$35.98
Brewster	75.1%	\$46.28	Hardeman	70.8%	\$47.98	Panola	80.0%	\$64.72
Briscoe	70.1%	\$67.89	Hartley	85.1%	\$106.68	Parmer	75.6%	\$93.63
Brooks	64.2%	\$37.36	Haskell	72.0%	\$55.91	Pecos	70.4%	\$97.06
Brown	78.5%	\$40.39	Hemphill	81.0%	\$91.10	Presidio	62.9%	\$41.16
Burleson	76.4%	\$44.68	Hill	81.5%	\$28.46	Rains	78.4%	\$19.69
Burnet	83.9%	\$36.94	Hockley	76.8%	\$50.39	Reagan	76.3%	\$388.30
Calhoun	79.4%	\$165.81	Hopkins	82.6%	\$44.42	Real	63.4%	\$23.85
Camp	75.5%	\$28.28	Houston	67.3%	\$43.09	Red River	71.4%	\$28.35
Cass	75.4%	\$29.69	Howard	79.2%	\$96.51	Reeves	65.3%	\$256.10
Castro	73.5%	\$74.05	Hutchinson	83.2%	\$200.04	Refugio	72.8%	\$38.60
Childress	77.6%	\$36.45	Irion	65.9%	\$326.49	Roberts	80.5%	\$291.22
Cochran	71.8%	\$57.23	Jack	73.7%	\$44.80	Runnels	74.5%	\$31.28
Coke	73.5%	\$26.95	Jackson	76.4%	\$43.54	Sabine	78.3%	\$24.73
Coleman	76.0%	\$28.73	Jasper	73.6%	\$27.83	San Augustine	74.1%	\$58.48
Collingsworth	67.4%	\$28.32	Jeff Davis	63.2%	\$42.14	San Jacinto	78.2%	\$14.14
Colorado	73.3%	\$39.75	Jim Hogg	57.6%	\$36.08	San Saba	80.2%	\$30.84
Comanche	75.1%	\$36.12	Jim Wells	65.4%	\$32.16	Schleicher	63.9%	\$51.96
Concho	74.0%	\$43.98	Karnes	70.0%	\$175.63	Scurry	76.8%	\$67.09
Cooke	77.7%	\$56.24	Kenedy	50.4%	\$461.28	Shackelford	80.5%	\$62.37
Cottle	68.4%	\$42.52	Kent	79.0%	\$116.89	Shelby	72.6%	\$40.29
Crane	72.3%	\$78.15	Kimble	75.9%	\$35.67	Sherman	81.4%	\$106.33
Crockett	66.9%	\$116.18	King	92.2%	\$171.06	Stephens	76.7%	\$40.76
Culberson	54.8%	\$335.95	Kinney	59.3%	\$33.43	Sterling	89.1%	\$172.80
Dallam	76.8%	\$90.08	Kleberg	78.2%	\$37.62	Stonewall	83.4%	\$57.29
Dawson	77.4%	\$45.29	Knox	78.8%	\$39.73	Sutton	55.1%	\$57.20
Deaf Smith	79.0%	\$68.89	La Salle	70.0%	\$375.23	Swisher	74.8%	\$48.35
Delta	69.6%	\$20.02	Lamar	70.4%	\$14.14	Terrell	66.8%	\$94.35
DeWitt	67.9%	\$90.13	Lamb	82.1%	\$44.68	Terry	74.9%	\$38.43
Dickens	82.7%	\$46.68	Lavaca	78.5%	\$47.41	Throckmorton	76.9%	\$32.07
Dimmit	65.3%	\$142.45	Lee	79.5%	\$49.35	Titus	78.9%	\$59.14
Donley	67.0%	\$42.64	Leon	72.3%	\$36.53	Trinity	72.5%	\$19.46
Duval	65.7%	\$27.10	Limestone	66.6%	\$58.39	Tyler	73.3%	\$19.37
Eastland	72.3%	\$39.54	Lipscomb	86.3%	\$126.26	Upton	61.1%	\$562.20
Edwards	48.3%	\$39.86	Live Oak	63.8%	\$67.53	Uvalde	70.3%	\$34.68
Erath	86.7%	\$39.34	Llano	83.6%	\$38.48	Val Verde	67.1%	\$37.11
Fannin	74.7%	\$29.21	Loving	96.8%	\$11,723	Ward	76.8%	\$135.29
Fayette	65.4%	\$59.94	Lynn	79.4%	\$50.70	Washington	76.8%	\$50.18
Fisher	75.6%	\$52.30	Madison	83.7%	\$23.44	Wharton	76.6%	\$46.09
Floyd	73.6%	\$54.77	Marion	75.6%	\$49.57	Wheeler	77.1%	\$67.06
Foard	69.0%	\$88.42	Mason	72.0%	\$720.19	Wilbarger	70.2%	\$61.24
Franklin	84.4%	\$35.69	Matagorda	77.0%	\$3.80	Willacy	66.7%	\$23.38
Freestone	68.5%	\$47.69	McCulloch	65.4%	\$217.37	Winkler	79.0%	\$122.95
Frio	65.3%	\$43.09	McMullen	77.3%	\$885.98	Wood	80.2%	\$29.82
Gaines	80.3%	\$62.37	Menard	63.5%	\$23.66	Yoakum	83.6%	\$115.58
Garza	82.5%	\$29.92	Milam	73.1%	\$23.35	Young	79.7%	\$44.70
Gillespie	83.1%	\$44.69	Mills	76.5%	\$47.85	Zapata	61.8%	\$34.17
						Zavala	61.7%	\$35.96

Sources: American Community Survey, Bureau of Economic Analysis, TXP

Table 6: 2019 Access to Broadband and Five-Year Job Growth (2014-19)

County	Broadband	Jobs	County	Broadband	Jobs	County	Broadband	Jobs
Andrews	89.1%	3.6%	Glasscock	85.7%	2.4%	Mitchell	72.4%	-16.2%
Austin	80.7%	5.3%	Gonzales	77.2%	-0.5%	Montague	75.8%	-8.9%
Bailey	73.1%	-3.9%	Gray	76.8%	-15.4%	Moore	84.7%	1.7%
Baylor	78.6%	4.9%	Grimes	77.5%	-3.1%	Morris	81.1%	-13.4%
Bee	68.4%	-3.7%	Hale	75.9%	0.6%	Motley	69.8%	4.5%
Blanco	87.8%	16.1%	Hall	70.2%	-8.9%	Nolan	74.9%	3.9%
Borden	81.6%	44.9%	Hamilton	74.3%	3.4%	Ochiltree	81.2%	-19.9%
Bosque	74.8%	2.3%	Hansford	75.6%	-14.4%	Palo Pinto	82.1%	3.5%
Brewster	75.1%	9.0%	Hardeman	70.8%	3.5%	Panola	80.0%	-12.9%
Briscoe	70.1%	3.9%	Hartley	85.1%	18.5%	Parmer	75.6%	3.5%
Brooks	64.2%	-1.4%	Haskell	72.0%	6.0%	Pecos	70.4%	-3.4%
Brown	78.5%	0.3%	Hemphill	81.0%	-18.5%	Presidio	62.9%	3.8%
Burleson	76.4%	7.9%	Hill	81.5%	6.7%	Rains	78.4%	8.5%
Burnet	83.9%	12.7%	Hockley	76.8%	-3.8%	Reagan	76.3%	-4.4%
Calhoun	79.4%	18.8%	Hopkins	82.6%	3.4%	Real	63.4%	4.4%
Camp	75.5%	-3.6%	Houston	67.3%	4.2%	Red River	71.4%	4.3%
Cass	75.4%	4.5%	Howard	79.2%	5.2%	Reeves	65.3%	84.9%
Castro	73.5%	-3.2%	Hutchinson	83.2%	-9.8%	Refugio	72.8%	-9.6%
Childress	77.6%	4.8%	Irion	65.9%	-25.4%	Roberts	80.5%	0.9%
Cochran	71.8%	-7.1%	Jack	73.7%	-17.9%	Runnels	74.5%	-4.9%
Coke	73.5%	-1.9%	Jackson	76.4%	7.5%	Sabine	78.3%	7.2%
Coleman	76.0%	-6.3%	Jasper	73.6%	-7.8%	San Augustine	74.1%	18.1%
Collingsworth	67.4%	-0.3%	Jeff Davis	63.2%	-1.9%	San Jacinto	78.2%	21.3%
Colorado	73.3%	1.8%	Jim Hogg	57.6%	-7.5%	San Saba	80.2%	8.8%
Comanche	75.1%	4.9%	Jim Wells	65.4%	-15.3%	Schleicher	63.9%	-18.7%
Concho	74.0%	-0.6%	Karnes	70.0%	11.0%	Scurry	76.8%	-19.7%
Cooke	77.7%	-0.4%	Kenedy	50.4%	-25.9%	Shackelford	80.5%	-19.0%
Cottle	68.4%	6.8%	Kent	79.0%	-0.2%	Shelby	72.6%	2.9%
Crane	72.3%	-14.2%	Kimble	75.9%	-4.5%	Sherman	81.4%	-0.8%
Crockett	66.9%	-5.9%	King	92.2%	10.5%	Stephens	76.7%	-6.9%
Culberson	54.8%	19.1%	Kinney	59.3%	11.1%	Sterling	89.1%	-17.3%
Dallam	76.8%	-6.9%	Kleberg	78.2%	-6.8%	Stonewall	83.4%	-7.3%
Dawson	77.4%	-0.9%	Knox	78.8%	-13.1%	Sutton	55.1%	-26.2%
Deaf Smith	79.0%	2.1%	La Salle	70.0%	9.5%	Swisher	74.8%	-6.2%
Delta	69.6%	-13.5%	Lamar	70.4%	-3.2%	Terrell	66.8%	-9.2%
DeWitt	67.9%	-0.5%	Lamb	82.1%	4.3%	Terry	74.9%	-3.8%
Dickens	82.7%	0.0%	Lavaca	78.5%	-2.1%	Throckmorton	76.9%	-9.8%
Dimmit	65.3%	-5.2%	Lee	79.5%	7.2%	Titus	78.9%	5.8%
Donley	67.0%	-1.7%	Leon	72.3%	-8.0%	Trinity	72.5%	2.2%
Duval	65.7%	-6.4%	Limestone	66.6%	-1.7%	Tyler	73.3%	1.3%
Eastland	72.3%	-3.7%	Lipscomb	86.3%	-8.0%	Upton	61.1%	-11.2%
Edwards	48.3%	13.0%	Live Oak	63.8%	-8.0%	Uvalde	70.3%	4.4%
Erath	86.7%	12.8%	Llano	83.6%	11.5%	Val Verde	67.1%	13.3%
Fannin	74.7%	13.1%	Loving	96.8%	294.1%	Ward	76.8%	19.4%
Fayette	65.4%	0.8%	Lynn	79.4%	15.0%	Washington	76.8%	2.0%
Fisher	75.6%	-2.9%	Madison	83.7%	-12.7%	Wharton	76.6%	3.6%
Floyd	73.6%	-0.4%	Marion	75.6%	-7.2%	Wheeler	77.1%	-19.7%
Foard	69.0%	1.6%	Mason	72.0%	30.7%	Wilbarger	70.2%	-4.3%
Franklin	84.4%	10.8%	Matagorda	77.0%	4.2%	Willacy	66.7%	-5.9%
Freestone	68.5%	-11.8%	McCulloch	65.4%	7.0%	Winkler	79.0%	21.2%
Frio	65.3%	1.4%	McMullen	77.3%	-11.5%	Wood	80.2%	5.4%
Gaines	80.3%	20.3%	Menard	63.5%	-0.5%	Yoakum	83.6%	-6.4%
Garza	82.5%	-6.6%	Milam	73.1%	-4.3%	Young	79.7%	-12.2%
Gillespie	83.1%	7.7%	Mills	76.5%	2.7%	Zapata	61.8%	-25.3%
						Zavala	61.7%	0.9%

Sources: American Community Survey, Texas Workforce Commission, TXP

Table 7: 2019 Access to Broadband & Share of Adult Population with High School +

County	Broadband	HS+	County	Broadband	HS+	County	Broadband	HS+
Andrews	89.1%	76.7%	Glasscock	85.7%	69.3%	Mitchell	72.4%	84.8%
Austin	80.7%	87.6%	Gonzales	77.2%	76.2%	Montague	75.8%	86.7%
Bailey	73.1%	77.9%	Gray	76.8%	79.7%	Moore	84.7%	65.4%
Baylor	78.6%	87.4%	Grimes	77.5%	81.2%	Morris	81.1%	91.1%
Bee	68.4%	79.2%	Hale	75.9%	74.9%	Motley	69.8%	88.7%
Blanco	87.8%	91.6%	Hall	70.2%	81.1%	Nolan	74.9%	82.6%
Borden	81.6%	93.3%	Hamilton	74.3%	87.1%	Ochiltree	81.2%	74.3%
Bosque	74.8%	88.3%	Hansford	75.6%	71.5%	Palo Pinto	82.1%	87.7%
Brewster	75.1%	84.9%	Hardeman	70.8%	81.5%	Panola	80.0%	84.0%
Briscoe	70.1%	85.4%	Hartley	85.1%	84.2%	Parmer	75.6%	74.1%
Brooks	64.2%	67.1%	Haskell	72.0%	74.1%	Pecos	70.4%	72.5%
Brown	78.5%	87.0%	Hemphill	81.0%	82.3%	Presidio	62.9%	48.5%
Burleson	76.4%	84.1%	Hill	81.5%	84.5%	Rains	78.4%	83.0%
Burnet	83.9%	88.4%	Hockley	76.8%	75.6%	Reagan	76.3%	82.6%
Calhoun	79.4%	80.9%	Hopkins	82.6%	84.9%	Real	63.4%	87.9%
Camp	75.5%	87.7%	Houston	67.3%	81.2%	Red River	71.4%	89.0%
Cass	75.4%	86.9%	Howard	79.2%	80.1%	Reeves	65.3%	69.4%
Castro	73.5%	75.4%	Hutchinson	83.2%	86.2%	Refugio	72.8%	82.6%
Childress	77.6%	84.2%	Irion	65.9%	94.1%	Roberts	80.5%	92.7%
Cochran	71.8%	70.2%	Jack	73.7%	81.1%	Runnels	74.5%	81.1%
Coke	73.5%	83.2%	Jackson	76.4%	81.4%	Sabine	78.3%	85.7%
Coleman	76.0%	86.5%	Jasper	73.6%	85.0%	San Augustine	74.1%	82.0%
Collingsworth	67.4%	75.3%	Jeff Davis	63.2%	80.7%	San Jacinto	78.2%	85.5%
Colorado	73.3%	84.3%	Jim Hogg	57.6%	74.5%	San Saba	80.2%	80.8%
Comanche	75.1%	85.7%	Jim Wells	65.4%	78.2%	Schleicher	63.9%	79.2%
Concho	74.0%	69.2%	Karnes	70.0%	75.7%	Scurry	76.8%	80.2%
Cooke	77.7%	87.4%	Kenedy	50.4%	21.9%	Shackelford	80.5%	88.0%
Cottle	68.4%	81.1%	Kent	79.0%	93.5%	Shelby	72.6%	78.0%
Crane	72.3%	76.9%	Kimble	75.9%	83.7%	Sherman	81.4%	74.4%
Crockett	66.9%	78.6%	King	92.2%	78.4%	Stephens	76.7%	79.8%
Culberson	54.8%	65.4%	Kinney	59.3%	81.0%	Sterling	89.1%	89.1%
Dallam	76.8%	68.1%	Kleberg	78.2%	79.1%	Stonewall	83.4%	81.6%
Dawson	77.4%	71.6%	Knox	78.8%	80.7%	Sutton	55.1%	75.3%
Deaf Smith	79.0%	72.7%	La Salle	70.0%	86.1%	Swisher	74.8%	75.2%
Delta	69.6%	87.4%	Lamar	70.4%	75.8%	Terrell	66.8%	85.2%
DeWitt	67.9%	82.8%	Lamb	82.1%	89.9%	Terry	74.9%	69.7%
Dickens	82.7%	80.2%	Lavaca	78.5%	86.2%	Throckmorton	76.9%	87.0%
Dimmit	65.3%	67.8%	Lee	79.5%	83.0%	Titus	78.9%	78.2%
Donley	67.0%	89.5%	Leon	72.3%	81.9%	Trinity	72.5%	82.6%
Duval	65.7%	70.4%	Limestone	66.6%	83.2%	Tyler	73.3%	81.3%
Eastland	72.3%	85.2%	Lipscomb	86.3%	82.6%	Upton	61.1%	78.1%
Edwards	48.3%	76.9%	Live Oak	63.8%	77.6%	Uvalde	70.3%	75.9%
Erath	86.7%	87.2%	Llano	83.6%	86.5%	Val Verde	67.1%	70.0%
Fannin	74.7%	85.6%	Loving	96.8%	96.6%	Ward	76.8%	79.5%
Fayette	65.4%	89.1%	Lynn	79.4%	78.7%	Washington	76.8%	87.5%
Fisher	75.6%	88.9%	Madison	83.7%	80.4%	Wharton	76.6%	80.0%
Floyd	73.6%	75.2%	Marion	75.6%	81.2%	Wheeler	77.1%	79.9%
Foard	69.0%	81.2%	Mason	72.0%	78.9%	Wilbarger	70.2%	78.7%
Franklin	84.4%	90.6%	Matagorda	77.0%	85.5%	Willacy	66.7%	70.1%
Freestone	68.5%	81.8%	McCulloch	65.4%	61.5%	Winkler	79.0%	68.9%
Frio	65.3%	64.9%	McMullen	77.3%	88.9%	Wood	80.2%	85.6%
Gaines	80.3%	61.8%	Menard	63.5%	83.5%	Yoakum	83.6%	69.2%
Garza	82.5%	65.0%	Milam	73.1%	83.6%	Young	79.7%	84.8%
Gillespie	83.1%	89.7%	Mills	76.5%	82.8%	Zapata	61.8%	64.7%
						Zavala	61.7%	75.7%

Sources: American Community Survey, TXP

Table 8: 2019 Access to Broadband & Share of Adult Population with Associate +

County	Broadband	Assoc.+	County	Broadband	Assoc.+	County	Broadband	Assoc.+
Andrews	89.1%	22.4%	Glasscock	85.7%	28.2%	Mitchell	72.4%	17.4%
Austin	80.7%	29.4%	Gonzales	77.2%	17.4%	Montague	75.8%	26.4%
Bailey	73.1%	24.3%	Gray	76.8%	23.1%	Moore	84.7%	21.1%
Baylor	78.6%	27.1%	Grimes	77.5%	24.4%	Morris	81.1%	21.5%
Bee	68.4%	18.3%	Hale	75.9%	22.4%	Motley	69.8%	23.0%
Blanco	87.8%	37.6%	Hall	70.2%	26.1%	Nolan	74.9%	24.1%
Borden	81.6%	50.5%	Hamilton	74.3%	26.9%	Ochiltree	81.2%	22.5%
Bosque	74.8%	28.3%	Hansford	75.6%	28.4%	Palo Pinto	82.1%	25.8%
Brewster	75.1%	44.5%	Hardeman	70.8%	23.7%	Panola	80.0%	24.3%
Briscoe	70.1%	24.4%	Hartley	85.1%	24.6%	Parmer	75.6%	24.5%
Brooks	64.2%	19.3%	Haskell	72.0%	22.1%	Pecos	70.4%	15.3%
Brown	78.5%	27.1%	Hemphill	81.0%	26.2%	Presidio	62.9%	27.6%
Burleson	76.4%	27.8%	Hill	81.5%	26.2%	Rains	78.4%	23.1%
Burnet	83.9%	32.8%	Hockley	76.8%	24.8%	Reagan	76.3%	16.4%
Calhoun	79.4%	26.2%	Hopkins	82.6%	28.5%	Real	63.4%	27.2%
Camp	75.5%	28.8%	Houston	67.3%	22.9%	Red River	71.4%	23.2%
Cass	75.4%	25.2%	Howard	79.2%	19.8%	Reeves	65.3%	16.4%
Castro	73.5%	21.0%	Hutchinson	83.2%	23.9%	Refugio	72.8%	20.5%
Childress	77.6%	23.9%	Irion	65.9%	30.1%	Roberts	80.5%	34.8%
Cochran	71.8%	16.1%	Jack	73.7%	21.3%	Runnels	74.5%	24.1%
Coke	73.5%	27.2%	Jackson	76.4%	21.8%	Sabine	78.3%	25.5%
Coleman	76.0%	23.2%	Jasper	73.6%	20.7%	San Augustine	74.1%	18.1%
Collingsworth	67.4%	29.6%	Jeff Davis	63.2%	37.2%	San Jacinto	78.2%	20.3%
Colorado	73.3%	26.6%	Jim Hogg	57.6%	17.1%	San Saba	80.2%	21.6%
Comanche	75.1%	28.4%	Jim Wells	65.4%	21.9%	Schleicher	63.9%	22.2%
Concho	74.0%	18.4%	Karnes	70.0%	21.1%	Scurry	76.8%	22.8%
Cooke	77.7%	30.4%	Kenedy	50.4%	1.5%	Shackelford	80.5%	37.6%
Cottle	68.4%	26.4%	Kent	79.0%	41.0%	Shelby	72.6%	19.6%
Crane	72.3%	20.8%	Kimble	75.9%	30.0%	Sherman	81.4%	27.2%
Crockett	66.9%	12.9%	King	92.2%	14.4%	Stephens	76.7%	22.4%
Culberson	54.8%	20.8%	Kinney	59.3%	25.6%	Sterling	89.1%	20.9%
Dallam	76.8%	19.0%	Kleberg	78.2%	28.6%	Stonewall	83.4%	14.3%
Dawson	77.4%	18.6%	Knox	78.8%	25.8%	Sutton	55.1%	23.6%
Deaf Smith	79.0%	16.0%	La Salle	70.0%	27.5%	Swisher	74.8%	20.0%
Delta	69.6%	30.1%	Lamar	70.4%	20.3%	Terrell	66.8%	25.5%
DeWitt	67.9%	20.2%	Lamb	82.1%	31.6%	Terry	74.9%	15.5%
Dickens	82.7%	25.4%	Lavaca	78.5%	25.8%	Throckmorton	76.9%	29.6%
Dimmit	65.3%	18.0%	Lee	79.5%	20.9%	Titus	78.9%	25.0%
Donley	67.0%	26.4%	Leon	72.3%	20.3%	Trinity	72.5%	20.2%
Duval	65.7%	16.5%	Limestone	66.6%	23.3%	Tyler	73.3%	18.2%
Eastland	72.3%	28.8%	Lipscomb	86.3%	30.1%	Upton	61.1%	17.5%
Edwards	48.3%	24.8%	Live Oak	63.8%	16.0%	Uvalde	70.3%	28.4%
Erath	86.7%	40.0%	Llano	83.6%	33.0%	Val Verde	67.1%	25.4%
Fannin	74.7%	23.8%	Loving	96.8%	54.5%	Ward	76.8%	17.8%
Fayette	65.4%	29.4%	Lynn	79.4%	27.8%	Washington	76.8%	35.8%
Fisher	75.6%	31.4%	Madison	83.7%	23.4%	Wharton	76.6%	28.1%
Floyd	73.6%	23.2%	Marion	75.6%	20.0%	Wheeler	77.1%	24.4%
Foard	69.0%	23.2%	Mason	72.0%	23.4%	Wilbarger	70.2%	21.7%
Franklin	84.4%	38.0%	Matagorda	77.0%	40.0%	Willacy	66.7%	18.0%
Freestone	68.5%	24.6%	McCulloch	65.4%	21.8%	Winkler	79.0%	13.7%
Frio	65.3%	14.6%	McMullen	77.3%	22.0%	Wood	80.2%	26.4%
Gaines	80.3%	15.6%	Menard	63.5%	35.5%	Yoakum	83.6%	15.9%
Garza	82.5%	14.7%	Milam	73.1%	23.2%	Young	79.7%	28.4%
Gillespie	83.1%	40.3%	Mills	76.5%	27.3%	Zapata	61.8%	17.3%
						Zavala	61.7%	18.9%

Sources: American Community Survey, TXP

Table 9: 2019 Access to Broadband & Share of Adult Population with Bachelor +

County	Broadband	College+	County	Broadband	College+	County	Broadband	College+
Andrews	89.1%	14.9%	Glasscock	85.7%	25.5%	Mitchell	72.4%	12.1%
Austin	80.7%	23.0%	Gonzales	77.2%	12.4%	Montague	75.8%	17.4%
Bailey	73.1%	17.4%	Gray	76.8%	15.1%	Moore	84.7%	14.2%
Baylor	78.6%	21.0%	Grimes	77.5%	18.3%	Morris	81.1%	14.1%
Bee	68.4%	10.8%	Hale	75.9%	17.2%	Motley	69.8%	16.7%
Blanco	87.8%	28.2%	Hall	70.2%	18.3%	Nolan	74.9%	15.1%
Borden	81.6%	45.2%	Hamilton	74.3%	20.6%	Ochiltree	81.2%	16.7%
Bosque	74.8%	18.5%	Hansford	75.6%	23.2%	Palo Pinto	82.1%	18.1%
Brewster	75.1%	40.8%	Hardeman	70.8%	16.3%	Panola	80.0%	15.6%
Briscoe	70.1%	17.5%	Hartley	85.1%	21.1%	Parmer	75.6%	15.1%
Brooks	64.2%	16.4%	Haskell	72.0%	16.7%	Pecos	70.4%	11.6%
Brown	78.5%	20.1%	Hemphill	81.0%	20.6%	Presidio	62.9%	19.5%
Burleson	76.4%	21.3%	Hill	81.5%	17.5%	Rains	78.4%	15.3%
Burnet	83.9%	26.8%	Hockley	76.8%	15.7%	Reagan	76.3%	11.7%
Calhoun	79.4%	17.5%	Hopkins	82.6%	21.3%	Real	63.4%	16.8%
Camp	75.5%	21.9%	Houston	67.3%	15.6%	Red River	71.4%	15.7%
Cass	75.4%	18.3%	Howard	79.2%	13.4%	Reeves	65.3%	10.6%
Castro	73.5%	16.4%	Hutchinson	83.2%	15.4%	Refugio	72.8%	11.1%
Childress	77.6%	18.8%	Irion	65.9%	20.5%	Roberts	80.5%	23.9%
Cochran	71.8%	8.2%	Jack	73.7%	14.5%	Runnels	74.5%	16.6%
Coke	73.5%	22.2%	Jackson	76.4%	15.4%	Sabine	78.3%	17.4%
Coleman	76.0%	16.9%	Jasper	73.6%	13.3%	San Augustine	74.1%	14.0%
Collingsworth	67.4%	22.3%	Jeff Davis	63.2%	29.9%	San Jacinto	78.2%	15.2%
Colorado	73.3%	19.1%	Jim Hogg	57.6%	13.2%	San Saba	80.2%	17.4%
Comanche	75.1%	20.1%	Jim Wells	65.4%	16.2%	Schleicher	63.9%	16.1%
Concho	74.0%	13.2%	Karnes	70.0%	15.9%	Scurry	76.8%	16.1%
Cooke	77.7%	21.8%	Kenedy	50.4%	1.5%	Shackelford	80.5%	32.6%
Cottle	68.4%	18.9%	Kent	79.0%	32.8%	Shelby	72.6%	14.0%
Crane	72.3%	13.3%	Kimble	75.9%	24.7%	Sherman	81.4%	18.5%
Crockett	66.9%	9.7%	King	92.2%	13.5%	Stephens	76.7%	15.7%
Culberson	54.8%	16.5%	Kinney	59.3%	18.8%	Sterling	89.1%	18.4%
Dallam	76.8%	17.0%	Kleberg	78.2%	24.3%	Stonewall	83.4%	12.5%
Dawson	77.4%	14.5%	Knox	78.8%	18.8%	Sutton	55.1%	18.4%
Deaf Smith	79.0%	12.0%	La Salle	70.0%	18.7%	Swisher	74.8%	15.9%
Delta	69.6%	21.6%	Lamar	70.4%	12.6%	Terrell	66.8%	22.6%
DeWitt	67.9%	12.2%	Lamb	82.1%	18.4%	Terry	74.9%	11.6%
Dickens	82.7%	18.6%	Lavaca	78.5%	17.9%	Throckmorton	76.9%	22.3%
Dimmit	65.3%	14.8%	Lee	79.5%	14.0%	Titus	78.9%	16.8%
Donley	67.0%	18.1%	Leon	72.3%	15.0%	Trinity	72.5%	13.6%
Duval	65.7%	9.2%	Limestone	66.6%	16.7%	Tyler	73.3%	14.2%
Eastland	72.3%	19.2%	Lipscomb	86.3%	23.6%	Upton	61.1%	14.0%
Edwards	48.3%	18.2%	Live Oak	63.8%	11.1%	Uvalde	70.3%	19.4%
Erath	86.7%	33.0%	Llano	83.6%	25.9%	Val Verde	67.1%	19.1%
Fannin	74.7%	17.9%	Loving	96.8%	0.0%	Ward	76.8%	11.5%
Fayette	65.4%	22.3%	Lynn	79.4%	20.7%	Washington	76.8%	28.1%
Fisher	75.6%	20.3%	Madison	83.7%	17.7%	Wharton	76.6%	18.8%
Floyd	73.6%	15.7%	Marion	75.6%	13.8%	Wheeler	77.1%	15.3%
Foard	69.0%	12.8%	Mason	72.0%	19.4%	Wilbarger	70.2%	14.9%
Franklin	84.4%	30.3%	Matagorda	77.0%	35.0%	Willacy	66.7%	9.2%
Freestone	68.5%	14.8%	McCulloch	65.4%	15.7%	Winkler	79.0%	9.5%
Frio	65.3%	8.2%	McMullen	77.3%	14.8%	Wood	80.2%	19.2%
Gaines	80.3%	10.4%	Menard	63.5%	26.7%	Yoakum	83.6%	11.8%
Garza	82.5%	12.3%	Milam	73.1%	15.1%	Young	79.7%	23.6%
Gillespie	83.1%	34.1%	Mills	76.5%	21.1%	Zapata	61.8%	12.2%
						Zavala	61.7%	12.4%

Sources: American Community Survey, TXP

Table 10: 2019 Access to Broadband & Healthy Share of Adult Population

County	Broadband	Health	County	Broadband	Health	County	Broadband	Health
Andrews	89.1%	74%	Glasscock	85.7%	74%	Mitchell	72.4%	74%
Austin	80.7%	78%	Gonzales	77.2%	72%	Montague	75.8%	78%
Bailey	73.1%	75%	Gray	76.8%	74%	Moore	84.7%	72%
Baylor	78.6%	80%	Grimes	77.5%	74%	Morris	81.1%	76%
Bee	68.4%	71%	Hale	75.9%	73%	Motley	69.8%	79%
Blanco	87.8%	81%	Hall	70.2%	70%	Nolan	74.9%	74%
Borden	81.6%	85%	Hamilton	74.3%	77%	Ochiltree	81.2%	72%
Bosque	74.8%	78%	Hansford	75.6%	70%	Palo Pinto	82.1%	76%
Brewster	75.1%	78%	Hardeman	70.8%	75%	Panola	80.0%	77%
Briscoe	70.1%	75%	Hartley	85.1%	80%	Parmer	75.6%	71%
Brooks	64.2%	62%	Haskell	72.0%	69%	Pecos	70.4%	71%
Brown	78.5%	78%	Hemphill	81.0%	79%	Presidio	62.9%	59%
Burleson	76.4%	78%	Hill	81.5%	77%	Rains	78.4%	79%
Burnet	83.9%	80%	Hockley	76.8%	73%	Reagan	76.3%	74%
Calhoun	79.4%	73%	Hopkins	82.6%	78%	Real	63.4%	72%
Camp	75.5%	77%	Houston	67.3%	72%	Red River	71.4%	75%
Cass	75.4%	76%	Howard	79.2%	73%	Reeves	65.3%	71%
Castro	73.5%	73%	Hutchinson	83.2%	77%	Refugio	72.8%	74%
Childress	77.6%	75%	Irion	65.9%	80%	Roberts	80.5%	81%
Cochran	71.8%	66%	Jack	73.7%	75%	Runnels	74.5%	75%
Coke	73.5%	77%	Jackson	76.4%	77%	Sabine	78.3%	76%
Coleman	76.0%	78%	Jasper	73.6%	76%	San Augustine	74.1%	74%
Collingsworth	67.4%	74%	Jeff Davis	63.2%	77%	San Jacinto	78.2%	75%
Colorado	73.3%	77%	Jim Hogg	57.6%	65%	San Saba	80.2%	74%
Comanche	75.1%	78%	Jim Wells	65.4%	69%	Schleicher	63.9%	76%
Concho	74.0%	73%	Karnes	70.0%	72%	Scurry	76.8%	74%
Cooke	77.7%	79%	Kenedy	50.4%	55%	Shackelford	80.5%	80%
Cottle	68.4%	70%	Kent	79.0%	81%	Shelby	72.6%	73%
Crane	72.3%	74%	Kimble	75.9%	75%	Sherman	81.4%	76%
Crockett	66.9%	74%	King	92.2%	75%	Stephens	76.7%	75%
Culberson	54.8%	63%	Kinney	59.3%	68%	Sterling	89.1%	76%
Dallam	76.8%	74%	Kleberg	78.2%	71%	Stonewall	83.4%	77%
Dawson	77.4%	67%	Knox	78.8%	73%	Sutton	55.1%	74%
Deaf Smith	79.0%	70%	La Salle	70.0%	77%	Swisher	74.8%	69%
Delta	69.6%	79%	Lamar	70.4%	69%	Terrell	66.8%	75%
DeWitt	67.9%	74%	Lamb	82.1%	80%	Terry	74.9%	68%
Dickens	82.7%	74%	Lavaca	78.5%	78%	Throckmorton	76.9%	79%
Dimmit	65.3%	61%	Lee	79.5%	77%	Titus	78.9%	72%
Donley	67.0%	79%	Leon	72.3%	75%	Trinity	72.5%	75%
Duval	65.7%	66%	Limestone	66.6%	73%	Tyler	73.3%	76%
Eastland	72.3%	76%	Lipscomb	86.3%	77%	Upton	61.1%	73%
Edwards	48.3%	70%	Live Oak	63.8%	73%	Uvalde	70.3%	70%
Erath	86.7%	79%	Llano	83.6%	80%	Val Verde	67.1%	68%
Fannin	74.7%	78%	Loving	96.8%	80%	Ward	76.8%	73%
Fayette	65.4%	78%	Lynn	79.4%	71%	Washington	76.8%	79%
Fisher	75.6%	77%	Madison	83.7%	74%	Wharton	76.6%	73%
Floyd	73.6%	73%	Marion	75.6%	76%	Wheeler	77.1%	75%
Foard	69.0%	77%	Mason	72.0%	76%	Wilbarger	70.2%	72%
Franklin	84.4%	82%	Matagorda	77.0%	79%	Willacy	66.7%	62%
Freestone	68.5%	75%	McCulloch	65.4%	63%	Winkler	79.0%	72%
Frio	65.3%	67%	McMullen	77.3%	81%	Wood	80.2%	78%
Gaines	80.3%	72%	Menard	63.5%	74%	Yoakum	83.6%	71%
Garza	82.5%	69%	Milam	73.1%	75%	Young	79.7%	78%
Gillespie	83.1%	81%	Mills	76.5%	77%	Zapata	61.8%	62%
						Zavala	61.7%	60%

Sources: American Community Survey, University of Wisconsin Health Rankings, TXP

Statistical Analysis

Dependence refers to any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence. Familiar examples include the correlation between the physical statures of parents and their offspring, and the correlation between the demand for a product and its price. Correlations are useful because they can indicate a predictive relationship that can inform decision-making. For example, an electrical utility may produce less power on a mild day based on the observed correlation between electricity demand and weather.

Formally, dependence refers to any situation in which random variables do not satisfy a mathematical condition of probabilistic independence. There are several correlation coefficients, often denoted ρ or r , measuring the degree of correlation. The most common of these is the Pearson correlation coefficient, which is used here.

Table 11: Tests of Statistical Significance

Test	Description	Pearson Correlation Coefficient	Significant	Level (1-tail)
Table 3	Broadband v. AHI	0.5295	Yes	99.5%
Table 4	Broadband v. MHI	0.4835	Yes	99.5%
Table 5	Broadband v. GAP	0.2239	Yes	99.5%
Table 6	Broadband v. Job Growth	0.2529	Yes	99.5%
Table 7	Broadband v. High School+	0.3974	Yes	99.5%
Table 8	Broadband v. Associates+	0.3323	Yes	99.5%
Table 9	Broadband v. Bachelors+	0.2260	Yes	99.5%
Table 10	Broadband v. Good Health	0.5547	Yes	99.5%

Source: TXP

The results are compelling and validate the view that access to broadband is highly connected to economic and community development. The fairly large number of counties in the dataset means that the degrees of freedom available (a measure that helps calibrate the likelihood that the statistical findings replicate reality) are high, and the analysis shows statistical significance at the highest level commonly reported.

An Illustration of the Potential Economic and Tax Revenue Impact

Using the dataset from the ACS, the average level of broadband access across the 163 rural counties outside metro areas and below 50,000 population was 74.4 percent, with a standard deviation of 7.6 percent (creating a range with one standard deviation of 66.8 percent to 82.1 percent). Combining the study counties into these three categories (and then including counties in metro areas as a fourth category) creates interesting results.

Table 12: County Levels of Broadband & Household Income

County Broadband Penetration	Average Annual Household Income
Below 66.8% Broadband	\$59,589
Between 66.8% & 82.1% Broadband	\$68,779
Above 82.1% Broadband	\$79,093
MSA Counties	\$92,074

Sources: American Community Survey, TXP

This information can be used to illustrate the impact of increased broadband in rural Texas. The statistical analysis indicates that there is a significant relationship between broadband and household income; it therefore is reasonable to assume that increasing broadband will tend to increase incomes as well. For sake of illustration, assume that increased broadband allows each segment delineated above to move up one level, i.e., those below one standard deviation move to the level within one standard deviation, those within one standard deviation move to the level above one standard deviation, and those above one standard deviation move to the MSA level. See Table 13 below for the results.

Table 13: County Levels of Broadband & Household Income & Increase

County Broadband Penetration	Average Annual Household Income	Number of Households	Incremental Gain per Household	Total Annual Gain
Below 66.8%	\$59,589	97,262	\$9,190	\$893,852,101
Between 66.8% & 82.1%	\$68,779	606,921	\$10,314	\$6,259,951,201
Above 82.1%	\$79,093	123,872	\$12,981	\$1,607,951,437
MSA Counties	\$92,074	Total Annual Income Increase		\$8,761,754,738

Over \$8.7 billion (\$2019) in additional income will have additional impacts. Using data from BEA, in Texas wage & salaries accounted for 51% of total personal income in 2019; with an average annual wage of \$59,794 that year, that implies that this increased economic activity would create an additional 74,702 permanent jobs. In addition, the State itself will gain. Over the period from 2017-21, State General Fund revenue averaged the equivalent of 6.4% of total Texas personal income; applying that ratio to the \$8.7 billion figure above implies the State will gain \$556.9 million each year.

Conclusion

While traditional analysis of possible infrastructure investments has focused largely on user benefits, there is a growing sense that the broader impacts on the potential performance of a region and the nature and scope of its economic and community development over time should also be factored into the equation. There is no question that Texas has enjoyed a high level of relative economic success, as the state's economy grew at a compound annual rate of 3.1 percent from 2011-21, compared to 2.0 percent nationally. However, past success does not necessarily guarantee a bright future, as the overall economic development environment has perhaps never been more competitive than at present. As the level of competition (both between nations and within the United States) rises, a heightened focus on the economic development implications of decisions related to substantial public sector investments becomes increasingly appropriate. This is especially true for broadband, as at this point access to the internet has become integral to virtually all aspects of modern life. Moreover, the benefits of access to broadband have not been evenly distributed across Texas, as many rural areas either have limited or no access even to this day.

The discussion available on this topic is summarized, and suggests that broadband, in a variety of specific ways, can have a positive influence on economic and community outcomes. Beyond the discussion, the statistical analysis puts form and structure on the extent of the impact. The findings indicate a highly significant relationship between level of economic outcomes (as measured by household income and per capita economic output) and economic growth (as measured by job growth over a five-year period), education (as measured by the share of the adult population with at least a high school, associate's, and bachelor's degree) and community health (as measured by the share of the adult population who self-report "good" or "excellent" health). These findings are tempered by the old expression that "correlation does not imply causation," as it is inappropriate to suggest that broadband, by itself, is the direct cause of economic growth. Rather, the analysis indicates that the relationship between access to high-speed internet and economic and community development is not random, and that increasing access to broadband contributes to rural development. An illustration of the potential magnitude of this investment is then developed and suggests that greater rural access to broadband could easily yield an increase annual personal income in Texas of \$8.8 billion (\$2019). In Texas, wage & salaries accounted for 51% of total personal income in 2019; with an average annual wage of \$59,794 that year, that implies that this increased economic activity would create an additional 74,702 permanent jobs. In addition, the State itself will gain. Over the period from 2017-21, State General Fund revenue averaged the equivalent of 6.4% of total Texas personal income; applying that ratio to the \$8.7 billion figure above implies the State will gain \$556.9 million each year. These figures reflect investments that create incremental gains for rural areas, based on improving the level of aggregate access within the county. However, these findings do not reflect universal access; if that were achieved, the annual impact across Texas could

easily be several times what is reported here. This is especially true given the fact that the analysis does not include those within metropolitan areas who also lack adequate access. Based on the results here, it is likely that broadband access would raise average household incomes among those who currently lack it by approximately \$10,000 (\$2019) as well.

Sustained economic and community development is the product of a variety of factors, such as an educated and skilled workforce, high levels of worker productivity, local policies that are conducive to business and overall quality of life, access to appropriate education and healthcare, local transportation accessibility, mobility, and options, and a capacity to compete globally, to name a few. A region might grow without one of these factors, but rarely can it sustain growth without a fairly diversified portfolio of each. By the same token, the impact of these factors is cumulative, and is typically fully felt over an extended period of time. In the modern world, access to high-speed internet is an integral element of most of the factors cited above, especially in a rural context. As such, its full implementation is fundamental to the capacity for the more remote areas of Texas to grow and prosper.

The above having been said, as with almost all infrastructure categories, the economics of rural broadband deployment and operations cannot be addressed purely by market forces. Because of high capital and operating costs per potential customer, areas with low population density struggle to attract private investment in capital infrastructure. The challenging economics are directly correlated with low housing density and the location of many rural homes far from arterial roads or on large parcels of land. Long distances between homes, as well as long driveways or setbacks from the road, greatly increase the cost to deploy infrastructure to those locations. As a result, it is crucial that the public sector step forward to fill the gap and provide the means to fully access the capacity and benefits inherent in high-speed internet. Much like rural electrification did almost a century ago, the benefits for smaller communities will be life-changing, for both the residents themselves and the state as a whole.



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