Lincoln County Broadband Plan

FINAL DRAFT

Prepared By: North Central Wisconsin Regional Planning Commission

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CHAPTER 1

Background

1: BACKGROUND

Broadband is essential in today's world. Every segment of the population, businesses, and government relies on the integration of the internet. For Lincoln County to remain competitive, it needs to both expand and improve broadband throughout the county. Both the state and federal governments have established a grant program to help promote the adoption of broadband across unserved and underserved areas.

The Broadband Equity, Access, and Deployment (BEAD) Program will provide $42.45 billion for expanding high-speed internet access by funding planning, infrastructure deployment, and adoption programs in all 50 states. Wisconsin's allocation of BEAD funding is just over $1 billion. To qualify for this funding, local entities must engage in broadband planning to gain insight into each community's vision for broadband development. These local plans may include outreach initiatives, conducting local needs assessment, and developing local or regional broadband plans. Ultimately, these local broadband planning activities will inform the state Five-Year Action Plan which will guide broadband deployment and implementation of the BEAD program.

The broadband plan outlined is a comprehensive strategy designed to bridge the digital divide by increasing connectivity and accessibility of broadband in Lincoln County. Further, this plan will identify both barriers and goals to infrastructure expansion and broadband adoption. As a result, Lincoln County will be better positioned to apply and hopefully receive BEAD funding for broadband deployment.

PREVIOUS REGIONAL EFFORTS

The North Central Wisconsin Regional Planning Commission has identified Broadband as a foundational pillar critical to a strong economic recovery and increasing economic resilience in the North Central Wisconsin Regional Recovery Plan. This plan acknowledges that Covid-19 magnified the significance of broadband access and the quick shift to a virtual world created significant disadvantages for businesses, workers, and residents alike. Additionally, this plan sought to expand broadband infrastructure and increase both the affordability and performance of broadband.

Specifically, this plan highlighted that most of the North Central Wisconsin Regional area geographically remains unserved or underserved for broadband access, with the exception being more urbanized areas. Throughout the Region overall, about 62 percent of households have broadband access. Therefore, the most significant consideration is the establishment of needed

infrastructure throughout the Region to allow residents to access broadband. This Plan also recommends an examination of a multitude of factors that influence broadband adoption, including household income, educational attainment, age, and employment status. Other important considerations include the rural digital divide, cost, and digital literacy.

The following **goals** have been identified to be most important to the vision of the broadband future of the Region. When setting the goals top considerations include successfully expanding broadband access to residences, businesses, and institutions throughout the Region, fostering quality broadband service that meets the needs of residences, businesses, and institutions throughout the region, and optimizing digital inclusion, digital literacy, and competitive costs.

- Create universal broadband infrastructure throughout the Region.
- Bring high-performance broadband service throughout the Region.
- Make broadband affordable and competitive.
- Advance digital literacy and inclusion.

PLANNING PROCESS

The planning process for this initiative examined essential background information and data, facilitated the development of broadband deployment, and proposed adoption strategies. To ensure a comprehensive and locally informed approach, the county established a dedicated committee tasked with overseeing the planning process, offering valuable local insights, and ensuring effective oversight.

The process involved documenting broadband objectives sourced from both regional and local perspectives. Furthermore, it entailed a thorough mapping of the existing state of broadband infrastructure, including pinpointing areas of high demand. This mapping exercise will help pinpoint coverage gaps and areas requiring substantial improvements.

In addition to these steps, the initiative involved the identification of potential barriers to broadband expansion and explored various funding options. Detailed cost estimates for infrastructure deployment were also generated. These efforts collectively aim to provide the county with valuable guidance, enabling them to engage with local Internet Service Providers (ISPs) effectively and advance their broadband access goals.

Lincoln County's Broadband Committee consulted with the North Central Wisconsin Regional Planning Commission (NCWRPC) at three sperate meetings during the planning process. The first meeting on June 27, established the plan's timeline, and next steps, and NCWRPC shared information on the broadband speed test being conducted. The second meeting on September 18, was an opportunity to discuss and review the draft plan format as well as formalize the goals

of the Plan. The final meeting included a final review of the plan by the committee before the adoption of the Broadband Plan.

BROADBAND COMMISSION

The Lincoln County Economic Development Corporation has formed a Broadband Commission to gather data for determining optimal fiber optic cable routing, accessing grant monies to assist with that process, and attracting ISP partners to make high-speed broadband accessible throughout the county.

Invited membership consists of a representative designated by each the following entities:

- Lincoln County Economic Development Corporation
- Lincoln County Board of Supervisors
- Lincoln County Sheriff's Department/Dispatch
- Lincoln County Administrative Coordinator
- Lincoln County Emergency Management Director
- Lincoln County Information Technology Director
- Lincoln County Land Information Program Manager
- Municipalities (each city and town)
- Merrill Chamber of Commerce
- Tomahawk Chamber of Commerce
- Merrill School District
- Tomahawk School District
- T. B. Scott Public Library
- Tomahawk Public Library
- Lincoln County Fire Departments (A representative of all fire departments within the County as agreed upon and nominated by the departments)
- Cooperative Educational Service Agency (CESA) 9
- Major Medical Providers in Lincoln County
- Other citizens and/or stakeholders at the discretion of the Lincoln County Economic Development Corporation

CHAPTER 2

Broadband: What It Is and Why It Matters

2. BROADBAND: WHAT IT IS AND WHY IT MATTERS

INTRODUCTION

Broadband accessibility has become a requirement, and not just a luxury for communities, businesses, workers, and residents in today's world. The benefits of broadband access and the drawbacks of a lack of access are quickly making broadband an essential utility. Broadband accessibility is a vital resource for businesses to operate and stay competitive in an increasingly digital economy. Broadband accessibility is also critical for residents, as those who lack access to high-speed internet have a harder time accessing jobs, healthcare, education, job and skills training, and services.

For most Americans, broadband is commonplace in professional, personal, and social environments. Yet, broadband is the country's most inequitable infrastructure with around 15% of households not having subscriptions to any form of "broadband" internet service. Many residents and businesses in Lincoln County do not have access to adequate broadband, while others have no access to broadband at all, and are thus not able to use broadband internet service, putting them at a disadvantage as the world's reliance on the internet grows.

WHAT IS BROADBAND?

Broadband is the provision of a high-speed connection to the internet via the transmission of data through wide bandwidths, allowing for multiple signals to be transferred at once, as opposed to dated dial-up technology where only a single-line of data can be transferred. Broadband internet access is always on and is faster than dial-up access. The Federal Communications Commission (FCC) defines broadband as any of the following high-speed technologies: fiber, cable, fixed wireless, or satellite.

The standard for reliable broadband internet access is defined by the FCC as internet access with a download speed of 25 Mbps and an upload speed of 3 Mbps. Generally, these speeds are the minimum speeds where video streaming and a few in-home devices can work simultaneously. However, higher internet speeds are becoming increasingly important as broadband demand and data traffic rates continue to increase.

Benefits of Broadband Connectivity

- **Economic Development**

  Broadband connectivity enables communities to develop, attract, retain, and expand job-creating businesses. Without reliable access to broadband, businesses and workers will likely be located where there is broadband.

- **Education**

  Broadband access provides students and educators with vast amounts of educational resources, enables online/remote education, and facilitates real-time collaboration and communication.

- **Healthcare**

  Broadband plays a crucial role in transforming healthcare and offers numerous benefits to patients and healthcare providers. Broadband enables telemedicine and remote consultations with doctors which is particularly valuable for patients in rural or underserved areas.

- **Public Safety**

  Broadband connectivity greatly enhances public safety by enabling faster communication among first responders and emergency services during emergencies. Broadband also allows for the deployment of video surveillance and monitoring in public spaces along with enabling emergency alerts through various digital channels.

- **Entertainment**

  Broadband has enhanced entertainment by offering high-quality streaming, on-demand content, social media engagement, online gaming, and much more.

TYPES OF INTERNET CONNECTIONS

Digital Subscriber Line (DSL): Transmits data over already available traditional copper telephone lines. DSL is good for light internet use but is not recommended for activities that require significant speed like video streaming.

Cable Modem: provides broadband through the same cables that generate sounds and pictures to a cable tv set. Cable internet usually provides reliable speeds but is not available in all areas.

Fiber-Optic: coverts electrical signals carrying data to light and sends the light through transparent glass fibers. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps. Currently, availability is limited, and it is costly to install.

Fixed Wireless: connects a home or business to the internet through a radio link between the customer's location and the internet service provider. Often used in rural areas and speeds are comparable to DSL or cable modem.

Mobile Wireless: relies on a cellular network to provide internet access to devices like smartphones and tablets.

Satellite: Another form of wireless internet from satellites orbiting the earth that can be useful in serving sparsely populated areas. It must have a good line-of-sight, but speeds are slower and there can be high installation costs.

Source: Federal Communications Commission

HOW FAST SHOULD BROADBAND BE?

The Federal Communications Commission (FCC) broadband capability requires consumers to have access to actual download speeds of at least 25 Mbps and actual upload speeds of at least 3 Mbps to be considered unserved locations. For grant funding, The Public Service Commission of Wisconsin will target businesses lacking 25 Mbps download and 3 Mbps upload. Underserved locations are those that do not have access of at least 100/20 mbps.

Typical Internet Speeds

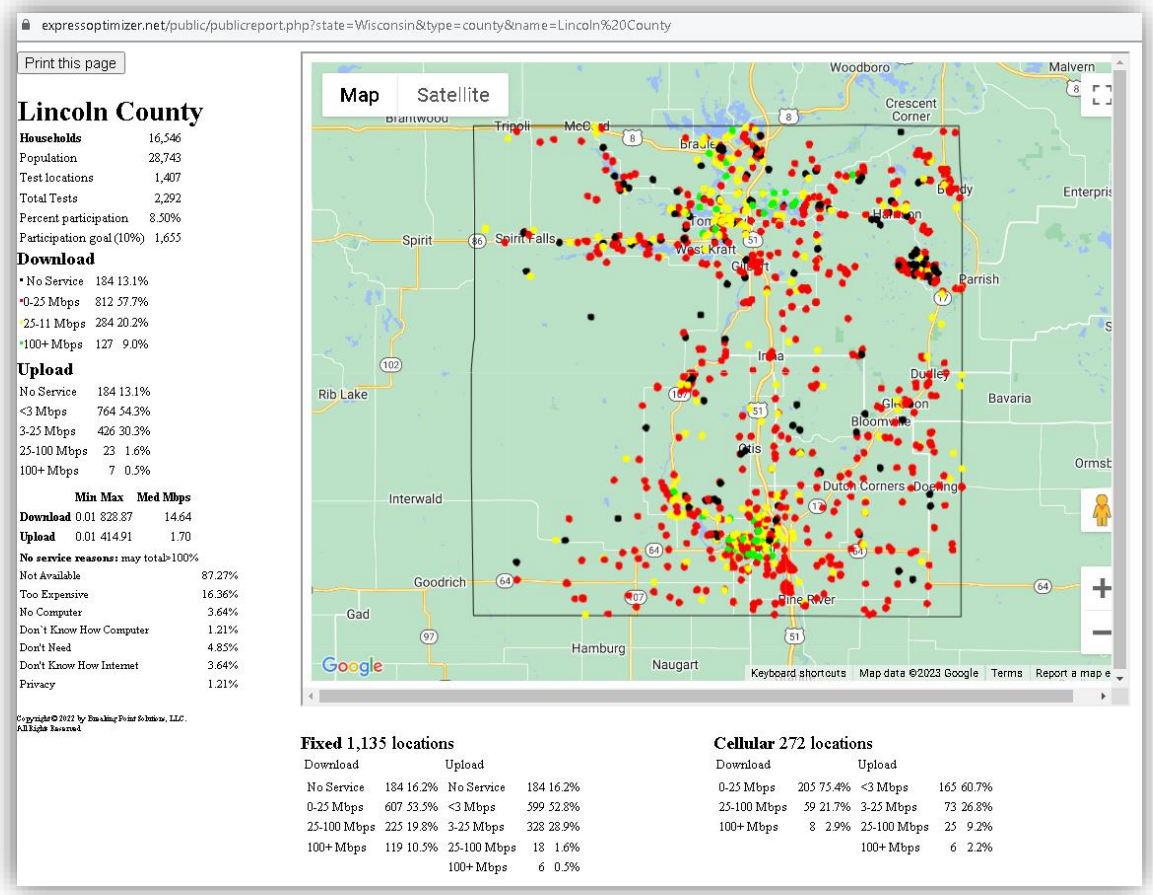
Speed	Number of users/devices	Tasks
5 Mbps	*1-2*	Online browsing, email, and research
25 Mbps	*3-5*	Downloading large files, business communications, and basic business Wi-Fi use
75 Mbps	*5-10*	Video streaming, numerous point-of-sale transactions, and frequent file-sharing
150 Mbps	*10-15*	Video conferencing, frequent cloud computing, and data backups
250 Mbps	*15-20*	Seamless streaming, conferencing, and server hosting
500 Mbps	*20-30*	Multiple servers hosted, heavy online backups, and constant cloud-based computing
1 GB	*30 +*	Extreme speed operations with zero interruptions

Source: Business.com

Lincoln County Broadband Committee recommends broadband speeds initially should be at least 100 megabits per second download and 20 megabits per second upload.

WISCONSIN SPEED TEST COLLECTION

In a partnership with the North Central Wisconsin Regional Planning Commission (NCWRPC) Wisconsin Economic Development Corporation (WEDC) and the Wisconsin Public Service Commission (PSC), a statewide internet speed testing application was secured to help collect locations, estimate cost, and upload/download speeds. The public can also note if they have no service or cannot afford service at their location. This application is a crowdsource data collection application. Counties and municipalities need to promote the speed test application to get enough tests to analysis the results. Lincoln County currently has 2,292 total tests at 1,407 test locations and a participation rate of 8.5%. Tests can be taken, and results reviewed at www.wisconsinspeedtest.net.

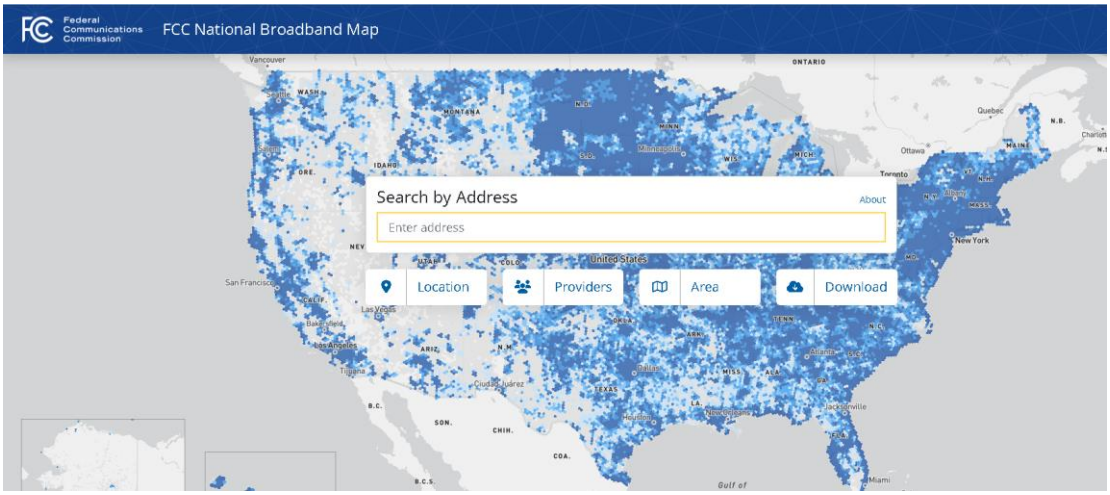


NATIONAL BROADBAND MAP

In November of 2022, the FCC released a pre-production draft of its new National Broadband Map. This map was the first of its kind, showing address-level broadband coverage data for homes and businesses in the nation. Previously, the FCC had mapped broadband coverage data as reported by the census block. This led to the overstatement of broadband coverage and inaccuracies in the map. The new map displays fixed and mobile broadband availability in the United States and allows users to search by address, view provider coverage areas, display location and area summaries, download the data, and more. The map also allows users to filter by data vintage, residential vs. business service, technology type, and speed.

A recent update to the map was released in May of 2023 and incorporated millions of availability and location challenges from the public, state, local, and Tribal governments nationwide. Challenges to the map are a critical mechanism to create the most accurate and up-to-date map possible. Location challenges allowed users, where appropriate, to challenge that an address was either incorrectly located, missing, an incorrect unit count, not contained within the correct building footprint, not broadband serviceable, or the wrong building type. Availability challenges

allowed users to challenge that a provider was incorrectly reported at an address for reasons such as the provider requested more than the standard installation fee to connect service, failed to schedule a service installation within 10 business days of request, denied a request for service, or did not offer the technology reported to be available. As a result of other advancements and the challenge process, the National Broadband Map will continue to improve and be updated twice a year.



CHAPTER 3

Lincoln County Community Profile

3. LINCOLN COUNTY COMMUNITY PROFILE

PURPOSE

Demographics play a critical role in broadband planning by offering insights that guide strategic decisions. They enable targeted investment by identifying areas with high demand for broadband services, ensuring efficient allocation of resources. Additionally, demographic data helps address inequalities in access, promoting equitable connectivity across various segments of the population. By estimating demand and usage patterns, planners can design networks that cater to specific needs. This customization extends to business development, education, and digital inclusion efforts, fostering economic growth and bridging societal gaps. Demographics essentially serve as a foundation for inclusive and well-informed broadband planning, enabling better connectivity and opportunities for all.

GENERAL POPULATION

Population growth has slowed at the state level and continued to decline at the county level. In the 1990s, the County shrunk 9.8 percent while the state grew 4.0 percent. In 2010, Lincoln County had a total population of 29,075 residents. By 2020, 28,415 persons resided in the County, which is a 2.3 percent decrease from the 2010 census total. From 2000 to 2010, the County's population shrunk by 566 residents, which represents a 1.9 percent decrease. Overall, Lincoln County's population decreased by 4.1 percent between 2000 and 2020. In comparison, the state's population grew by 9.9 percent between 2000 and 2020, with a 3.6 percent increase between 2010 and 2020.

Understanding the population of an area provides insights into the potential user base for broadband services. Higher population density often correlates with greater demand for internet access, making it important to allocate resources to meet this demand effectively. Moreover, population distribution across urban and rural areas influences the deployment strategy, as densely populated urban centers may require different infrastructure solutions compared to sparsely populated rural regions. Additionally, the size of the population affects the economic viability of broadband projects.

Table 3-1 displays the total population for each local unit (minor civil division), the county, and the state. Seven out of the 18 municipalities in Lincoln County lost population from 2000 to 2020. During this time, the City of Merrill saw the largest net decrease, losing 799 people.

At the same time, the Town of Skanawan experienced the largest percentage increase, at 9.9 percent. The Town of King had the largest net increase, adding 122 people. Not reflected in the population numbers is the seasonal population, particularly the summer visitor season.

Table 3-1: Population

Minor Civil Division	2000	2010	2020	2000-20 % Change	2000-20 Net Change
City of Merrill	10,146	9,661	9,347	-7.8%	-799
City of Tomahawk	3,770	3,397	3,441	-8.7%	-329
Town of Birch	801	594	570	-28.8%	-231
Town of Bradley	2,573	2,408	2,382	-7.4%	-191
Town of Corning	826	883	825	-0.1%	-1
Town of Harding	334	372	364	8.9%	30
Town of Harrison	793	833	828	4.4%	35
Town of King	842	855	964	14.9%	122
Town of Merrill	2979	2,980	2,881	-3.3%	-98
Town of Pine River	1,877	1,869	1,874	-0.2%	-3
Town of Rock Falls	598	618	635	6.2%	37
Town of Russell	693	677	693	0.0%	0
Town of Scott	1,287	1,432	1,377	6.9%	90
Town of Schley	909	934	950	4.5%	41
Town of Skanawan	354	391	386	9.9%	32
Town of Somo	121	114	123	1.6%	2
Town of Tomahawk	439	416	458	4.3%	19
Town of Wilson	299	309	317	6.0%	18
Lincoln County	29,641	29,075	28,415	-4.1%	-1,226
State	5,363,675	5,686,986	5,893,718	9.9%	530,043

Source: U.S. Census

HOUSEHOLDS

Understanding the number of households holds significant importance in broadband planning, as it influences the scope of infrastructure deployment, service coverage, resource allocation, financial viability, and equitable access.

In 2020, there were 12,473 households in Lincoln County following at least three decades of household growth. The early 2000s saw a 2.9% percent increase in the number of households.

Between 2010 and 2020, the number of households grew 3.1 percent. Generally, the number of households across the country has been increasing as more people decide to live alone and more couples have fewer children or no children at all for several decades.

YEAR-ROUND AND SEASONAL HOUSING

Table 3-2 displays the percentage of seasonal and year-round housing in the County. Not reflected in the population numbers is the seasonal population, particularly the summer visitor season. In 2020, 22.4% of housing units were seasonal housing.

The county has several tourist destinations and popular vacation home areas. There are campgrounds, resorts, hotels, short-term rentals, and seasonal housing units in the county. This summertime population places an increased demand on county and local government resources and should be considered in the broadband planning process.

Table 3-2: Year-round and Seasonal Housing

Minor Civil Division	Seasonal Housing	Year-Round Housing*
City of Merrill	1.3%	98.7%
City of Tomahawk	10.6%	89.4%
Town of Birch	11.9%	88.1%
Town of Bradley	39.5%	60.5%
Town of Corning	37.6%	62.4%
Town of Harding	54.1%	45.9%
Town of Harrison	66.6%	33.4%
Town of King	54.0%	46.0%
Town of Merrill	5.6%	94.4%
Town of Pine River	4.6%	95.4%
Town of Rock Falls	36.6%	63.4%
Town of Russell	21.9%	78.1%
Town of Scott	5.4%	94.6%
Town of Schley	7.1%	92.9%
Town of Skanawan	49.8%	50.2%
Town of Somo	57.3%	42.7%
Town of Tomahawk	65.5%	34.5%
Town of Wilson	92.6%	7.4%
Lincoln County	22.4%	77.6%
State	7.0%	93.0%

Source: U.S. Census, 2020

* Year-round population percentages do not include vacant housing.

BROADBAND SERVICEABLE LOCATIONS (BSL)

A broadband serviceable location (BSL) is a business or residential location in the United States at which mass-market fixed broadband internet access service is, or can be, installed. BSLs were estimated using Lincoln County tax parcels. Centroids were created for each parcel with an improvement value that was counted as a BSL. Table 3-3 summarizes the BSL by minor civil division.

Table 3-3 Broadband Serviceable Locations (BSL)

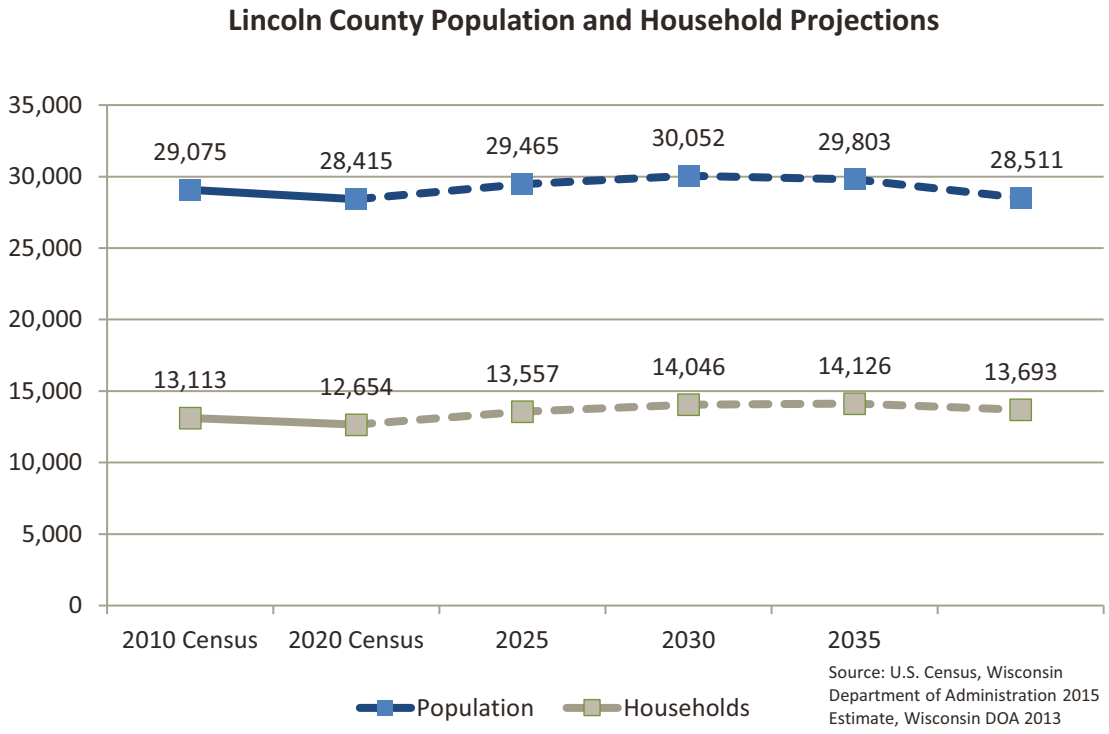
Minor Civil Divisions	Estimated BSL	BLS Per Sq Mile	Housing Units
City of Merrill	3404	436.4	4,484
City of Tomahawk	1552	165.1	1,725
Birch	313	8.7	271
Bradley	2312	36.8	1,884
Corning	515	3.5	526
Harding	281	3.9	252
Harrison	940	13.0	911
King	926	25.1	772
Merrill	1457	27.3	1433
Pine River	870	13.6	740
Rock Falls	581	11.8	494
Russell	386	10.6	431
Schley	520	10.8	361
Scott	664	21.6	608
Skanawan	310	8.6	291
Somo	163	4.5	114
Tomahawk	489	6.8	462
Wilson	411	11.3	374

Source: NCWRPC and Lincoln County GIS

LINCOLN POPULATION AND HOUSEHOLD PROJECTIONS

Figure 3-3 shows the population and household future projections for Lincoln County. Despite the past few decades of population declines, the County is expected to grow by 5.8 percent over the next 10 years. After peaking in population in 2030, the population is expected to decline by 5.1 percent through 2040.

The number of households in the County is projected to increase by 11 percent between 2020 and 2030. The population is expected to then slightly decline by 2.5 percent between 2030 and 2040.



AGE DISTRIBUTION

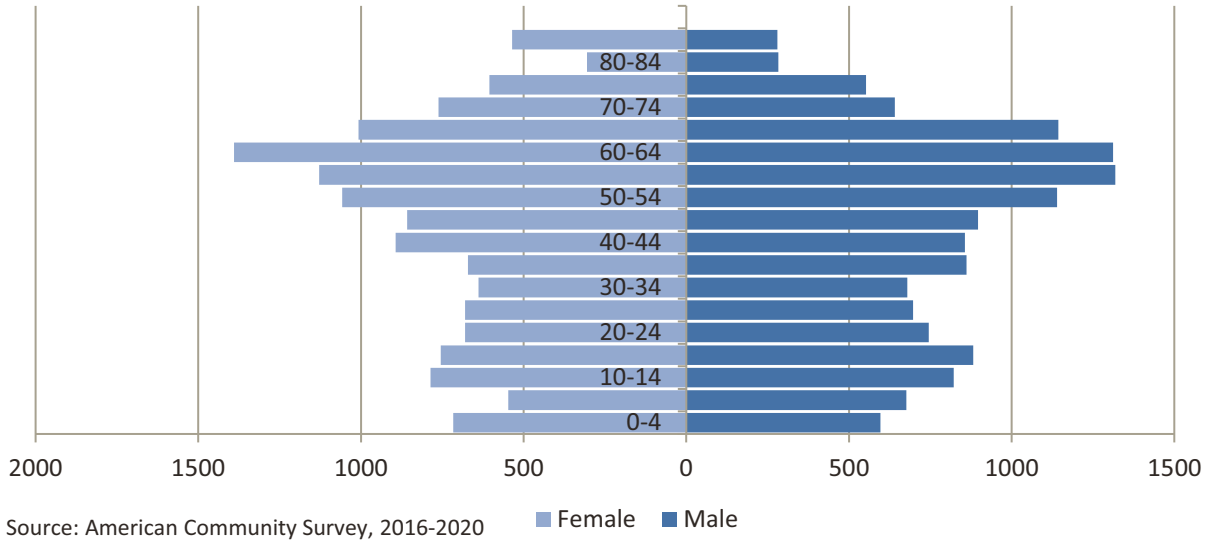
Population distribution is important to the planning process. In particular, understanding and considering age-related factors will better ensure that broadband services will effectively meet the needs of all community members, regardless of age. Factors like tailoring infrastructure for different age groups based on varying needs and preferences are important. For example, communities with a significant number of elderly residents might need services like telemedicine. Age distribution can also provide insights into broadband adoption and usage patterns. Understanding the adoption of broadband by age group can help determine where resource allocation is most appropriate.

Like many rural counties in Wisconsin, Lincoln County is aging faster than the state and country. In 2010, the median age in Lincoln County was 44 years old, compared to 38.1 for the state. By 2020, the median age in the county increased to 47.9 years old, compared to 39.6 for the state. Furthermore, the percentage of the county's population 62 years old or older is increasing.

In 2010, 21.7 percent of the county's total population was 62 years old or older. By 2020, 27.3 percent of the county population was 62 years old or older. Comparatively, the state's share of the population 62 years or older increased from 16.2 in 2010 to 20.8 percent of the population in 2020. It is believed that this age demographic has been slower adopters of broadband and internet usage more generally.

On the other hand, the share of the population that are 17 and younger in the county has increased over the last decade (2010-2020), from 16.9 percent in 2010 to 18.4 percent in 2020. Similarly, in 2010, 17.5 percent of the state's population was under 18 in 2010 and rose to 21.9 percent in 2020. Similarly, to the senior citizen population, this younger age cohort has technology needs, and many younger people rely heavily on having reliable internet access for school or connecting with their peers online.

Figure 3-4 Lincoln County 2020 Age Pyramid

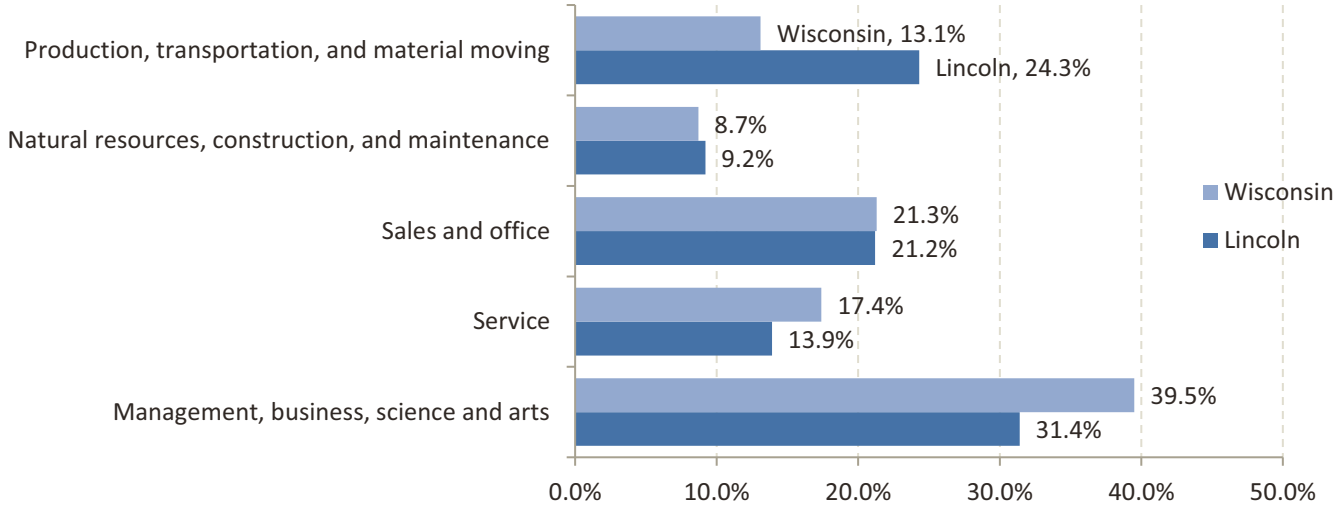


Source: American Community Survey, 2016-2020

EMPLOYMENT

In 2020, there were 13,669 residents employed. (Note that these are persons employed and many of them work outside the county.) This reflected a 3.4 percent decrease in the county's employment since 2010, compared to 3.9 percent growth for the state, as shown in **Table 1-7**. The decrease in the number of workers in Lincoln County is likely tied to the aging population. Prominent resident occupations in the county include the production, transportation, and material moving industries as well as management, business, science, and arts industry category. Both the production, transportation, and material moving industry categories and natural resources, construction, and material moving categories have a bigger share of jobs in the county than the state overall.

Figure 3-5 Lincoln County and Wiscoinsin Employment Industries



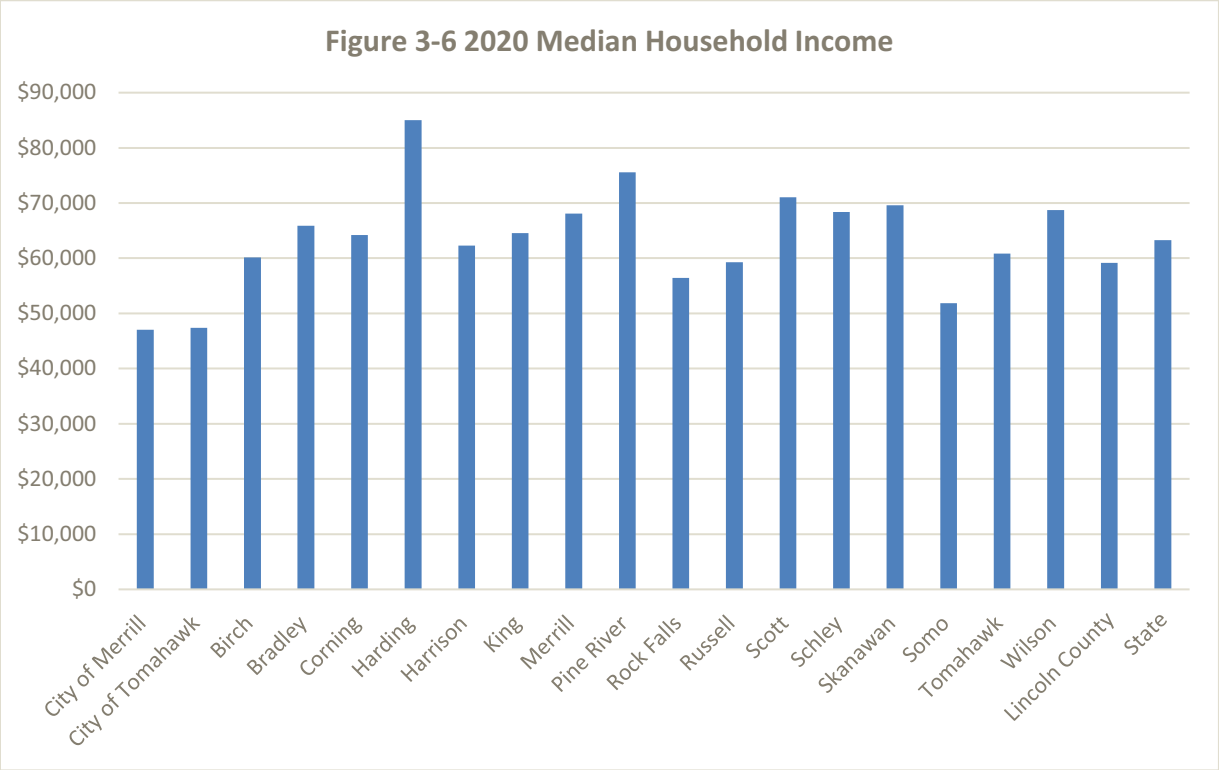
Source: American Community Survey

INCOME

Income levels are important in broadband planning due to their impact on affordability, digital inclusion, and the overall effectiveness of broadband initiatives.

Median household income is displayed in figure 3.6. The county median household income rose about 26.9 percent between 2010 and 2020, compared to a state increase of 22.7 percent. Meanwhile, the county per capita income increased by 32.9 percent, compared to the state increase of 29.4 percent. Overall, the total county median income and per capita income is lower than the state level.

However, when incomes are adjusted for inflation, it is apparent that household incomes have stagnated. Had the median household income risen with the Consumer Price Index, it would have been $65,439 in 2020, higher than the actual $59,183 median household income. The decrease in household size during this time likely plays a role, as per-person capita incomes within the County have almost kept up with inflation over time. Per capita income would have been $33,394 if it rose similarly to inflation. However, the per-person capita income in 2020 was $31,609. The municipalities with the highest median household income include Harding, Pine River, and Scott. The lowest median incomes include Merrill, Tomahawk, and Somo.



American Community Survey, 2017-21

CHAPTER 4

Current Broadband Assessment of Lincoln County

4. CURRENT BROADBAND ASSESSMENT OF LINCOLN COUNTY

This section primarily provides an overview of the current state of broadband supply (available broadband services) in Lincoln County from readily available sources. This section is supplemented by the Wisconsin Speed Test (M-Lab) data, American Community Survey Data, FCC form 477 data, and Wisconsin Department of Public Instruction data.

Broadband adoption is typically measured in the percentage of households that subscribe to home broadband internet service. Broadband internet includes internet via cable, fiber optic, wireless or DSL service. On the other hand, wireless internet (ex. Mobile cellular service), is typically not considered broadband, yet many households only use mobile cellular service to connect to the internet.

WISCONSIN SPEED TEST COLLECTION

In a partnership with the North Central Wisconsin Regional Planning Commission (NCWRPC) Wisconsin Economic Development Corporation (WEDC) and the Wisconsin Public Service Commission (PSC), a statewide internet speed testing application was secured to help collect locations, estimate cost, and upload/download speeds. The public can also note if they have no service or cannot afford service at their location. This application is a crowdsource data collection application. Counties and municipalities need to promote the speed test application to get enough tests to analysis the results. Lincoln County currently has 2,339 total tests at 1,440 test locations and a participation rate of 8.7%. Tests can be taken, and results reviewed at www.wisconsinspeedtest.net.

Speed Test Results for Lincoln County

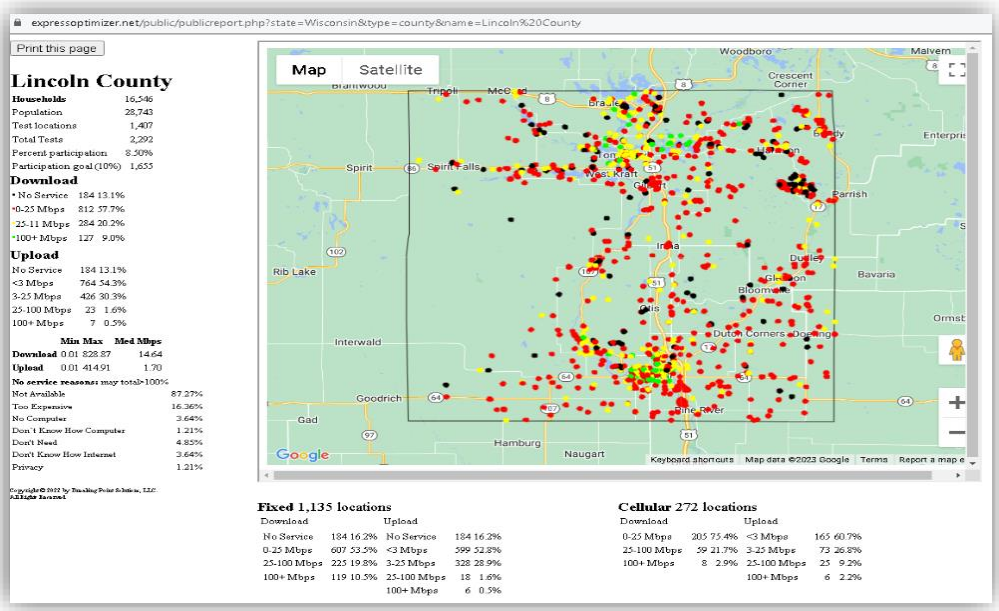
- While the 2023 State median download speed is 68.7 Mbps, the Lincoln County median (33.5 Mbps) barely meets the FCC's minimum standard to qualify as broadband (25 Mbps).

- Wisconsin's monthly median download speeds have been steadily increasing over the past several years, while there is no significant improvement for Lincoln County

- The difference between the State and Lincoln County in terms of monthly median upload speeds is also significant. Lincoln County's speeds were less than half of those of the State in 2023 (5 Mbps vs. 16.8 Mbps). As a reminder, the FCC's current minimum upload standard for broadband is 3 Mbps.

Table 4-1 Lincoln County Speed Test Average Download and Upload Speeds		
Minor Civil Division	**Average Download Speeds**	**Average Upload Speeds**
City of Merrill	126.4	19.0
City of Tomahawk	57.1	7.1
Birch	15.9	6.2
Bradley	30.5	4.5
Corning	20.8	3.5
Harding	20.4	3.5
Harrison	15.8	2.7
King	41.0	7.1
Merrill	39.3	4.3
Pine River	12.0	2.3
Rock Falls	17.2	2.1
Russell	12.7	1.7
Scott	12.2	1.6
Schley	12.7	3.4
Skanawan	16.8	2.2
Somo	24.2	18.6
Tomahawk	15.1	1.4
Wilson	15.8	1.8
Lincoln County	33.5	5.0
State	68.7	16.8

Lincoln County Speed Test Map



AMERICAN COMMUNITY SURVEY

The U.S Census Bureau's American Community Survey gathers information from households to understand broadband adoption. The 2017-2021 5-year American Community Survey revealed that 82 percent of households in Lincoln County have access to an internet subscription. A few rural towns have relatively low rates of broadband or internet subscriptions per household; with the towns of Rock Falls, Russell, and Tomahawk having under 70 percent of households with access to broadband. On the other hand, the communities of Merrill, Tomahawk, and several other rural towns have relatively high broadband adoption rates.

Approximately 52 percent of households within Lincoln have a broadband subscription (cable, fiber optic, or DSL), not including cellular data plan service. While typically not as reliable or as fast as broadband, mobile data subscriptions, and more costly satellite internet services help fill the internet gap within the County by providing access to the internet for households without broadband subscriptions. Mobile data services are often required for households that cannot afford a broadband subscription, while both mobile data and satellite services are often required for those who do not live in an area where broadband service is readily available. The percentage of households with a cellular data plan and no other internet subscription in the county is 17.6%. The Towns of Corning, King, and Schley have households with at least 30% only having access to the internet through a cellular data plan (i.e., cell phone service).

Comparatively, Lincoln County has a smaller proportion of households than the state with access to broadband by about 5 percent. Additionally, the percentage of households with cellular data but no other internet plan is greater than the state by approximately 6.6 percent. Also, the percentage of Lincoln County households with broadband access can also be compared to neighboring counties. Except for Marathon County (which is significantly more urban), Lincoln County households have comparable access to broadband as the surrounding counties. As mentioned, 82 percent of Lincoln County households have some kind of internet subscription. This is compared to 82.3 percent of Langlade County households, 85.3 percent of Oneida County households, and 78.5 percent of Taylor County households, and 86.9 percent of the state having internet service.

In general, broadband adoption rates within the county are typically highest in and around population centers, and lowest in the more scarcely populated areas. This disparity in broadband adoption rates is partly due to differences in the availability of broadband in these areas, as broadband availability is much higher in more densely populated areas than in areas with low-density populations.

Table 4-2 Lincoln County Households with an Internet Connection		
Minor Civil Division	**% of Households with Internet Subscription**	**% of Households with Cellular Data Plan & No Other Internet Subscription**
City of Merrill	83.5%	11.9%
City of Tomahawk	88.7%	13.7%
Birch	85.2%	25.8%
Bradley	87.8%	20.7%
Corning	82.7%	32.2%
Harding	70.7%	20.3%
Harrison	76.2%	21%
King	76.6%	30.9%
Merrill	82.1%	20.3%
Pine River	87.8%	21.2%
Rock Falls	69.5%	16.5%
Russell	55.5%	19.3%
Scott	80.2%	20%
Schley	77.6%	33.9%
Skanawan	88.5%	24.6%
Somo	86.5%	5.4%
Tomahawk	58.6%	11.2%
Wilson	73.8%	20.6%
Lincoln County	82.0%	17.6%
State	86.9%	11.0%

Source: American Community Survey

FEDERAL COMMUNICATIONS COMMISSION FIXED BROADBAND DEPLOYMENT

The data and National Broadband Map in this sub-section are primarily drawn from internet service provider (ISP) reporting to the Federal Communications Commission (FCC) via Form 477. All facilities-based ISPs are required to file data with the FCC twice a year (Form 477) where they offer Internet access service at speeds exceeding 200 kbps in at least one direction.

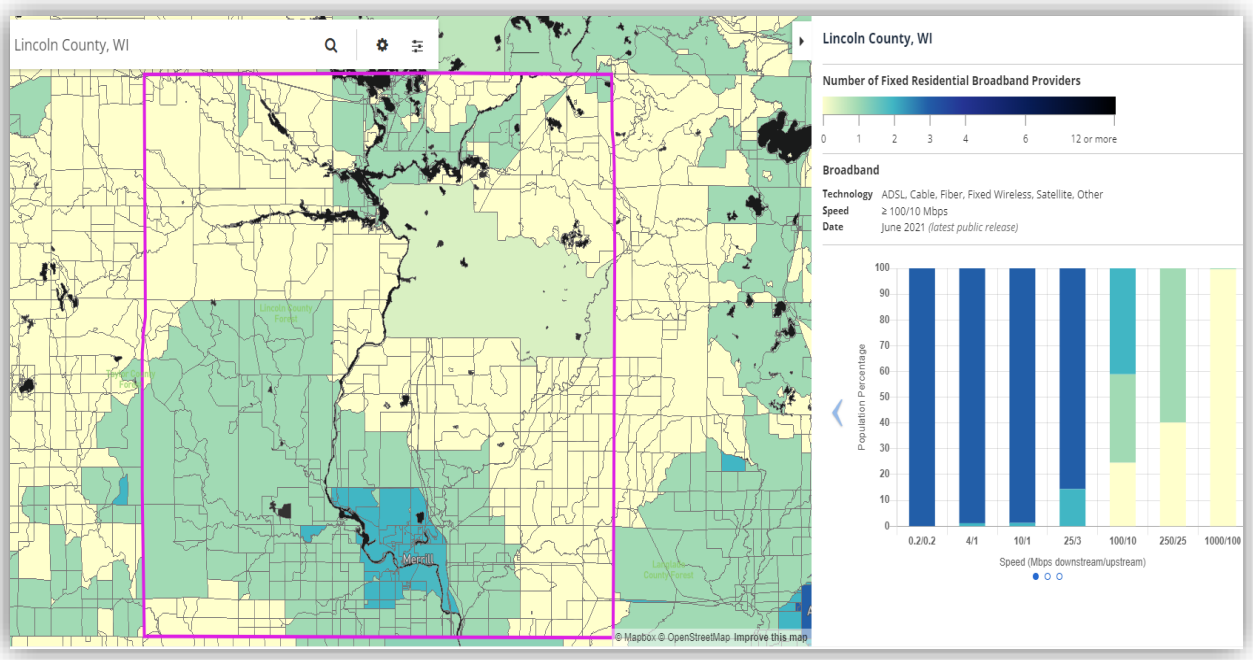
There are two important factors to remember about FCC Form 477 Reporting and "Advertised Speeds."

(1) Fixed providers file lists of census blocks in which they can or do offer internet service to at least one location. Rarely, some ISPs may provide more detailed mapping to the WBO. So, while a map may suggest that an entire census block has the reported broadband service available, this is often not the case and only one customer may be connected within that entire block. To

confuse things further, on occasion, an ISP may only report those census blocks in which they have a franchise agreement with a municipality or are exclusively allowed to cover; they may also provide some service in an unreported area.

(2) ISPs report their "advertised speed." Actual speeds can be significantly lower. A 2020 Purdue study found that "on average, FCC advertised download speeds were 10.7 times higher than average [M-Lab] test speeds in the country compared to 7.4 times regarding upload speeds." The report also found that advertised speeds are closer to the speed test results in urban counties, while the gap in rural counties is larger. This is very important and justifies the need for studies such as this. Higher, inaccurate reported speeds may deter much needed investment, especially in rural areas such as Lincoln County, if the State and Federal governments are basing policy and financial decisions on advertised speeds (and not actual speeds). As explained in the Purdue article and Section VI, actual speeds will differ for numerous reasons, including some factors not controlled by the ISPs, such as the choice in subscription plans by the end user.

ISP Advertised Speeds and Number of Broadband Providers to FCC



WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION (DPI) DATA

The Wisconsin Department of Public Instruction (DPI) has become a State leader in internet/broadband data collection in recent years. DPI partners with local school districts and public libraries for data collection. The DPI Digital Equity Gap webpage (https://dpi.wi.gov/broadband) includes a variety of resources and DPI has partnered with M-Lab to collect data on internet connections speeds across Wisconsin.

The latest 2020-2021 Digital Equity Survey showed three of the four school districts in the county participated in the DPI survey on broadband. Specifically, DPI received data from the School Districts of Merril, Tomahawk, Rhinelander, but not Prentice. This survey revealed that the vast majority of students in the county have access to internet at home (>95%). The primary reason why some homes lack internet access is the absence of internet availability in their area. At the same time, respondents indicated that the internet was less reliable to them at home, even if they had access to it (>25%). Further, the majority of respondents mentioned that they have issues with streaming on their primary device.

DPI Lincoln County Digital Equity Findings-Access			
School District	**% of respondents without home internet**	**% of respondents without home internet due to affordability**	**% of respondents without home internet due to availability**
Merrill School District	**4.5%**	**23.8%**	**57.7%**
Tomahawk School District	**4.4%**	**22.2%**	**71.1%**
Rhinelander School District	**2.6%**	**27.3%**	**72.7%**
Source: Department of Public Instruction Digital Equity Survey, 2021-2022			

*No Data for Prentice School District

DPI Lincoln County Digital Equity Findings-Affordability			
School District	**% of respondents with partially or completely unreliable internet**	**% of respondents who cannot reliably stream video on primary device**	**% of respondents who have issues with quality or interruptions of the stream on primary device**
Merrill School District	**24%**	**7.66%**	**92.34%**
Tomahawk School District	**36.3%**	**9.9%**	**90.2%**
Rhinelander School District	**33%**	**7.1%**	**92.9%**
Source: Department of Public Instruction Digital Equity Survey, 2021-2022			

*No Data for Prentice School District

OVERVIEW

In Lincoln County, the recent internet speed test collection effort and several other past initiatives has revealed disparities in internet access. While the statewide median download speed exceeds 100 Mbps, Lincoln County lags behind with a median of just **33.5 Mbps**, barely meeting the FCC's broadband standard. The situation is similarly poor for upload speeds, which are significantly lower in the county. The American Community Survey reports that approximately **82% of households have internet subscriptions**, but there are variations among towns, with rural areas facing lower rates of broadband access. To bridge the digital divide, mobile data subscriptions and satellite internet services are used by a substantial portion of households in areas without broadband. The Federal Communications Commission's data highlights the challenge of advertised speeds significantly exceeding actual speeds, especially in rural regions. Furthermore, the Wisconsin Department of Public Instruction's data indicates that **internet reliability is an issue for many residents**, impacting streaming capabilities. Addressing these disparities in internet access and speeds, especially in less densely populated areas, is essential for improving digital connectivity in Lincoln County.

CHAPTER 5

Common Barriers to Broadband Connectivity

5. COMMON BARRIERS TO BROADBAND CONNECTIVITY

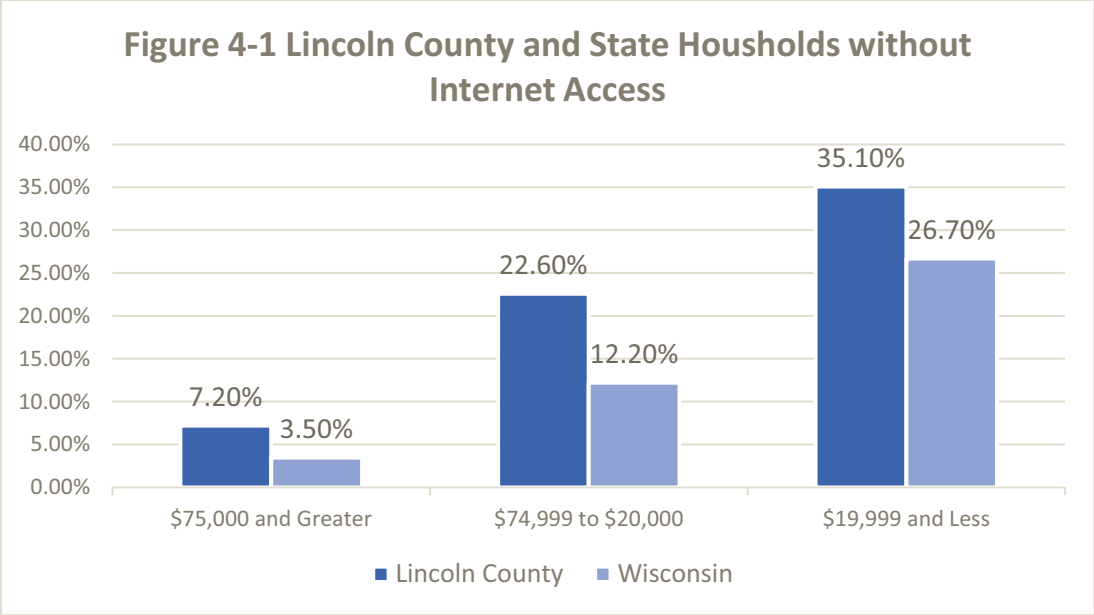
In today's interconnected world, widespread broadband connectivity is essential, yet several barriers hinder its adoption. Common challenges like affordability, a lack of interest in broadband adoption, and connectivity hurdles associated with rural areas continue to persist. These challenges are highlighted in detail below:

AFFORDABILITY BARRIER

The affordability of broadband continues to be a significant challenge for many households. Monthly broadband costs can range from as low as $10 (ex. with a subsidy) to over $100 depending on the speed, the type of internet (ex. fiber, DSL, etc), and whether the service area is rural. Broadband for commercial use can be up to $1000 per month. In general, American consumers pay higher prices than broadband consumers in other countries, with one study finding that Americans pay two or three times more per month than European consumers.

Research has found that cost is the primary barrier to low-income households having an internet connection at home. According to the Pew Research Center, 45% of people mention cost as the reason they do not have broadband at home.

Figure 4-1 shows household incomes and internet subscription rates for Lincoln County and Wisconsin. Among County households with incomes of $75,000 and above, a substantial 92.5 percent have access to broadband in their homes. Households with incomes of $74,999 to $20,000, 76.7 percent have access to broadband in their homes. For households with incomes below $20,000, only 64.5 percent of households have broadband access. Comparing the share of households at the state level with broadband access shows a similar pattern, with the highest earners having the most access to broadband. However, as a whole, the state has a higher proportion of households with broadband access across each income group than Lincoln County.



Source: American Community Survey, 2017-2021

Overall, an examination of the Lincoln County households without an internet subscription shows a clear correlation between internet access and household income. This is substantiated by the fact that a 2015 U.S. Department of Commerce study revealed that 24 percent of households do not use the internet at home because of cost concerns. Further, 23 percent of all households that did not use the internet at home in 2015 would purchase internet if it was less expensive. In general, broadband affordability is a major barrier to broadband connectivity, and programs and policies to mitigate this should be promoted.

NO INTEREST BARRIER

Lack of interest is another significant barrier to more broadband connectivity in certain places. According to a 2015 study by the U.S. Department of Commerce, 55 percent of households that were not using the internet cited a lack of need or interest as the primary reason for their non-adoption. This trend was consistent regardless of demographics, rural or urban residence, or the presence of school-aged children at home.

There are several factors that might be contributing to this lack of interest. In some regions, people might not be fully aware of the benefits of broadband connectivity or may not understand how to use it to its full potential. Benefits like telehealth, online banking, and online booking/shopping are just a few examples of basic online services that greatly benefit people and have been fully embraced by most people. Along these lines, the lack of digital literacy can also play a role. If people are not familiar with the internet or lack the skills to use the internet

effectively, they may not perceive the need for the Internet. Lastly, cultural and societal factors might also contribute to the level of interest in using the internet.

ACCESSIBILITY BARRIER

Rural broadband faces several challenges that make it a significant barrier to achieving widespread internet connectivity in rural areas. Currently, around 22 percent of Americans in rural areas and 27 percent of Americans in Tribal lands lack coverage from fixed terrestrial 25/3 Mbps broadband, as compared to only 1.5 percent of Americans in urban areas.

Most of the challenges of bringing fast broadband to rural areas are a direct result of the low density of housing in most rural areas. This low density leads to high costs for land-based broadband technology, which results in costs customers will not always pay. The second challenge is that companies that have never sold in a competitive market struggle with marketing and selling broadband. Also, internet service providers might face operational risks associated with failing to execute the business plan as well as increased costs, supply chain issues, etc. Lastly, there are competitive risks to deploying broadband in new markets. Competition can cut costs, try to get customers to sign long-term contracts, or react by upgrading their broadband.

CHAPTER 6

Broadband Strategies and Programs

6. BROADBAND STRATEGIES AND PROGRAMS

ADOPTION STRATEGIES

Increasing broadband adoption is essential for bridging the digital divide. Some of the strategies that public and private entities have done to promote broadband adoption include the following:

1. Digital literacy programs: Increasing people's knowledge about the advantages of broadband and teaching them how to use the internet proficiently can enhance their overall internet experience and encourage broader adoption. For instance, local libraries are ideal places to teach residents how to effectively use and access digital resources.

2. Community Outreach: Engaging the community through outreach programs can raise awareness of the importance of broadband access and the opportunities it brings.

3. Infrastructure development: Investing in building and expanding broadband infrastructure will enable more people to connect to the internet. This includes building more fiber optic networks, fixed wireless, and satellite-based connections. Sometimes, this means providing incentives to service providers to expand their coverage. This includes tax breaks, grants, or streamlined permitting processes.

4. Public Wi-Fi initiatives: Setting up public WI-FI hotspots in areas with limited connectivity can provide access to people without broadband at home.

5. Broadband Affordability: Promote broadband affordability programs such as the Federal Communication Commission's Affordable Connectivity Program

GRANTS AND BROADBAND ADOPTION PROGRAMS

There are several programs and initiatives aimed at promoting broadband access and adoption. Both the state of Wisconsin and the federal government have implemented programs that are available to either residents or internet service providers.

At the **state level**, the Public Service Commission (PSC) of Wisconsin's Broadband Office has awarded grants to organizations, (ex. telecommunications utilities, municipalities, or counties) or telecommunications utilities to encourage the deployment of broadband and improve broadband access for Wisconsin residents.

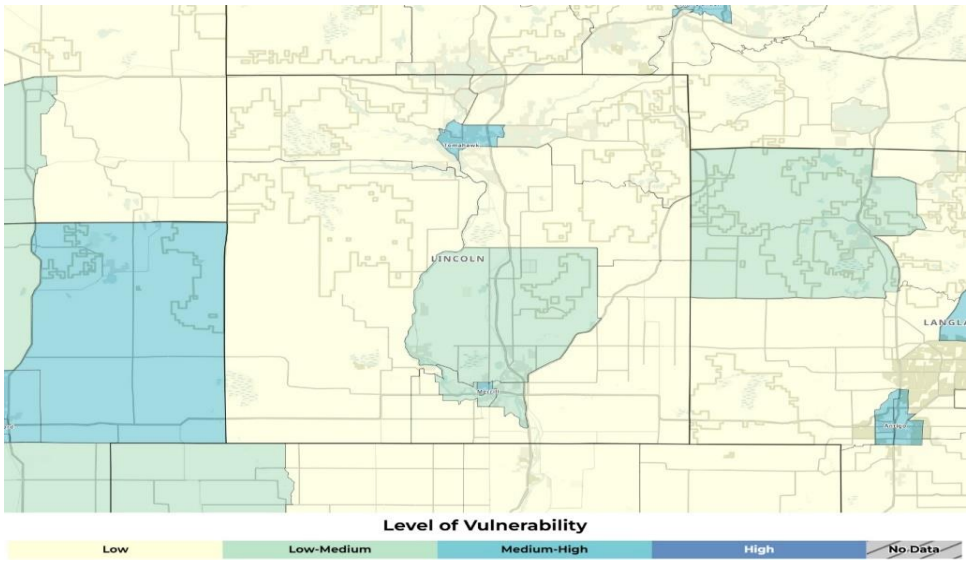
BROADBAND EXPANSION GRANT PROGRAM

Over the past 9 years, the State has run the *Broadband Expansion Grant Program* to encourage the deployment of broadband capability in underserved areas of the state. Since the program's inception, over $200 million in grants have been given to ISPs for broadband expansion.

CAPITAL PROJECTS BROADBAND INFRASTRUCTURE

Under the program name Capital Projects Broadband Infrastructure, the PSC, at the discretion of the Governor, administers limited federal funds to expand broadband access, adoption, and affordability. For-profit internet service providers, telecommunications utilities, co-operatives, local governments, and non-profit organizations are eligible to apply for grants. In fiscal year 2023, the Commission awarded funds from the federal American Rescue Plan Act (ARPA) of 2021 under the Capital Projects Fund (CPF) Broadband Infrastructure Grant Program. CPF Broadband Infrastructure Grants will provide up to $42 million in grant funding during **Fiscal Year 2024** to eligible applicants. As part of the merit criteria, projects that have the highest share and highest index score of vulnerable locations, as defined by the Center for Disease Control's **Social Vulnerability Index (SVI)**, will receive the most points.

Lincoln County Social Vulnerability



ARPA BROADBAND ACCESS

More broadly, the American Rescue Plan Act *(ARPA) Broadband Access Grants* Program administered federal funds for the purpose of expanding broadband, access, adoption, and affordability. ISPs, telecommunications utilities, co-operatives, local governments, and profit and non-profit organizations are eligible to apply for grants. Under the 2020 CARES Act, approximately $5.3 million of total funds were awarded to 12 applicants/projects to expand broadband access. In 2022, using ARPA funds, just under $100 million was allocated for 83 broadband expansion projects.

RURAL DIGITAL OPPORTUNITY FUND (RDOF)

The Rural Digital Opportunity Fund (RDOF) will disburse up to $20.4 billion over 10 years to bring fixed broadband and voice service to millions of unserved homes and small businesses in rural America. Building on the success of the Connect America Fund Phase II Auction (CAF II Auction), RDOF uses a two-phase, competitive reverse auction (Auction 904) that prioritizes higher network speeds and lower latency to ensure the deployment of robust, sustainable high-speed networks that meet the needs of consumers now and in the future.

The RDOF Phase I Auction ended on Nov. 25, 2020, and awarded $9.2 billion in support to 180 winning bidders, including incumbent telephone companies, cable operators, electric cooperatives, satellite operators, and fixed wireless providers. Winning bidders have committed to deploy broadband to more than 5.2 million homes and small businesses in census blocks that previously lacked broadband service with minimum speeds of 25 megabits per second downstream and 3 megabits per second upstream (25/3 Mbps) as determined by FCC Form 477 data. Phase II will cover locations in census blocks that are partially served, as well as locations not funded in Phase I. The Rural Digital Opportunity Fund will ensure that networks stand the test of time by prioritizing higher network speeds and lower latency so that those benefitting from these networks will be able to use tomorrow's Internet applications as well as today's.

ALTERNATIVE CONNECT AMERICA COST MOEL (ACAM)

The Alternative Connect America Cost Model (ACAM) provides funding to rate-of-return carriers that voluntarily elected to transition to a new cost model for calculating High-Cost support in exchange for meeting defined broadband build-out obligations. ACAM models the forward-looking economic costs of deploying a high-speed network and delivering broadband service. Carriers that elected this option receive predictable monthly payments to provide voice and broadband service to all funded locations over the program's 10-year support term (2017-2026). Carriers that elected ACAM funding must meet the deployment obligations published in the Public Notice authorizing them to receive A-CAM support. Some of these requirements include maintaining existing voice and broadband service and offer broadband speeds of at least 10 Mbps downstream/1 Mbps upstream (10/1 Mbps) to a number of eligible locations equal to the number of fully funded locations. (locations for which the carrier receives support for the full cost of build-out). Or offer broadband speeds of at least 25/3 Mbps to a number of eligible locations equal to a certain percentage of fully funded locations depending on the population density of the carrier's service area.

BIPARTISAN INFRASTRUCTURE LAW (BEAD & DIGITAL EQUITY ACT)

The recent Bipartisan Infrastructure Bill (BIL) provides $65 billion to connect more Americans to high-speed broadband internet that is affordable and reliable. Within BIL there are several programs that support broadband planning, infrastructure, and adoption. Wisconsin will administer funding under the *Broadband Equity, Access & Deployment Program (BEAD)* program and *Digital Equity Act (DEA)* programs. BIL grant programs are not intended for household or individual

applicants. Instead, states will lead planning and grantmaking efforts to provide funding to internet service providers which will build and provide service to households and businesses.

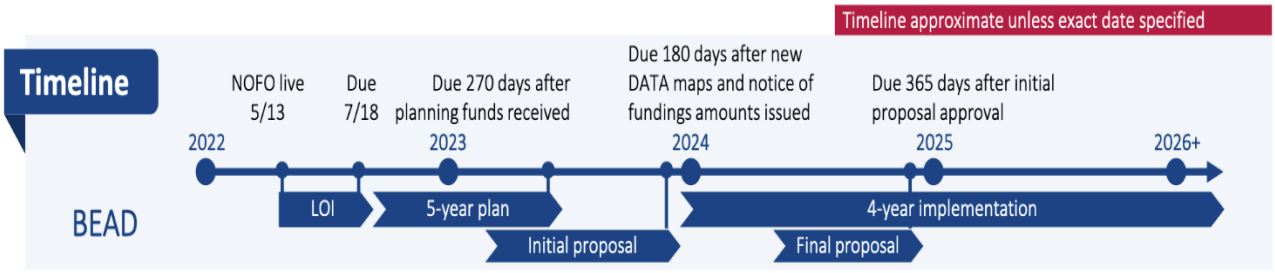
BEAD PROGRAM

Wisconsin's allocation of the BEAD program is approximately $1.06 billion, which was determined through a formula based on the state's proportion of locations lacking access to broadband service. Ultimately, BEAD will support the deployment of primarily fiber internet technology that provides service of 100/20 Mbps to all households and residences in Wisconsin that lack access to 25/3 Mbps service.

The following are eligible uses of funds:

1. Planning for the deployment of high-speed Internet, including conducting research, collecting data, outreach, and training.
2. Deploying or upgrading Internet in unserved or underserved areas or improving service to community anchor organizations
3. Installing Internet and Wi-Fi in multi-unit residential buildings
4. Adoption and digital equity programs
5. Workforce development programs and vocational training

Timeline for Bead Planning



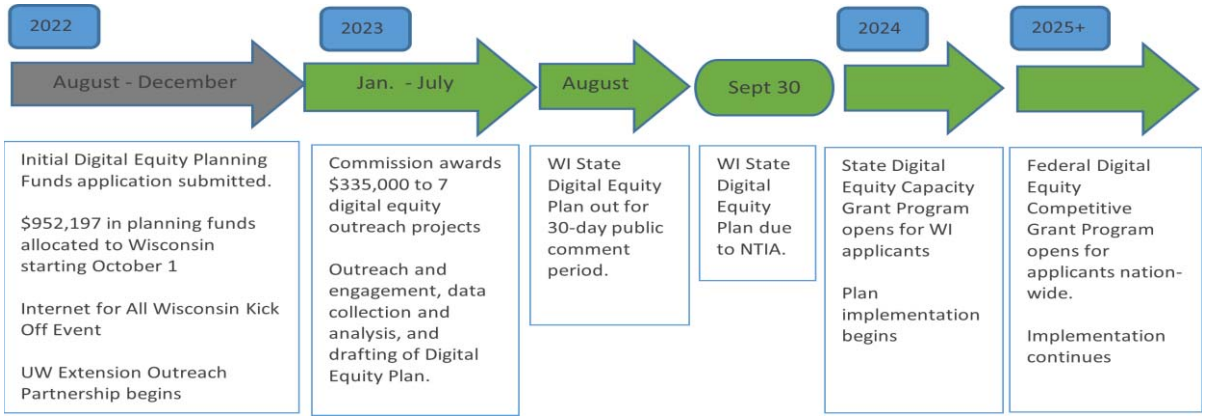
HOUSEHOLD ADOPTION PROGRAMS

Broadband costs continue to be a significant barrier for many low-income households. Local, state, and federal partners have aimed to make broadband affordable by subsidizing the cost of internet for many households.

DIGITAL EQUITY ACT

The Digital Equity Act (DEA) consists of three separate planning and implementation grant programs that promote digital equity. Digital equity is the condition where all citizens have the skills, devices, and broadband service necessary to fully participate in the economy and society of Wisconsin. Specific populations will be targeted with digital equity funding include: residents of rural areas, individuals of color, aging individuals, and more. Funding will be distributed through three programs, two of which are administered by the PSC. The first program is the State Planning Program, which provides funding to states based on a formula for the development of a state digital equity plan. Wisconsin's share of planning funds is $952,197. Secondly, the State Capacity Grant Program provides funding to states through a formula to support digital equity projects and implement each state's digital equity plan. Wisconsin's estimated share of capacity grant funding is approximately $24 million to $30 million over five years. The final program is the Competitive Grant Program, administered by NTIA, which will support digital equity projects nationally over a five-year period.

Estimated Digital Equity Act Programs Timeline



AFFORDABLE CONNECTIVITY PROGRAM

The Federal Communications Commission's (FCC) Affordable Connectivity Program (ACP) is a benefit program that helps to ensure households can afford broadband at their home. The ACP provides a discount of up to $30 per month toward internet service for eligible households and up to $75 per month for households on qualifying Tribal lands. Additionally, households can

receive one-time discounts of up to $100 to purchase a laptop, desktop computer, or tablet from participating providers if they contribute up to $50 toward the purchase price. One of the guidelines to be eligible for the ACP, is that a household must have an income that is at or below 200% of the federal poverty guidelines. Other potential eligibility criteria include participation in certain assistance programs (Ex. SNAP, Medicaid, WIC, etc.), participation in Tribal specific programs (Ex. Bureau of Indian Affairs General Assistance), or approval to receive free and reduced-price school lunch programs.

Participation by internet service providers is voluntary by the company, but most providers in Wisconsin are participating in the ACP program. Several providers offer one or more plans that are covered in full by the ACP discount, resulting in those plans costing nothing for those households.

LIFELINE

Lifeline is another FCC program that helps make communications services more affordable for low-income consumers. Lifeline provides subscribers with a discount on qualifying monthly telephone service, broadband Internet service, or bundled voice-broadband packages purchased from participating wireline or wireless providers. Lifeline provides up to a $9.25 monthly discount on service for eligible low-income subscribers and up to $34.25 per month for those on Tribal lands. Subscribers may receive a Lifeline discount on either a wireline or a wireless service, but they may not receive a discount on both services at the same time. Lifeline also supports broadband Internet service and broadband-voice bundles. FCC rules prohibit more than one Lifeline service per household.

To participate in the Lifeline program, consumers must either have an income that is at or below 135% of the Federal Poverty Guidelines or participate in certain federal assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), Medicaid, Federal Public Housing Assistance, Supplemental Security Income, the Veterans and Survivors Pension Benefit, or certain Tribal Programs.

FUNDING

Funding and financing broadband projects is essential for expanding access to high-speed internet and bridging the digital divide. Various sources of funding are available, including private sector investments, government programs at federal and state levels, tax incentives and credits to encourage private sector participation, bond financing by local governments, and grants from foundations and nonprofits, particularly for projects emphasizing digital inclusion. Public-private partnerships can also play a crucial role in leveraging resources for broadband expansion. These funding options collectively provide the necessary financial support to develop and deploy broadband infrastructure, ultimately improving internet connectivity and accessibility for underserved and rural communities.

PRIVATE SECTOR INVESTMENTS:

Telecommunications companies and Internet Service Providers (ISPs) frequently allocate resources to expand broadband infrastructure, particularly in areas with a potentially lucrative customer base. Collaboration through public-private partnerships can also incentivize and facilitate such investments.

FEDERAL AND STATE PROGRAMS:

Governments at both the federal and state levels administer programs and initiatives to support broadband expansion. These may include subsidies, grants, and other financial incentives aimed at bolstering infrastructure development.

TAX INCENTIVES AND CREDITS:

In certain scenarios, government authorities may provide tax incentives or credits as a means to stimulate private sector participation in broadband infrastructure investment. These incentives serve to encourage companies to engage in these critical projects.

BOND FINANCING:

Local governments have the option to issue bonds as a financial mechanism to fund broadband projects. The expectation is that the revenue generated from broadband services will eventually cover the debt incurred through bond issuance.

GRANTS AND FOUNDATIONS:

A variety of foundations, nonprofit organizations, and philanthropic entities may extend grants and financial support to broadband initiatives. These sources of funding often prioritize projects focused on digital inclusion and promoting equitable access to broadband services.

COST ESTIMATES

Cost estimation for broadband infrastructure and deployment and programs are important to help seek funding options and partners for each of the proposed broadband expansion projects. See the appendix for cost estimates for each of the proposed project areas based on the OptiDesign Rapid Design Study. Other cost estimates for programs could be developed to help increase the adoption of broadband in Lincoln County.

CHAPTER 7

Broadband Goals

7. BROADBAND GOALS

The following are goals identified by several entities to bolster broadband access, affordability, and adoption. The State of Wisconsin's Governor's Task Force worked with the Public Service commission of Wisconsin (PSC), Federal Communications Commission (FCC), National Telecommunications and Information Commission (NTIA), and other state and federal agencies, and the public to create a series of goals and initiatives.

STATE OF WISCONSIN GOALS

2023 Governor's Task Force on Broadband Access produced recommendations in five areas for the State of Wisconsin:

PREPARING TO CAPITALIZE ON FEDERAL FUNDS

- Wisconsin needs to plan, coordinate, distribute, and capitalize on the increasing federal funding dollars available, including those through the Bipartisan Infrastructure Law (BIL) such as the Broadband, Equity, Access, and Deployment (BEAD) Program and Digital Equity Programs.
- Support the Wisconsin Broadband Office and Public Service Commission of Wisconsin in their drafting and submission of Wisconsin's 5-Year BEAD Action Plan and Digital Equity Plan.
- Find ways to reduce or combat the impacts of inflation and supply chain pressures to create a more hospitable environment for broadband expansion.
- Continue to find ways to braid BIL funds with other funding sources such as local, state, private, philanthropic, and other federal.
- Recognize and emphasize the importance of other sources of funding beyond the BIL. Advocate for increasing those funding sources to complement the BIL.
- Ensure that all Wisconsinites and broadband stakeholders are aware of federal and state funding opportunities by way of technical support, sharing best practices, webinars, workshops, newsletters, local, regional, and statewide in-person meetings, providing general assistance, and supporting applications.
- Help to secure Wisconsin's future by encouraging the use of federal dollars on forward thinking and future proof solutions.
- Support, engage with, and consider the needs of Internet Service Providers and Telecommunications Associations in their preparations for the BEAD program.

- Explore and promote available low-interest loan programs that help to support internet service providers in their pursuit of broadband infrastructure expansion.
- The Wisconsin State Legislature should consider flexibilities and/or waivers to existing State statutes that may be burdensome to federal funding investment.
- Fiber technology should be prioritized, but not exclusively required in publicly funded broadband deployment. Terrestrial fixed wireless solutions are viable in particularly hard-to-reach areas and/or as a short-term solution.

SUPPORTING LOCAL COMMUNITIES

- Support organizations such as the Public Service Commission of Wisconsin, University of Wisconsin – Madison, Division of Extension, and Wisconsin Economic Development Corporation in their technical assistance efforts.
- Maintain a continued focus on how best to assist local communities in broadband planning to ensure their involvement and participation in the rollout of federal funds.
- Support local broadband champions, including digital navigators embedded within the community.
- Help these champions and navigators carry out and see through their community connectivity vision.
- Continue to improve and promote broadband planning playbooks and toolkits available to local communities.
- Find more ways for the public to better understand and utilize broadband maps and data.
- Encourage public participation and input in the planning process where appropriate.
- Engage local communities through statewide listening sessions and take information and stories to the Task Force for continued advancement and strengthening of the Task Force annual report.

WORKFORCE DEVELOPMENT

- Support and include organizations such as workforce development boards, economic development, labor groups and unions, contractors, high schools, higher education and technical colleges, and State agencies (DPI, DWD, PSC). Ensure that these organizations are connected with internet service providers and telecommunications associations to increase awareness and create a sustainable and viable pipeline of talent.
- Ensure a sufficient and trained telecom workforce for internet service providers, contractors, and subcontractors to construct, operate and maintain current and new broadband infrastructure.
- Where practicable and with input from higher education and employers, Wisconsin should encourage hiring from within local communities to help retain local talent and grow good jobs within Wisconsin.

MAPPING AND DATA

- Promote the Federal Communications Commission's (FCC) National Broadband and the opportunities for the public and stakeholders to challenge availability and location data within the map.
- Continue to support statewide speed testing and surveying such as funding and promotion of the
- OptiMap (formerly known as Geo Partners) software and the Wisconsin Internet Self-Report (WISER) survey.
- Support local communities in their efforts to pursue, intake, and make meaning of local data.
- Align state mapping efforts and products with the federal government.
- Find ways to quantify and capture the quality of broadband service beyond basic metrics like download and upload speed.

AFFORDABILITY AND ADOPTION

- Continue outreach and promotion of the Affordable Connectivity Program (ACP) to reach the highest possible levels of participation in Wisconsin.
- Maintain federal funding for the ACP program to ensure access to this vital program for eligible households in Wisconsin. Consider establishing a state internet assistance affordability program.
- Increase outreach and engagement with underserved populations such as aging individuals, incarcerated individuals, veterans, individuals with disabilities, individuals with a language barrier, individuals who are members of racial or ethnic minority groups, and individuals who primarily reside in rural areas to ensure all Wisconsin residents can make full use of the internet.
- Wisconsin should develop and define standard metrics for affordability of broadband services for all Wisconsinites.

NORTH CENTRAL WISCONSIN REGIONAL RECOVERY PLAN BROADBAND GOALS

The following goals were identified in the North Central Wisconsin Regional Recovery Plan. The Advisory Committee, who were represented by economic development professionals from throughout the region, identified these goals as the most important to the vision of the future of broadband in the region.

1. Create universal broadband infrastructure throughout the region.

2. Bring high-performance broadband service throughout the region.

3. Make broadband affordable and competitive.

4. Advance digital literacy and inclusion.

CENTERGY-CENTRAL WI ALLIANCE FOR ECONOMIC DEVELOPMENT, BROADBAND GOALS

The following goals were identified in the Centergy Region to assist with planning at a regional level.

1. Inventory existing efforts across region, such as past Broadband Expansion Grant recipients, past broadband plans and studies, past surveys, existing maps, etc. Outcomes: This inventory and research will allow staff to create a baseline of existing and current efforts which will help inform us of the next steps in our planning process.

2. Form a regional broadband committee with appointments from each of the counties and tribes. Outcomes: This committee will be the working group for the duration of the project. They will assist staff in outreach and communication to their respective counties/tribe and communities.

3. Coordinate and implement sub-regional meetings for communities (these may be in-person or virtual depending on the input received from the regional broadband groups. Outcomes: These meetings/sessions will help inform the regional broadband vision and goals by providing stakeholders with an opportunity to be engaged.

LINCOLN COUNTY GOALS

1. Support establishment of broadband telecommunications availability to all areas, residences, and businesses of Lincoln County. Broadband speeds initially should be at least 100 megabits per second download and 20 megabits per second upload.

2. Create a map of internet service in Lincoln County and identify and prioritize areas that are unserved or underserved for broadband by the end of the first quarter of calendar year 2024.

3. By the end of the first quarter of the calendar year 2024, produce a plan that provides a realistic scenario for deploying broadband infrastructure in Lincoln County.

4. Identify and promote opportunities for Lincoln County residents and businesses to access internet educational and self-help opportunities.

5. On an ongoing basis, encourage internet infrastructure and service providers to invest in Lincoln County through county and community support of funding applications by matching funds, in-kind services, or other collaboration or coordination opportunities.

6. Establish by the fourth quarter of the calendar year 2023 a Lincoln County Broadband Commission that reflects and includes representatives from our county's citizens, municipalities, businesses, and government.

CHAPTER 8

Recommendations and Conclusion

8. RECOMMENDATIONS AND CONCLUSION

GAP ANALYSIS RECOMMENDATIONS

A broadband gap analysis assessment of the potential expansion of broadband internet access within Lincoln County was performed by the consulting firm Breaking Point Solutions LLC. This analysis included several broadband implementation strategies including both design and financial analysis in order to explore a wide range of broadband expansion possibilities. Each expansion scenario included a cost model that considered several elements including anticipated grant funding.

In Lincoln County, two strategies are proposed to address the broadband deficit. The first, "completion of existing networks," aims to encourage incumbent ISPs like Charter to complete their broadband infrastructure deployments in areas they have already started serving, including specific communities, and surrounding rural regions. The second strategy, "greenfield deployment," involves creating new infrastructure in areas where Charter lacks a presence. However, the estimated BEAD program allocation of $12.5 million falls short of covering all unserved or underserved households with fiber. To bridge this gap, a hybrid approach combining fiber and fixed wireless is suggested, potentially improving service quality for around 92% of households.

The county's relatively flat terrain makes fixed wireless, particularly using CBRS technology, a feasible option to cover approximately 86% of households. Nonetheless, efforts should be made to deploy as much fiber as the budget allows. In grant analysis, Lincoln County is considered an "average" county, with no special needs or high-cost opportunities identified under the BEAD program.

The recommended alternative, known as “C3”, seeks to expand broadband in Lincoln County through the deployment of a blend of fiber and fixed wireless solutions. This alternative seeks to strike a balance between the goal of extending broadband access to as many underserved households as feasible and acknowledging the financial constraints associated with broadband expansion. Table 7-1 highlights the key details of this alternative.

Mixed Fiber and Fixed Wireless Recommended Option (C3)	
# of Fiber Households	881
# of Wireless Households	1,986
Uncovered Households	225
Fiber Coverage Rate	30.7%
Fixed Wireless Rate	61.4%
Total System Cost	$9,354,563

DATA COLLECTION

COVERAGE GAPS

By analyzing GIS data and broadband speed tests we can find areas that lack reliable broadband coverage. The county should work with Internet Service Providers (ISP) to utilize the BEAD program to help fund broadband expansion into these areas. Broadband infrastructure gaps, often referred to as "digital divides" or "digital deserts," are areas or regions where there is inadequate or limited availability of high-speed broadband internet access. See Map 8 and Rapid Design Study in the Appendix.

ADOPTION GAPS

Broadband adoption gaps represent disparities in the usage of high-speed internet services across various demographic groups or geographic regions. These discrepancies underscore unequal access to and utilization of broadband internet, with consequential impacts on society, the economy, and education. You can find a detailed definition of these adoption gaps in Chapter 3, beginning on page 20. Lincoln County can collaborate with various county departments and local organizations to tackle these disparities. Effectively addressing these gaps is crucial for promoting broader broadband technology adoption.

INFRASTRUCTURE GAPS

Broadband infrastructure gaps involve identifying areas with limited or no access to high-speed internet services. Finding broadband infrastructure gaps is an ongoing process, it will require a combination of data analysis (see maps 5a to 5e), community engagement (speed test data maps 7 and 8) and cooperation with local ISP to know where existing infrastructure is currently located or planned to be deployed.

IMPACT

ECONOMIC

Broadband access in a county can have a significant negative impact on its economic development and overall growth. A few ways the economy can be affected, Limited business growth, reduced innovations, impaired remote work opportunities, loss of competitiveness, education and workforce development, and limited tourism industry.

EDUCATIONAL

Broadband access can have a profound and far-reaching impact on education at all levels. It can limit access to online learning, homework gaps, increased digital literacy, access to educational resources, teacher professional development, access to higher education, e-learning during crises, and teacher recruitment and retention.

HEALTHCARE

Access to broadband can exert a substantial influence on healthcare, influencing not only the provision of medical services but also patient outcomes. It plays a pivotal role in facilitating telemedicine, extending the reach of healthcare services, enabling telehealth initiatives, and fostering seamless patient data sharing between medical providers.

SOCIAL AND CIVIC

The lack of broadband access can have significant social and civic impacts on a community or county, affecting the way residents engage with government, access information, and participate in society. Limited civic engagement, access to government services, community information, crisis response

ADDITIONAL RECOMMENDATIONS

To address broadband gaps in economic, educational, healthcare, social, and civic aspects, comprehensive strategies are needed. Here are recommendations for bridging these gaps:

INFRASTRUCTURE INVESTMENT:

Investing in infrastructure is crucial for improving broadband access and connectivity. Broadband funding, including BEAD and other available sources, presents significant opportunities for the expansion of high-speed internet access in Lincoln County. Here are recommendations for governments and organizations looking to invest in broadband infrastructure:

1. Assessment and Planning:
    - Utilize current assessment of broadband infrastructure and coverage to fully understand broadband gaps.
    - Collaborate with Internet Service Providers (ISPs) to expand broadband services to high priority areas, residents, and businesses within Lincoln County. Consider submitting a "Request for Information (RFI)" to learn more about ISPs services and their plans.
    - Understand the physical broadband technologies that can best meet the needs of the community (Ex. Fiber, DSL, Fixed Wireless, etc.). Each solution will be influenced by factors such as: available infrastructure and broadband providers, capital costs, topography, potential sources of interference, current community adoption, and existing and future broadband needs. For example, DSL may be

effective up to 2-3 miles maximum, while fixed wireless towers may be effective up to 5-10 miles, if there is good line of sight.

- Consider the allocation of funding for broadband infrastructure development in areas that first prioritize "unserved" areas and then "underserved" rural areas.
- Utilize relevant data and maps to position community for potential grant project.
- Keep informed about current funding opportunities, including the Bead program, along with details and deadlines for applying for grants.

2. Public Awareness and Engagement
    - Continue to engage the Lincoln Broadband Commission and ensure that they are actively involved in decision making.
    - Compile a list of Community Anchor Institutions (CIAs), who will be needed to provide letters of support. CIAs are organizations and entities that play a vital role in their communities by providing essential services and resources. These institutions typically serve as hubs for education, healthcare, and various community services.
    - Involve the community in the decision-making process by conducting public forums and awareness campaigns. Engaged citizens are more likely to support and participate in broadband infrastructure development.
3. Remove Barriers
    - Adopt dig-once and joint trench-use policies and ordinances. Require that conduit or fiber installation will be allowed in R-O-W and require related notification.
    - Adopt public rights-of-way policies that waive fees or expedite use for broadband installation.
    - Adopt tower ordinances that allow agreements for the installation/cp-locating of antennae and equipment.
    - Amend zoning, subdivision, and design review ordinances to consider, encourage, or require the installation of broadband. Potentially include design plates or cross-sections with standards.
4. Regular Assessment and Adjustment
    - Once broadband infrastructure is deployed, periodically review the effectiveness of infrastructure investments, and adjust as needed. Encourage residents to continue taking speeds tests.

PROMOTE AFFORDABLE BROADBAND

1. Public Awareness and Engagement

- Promote Affordable Connectivity (ACP) and Lifeline programs which provide affordable access to broadband.
- Utilize the (ACP) government outreach toolkit.
- Raise awareness about these programs through advertising, both online and offline. Use social media, local newspapers, radio, and TV to reach a wide audience.
- Partner with community centers, schools, libraries, and local nonprofits to spread the word. They can assist in reaching specific demographics.
- Engage local government officials to endorse and support these programs. They can help with funding, resources, and promotion.

2. Tracking and Reporting
    - Monitor the impact of your promotion efforts through analytics and data collection, adjusting strategies as needed.

BROADBAND ADOPTION STRATEGIES

1. Increase Digital Literacy
    - Provide digital literacy training to help individuals and families navigate the internet safely and effectively.
    - Organize workshops and classes at local schools, libraries, and community centers.
    - Partner with local organizations to deliver training programs.
2. Raise Awareness
    - Create public awareness campaigns about the advantages of broadband access, such as education, job opportunities, healthcare, and entertainment.
    - Highlight success stories of individuals and communities that have benefited from broadband.

These recommendations involve a multi-pronged approach, combining infrastructure development, community outreach, and digital literacy efforts to ensure that broadband gaps are addressed comprehensively across these critical areas. Collaboration between government, private sector, and community organizations is essential for effective implementation.

CONCLUSION

This broadband plan outlines a strategy for the deployment and expansion of high-speed internet access within a specific region or community. Typically, such a plan includes key components like an assessment of current broadband infrastructure and demand, identification of funding sources and financial strategies, mapping of coverage gaps, and goals for improving connectivity. It often involves collaboration between public and private sectors, aiming to enhance digital inclusion and equitable access to the internet. Broadband plans play a crucial role in addressing the digital divide and promoting economic growth and innovation by ensuring that robust internet connectivity reaches all residents and businesses within the target area.

The digital age has ushered in a world of opportunities, but millions are still left on the wrong side of the digital divide, unable to access the benefits of high-speed internet. Now, it's time to act and change that. The information in this plan is intended to help the county engage internet service providers and leverage BEAD funding to help make good decisions to benefit citizens of Lincoln County with expanded high-speed broadband expansion.

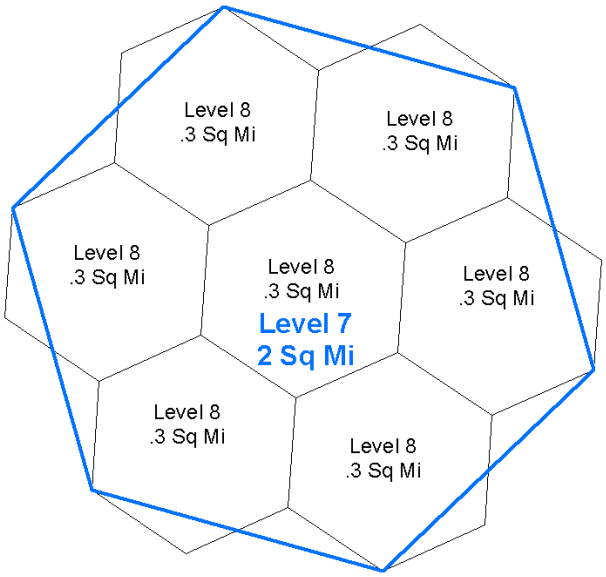
Moving forward, it is important to designate a point of contact who can help facilitate the next steps and communicate directly with ISPs.

APPENDIX 1

MAPS

MAPPING PROCESS

Much of the data on the maps are displayed using hexbin geometry used on the FCC broadband maps. The FCC collected data from providers on coverage and broadband type by this geometry. Level 7 is 2 square miles in size and Level 8 is .3 square miles in size. See the graphic below.



MAP 1- BROADBAND SERVICEABLE LOCATIONS (BSL)

Summary of development patterns and density. Centroids of tax parcels with improvement values greater than zero were summarized within level 8 hexbins. Summary of the total number of centroids counted by hexbins displayed on the map.

Map 2a - Managed Forest Lands (MFL)

Summary of large areas of managed forest lands. Tax parcels coded in a MFL programs were union with hexbins level 8. If greater than 75% of the area of hexbins level 8 was in MFL they are displayed on the map

MAP 2B – ASSESSED AGRICULTURAL LANDS

Summary of large areas of assessed agricultural lands. Tax parcels coded with an assessment code of agriculture were union with hexbins level 8. If greater than 25% of the area of hexbins level 8 was assessed agriculture, they are displayed on the map.

MAP 2C – ASSESSED TAX EXEMPT LANDS

Summary of large areas of tax-exempt lands. Tax parcels coded with an assessment code for tax-exempt status were union with hexbins level 8. If greater than 50% to 75% and greater than 75% of the area of hexbins 8 was assessed tax exempt are displayed on the maps

MAP 3 – CRITICAL FACILITIES

Summary of critical facilities. Airports, Ambulance Service, Fire Stations, Hospitals, Health Services, Business and Industrial Parks, Campgrounds, city, village, and town facilities, schools, correctional facilities, DNR Ranger Stations, Emergency Operation Centers, Libraries, Nursing Homes, Post Offices, and Tech Colleges. Summarized within hexbins level 7.

MAP 4A- RURAL DIGITAL OPPORTUNITY FUND (RDOF)

Census blocks of areas covered by the Rural Digital Opportunity Fund program. Provided to areas that lacked 25/3 Mbps fixed broadband service. 40 percent deployment by 2025, 60 percent by 2026, 80 percent by 2027, and 100 percent by 2028.

MAP 4B- EXISTING GRANT AREAS

Wisconsin Public Service (WPS) existing broadband grant footprint locations 2014 to 2022

MAP 5A- BROADBAND AVAILABILITY COPPER

Summary of FCC reported copper broadband availability. Copper broadband refers to a type of internet connection that utilizes copper-based infrastructure, primarily copper telephone lines, to deliver internet services to users' homes or businesses. The most common technology associated with copper broadband is Digital Subscriber Line (DSL). DSL technology enables the simultaneous transmission of voice and data signals over the same copper line by utilizing different frequency bands. DSL comes in different variants, such as ADSL (Asymmetric DSL) and VDSL (Very-high-bit-rate DSL), offering varying speeds and capabilities Areas reported at level 8 hexbins.

MAP 5B- BROADBAND AVAILABILITY CABLE

Summary of FCC reported cable broadband availability. Cable internet, also known as broadband cable or cable broadband, refers to a high-speed internet connection that utilizes the same coaxial cable infrastructure that delivers cable television signals to homes and businesses. This type of internet connection offers faster speeds compared to traditional dial-up and DSL (Digital Subscriber Line) connections. Areas reported at level 8 hexbins.

MAP 5C- BROADBAND AVAILABILITY FIBER

Summary of FCC reported fiber broadband availability. Fiber internet, also known as fiber-optic internet, is a high-speed broadband internet connection that utilizes fiber-optic cables to transmit data at incredibly fast speeds. Fiber-optic technology employs thin strands of glass or plastic fibers to carry digital information as pulses of light, enabling faster and more reliable data transmission compared to traditional copper-based cables. Areas reported at level 8 hexbins.

MAP 5D- BROADBAND AVAILABILITY FIXED WIRELESS

Summary of FCC reported fixed wireless broadband availability. Fixed wireless broadband is a type of high-speed internet connection that utilizes wireless communication technology to provide internet access to homes, businesses, and other locations. Unlike mobile wireless connections, which are designed for on-the-go access, fixed wireless connections are stationary and provide consistent connectivity to a specific location. Areas reported at level 8 hexbins.

MAP 5E- BROADBAND AVAILABILITY MOBILE

Summary of FCC reported mobile broadband availability. Mobile broadband refers to high-speed internet access provided through wireless networks, enabling users to connect to the internet using mobile devices such as smartphones, tablets, laptops, and other portable devices. Unlike fixed broadband connections, which are typically stationary and serve specific locations, mobile broadband provides on-the-go connectivity, allowing users to access the internet from virtually anywhere within the coverage area of a mobile network. 4G and 5G areas are summarized at hexbins level 7 hexbins.

MAP 6- AVERAGE DOWNLOAD SPEEDS

Information was collected from wisconsinspeedtest.net and Ookla Open Data speed tests. These areas are summarized at level 7 hexbins. Areas that reported no service are highlighted.

MAP 7- AVERAGE UPLOAD SPEEDS

Information was collected from wisconsinspeedtest.net and Ookla Open Data speed tests. These areas are summarized at level 7 hexbins.

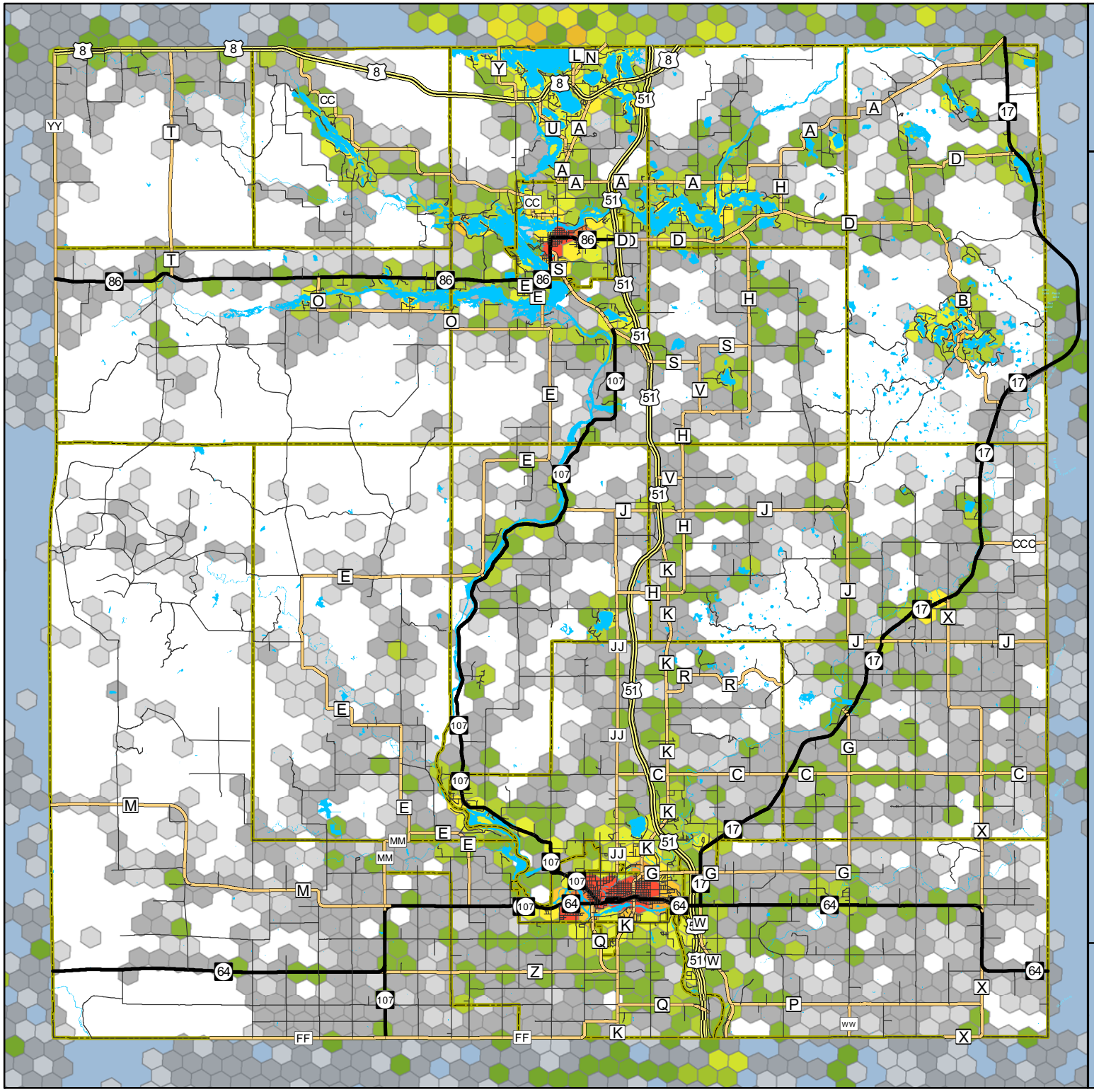
MAP 8- RECOMMENDED BROADBAND EXPANSION AREAS

Areas determined by existing data and committee input for potential project locations.

Map 1 **DRAFT**

Broadband Serviceable Locations (BSL)

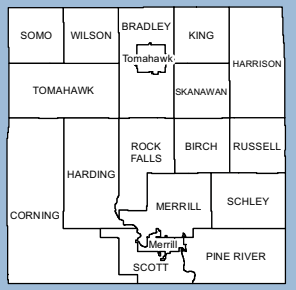
Lincoln County, Wisconsin



- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Count

- 1
- 2 - 5
- 6 - 10
- 11 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 150
- 151 - 200
- > 200



Source: WI DNR, NCWRPC, Lincoln Co, WisDOT, FCC

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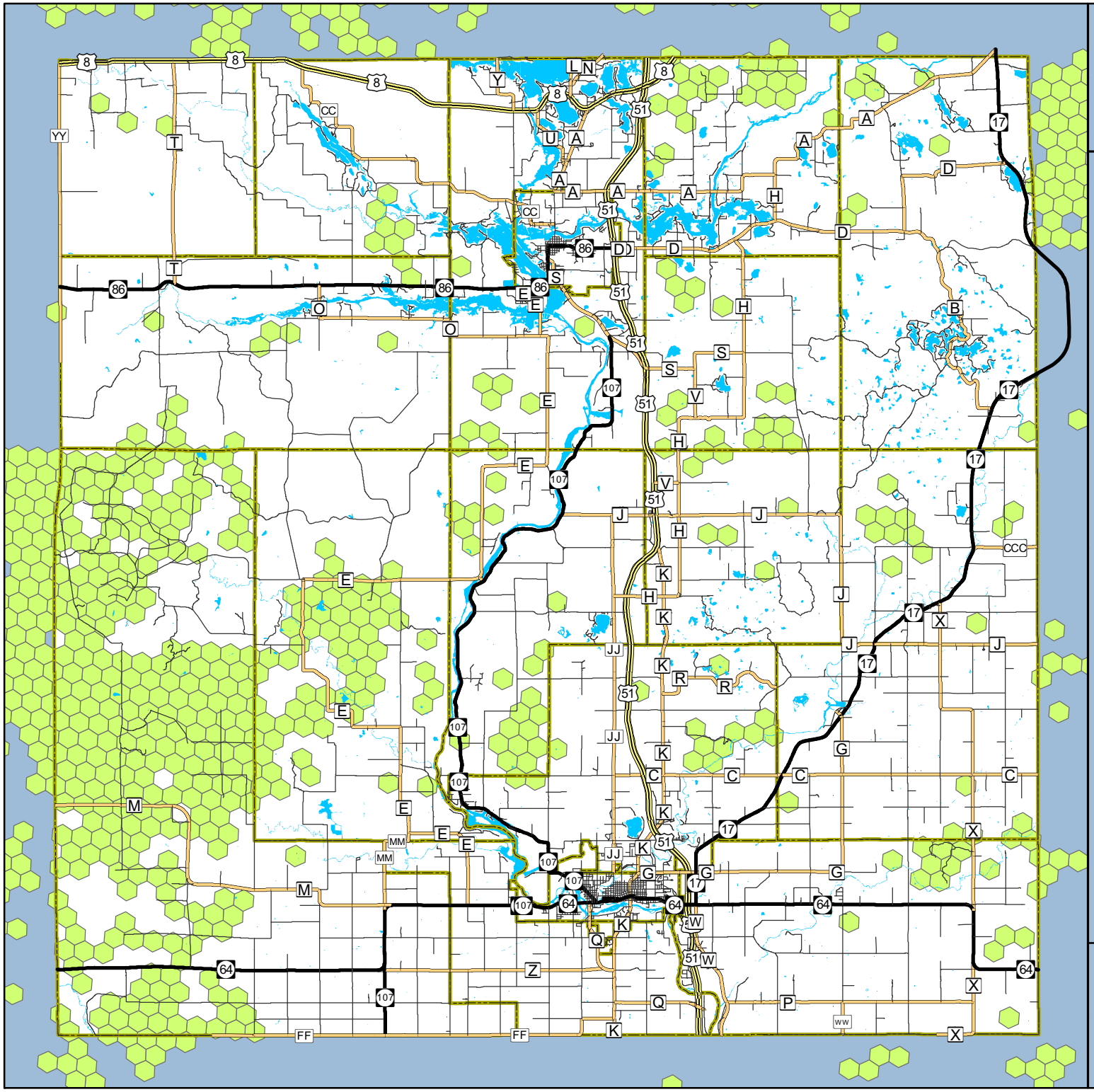
Map 2a **DRAFT**

Managed Forest Lands (MFL)

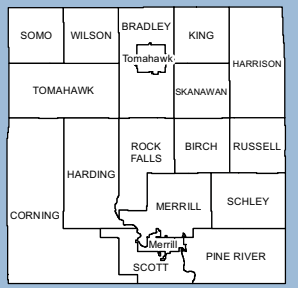
Lincoln County, Wisconsin



- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water
- > 75 % MFL

N W E S

0 2.5 5 Miles



Source: WI DNR, NCWRPC, Wood Co, WisDOT, FCC

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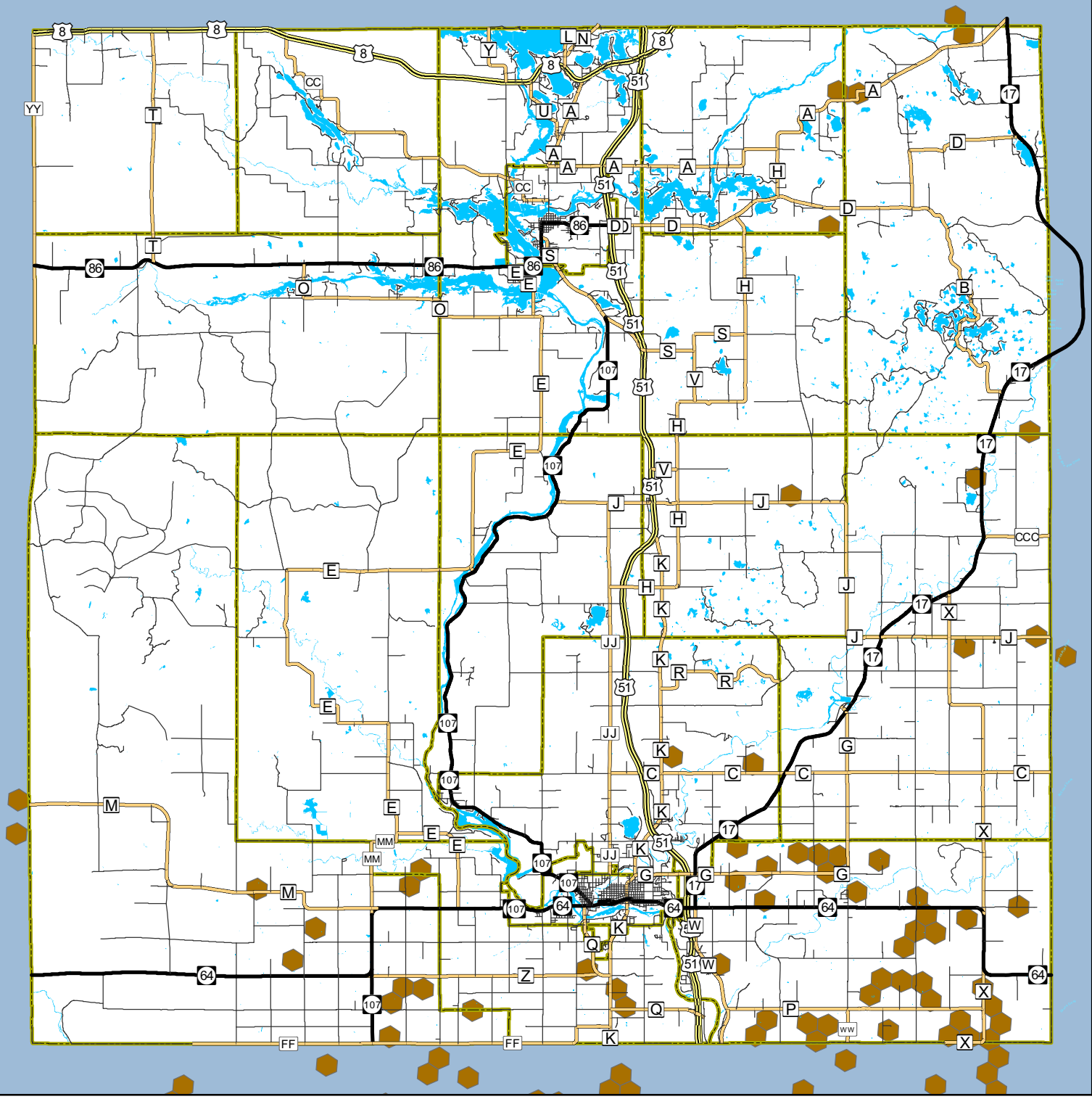
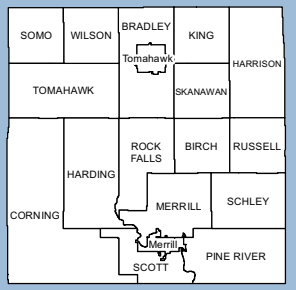
Map 2b **DRAFT**

Assessed Agricultural Lands

Lincoln County, Wisconsin



- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water
- > 25% Agricultural Lands



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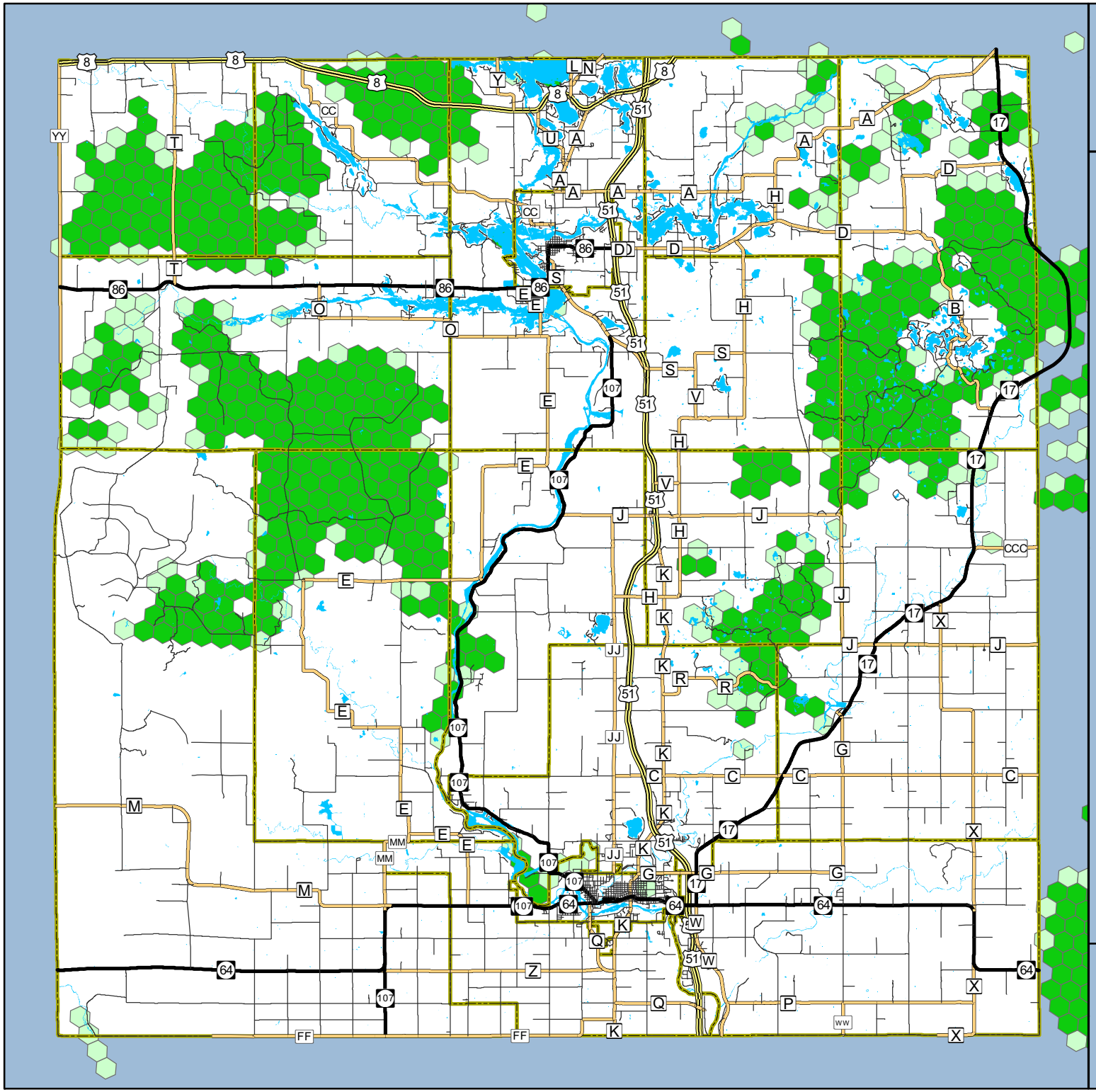
Map 2c **DRAFT**

Assessed Tax Exempt Lands

Lincoln County, Wisconsin



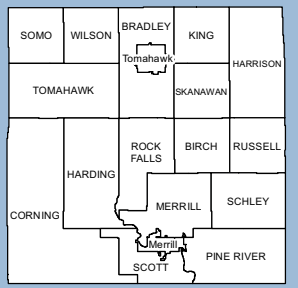
- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Tax Exempt

- 50 to 75%
- > 75%

N W E S

0 2.5 5 Miles



Source: WI DNR, NCWRPC, Wood Co, WisDOT, FCC

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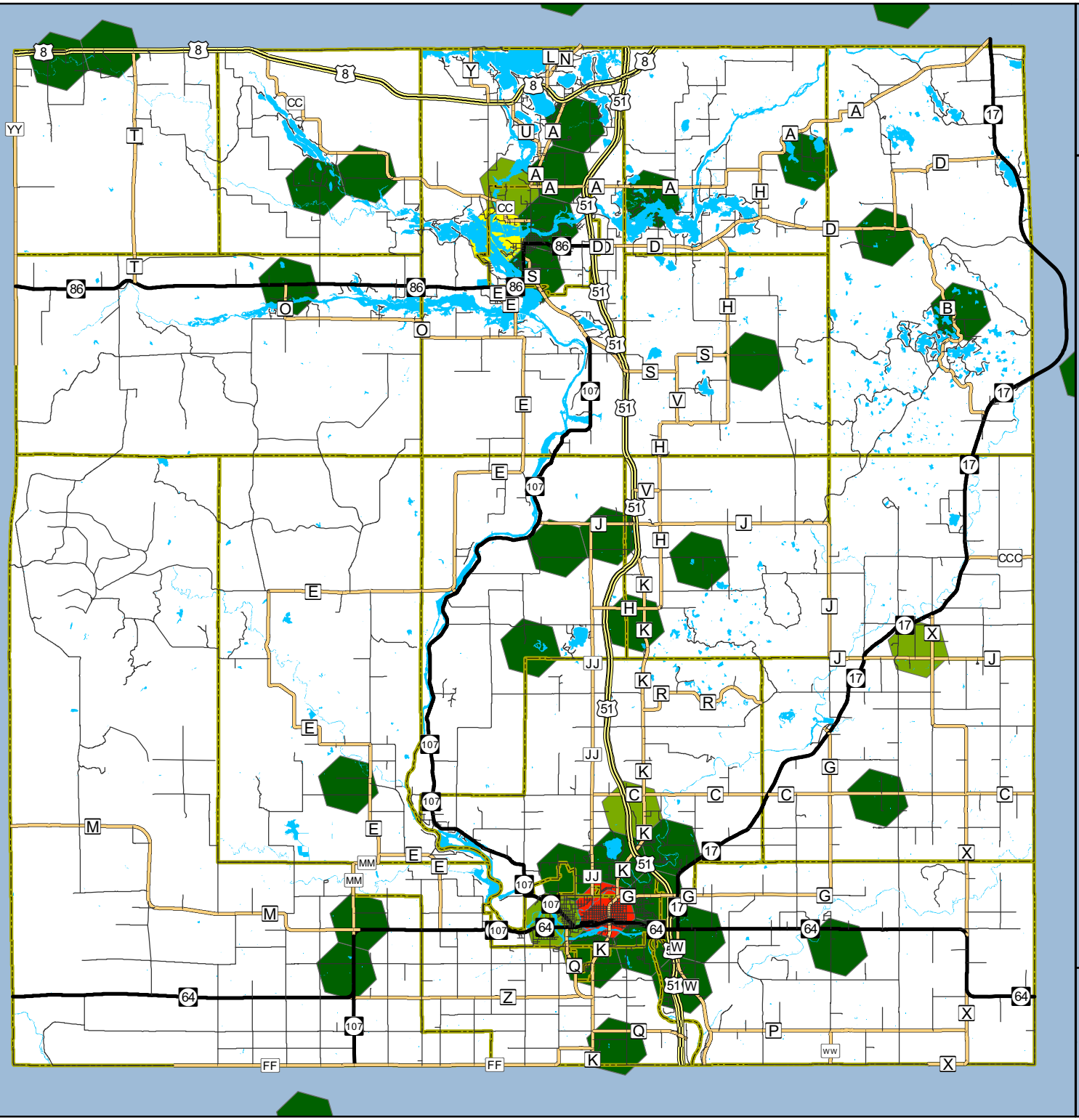
Map 3 **DRAFT**

Critical Facilities

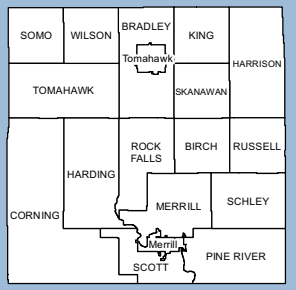
Lincoln County, Wisconsin



- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Count

- 1 - 2
- 3 - 5
- 6 - 8
- 9 - 12
- 13 - 20



Source: WI DNR, NCWRPC, Lincoln Co, WisDOT, FCC

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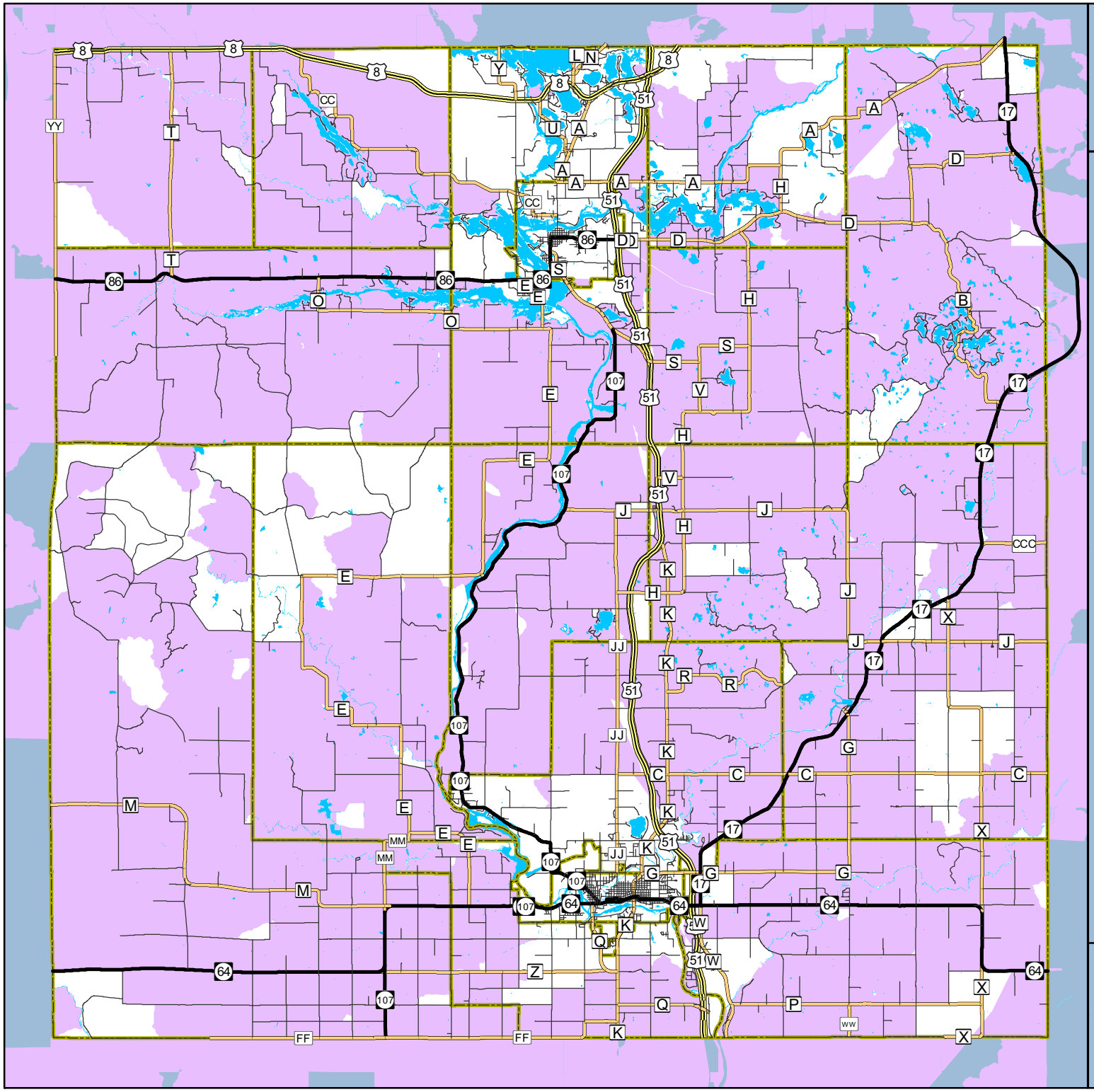
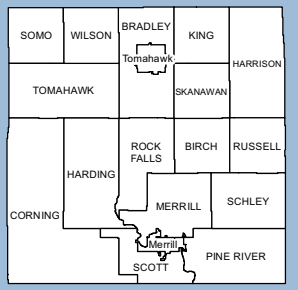


Map 4a **DRAFT**

Rural Digital Opportunity Fund (RDOF)

Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water
- RDOF Areas



Source: WI DNR, NCWRPC, Lincoln Co, WisDOT, FCC

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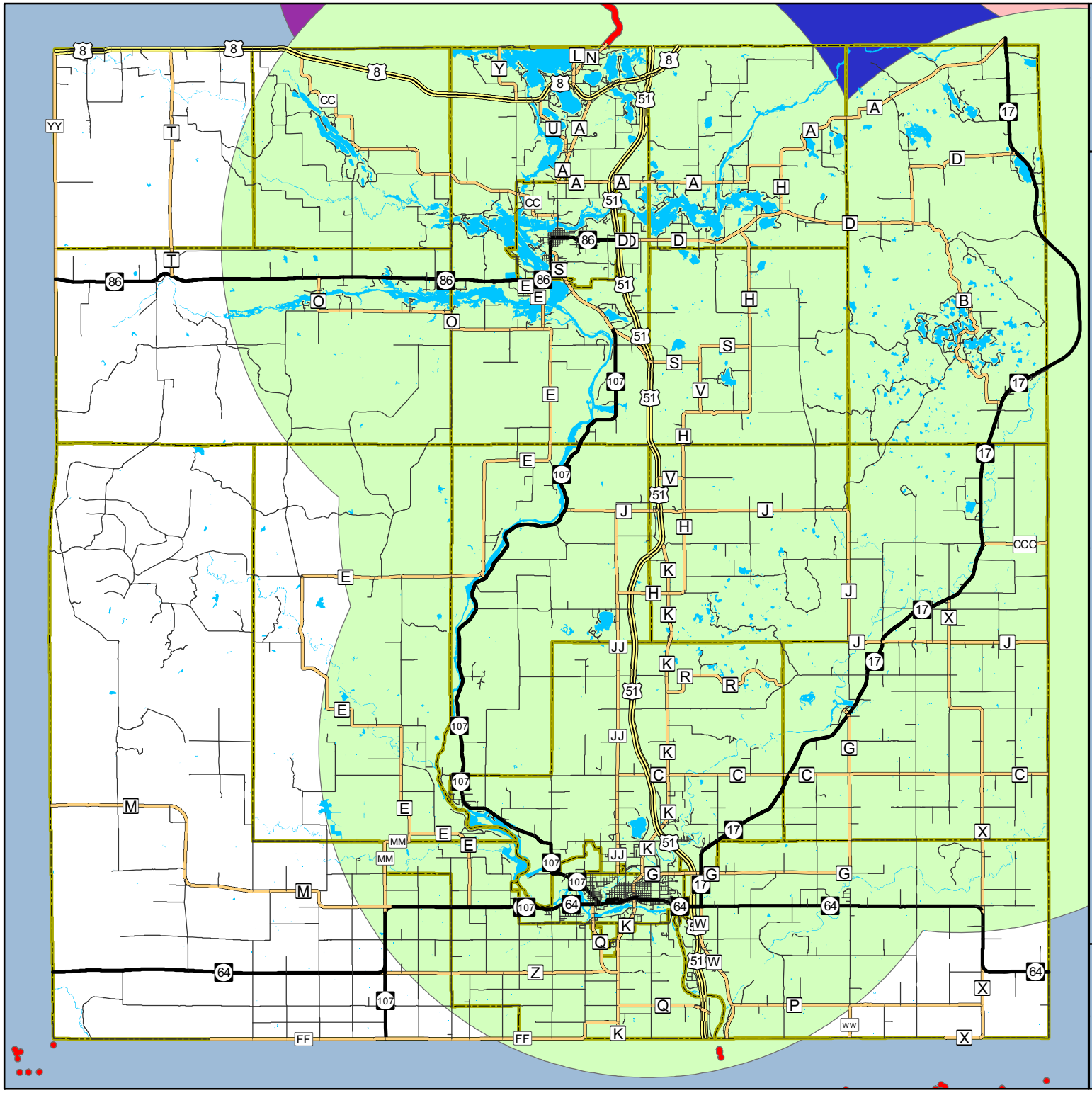


Map 4b **DRAFT**

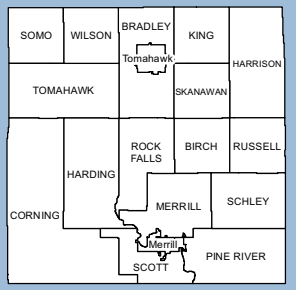
Existing Grant Areas

Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Grant Round

- No Year Noted
- 2017
- 2018, Round 2
- 2019
- 2020



Source: WI DNR, NCWRPC, Lincoln Co, WisDOT, FCC, PSC

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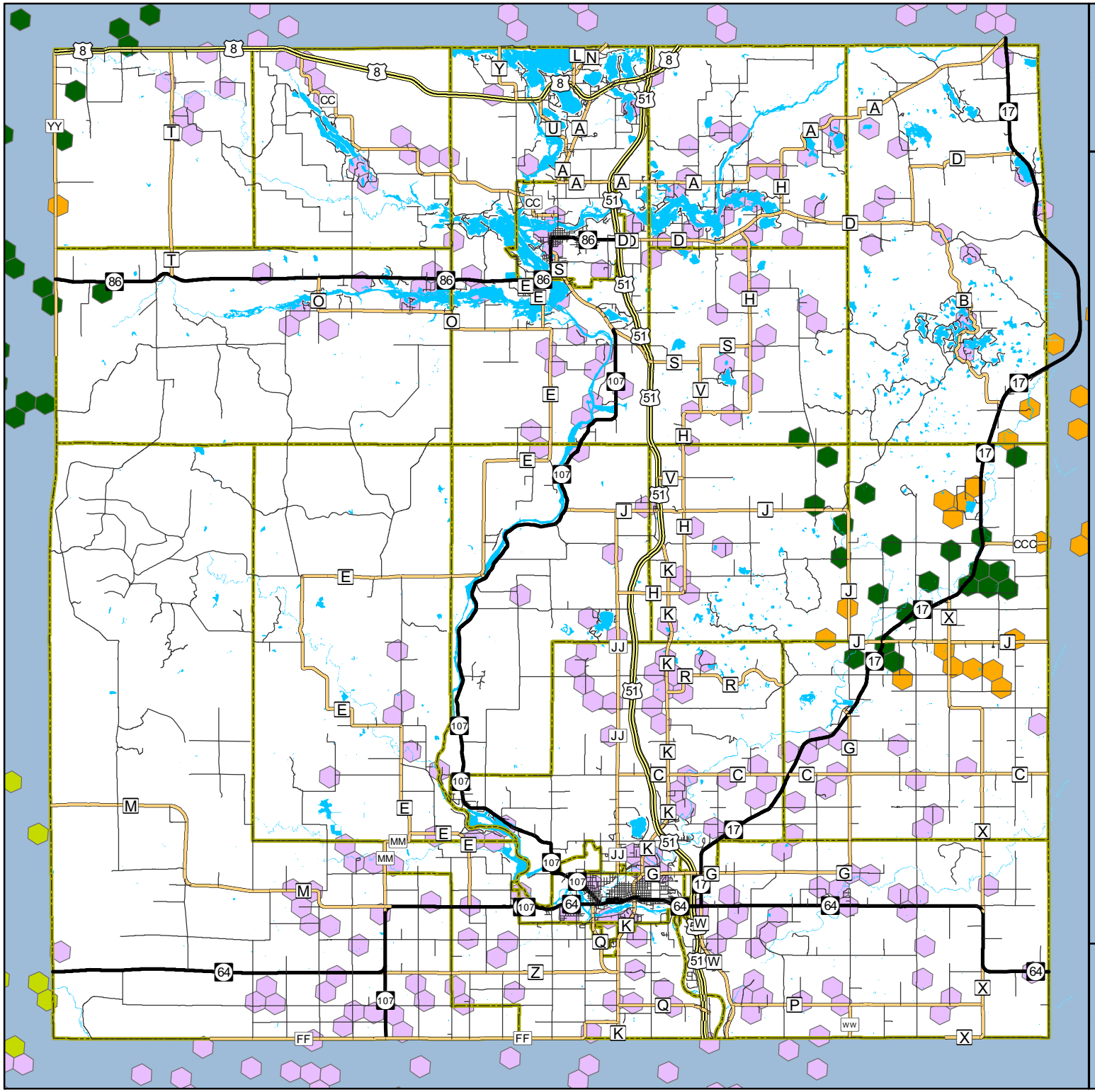


Map 5a **DRAFT**

Broadband Availability Copper

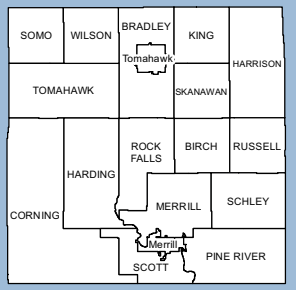
Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Copper

Provider

- Brightspeed
- CenturyLink
- Frontier
- TDS Telecom



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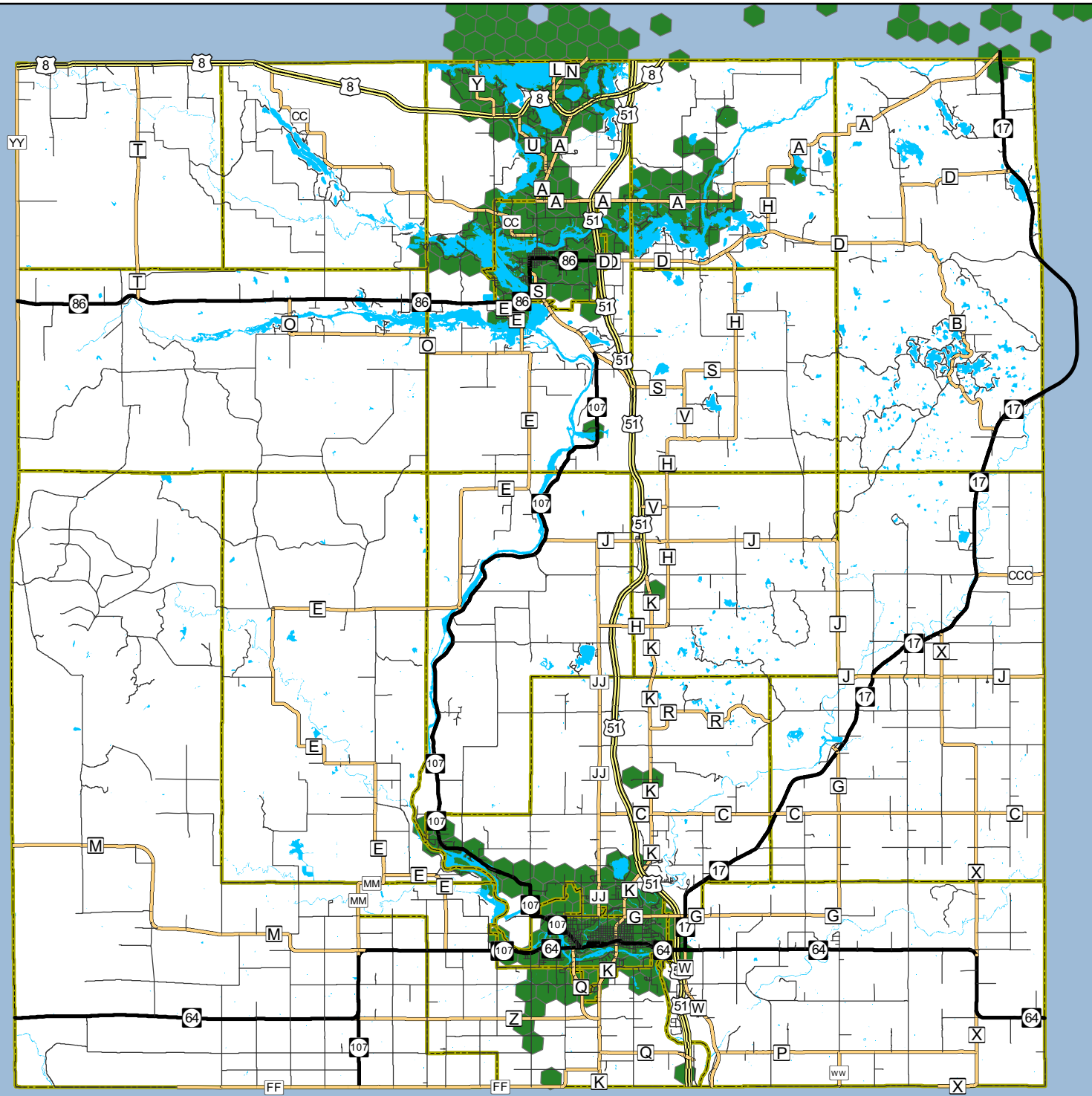


Map 5b **DRAFT**

Broadband Availability Cable

Lincoln County, Wisconsin

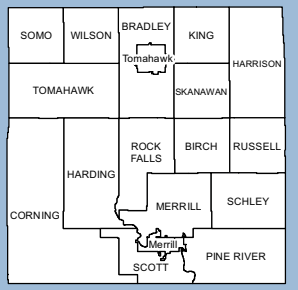
- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Provider

- Charter Communications Inc

N W E S

0 2.5 5 Miles



Source: WI DNR, NCWRPC, Lincoln Co, WisDOT, FCC

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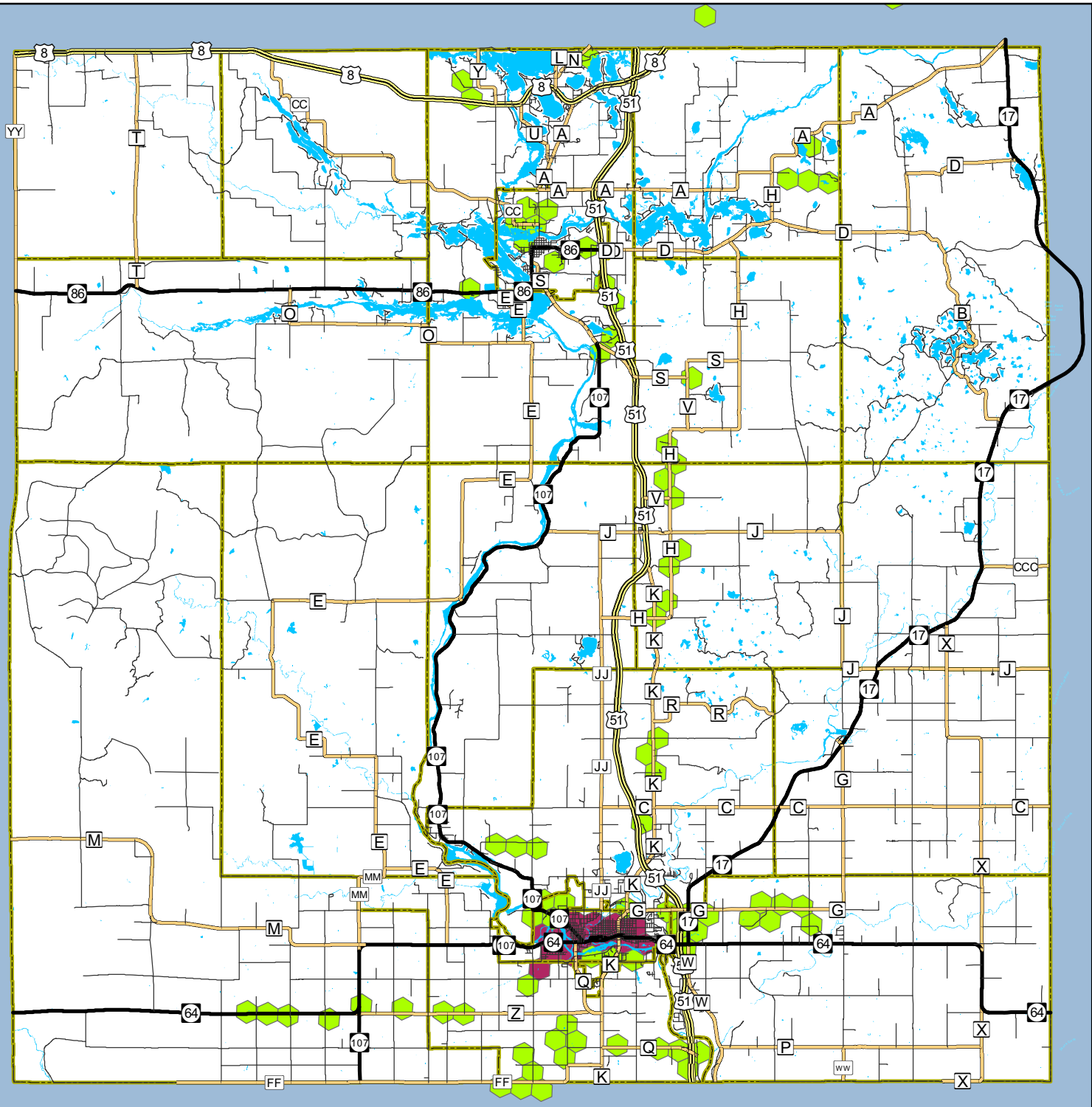


Map 5c **DRAFT**

Broadband Availability Fiber

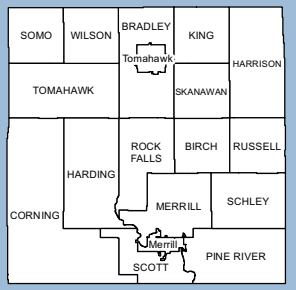
Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Fiber

Provider

- Charter Communications Inc
- Frontier



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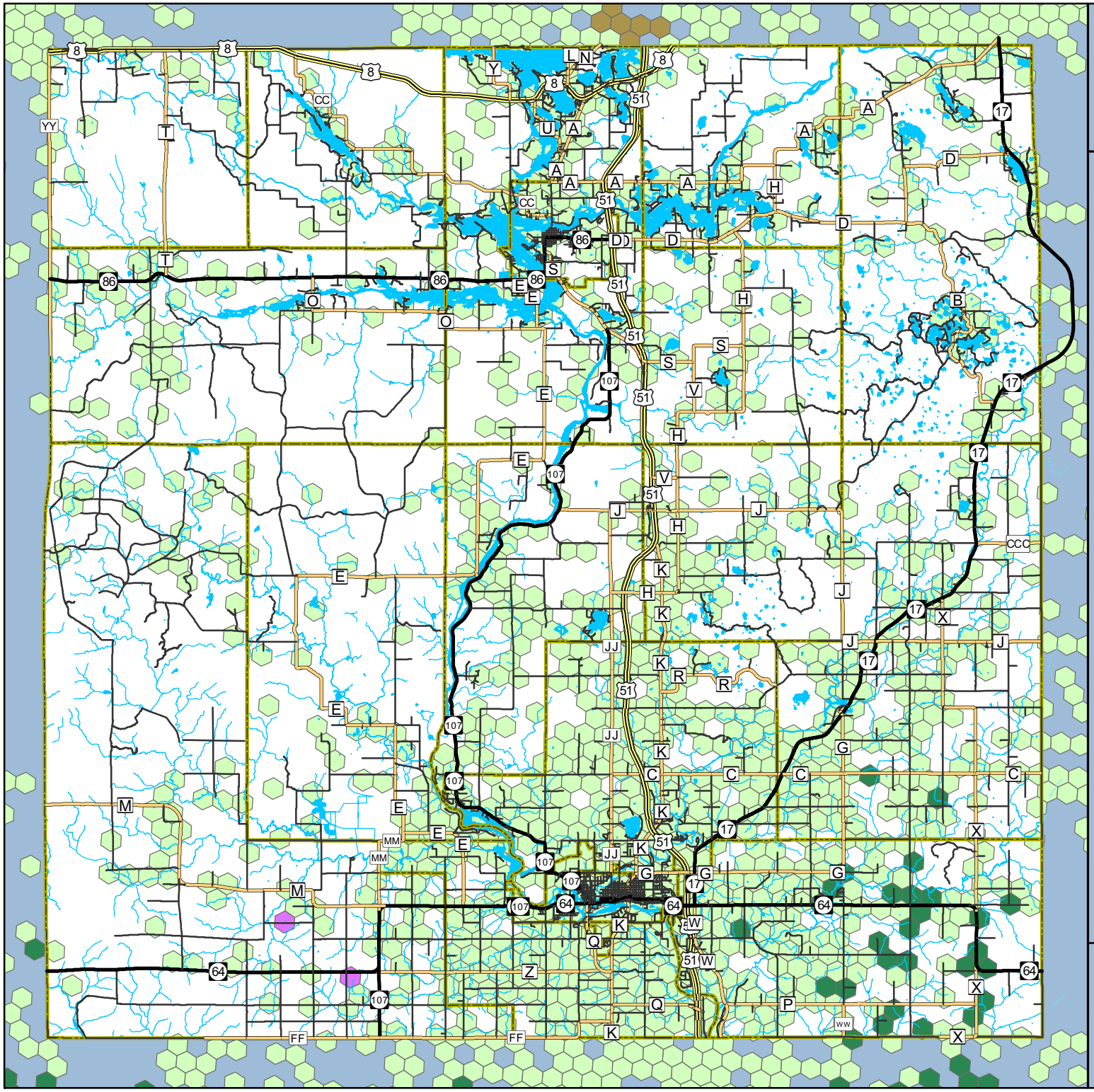


Map 5d **DRAFT**

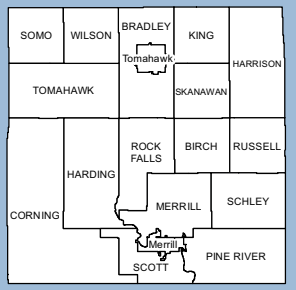
Broadband Availability Fixed Wireless

Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Provider

- Northwoods Connect
- T-Mobile US
- US Cellular
- Verizon



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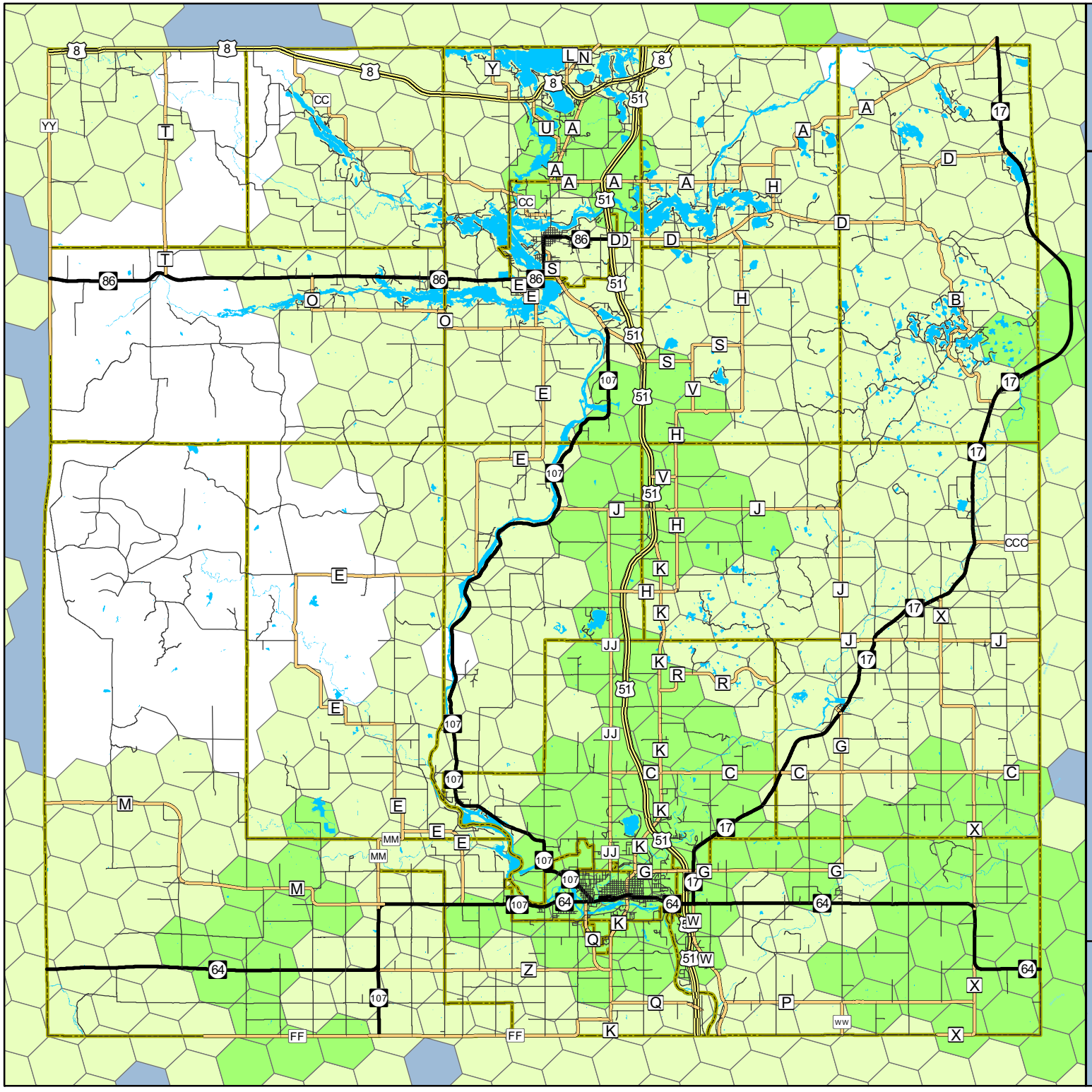
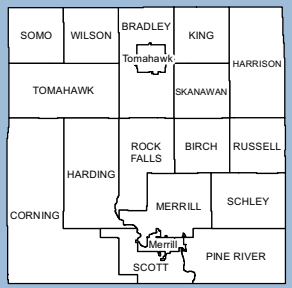


Map 5e **DRAFT**

Broadband Availability Mobile

Lincoln County, Wisconsin

- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water
- 5G Coverage
- 4G Coverage



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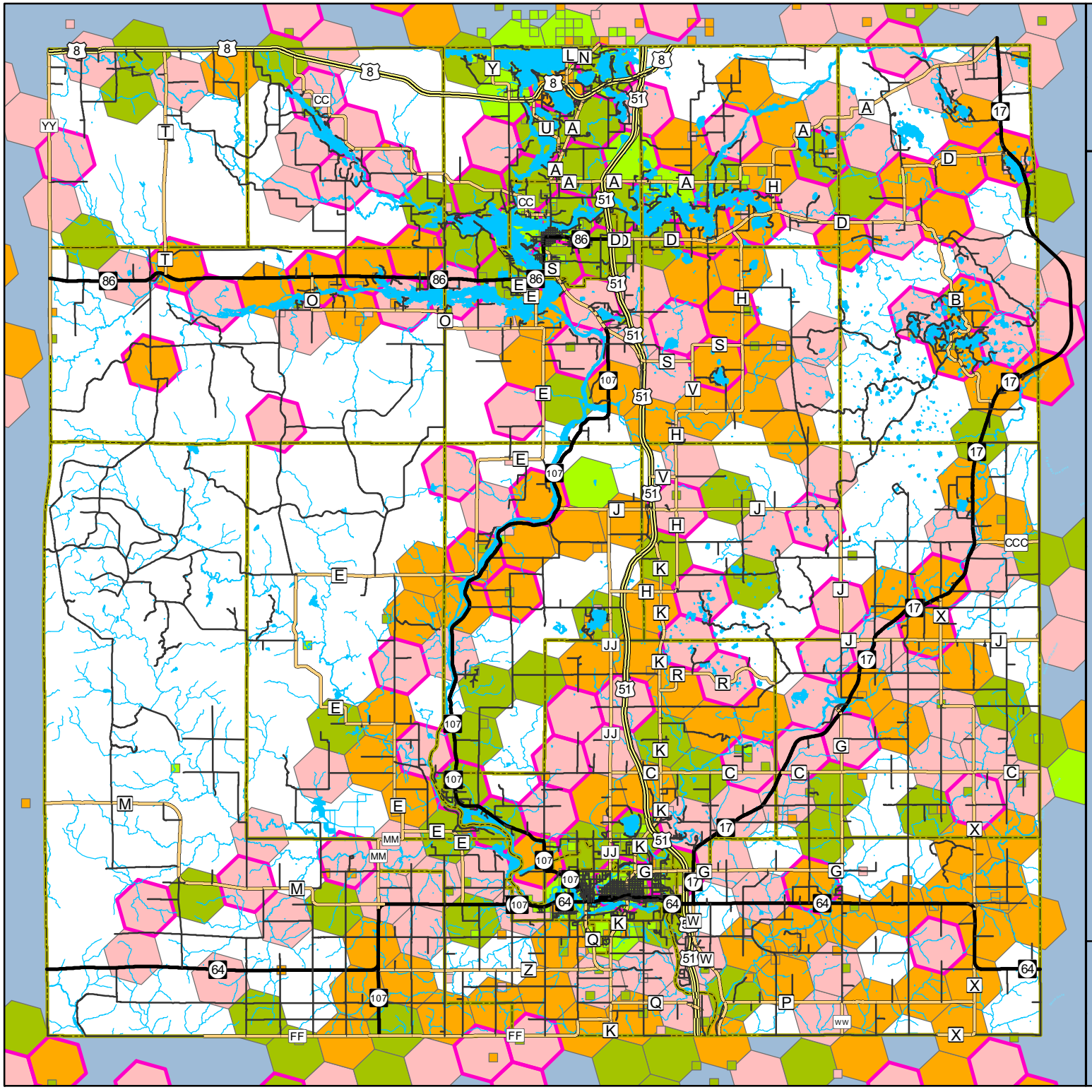


Map 6 **DRAFT**

Average Download Speeds

Lincoln County, Wisconsin

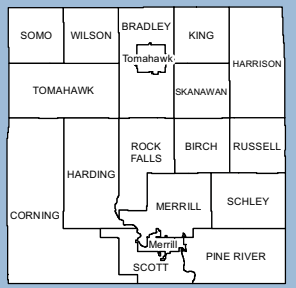
- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Download Speed

- < 10 Mbps
- 10 to 25 Mbps
- 25 to 100 Mbps
- > 100 Mbps
- Reported No Service

From wisconsinspeedtest.net - August 8, 2023
No service reported - Cost and or can not find a provider.

Small square test locations from Ookla speed test
Fixed wired only October 2022 - Open Data



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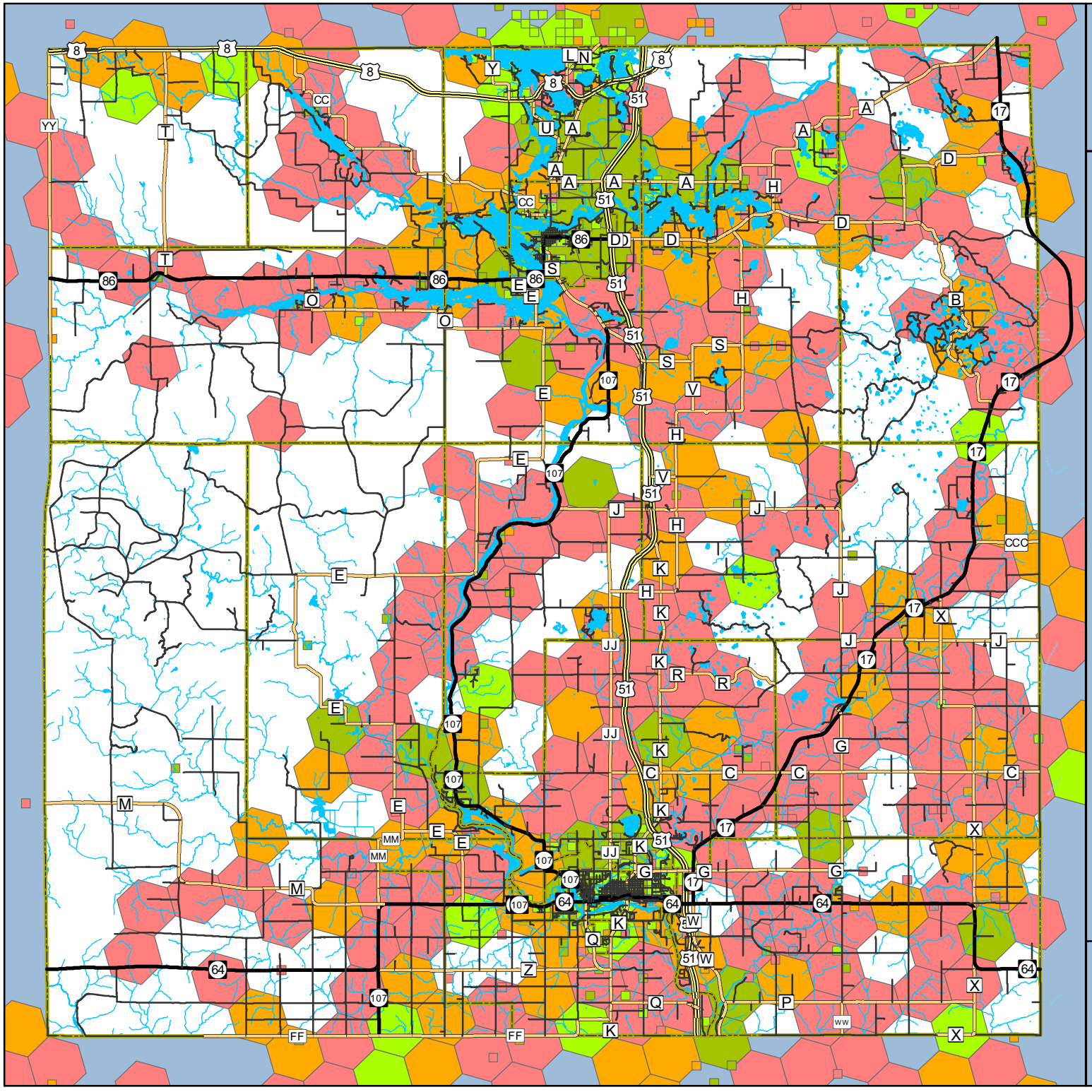


Map 7 **DRAFT**

Average Upload Speeds

Lincoln County, Wisconsin

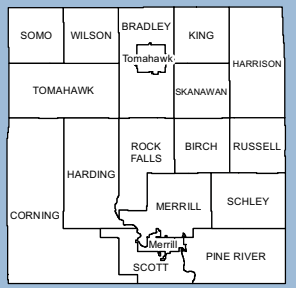
- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water

Upload Speed

- < 2 Mbbs
- 2 to 5 Mbbs
- 5 to 10 Mbps
- > 10 Mbps

From wisconsinspeedtest.net - August 8, 2023

Small square test locations from Ookla speed test
Fixed wired only October 2022 - Open Data



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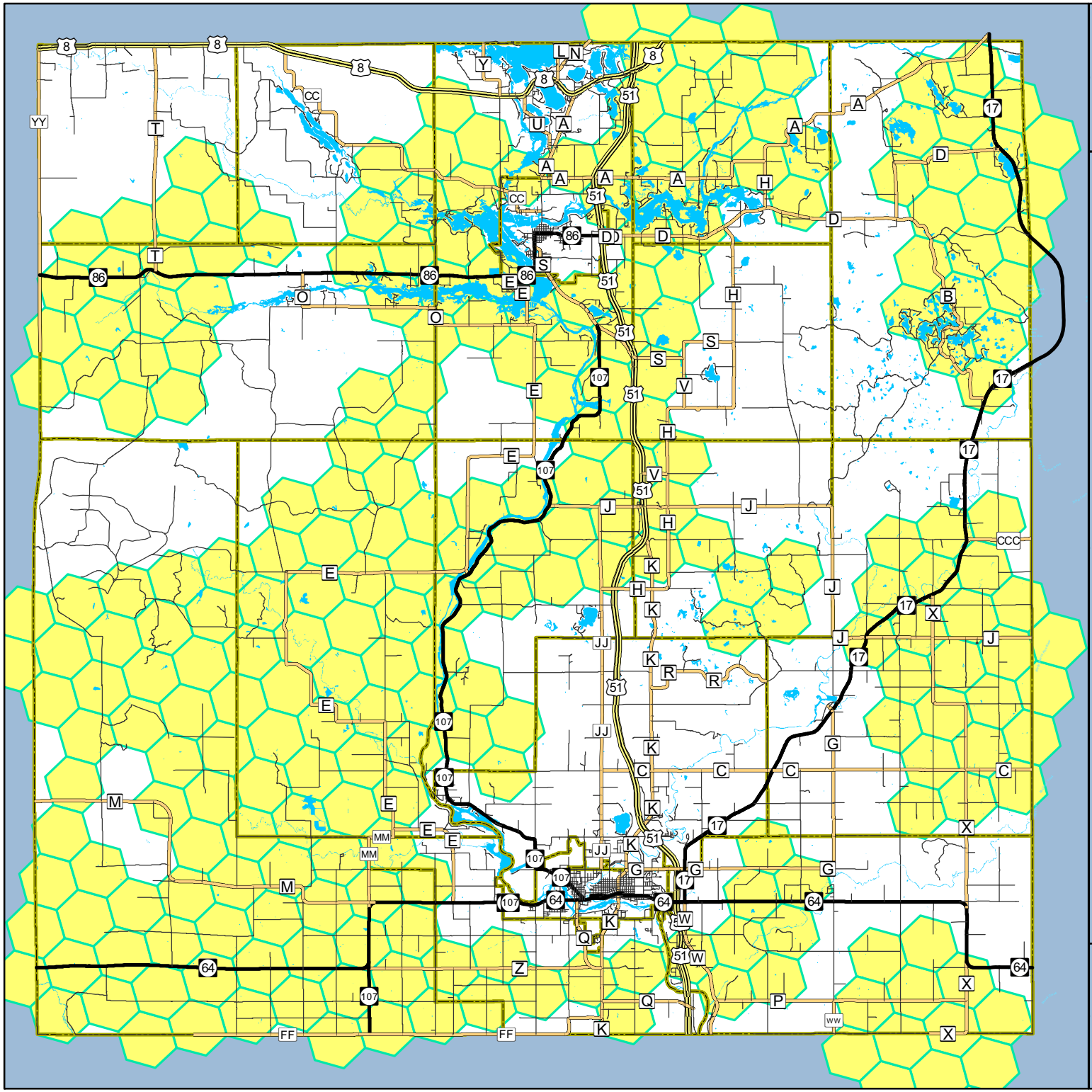
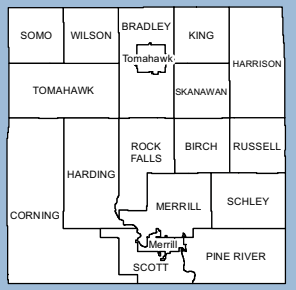
Map 8 **DRAFT**

Possible Project Areas

Lincoln County, Wisconsin



- Minor Civil Divisions
- U.S. Highway
- State Highway
- County Highway
- Local Road
- Water
- Possible Project Areas



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Lincoln

Recommendations

Contents

Key Factors

Lincoln county will require two distinct activities to deal with the broadband deficit. The first is what we call "completion of existing networks". The second is what we call "greenfield deployment. In the first case, we are looking at existing deployments from incumbent ISPs that have started to penetrate certain geographies, but have not completed covering these geographies. In particular we see that Charter has started deployments in and near Tomahawk city, Bradley town, Merrill city, and Scot town, and has proceeded somewhat into the surrounding rural areas around these communities. In these types of cases, emphasis should be given to getting the incumbent to complete their deployments in these areas since they already have infrastructure present in these areas.

In the case of greenfield, we are talking about adding adequate infrastructure where infrastructure is either inadequate or doesn't exist. These would essentially be areas which have no Charter presence.

If we look at the probably BEAD allocations for the county, we estimate on a pro-rata basis, the county should be able to receive about $12.5 million to expand broadband services. This # is about $30 million too small to cover 100% of the unserved/underserved households with fiber. However, a hybrid approach could dramatically improve the quality of service for about 92% of these households with about 1/3 fiber and 2/3 fixed wireless.

From a fixed wireless point of view the county is sufficiently flat and devoid of blocking forests that a fixed wireless only solution would cover about 86% of the households. However, the community should attempt to get as much fiber deployed as can be afforded.

For the fixed wireless, the most likely technology would be CBRS. If this were chosen, we have range limited this technology in our analysis to 3 miles to ensure that 100/20 performance can be met. In this regard possible a company to explore this option would be Country Wireless.

Our grant analysis indicates that the county does not have any special needs or high-cost opportunities under the BEAD program and would probably be treated as an “average” county during State allocation phases.

Subsidized construction

In this approach, the total project has a probable cost of, for example, $5 million. Unless the community would consider building and operating the network, it will likely be trying to work with an independent ISP. But even if This area is considering being the ISP itself, the business case analysis is similar.

An ISP may look at the total market value of the project and conclude that if it spends $5 million, it will have a negative Internal Rate of Return (IRR). It would lose money during a time frame of a few years, and will therefore look elsewhere to projects where it will create a better return. One possible approach here is to work with the ISP and discover how much the project needs to cost for it to find construction profitable. If for example, the ISP believes it could be sufficiently profitable at an investment of $4.5 million, then the community could identify a source for the additional $500,000 estimated cost of the network. This could be via public money (whether bond or other source) or securing a grant from another party. Once the community is committed to partner with the ISP, it could request to own some of the relevant infrastructure and lease it to the ISP in order to ensure the community has a return on its investment.

Some of the hybrid fiber and wireless models show a positive IRR, so they can be considered attractive to an ISP that is capable of working with both fiber and fixed wireless. A growing number of ISPs have this capability.

Phased Construction

In a phased construction approach, each completed phase generates cash for the next phase of deployment. In this model, either the ISP agrees to reinvest at a certain rate, or the community becomes the ISP. If the community becomes the ISP it almost certainly lacks key infrastructure that must be created or subcontracted out. Key among these are:

1. Field Service response. When things break, and they will, someone must go fix what is broken. The community could either train existing utility workers, or subcontract these services to a regional provider.

2. Customer Service response. Essentially, this is a call center function, the first line of problem reporting by the retail customer. The community must have the means of taking inbound calls, and either fixing problems over the phone or dispatching field service response. This can be developed in house if there is an existing call center capability, or subcontracted if there is not. Some have chosen to subcontract this in early years and then internalize it later.

3. Access and billing: Each authorized user on the network must be authenticated and enabled or not in order to access the services. This requires an access control server(s) in a data center which is centrally located internal to the ultimate network design. Further, authenticated users need to be billed for access. Again, the community could either purchase and manage this server and software, or subcontract this to a regional provider.

4. Network management response. Adverse weather, accidents, and core equipment failures will from time to time take down large portions of the network. Where hundreds or thousands of users are affected, this requires a 24/7 response team of network engineers who can be

dispatched and repair network problems. Again, existing utility workers could be trained to provide this response, or this could be subcontracted out.

The phased construction model works best if the community itself owns the infrastructure that is built. Owning the network does not necessarily require the community to operate it – much of it can be contracted out or provided via a partnership. This provides:

1. Access to municipal financing where the network itself becomes the collateral for the loan.

2. Access to the network revenues to manage the network ongoing expenses.

3. Access to "profits" to pay for network expansion. Over time the "profits" will increase which will accelerate deployments to other areas, in phases, which will in turn increase revenues. Once the network is complete, these "profits" can be used to pay off any outstanding debt, and subsidize other community projects.

4. Potentially otherwise uninterested municipal financing organizations can be "enticed" to participate if the community offers to share a portion of the "profits" to the financing organization in addition to or in place of the loan repayment costs.

The fastest strategy in phased construction is to start deployment with a fixed wireless network. While this will always be slower and less robust than a fiber network, for a minimal cost per household, large numbers of underserved users can be brought online rapidly. Unfortunately, RF propagation is often a hit or miss depending upon terrain and vegetation and nearby buildings, so it's reasonable to assume that in a cluster of housing units, some will have service, and some will not. However, the deployment costs and timeframe can be relatively low compared to fiber deployments and will throw off reinvestment

dollars much faster than any other approach. Once the fixed wireless deployment is stable and positive cash flow, that cash can be used to even out the network either through more fixed wireless deployments or fiber to the home deployments. One additional challenge is that the wireless service may not be as competitive in areas that have cable modem Internet access, potentially both in practice and in marketing materials focused on “up to” speeds.

Alternatively, This area can start with a fiber project in addition to a fixed wireless effort. The fiber project could begin with a more limited budget and build first to the area of the city with the highest demand or to the area with the lowest cost of construction. There are additional ways to finance the network by taking advantage of community members that are the most enthusiastic in the same way water systems have often been financed via assessment districts. This is discussed more significantly in the Guidance and References section.

If the ultimate goal is 100% fiber, as a fiber construction is completed for a specific area, the fixed wireless hardware can be repurposed to cover additional areas to expand the revenue stream to expand the network.

Dealing with ISPs and Bids for Deployment

While we do not claim that our software and analysis methods are 100% accurate, we are extremely confident that we have provided an accurate picture of your potential broadband deployment based on the data that we have, and the analysis we have done.

Our recommendation is to share the information that we have provided in a prospective bid situation, whether it is an advanced design study, or actual project procurement. Based on our experience, including regional providers in your region, we are confident, that the methodology of our approach has given you the best currently available information at the lowest possible cost. Our experience is that what we have provided for you is consistent with the best practices modeling of top tier companies including Samsung, Sprint, Microsoft, Windstream, and many others.

If you move forward with your project, we urge you to share what we have provided to you with your prospective vendors, your team, and residents in your community.

Our combined goal is to provide broadband to everyone. All who are critical of our methods are extremely welcome to critique. We can only improve our quality of service from discovering errors, omissions or criticism of any kind. We urge you to provide this information to all future project participants, and we believe and hope, we have provided them, and you, with the value that we promised.

Next Steps

Our goal is to quickly offer basic guidance and estimates for the costs of various investments to improve Internet access. As you move forward, we suggest additional next steps:

- *Education* – The most successful projects have occurred in areas where local leaders took it upon themselves to deeply understand the opportunities and challenges of improving Internet access. Consulting outside experts should be a part of the process, but every project needs a champion or small team that will become a local expert and take responsibility for vetting options. Education can take many forms, including visiting nearby communities that have solved this problem to meet with the relevant decision-makers. There are a variety of conferences from local regional events to national events where an individual or small group can quickly get up to speed on these discussions and develop a network of others working on similar projects. Ultimately, this should culminate in a vision – an articulated document of what the goals are for any project along these lines. We recommend a tripod of educated support that includes some elected officials, some municipal staff, and representatives of local businesses and residents. Each of these groups should be represented in the process to improve the odds of success.

  The Institute for Local Self-Reliance runs MuniNetworks.org – a news source tracking local government policies to improve Internet access as well as the role of cooperatives in rural areas. It has a newsletter and weekly podcast among other resources.

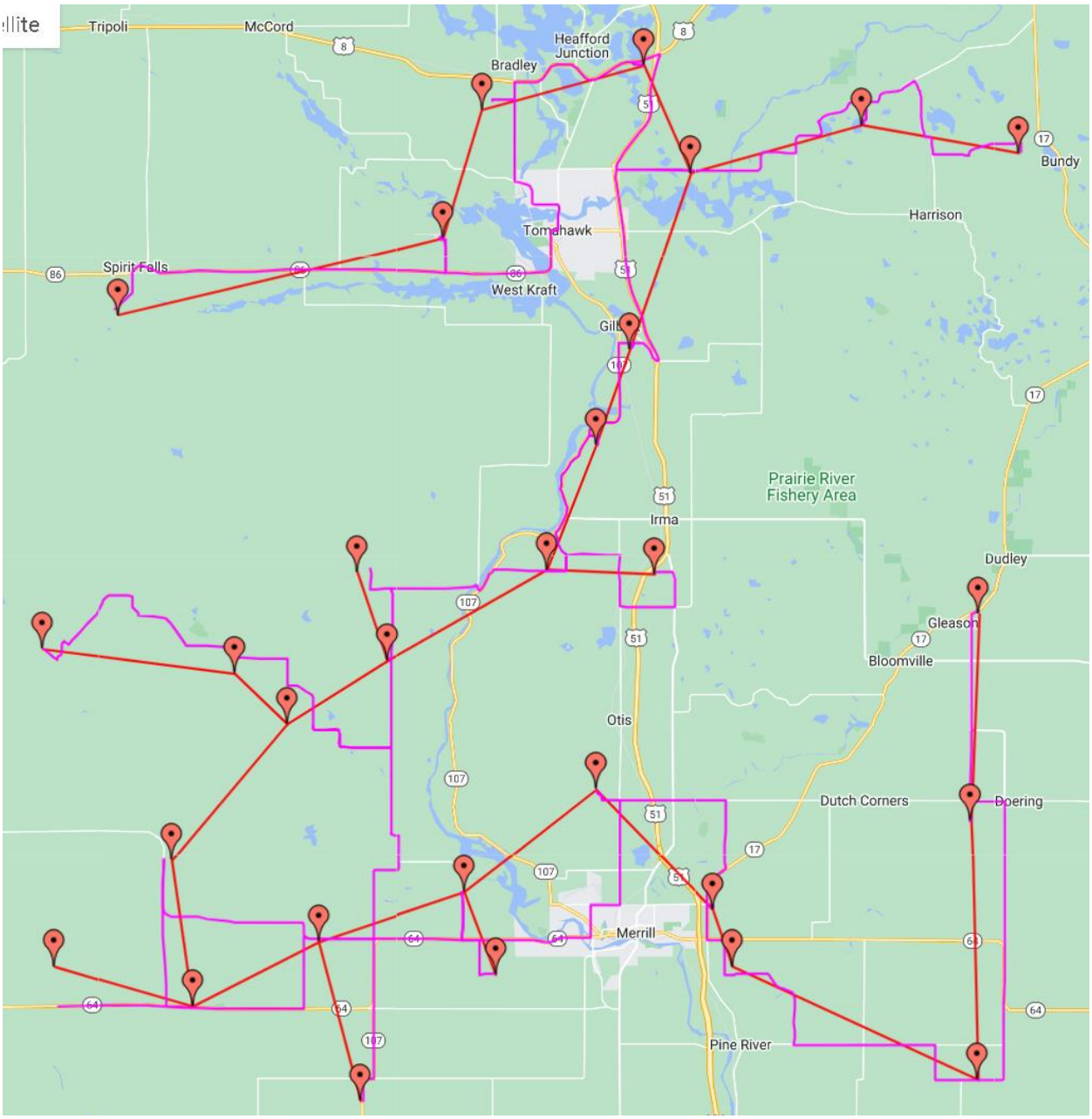
  We encourage you to join Next Century Cities, an organization created specifically to help communities in the situation you are in. There is no

cost to join – more details here. Next Century Cities has compiled a very useful toolkit, called Becoming Broadband Ready.

- *Consultants* – As you move forward, you may want to consider a feasibility study or simply some expert hand-holding. Our goal has been to prepare you to have good questions and more information before you engage a consultant. Consultants will be helpful in collecting more information based on your goals and potential models, including issuing an RFP or RFI to gauge the interest of local ISPs in any form of partnership.

- *Survey* – Many consultants will offer a survey to better understand local interest in better Internet access. Are people and businesses frustrated with their current level of service? If so, is it due to speed, prices, customer service, reliability, etc.? Are people excited at the prospect of the favored solution or solutions being contemplated? Do you have a sense of how many people will really sign up for a new service?

- *Public Meetings* – A consultant can also help regarding public meetings to discuss potential investments and gather public feedback. Here again, ILSR or Next Century Cities may also be able supply a speaker to discuss the trade-offs of different approaches and what other communities have seen from their approaches. These meetings frequently give an opportunity for incumbent telephone and cable companies to oppose a contemplated investment, sometimes via proxy people or groups that may make dramatic claims to scare the public and generate opposition. As such, it is best for these meetings to happen after some significant internal education and planning.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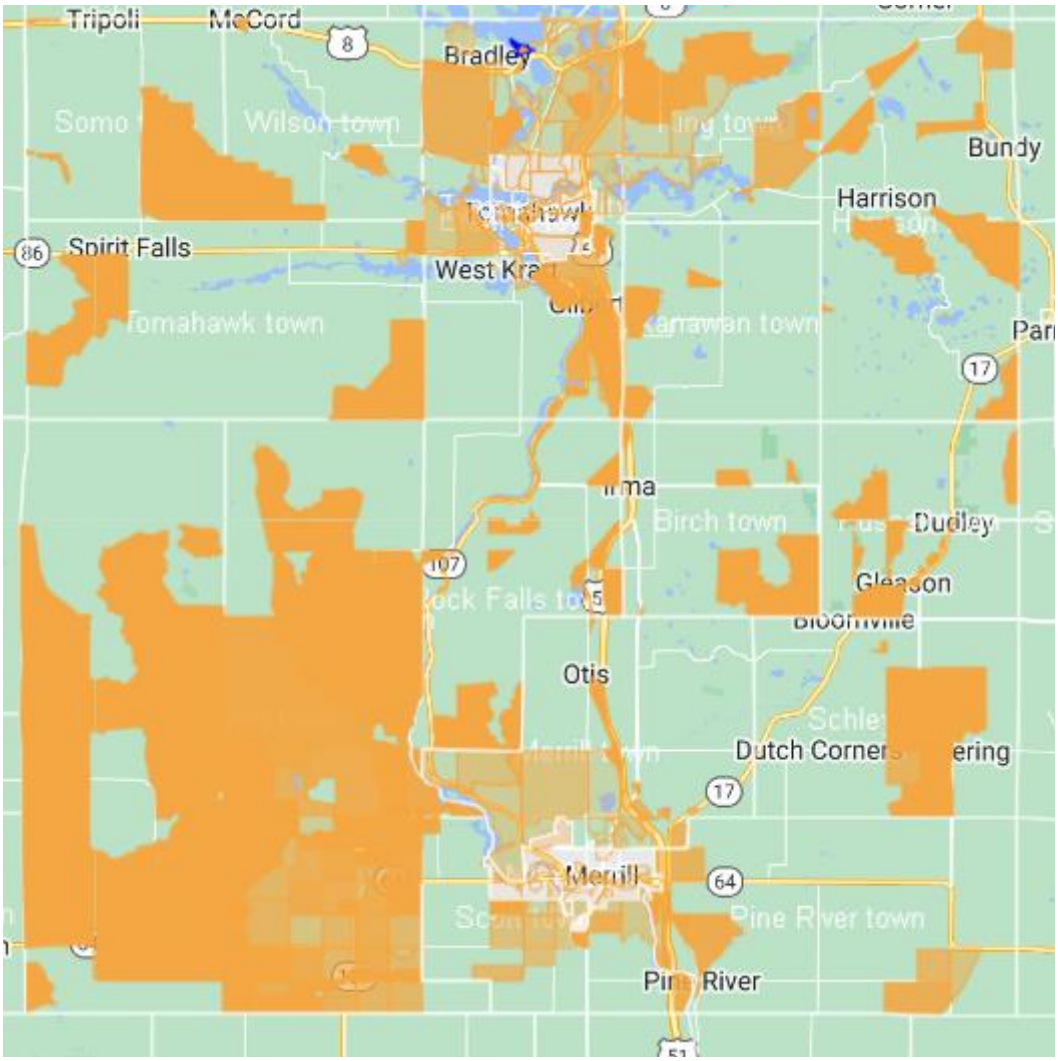
Tripoli
McCord
Heafford Junction
Bradley
Bundy
Harrison
Tomahawk
Spirit Falls
West Kraft
Prairie River Fishery Area
Irma
Dudley
Gleason
Bloomville
Otis
Dutch Corners
Doering
Merrill
Pine River


Tripoli
McCord
8
Bradley
Somo
Wilson town
Bundy
Harrison
86
Spirit Falls
West Kra
Tomahawk town
17
Irma
Birch town
Dudley
107
Gleason
Otis
Dutch Corner
17
Merrill
64
Pine River town
Pine River

WI LINCOLN WI
BROADBAND INTERNET ACCESS PROJECT
Shaded cells accept inputs

TABLE OF CONTENTS **Page**

WI LINCOLN WI
BROADBAND INTERNET ACCESS PROJECT
SYSTEM OPERATING DESIGN & FINANCING OPTIONS

WHY A LOCAL SOLUTION?

In many industries, market competition ensures good outcomes. Unfortunately, investor-owned cable and internet networks are, and will remain, largely uncompetitive since wired telecommunications networks are a natural monopoly - they have very high upfront capital costs and declining marginal costs. This makes robust competition all but impossible.

State and federal government will not solve the problem

- The Federal government has offered billions of dollars to incumbents like CenturyLink and AT&T with little infrastructure improvement. Despite this funding, in many places, speeds still do not meet the FCC definition of broadband - 25 megabits per second download speed; 3 Mbps upload.
- State government is often too focused on the interests of Big Telecom, protecting large, absentee service providers and taking control from communities.

Why Broadband?

- Faster speeds
- Affordable service
- Reliable performance
- Universal access
- Scalable networks
- Economic development

Large telecom companies refuse to invest in rural areas

- Many ISPs use outdated technology like DSL that does not meet current service demands. These companies do not upgrade infrastructure because they do not have competitors.
- Mobile wireless connections are insufficient for long-term use due to bandwidth caps. Fiber optics are future-proof and affordable with a local business plan.

Local leaders can best resolve local issues

- You know what is best for your community.
- Local leaders can improve internet access in a multitude of ways: 1) institutional networks connect businesses, schools, libraries, governments, and hospitals; 2) municipal fiber networks come in many models as described below. For example, open-access networks allow multiple ISPs to operate on publicly-owned infrastructure, creating competition to improve speeds and lower prices; 3) co-ops are non-profit entities that may already provide utilities like telephone service and electricity; and 4) carrier neutral locations promote collaboration between ISPs by acting as a major connection point. CNLs create savings by lowering infrastructure costs.

TYPES OF MUNICIPAL BROADBAND OPERATING MODELS

Community broadband network operations may be structured in a variety of ways, each with its own strengths and weaknesses. Below are some common approaches, any of which may be tweaked to fit the needs of your particular community.

Full Retail - The municipality offers services directly to the public just like a private company. Most, but not all, of the communities that have used this model already had a municipal electric utility in place. Examples include Chattanooga TN, Wilson NC, Lafayette LA, and Sandy OR.

Dark Fiber - The municipality installs the broadband network and makes it available for lease to ISPs or for future municipal use. This option is generally pursued in a limited area such as a business district, but some communities have used it throughout their jurisdiction. See Stockholm Sweden, Huntsville AL, Rockport ME, and Lincoln NE.

Open Access - The municipality builds and maintains the network infrastructure, making it available to multiple ISPs that compete for subscribers. Examples include UTOPIA in UT, NoaNet in WA, and Ammon ID.

NETWORK FINANCING STRATEGIES

Over 400 local governments across the U.S. offer internet access to local businesses or residents, often in reaction to a lack of fast, affordable, and reliable connections in their community from investor-owned providers. Though private service providers may get away with regular price hikes and cross-border subsidies, elected officials are accountable to citizens and reluctant to raise taxes, consequently most municipal networks have not been financed with tax dollars, rather they have used one or a combination of the three methods below.

Revenue Bonds - A municipality issues bonds to, or leases assets from, private investors and the obligations are then repaid with revenues from the network. Municipal credit quality is quite high - less than 2% of municipal networks have defaulted - but municipal finance rules vary by location. For example, in Minnesota, if network service fees cover at least 75% of the annual debt service, bonds may be issued as general obligations without the need for a bond election. Examples include Lafayette LA, Cedar Falls IA, and Longmont CO.

Internal Loans - One department within the municipality lends another the necessary capital for building the network. Many states regulate the minimum interest rate and other requirements for such a loan. Examples include Chattanooga TN, Spanish Fork UT, and Auburn IN.

Avoided Cost - Funding used to lease connections from existing providers is re-directed towards building and operating a municipal network, often resulting in faster connections at lower prices. If payback is longer than one year, bonds may be issued and repaid with the leased lines budget. This approach is most common with smaller networks built incrementally. Examples include Santa Monica CA and Scott County MN.

WI LINCOLN WI
BROADBAND INTERNET ACCESS PROJECT
SYSTEM DESIGN & IMPLEMENTATION PROCESS FLOWS
Shaded cells accept inputs

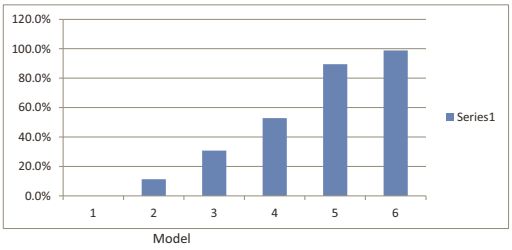
last update 10/27/23 12:25 PM

	Time required			Step completion dates		
				Start date		01/01/19
	Short	Average	Long	Short	Average	Long
1 - NewMark markets its services to potential broadband network hosts, each, a "Municipality"						
2 - If there is interest, the Municipality engages NewMark and pays a project design fee	0 dys	15 dys	30 dys	01/01/19	01/16/19	01/31/19
3 - Municipality holds meetings to spec out installation and financing options; make GO/NO GO decision	30 dys	60 dys	90 dys	01/31/19	03/17/19	05/01/19
4 - If GO, bonding partner finalizes project design & engineering and on behalf of Municipality and depending upon system design, state legal requirements, and expected project costs, requests bids or proposals from prospective financing sources (each, a "FIN"), network installation contractors (each, a "NIC"), and internet service providers (each, an "ISP")	90 dys	90 dys	90 dys	05/01/19	06/15/19	07/30/19
FINs / NICs / ISPs						
5 - Municipality selects Service Providers and lets contracts	7 dys	7 dys	7 dys	05/08/19	06/22/19	08/06/19
6a - Project site acquisition & permitting (Processes overseen by bonding partner on behalf of Municipality)	30 dys	60 dys	90 dys	06/07/19	08/21/19	11/04/19
6b - System construction begins	329 dys	365 dys	402 dys			
Total time elapsed	**486 dys**	**597 dys**	**709 dys**			
Project operations begin				**04/30/20**	**08/20/20**	**12/09/20**
7 - Municipality selects infrastructure maintenance contractor						

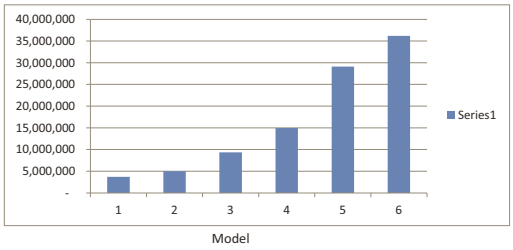
NOTE
Procurement structure and process, financing activity, and contracts must comply with laws with respect to acquisition of goods and services with public money

Summary Charts

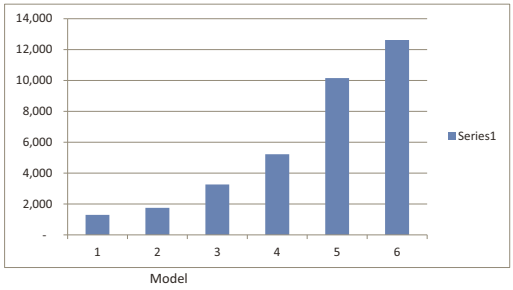
Percent Fiber



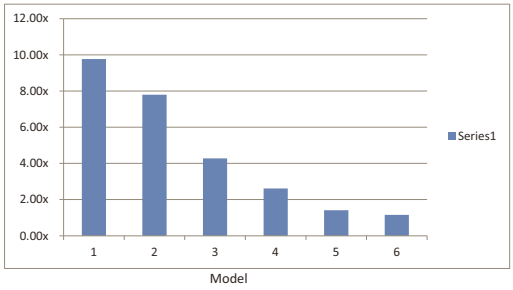
Fiber Cost



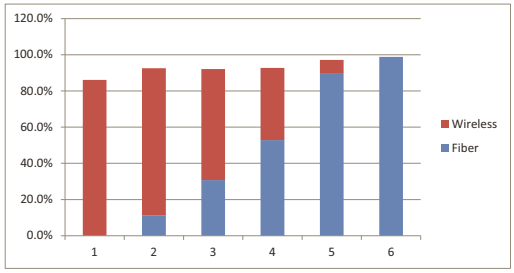
cost/household



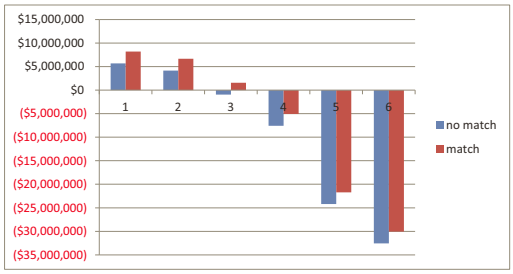
Debt Service



Coverage



Delta of BEAD



WI LINCOLN WI
BROADBAND INTERNET ACCESS PROJECT
SYSTEM DESIGN & COST ALTERNATIVES
Shaded cells accept inputs

last update 10/27/23 12:30 PM

Area	Municipality	State
Name	WI Lincoln	WI
Total population		3,373
Total households		2,867
Total square miles		303
Green system design		**C3**
Cost/household		$3,843
Cost/Covered household		$4,170
Coverage %		92.2%
Fully Burdened Cost		$11,016,500

Installed capital costs	Cost/unit	Percent
Aerial fiber ($/mile)	$65,750	90%
Trenched fiber ($/mile)	$75,000	10%
bored ($/mile)		0%
80 ft tower ($/tower)	35,000	100%
Fiber connection($/user)	1,250	
NAP per each	3,000	
FDH per each	60,000	
fixed CPE	250	
wireless CPE	650	4 sectors/tower
base backhaul	110,000	$12,500.00 cost/sector

Depreciation	% of cost	Period
Fiber cable	95%	30 yrs
Fiber equipment	5%	5 yrs
Tower poles	5%	30 yrs
Tower equipment	95%	5 yrs
Capitalized interest	100%	20 yrs
Capitalized project costs	100%	20 yrs

Least fiber, most wireless ←←←←← ***Broadband technology spectrum*** →→→→→ ***Most fiber, least wireless***

System Name	**A1**	**B2**	**C3**	**D4**	**E5**	**F6**
System Design & Construction						
Max FTTP (ft)	-	600	**1,000**	1,500	3,000	10,000
Future-proof rating (note 1)	-	11	**31**	53	89	99
Fiber households (#)	-	323	**881**	1,516	2,565	2,835
NAP		33	**89**	152	257	284
FDH		1	**3**	5	8	9
Wireless households (#)	2,867	2,544	**1,986**	1,351	302	32
Covered households (#)	2,470	2,331	**1,761**	1,144	221	-
Coverage fiber (miles)	-	15	**72**	154	363	489
Backhaul fiber (miles)						
Total fiber (miles)	-	15	**72**	154	363	489
Total towers (#)	29	29	**29**	25	17	-
Fiber coverage rate	0.0%	11.3%	**30.7%**	52.9%	89.5%	98.9%
Wireless coverage rate	86.2%	81.3%	**61.4%**	39.9%	7.7%	0.0%
Combined coverage rate	86.2%	92.6%	**92.2%**	92.8%	97.2%	98.9%
Uncovered households (#)	397	213	**225**	207	81	32
Capital Costs & Depreciation						
Fiber cost ($)	-	1,191,000	**5,374,000**	11,168,000	25,728,000	34,322,000
Tower cost with CPEs($)	3,594,000	3,500,000	**3,336,000**	2,771,000	1,704,000	10,000
Connection Costs ($)	-	181,688	**495,563**	852,750	1,442,813	1,594,688
Capitalized interest ($)	14,000	21,000	**39,000**	62,000	121,000	151,000
System cost ($)	3,718,000	5,003,688	**9,354,563**	14,963,750	29,105,813	36,187,688
Cost/covered household ($)	1,297	1,745	**3,263**	5,219	10,152	12,622
Annual depreciation expense ($)	156,917	741,058	**901,617**	1,057,692	1,517,550	1,579,900
Wtd avg depreciation period	6.33 yrs	7.28 yrs	**11.18 yrs**	15.25 yrs	20.67 yrs	24.68 yrs
Comparison						
Key Constants (2)						
Residential subscription rate	0	45.0%	**45.0%**	45.0%	45.0%	45.0%
Residential broadband service	50.00	50.00	**50.00**	50.00	50.00	50.00
Residential network access fee	12.50	12.50	**12.50**	12.50	12.50	12.50
Total residential service price ($/mo/sub)	62.50	62.50	**62.50**	62.50	62.50	62.50
ISP network access fee	27.50	27.50	**27.50**	27.50	27.50	27.50
Key Results						
Municipality						
Avg debt service coverage, yrs 1 to 5	9.77x	7.80x	**4.28x**	2.61x	1.41x	1.15x
Avg debt service coverage, yrs 6 to 20	10.87x	8.67x	**4.76x**	2.91x	1.57x	1.28x
Monthly debt service/household ($)	2.22	2.98	**5.46**	8.92	17.35	21.57
Internet Service Providers						
5 yr internal rate of return	154.85%	111.40%	111.43%	111.37%	111.70%	111.84%

Notes
1 - Future-proof rating ranges from 0 to 100 and indicates estimated percentage of system not subject to likely technological obsolescence within 5 years.
2 - Assumes no growth from year 0 base.

BROADBAND BASICS

KEY DEFINITIONS

- ***Bits*** are the base unit of information in computing and data transfer speeds are usually measured in ***bits per second*** or ***bps***:
  - o 1 kbps = 1 thousand bps; dial-up connections are 56 kbps;
  - o 1 megabit per second (Mbps) = 1 million bps; about 30 seconds to download an MP3 song;
  - o 1 gigabit per second (Gbps) = 1 billion bps; about 10 seconds to download an HD movie.
- ***Bytes*** are the base unit for file size and used in computing monthly caps.
- ***Broadband***, as defined by the Federal Communications Commission (FCC), is a minimum download and upload speed of 25 Mbps and 3 Mbps, respectively; many uses require faster speeds.
- ***Download*** (aka "down") and ***upload*** (aka "up") are the speeds at which a computer receives and sends data, respectively.
- ***Symmetric*** connections have the same down and up speeds. DSL and cable often have upload speeds 5 to 10 times slower than down. Businesses increasingly need symmetric connections to maximize productivity.

BROADBAND TECHNOLOGIES

- ***DSL***, or digital subscriber line, uses copper telephone wires to deliver access to the internet. Common DSL download speeds are 0.5 to 6 Mbps, though they can get up to 40 Mbps for people living very close to the equipment that generates the signal. Upload speeds are often below 1.5 Mbps and rarely exceed 4 Mbps.
- ***Cable*** uses a coaxial cable TV network to deliver services. Standard speeds vary from 6 to 30 Mbps down and 1 to 3 Mbps up but some companies offer 100 Mbps down and 10 Mbps up for a hefty premium. Cable networks are shared, meaning you may not achieve advertised speeds during periods of peak usage due to congestion from your neighbors.
- ***Fiber Optics*** uses LED lasers to shoot pulses of light along very thin strands of glass. Fiber is the gold standard among broadband networks due to its speed (up to 1 Gbps down and up), longevity, reliability, resiliency, and nearly unlimited expansion capability. Capacity can be increased by upgrading the lasers on each end without laying new fiber. The comparatively high cost of a new network is mostly installation; operating costs are lower than for cable, DSL, or wireless networks.
- ***Satellite*** internet service is wireless but expensive and suffers from technical limitations; most people do not subscribe to this service if a DSL or cable option is available. Cell phones do not use satellites; the signal travels from your phone to an antenna on a tower within a few miles of your location.
- ***Wireless*** is the technology that today most resembles magic. We want to be mobile, not tethered. Our desires notwithstanding, the future of telecommunications is more complicated than simply removing wires. Consider your home network. You likely use a Wi-Fi router to share a DSL or cable wired connection to your home. Even as wireless devices become increasingly common, most homes will still have a wired connection, ideally using fiber optics, as there is no single "wireless" technology. There are many different standards, speeds, and issues – for example, your phone may support 4G LTE, Wi-Fi, and Bluetooth – each with unique capacities and limitations.
  - o ***Spectrum*** is the range of electromagnetic waves with frequencies from below 1 to above 1025 hertz (cycles per second) corresponding to wavelengths (the distance over which a wave's shape repeats) from thousands of kilometers down to a fraction of the size of an atomic nucleus. In the U.S., the FCC regulates how the spectrum may be used and by whom.
    - ***Licensed spectrum*** are ranges of wavelengths that may only be used by those holding licenses from the FCC and include 3G, 4G, LTE, WiMax, and others.
      - ☐ ***3G*** and ***4G*** (the "G" is short for generation) are forms of cellular network, which may mean different things to different providers.
      - ☐ ***LTE*** abbreviates long term evolution and is a 4G wireless standard used by most cell phone companies to deliver wireless services, most often to mobile phones.
    - ***Unlicensed spectrum*** are ranges of wavelengths that anyone may use, often with power limits. Includes microwaves, garage door openers, Wi-Fi, cordless phones, and others.
      - ☐ ***Wi-Fi*** is sometimes confused with wireless but is a specific set of shared wireless protocols commonly used by computers and mobile devices. Wi-Fi networks are often faster than the underlying internet connection, peaking at 54 Mbps or more compared to 5 or 10 Mbps for the internet connection.
      - ☐ ***Bluetooth*** is a wireless standard for exchanging data between devices over short distances, up to 33 to 330 feet, using radio waves in the band from 2.400 to 2.485 GHz.

APPLICATIONS & BANDWIDTH CONSUMPTION

Application	Data rate required (1)
Personal communications, instant messengers	300 bps to 9.6 kbps
Remote control programs	9.6 kbps to 56 kbps
Streaming radio; phone calls (VoIP)	< 0.5 Mbps
E-mail; web browsing: job searching, navigating government websites	0.5 Mbps
Database query	Up to 1 Mbps
Game console connecting to the internet; basic video conferencing; web browsing: interactive pages and short educational videos	1 Mbps
Skype HD video call with 2 people	1.5 Mbps symmetrical
Download a 1 MB book in 2.7 seconds, a 4 MB song in 10.7 seconds, or a 6.144 GB movie in 4 hours and 33 minutes	1.5 to 3 Mbps
Digital audio	1 to 2 Mbps
Access images	1 to 8 Mbps
Skype group video-with 3 people	2 Mbps down/512 kbps up
Compressed video	2 to 10 Mbps
HD video streaming; HD video conferencing; tele-learning; two-way online gaming in HD	4 Mbps
Skype group video with 5 people	4 Mbps down/512 kbps up
Netflix recommended download speed for HD	5 Mbps
Skype group video with 7 or more people	8 Mbps down/512 kbps up
Tele-commuting (high quality video)	10 to 100 Mbps
Netflix recommended download speed for Ultra	25 Mbps
Medical transmissions - at 50Mbps, a digital chest film takes 3 seconds, an MRI takes 30.5 seconds, and an echocardiogram study takes	Up to 50 Mbps
Download a 1 MB book in 0.1 seconds, a 4 MB song in 0.3 seconds, or a 6.144 GB movie in 8 minutes	50 to 100 Mbps

1 - Many households use multiple devices simultaneously, thereby driving up bandwidth consumption. According to a 2017 forecast by Cisco, by 2021 in North America, there will be 13 networked devices and connections per person, up from 8 in 2016.

KEY POINTS ABOUT NETWORKS

- ***Wired and wireless networks complement each other; one is not a substitute for the other*** The explosion of wireless demand requires high capacity fiber optic connections between antenna sites.
- ***Wireless networks need wires.*** When a cell phone connects to a tower, the signal travels via wires to a processing hub, then again to another antenna to connect wirelessly to the call recipient. Objects such as trees, hills, and buildings can degrade signals and congestion may result when too many devices try to share the same antenna. This can be resolved by deploying more antennas with fiber connections.
- ***Fixed wireless*** connects two permanent locations such as a house and tower. Directional antennas allow higher power and faster speeds than for mobile applications.
- ***Data caps***, although not a technical limitation, may be imposed by wireless internet providers, limit the amount of data used, and discourage the use of applications such as streaming video. They are a reason that wireless is not replacing wired connections as exceeding them results in overages or interruptions in service and make for an expensive solution for the regular transfer of lots of data. Providers justify caps as a way of managing congestion, but consumer advocates posit that the real motivation is maximizing revenue - an analogy is managing traffic jams by limiting how many miles one can drive per month

REGIONAL INTERNET SERVICE PROVIDERS

*** Indicates known Internet Service Provider in Lincoln County**

Provider	Website	Phone	Mailing Address
Airnet	netpros-inc.net	715-241-0200	117 S. 17th Avenue Suite B Wausau, WI 54401
AirRunner Networks*	www.airrun.net	715.443.3700	216 Main St #3, Marathon City, WI 54448
Amherst Telephone Company	amherstcomm.net	715.842.5529	120 Mill St, Amherst, WI 54406
Astrea	astreaconnect.com	800.236.8434	105 Kent St, Iron Mountain, MI 49801
AT&T*	www.att.com	210.821.4105	208 S. Akard Street, Suite 2954, Dallas, Texas 75202.
Bertram Internet	gobertram.com	920.351.1023	300 Industrial Dr, Random Lake, WI 53075
Brightspeed	www.brightspeed.com	833.692.7773	1120 S Tryon St, Charlotte, NC 28203
Bug Tussel Wireless LLC	btussel.com	877.227.0924	417 Pine St, Green Bay, WI 54301
Cellcom*	www.cellcom.com	920-339-4000	1580 Mid Valley Drive, De Pere, WI 54115
CenturyLink*	www.centurylink.com	877.862.9343	100 CenturyLink Dr. Monroe, LA 71203
Charter Communications Inc (Spectrum)*	www.spectrum.com	855.860.9068	5720 Bandel Rd NW, Rochester, MN 55901
Cirrinity (Wittenberg Telephone Company)	cirrinity.net	715.253.2111	104 W Walker St, Wittenberg, WI 54499
Community Antenna System Inc	comantenna.com	888.394.4772	1010 Lake Street Hillsboro, WI 54634
Country Wireless*	countrywireless.com	715.389.8584	205 W Willow Dr, Spencer, WI 54479
Ethoplex	www.ethoplex.com	262-252-9000	N115 W19150 Edison Drive, Germantown, WI 53022
Frontier*	frontier.com	844.817.0206	401 Merritt 7, Norwalk, CT 06851
HughesNet*	www.hughesnet.com	844.7.37.2400	11717 Exploration Lane, Germantown, MD 20876
LTD Broadband	ltdbroadband.com	507.369.6669	PO Box 3064, Blooming Prairie, MN 55917

Lumen	www.lumen.com	877.753.8353	3340 Peachtree Road NE Suite 200 Atlanta, GA 30326
Marquette-Adams Telephone Cooperative	www.marquetteadams.com	608-586-4111	113 N, 113 S Oxford St, Oxford, WI 53952
Mediacom Wisconsin LLC	mediacomcable.com	844.987.3260	100 N Marquette Rd Suite 116, Prairie du Chien, WI 53821
Norvado	norvado.com	800.250.8927	105 N Avon Ave, Phillips, WI 54555
Nsight	www.nsighttel.com	920.865.7000	122 S St Augustine St, Pulaski, WI 54162
Reach	reachconnects.com	715.298.4414	1710 Garfield Ave, Wausau, WI 54401
Solarus	www.solarus.net	715.421.8111	440 E Grand Ave, Wisconsin Rapids, WI 54494
SonicNet Inc.	www.sonicnet.us	715.301.0600	103 N Railroad St, Eagle River, WI 54521
Starlink*	www.starlink.com	888.479.9644	500 Center Ridge Dr Austin, TX 78753
TDS Telecom	tdstelecom.com	855.220.2592	525 Junction Road Madison, WI 53717
T-Mobile US*	www.t-mobile.com	844.249.6310	12920 Se 38th St., Bellevue, WA, 98006
Union Telephone Company	uniontel.net	715.335.6301	W North St, Plainfield, WI 54966
US Cellular Corporation	www.uscellular.com	800.819.9373	8410 W Bryn Mawr Ave, Chicago, IL 60631
Verizon*	www.verizon.com	800.922.0204	One Verizon Way, Basking Ridge, New Jersey 07920
Viasat*	www.viasat.com	844.702.3199	6155 El Camino Real Carlsbad, CA 92009

GLOSSARY

ADSL: Asymmetric Digital Subscriber Line - This is a type of digital communication technology used for transmitting digital data over traditional copper telephone lines. ADSL is a common method for providing high-speed internet access to homes and businesses. The term "asymmetric" in ADSL refers to the fact that it allows for different data transfer rates in the upstream (from the user to the internet) and downstream (from the internet to the user) directions. Typically, ADSL provides a much faster downstream speed compared to the upstream speed. This is because it is designed to cater to the typical internet usage pattern where users download more data (e.g., web pages, videos, and files) from the internet than they upload.

Backhaul: Backhaul refers to the part of a telecommunications network that connects the core or backbone network to smaller subnetworks or distribution points. It is a crucial component in the overall network infrastructure, as it facilitates the flow of data between various network segments, ensuring efficient data transport.

Bandwidth: commonly refers to the speed of internet service, measured in bits per second.

Broadband: Commonly refers to high-speed internet access that is always on and faster than traditional dial-up access. Broadband includes several high-speed transmission technologies, such as fiber, wireless, satellite, digital subscriber line, and cable. For the Federal Communications Commission (FCC), broadband capability requires consumers to have access to actual download speeds of at least 25 Mbps and actual upload speeds of at least 3 Mbps.

Broadband Adoption: The use of broadband in places where it is available, measured as the percentage of households that use broadband in such areas.

CO: Central Office - is a facility used by a telecommunications service provider to manage and distribute telecommunications services, including landline telephone, broadband internet, and sometimes other services like DSL, ISDN, or traditional fax services. These central offices play a critical role in connecting customers to the larger telecommunications network.

Dark Fiber: Unused fiber infrastructure that has not been "lit" with Internet service. When someone is building a fiber network, the cost of adding more fiber than immediately required is negligible and the cost of having to add more fiber later is very high. Therefore, many include dark fiber in projects – fibers that can be leased to others or held in reserve for a future need.

Digital Divide: The gap between those of a populace that have access to the internet and other communications technologies and those that have limited or no access.

Digital Equity: Parity in digital access and digital skills that are now required for full participation in many aspects of society and the economy. Digital equity links digital inclusion to social justice and highlights that a lack of access and/or skills can further isolate individuals and communities from a broad range of opportunities.

Digital Inclusion: Access by individuals and communities to robust broadband connections; internet-enabled devices that meet user needs; and the skills to explore, create, and collaborate in the digital world. Digital inclusion programs can be used to promote digital equity.

Digital Literacy: The ability to leverage current technologies, such as smartphones and laptops, and internet access to perform research, create content, and interact with the world.

Download Speed refers to the rate at which digital data is transferred from the Internet to a computer. How quickly you receive online data like texts, images, and videos is based on download speed.

DSL: Digital Subscriber Line - DSL refers to a technology that provides high-speed internet access over traditional copper telephone lines. It allows for a faster internet connection than dial-up and is a common method for broadband internet access in many areas.

FTTC: Fiber to the Curb (or Cabinet) - It is a broadband internet service delivery architecture that combines fiber-optic technology with traditional copper or coaxial cables to provide high-speed internet access to homes and businesses.

FTTH: Fiber to the Home - It is a type of broadband internet service delivery architecture that uses optical fiber cables to provide high-speed internet access directly to residential homes and businesses.

FTTN: Fiber to the Node - It is a broadband internet service delivery architecture that combines fiber-optic technology with traditional copper or coaxial cables to provide high-speed internet access to homes and businesses.

FTTP: Fiber to the Premises – same as FTTH is a broadband internet service delivery architecture that provides high-speed internet access by extending fiber-optic cables directly to residential homes, businesses, or other types of properties.

Gbps: Gigabits per Second - It is a unit of data transfer speed used to measure the rate at which data is transmitted or received over a network or data connection. A gigabit is a unit of digital information that represents one billion individual bits.

Gig- Shorthand for 1 gbps (1,000 mbps) download speeds. More colloquially, a speed fast enough that any number of applications can use the network without creating congestion

HFC: Hybrid Fiber-Coaxial – same as FTTN

Internet Service Provider (ISP): an entity that provides access to the internet and the services available, which a customer buys internet from.

IoT: Internet of Things - It refers to a network of physical objects or "things" that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet. These objects can be everyday items such as appliances, vehicles, wearable devices, industrial machines, or even buildings.

Jitter: Jitter refers to the deviation or variability in the timing or periodicity of a signal or event. It is commonly used in the context of digital data transmission, electronics, and telecommunications. Jitter can manifest as small, random variations in the timing of signal edges, which can lead to problems such as data errors or reduced performance in various systems.

Latency: is a measure of the delay or lag in data communication over the internet or any other network. It represents the time it takes for data to travel from the source (sender) to the destination (receiver) and back. Latency is typically measured in milliseconds (ms).

LOS: Line of Sight - refers to the unobstructed and direct path between two points that enables visual or electromagnetic communication. Line of sight is important in fields like wireless communication and optical communication, where obstacles or terrain can block signals.

Mbps: Mbps: Megabits per Second - t is a unit of measurement used to express data transfer speeds in telecommunications and computing. Megabits per second measure the rate at which data is transmitted or received over a network or data connection. A megabit is a unit of digital information that represents one million individual bits.

PING: Packet Internet Groper - When you PING a host, your computer or device sends a small data packet to the target host's IP address and waits for a response. The primary purposes of using the PING command are checking network connectivity and measuring latency.

Public Service Commission (PSC): an agency responsible for the regulation of Wisconsin public utilities, including those that are municipally owned. The PSC staff's the Wisconsin Broadband Office (WBO), which leads statewide efforts to expand access, adoption, and affordability. WBO provides support to residents seeking internet access, manages broadband

grant programs, compiles broadband service maps, and builds capacity through planning and outreach.

RF: Radio Frequency refers to the range of electromagnetic frequencies that are commonly used for wireless communication and broadcasting. RF waves are a type of electromagnetic radiation, which includes various forms of energy traveling through space in the form of oscillating electric and magnetic fields. RF waves occupy a specific portion of the electromagnetic spectrum, typically ranging from about 3 kilohertz (kHz) to 300 gigahertz (GHz). This range includes frequencies commonly used for radio broadcasting, television, cellular communication, Wi-Fi, and many other wireless technologies.

SDSL: It is a type of digital communication technology that provides high-speed internet access over standard copper telephone lines. Unlike Asymmetric Digital Subscriber Line (ADSL), which offers different upload and download speeds, SDSL provides equal upload and download speeds. This symmetry is particularly advantageous for businesses and applications that require consistent data transfer rates in both directions.

SVI: Social Vulnerability Index (SVI) is a widely used tool in the field of disaster management and public health that assesses the vulnerability of communities to various natural and man-made hazards. It was developed by the Centers for Disease Control and Prevention (CDC) in the United States and is primarily used for disaster preparedness, response, and recovery efforts.

Upload Speed: refers to the rate at which online data is transferred from a computer to the Internet. Sending emails, video calling, and uploading pictures to the internet requires good upload speed.

VDSL: Very-high-bit-rate Digital Subscriber Line - It is a type of digital subscriber line (DSL) technology used for high-speed internet access over traditional copper telephone lines. VDSL is an improvement over earlier DSL technologies like ADSL (Asymmetric Digital Subscriber Line) and SDSL (Symmetric Digital Subscriber Line) in terms of data transfer rates.

Wi-Fi: a technology that produces a wireless local area network allowing a computer or other device to connect to the internet wirelessly. Equipment in the device communicates with the Wi-Fi router, which is connected to the network with some type of physical cable or wire. Examples include the Wi-Fi in a home or hotspot at a coffee shop.

ADDITIONAL PROGRAM DETAILS AND RESOURCES

Helpful Websites:

Broadband USA Program. The National Telecommunications and Information Administration's (NTIA) programs and policymaking focus largely on expanding broadband Internet access and adoption in America, expanding the use of spectrum by all users, and ensuring that the Internet remains an engine for continued innovation and economic growth. NTIA will implement a number of broadband programs including the BEAD program. The website is very helpful for staying informed about the most recent developments and updates concerning broadband programs.

https://broadbandusa.ntia.doc.gov/

Community Economic Development-UW Extension. The UW-Extension works to support communities by providing resources and training opportunities to increase broadband access.

https://economicdevelopment.extension.wisc.edu/topics/broadband/

Wisconsin Public Service Commission. The Wisconsin Broadband Office, part of the Public Service Commission, leads statewide efforts to expand broadband access, adoption, and affordability. WBO provides support to residents seeking internet access, manages broadband grant programs, compiles broadband service maps, and builds capacity through planning and outreach.

https://psc.wi.gov/Pages/ServiceType/Broadband.aspx

Fact Sheets and Resources

- ***BEAD program sheet****: https://www.internetforall.gov/sites/default/files/2022-05/BEAD%20Info%20Sheet%20-%20IFA%20Launch%20-%20Final.pdf*
- ***BEAD Application Guidance Package****: https://broadbandusa.ntia.doc.gov/sites/default/files/2022-09/BEAD-Planning-Grant-Application-Checklist-and-Packet_Final.zip*
    - *Step by step application guidance*
    - *Letter of Intent and Application Templates*
    - *Application Checklist and Form Packet*
- ***Wisconsin Total State Funding by Program****: https://www.internetforall.gov/sites/default/files/2023-10/wisconsin-october2023-update.pdf*
- ***Directory of Internet Service Providers:*** *https://economicdevelopment.extension.wisc.edu/articles/directory-of-internet-service-providers/*
- ***UW-Extension Broadband Toolkit****: https://economicdevelopment.extension.wisc.edu/broadband-toolkit/*

Broadband 101

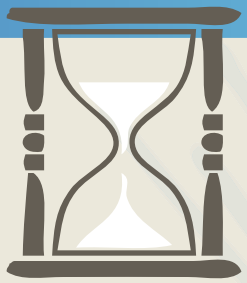
A handy guide to the **basics of broadband terminology** and **technology for policymakers and concerned citizens.**

ILSR
INSTITUTE FOR Local Self-Reliance

Basic Terminology

- **Bits** are the base unit of information in computing. Network speeds are usually measured in "bits per second"
  - 1 **Kilobit** (Kbps) = 1,000 bits transferred per second (bps) Dial-up connections are 56 Kbps
  - 1 **Megabit** (Mbps) = 1,000,000 bps; about 30 seconds to download an MP3 song
  - 1 **Gigabit** (Gbps) = 1,000,000,000 bps; about 10 seconds to download an HD movie
- **Bytes** are the base unit for file size and used in computing monthly caps
- FCC Definition of "**broadband**" is minimum speeds of 25 Mbps downstream and 3 Mbps upstream; many uses of connectivity require faster speeds than the minimum of 25/3
- **"Download"** is the speed, measured in bits, that your computer receives data
- **"Upload"** is the speed that your computer sends data
- **"Symmetric"** connections are comparable in upload and download speeds. DSL and cable often has upload speeds 5-10x slower than downstream. Businesses increasingly need symmetric connections to maximize productivity

Traditional Technology



- **DSL** uses the copper telephone lines to deliver access to the Internet. Common DSL downstream speeds are .5 to 6 Mbps, though they can get up to 40 for people living very close to the equipment that generates the signal. Upstream speeds are often below 1.5 Mbps and rarely exceed 4.
- **Cable,** fittingly enough, uses a cable network to deliver services. Speeds commonly vary from 6-30 Mbps download and 1-3 Mbps upload on standard tiers. Some cable companies offer 100 Mbps down and 10 Mbps up for a hefty premium. However, **cable networks are shared**, meaning you may not achieve the advertised speeds during periods of peak usage due to congestion from your neighbors.
- **Wireless** Internet access is a complement to wired connections, not a substitute. Many 4G networks have **caps that strictly limit usage**. For more on wireless, see our Wireless Fact Sheet.

http://muninetworks.org/content/wireless-internet-access-fact-sheet

Common Broadband Goals

- Faster speeds now
- Affordable service
- Reliable performance
- Universal access
- Scalable Networks (often fiber-optic) that allow capacity to grow as a rapidly as demand

Fiber Optics

- The Gold Standard.
- Basic idea: Lasers shoot pulses of light across very thin strands of glass.
- Fiber optic networks are **reliable**, **resilient**, and use technology that offers nearly **unlimited** expansion. They have fewer points of failure than copper and cable networks.
- Fiber strands last for **decades** and capacity can be increased by upgrading the lasers on each end without having to lay new fiber.
- The high cost of new fiber networks is mostly the labor to put the cables in place on poles or in conduit underground; operating costs are lower than for cable, DSL, or wireless networks.

Cable and DSL Are Inadequate

- 21st Century businesses require faster connections – "basic broadband" is not sufficient
- DSL/Cable technology is unreliable: Interrupted Service = Lost Revenue
- Cable and DSL advertise "up to" speeds – actually reaching those speeds is rare

"All the Internet-connected, data-hungry gadgets that are coming to market sent a strikingly clear message: we're going to need faster broadband networks."

FCC Chairman Genochowski, 2013

COMPETITION

- In many industries, market competition ensures good outcomes. Unfortunately, cable and Internet networks are, and will remain, largely uncompetitive.
- Most of us have two options at home for Internet access. DSL is the slow, less expensive option and cable a more expensive, faster option.
- Wired telecommunications networks are a **natural monopoly** - they have very high upfront capital costs and declining marginal costs. This makes **robust competition all but impossible**... and Wall Street knows it.

"We're big fans of [Comcast's] Video and High-Speed Internet businesses because both are either monopolies or duopolies in their respective markets."

SeekingAlpha.com, 2012

Learn More – Increase Your Understanding – Impress Your Friends, Neighbors, and In-Laws!

To learn more about broadband and the Internet, check out our other fact sheets, case studies, reports, podcasts, and more on **MuniNetworks.org**

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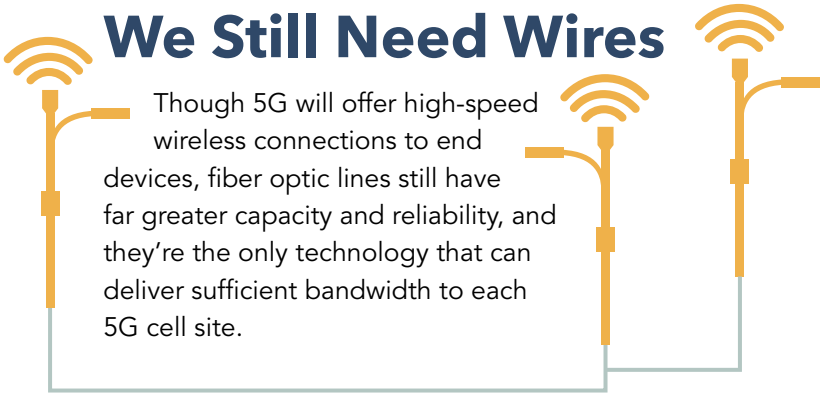
A Pocket Guide To 5G HYPE

5G, or "fifth generation" wireless, is a set of new standards and technological improvements that will enable faster wireless connectivity once implemented.

Compared to current 4G LTE networks, in which users connect to towers thousands of feet away, typical 5G networks require much more densely deployed infrastructure, with small cell base stations less than 1,000 feet from devices. The cell sites will be connected to each other and the broader Internet by fiber optic cables. 5G networks are being marketed both for mobile (e.g., cell phones) and fixed (e.g., home Internet access) uses and as smart city infrastructure.

We Still Need Wires



Though 5G will offer high-speed wireless connections to end devices, fiber optic lines still have far greater capacity and reliability, and they're the only technology that can deliver sufficient bandwidth to each 5G cell site.

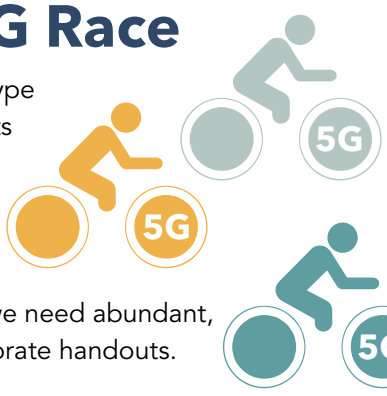
5G Won't Fix the Broadband Market

Competition is limited by economic considerations, not technology. 5G providers are unlikely to rival cable directly because big companies prefer to divide markets rather than engage in robust competition. 5G development won't open the market to new competition because only the biggest telephone companies, like AT&T and Verizon, have access to the volume of spectrum needed.

5G Won't Solve the Digital Divide

Since 5G connectivity relies on fiber optics that aren't available in many rural areas, these communities won't receive 5G access anytime soon. The same market reality discouraging investment in rural broadband will also discourage 5G investment. Even in urban areas, companies like AT&T and Verizon are unlikely to start investing in the low-income neighborhoods they have neglected for years.

There's No 5G Race



The "5G Race" is marketing hype designed to scare governments into giving companies large subsidies and consumers into paying a premium for prototype devices. To achieve widespread 5G deployment, we need abundant, open fiber networks, not corporate handouts.

This fact sheet is a response to the hype around 5G in the United States, primarily from the big wireless companies.

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Published August 2019

5G and Fiber-to-the-Home (FTTH) are complementary technologies that are each best suited to different applications.

	RELIABILITY	SPEED	AFFORDABILITY	BEST USES
5G	Requires line-of-sight. Trees, buildings, and sometimes weather can impact reliability.	Eventually more than 1 gigabit to devices in ideal conditions, but often slower based on environmental factors and congestion.	Mobile plans often have restrictive data caps with overage fees and throttling.	Well suited for mobile uses, like cell phones and smart transportation, in densely populated areas.
FTTH	Very reliable connectivity not impacted by environmental conditions.	No known limits on speed with providers commonly offering 1 gigabit or even 10 gigabits.	Varies by the provider with locally-based networks offering the best prices.	Ideal option for fixed Internet access at a home or business in both urban and rural areas, using Wi-Fi to connect most devices.

FCC Small Cell Order Hurts Local Control

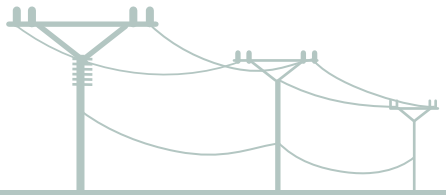
In late 2018, the Federal Communications Commission (FCC) adopted an Order that limits how municipalities and local governments can negotiate with carriers over 5G small cell deployments. By preempting local authority, the FCC has undermined the ability of communities to promote digital equity, to the benefit of national telecom companies.

Don't Fall for Big Telecom's 5G Hype

Wireless technologies like 5G are complementary to robust, wired networks. On their own, 5G networks will not achieve key goals, such as connecting rural America and closing the digital divide.

Additional Resources

- The Wireless Industry's 5G Hype is Funny and Overblown from New America
- Moving Toward 5G: What Cities Need to Know from Next Century Cities
- Guide to FCC Small Cell Order from Next Century Cities
- FCC Stomps on Local Control in Latest Small Cell Order from the Institute for Local Self-Reliance
- Dive Deep Into 5G with Mobile Expert Sascha Segan from Community Broadband Bits Podcast
- Straight Talk About 5G from Community Broadband Bits Podcast
- Will 5G end up leaving some people behind? from NBC News



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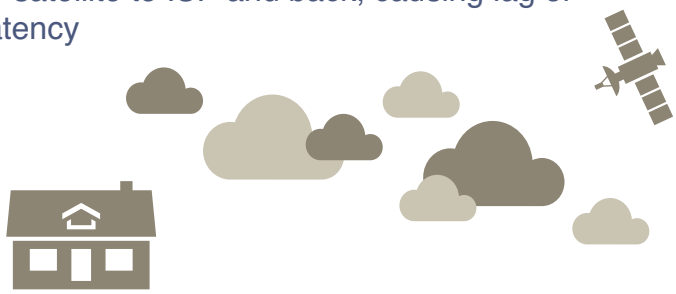
Satellite Is Not Broadband

In 1996, Congress recognized the need for both urban and rural communities to have high-speed Internet service and passed the Telecommunications Act to encourage deployment across the entire U.S. New technologies have helped bring high-quality connectivity to more people than ever before, but many rural Americans still don't have access to broadband.

High-quality connectivity needs to be fast, affordable, and reliable. Satellite is none of the three.

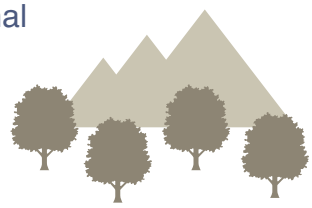
High Latency

- Signal travels long distance from home to satellite to ISP and back, causing lag or latency



Unreliable Connections

- Natural phenomenon, such as trees, hills, and clouds can interfere with signal
- Erratic performance and dropped connections are common

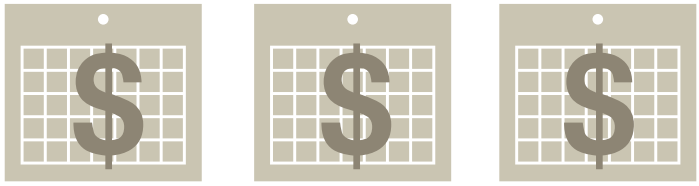


Slow Speeds

- Subscribers rarely reach minimum federal standards for broadband, regardless of advertising claims
- Maximum speeds require optimal conditions

Bad Service Plans

- Often require long-term commitments
- Service costs may increase after subscribers sign a contract
- Data Caps drive up the cost and interfere with subscribers' service until next billing cycle



"If it rains, or if it snows, or if they need to [listen to] a podcast or they want to watch anything educational, do research, listen to teachers online, they cannot do so because the connection ping time is so bad and on top of that, it uses too much of our plan…. Our kids can't do their homework at home."

— Gerald Pine, Retired USAF; Eureka Springs, AR
Comment to the FCC

Banner County, Nebraska.
Public Domain Image from Wikimedia Commons

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September 2018

Rural areas need Internet access on par with urban areas.

Education

K-12 education in both rural and urban areas relies heavily on online resources. If satellite Internet service can handle the required upload capacity, uploading homework often uses up allocated data, driving up the cost of a family's plan. Rural kids who must rely on satellite Internet service are steps behind their urban peers.

Distance learning is a necessity when colleges and technical training programs are too far away from home. Satellite Internet access prevents rural residents from improving their economic opportunities through education.

Healthcare for Seniors and Veterans

Slow upload speeds prevent rural Americans from using telehealth applications if they depend on satellite Internet access.

Economic Development

Rural industries such as agriculture and food processing increasingly rely on high-speed Internet access for daily operations, including real-time commodity price reporting and Just-in-Time inventory management. Other companies seek out rural and exurban areas with fiber connectivity for large data centers and distribution centers. Satellite Internet does not have the capacity to meet the needs of these businesses.

Peaceful rural areas can also attract families, enhancing the tax base and strengthening the community. People can establish home-based businesses or work remotely, but satellite Internet access limits the ability to do so.

Calling Satellite Internet "Broadband" Means Leaving Rural Communities Behind

The fact that we can access the Internet using satellites is a triumph of technology. But it is better suited to truly remote locations, like in largely unsettled areas of Alaska and northern Canada. Satellite is not a long term solution for the vast majority of rural America that already has a wire running to the home for electricity. It may be useful while rural communities are waiting to be connected with better options, but embracing satellite as a long term solution condemns those regions to rapidly declining property values and few opportunities for economic development.

Franklin, Nebraska.
Public Domain Image from Wikimedia Commons

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WIRELESS INTERNET 101

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Wireless is the technology that today most resembles magic. We want to be mobile, not tethered. Our desires notwithstanding, the future of telecommunications is more complicated than simply removing wires.

Consider your home network. You likely use a Wi-Fi router to share a DSL or cable wired connection to your home. Even as wireless devices become increasingly common, most homes will still have a wired connection (ideally using fiber optics).

There is no single "wireless" technology. There are many different standards, speeds, and issues. Your phone may support 4G LTE, Wi-Fi, and Bluetooth – each is unique in capacity and limitations.

BASIC TERMINOLOGY

Spectrum: This is the entire range of electromagnetic wavelengths from the colors we see to frequencies used by radio and television broadcast stations. The Federal Communications Commission (FCC) regulates how the spectrum may be used and by whom.

Licensed spectrum: Specific ranges of radio wavelengths that may only be used by those holding licenses from the FCC. Technologies include 3G, 4G, LTE, WiMax, and others.

- **3G, 4G:** G is short for "Generation" of commercial cellular network. However, marketing departments have perverted these designations so the 4G used by AT&T is not the same as 4G used by Verizon, etc.
- **LTE:** "Long Term Evolution" is a wireless standard (4G) used by most cell phone companies to deliver cellular wireless services, most often to mobile phones.

Unlicensed spectrum: Specific ranges of radio wavelengths dedicated to a commons that anyone may use, often with power limits. Includes microwaves, garage door openers, Wi-Fi, cordless phones, and others.

- **Wi-Fi:** Sometimes confused with "wireless." Wi-Fi is a specific set of wireless protocols commonly used by computers and mobile devices. Many different firms manufacture Wi-Fi devices that meet standards to communicate with each other.

Fixed Wireless: Connects two non-mobile locations, such as between a house and tower. The antennas are often directional to allow higher power and faster speeds than used for mobile phones.

Data Caps: limits on the amount of data a device may use over a period of time.

KEY POINTS

Cell phones do not use satellites. The signal travels from your phone to an antenna, likely on a tower (as shown on left) within a few miles of your location.

Wireless networks require wires. When your cell phone connects to the tower, the signal travels via wires to a processing hub, then again via wires to another antenna to connect "wirelessly" to the call recipient.

Wireless networks require better fiber optic networks. The explosion of wireless demand requires higher capacity fiber optic connections to antenna sites. Wired and wireless networks complement each other; they are not substitutes.

Home Wi-Fi connections are often already faster than the Internet connection. Your wireless network may peak at 54 Mbps or more whereas your Internet connection may only be 5-10 Mbps.

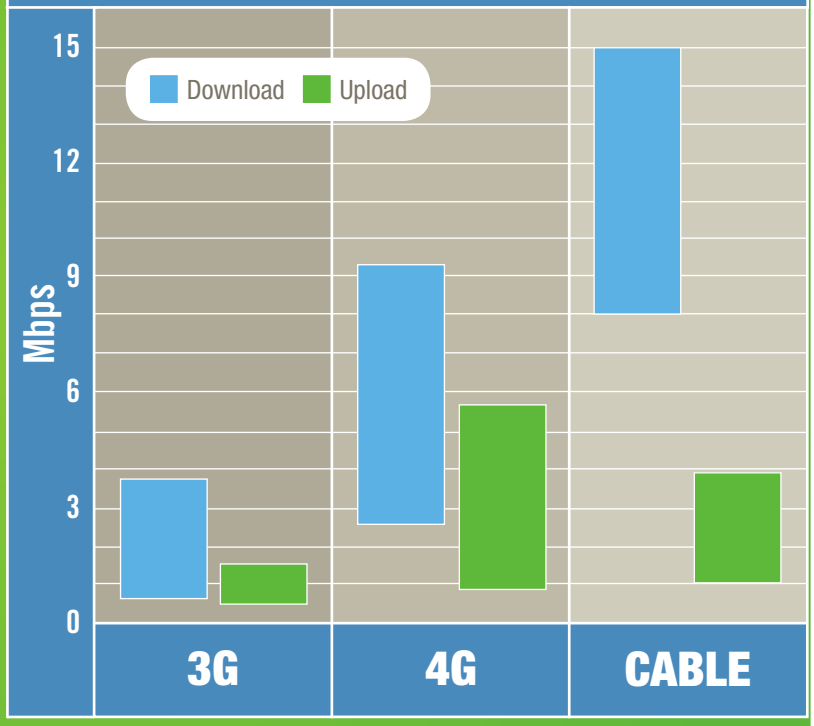
REAL WORLD MEASUREMENTS

Today's mobile wireless technology alone does not meet our demand for fast Internet access. 4G wireless is slower than modern wired cable connections.

Though wireless speeds continue to improve, each tower is shared by many users whereas home wired connections are shared by comparatively fewer users. As a result, these wireless connections are unlikely to overtake modern wired connections in the home.

In 2012, PC World tested wireless Internet services from four mobile carriers in 13 U.S. cities. 3G was comparable to home DSL connections and 4G a bit slower than home cable connections. Both download and upload speeds were tested. Cable reference based on PC World tests of multiple cable companies' standard tier.

COMMON SPEEDS (in Mpbs)



PC WORLD SPEED TEST RESULTS

3G Download / Upload	4G Download / Upload
Fastest: 3.84 / 1.44 Mbps	Fastest: 9.12 / 5.85 Mbps
Slowest: .59 / .56 Mbps	Slowest: 2.81 / .97 Mbps

DATA CAPS

Wireless Internet providers often impose **data caps** that discourage subscribers from using certain applications, most notable streaming video. These are generally business decisions, not technical limitations. Nonetheless, they are a reason wireless is not replacing wireline connections at home.

Exceeding **data caps** results in overages or interruptions in service that make wireless alone an expensive solution for businesses that regularly transfer large amounts of data.

Wireless providers justify data caps as a means of managing **congestion**, but consumer advocate groups argue the real motivation is maximizing revenue. An analogy is trying to manage rush hour traffic jams by limiting how many miles one can drive per month.

WIRELESS LIMITATIONS

Objects such as trees, hills, and buildings can degrade wireless signals.

Satellite Internet service is wireless but is expensive and suffers from technical limitations. We have not found anyone subscribing to satellite Internet when a DSL or cable option was available.

Congestion can result when too many devices are attempting to share the same antenna. This can be resolved by deploying more antennas, each of which should have a fiber connection. Cities with ubiquitous fiber networks can offer better wireless options.

ADDITIONAL RESOURCES:

Collect all of our Internet-Related Fact Sheets at MuniNetworks.org/fact-sheets

Broadband Bits Interviews with Dewayne Hendricks

New America Foundation - Wireless Future Project

Public Knowledge - Mobile Innovation

Free Press - Save the Internet

For more information, visit MuniNetworks.org

@CommunityNets ; broadband@muninetworks.org

ILSR INSTITUTE FOR Local Self-Reliance

Next Century Cities

The Opportunity of Municipal Broadband

The Federal Communications Commission estimates that 21 million Americans don't have access to broadband internet (though this analysis has been widely proven to underreport the scale of the problem).[1] Municipal broadband networks provide an opportunity to connect the unconnected to the essential twenty-first century infrastructure. Over 500 municipalities have invested in creative public networks, using a variety of models to connect rural and underserved communities. Building a municipal network is rarely a community's first choice, but cities and towns have taken it upon themselves to connect residents to broadband when existing cable and telephone companies have chosen not to offer competitive services.

The Benefits of Municipal Networks

Municipalities use a variety of funding methods to build broadband networks. Most use funding mechanisms without direct taxpayer dollars, such as revenue bonds, loans, or Tax Increment Financing.

Longmont, Colo. financed its city-wide fiber network through revenue bonds, putting no financial burden on the taxpayer.[2] Residents in **Islesboro, Maine** voted to accept a slight property tax increase to finance the bond that paid for their fiber network. The cost of funding the bond was comparable to the price they had been paying for poor quality DSL service.[3]

For more information: How municipal networks are financed; Creative funding sources for fiber infrastructure

Municipal networks are not a small undertaking but can provide immense long-term benefits to a community even beyond improved internet access.

Chattanooga, Tenn.'s municipal network EPB not only retired its telecom debt, but revenues from fiber services were so high that the electric utility was able to forego several rate increases.[4] **Virginia Beach, Va.** leverages its fiber network to connect the city's government buildings, schools, fire stations, and more. By connecting these anchors directly as opposed to purchasing service from an ISP, the city saves at least $500,000 per year.[5] **Portland, Ore.** had been paying $1,310 per month per site to a private ISP to connect its schools. The district eventually switched to a publicly owned network, and was able to connect schools to a speed 40 times greater for just $616 per month per site.[6]

For more information: Municipal networks deliver local benefits; Community broadband creates public savings

Why We Need Broadband

Americans need access to broadband in order to start businesses, compete for jobs, complete homework assignments, apply for a mortgage, find a polling location, and much more.

Connecting Communities

Next Century Cities

The Benefits of Municipal Networks

Municipal networks provide the robust access necessary for job growth and economic development.

Lafayette, La.'s network helped attract new technology businesses to town, diversifying the local economy which had previously been dependent on oil and gas. In **Chattanooga**, the fiber network is estimated to have created up to 5,200 new jobs and up to $1.3 billion in economic and social benefits in the community between 2011-2015.[7]

Fiber utilities can drastically improve utility efficiency and city cost savings.

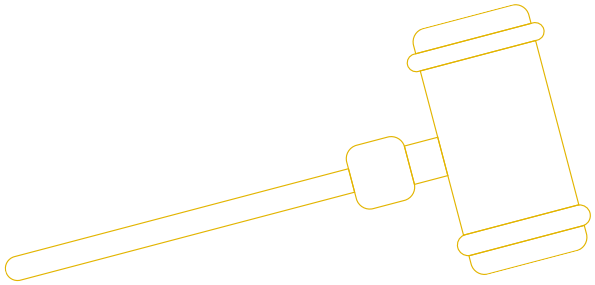
Lafayette's "smart" electric grid uses fiber to monitor power and alert the city when there's an outage. As a result, the average length of a power outage in **Lafayette** is one quarter the state average, which saves ratepayers about $25 million per year.

Locally owned networks are committed to local success.

Municipal networks are small, and the people who run them are members of the community themselves, creating a high level of visibility and accountability that is often not present with larger ISPs. Typically, the result is exceptional customer service, a vested interest in the community, and awards (see: Ammon, Id.; Longmont, Colo.; and Clarksville, Tenn.).

What's Holding Us Back

Municipal broadband networks present an opportunity to connect communities to this vital future-proof infrastructure —but many states have legislation in place that outright bans or de facto bars municipal networks from being built. Conservative analysis shows that over 11 million Americans—over half of the country's estimated unconnected population—who do not have access to broadband live in states where municipal networks are barred or outright banned by state legislation.



How States Can Help

States can facilitate connectivity by:

- Allowing local governments the authority to build and manage network infrastructure and offer broadband services
- Including municipal governments among eligible awardees in broadband grant and loan programs

Find more information about the hundreds of municipal broadband success stories from the Institute for Local Self-Reliance's Community Broadband Networks Initiative and from Next Century Cities.

Sources

[1] https://docs.fcc.gov/public/attachments/FCC-19-44A4.pdf
[2] https://muninetworks.org/content/longmont-prepares-vote-fiber-bonds-community-broadband-bits-episode-68
[3] https://muninetworks.org/content/islesboro-maine-finalizes-fiber-agreement-mainland
[4] https://muninetworks.org/sites/www.muninetworks.org/files/2017-05-TPA-boondoggle-rebuttal-final.pdf
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