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Southwest New Hampshire Broadband Plan

Adopted January 13, 2015

Prepared by the Southwest Region Planning Commission with assistance from the Southwest Broadband Stakeholders Group.

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January 2015

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EXECUTIVE SUMMARY

Broadband is in 2014 what electricity was to New Hampshire in the 1930's - a necessity. In a relatively short time period, access to fast and reliable broadband, also known as 'high-speed Internet,' has become integral to economic growth and competitiveness and improved quality of life. It is changing how we educate children, deliver health care, ensure public safety, engage government, and access and disseminate information.

However, broadband in Southwest New Hampshire is not all it needs to be. Within the Region, access varies from good coverage and availability in more densely developed areas to rural parts of communities that are either un-served or under-served by broadband.

The Region's challenging topography and low population density presents both technological and economic barriers to deploying broadband infrastructure and services. Lack of information on the location and type of broadband available at the address level limits the ability to plan for improvements. In addition, regulatory and policy barriers can inhibit broadband expansion. In spite of these challenges, more can and needs to be done to address the lack of adequate broadband within the Region.

The Southwest Region Planning Commission, advised by a group of representatives from a variety of sectors and communities in Southwest New Hampshire, developed this regional broadband plan to better understand current levels of broadband service, identify challenges and barriers to improved broadband access, and to plan for increased broadband availability and utilization. This Plan addresses the linkages between various sectors in the Region and their growing reliance on broadband connectivity. It recognizes broadband as critical infrastructure and suggests approaches for addressing the future of broadband in the Region.

This Plan contains recommendations oriented around a central vision and four primary goals, which respond to broadband challenges and needs specific to the Southwest Region at the time of release. The objectives and proposed strategies identified in this Plan are viewed as realistic measures for improving the landscape of broadband in the Southwest Region over the next five years and beyond. They are directed at regional organizations, municipalities, community anchor institutions, broadband providers, policy and decision makers and others to consider, pursue, and/or support their efforts to increase access to and the utilization of high quality broadband in the Region.

Southwest New Hampshire Broadband Vision

Recognizing that the universal availability of high capacity broadband is vital to the region's future and long term prosperity, this Plan is guided by a vision of Southwest New Hampshire where every person has the ability to access and fully utilize a reliable, affordable and sustainable broadband network.

Southwest New Hampshire Broadband Plan Goals

- Position broadband as a critical utility and a basic requirement for economic development, community vitality and sustained quality of life.
- Eliminate gaps in broadband availability for all users and provide choices in cost and quality of service.
- Provide and maintain reliable, high-capacity broadband infrastructure and technology in all areas of the Region over time.
- Respect those features that define the Region's cultural and physical landscape while meeting the broadband infrastructure needs of the future.

INTRODUCTION

As a rural area with low population density and mountainous, forested terrain, the development of high-performing, affordable broadband, also known as high-speed Internet, has been slow in coming to the Southwest Region of New Hampshire. Since the late 1990s, the Region has been working to address challenges related to the availability of broadband. Although progress has been made, especially in recent years, much more remains to be done.

The Southwest Region Planning Commission (SWRPC) worked in partnership with a group of diverse stakeholders to develop this regional Broadband Plan with the intent of assisting communities, institutions, service providers and other interested parties in their collective efforts to improve broadband throughout the Region. This Plan highlights the current landscape of broadband availability in the Southwest Region and identifies ways to increase regional broadband availability and utilization.

This represents one of nine regional broadband plans developed by New Hampshire's regional planning commissions as part of the NH Broadband Mapping and Planning Program (NHBMPP) spanning the period of 2010-2014. These plans are intended to serve as guidance documents for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for broadband now and into the future.

Project Background

The New Hampshire Broadband Mapping and Planning Program (NHBMPP) is a comprehensive initiative that began in 2010 with the goal of understanding where broadband is currently available in the state, how it can be made more widely available in the future, and how to encourage increased levels of broadband adoption and usage. Funded through the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce, the NHBMPP is part of a national effort to expand broadband access and adoption.

The NHBMPP is managed by the GRANIT (Geographically Referenced Analysis and Information Transfer) System within the Earth Systems Research Center at the University of New Hampshire (UNH), and is a collaboration of multiple partners. These include the NH Office of Energy and Planning (OEP), NH Department of Resources and Economic Development (DRED), UNH Cooperative Extension (UNHCE), UNH Information Technology (UNHIT) and the state's nine regional planning commissions (RPCs).

The NHBMPP is comprised of several components, including a broadband availability inventory and mapping effort and a suite of planning and technical assistance initiatives. A comprehensive overview of each of these components is included in Appendix A.

Regional Broadband Plan Process

In 2011, Southwest Region Planning Commission (SWRPC), along with other NHBMPP partners, embarked on a four-year planning effort to better understand the current availability of broadband in the Southwest Region and to plan for increased broadband adoption and utilization. This effort incorporated and built off of the information gained during the mapping activities of the NHBMPP. It also involved the development of a committee to assist SWRPC staff with the planning process.

This committee, which is comprised of individuals representing a broad range of sectors and geographic areas of the Region, is called the Southwest Region Broadband Stakeholder Group (SWBSG). The SWBSG

has played a vital role in helping SWRPC assess the need for improved broadband in the Region, identify barriers to meeting these needs, and develop recommendations for improving broadband.

FIGURE 1. SOUTHWEST BROADBAND STAKEHOLDER GROUP REPRESENTED SECTORS

To better understand the broadband needs and challenges experienced by specific sectors in the Region, SWRPC conducted a series of focus group meetings and structured interviews. The sectors examined included healthcare, education, local government, economic development, and public safety. The findings of these focus groups are described further in this document. SWRPC staff also held forums throughout the course of the project to share information with the larger public regarding the NHBMPP and ongoing regional broadband efforts and to receive feedback and input from community members.

UNDERSTANDING BROADBAND

What is Broadband?

Broadband, also called 'high-speed Internet,' is the umbrella term typically used to describe Internet service that is faster than dial-up Internet access. It is characterized as being 'always on,' allowing users to surf the Internet and make phone calls at the same time. The NTIA describes broadband as, "advanced communications systems capable of providing high-speed transmission of services such as data, voice, video, complex graphics, and other data-rich information over the Internet and other networks."[1]

The performance of a broadband connection is most often defined by its speed or bandwidth. This is the amount of digital data that can be transmitted in a given time, measured in bits per second. Common units of data transfer are kilobits per second (Kbps), megabits per second (Mbps), and gigabits per second (Gbps). Most broadband technologies have varying speeds at which data can be downloaded from or uploaded to the Internet, with uploading speeds typically being more limited.

Defining Broadband

It is important to develop a shared definition of broadband so stakeholders can determine the level of broadband currently accessible in an area, and how it can be made more widely available. This task is challenging as technology and the minimum bandwidth needed to support certain applications is continually evolving.

Since 2010, the Federal Communications Commission (FCC) has defined broadband as the exchange of digital data between two points at a rate consisting of download speeds of 4 Mbps or greater and upload speeds of 1 Mbps or greater. The NTIA uses a more conservative approach, defining broadband as download speeds of 768 kbps or greater and upload speeds of 200 kbps or greater.

*Only 15 years ago, a 56 kbps connection was sufficient to conduct most business on the Internet. Today, in order to use many Internet applications successfully, a minimum download speed of 6 Mbps is required – **a 100-fold increase.***

The NHBMPP adopted the NTIA guidance, but introduced an enhanced, tiered definition of broadband – distinguishing between areas that it considers fully served, areas that are underserved, and areas with no service at all—the unserved (see Figure 2). While these definitions limit the focus on broadband access to transmission speeds, it is understood that affordability and functionality are also key factors when assessing broadband availability.

Further, it is well recognized that broadband functions, applications and technologies are continually evolving. Only 15 years ago, a 56 kbps connection was sufficient to conduct most business on the Internet. Today, in order to use many Internet applications successfully, a minimum download speed of 6 Mbps is required – a 100-fold increase. This trend towards increasing requirements for bandwidth capacity will certainly continue into the future as new broadband-intensive applications emerge.

[1] "Broadband: As defined by the NH Broadband Mapping and Planning Program," *New Hampshire Broadband Mapping and Planning Program*, February 15, 2012, http://iwantbroadbandnh.com/planning-and-assistance. (accessed July 17, 2013).

FIGURE 2. NHBMPP BROADBAND DEFINITION MATRIX

Category	*Download Speed*	*Upload Speed*	*Typical Functions/Use (functions additive to level above)* NEW HAMPSHIRE broadband MAPPING & PLANNING PROGRAM
Unserved	**< 768 Kbps**	**< 200 Kbps**	• Email (Client/Server-based; POP)
Underserved	**768 Kbps to < 6 Mbps**	**200 Kbps to < 1.5 Mbps**	**Minimum Download Speed: 768 Kbps** | **Minimum Upload Speed: 200 Kbps** • Web-based email • Limited web browsing and shopping • Minimal social media use • Sending/receiving small documents/files (photos, word processing, invoices) • Use of internet not integrated in daily life function • Single user internet device **Minimum Download Speed: 1.5 Mbps** | **Minimum Upload Speed: 768 Kbps** • Web browsing and shopping • Medium social media use • Sending/receiving medium-sized documents/files (photos, word processing) • Limited streaming content; buffering a concern Standard Definition (SD) content • VPN access possible, but speed of operation not critical to job function • Internet integrated in daily life, and "always" connected • 1-3 simultaneous internet devices possible • Multiple functions working simultaneously possible (e.g. web browsing, streaming video/music, downloading content). Not concerned with speed of transmission. • VoIP (Voice over IP, i.e. telephone over the Internet) **Minimum Download Speed: 3 Mbps** | **Minimum Upload Speed: 768 Kbps** • Medium to high social media use • Sending/receiving medium to large-sized documents or files (photos, word processing) • Streaming SD content; buffering not a concern; downloading High Definition (HD) content (movies, video) • 3-5 internet devices possible • VPN access needed, speed of operation important but not critical to job function • Multiple functions performed simultaneously required (e.g. web browsing, streaming video/music, downloading content), but not concerned with speed of downloads • Low quality, small window frame videoconferencing (Skype) • Cloud-based computing and data storage
Served	**6 Mbps to 25+ Mbps**	**1.5 Mbps to 6+ Mbps**	**Minimum Download Speed: 6 Mbps** | **Minimum Upload Speed: 1.5 Mbps** • Heavy social media use • Sending/receiving large documents or files (photos, word processing, small videos) • Streaming HD content (movies, video); buffering not a concern • 5+ internet devices possible • VPN access needed, speed of operation critical to job junction • Higher quality, codec-based videoconferencing • Multi-player online gaming **Minimum Download Speed: 10 Mbps** | **Minimum Upload Speed: 3 Mbps** • Sending/receiving large files and small to medium-sized databases • HD quality, codec-based, large frame videoconferencing; multiple (bridged) sites/users • Remote synchronous education, professional development, workshops, etc., facilitated simultaneously at multiple classrooms and/or other locations • Telehealth/telemedicine applications possible **Minimum Download Speed: 25+ Mbps** | **Minimum Upload Speed: 6+ Mbps** • Sending/receiving medium to large-sized databases • HD quality, codec-based, large frame videoconferencing (Telepresence) connecting multiple (bridged) sites/users • High speed end to end network and business to business applications • Telemetry-based applications (rely critically on the ability of broadband to continuously monitor and multiplex data, i.e. remote patient monitoring, sensing systems, etc.) • Real-time HD medical imaging and consultation (remote dermatology, etc.) • "Internet 2" connectivity and applications

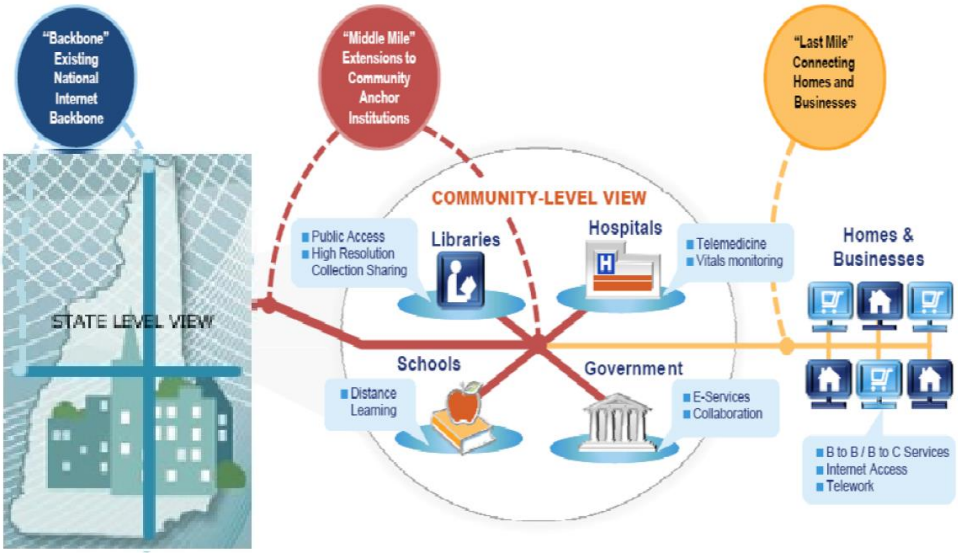
Source: New Hampshire Broadband Mapping and Planning Program http://www.iwantbroadbandnh.org

How Broadband Works

Broadband infrastructure consists of the Internet "backbone" which is hosted by large commercial, government, academic, and other high-capacity network centers. The "middle mile" refers to the segment linking a network operator's core network to the local network plant. In order to transport the Internet to homes and businesses, known as the "last mile," it can be most cost-effective to increase the reach of the "middle mile" through community anchor institutions. Community anchor institutions are typically municipal libraries and Town offices, hospitals and schools, emergency services and public safety operations, and large businesses that have the means and capacity to access broadband-based services. The majority of home and small business users rely on the last mile hosts, Internet service providers (ISPs), to obtain broadband services.[2]

There are many different broadband delivery technologies, i.e. how individual homes, businesses or facilities are connected to the Internet. These technologies can be separated into two major categories of wired and wireless broadband. Table 1 displays examples of both types of technology. Wired broadband technologies bring a wire connection to the home or business. A Wi-Fi router may be used by a subscriber to share the Internet connection wirelessly among different devices, such as a laptop computer or tablet, at a location. [3]

FIGURE 3. UNDERSTANDING THE 'MIDDLE MILE' AND 'LAST MILE'



Source: http://www.whitehouse.gov/sites/default/files/20091217-recovery-act-investments-broadband.pdf

Digital Subscriber Lines (DSL) and Cable Modem are wired technologies commonly used by residential and small businesses. DSL uses copper phone lines to deliver direct, one-on-one connections to the Internet, allowing users to not have to share bandwidth with neighbors. However, users must be located within 18,000 feet (3.4 miles) of a phone company's central office, which means service is often unavailable in remote areas.[4]

[2] State of New Hampshire, Department of Resources and Economic Development and The Telecommunications Advisory Board, State of New Hampshire Broadband Action Plan: Appendix A, 2008, http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf . (accessed July 17, 2013).

[3] "Wireless Internet 101," *Institute for Local Self-Reliance*, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).

[4] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).

Cable Modem, which is typically faster than a common, asymmetric DSL connection, uses the cable network to deliver broadband to users. Cable networks are a shared connection, so speeds can slow during peak usage times due to congestion when people in the same neighborhood are online. Fiber optic systems use lasers across very thin strands of glass creating reliable, resilient technology that has an extremely high capacity for speeds and data transmission. There is a high cost associated with laying out the fiber network but once in place the system can be easily upgraded and maintained, with lower operating costs than DSL, cable, or wireless networks.[5] Building out the fiber network is currently the most effective means to provide the highest capacity broadband.

Unlike wired technologies, which bring wires directly to a location, wireless technologies use radio frequencies through transmitters and receivers to deliver broadband. Wireless broadband can be categorized as wireless networks or satellite. Wireless Internet Service Providers (WISPs) are designed to cover large areas using point-to-multipoint networks to broadcast wireless data up to 20 miles. A signal is broadcast from a base station and is received by a fixed wireless antenna mounted on a customer's premises. A combination of a Wi-Fi Hotspot and a WISP can enable a Neighborhood Internet Service Provider (NISP) or a Wi-Fi Hotzone. A Wi-Fi Hotzone can cover an area such as a neighborhood, shopping mall, or campground.

Satellite Internet users send and receive information via small dishes installed on the premises to a satellite in space which retransmits the signal to a network operation center that is connected to the Internet. Satellite-based Internet connection can be interrupted by objects and weather, and broadband upload speeds are typically slower than wired or other wireless networks.

TABLE 1. TYPES OF BROADBAND TECHNOLOGY

Wired Broadband Technologies	Wireless Broadband Technologies
Digital Subscriber Lines (DSL)	Mobile wireless (3G, 4G, LTE, WiMax)
Cable Modem, Fiber Optics	Wi-Fi, satellite
Leased Lines (T1)	Wireless Internet Service Providers (WISPs).
Broadband over Powerline (BPL)	

For those seeking greater understanding of broadband and the types of services and functions supported by it, see Appendix B and C at the end of this document. Appendix B provides greater insight into the technology and functions of broadband. Appendix C includes a list of definitions for common broadband terms and acronyms.

Why Broadband Is Important

Broadband is in 2014 what electricity was to New Hampshire in the 1930's - a necessity. As a predominantly rural state, the availability of high-speed internet is one of the most significant factors that will impact the ability of communities to achieve economic growth and maintain quality of life. In a relatively short period of time, fast and reliable broadband has become essential for economic and community development and is critical infrastructure for public safety, education, health care, business, and government operations.[6]

Communities today face many challenges: a competitive global marketplace; an aging population; the need for a better-educated and better-prepared workforce; and, access to health care. These issues are magnified in rural areas as the distance between households and services makes it difficult to access

[5] "*Broadband 101," Institute for Self-Reliance,* http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed on July 17, 2013).
[6] "Building Community Capacity through Broadband (BCCB) Initiative," *University of Wisconsin Extension*, November 2010, http://www.uwex.edu/broadband/documents/BCCBUWEXFAQ_rev_11_18_10withmap.pdf. (accessed June 2013).

certain resources and opportunities. The financial resources traditionally available to overcome these challenges are often unavailable to rural communities and regions. New solutions are required.

There is no doubt that we live in an information society, and broadband connects us to opportunities and services. Whether this is training for a new skill, a new language, or completing an online course - broadband facilitates the access of information in many different forms. In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.[7] While this is an impressive increase, there are still many Americans with insufficient access to broadband services. In New Hampshire, access varies from good coverage and availability in more densely developed areas of the state to areas of un-served and under-served communities in more rural areas of the state. This variability can lead to disparities in economic opportunity, education, community vitality, public health and safety, and quality of life.

In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.

The critical importance and value of broadband to society and the economy is described in Appendix B of this document. This section highlights the increasing role of broadband in the education, health, government, public safety, and economic sectors.

[7] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

REGIONAL VISION

Guiding the Plan is a vision of Southwest New Hampshire where every person has the ability to access and fully utilize a reliable, affordable and sustainable broadband network. To support this vision, the Plan outlines a series of goals, objectives and related strategies that focus on improving broadband access and adoption in the Region over the next five years and beyond.

The following sections of this document explore the current understanding of broadband availability in the Region and provide an overview of residential and sector specific broadband needs. In addition, there is a review of the challenges to and potential opportunities for the expansion and enhanced utilization of broadband in the Region. At the conclusion of this document is an implementation section that more fully addresses and prioritizes strategies for improving broadband availability and utilization.

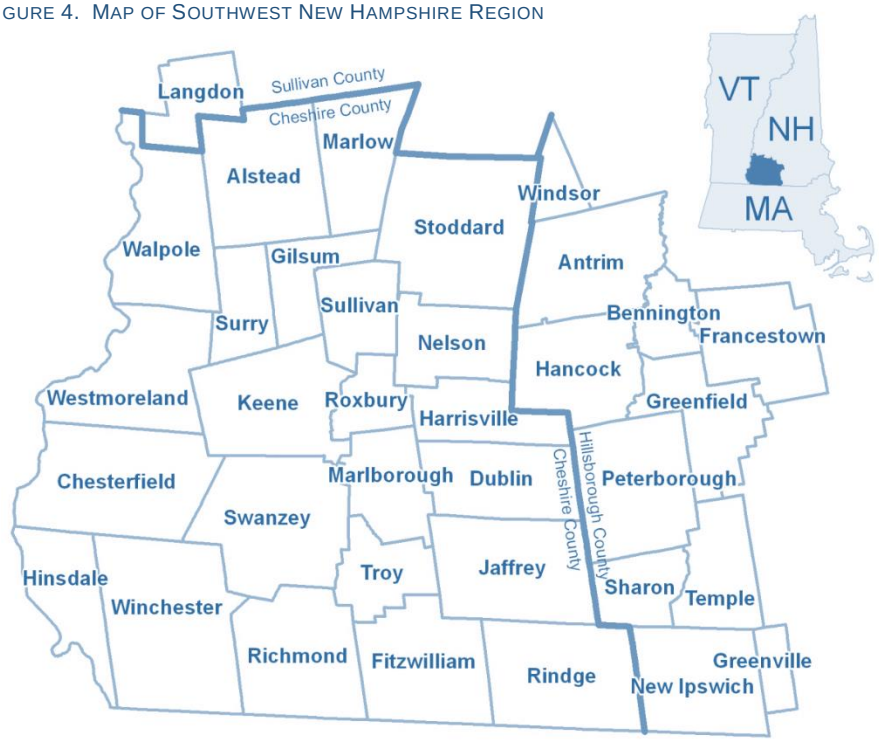
Recognizing that the universal availability of high capacity broadband is vital to the region's future and long term prosperity, this Plan is guided by a vision of Southwest New Hampshire where every person has the ability to access and fully utilize a reliable, affordable and sustainable broadband network.

SOUTHWEST REGION BROADBAND VISION

REGIONAL OVERVIEW

The Southwest Region is comprised of 35 municipalities including 23 in Cheshire County, 11 in western Hillsborough County, and one in Sullivan County. A central and defining feature of the Region is Mount Monadnock, which rises 3,165' above sea level. The Mountain and its highlands shape the landscape, which is rolling hills and valley floors. Forests cover 83% of this land with rural and suburban residential development emanating from village centers and small downtown areas. With the exception of Keene and other small downtown centers, much of this development is dispersed with one house for every ten or more acres.

FIGURE 4. MAP OF SOUTHWEST NEW HAMPSHIRE REGION



Population

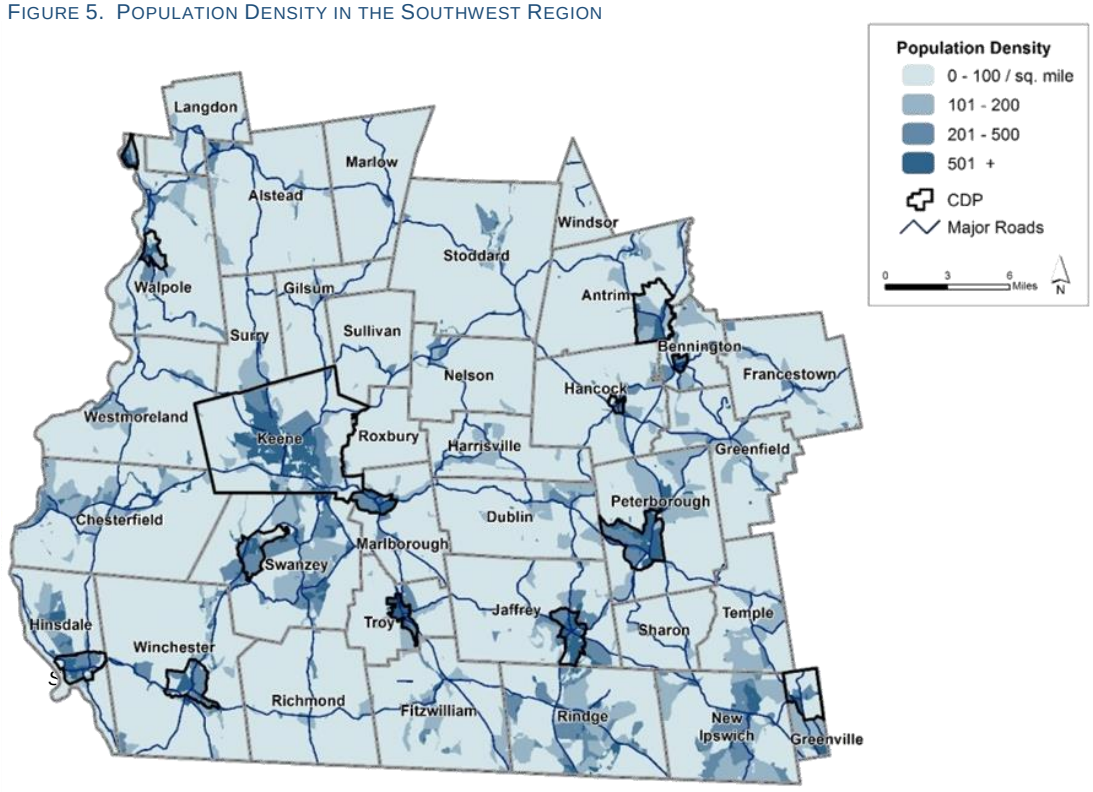
According to the U.S. Census Bureau, there were 102,313 people living in the 1,007 square-mile region in 2010 - an overall population density of approximately 101 people per square-mile. Municipal populations range from 23,409 in the City of Keene to 224 in Windsor.[8] Excluding Keene, the average population of communities in the Region is 2,321.

While the Region's population grew by 39% between 1970 and 1990, growth in more recent decades has slowed significantly. The Region grew by 6.2% between 1990 and 2000; and, by 5.1% between 2000 and 2010. This trend of slow growth is anticipated to continue into the future. The most recent projections from OEP anticipate a 5-6% increase in the Region's population from 2010 to 2040, or 0.2% per year. These 30-year projections indicate both dramatically lower population growth and some

[8] U.S. Decennial Census, 2010

declining populations over the short and long terms. Population projections for municipalities within the Region range from an expected 27% increase in Stoddard to a 13% decrease in Harrisville.

FIGURE 5. POPULATION DENSITY IN THE SOUTHWEST REGION



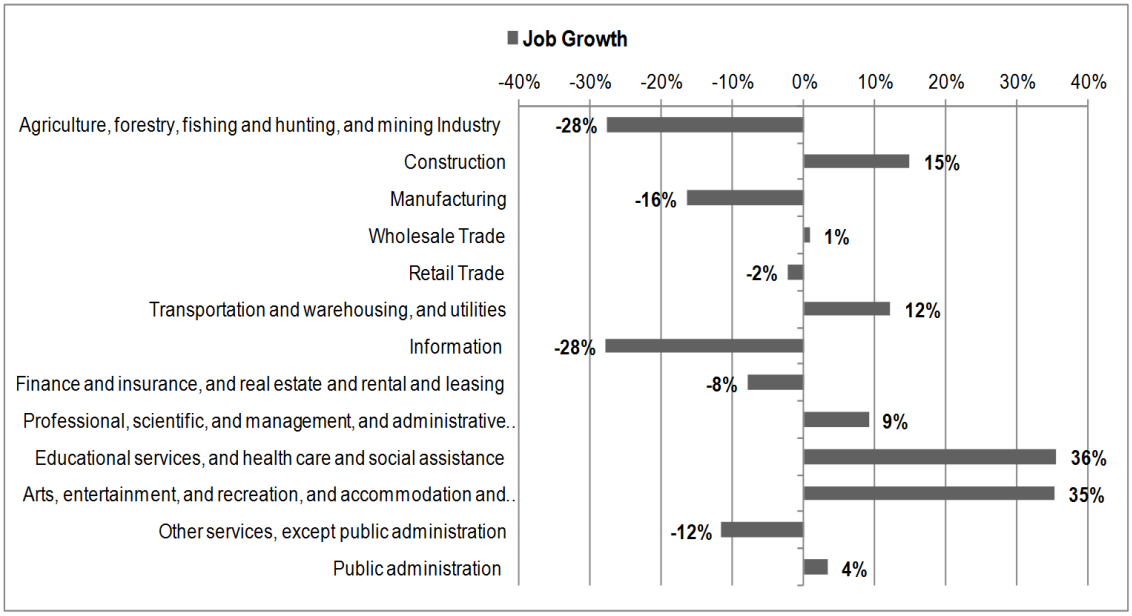
Economic Development

Since the 18th Century, the Region's economy has changed from agriculture and forestry to village industry to manufacturing, high-tech industry and business. A major driver of these changes has been technological advancements in transportation and communications. The introduction of the railroad and telegraph in the 1800s opened new markets to the Region and led to dramatic decreases in the costs and time to transport goods and services. In recent years, the Internet has allowed for greater personal mobility and flexibility in where people choose to live and work as well as what they do with their spare time. However, as the Region becomes more connected, there is greater competition with other parts of the country and global economy.

This competitive pressure has influenced the regional economy and led in part to a decline in one of the Region's highest-paying employment sectors, manufacturing. During the mid-1900s, manufacturing disappeared from many parts of the Region, often relocating to southern states, the rust belt and foreign countries. Still today, the Region is losing manufacturing jobs. Between 1990 and 2000 employment in manufacturing decreased by 4%. This trend continued in the following decade, with employment in manufacturing decreasing 16% between 2000 and 2011. Despite this decline, the sector remains one of the largest in the Region, employing 15% of its civilian population.

The predominant industry sector in the Region is *educational services, health care and social assistance*, which employs 28% of the Region's workforce. This sector grew by 35.6% between 2000 and 2011.[9] The figure below highlights how employment has changed by industry sectors in the Region between 2000 and 2011.

FIGURE 6. 2000-2011 PERCENT CHANGE OF EMPLOYED POPULATION BY INDUSTRY



Travel Patterns

The Region's population is highly mobile, as most residents work and shop outside of their town of residence. As a whole, 65% of the working population (23,267 people) lives and works in the Region. The top five employment centers for residents of the Region are Keene, Peterborough, Jaffrey, Swanzey and Brattleboro, VT. Almost half of all commuters travel less than 10 miles from home to work, but there are approximately 4,000 workers or 7.5% of the Region's workforce that travel greater than 50 miles on a regular basis.

Access to basic services depends on each town's geographical location, but most services are within a 20 mile drive. The majority of trips that Southwest Region residents make for shopping, services or medical appointments are local or regional in nature depending on the town of residence. Major supermarkets are distributed around the Region in Walpole, Keene, Swanzey, Hinsdale, Peterborough and Rindge, and just outside of the Region in places like Hillsborough and Brattleboro, VT, although there are several smaller business and food stores distributed throughout the Region. Small clothing stores are distributed throughout the Region, with the only larger stores located in Keene, Rindge and Hinsdale. There are hospitals located in Keene and Peterborough, as well as a hospital in Brattleboro, VT, all of which provide medical services including some medical specialization services.

[9] 2011 American Community Survey, 5-yr Estimates 2007-2011

History of Broadband Planning in Southwest NH

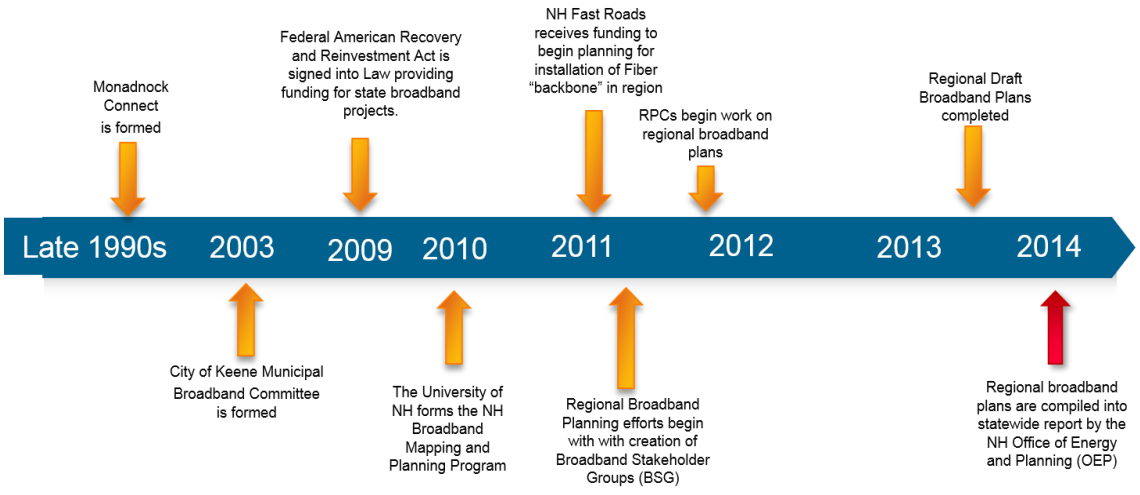
Over the course of the past decade, a range of initiatives have sought to encourage expansion and improvement of broadband infrastructure in the Southwest Region. The most notable of early efforts was the formation of Monadnock Connect in the late 1990s to address the need for high quality, reliable, state of the art and cost effective telecommunications services for large and small users. In 2001, this public/private collaboration of numerous business and nonprofit agencies received financial support from NH DRED, NH Community Development Finance Authority (CDFA), and other public and private contributions to build a broadband access network serving businesses and institutions in the Region. The goal of this project was to attract telecommunications providers to the area, while lowering the cost of broadband service for businesses and nonprofits.

In 2003, the City of Keene formed a Municipal Broadband Committee to examine broadband availability in the Southwest Region and determine goals, objectives, and strategies for addressing the many challenges associated with providing high-speed internet in rural, western NH. This Committee was composed of representatives of the City of Keene, private businesses, SWRPC, non-profit organizations, educational and medical institutions, and internet service providers. In 2009, the Committee established a series of objectives for advancing broadband in the Region and conducted preliminary mapping of broadband availability in communities.

Later in 2009, funding became available through the NTIA with support from the Federal American Recovery and Reinvestment Act to fund the expansion and development of broadband infrastructure and technology. UNH successfully applied for funds to build 750 miles of middle-mile fiber-optic infrastructure across the state. In the Southwest Region, this funding helped support the development of NH FastRoads and its effort to deploy middle-mile fiber-optic infrastructure in 35 communities in western New Hampshire and last-mile fiber-to-the-home in the towns of Rindge and Enfield. NH FastRoads is a collaboration of the NH CDFA, the Monadnock Economic Development Corporation (MEDC), and 42 communities in western New Hampshire.

Upon completion, NH FastRoads will allow any provider to lease space on its network to deliver high speed internet to customers. Profits received by NH FastRoads will be used to maintain existing and build new broadband infrastructure in the Region. The intent of this open-access network model is to encourage increased competition in the market for broadband service, potentially decreasing costs for consumers and reducing economic and technological barriers to future broadband expansion.

FIGURE 7. HISTORY OF BROADBAND PLANNING IN SOUTHWEST NH



UNH was also successful at procuring funding from the NTIA in 2009 to establish the NHBMPP. More information about the NHBMPP is described earlier in this Plan in the section entitled, *Project Background*. SWRPC and the other eight RPCs in NH received support from this program to develop nine, regionally distinct broadband plans. In 2011, the RPCs initiated the broadband planning process with the formation of regional broadband stakeholder groups (BSGs). Composed of representatives from diverse sectors such as health, local government, economic development, public safety, and education, BSGs were established to advise and guide RPC staff in the planning process. SWRPC staff worked closely with the Southwest Region BSG (SWBSG) to identify the diverse needs for and the challenges to improving broadband in the Region. The SWBSG helped staff establish potential strategies to address these needs and barriers and played a pivotal role in overseeing the development of this Plan.

BROADBAND AVAILABILITY

Since 2010, SWRPC has been working with UNH and other partners on NHBMPP's Broadband Mapping Program. This initiative is part of a national effort, led by the NTIA to create and maintain a searchable, public database of information on broadband availability in the United States. It is also the first comprehensive statewide effort to understand where broadband is currently available in NH.

As noted in earlier sections of this Plan, broadband is defined in terms of how fast the user's computer can download and upload information from the Internet. That capacity can be described in terms of how much data, measured in bits, can be transmitted per second, and is reported in kilobits (Kbps), megabits (Mbps), and gigabits (Gbps). When this project began, NTIA defined broadband as providing a minimum speed of 768 Kbps download and 200 Kbps upload. However, due to the limited functionality offered at these speeds, the NHBMPP chose to consider areas with available download speeds less than 768 Kbps as 'un-served' and areas with download speeds of less than 3 Mbps as 'underserved.'

The maps and information included in this section represent data received on broadband availability through UNH's direct work with over 40 of the state's 63 identified broadband service providers and through an inventory of over 4,000 community anchor institutions[10] (CAIs) across the state. This data is updated every six months to ensure information remains accurate and current. The information presented in the maps contained in this Plan is based on data collected through the summer of 2013 and submitted to NTIA in September 2013.

Information on the maps included in this section is displayed according to NTIA guidelines. Speeds shown are the maximum advertised speeds for the geographic features depicted, and must exceed the NTIA minimum definition for broadband speed, which was 768 kbps download and 200 Kbps upload at the time of this project, to be included. Actual speeds may vary due to the granularity and currency of the data, technological limitations, and service plan limitations.

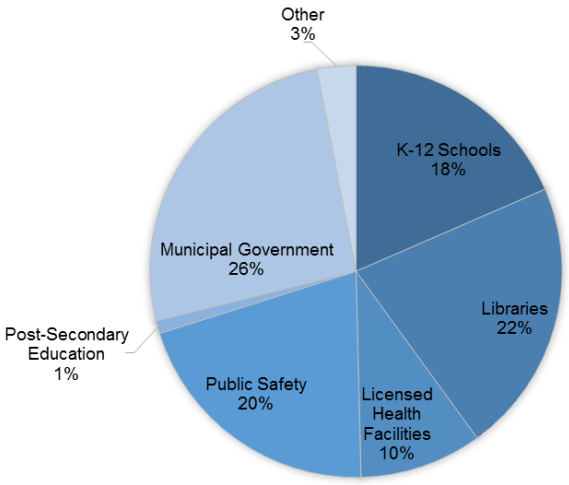
More information regarding the protocol utilized by UNH to collect, analyze and disseminate information on broadband availability received by service providers and CAIs in New Hampshire is included in Appendix D.

Community Anchor Institutions

Information regarding the Internet speeds, cost of service, type of technology, service provider, and level of satisfaction with current service was collected from each of 451 CAIs in the Southwest Region through a comprehensive survey completed by SWRPCs in 2010. Since that time, this information has been verified and updated semiannually by UNH and RPC staff.

Of the 451 CAIs surveyed, 86% (390) have access to broadband at their physical location and 13.5% (61) do not. Among the CAIs with broadband access, 358 were able to share information regarding broadband

FIGURE 8. COMMUNITY ANCHOR INSTITUTIONS BY TYPE



[10] Community Anchor Institutions are institutions of local and state significance and include municipally owned buildings, public safety facilities, licensed health facilities, K-12 schools, libraries, and higher education institutions.

service speed and technology of transmission. An overview of the share of CAIs with broadband access by category is depicted in Figure 8. The list below highlights the different categories of CAIs surveyed.

- Municipal government (e.g. town offices, highway departments, town recreation centers, etc.)
- Primary and secondary schools (e.g. public and private elementary, middle and high schools)
- Libraries (including public, school and hospital libraries)
- Licensed health facilities (e.g. hospitals, residential and nursing care facilities, diagnostic testing facilities, etc.)
- Public safety (e.g. fire departments, police stations, emergency management centers, etc.)
- Post-secondary education (e.g. universities and colleges and community education)
- Other includes non-governmental organizations such as chambers of commerce, human service and transportation agencies, and senior centers.

Among the CAIs surveyed, the most common type of technology used to deliver broadband is cable-modem (39% of CAIs surveyed), followed by asymmetric DSL (19%), and other copper wireline[11] (18%). Approximately 11 % of the CAIs surveyed have Fiber, while 1.5% rely on satellite. Table 2, illustrates the various types of broadband technology available at CAIs in the Region.

TABLE 2. TYPE OF CAI BROADBAND TECHNOLOGY

Transmission Technology	# CAIs	% of Total
No Data	22	5.9%
Asymmetric xDSL	74	19.5%
Symmetric xDSL	5	1.3%
Other Copper Wireline	69	17.7%
Cable Modem – DOCSIS 3.0	2	0.5%
Cable Modem	151	39%
Optical Carrier/Fiber to the End User	44	11.3%
Satellite	6	1.5%
Terrestrial Fixed Wireless – Licensed	17	4.4%
Total	390	100%

The download and upload speeds experienced by CAIs vary significantly. Of the 390 CAIs with broadband access, 39% are considered 'underserved,' with download speeds that are less than 3 Mbps. The majority of these CAIs (53%) have access to download speeds that are less than 6 Mbps. The only CAI that reported download speeds greater than 100 Mbps was Cheshire Medical Center, one of the Region's two major hospitals. It should be noted that CAIs were not always able to report download or upload speed. Figures 9 and 10 show the breakdown of speed tiers reports by the CAIs surveyed. The field, 'No Data,' indicates that this information was not shared by the CAI surveyed.

Map 1 illustrates the location and broadband access status of 451 CAIs of local and regional significance in the Southwest Region. The various types of CAIs are represented by different colors on this Map (green = K-12 schools; red = libraries; pink = colleges and universities; blue = public safety; brown = health/medical facilities; purple = governmental organizations; yellow = other non-governmental organizations). Circles represent CAIs that identified having access to broadband and/or a minimum of 768 Kbps downstream and 200 Kbps upstream. Squares represent those CAIs that do not have access to broadband.

[11] Other copper wireline are technologies that use phone lines to transmit data such as T-1

FIGURE 9. CAI DOWNLOAD SPEED TIERS

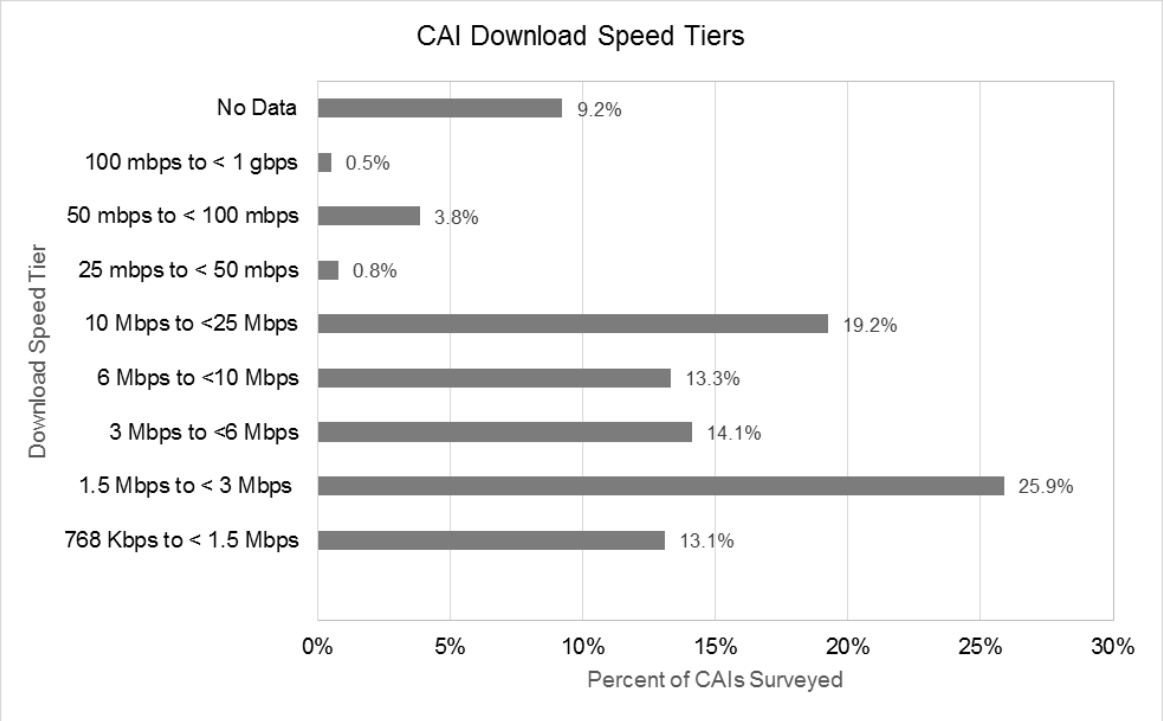
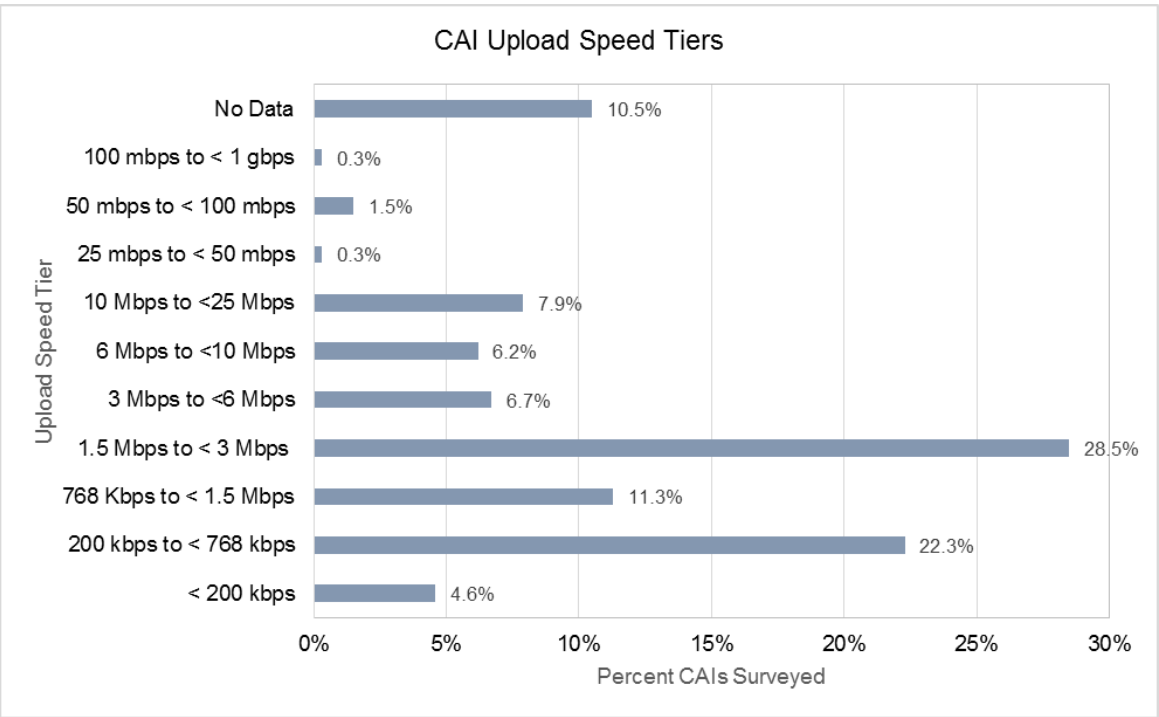
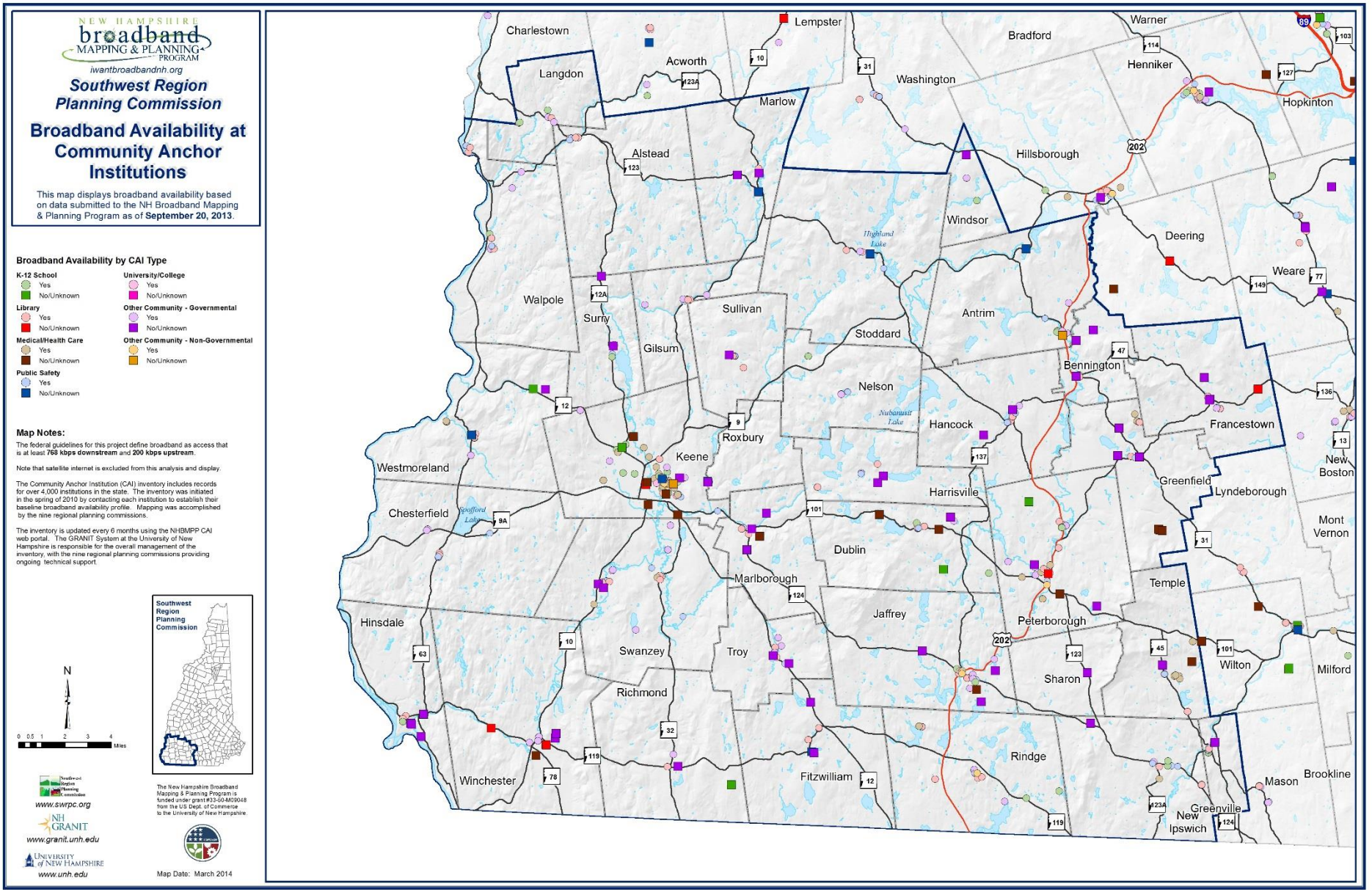


FIGURE 10. CAI UPLOAD SPEED TIERS



MAP 1. BROADBAND AVAILABILITY AT CAIS IN SOUTHWEST NH



Maximum Advertised Download Speed

Map 2 displays the maximum download speeds available to customers as advertised by service providers in the Southwest Region. Service providers submitted data to the NHBMPP in a range of geographies including road segments, addresses, Census block groups, Census tract, etc. It is important to note that for mapping purposes this information was aggregated and mapped at the U.S. Census block level. The Census block is the smallest geography measured by the U.S. Census Bureau. These blocks are determined by population and can be greater than 2 square miles in size, especially in less densely populated areas. If a broadband provider offers service to a location within a census block, the entire block is depicted as having access to this level of service.

In addition, the information presented does not differentiate between speeds provided for business/commercial service and residential broadband service. Because of these limitations, Map 2 and Map 3 depict overstated levels of broadband service that may not reflect the types of service available to the majority of residences, businesses and CAIs in the Region.

The different colors presented on Map 2 represent speed tiers. Much of the Region located in the greater Keene area is shown as having access to maximum advertised downloads speeds greater than 50 Mbps and less than 100 Mbps. While many of the residents in this area may not have access to such speeds there are businesses and institutions such as Keene State College and Cheshire Medical Center that do. The same situation is true for those areas of the Region shaded in pink on the map, which represent areas with access to maximum download speeds greater than 100 Mbps and less than 1 Gbs. No areas of the Region shown on Map 2 have access to download speeds of 1 Gbs or greater. The dark green areas on this map represent Census blocks with maximum advertised download speeds of 1.5 Mbps or less. These areas include small segments of Marlow, New Ipswich, Rindge, Sharon, and Troy.

Degree of Competition for Broadband Availability

Map 3 shows the number of broadband providers actively offering service within the Southwest Region. Providers represented on this map include fixed wireline, wireless, and mobile Internet service providers. Similar to Map 2, the information is displayed at the Census block level. Areas shaded in colors such as dark orange or red represent locations with greater numbers of broadband providers serving an area. Areas shaded in light to dark green represent areas with five or less providers. Areas with the highest concentrations of broadband providers include Keene, Swanzey, and Jaffrey. Areas with significantly fewer options for providers include, but are not limited to, the northeast (Marlow, Stoddard, Windsor) and southern (Richmond, Fitzwilliam, Rindge, Winchester) areas of the Region. Presumably, the more providers represented in an area, the lower the cost of service as a result of competition among providers.

Online Speed Test Data

To enhance the dataset on broadband service available at the local level, UNH, in cooperation with SWRPC and other RPCs, collected broadband access information from residents of the Region through an online broadband speed test and survey. This online speed test measures the download and upload speeds available at a particular location. SWRPC promoted use of the speed test and survey at events throughout the Region and encouraged municipalities to share links to it on their websites. Some communities distributed and collected paper copies of this survey to residences.

Within the Southwest Region, broadband service information has been collected from 572 discrete address locations through the online speed test. This information does not differentiate between residential and commercial locations. However, for locations where a speed test was conducted multiple times, the maximum speed recorded is used. Analysis of speed test results for the Region shows that approximately 27% of those who conducted the test are at locations considered "un-served", meaning their Internet speeds are less than 768 Kbps downstream and 200 Kbps upstream (*see Figure 2*). Approximately 43% are considered unserved are considered underserved, with recorded download speeds between 768 Kbps and less than 3 Mbps. 31% are served, with download speeds of 3 Mbps or greater. Download speeds of 3 Mbps are the minimum level of broadband needed for sending and receiving medium to large files, streaming video content, and having basic video conferencing capabilities. These speed test numbers reveal that there are significant gaps in access to adequate Internet speeds around the Region.

FIGURE 11. NHBMPP ONLINE SPEED TEST

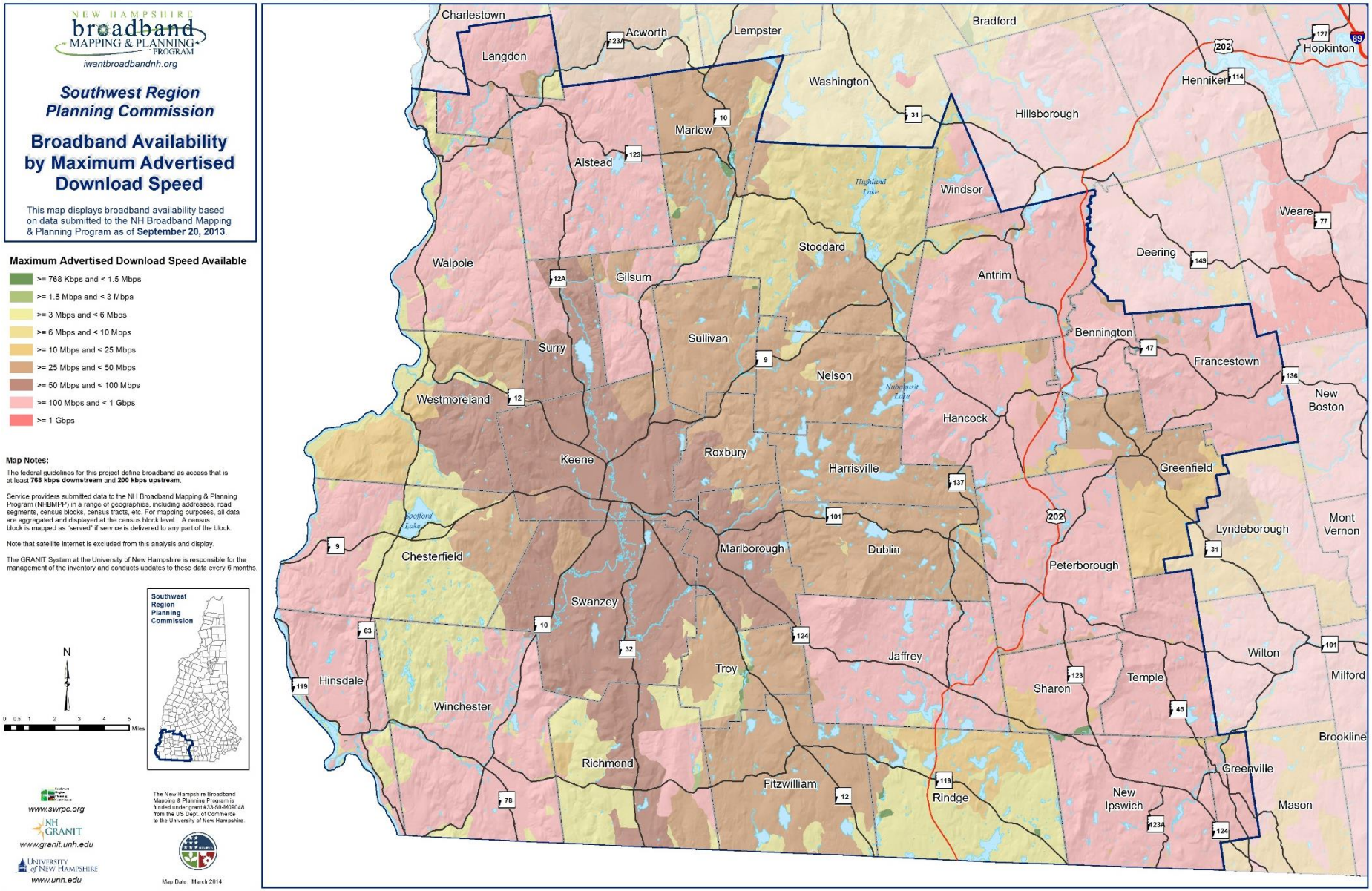
Staff utilized Geographic Information Systems (GIS) software to map the locations and related broadband speeds of the 572 respondents. Map 4 depicts these locations by actual download speeds. In contrast to information on maximum 'advertised' broadband speed shared by broadband providers through the NHBMPP (Map 2), the speed test results show 'actual' download speeds available at a given time according to the Speed Test (Map 4). A number of factors impact the 'actual' speed experienced at a location. Some of these factors include proximity of the device to the infrastructure, the number of users utilizing the service (in the case of DSL and Cable technology, peak demand will result in decreased speeds), and the type of technology used.

TABLE 3. BROADBAND SPEED TEST LEVEL OF SERVICE

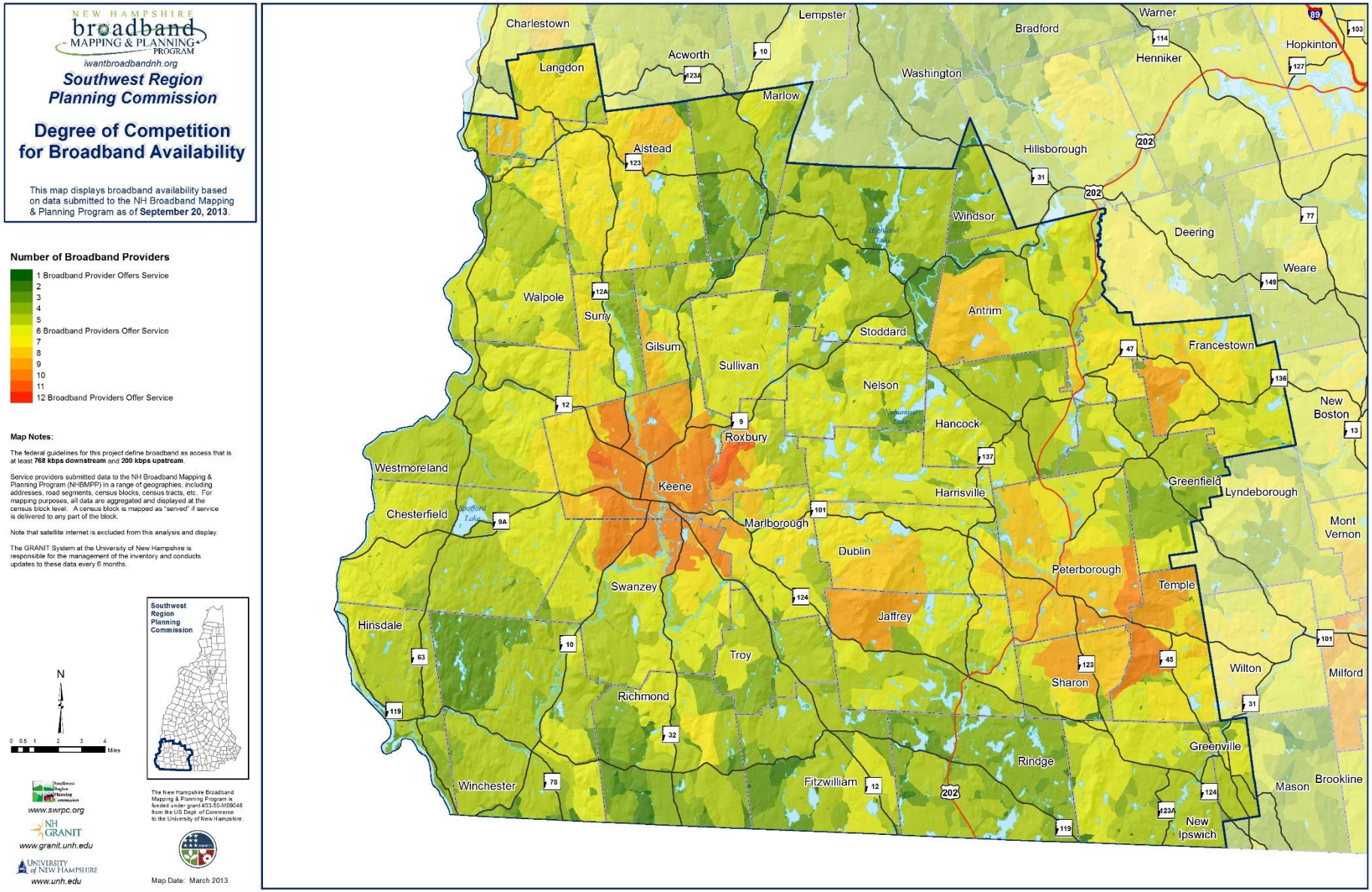
Level of Service by Download Speed	# Addresses	Percent of Total
Served (> 3 Mbps)	176	30.8%
Underserved (768 Kbps to less than 3 Mbps)	244	42.7%
Unserved (Less than 768 Kbps)	152	26.6%
Total Speed Tests	572	100%

Additional maps displaying broadband availability in the Southwest Region are included in Appendix E.

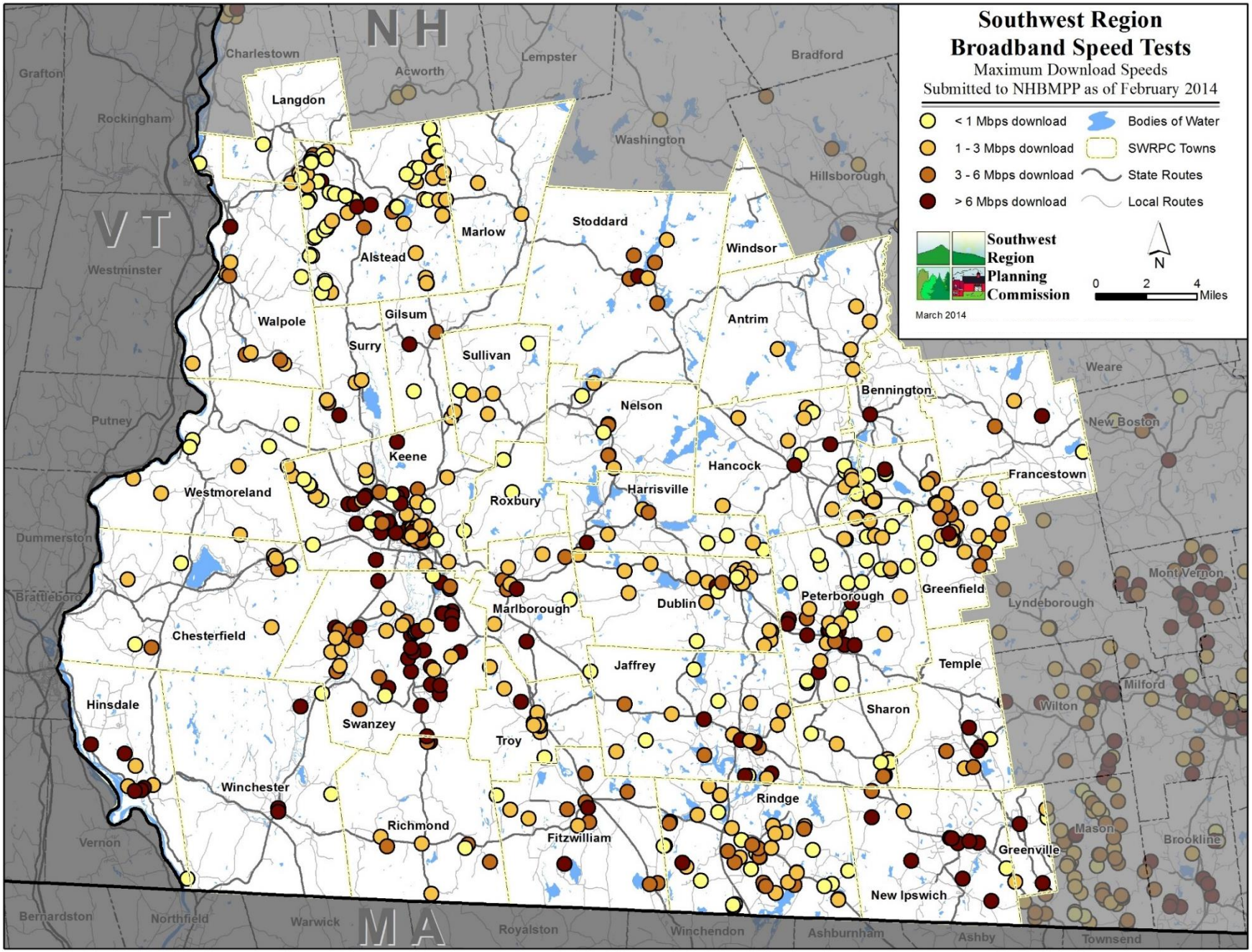
MAP 2. BROADBAND AVAILABILITY BY MAXIMUM ADVERTISED DOWNLOAD SPEED IN SOUTHWEST NH



MAP 3. DEGREE OF COMPETITION FOR BROADBAND AVAILABILITY IN SOUTHWEST NH



MAP 4. BROADBAND SPEED TESTS IN SOUTHWEST NH



BROADBAND DEMAND

In an effort to better understand the demand for broadband in the Region, SWRPC staff along with members of the SWBSG employed a variety of approaches to gathering information on the uses of and needs for broadband. These methods included public forums, an online residential broadband survey, a series of sector-specific focus groups, and a household survey conducted by the UNH Survey Center. Through these efforts, much was learned about the range of needs and barriers related to broadband throughout the Region. An overview of these activities and related observations is described in the following sections.

Public Broadband Forum

SWRPC held its first of two public forums in September of 2012 at the Town of Dublin Public Library. This event was an opportunity to share information about the NHBMPP and to gather input from the public on their broadband needs and concerns. Nearly forty individuals attended this forum including residents, business owners, and municipal officials.

Public feedback received at this forum was largely focused on frustration and concern for the lack of broadband access at the residential level in the Region. Attendees emphasized the negative impacts that limited broadband coverage has on the economic and education sectors. Other concerns addressed included the need for legislation requiring broadband providers to offer the same levels of service to rural areas as they do in more urban areas. Multiple participants expressed interest in the development of a toolkit for communities to use in understanding broadband and identifying opportunities for broadband expansion at the local level.

SWRPC held its second public forum on September 25, 2013 at the Historical Society of Cheshire County in Keene, NH. The focus of this event was on gathering public comment and feedback on the draft version of this Plan.

FIGURE 12. CAROLE MONROE, EXECUTIVE DIRECTOR OF NH FASTROADS, AT THE 2012 FORUM

Household Survey

During the spring and summer of 2013, the UNH Survey Center[12] conducted a telephone survey of 2,935 New Hampshire adults as part of the Granite State Future[13] initiative as well as the Broadband Planning effort. The aim of this survey, which had a response rate of 33% and a margin of sampling error of +/- 2.2%, was to better understand the perspectives and needs of NH residents with regard to housing, transportation, land use, economic development, health, and the environment. Included in this survey[14] was a series of questions to better understand the current landscape and demand for broadband in the state.

Due to similar landscape and demographic characteristics, the Southwest Region and the area comprising the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) were considered one region for the purposes of this survey. Detailed below are responses to the series of survey questions regarding broadband access, along with a brief summary of findings for both the state of NH and the Southwest/Upper Valley regions.

Question 1: Do you have access to the Internet at home?

Geography	Yes	No	Don't Know	# Responses
NH	91%	9%	0%	2,925
Southwest / Upper Valley	84%	16%	0%	400

Of those surveyed, 84% of regional residents responded that they had internet access at home. However, households that earned less than $40,000 a year reported having a substantially lower rate of internet access. While this question does not differentiate between types of broadband technology (DSL, cable, fixed wireless, satellite, etc.), it presents an understanding of the general availability of Internet access at the residential level.

Question 2: Which of the following is the most important reason why you don't have internet access at home?

Geography	It is not available where I live	I have access at another place such as my job	It is too expensive	I don't know how to use it	I don't need it	I don't have an adequate computer	Some other reason	Don't know	# Responses
NH	5%	9%	20%	8%	26%	9%	21%	2%	262
Southwest / Upper Valley	7%	9%	23%	1%	25%	10%	21%	3%	64

Approximately 23% of the adults surveyed in the Region reported cost being the primary reason why they do not have Internet access. 25% of regional respondents reported that the primary reason for not having Internet access is that they do not need it.

[12] The UNH Survey Center is an independent, non-partisan academic survey research organization and a division of the UNH College of Liberal Arts.
[13] A partnership of the state's nine RPCs and other state agencies and organizations, funded by the Department of Housing and Urban Development's Sustainable Communities Initiative, to update regional plans in New Hampshire.
[14] NH Regional Planning Commissions: A Granite State Future 2013 Statewide Survey, Upper Valley & Southwest Region Report. Tracy A. Keirns, M.A., Et al.

Question 3: What type of connection to the Internet do you have at home?

Geography	Dialup	DSL	Cable	Fixed Wireless	Cellular	Satellite	Fiber	Other	Don't Know	# Responses
NH	1%	16%	68%	5%	2%	2%	2%	1%	3%	2,646
Southwest / Upper Valley	1%	33%	52%	5%	3%	3%	1%	1%	2%	335

The predominant broadband technology available in the Region is cable (52% of connections), followed by DSL (33%). Compared to the rest of NH, significantly more households in the Region have a DSL connection (33% versus 16%). Only 1% of respondents, both at the state and regional level, identified having a dial up connection.

Question 4: If on dialup or satellite, why?

Geography	Only Option Available	Too Costly to Change	I Don't Know What Other Options are Available	Other	Don't Know	# Responses
NH	26%	9%	2%	10%	49%	158
Southwest / Upper Valley	50%	11%	5%	5%	29%	21

When asked why residents in the Region were using a dialup or satellite connection, 50% noted that it is the only option available.

Question 5: Why are you using your current provider?

Geography	I'm happy with current provider	Only option available	Too costly to change	Too much effort to change	Learning curve is too steep	I don't know what other options are available	Other	Don't Know	# Responses
NH	22%	39%	5%	3%	0%	2%	23%	6%	2,631
Southwest / Upper Valley	24%	43%	3%	3%	0%	1%	23%	3%	335

Of the regional residents surveyed, 43% noted that the reason they are using their current service provider is because it is the only option available.

Question 6: What is your monthly bill?

Geography	Less than $20	$20-49	$50-99	$100 or more	Don't know	# Responses
NH	3%	25%	29%	24%	19%	2,590
Southwest / Upper Valley	5%	32%	31%	16%	17%	329

The majority of respondents in the Region appear to spend between $20 and $99 each month for broadband service. Of which, 69% pay for bundled TV and/or phone service (see question 7).

Question 7: Do you pay for bundled service (Internet, TV, Phone)?

Geography	Yes	No	Don't Know	# Responses
NH	76%	22%	2%	2,624
Southwest / Upper Valley	69%	29%	2%	331

Question 8: Do you use the Internet to check your email at home? If Yes: Is the speed of your internet connection too slow, or is the speed of your Internet connection adequate for this?

Geography	Do not check email at home	Do, but connection speed is slow	Do, and connection speed is adequate	Don't Know	# Responses
NH	4%	5%	90%	1%	2,622
Southwest / Upper Valley	4%	6%	89%	1%	334

Question 9: Do you use the internet to shop on-line at home? If YES: Is the speed of your internet connection too slow, or is the speed of your internet connection adequate for this?

Geography	Do not shop online	Do, but connection speed is slow	Do, and connection speed is adequate	Don't Know	# Responses
NH	19%	5%	75%	0%	2,622
Southwest / Upper Valley	19%	7%	73%	0%	334

The results show that most residents (73%) are able to shop online with adequate internet speeds (considered 3 Mbps downstream and 1.5 upstream), with 7% reporting slow speeds.

Question 10: Do you use the internet to watch on-line video, such as on YouTube or NetFlix at home? IF YES: "Is the speed of your internet connection too slow, or is the speed of your internet connection adequate for this?"

Geography	Do not watch online video at home	Do, but connection speed is slow	Do, and connection speed is adequate	Don't Know	# Responses
NH	37%	10%	53%	1%	2,622
Southwest / Upper Valley	41%	12%	47%	1%	334

Nearly half of the respondents to this question noted that they watch streaming content using the Internet and deem it to be adequate. Whereas 12% claim that the Internet connection is too slow.

Question 11: Do you use the Internet to connect to other computers using VPN (Virtual Private Network) at home?

Geography	Do not connect to other computers at home?	Do, but connection speed is slow	Do, and connection speed is adequate	Don't Know	# Responses
NH	66%	4%	27%	2%	2,612
Southwest / Upper Valley	74%	3%	21%	2%	334

Question 12: Overall, do you consider your internet connection at home to be adequate for your uses?

Geography	Yes	No	Don't know	# Responses
NH	92%	7%	1%	2,630
Southwest / Upper Valley	88%	9%	2%	333

According to these results, 88% of regional respondents reported having adequate Internet for their use at home with 9% saying they had inadequate broadband.

Question 13: How much more (if any) would you willing to pay for faster speeds?

Geography	Nothing	25% more per month	50% or more per month	Don't Know	# Responses
NH	85%	11%	2%	3%	2,622
Southwest / Upper Valley	84%	12%	3%	2%	334

According to the survey, 84% of regional residents are unwilling to pay additional money for increased broadband speeds (compared to 85% statewide) if it were offered.

Question 14: Do you favor or oppose - using municipal funds to provide the following utilities to existing and potential development: Broadband Access? If FAVOR: Would you be willing to pay higher fees or taxes to pay for it?

Geography	Favor; higher taxes	Favor; no taxes	Oppose	Don't Know	# Responses
NH	26%	16%	51%	6%	2,910
Southwest / Upper Valley	35%	16%	44%	6%	395

Within the region, 35% of those surveyed said that they favor using municipal funds to provide updates to new installation of broadband infrastructure compared to 26% statewide.

SECTOR BASED ANALYSIS

Throughout the fall of 2012 and winter of 2013, SWRPC convened a series of focus groups to better understand the broadband needs and concerns of various sectors. Representatives from the Region's education, economic development, local government, public safety, communications, and medical fields were invited to participate in sector specific focus groups. Each focus group explored questions related to the reliance of the sector on broadband as well as the broadband challenges faced by each sector now and into the future. An overview of primary findings from each of these focus groups and related interviews is detailed in the sections below.

Education Sector

Teachers, administrators, staff and technology professionals from a sample of the Region's primary, secondary and higher education institutions participated in the education focus group, which underscored the increasing dependence of the education sector on reliable and high performing broadband connections. Although the educational experience of today's students is profoundly influenced by broadband-enabled resources and devices, schools in the Southwest Region of all sizes are struggling to keep up to speed with the demands for improved broadband connections.

- ***A predominant theme of this focus group was the need for students to have access to high-speed Internet connections both inside and outside the classroom.*** Many educational professionals struggle assigning projects that require Internet access at home because some students do not have residential broadband access. Even students with access to the Internet at home can experience challenges connecting to graphic-intensive websites or downloading large files due to limited bandwidth. A representative from a local community college noted that the same concern is felt by their educators and students, who rely on Internet-based tools to access and submit coursework and assignments. It was clear that disparate and inadequate broadband availability poses additional challenges for learners seeking more flexible options like online and distance learning courses and programs.

  > *Innovative ideas like "flipping the classroom" are out of reach for many students and teachers, not only because of the inadequate connections at school, but also in the home. A staff person at a local school noted that students find ways to work around this issue by taking a laptop or tablet to a local Wi-Fi hotspot in a library or restaurant to conduct online assignments and research.*

- ***All participants expressed the need for improved and increased broadband connections at their facility or institution.*** Even schools with access to advertised speeds of 1 Gbps or greater noted that their demand for bandwidth often exceeds what is available. According to SWRPC's CAI inventory of K-12 schools in the Region, a large share (44%) of the Region's schools are considered underserved, with maximum download speeds of 3 Mbps or less.[15] From the data collected in this survey, it appears that broadband availability tends to improve with grade level. For example, the majority (61%) of public elementary schools in the Region are underserved, and 5.6% are unserved. Although public middle schools have improved speeds, a significant portion (37.5%) are underserved. Among the Region's 7 public high schools, one (14.3%) is underserved. All of the Region's colleges and universities are considered adequately served by broadband. This information is outlined in Table 4.

[15] NHBMPP Community Anchor Institution database, 2013

Considering the broadband needs of these schools, which include but are not limited to accessing online learning modules, conducting online standardized testing, downloading digital textbooks, and utilizing broadband-enabled platforms for communicating with students and parents, speeds of 3 Mbps or less are not nearly sufficient. The State Educational Technology Directors Association recommends that K-12 schools have access to broadband speeds of 100 Mbps for every 1,000 students and staff by the year 2014 and 1 Gbps by 2017. According to this standard, we have a long way to go.

TABLE 4. LEVEL OF BROADBAND AVAILABILITY BY SCHOOL TYPE IN SOUTHWEST NH

School Type	Total Surveyed	% Unserved	% Underserved	% Served
Public Elementary School	36	5.6%	61.1%	33.3%
Public Middle School	8	0%	37.5%	62.5%
Public High School	7	0%	14.3%	85.7%
Colleges/Universities	3	0%	0.0%	100%

- *For teachers, limited broadband connectivity inhibits their ability to utilize innovative teaching methods* such as 'flipping the classroom' or to capitalize on web-based resources such as Google Earth that can enhance the learning experience and engage students in nontraditional ways. 'Flipping the classroom' is a term used to describe a model of teaching in which a student's homework is to review traditional lecture content via online methods such as videos posted to YouTube, podcasts or other interactive web tools. This allows teachers to extend the lesson of a particular topic, prompting more dialogue in the classroom as well as providing parents an opportunity to see what his or her child is learning in school. Teachers and education professionals are also limited in their ability to customize learning processes to particular students. It was noted by one participant in the focus group that it can take multiple hours to download education applications and resources available to students with Individualized Education Plans (IEPs).

- *Disparity between students with and without access to adequate broadband can have far-reaching impacts on student performance and readiness.* Schools that lack adequate broadband capabilities may be unable to provide students with the necessary training and exposure to 21st century skills and resources that make them more competitive candidates for higher education and the workforce. This gap in digital literacy is evidenced by education professionals at all levels, who have witnessed the difference in students transferring from schools in areas unserved or underserved by broadband and those who have had previous exposure to broadband-enabled learning opportunities. Starting in the 2014-2015 academic year, schools throughout the state will be required to implement testing standards, known as the Smarter Balanced Assessment Consortium, which will be based predominantly online. There is a concern that schools with slower and unreliable Internet connections will experience difficulty in completing these tests.

- *Participants of the focus group also noted challenges related to raising the necessary funds to improve the broadband infrastructure and technology available in schools.* Despite programs like E-Rate, which provides discounts to assist schools and libraries in the United States to obtain affordable Internet access, the costs to upgrade and maintain telecommunications infrastructure can be prohibitive, especially in older facilities.

The widespread use of multimedia and video conferencing programs such as YouTube, Skype, and Khan Academy have revolutionized how students are learning and experiencing new topics. However, as a staff person from a regional high school explained, many schools in the Region are underserved in their broadband capacity. This staff person noted that "it can take some students 15-20 minutes to load a single webpage during peak hours of school day."

Economic Development Sector

To better understand the broadband related needs of the economic development sector, staff facilitated a focus group with members of the SWRPC's Economic Development Advisory Committee (EDAC). EDAC is comprised of business owners, municipal officials, and representatives of the region's chambers of commerce, economic development corporation, higher education institutions, and non-profit organizations.

- ***A significant theme of this focus group was the importance of reliable broadband to the Region's ability to successfully compete in the global economy.*** Participants emphasized that long term regional economic growth and vitality is dependent on the capacity of businesses and institutions to keep pace with rapidly evolving technology. However, many expressed uncertainty about their ability to do so; especially, as neighboring states invest greater resources and support for expanding and upgrading broadband capabilities than NH. If businesses are unable to access or utilize similar speeds and technologies as those available in surrounding states and across the globe, they will lag behind competitors.

- ***It was noted that it is becoming increasingly difficult to attract new businesses and residents to the Region because of inadequate broadband infrastructure and limited information on the location and quality of existing broadband resources.*** Representatives from the real estate sector stated that the question, 'what type of broadband service is available?' is routinely addressed by clients and is often one of the first questions asked about a property. In many instances, businesses need additional information beyond whether there is broadband available at a site. This information can include the type of technology, download and upload speeds, redundancy, and latency of the available broadband infrastructure. However, without a public source of information on the availability of broadband at the address level, answering this question can be a significant challenge.

- ***Residents working from home need access to reliable residential broadband service that is capable of performing tasks such as large data transfers, videoconferencing, and remote computing.*** Nationally, many businesses are adopting the practice of telecommuting, which involves employees working remotely from home using a computer or other devices. According to survey[16] data collected from the U.S. Bureau of Labor Statistics between 2006 and 2010, 24% of employed Americans reported that they work at least some hours from home each week. Additionally, more than half (51.6%) of all businesses in the United States that responded to the U.S. Census Bureau's 2007 Survey of Business Owners were operated primarily from someone's home in 2007.

> *More than half (51.6%) of all businesses in the United States that responded to the U.S. Census Bureau's 2007 Survey of Business Owners were operated primarily from someone's home in 2007.*

Public Safety Sector

Representatives from the police, fire, medical, emergency management, municipal and county government sectors attended the public safety focus group, which focused on the opportunities broadband offers for improving the ability of first responders and other sector stakeholders to monitor

[16] American Time Use Survey—2010 Results, USDL11-0919, U.S. Bureau of Labor Statistics, June 22, 2011. Accessed on September 18, 2013 at http://www.bls.gov/news.release/archives/atus_06222011.pdf

public safety and respond to emergencies. For emergency and public safety officials to improve the methods by which they protect public health and safety, fast and reliable broadband is needed in all areas of the Region.

- ***In today's digital age, there are a suite of broadband-enabled devices and technologies that can be used to enhance channels of communication among public safety and emergency management officials; however, in order for these tools to be effective, ubiquitous and reliable high performing broadband is often necessary.*** For example, the Southwest NH Fire Mutual Aid Dispatch Center, which dispatches fire and ambulance service in 78 communities in southwest NH and southeastern Vermont, is currently unable to transmit live feeds despite having the technology available to do so due to the limited bandwidth and broadband connectivity available at its monitoring locations. Universal broadband access would enable emergency medical technicians to share information digitally and in real time to hospitals and emergency facilities from the ambulance or point of response.

- ***Lack of understanding of regional broadband availability, presents challenges for emergency personnel, who would like to rely on broadband as part of emergency response efforts.*** Broadband can be used to share information and updates with the public on emergency or disaster warnings affecting the Region. In the event of a man-made or natural disaster, remote triage centers known as Points of Dispense (POD), would be reliant on adequate broadband connectivity to provide relief and services to those injured or affected by a disaster. However, publically available information on the actual broadband capabilities at proposed POD locations is limited.

> *"Proper communication capabilities are essential, especially during an emergency, such as a flood or an ice storm. Live video feeds from Points of Dispense (POD), which can be placed in the field and act like a mobile hub, are challenging due to sparse internet connections."*
>
> *-Eileen Fernandes, Coordinator of the Greater Monadnock Public Health Network*

- ***Increased training opportunities and improved guidance is needed on how public safety stakeholders can keep current with changing demands and technologies.***

Local Government

The Region's local government sector plays an instrumental role in shaping and sustaining community support functions and services. Town administrators, professional and volunteer planners, selectmen, and economic development committee members from across the Region were invited to participate in the local government focus group, which explored the evolving influence of broadband on the municipal realm. Although focus group participants emphasized the importance of improved broadband access at the residential level, they also discussed specific needs and opportunities for integrating broadband into municipal services.

- ***The importance of having reliable, redundant Internet connections was identified as a predominant need of this sector.*** More specifically, there is a need for built-in backup connections in the event of service interruptions. Focus group participants shared their experiences of lost productivity and frustration from internet connections that time out frequently, which impede the ability of municipal staff to complete necessary administrative tasks.

- ***Broadband offers significant opportunities for the local government sector to save resources and increase efficiencies.*** It was noted that the ability to gather, access and manage data has vastly improved with the advent of online tools such as cloud-based storage, which provides space for

data to be electronically and securely stored and remotely accessed, and file sharing websites such as Dropbox. In NH, the period of time for retaining and preserving municipal records including voter registrations, subdivision applications, police and personnel files, is governed by state standards and procedures. According to NH RSA 33-A: 5-a, electronic records that are designated to be retained for less than 10 years may be retained in their electronic form. The ability to store electronic documents online via cloud-based storage can save physical space in crowded municipal offices as well as space on computer hard drives and servers. Remote record storage offers increased security for preserving these records in the event of a fire, flood or other disaster.

Another broadband-enabled opportunity for local governments to save resources such as time and money is the ability to video-conference. Videoconferencing is a web-based capability for people in separate locations to communicate in real-time by transmission of high quality audio and full-motion video images. Focus Group participants noted that utilizing videoconferencing capabilities, which require minimum download speeds of 3 Mbps and minimum upload speeds of 1 Mbps, to replace in-person meetings can reduce costs related to travel for consultants, lawyers, and municipal staff. Some municipalities are using videoconferencing tools to interview prospective job candidates, which reduces costs and expands the pool of potential applicants for certain positions.

- ***The task of sending and receiving large files can be difficult for many municipalities in the Region with slower broadband connections.*** It was reported that file sharing websites such as Dropbox are valuable tools for municipalities to efficiently upload, download and share files of medium and large sizes. However, this process can also take a long period of time depending on available speeds.

- ***Expanded broadband can help improve the ability of residents to access government services.*** Some municipalities in the Region are offering expanded options for residents to perform tasks online such as paying bills and fees, completing forms for permitting and registration. Hosting these services online allows municipalities to expand citizen access to the town offices beyond its physical location and hours of operation.

Health/Medical

To identify current and future broadband needs of the health/medical sector, SWRPC staff conducted interviews with representatives from a range of health facilities in the Region. Many of the broadband needs addressed in these interviews are similar to those examined in the sectors described above.

- ***In recent years, staff at health facilities have noticed an increased reliance on broadband-supported devices and applications to perform and streamline administrative functions*** such as billing, record keeping, and data management. However, the most important use of the Internet identified by those interviewed is managing Electronic Health Records (EHR)[17]. EHR software, which is web-based, is an important aspect of health and human service agency operations. It enables providers to securely store and manage health records and to share information across different health care settings.

  Since January 2014, digital record-keeping is required of public and private healthcare providers as part of federal mandates enacted by the Affordable Care Act. Currently, any health care provider funded through the state is required to maintain EHR. It was noted that unreliable broadband connections and lack of bandwidth impact the ability of offices to connect to EHR software systems. Those interviewed expressed concern for keeping up to date with technology to support upgrades to this software and for maintaining privacy of health records.

[17] Electronic Health Records is a digital record of health related information about a patient that can be shared across different health care settings via information networks or exchanges.

- ***Advances in telecommunications technology have significantly enhanced the ability of the medical sector to expand access to health care.*** A myriad of technology solutions are available for health specialists to communicate with and deliver services to patients, clients, and colleagues via nontraditional channels such as videoconferencing, remote patient monitoring[18], and 'cloud-based' digital medical imaging. These innovations are driven by the need of the medical sector to decrease costs through operational efficiencies while expanding access to and improving quality of care. Telehealth, the delivery of health-related services over telecommunications technologies, is dependent on adequate broadband availability throughout the state. However, widespread and adequate broadband availability is needed for telehealth to be successful in the Region.

  Telehealth is a tool that can greatly benefit the Southwest Region, which has limited public transportation options and an aging population. Numerous studies cite the inevitable increase in New Hampshire's older population and a diminishing younger, family age population. In one report it was noted that the population age 65 and over will almost certainly double in the next two decades.[19] With these demographic changes comes concern for increases in the cost of providing state and local services, as well as health care. Telehealth can increase access to care and help residents age in place. It can be used to substitute or delay the need for nursing home care, reducing costs to families.

> *In our connected world, many fields are changing to utilize broadband as a way to increase productivity and communication. The public health field is no different. Telehealth, which uses the internet to enhance capabilities, allows physicians and other medical professionals to communicate with patients on the other side of the world via video conferencing, live vital readings, and interactive media.*

Media/Communications

Increased reliance on broadband has influenced nearly every aspect of the media/communications sector from how people access information and communicate with each other, to how they exchange and market ideas. To better understand the needs of this sector, SWRPC facilitated a focus group discussion with representatives from regional newspapers, publishing, marketing, web development, and video production fields.

- ***A central theme of this focus group, was the increasing demand from consumers to quickly and conveniently access information online.*** A representative from a regional newspaper noted that nearly half of the newspaper's subscribers are reading the paper online. Smart phones and tablets have become preferred devices for accessing news while social media sites such as Facebook and Twitter are leading platforms for sharing and communicating information.

- ***There is a demand for highly visual media and interactive websites and tools to communicate information.*** Despite the ability of some organizations and businesses to accommodate demand for highly visual online content, many are limited by the consumer's ability to access Internet connections that support these applications.

[18] Remote patient monitoring, also called homecare telehealth, is a type of ambulatory healthcare that allows a patient to use a mobile medical device to perform a routine test and send the test data to a healthcare professional in real-time.
[19] Johnson, Kenneth M. New Hampshire Demographic Trends in the 21st Century. Carsey Institute. 2012. Accessed on March 21, 2014 at http://www.carseyinstitute.unh.edu/publications/Report-Johnson-Demographic-Trends-NH-21st-Century.pdf.

Sector-Based Analysis Summary

Most of the focus groups addressed similar challenges and opportunities related to broadband. These themes are outlined in Table 5 below.

TABLE 5. COMMON THEMES AMONG SECTORS

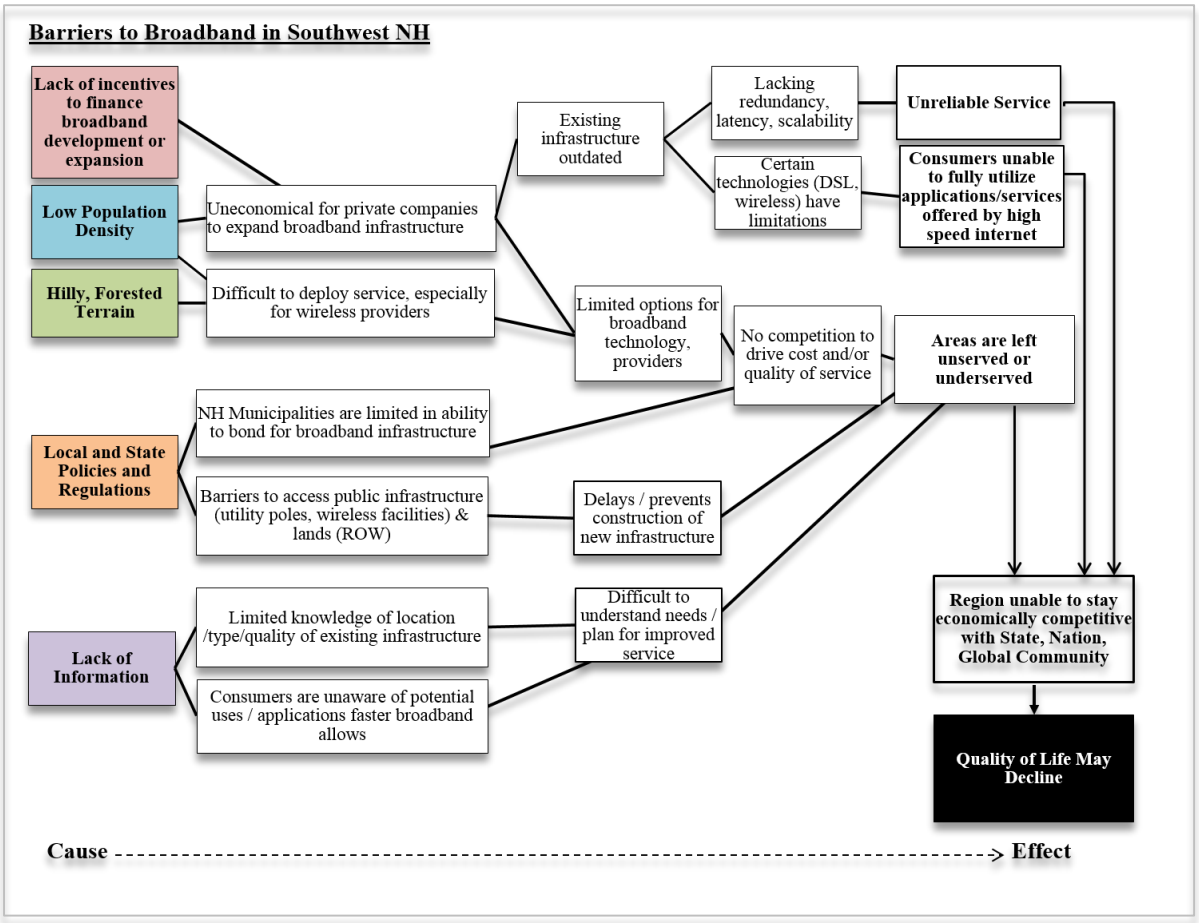
Opportunities:
▪ There is a perception that better broadband will lead to increased savings from efficiencies and increased productivity and decreased costs of services.
▪ Increased broadband at the residential level expands possibilities for improved healthcare, access to services and economic development.
▪ Sharing, storing, and backing-up data could be made easier by utilizing "cloud" based storage options.
Threats:
▪ In order to remain economically competitive and sustain high quality of life, the state and Region need access to applications that are becoming standard in other parts of the world such as videoconferencing.
▪ Redundant and reliable broadband connections are critical for all sectors.
▪ There is concern that New Hampshire will fall behind neighboring states of Vermont, Maine, and Massachusetts with planning for broadband.
▪ College graduates, businesses, and potential home-buyers that are accustomed to faster broadband speeds, might not be interested in locating to communities where many households are either un-served or underserved.
▪ Students need access to good internet connections at home to access online courses, educational opportunities, and to stay competitive with their peers across the state, nation, and world.
Challenges:
▪ It is difficult for organizations/businesses to keep up with rapidly changing technology. Many lack necessary resources/funding for adequate IT support services.
▪ The primary barriers to accessing better service are cost and/or lack of provider choice in a given area.
▪ There is limited knowledge of what service types/providers are available at the address level. This information directly impacts decisions made by businesses and individuals seeking to move here and should be made publically available.
▪ Many of the broadband needs/barriers affecting each sector stem from/are related to residential areas not having access to sufficient broadband.
▪ The state/federal government mandates much of what is happening in communities, schools, and medical facilities with regards to broadband. Better broadband is becoming more of a necessity for these institutions as certain online applications and activities become requirements.
▪ There is a need for broadband education/training for all sectors.

CHALLENGES & OPPORTUNITIES

Although the need for improved and expanded access to broadband in Southwest NH is well understood, the Region faces numerous challenges to achieving this goal. Many of the desired and necessary applications of broadband expressed by residents and sector representatives in preceding sections of this Plan are dependent on factors such as widespread digital literacy and access to reliable, affordable, and high performing broadband connections. This section describes the primary barriers to meeting regional broadband needs and explores potential opportunities for addressing these barriers at the regional level.

The graphic below illustrates the interconnectedness of many of these challenges and their resulting impact on overall quality of life and economic competitiveness in the Region.

FIGURE 13. UNDERLYING BARRIERS TO BROADBAND IN SOUTHWEST NH



Lack of Information

A central barrier to planning for improved and expanded broadband access in Southwest NH is the lack of information on broadband availability at the street address level. Despite recent efforts to track and map broadband availability, the smallest geography at which providers in the state have publicly shared service information is the census block.[20] Although this information represents significant advancements in the collection and dissemination of broadband data, it is limited and has the potential to overstate the relative availability of broadband.[21]

Since 2000, the FCC has systematically collected and compiled data from broadband providers on basic information about their service offerings to measure broadband deployment and telephone competition. Twice a year, the FCC requires certain providers[22] to report information on their broadband services, including the type of technology, speed, and number of connections. Despite this process, the information collected, which is considered competitively sensitive data, is withheld from public disclosure (except in aggregate form). The FCC grants providers the option to request non-disclosure of some or all of the information shared if public disclosure of this information would cause substantial harm to the competitive position of the provider. However, even if it were available for public consumption, the information collected by the FCC does not provide data at a scale sufficient to adequately assess service coverage available to consumers in a community.

The FCC requires providers to share information at the Census tract[23] level, which has resulted in an overstatement of areas served by broadband. For instance, if a provider delivers broadband service to a single customer in a Census tract, the entire tract is depicted as being served, regardless of whether other businesses or households in the tract do not have access to broadband or to the same level of service.

Additionally, the reported connection speed is based on the advertised speed of service, not the actual speed received at a location. Many variables, including time of day and type of technology, impact the actual speed of transmission. These speeds can significantly vary from the speeds advertised by providers.

In 2010, the NHBMPP began work to develop a public database on broadband availability in NH. This work, which is part of NTIA's State Broadband Initiative, represents the state's most comprehensive broadband inventory and mapping effort. Yet, this database is also subject to limitations. The NHBMPP database is reliant on the voluntary submission of broadband service information from providers. While over 40 providers have participated in the program, not all of the state's 63 identified broadband providers have submitted information. The data collected from providers, which includes advertised speeds of transmission and technology type, are processed into the NTIA standardized format of US Census blocks or US Census road centerlines where blocks are greater than 2 square miles. Although the scale at which information is displayed is more granular than the FCC data, it may also result in an overstatement of coverage footprints.

[20] Census block is the smallest geography measured by the U.S. Census Bureau. These blocks are determined by population and can be greater than 2 square miles in size, especially in less densely populated areas.
[21] W. Lehr, T. Smith-Grieco, and G. Rusi Woo, "Broadband Metrics Best Practices: Review and Assessment Report," *Massachusetts Technology Collaborative*, 2008, http://people.csail.mit.edu/wlehr/Lehr-Papers_files/Broadband%20Metrics%20Best%20Practices%20Survey%20Feb08.pdf (accessed September 21, 2013).
[22] The FCC requires facilities-based providers of broadband connections of high speed connections (at least 200 Kbps in one direction) to end user locations, providers of wired or fixed wireless exchange telephone service, providers of interconnected Voice over Internet Protocol service, and facilities-based providers of mobile telephony service in the United States and its territories to complete and submit Form 477.
[23] Census tracts are small, relatively permanent statistical subdivisions of a county or equivalent entity that generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people. A census tract usually covers a contiguous area; however, the spatial size of census tracts varies widely depending on the density of settlement.

Given the importance of high-speed Internet for the Region's economy and quality of life, the need for more granular and accessible broadband availability data is imperative to understanding how broadband access is evolving in the Region. A comprehensive understanding of broadband availability would enable communities and stakeholders to adequately assess regional broadband needs, address deployment gaps, and monitor the performance of current and future broadband providers. While the demand for and potential applications of this data are extensive, the ability of regional stakeholders and communities to improve the granularity of current datasets is limited.

Within the Southwest Region, opportunities for enhancing broadband availability data are focused on expanded broadband surveying and mapping efforts. Since 2010, the NHBMPP has supplemented information shared by providers on broadband availability with an online broadband speed test and survey. To date 572 speed tests have been submitted to the program in the Southwest Region. This data, along with the semiannual survey of CAIs in NH, has served as an important tool for cross-checking and verifying service provider data. The NHBMPP and regional communities should encourage and promote individuals, providers and CAIs to complete and routinely participate in existing survey methods, such as the online speed test, as a means of improving the availability of address specific broadband information.

Lack of Understanding

Although the issue of access to broadband is critically important to the Region's economic competitiveness and quality of life, it is only one challenge. Limited knowledge and understanding of how to utilize broadband is as significant of a barrier as broadband availability. A common theme identified throughout the focus groups and surveys conducted by SWRPC staff to inform this Plan was the need for an improved understanding of how consumers can use the Internet to their fullest advantage. Many individuals expressed that they feel they could be using the Internet to improve efficiency and save time and costs; however, they were unaware of the tools available to do so.

Within the Region, there are programs available that teach skills on how to utilize computer systems and software; however, there are few opportunities to learn about how to use broadband and broadband-enabled devices. The availability of affordable and accessible broadband education/training opportunities would improve digital literacy and awareness.

Through the NHBMPP, the UNH Cooperative Extension is providing technical assistance and broadband digital literacy training to educational institutions, health organizations, local government, and small businesses throughout New Hampshire. These trainings have been provided free of charge and are held at the location or in proximity to the organization(s), group(s) or communities receiving the training. Continuing these trainings or developing similar programs would be a tool to help address the digital literacy and technology proficiency needs of the Region's diverse sectors and residents.

Policies and Regulations

While it is understood that policies and regulations are important tools for managing development at the state and local level, there is need for improvements in the regulatory environment governing the development of broadband infrastructure in the state. Currently, the process for procuring necessary permissions to deploy and build a broadband network is both lengthy and costly. It can be difficult for providers to access conduits, ducts, poles and rights-of-way on public and private lands as the rules governing the pole attachment process in New Hampshire often involve lengthy time periods. Streamlining these processes could potentially lower deployment costs and accelerate broadband expansion efforts.

Currently, state law (NH RSA 33:3) limits the ability of municipalities in the state to issue general obligation bonds for broadband infrastructure. NH RSA 33:3 grants municipalities or counties the authority to issue bonds or notes for the purchase or construction of broadband infrastructure only in areas not served by an existing broadband carrier or provider. In this statute broadband infrastructure is defined as "all equipment and facilities, including all changes, modifications, and expansions to existing facilities, as well as the customer premises equipment used to provide broadband, and any software integral to or related to the operations, support, facilitation, or interconnection of such equipment, including upgrades, and any installation, operations and support, maintenance, and other functions required to support the delivery of broadband."

This limitation has represented a significant challenge in rural areas where there is limited competition among the private sector or incentive to expand broadband networks. Without this ability, there are few options available to communities seeking expanded and improved coverage.

Challenging Geography

The Southwest Region is defined by its hilly, forested terrain and rural landscape. This challenging topography and low population density presents both technological and economic barriers to deploying broadband infrastructure and services. While deployment costs can vary significantly by technology type and location, it is generally more expensive to deploy fixed-wireline infrastructure (e.g. cable modem, DSL) in areas with greater geographical distances between customers.[24]

In addition to high infrastructure costs, the low volume of potential subscribers along these routes presents limited economic incentive for private service providers to deploy infrastructure in rural areas. According to a report conducted by the FCC in 2012 on broadband deployment in the United States, approximately 14.5 million rural Americans, or 23.7% of 61 million people living in rural areas, had no broadband. Conversely, only 1.8% of Americans living in non-rural areas, 4.5 million out of 254.9 million, had no broadband access.[25]

According to a report conducted by the FCC in 2012 on broadband deployment in the United States, approximately 14.5 million rural Americans, or 23.7% of 61 million people living in rural areas, had no broadband. Conversely, only 1.8% of Americans living in non-rural areas, 4.5 million out of 254.9 million, had no broadband access.

As these topographical features are an important component of the Region's landscape, there is a need for innovative technology solutions that can navigate challenging terrain and distance with greater ease and less expense than fixed-wireline solutions. Advanced wireless technologies, which are generally less sensitive to population density and easier to install than fixed-wireline, present an opportunity for expanded broadband deployment in rural areas. Wireless solutions use radio or microwave frequencies to provide a connection between the customer and the operator's network. They are broadly categorized by those technologies that require line-of-sight, where obstructions such as trees and hills impede service delivery, and those that do not.

Additionally, there are a range of frequencies within which wireless broadband can operate. Higher frequency technologies, which have more spectrum available, allow for smaller antennas and easier installation than those with lower frequency. Yet, the capabilities of higher frequency systems can be

[24] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).
[25] Federal Communication Commission, *Ninth Broadband Progress Report,* August 2012, http://www.fcc.gov/document/fcc-launches-ninth-inquiry-broadband-availability. (accessed September 21, 2013)

severely weakened by poor weather conditions such as rain or fog. Especially, when obstructions such as trees and hills can impede current line-of-sight wireless technologies.

In the United States, the FCC and NTIA are responsible for assigning different frequencies for specific uses and licensing the rights to broadcast over these frequencies. To avoid inference, unused space is assigned between frequencies. In 2008, the FCC agreed to open these unused portions of the spectrum, called White Space, for unlicensed use.[26] Companies are now able to track what broadband frequencies are being used for licensed television broadcast so that wireless broadband devices can take advantage of unlicensed space between these frequencies without fees or permissions. Television White Space Technology, also known as "Super Wi-Fi", delivers Internet bandwidth across the same frequency used on analog televisions. Utilizing this white space for commercial broadband applications is an appealing opportunity for rural areas because television frequencies have powerful signals that are able to travel over mountainous and forested terrain. However, examples of successful applications of White Space spectrum for broadband delivery are limited as this is a recent innovation.

Lack of Incentives

Without incentives to encourage broadband deployment in rural communities, it is unlikely that the Region can create, or maintain, a level of demand needed to attract private sector interest in expanding or upgrading broadband infrastructure. As described in the previous section, it can be cost prohibitive for service providers to expand or upgrade broadband infrastructure in rural areas. Given these economic challenges, it is not surprising that there are limited options for accessing broadband in the Region.

According to the NTIA National Broadband Map, only 34.8% of Cheshire County has access to more than 3 options of fixed-wireline broadband providers, compared to 87.4% of Hillsborough County, the most densely populated county in NH.[27] Absent competitive market conditions, the Southwest Region is challenged with finding affordable and feasible solutions to encourage broadband expansion in un-served and underserved areas and upgrades to existing network capabilities.

According to the NTIA National Broadband Map, only 34.8% of Cheshire County has access to more than 3 options of fixed-wireline broadband providers, compared to 87.4% of Hillsborough County, the most densely populated county in NH.

Potential solutions include encouraging and promoting the development of open access networks, such as NH FastRoads. Open access describes networks where the owner or manager of the network does not supply services for the network. These services are supplied by separate retail service providers. By eliminating the economic burden of building and maintaining network infrastructure, this model is thought to facilitate increased competition among and entry into the market for broadband providers of all sizes. More information about NH FastRoads is described in the *History of Broadband Planning* section of this document.

Another opportunity to incentivize further broadband deployment is the development of mechanisms, similar to Tax Increment Financing Districts, to generate committed revenue streams to support local broadband initiatives. Tax Increment Financing is a method to use future gains in taxes to subsidize current capital or community development improvements, which are projects to create the conditions for said gains. The community of Moultonborough, NH, located in the Lakes Region, developed a Community Broadband Fund in 2007, which is intended "to promote the development of

[26] The Federal Communications Commission, "White Space," http://www.fcc.gov/topic/white-space (accessed September 13, 2013)
[27] National Telecommunications Information Administration, "National Broadband Map," December 2012 http://www.broadbandmap.gov (accessed September 10, 2013)

communications infrastructure to underdeveloped parts of Town." The fund is maintained through franchise fees paid to the Town by their cable provider. Annually, this fund accrues approximately $22,500. Currently, the Town is in the process of determining how to best utilize these funds.

Some grant funding is available for broadband expansion efforts. One source of funding is the Connect America Fund, which is an initiative by the FCC to expand broadband capabilities to the estimated 19 million Americans that lack high-speed Internet. Portions of this fund were used by the NH FastRoads project to install a middle-mile fiber backbone and last-mile fiber, also known as "fiber to the home," in parts of western NH. In early 2014, Cheshire County partnered with NH FastRoads and the SWRPC to develop a proposal to the FCC for funding to expand NH FastRoad's middle-mile and last-mile fiber infrastructure to five additional communities in the Region. These communities include Walpole, Langdon, Surry, Alstead, and Marlow. This expansion of the NH FastRoads network would provide hundreds of underserved residences with broadband capabilities.

RECOMMENDATIONS

The following goals, objectives and strategies were developed by SWRPC staff in partnership with the SWBSG as a means of addressing the challenges to and demand for improved broadband in the Southwest Region. They are directed at regional organizations, municipalities, CAIs, broadband providers, policy and decision makers, and others to advance the following vision for broadband in southwest NH:

> *Recognizing that the universal availability of high capacity broadband is vital to the Region's future and long term prosperity, this Plan is guided by a vision of Southwest New Hampshire where every person has the ability to access and fully utilize a reliable, affordable, and sustainable broadband network.*

Four overarching goals were identified for reaching this vision. These goals represent broad aims toward which future efforts should be directed. Each goal is supported by a series of objectives. Objectives can be viewed as measureable milestones that, once achieved, move an effort closer to reaching a goal. A strategy is a plan of action designed to accomplish an objective. The Implementation Section of this Plan prioritizes each of the strategies described below and identifies potential partners, timeframe and funding sources for employing these action items.

Goals, Objectives & Strategies

Goal 1. Eliminate gaps in broadband availability for all users and provide choices in cost and quality of service.

Objective 1a: Routinely inventory the geographic availability and technological capabilities of broadband infrastructure.

- Strategy 1a.i: Promote participation in the NHBMPP Broadband Speed Test and Household Survey and encourage service providers and others to share these links on their respective websites.
- Strategy 1a.ii: Continue support for and participation in the NHBMPP Mapping Program and surveying of Community Anchor Institutions.
- Strategy 1a.iii: Encourage service providers to disclose information on the location, type of service (residential or commercial), and technological capabilities of infrastructure at the address level.
- Strategy 1a.iv: Work with educational institutions to inventory and map broadband availability.

Objective 1b: Research and implement diverse technology solutions to expand broadband access.

- Strategy 1b.i: Conduct research on the most cost effective, scalable, and innovative technologies and potential applications for the Region.
- Strategy 1b.ii: Promote opportunities for connecting fiber technology or other fixed broadband infrastructure to wireless infrastructure.

- Strategy 1b.iii: Support the merger of fixed and wireless technologies to expand the availability of service. Especially, in areas where topography is a challenge.

- Strategy 1b.iv: Inventory existing assets (e.g. conduit, utility poles, water towers) and infrastructure that could be used to facilitate and expand broadband availability.

- Strategy 1b.v: Expand utilization of open access fiber networks and facilities such as the NH FastRoads Network.

Objective 1c: Promote development and use of open access networks.

- Strategy 1c.i: Support open access networks and facilities such as NH FastRoads and expansion of open access middle-mile and last-mile fiber networks.

- Strategy 1c.ii: Research financing/funding structures and business models for developing new or supporting/expanding existing open access networks and facilities.

- Strategy 1c.iii: Market and promote use of open access fiber networks and facilities to service providers and consumers.

Objective 1d: Identify incentives to encourage providers to expand broadband infrastructure in areas unserved or underserved.

- Strategy 1d.i: Inventory Community Anchor Institutions to better understand their plans to increase broadband access and speeds.

- Strategy 1d.ii: Identify existing or potential financial or regulatory incentives such as subsidies, tax credits, or grant opportunities to support broadband expansion efforts.

- Strategy 1d.iii: Evaluate the feasibility of establishing a mechanism to generate committed revenue streams for broadband initiatives.

Objective 1e: Reduce or remove regulatory barriers to broadband development or expansion.

- Strategy 1e.i: Improve, where appropriate, the permitting and approval process to secure pole attachments, access ROW, and make modifications to and site wireless facilities.

- Strategy 1e.ii: Identify and modify local regulations that impede or discourage broadband deployment or expansion.

- Strategy 1e.iii: Support initiatives to enhance municipal efforts to finance broadband infrastructure needs.

Goal 2. Provide and Maintain reliable, high-capacity broadband infrastructure and technology in all areas of the Region over time.

Objective 2a: Regularly upgrade infrastructure to support the capabilities of available technology and services.

- Strategy 2a.i: Encourage providers to design and implement capacity expansions where they are most feasible and needed (i.e. unserved or underserved areas).

- Strategy 2a.ii: Encourage policies that promote the installation of broadband conduit when construction occurs in roadway rights of way.

- Strategy 2a.iii: Promote the inclusion of broadband infrastructure development and maintenance in public works projects.

Objective 2b: Ensure that existing and future broadband infrastructure is resilient, redundant, and has low latency.

- Strategy 2b.i: Encourage municipalities and local businesses to install backup power sources, generators, etc. to ensure continuous and reliable broadband and internet access during emergencies and natural disasters.

- Strategy 2b.ii: Encourage service providers to account for redundancy and resiliency when planning, constructing and deploying broadband infrastructure.

- Strategy 2b.iii: Establish best management practices that account for broadband resiliency and redundancy and encourage their use as a necessary part of doing business.

Objective 2c: Encourage investments in infrastructure to support security measures.

- Strategy 2c.i: Inventory and identify potential public and private funding sources for broadband infrastructure and security.

- Strategy 2c.ii: Establish a working group to identify potential threats and policies to enhance broadband security.

Goal 3. Position broadband as a critical utility and a basic requirement for economic development, community vitality and sustained quality of life.

Objective 3a: Ensure that everyone has the knowledge and understanding of how to utilize and apply broadband technology and services.

- Strategy 3a.i: Develop educational materials that generally describe the importance of broadband to quality of life and the range of applications in which broadband can be utilized.

- Strategy 3a.ii: Work with regional institutions, organizations, and communities to sponsor free and affordable training opportunities on broadband utilization.

- Strategy 3a.iii: Support existing and expanded programs for digital literacy for all levels of learners in regional educational institutions.

- Strategy 3a.iv: Identify incentives and support for community anchor institutions and residents to access affordable and adequate broadband service and technology.

- Strategy 3a.v: Establish high capacity broadband connection centers and/or public Wi-Fi networks in appropriate locations such as village centers and community institutions.

- Strategy 3a.vi: Identify funding programs for community anchor institutions to update, maintain, and expand broadband technology and devices.

- Strategy 3a.vii: Share information with New Hampshire Legislators, and other state and local officials, on the importance of improving access to affordable and adequate broadband services.

Objective 3b: Make information on the location and type of broadband publically available.

- Strategy 3b.i: Establish and maintain a public database on broadband availability at the address level.

- Strategy 3b.ii: Track and monitor public and private investment in broadband technology Infrastructure.

Objective 3c: Encourage municipalities to incorporate broadband as a component of local planning.

- Strategy 3c.i: Establish guidance materials for municipalities on developing broadband sections of local master plan chapters.

- Strategy 3c.ii: Establish municipal committees focused on broadband development and utilization.

Goal 4. Respect those features that define the Region's cultural and physical landscape while meeting the broadband infrastructure needs of the future.

Objective 4a: Encourage utilization of broadband-enabled applications to increase community involvement in town and community functions.

- Strategy 4a.i: Establish opportunities for citizens to participate in or view public meetings remotely.

- Strategy 4a.ii: Promote training and education for municipalities on utilizing broadband to encourage social and civic engagement.

Objective 4b: Ensure that broadband infrastructure and technology do not detract from the scenic value of landscapes and rural character.

- Strategy 4b.i: Promote colocation of broadband technology and equipment such as wireless antennas on existing structures.

- Strategy 4b.ii: Establish guidance for municipalities on local policies or regulations to ensure protection of scenic view-sheds.

- Strategy 4b.iii: Expand existing model telecommunications ordinances to include a range of broadband technology and infrastructure in addition to telecommunications towers.

IMPLEMENTATION

Table 6 organizes the 42 strategies for improving broadband access and utilization in the Southwest Region, described in the Recommendations section of this document, by level of priority for the Southwest Region. The SWBSG worked with SWRPC staff to review and categorize each strategy as either of high, medium or lower importance for the Region. This determination was based on the readiness of each strategy for implementation, as well as the importance of each strategy for advancing the vision, goals and objectives outlined in this Plan. Instances in which a strategy is designated lower priority should not be interpreted as though the action is not important.

The SWBSG and SWRPC staff also identified potential partners that could play a role in undertaking or facilitating each strategy. These partners range from education institutions, CAIs, and municipal officials located within the Region to UNH, state agencies, and NH legislators. The list of partners is not intended to be comprehensive nor definitive.

For each strategy, phasing, 'level of action' and relevant sectors of impact are identified. Phasing refers to the relative time period with which the proposed category is likely to be carried out or pursued. For example, "short" refers to strategies that could occur within the next year, "medium" refers to a 1-3 year timeframe and "long" refers to strategies that are not likely to be pursued until 3 years or longer from the creation of this document.

'Level of action' refers to whether the strategy would primarily be taking place at either the local, regional, state, or national level. Most strategies have multiple levels of action identified, as a strategy might be most relevant to the Region but impact municipalities at the local level as well. The primary geographic area or level of action is noted with a closed circle. Secondary geographic levels of action are marked with an open circle.

Relevant sectors include economic, education, government, health, public safety, and residential. Similar to 'level of action,' described above, a closed circle indicates which sectors would be most impacted or involved with a strategy, while an open circle notes sectors that might be impacted but to a lesser extent than the primary sectors. While specific strategies might result in improvements that impact all sectors, this field is intended to highlight which of the sectors would be most directly impacted by the strategies proposed. Still, many strategies included in Table 6 are likely to involve multiple sectors.

The numbers and letters preceding each strategy correspond to the goal and objective for which the strategy is related to in the Recommendations section of this Plan. For example, the combination of '1.a.i' before a strategy, specifies that this is strategy i, under objective a, of goal 1.

TABLE 6. SOUTHWEST REGION BROADBAND STRATEGY IMPLEMENTATION MATRIX

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
High	Short	1a.iv. Work with educational institutions to inventory & map broadband availability.	●Region ○Local	●	●	●	●	●	●	Higher Education Institutions; High Schools; Cooperative Education Programs	Look to Dartmouth Atlas as model for this strategy.
High	Short-Med	1e.i. Improve the permitting & approval process to secure pole attachments, access ROW, & make modifications to & site wireless facilities.	●State ●Local			●				NH PUC; NH Legislature; SWRPC; NH Telecommunications Advisory Board; NH OEP; Broadband Providers; Municipalities	
High	Short-Long	3a.iii. Support existing & expanded programs for digital literacy for all levels of learners in regional educational institutions.	●Region ○Local ○State	●	●	●	●	●	●	Educational Institutions or organizations; UNH CE; UNH; CAIs	
High	Short; Ongoing	1b.iv. Inventory existing assets (e.g. water towers, conduit, utility poles) & infrastructure that could be used to expand broadband availability.	●Local ○Region	○	○	○	○	○	○	Municipalities; Existing Broadband Providers; Educational Institutions; RPCs; NH PUC	
High	Short; Ongoing	1b.v. Expand utilization of open access fiber networks & facilities such as NH FastRoads.	●State ○Local ○Region	○	○	○	○	○	○	Municipalities; CAIs; NH Legislators; NH PUC; NH Fast Roads	
High	Short; Ongoing	1d.ii. ID existing or potential financial or regulatory incentives such as subsidies, tax credits, or grant opportunities to support broadband expansion efforts.	●Region ●State ○Local	○	○	○	○	○	○	RPCs; UNH; UNH BCoE; NH DRED; UNH CE; NH OEP; NH Legislators; Municipal Officials	

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
High	Short; Ongoing	3a.i. Develop educational materials that generally describe the importance of broadband to quality of life & the range of applications in which broadband can be utilized.	○Local ●Region ●State	○	○	○	○	○	○	UNH CE; NH OEP; UNH; SWRPC; UNH BCoE; NH Municipal Association	
High	Short; Ongoing	3a.ii. Work with regional institutions, organizations, & communities to sponsor free & affordable training opportunities on broadband utilization.	●Local ●Region ○State	●	●	●	●	●	●	UNH CE; SWRPC; Municipalities; CAIs; NH Municipal Association; Educational Institutions	
High	Short; Ongoing	3a.iv. ID incentives & support for CAIs & residents to access affordable & adequate broadband service & technology.	●Local ●Region ●State	●	●	●	●	●	●	Broadband Providers; CAIs; Municipalities; Chambers of Commerce; Charitable-Giving Organizations; State Agencies; UNH BCoE	
High	Short; Ongoing	3a.vii. Share information with NH Legislators and other state/local officials on the importance of improving access to affordable & adequate broadband services.	●State ○Local ○Region			●				NH Legislators; Municipalities; SWBSG; SWRPC; UNH; CAIs	
High	Short; Ongoing	1c.iii. Market & promote use of open access fiber networks & facilities to service providers & consumers.	●Local ●Region ○State	○	○	○	○	○	○	NH FastRoads; Municipalities; CAIs; Media Outlets; Chambers of Commerces; Broadband Providers	
High	Short; Ongoing	1d.i. Inventory CAIs to better understand their plans & projects regarding increasing broadband access & speeds.	●Local ●Region ○State	○	●	●	●	●	○	CAIs; RPCs; Educational institutions; Municipalities; State Agencies	This strategy relates to having an understanding of what is needed by CAIs to plan for and make improvements.

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
High	Short; Ongoing	2a.i. Encourage providers to design & implement capacity expansions where they are most feasible & needed (i.e. unserved or underserved areas).	●State ○Local ○Region	○	○	○	○	○	○	Service Providers; Municipalities; NH Legislators	
High	Short; Ongoing	2a.ii. Encourage policies that promote the installation of broadband conduit when construction occurs in roadway rights of way.	●Local ●State			●				NH DOT; Municipalities; NH PUC	
High	Short; Ongoing	2a.iii. Promote the inclusion of broadband infrastructure development & maintenance in public works projects.	●Local ●State			●				Municipalities; NH DOT; NH PUC	
High	Short; Ongoing	2b.ii. Encourage service providers to account for redundancy & resiliency when planning, constructing & deploying broadband infrastructure.	●Local ●Region ●State	○	○	○	○	○	○	Broadband Providers; Municipalities; NH Legislators	
High	Short; Ongoing	3a.vi. ID funding programs for CAIs to update, maintain, & expand broadband technology & devices.	●Region ●State ○Local	●	●	●	●	●	●	CAIs; Broadband Providers; UNH; SWRPC; UNH BCoE; Municipalities; State Agencies	
High	Short; Ongoing	3b.i. Establish and maintain a public database on broadband availability at the address level for Region and state.	●Region ●State ○Local	●	●	●	●	●	●	UNH; SWRPC; Municipalities; Realtors; Chambers of Commerce; Economic Development Groups; NH PUC; CAIs; Large Employers; State Agencies;	

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
High	Med; Ongoing	2b.iii. Establish best management practices (BMPs) that account for broadband resiliency & redundancy & encourage their use as a necessary part of doing business.	●State ○Local	○	○	○	○	○	○	UNH; UNH BcoE; NH Legislators; NH DRED; NH PUC; Municipalities	BMPs could be for both consumers and providers. BMPs could provide guidance for towns to manage and address issue of broadband availability, including how to communicate with providers, access grant funds, etc.
High	Ongoing	1a.i. Promote participation in the NHBMPP Broadband Speed Test and Household Survey and encourage service providers and others to share these links on their respective websites.	●Local ○Region ○State	○	○	○	○	○	●	UNH; Municipalities; RPCs; Media Companies; Broadband Providers	
High	Ongoing	1a.iii. Obligate service providers to disclose information on the location, type of service & technological capabilities of infrastructure at the address level.	●State ○Local ○Region ○Nation	○	○	○	○	○	●	NH Legislators; NH Public Utility Commission (PUC)	
High	Ongoing	4b.i. Promote colocation of broadband technology & equipment such as wireless antennas on existing structures.	●Local ●State ○Region			●				Municipalities; NH PUC; NH Legislators	
Med-High	Short	3c.i. Establish guidance materials for municipalities on developing broadband sections of local master plan chapters.	●Local ○Region ○State			●				SWRPC; Municipalities; NH OEP	

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
Med-High	Short; Ongoing	1e.iii. Support initiatives to enhance municipal efforts to finance broadband infrastructure needs.	●State ○Local			●				NH Legislators; Municipalities	
Med-High	Short-Med	3c.ii. Establish municipal committees focused on broadband development & utilization.	●Local			●				Municipalities; SWRPC	
Med	Short	4b.iii. Expand existing model telecommunications ordinances to include a range of broadband technology & infrastructure in addition to telecommunications towers.	●Local ○Region ○State			●				SWRPC; NH OEP; Municipalities	
Med	Short	1e.ii. Identify and modify local regulations that impede or discourage broadband deployment or expansion.	●Local ○Region			●				Municipalities; RPCs; Educational Institutions	
Med	Short	4b.ii. Provide guidance to municipalities on developing local policies or regulations to ensure protection of scenic view-sheds.	●Local ○Region ○State			●				SWRPC; NH OEP; Municipalities	
Med	Short-Med	1d.iii. Evaluate the feasibility of establishing a mechanism to generate committed revenue streams for broadband initiatives.	●Local ○Region			○				Communities that have successfully established Broadband Funds; Municipalities; SWRPC; CAIs	

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
Med	Med	1b.ii. Promote opportunities for connecting fiber technology or other fixed infrastructure to wireless infrastructure.	●Local ○Region ●State	○	○	○	○	○	○	Municipalities; NH PUC; State Agencies	
Med	Med-Long	1c.ii. Research financing/funding structures & business models for developing new or expanding existing open access networks & facilities.	●State ●Region	○	○	○	○	○	○	UNH BCoE; Economic Development Corporations; Municipalities; NH FastRoads	
Med	Med-Long	3a.v. Establish and encourage high capacity broadband connection centers &/or public Wi-Fi networks in appropriate locations such as village centers & community institutions.	●Local ●Region	●	●	●			●	Municipalities; CAIs; Businesses; Chambers of Commerce; Educational Institutions; Libraries	
Med	Med; Ongoing	1c.i. Support open access networks & facilities & expansion of open access middle-mile & last-mile fiber networks.	●State ○Region	○	○	○	○	○	○	Legislators; Municipalities; Broadband Providers	This strategy should be considered a high priority at the state level.
Med	Med; Ongoing	3b.ii. Track & monitor public & private support for broadband technology infrastructure.	●State ○Local ○Region	○	○	○	○	○	○	UNH BCoE; SWRPC; Municipalities; CAIs; Broadband Providers	
Med	Long	1b.iii. Support merger of fixed & wireless technologies to expand the availability of service; Especially, in areas where topography is a challenge.	●Local ○Region ○State	○	○	○	○	○	○	Broadband Providers; Municipalities; NH PUC	
Med	Ongoing	1a.ii. Continue support for & participation in the NHBMPP Mapping Program & surveying of CAIs.	●State ○Region	○	●	●	●	●	○	UNH; SWRPC; CAIs; Broadband Providers	

Priority	Phase	Strategy	Level of Action	Relevant Sectors						Potential Partners	Notes
				Economic	Education	Government	Health	Public Safety	Residential		
Med	Ongoing	2b.i. Encourage municipalities & local businesses to install backup power sources, generators, etc. to ensure continuous & reliable broadband access during emergencies & natural disasters.	●Local ●Region ○State	●	○	●	●	●	○	Municipalities; CAIs; SWRPC; Chambers of Commerce; Economic Development Corporations; Public Safety Institutions	
Med-Low	Med	2c.i. Inventory & ID potential public & private funding sources for broadband infrastructure & security.	●State ○Region	○	○	○	○	○	○	Municipalities; SWRPC; CAIs; UNH; UNH BCoE	
Med-Low	Med-Long	2c.ii. Establish a working group to ID potential threats and policies to enhance broadband security.	●State	○	○	○	○	○	○	NH Department of Safety; NH PUC; NH TAB; Broadband Providers; NH DRED; UNH; UNH BCoE; NH Municipal Association	
Low	Short-Med	4a.i. Establish opportunities for citizens to participate in or view public meetings remotely.	●Local			●			●	Municipalities; Broadband Providers; CAIs	
Low	Short-Med	4a.ii. Promote training & education for municipalities on utilizing broadband to encourage social & civic engagement.	●Local ○Region ○State			●				UNH CE; Educational Institutions; CAIs; SWRPC; Municipalities	
Low	Ongoing	1b.i. Conduct research on the most cost effective, scalable and innovative broadband technologies and potential applications for the Region.	●State ○Region	○	●	○	○	○	○	UNH Broadband Center of Excellence (BCoE); Broadband Providers; Technology Industry Representatives	An example would be to research how white space technology or Super WiFi could be developed in the Southwest Region. This is a lower priority for the Region but considered a high priority for the state to pursue.

CONCLUSION

This Plan is intended to be a dynamic document that is to be periodically revisited and updated to address developments in technologies and to recognize opportunities that were unforeseen at the time of its development. The objectives and proposed strategies identified in this Plan are viewed as realistic and feasible measures for improving the landscape of broadband in the Southwest Region over the next five years and beyond. They are directed at municipalities, business and institutional leaders, CAIs, broadband providers, elected officials, and others to consider, pursue, and/or support their efforts to increase access to and the utilization of high quality broadband in the Region.

Today and in the foreseeable future, high speed broadband is required for maintaining vibrant economies, competitive communities, and overall quality of life. Due to our relatively lower development densities, topography, tree cover and other variables, the communities, businesses, and residents of Southwest New Hampshire are challenged to advocate for quality broadband infrastructure and service at affordable rates. The content of this Plan is intended to provide a thoughtful framework for keeping us focused on ensuring attention to this important initiative.

APPENDICES

APPENDIX A. PROJECT BACKGROUND

The Southwest Region Broadband Plan was developed with support from the New Hampshire Broadband Mapping and Planning Program (NHBMPP). The NHBMPP is a comprehensive initiative that began in 2010 with the goal of understanding where broadband is currently available in the state, how it can be made more widely available in the future, and how to encourage increased levels of broadband adoption and usage. Funded through the National Telecommunications and Information Administration (NTIA), the NHBMPP is part of a national effort to expand broadband access and adoption.

The NHBMPP is managed by the GRANIT (Geographically Referenced Analysis and Information Transfer) System within the Earth Systems Research Center at the University of New Hampshire (UNH), and is a collaboration of multiple partners. These include the NH Office of Energy and Planning (OEP), NH Department of Resources and Economic Development (DRED), UNH Cooperative Extension (UNHCE), UNH Information Technology (UNHIT) and the state's nine regional planning commissions (RPCs).

The NHBMPP is comprised of several components, including a broadband availability inventory and mapping effort and a suite of planning and technical assistance initiatives. Following are brief descriptions of these components as well as an overview of the broadband planning initiative.

Mapping

In 2010, UNH GRANIT, the RPCs, and other partners began an inventory and mapping effort aimed at better understanding the current availability of broadband throughout the state through several projects and activities, which include:

- Collecting data semi-annually from the public and commercial entities that provide broadband services in New Hampshire on the location, type and speed of broadband technology available;
- Refining the information collected on broadband availability by initiating a series of verification efforts, including map verification with community collaborators, online speed tests and user surveys, a statewide cell phone reception study, and other related activities;
- Surveying and mapping broadband availability at community anchor institutions (CAIs) such as schools, libraries, hospitals, public safety facilities, and municipal buildings;
- Developing the first public master address file of households located in rural census blocks;
- Collecting and hosting a statewide inventory of cable franchise agreements; and,
- Sharing information and data on broadband availability with the NTIA and the Federal Communications Commission (FCC) on a semi-annual basis for inclusion in the National Broadband Map.

Technical Assistance and Training

UNHCE has taken the lead on developing and administering technical assistance and training opportunities to help businesses, local governments, organizations and individuals better understand the importance of and applications for broadband in today's world. The activities undertaken by UNHCE through the NHBMPP include:

- Assessing the broadband training and technical needs of stakeholder groups including educational institutions, small business, municipalities, healthcare providers and organizations to determine topics stakeholders would like to receive training on and applications that would be of use to stakeholders;
- Developing tools and learning modules on topics related to broadband utilization and adoption such as "Leveraging Broadband to Promote Economic Development", "Putting your Business on the Digital Map", and "Three Free Ways to Promote Your City/Town/School via the Web"; and,
- Delivering workshops, training and technical assistance to broadband stakeholder groups to support increased broadband adoption and use.

Capacity Building

A third component of the NHBMPP, capacity building, is focused on the development of tools and resources necessary to implement broadband projects within communities and regions across the state. The Director of Broadband Technology, DRED, and project staff from UNHCE and UNHIT, are working together to enhance broadband capacity by:

- Encouraging collaboration to establish best practices in policy management, financial resources, and advocacy for business and residential broadband;
- Tracking and reviewing legislation related to broadband and telecommunications;
- Working with the NH Telecommunications Advisory Board, to analyze and assess the state's broadband infrastructure and promote access to affordable and reliable advanced telecommunications services;
- Researching successful community broadband solutions and funding options, including and aggregating them into a toolkit on broadband solutions and funding for NH; and,
- Establishing a Resource Team, who will work with RPCs and broadband stakeholder groups to identify communities prepared to initiate their broadband plans and provide assistance with community broadband decision making.

Planning

In 2011, NHBMPP partners engaged in a four-year effort aimed at incorporating the information and momentum gained during the mapping activities to better understand current broadband availability in New Hampshire and plan for increased broadband adoption and utilization through outreach, community engagement, and surveying activities.

As part of an effort to gain a better understanding of broadband at the regional level, each RPC developed a broadband stakeholder group (BSG), comprised of individuals representing a wide range of sectors, which met quarterly. The BSGs have played a vital role in assisting RPCs in assessing the need for improved broadband capability, availability, and affordability. The BSGs helped RPCs develop a list of broadband needs and barriers to broadband adoption and utilization. They also assisted with developing goals, objectives, and strategies to overcome barriers in each region.

A major undertaking of the broadband planning component was a sector-based analysis. This activity involved developing and facilitating focus group meetings, structured interviews, and other methods to identify broadband needs and challenges specific to various sectors, including healthcare, education, local government, economic development, and public safety. Each RPC conducted focus groups or interviews with representatives from these sectors to better understand the importance of broadband accessibility to each sector.

Additionally, each RPC held public forums throughout the course of the project. These forums were an opportunity to share information regarding ongoing broadband efforts in the region, progress of the NHBMPP, and to receive feedback from community members regarding broadband availability.

Information gathered from the activities described above led to the development of nine regional broadband plans in NH. Each RPC reviewed and analyzed data collected through the mapping efforts, outreach activities, sector-based analysis, as well as public forums to develop comprehensive documents that highlight the current landscape of broadband availability in the state and identify ways to increase broadband adoption and utilization. The regional broadband plans serve as guidance documents for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for and utility of broadband now and into the future. All nine plans are to be compiled into a statewide broadband planning document by OEP.

APPENDIX B. UNDERSTANDING BROADBAND

Broadband, also called 'high-speed Internet,' is the umbrella term referring to Internet access that is always on and is faster than dial-up Internet access. The NTIA defines broadband as, "advanced communications systems capable of providing high-speed transmission of services such as data, voice, video, complex graphics, and other data-rich information over the Internet and other networks."[28] As our technology capabilities are continually changing, it is important to define what broadband is so that stakeholders can determine where broadband is currently available, and how it can be made more widely available to more people.

Broadband is defined in terms of how fast the user's computer can download and upload information from the Internet. Download speed is the rate that a computer receives data from the Internet while upload speed is the rate at which a computer can send data. The speed at which information can be transmitted depends on bandwidth. Bandwidth is the transmission capacity of an electronic pathway. That capacity can be described in terms of how much data, measured in bits, can be transmitted per second, and is reported in kilobits (Kbps), megabits (Mbps), and gigabits (Gbps). NTIA defines broadband as providing a minimum speed of 768 Kbps download and 200 Kbps upload. Most broadband technologies have different downloading and uploading speeds, with upload speed typically being more limited. As technology and applications continually change, there are many different types of broadband services as well as resulting speeds and functions for using the Internet.

Although NTIA defines broadband at a 768 Kbps minimum download threshold, download speeds up to 3 Mbps have limited functionality. At up to 3 Mbps Internet users are able to use web-based email, send and receive small to medium-sized documents, and browse the web. However, operating multiple functions may cause potential slowness, making it difficult to conduct necessary business and education operations. Today, in order to use many Internet applications successfully, a minimum download speed of 3 Mbps is required. From 3 Mbps to 6 Mbps download speed, and 1.5 Mbps to 3 Mbps upload speed, users can send and receive photos and word documents through email, conduct multiple functions simultaneously, and access small window videoconferencing, such as Skype. At 6 Mbps to 10 Mbps download and 3 Mbps to 6 Mbps upload, users can send and receive large documents and files, such as small videos, and can access their company's network while traveling or working from home with a speed of operation that is similar to being in the office. Also, higher quality videoconferencing can be conducted allowing businesses to communicate with clients, partners, and employees. At 10 Mbps to 25 Mbps download and 6 to 10 Mbps upload, telemedicine and telehealth applications are possible and remote education, professional development, and workshops can occur in high definition (HD) quality. At 25+ Mbps download and 10+ Mbps upload, real time HD medical imaging and consultation can occur.[29] As Internet technology and applications continuously emerge and evolve it takes much more than the minimum broadband threshold to operate successful businesses, and provide relevant education and quality medical care.

The NHBMPP developed a matrix to assist stakeholders in understanding the many levels of broadband available in the state of New Hampshire today, and the typical functions a user might be able to perform within a range of download and upload speed tiers. Using these tiers, the NHBMPP has established broadband availability categories ("un-served," "underserved," and "served") to describe access to broadband service. The table below is a condensed version of the NHBMPP matrix.

[28] "Broadband: As defined by the NH Broadband Mapping and Planning Program," *New Hampshire Broadband Mapping and Planning Program*, February 15, 2012, http://iwantbroadbandnh.com/planning-and-assistance. (accessed July 17, 2013).
[29] "Broadband: As defined by the NH Broadband Mapping and Planning Program," *New Hampshire Broadband Mapping and Planning Program*, February 15, 2012, http://iwantbroadbandnh.com/planning-and-assistance. (accessed July 17, 2013).

FIGURE 4. NHBMPP BROADBAND DEFINITION MATRIX

Tiers of Service	Download Speed	Upload Speed	Typical Functions / Use *(functions additive to level above)*
Un-served	< 768 Kbps	< 200 Kbps	• Email (client/served-based)
Underserved	768 Kbps to < 1.5 Mbps	200 Kbps to < 768 Kbps	• Web-based email • Limited web browsing • Send/receive small documents • Single user Internet device
	1.5 Mbps to < 3 Mbps	768 Kbps to <1.5 Mbps	• Medium social media use • Send/Receive medium-size documents/files • Limited streaming content, buffering a concern • 1-3 simultaneous Internet devices possible
Served	3 Mbps to <6 Mbps	1.5 Mbps to <3 Mbps	• Send/Receive medium to large-size documents or files • Streaming content, downloading High Definition (HD) content, speed a concern • Low quality, small window videoconferencing
	6 Mbps to <10 Mbps	3 Mbps to 6 Mbps	• Send/Receive large documents or files (small videos) • Streaming HD • Virtual Private Network (VPN) access for remote work at speed critical to job function • Multi-player online gaming
	10 Mbps to <25 Mbps	6 Mbps to <10 Mbps	• HD quality, large frame videoconferencing • Remote synchronous education, professional development facilitated concurrently at multiple locations • Tele-health applications possible
	25+ Mbps	10+ Mbps	• Send/Receive medium to large databases • Real-time HD medical imaging and consultation, remote patient monitoring

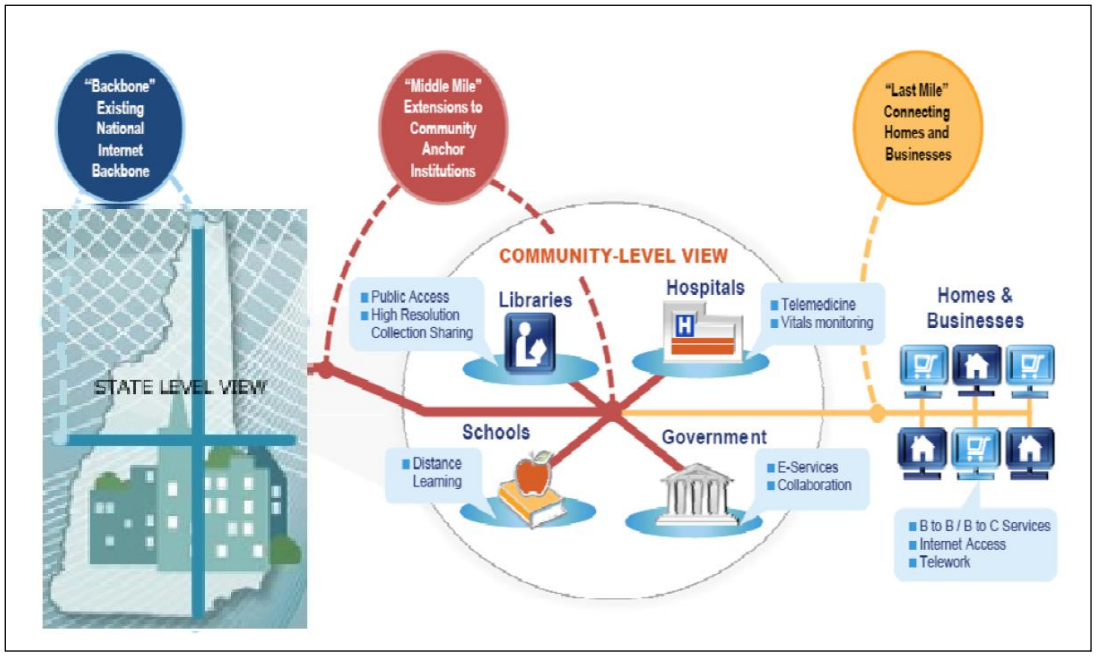
Source: New Hampshire Broadband Mapping and Planning Program http://www.iwantbroadbandnh.org

How Broadband Works

Broadband infrastructure consists of the Internet "backbone" which is hosted by large commercial, government, academic, and other high-capacity network centers. The "middle mile" refers to the segment linking a network operator's core network to the local network plant. In order to transport the Internet to homes and businesses, known as the "last mile," it can be most cost-effective to increase the reach of the "middle mile" through community anchor institutions. Community anchor institutions are typically municipal libraries and Town offices, hospitals and schools, emergency services and public safety operations, and large businesses that have the means and capacity to access broadband-based services. The majority of home and small business users rely on the last mile hosts, Internet service providers (ISPs), to obtain broadband services.[30]

[30] State of New Hampshire, Department of Resources and Economic Development and The Telecommunications Advisory Board, State of New Hampshire Broadband Action Plan: Appendix A, 2008, http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf . (accessed July 17, 2013).

FIGURE 5. UNDERSTANDING THE 'MIDDLE MILE' AND 'LAST MILE'



Source: http://www.whitehouse.gov/sites/default/files/20091217-recovery-act-investments-broadband.pdf

There are many different broadband delivery technologies. These technologies can be separated into two major categories of wired and wireless broadband. Wired technologies include Digital Subscriber Lines (DSL), Cable Modem, Fiber Optics, Leased Lines (T1), and Broadband over Powerline (BPL). Wireless technologies include mobile wireless (3G, 4G, LTE, WiMax), Wi-Fi, satellite, and Wireless Internet Service Providers (WISPs).[31] Wired broadband technologies bring a wire connection to the home or business. Often, a Wi-Fi router is used by the subscriber to share the Internet connection wirelessly among different devices within the home, such as a laptop computer or tablet.

Digital Subscriber Lines (DSL) and Cable Modem are wired technologies commonly used by residential and small businesses. DSL uses copper phone lines to deliver direct, one-on-one connections to the Internet, allowing users to not have to share bandwidth with neighbors. Users must be located within 18,000 feet (3.4 miles) of a phone company's central office, which means service is often unavailable in remote areas.[32] The most common DSL connections are asymmetric, with networks offering more bandwidth and faster speeds for download compared to upload, since residential users predominately are downloading more information from the Internet than uploading. Symmetric types of DSL provide equal bandwidth for uploading and downloading speeds, which is sometimes marketed as "Business DSL" as companies often have greater needs for uploading, or transmitting data.

Cable Modem, which is typically faster than a common, asymmetric DSL connection, uses the cable network to deliver broadband to users. Cable networks are a shared connection, so speeds can slow during peak usage times due to congestion when people in the same neighborhood are online. Fiber optic systems use lasers across very thin strands of glass creating reliable, resilient technology that has an extremely high capacity for speeds and data transmission. There is a high cost associated with laying out the fiber network but once in place the system can be easily upgraded and maintained, with lower

[31] "Wireless Internet 101," *Institute for Local Self-Reliance*, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).
[32] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).

operating costs than DSL, cable, or wireless networks.[33] Building out the fiber network is currently the most effective means to provide the highest capacity broadband.

Wireless broadband is available through many technologies, including mobile wireless, Wi-Fi, satellite, and WISPs. Unlike wired technologies, which bring wires directly to a location, wireless technologies use radio frequencies through transmitters and receivers to deliver broadband. Wireless broadband can be categorized as wireless networks or satellite. Cell phones, and other mobile devices, use mobile wireless licensed technologies such as 3G, 4G, LTE, WiMax, and other networks. Wi-Fi or 'hotspots' are designed to broadcast the Internet for several hundred feet. They are used by public and private networks, including businesses for their employees or retailers for their customers, who connect to the Internet using built-in Wi-Fi cards in their mobile devices (e.g. laptops, tablets, or cell phones, etc).

WISPs are designed to cover large areas using point-to-multipoint networks to broadcast wireless data up to 20 miles. A signal is broadcast from a base station and is received by a fixed wireless antenna mounted on a customer's premises. A combination of a Wi-Fi Hotspot and a WISP can enable a Neighborhood Internet Service Provider (NISP) or a Wi-Fi Hotzone. A Wi-Fi Hotzone can cover an area such as a neighborhood, shopping mall, or campground.[34] WISP networks can provide "last mile" solutions and broadband availability to rural areas where it is often cost-prohibitive to build wired networks.

Satellite Internet users send and receive information via small dishes installed on the premises to a satellite in space which retransmits the signal to a network operation center that is connected to the Internet. Satellite-based Internet connection can be interrupted by objects and weather, and broadband upload speeds are typically slower than wired or other wireless networks.[35] While wireless broadband can offer mobility and access for rural locations, wireless connections are unlikely to overtake the wired network which is likely to maintain higher speeds and lower costs, especially when compared to a ubiquitous fiber network. Wireless and wired broadband networks can be thought to complement each other to create available broadband Internet connections.[36]

Why Broadband Is Important

Broadband is in 2014 what electricity was to New Hampshire in the 1930's - a necessity. As a predominantly rural state, the availability of high-speed internet is one of the most significant factors that will impact the ability of communities to achieve economic growth and maintain quality of life. In a relatively short period of time, fast and reliable broadband has become essential for economic and community development and is critical infrastructure for public safety, education, health care, business and government operations.[37]

Communities today face many challenges: a competitive global marketplace; an aging population; the need for a better-educated and better-prepared workforce; and, access to health care. These issues are magnified in rural areas as the distance between households and services makes it difficult to access certain resources and opportunities. The financial resources traditionally available to overcome these challenges are often unavailable to rural communities and regions. New solutions are required. Broadband can help community leaders find innovative solutions to these challenges.

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[33] "*Broadband 101," Institute for Self-Reliance,* http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed on July 17, 2013).
[34] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).
[35] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).
[36] "Wireless Internet 101," *Institute for Local Self-Reliance*, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).
[37] "Building Community Capacity through Broadband (BCCB) Initiative," *University of Wisconsin Extension*, November 2010, http://www.uwex.edu/broadband/documents/BCCBUWEXFAQ_rev_11_18_10withmap.pdf. (accessed June 2013).

There is no doubt that we live in an information society, and broadband connects us to opportunities and services. Whether this is training for a new skill, a new language, or completing an online course - broadband facilitates the access of information in many different forms.[38] In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.[39] While this is an impressive increase, there are still many Americans with insufficient access to broadband services. In New Hampshire, access varies from good coverage and availability in denser areas of the state to areas of un-served and under-served communities in the northern, western and eastern parts of the state. This variability can lead to disparities in economic opportunity, education, community vitality, public health and safety, and quality of life.

Education Sector

Broadband is an important tool to enhance access to and improve the quality of education at all levels. Broadband-enabled teaching and learning has the potential to extend learning beyond the limits of the classroom, provide more customized learning opportunities, and increase the efficiency of school systems.[40] The availability of a wide range of internet based resources such as distance learning programs, online learning modules, and digital textbooks allows students to engage in multimedia lessons, take virtual trips, and communicate with classrooms in other parts of the world. These tools offer educators a platform to share curricula and provide adult learners easy access to professional development or educational opportunities online.

However, as teaching and broadband technology become increasingly intertwined, students lacking access to adequate broadband both in school and at home will be unable to keep up with educational trends and potentially, be less prepared than their peers in more 'connected' areas. The State Educational Technology Directors Association recommends that K-12 schools have access to broadband speeds of 100 megabits per second for every 1,000 students and staff by the year 2014 and 1 gigabyte per second by 2017.[41] Although most schools provide some level of internet access, too often the speeds of these connections fall short of what is considered appropriate or necessary.[42] This need for improved broadband connections in schools will only increase over time; especially, as educators transition to web-based content and resources and more states require online assessments and testing.

Not only does the availability of reliable broadband technology offer advances in education, it is imperative to the economic welfare and long-term success of our state and nation.[43] Participation and competition in the global economy is increasingly dependent on twenty-first century skills, including the ability to effectively use technology and navigate the digital world.[44] Providing access to learning opportunities that address these skills can help empower students to actively engage in an increasingly technology-driven and digital culture.

[38] David Salway, "Why is Increasing Broadband Adoption so Important to Society?," *About.com Guide*, http://broadband.about.com/od/barrierstoadoption/a/Why-Is-Increasing-Broadband-Adoption-So-Important-To-Society.htm. (accessed July 2013).
[39] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).
[40] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013); United National Educational, Scientific, and Cultural Organization, Technology, *Broadband and Education: Advancing the education for all agenda*, Jan. 2013, http://unesdoc.unesco.org/images/0021/002196/219687e.pdf. (accessed July 17, 2013).
[41] C. Fox, J. Walters, G. Fletcher and D. Levin, "The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs," *State Education Directors Technology Association*, 2012, http://www.setda.org/web/guest/broadbandimperative. (accessed July 17, 2013).
[42] C. Fox, J. Walters, G. Fletcher and D. Levin, "The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs," *State Education Directors Technology Association*, 2012, http://www.setda.org/web/guest/broadbandimperative. (accessed July 17, 2013).
[43] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).
[44] Charles M. Davidson and Michael J. Santorelli, *The Impact of Broadband on Education*, A Report to the U.S. Chamber of Commerce, Dec. 2010, http://www.uschamber.com/sites/default/files/about/US_Chamber_Paper_on_Broadband_and_Education.pdf. (accessed July 2013).

Health Sector

With increasing and changing health needs, ranging from rising health care costs, to managing chronic illnesses, to meeting the needs of an aging population, and a shortage of specialists in rural locations, broadband Internet plays an important role in how these issues are addressed. Many emerging technologies and approaches to health care are dependent on broadband connections to improve health care outcomes while also controlling costs and extending the reach of health care providers.[45] Individual patients, providers, and the overall public health of a community benefit from more efficient, innovative, and informed health care systems as new technologies are adopted.

Telehealth, the broader term incorporating telemedicine, is the transfer of electronic medical data (images, sounds, live video and patient records) from one location to another. It includes the use of electronic information and telecommunications technologies to support long distance clinical care, patient and professional health related education, public health, and health administration.[46] New Hampshire, with rural geography, scarcity of local specialty medical services, and high percentage of elderly residents, can benefit from telehealth systems.[47] Broadband Internet is necessary to continue supporting current and emerging telehealth applications for patients, providers, hospitals, and health care businesses.

Electronic medical records systems enable providers to collaborate in patient care by accessing treatment information from different locations. Patients can have better access to their medical records and information in an effort to better engage patients and families in managing their health. Video conferencing allows physicians to conduct video consultation and monitor treatment of patients remotely. It also increases the reach of specialized physicians and research.[48] Broadband Internet connection plays an essential role in the ability to incorporate the latest health technologies that benefit patients, health providers, and health industry businesses.

Community Support / Government Sector

From providing a displaced community member with food and shelter to organizing community initiatives, local governments and community support organizations in New Hampshire deliver a wide variety of valuable services to their constituents. Demands for services are constantly increasing, yet organizational budgets rarely follow that same trend. Broadband connectivity provides the capacity to more efficiently and cost-effectively deliver services while opening up possibilities for new services and facilitating more robust public participation.

Undoubtedly, certain matters will always be best handled through face-to-face contact and technology should augment New Hampshire's tradition of accessibility to the public process. But citizens have come to desire, and sometimes expect, a certain level of online interactivity with government and community support organizations. Most towns in New Hampshire currently host websites providing immediate, remote access to public notices, event calendars, applications, forms, ordinances and regulations. While constituents benefit from easy access to the information they need, governments and community support organizations save time, money and resources when routine requests are handled online.

Equal in value to the administrative efficiencies associated with broadband technology are the accessibility opportunities broadband creates. Online meetings, surveys, blogs and other modules offer

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[45] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

[46] Louis Kazal Jr. and Anne Conner, "Planning and Implementing a Statewide Telehealth Program in New Hampshire", 2005, http://www.endowmentforhealth.org/uploads/documents/resource-center/Planning%20and%20Implementing%20a%20Statewide%20Telehealth%20Program%20in%20NH.pdf

[47] Louis Kazal Jr. and Anne Conner, "Planning and Implementing a Statewide Telehealth Program in New Hampshire", 2005, http://www.endowmentforhealth.org/uploads/documents/resource-center/Planning%20and%20Implementing%20a%20Statewide%20Telehealth%20Program%20in%20NH.pdf

[48] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

new ways for a larger percentage of the population to watch and participate in community decision-making processes. Similarly, technologies utilized by community support organizations now enable them to administer one-on-one services without travelling.

While new applications allowing for improved public sector interaction and transparency will continually surface, their reliance on perpetually maintained broadband infrastructure will remain a constant.

Public Safety Sector

New Hampshire is a predominantly rural state, where firefighters, law enforcement and emergency medical personnel cover wide geographic areas. These public safety officials are often required to quickly make potentially life-saving decisions in the field, despite the challenges of rugged terrain and natural and man-made disasters. Public safety personnel need the ability to quickly communicate with each other, access online resources (via a PC or mobile device), connect to networks, and quickly transfer important video and data files during emergencies. Broadband access through a combination of wired and wireless technologies can enhance public safety by enabling first responders to make informed decisions and allowing them to communicate with one another effectively, usually resulting in reduced loss of life and property.

Economic Development/Business Sector

The total economic impact of broadband in New Hampshire was estimated at $634 million in 2010 and in 2011, 11,000 net new jobs were created as a result of expanded broadband.[49] Broadband and economic development are connected in that, as we progress into the future, both are needed for each to be successful. The use of broadband for economic development improves the ability to retain and recruit businesses, increases business profitability, attracts highly skilled workers, improves the efficiency of municipal services, enhances access to healthcare, and contributes to stronger educational attainment. All are key ingredients to a successful economic development strategy.

Jobs depending on broadband and information and communications technology will grow by 25% between 2008 and 2018 or at a rate of 2.5% faster than the average for other occupations and industries.[50] To say that broadband technology has not changed the way we do business is to deny the tremendous impact that computers have had on our lives worldwide. In 2011, 73% of New Hampshire households and businesses had access to broadband and, nationally in 2012, 66% of adults have broadband at home, which is up from 3% in 2000.[51] Investment in broadband is showing benefits for small businesses and local economies, as well. A Connect Iowa study of the state's small businesses found that Iowa small businesses generate $1.9 billion in online sales and that small businesses with a broadband connection have revenues that are $200,000 higher annually than those which do not.[52]

Broadband and broadband-dependent applications allow small businesses to increase efficiency, improve market access, reduce costs and increase the speed of both transactions and interactions. By using Web-based technology tools, 68% of businesses surveyed boosted the speed of their access to knowledge, 54% saw reduced communications costs and 52% saw increased marketing effectiveness.[53] The use of broadband by small businesses has proven to be an efficient and cost effective tool. Business statistics have shown that small businesses have consistently been the backbone for job and wealth creation in the US economy. The use of broadband has truly served to enrich that position into the 21st century.

[49] R. Crandall and H. Singer. "The Economic Impact of Broadband Investment." *National Cable and Telecommunications Association*, 2010.
[50] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).
[51] The Pew Internet and American Life Project , Sept. 2012, available at http://www.pewinternet.org/ .
[52] Anna Read and Damon Poter, "Building High-Speed Communities," *APA Planning Magazine*, March 2013.
[53] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

APPENDIX C. BROADBAND TERMINOLOGY[54]

Backbone or Transport Layer - A backbone network or network backbone is a part of computer network infrastructure that interconnects various pieces of network, providing a path for the exchange of information between different LANs or sub-networks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than the networks connected to it.

Backbone networks should not be confused with the Internet backbone. The Internet backbone refers to the principal data routes between large, strategically interconnected networks and core routers in the Internet. These data routes are hosted by commercial, government, academic and other high-capacity network centers, the Internet exchange points and network access points that interchange Internet traffic between the countries, continents and across the oceans of the world. Internet service providers (often Tier 1 networks) participate in Internet backbone exchange traffic by privately negotiated interconnection agreements, primarily governed by the principle of settlement-free peering.

Bandwidth - The transmission capacity of an electronic pathway such as a communications line, computer bus or computer channel. In a digital line, it is measured in bits per second or bytes per second (see Mb/sec). In an analog channel or in a digital channel that is wrapped in a carrier frequency, bandwidth is the difference between the highest and lowest frequencies and is measured in Hertz (kHz, MHz, GHz).

Broadband - The term commonly refers to Internet access via cable and DSL, which is as much as 400 times faster than analog dial-up. The term has always referred to a higher-speed connection, but the speed threshold varies with the times. The FCC defines broadband as 4 Mbps download speed and 1 Mbps upload speed. Whereas, the NTIA defines broadband as 768 Kbps download speed and 200 Kbps upload speed.

Cable modem - A modem used to connect a computer to a cable TV service that provides Internet access. Cable modems can dramatically increase the bandwidth between the user's computer and the Internet service provider. Download speeds have reached 6 Mbps and beyond, but the connection is asynchronous. In order to prevent users with lower-cost cable access from hosting high-traffic Web servers, the upload speed is considerably slower, from 10 to 20 times slower. Cable operators also routinely change IP addresses assigned to users to prevent Web hosting.

DSL - (Digital Subscriber Line) A technology that dramatically increases the digital capacity of ordinary telephone lines (the local loops) into the home or office. DSL speeds are based on the distance between the customer and Telco central office. There are two main categories. Asymmetric DSL (ADSL) is for Internet access, where fast downstream is required, but slow upstream is acceptable. Symmetric DSL (SDSL, HDSL, etc.) is designed for connections that require high speed in both directions.

Fiber-optic - Refers to systems that use optical fibers. Fiber-optic communications networks have transformed the world. Barely starting in the late 1960s but gaining serious momentum in the 1980s, the phone companies began to replace their copper long distance trunks with fiber cable. Eventually, all transmission systems and networks are expected to become fiber based, even to the home. In time, the electronic circuits in computers may be partially or fully replaced with circuits of light, in which case fiber pathways would be used throughout the system.

[54] Source: State of New Hampshire Broadband Action Plan, June 30, 2008, Appendix A - Glossary of Terms http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf)

Fixed Wireless - Refers to point-to-point transmission through the air between stationary devices. Fixed wireless is typically used for "last mile" connectivity to buildings.

Kbps - One thousand bits per second. Kbps is used as a rating of relatively slow transmission speed compared to the common Mbps or Gbps ratings.

Last Mile - The connection between the customer and the Telephone Company, Cable Company or Internet service provider. The last mile has traditionally used copper-based telephone wire or coaxial cable, but wireless technologies offer alternative options in some locations. Also called "first mile" or "fiber to the home."

Mbps - Mbps means megabits per second and is used for transmission speeds in a network or in internal circuits.

Middle Mile[55]- In the broadband Internet industry, the "middle mile" is the segment of a telecommunications network linking a network operator's core network to the local network plant, typically situated in the incumbent telephone company's central office that provides access to the local loop, or in the case of cable television operators, the local cable modem termination system. This includes both the backhaul network to the nearest aggregation point, and any other parts of the network needed to connect the aggregation point to the nearest point of presence on the operator's core network.

Middle-mile provision is a major issue in reducing the price of broadband Internet provision by non-incumbent operators. Internet bandwidth is relatively inexpensive to purchase in bulk at the major Internet peering points, and provides access to end-customer ports in the incumbent operator's local distribution plant (typically where local loop unbundling is mandated by a telecom regulator.)

However, middle-mile access, where bought from the incumbent operator, is often much more expensive than either, and typically forms the major expense of non-incumbent broadband ISPs. The alternative, building out their own fiber networks, is capital-intensive, and thus unavailable to most new operators. For this reason, many proposals for government broadband stimulus initiatives are directed at building out the middle mile. Two examples are the Network New Hampshire Now and Maine Fiber Company in the Northeast US, both funded largely by the National Broadband Plan (United States) to connect all community anchor institutions.

Mobile Wireless - Refers to transmission through the air from a base station to a moving device such as a cell phone.

Cellular vs. Wi-Fi - Cellular carriers offer optional, digital data services for Web browsing, e-mail and other text and data applications. The data service is separate from the carrier's voice plans, often costing considerably more than a basic voice subscription. The cell phones must support the data service, which is also available for laptops and other portable devices with the installation of the appropriate modem.

Wi-Fi networks are available to the public in many cities and municipal areas. Individual venues such as airports and coffee shops also provide service (see hotspot). Typically fee based by the hour or day, some municipalities provide free service (see Muni Wi-Fi).

Location is the key issue in real estate and also the primary concern with wireless systems. For travelers who need ubiquitous connectivity, there are many gaps (white spaces) in Wi-Fi coverage. Although

[55] Source: http://en.wikipedia.org/wiki/Middle_mile

cellular data rates (EDGE, EV-DO, HSPA, etc.) are typically slower than Wi-Fi, cellular carriers offer the most inclusive coverage when traveling, very often equivalent to using a cell phone for voice.

Satellite Broadband[56]- Just as satellites orbiting the earth provide necessary links for telephone and television service, they can also provide links for broadband services. Satellite broadband is another form of wireless broadband and is particularly useful for serving remote or sparsely populated areas.

Downstream and upstream speeds for satellite broadband depend on several factors, including the provider and service package purchased, the consumer's line of sight to the orbiting satellite, and the weather. Satellite service can be disrupted in extreme weather conditions. Typically a consumer can expect to receive (download) at a speed of about 1 Mbps and send (upload) at a speed of about 200 kbps. These speeds may be slower than DSL and cable modem, but the download speed is still much faster than the download speed with dial-up Internet access. New facilities, scheduled for deployment in 2012, are expected to support consumer broadband services for several million customers at speeds up to 12 Mbps for downloads and 3 Mbps for uploads.

Obtaining satellite broadband can be more costly or more involved than obtaining DSL or cable modem. A user must have:

- a two or three foot dish or base station - the most costly item;
- a satellite Internet modem; and
- a clear line of sight to the provider's satellite.

To find out if satellite broadband is available to your home, contact broadband satellite companies or your state's public service commission.

56 Source: http://www.fcc.gov/guides/getting-broadband

APPENDIX D. NH BROADBAND MAPPING PROTOCOL[57]

Introduction

The New Hampshire Broadband Mapping & Planning Program (NHBMPP) is funded through the Department of Commerce's National Telecommunications and Information Administration (NTIA) State Broadband Initiative (SBI), formerly known as the State Broadband Data Development (SBDD) program. In 2010, grants were issued to each of the 50 states, 5 territories and the District of Columbia to compile and maintain a mapped inventory of broadband availability at the state level. The state data sets are regularly submitted to the NTIA for incorporation in the national broadband map, thereby contributing to national, regional, and state efforts to understand the current broadband landscape and to plan for future broadband expansion, access, and adoption.

Broadband Availability

The NHBMPP began mapping statewide broadband availability in January of 2010, with data collection and processing scheduled at 6-month intervals throughout the project end date of December 2014. All map data development is governed by NTIA guidelines and standards, which are enforced to accommodate the merging and analysis of data from NH with comparable data sets from the other 55 grantees.

The first NHBMPP mapping task was to generate a listing of the active internet service providers (ISPs) in the state. An initial list of approximately 70 ISPs was compiled from existing plans and documents as well as local knowledge. The list is continually reviewed and updated as required, and currently includes over 60 known active providers.

At the start of each biannual map update, NHBMPP staff contacts each active ISP and requests broadband service coverage information. The data requested by the NHBMPP comprises the footprint of the provider coverage area(s), the technology delivering service to that footprint, and the advertised download and upload data transmission speeds for the footprint. Per NTIA guidelines, the footprint represents both areas that are currently served and areas that could be served within 10 business days.

NHBMPP focuses on building strong relationships with providers, and actively encourages the provision of data by accommodating data submissions in a variety of forms, and by providing technical support to facilitate submission when requested. The coverage data received by the NHBMPP arrives in formats ranging from detailed maps with speed information to customer addresses to highlighted paper maps to full digital databases that align with the national broadband map format.

The ISP data submissions are processed by the NHBMPP, standardized to conform to NTIA programmatic requirements, verified with the providers, and submitted to NTIA during the spring and fall of each year. Key details of the data processing and standardization include:

- Wireline broadband technology (cable, DSL, T-1, fiber) data are processed into the NTIA standardized format of US Census blocks for areas where the blocks are less than two square miles, and US Census road centerlines for rural areas where the census blocks are greater than two square miles. (The US Census data are derived from the 2010 TIGER files.) If a provider indicates than an address within a Census block or along a road segment is served, the entire block or road is considered served. This may result in an overstatement of coverage footprints in some areas of the state.

[57] Prepared By: NHBMPP, September 2013

- Coverage footprints may also appear to be overstated due to the fact that some providers are submitting data on residential and business class services combined, without differentiating between the two classes. This means that the speed associated with a given census block may reflect the high-speed services delivered to businesses within that block rather than typical speeds available to residential customers. This is more likely to result in an overstatement of speed tiers achievable than it is an overstatement of the coverage footprint itself.
- Wireless broadband technology (cellular, fixed-wireless, satellite) data are processed to represent the actual region that the signal covers. For cellular and satellite providers, the provider submission to NHBMPP is typically the coverage footprint. For fixed wireless, the submission typically comprises the tower location and height, and associated antenna details (make, model, power, signal direction, and span). The NHBMPP then utilizes specialized software (Cellular Expert) to process these inputs and to generate a signal propagation model describing the coverage area.
- Providers are submitting maximum advertised download and upload streams to the NHBMPP, as per NTIA guidance. The NHBMPP recognizes that these may be higher than actual speeds experienced by consumers. However, the NHBMPP verification efforts detailed below, and specifically the collection of speed test records, helps to mitigate this issue.
- The NHBMPP invites participation from all providers. However, not all ISPs have opted to submit data in each data collection cycle. This may result in an understatement of coverage footprints for some areas and some technologies.

While the NHBMPP is required to process the coverage information in the aggregated format, each state does have the opportunity to advance and enhance the level of mapping locally. The NHBMPP collects a suite of complementary data in order to verify the service information supplied by the ISPs. These include user speed tests submitted to the project website (iwantbroadbandnh.org), broadband use and availability surveys also submitted to the project web site and/or collected at project meetings, and direct email feedback. The program has also conducted a number of technology-focused verification inventories, including the following:

- Statewide drive test to collect cellular service data. In the summer of 2012, every US interstate and state route in New Hampshire was driven and each of the 5 cellular provider networks was tested for a data signal using signal propagation software on a provider cell phone.
- Town verification maps to provide feedback on the wireline technologies service areas (DSL and cable). In the summer/fall of 2013, paper maps were provided to each of the 234 cities/towns in the state, requesting that community members with knowledge of the broadband landscape review and submit corrections to the NHBMPP, as appropriate.

Where any of these verification methods indicates that service may not be available in an area reported as served, that area is marked for additional inquiry. Direct contact with the appropriate provider is made to confirm that the mapped data are correct based on project standards. If the finding is that the block is appropriately mapped but there are interior service gaps, the census block (or road segment) is flagged as being partially served. In some cases, broadband service to NH residents was offered or improved based on these reports and direct provider feedback.

Community Anchor Institutions

Broadband connectivity information for New Hampshire's 4,000+ Community Anchor Institutions (CAIs), including schools, libraries, municipalities, hospitals, and public safety entities, is collected on the same biannual schedule as the broadband coverage data. At the project outset, the nine regional planning commissions (RPCs) compiled listings of each CAI in their jurisdiction, mapped their location, and conducted phone and email surveys with each institution. Since that time, the broadband connectivity

information collected has been updated and maintained every 6 months through utilization of a web based reporting tool, as well as direct contact by the RPCs to the CAIs. As recently reported by NTIA, these data have been used by policymakers, researchers and other stakeholders, as well as the Network NH Now broadband expansion project, in planning for broadband expansion in NH and nationally.

Data Management

All of the data collected as part of the inventory and verification process are managed in a geographic information system (GIS), which allows for extensive data analysis and reporting. These data are analyzed in concert with other spatial data available in the GRANIT database in order to identify areas of the state that are served, unserved, and underserved. Due to the ever-changing speed requirements of online applications, areas of New Hampshire that are designated as underserved are subject to ongoing review.

The data collected by the NHBMPP and its partners are available in multiple venues. Key data sets of broad interest may be downloaded through the GRANIT web site (www.granit.unh.edu). Other data may be requested directly from the NHBMPP (contact@iwantbroadbandnh.org). In addition, the basic broadband availability data and the CAI inventory are available for online viewing through an interactive map hosted on the NHBMPP website (www.iwantbroadbandnh.org).

Through direct provider contact as well as community engagement and feedback, the NHBMPP has been able to generate the most accurate and comprehensive broadband inventory available to date. Additionally, this engagement has increased the dialogue between stakeholders on resolving issues around broadband availability, accessibility and adoption.

However, the NHBMPP recognizes that in some cases, broadband access and adoption is more a matter of affordability than one of availability. While pricing information is not currently being inventoried, steps have been taken to collect these data and efforts will continue in the future.

In addition to the coverage data currently being collected, rural address points are also being inventoried across the state, and will be publically available to support more granular level mapping in the future. These data may be used to inventory specific addresses for their broadband availability in order to pinpoint those areas of the state with no service or when service is limited. Collecting the speed tests at the address level will yield a higher resolution of mapping in order to identify the gaps in service in the census block.

The Future of Mapping Broadband in NH

At the conclusion of the NTIA-funded program in 2014, responsibility for national broadband availability mapping will transfer to the Federal Communications Commission (FCC). Currently, there is a federal requirement for providers to submit to the FCC their service information at the US Census tract level. Starting in 2015, the FCC requirement will change to reflect the US Census block level geography that has been used by the NHBMPP and its counterparts around the country.

The NHBMPP hopes to secure funding and resources to continue this important broadband inventorying effort. One key data stream that we hope to continue is the collection of speed test data, as this represents actual speeds experienced by users around the state. These data may then be able to enhance the census block information collected by the FCC in order to indicate the areas in which actual transmission speeds experienced by users are lower than those reported by providers.

APPENDIX E. BROADBAND AVAILABILITY

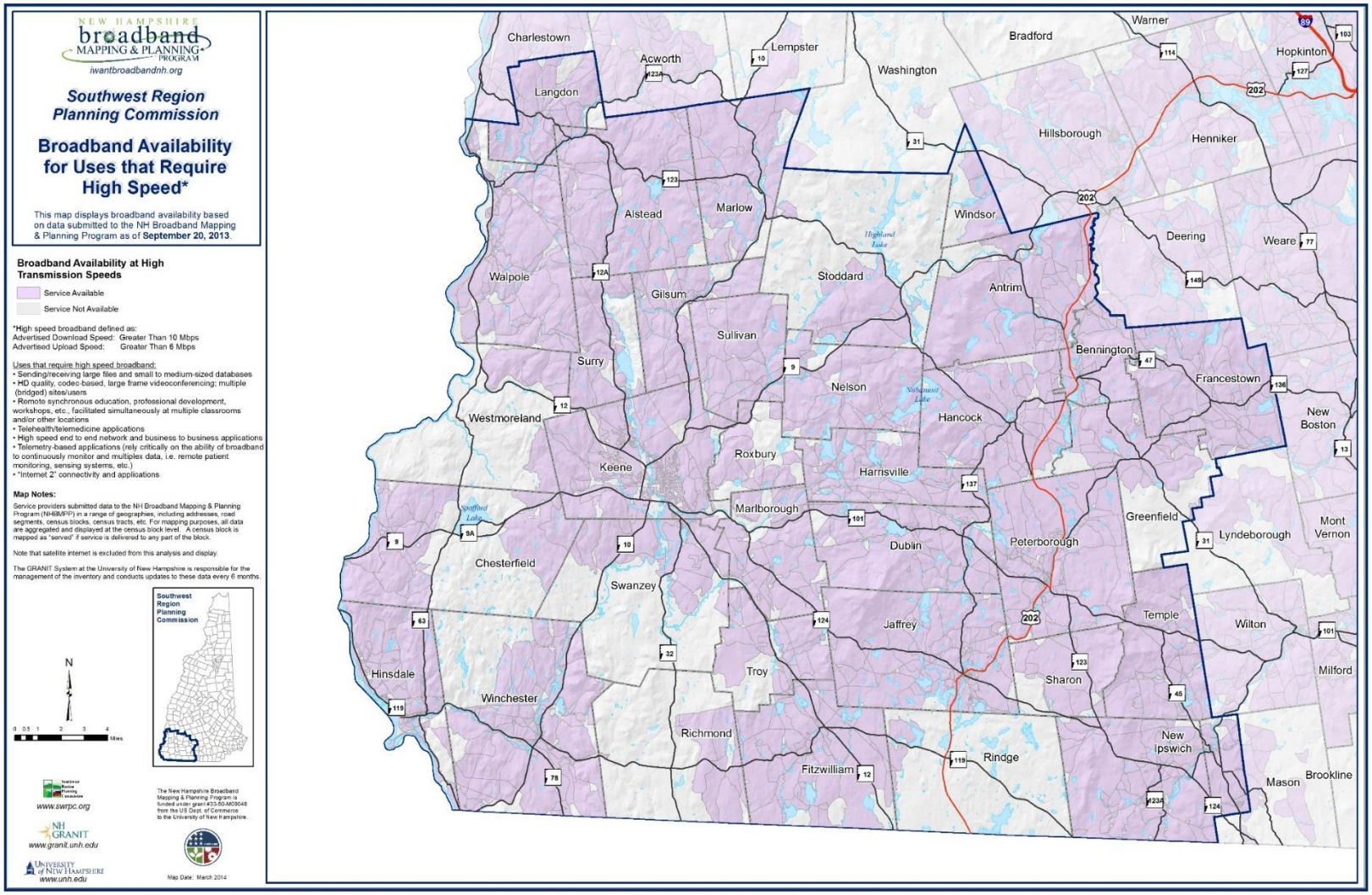
The maps included in this Appendix represent data received on broadband availability through UNH's direct work with over 40 of the state's 63 identified broadband service providers. The information presented in the maps below is based on data collected through the summer of 2013 and submitted to NTIA in September 2013. This information is displayed according to NTIA guidelines. Speeds shown are the maximum advertised speeds for the geographic features depicted, and must exceed the NTIA minimum definition for broadband speed, which was 768 kbps download and 200 Kbps upload at the time of this project, to be included.

For mapping purposes the information shared by service providers on broadband availability was aggregated and mapped at the U.S. Census block level. The Census block is the smallest geography measured by the U.S. Census Bureau. These blocks are determined by population and can be greater than 2 square miles in size, especially in less densely populated areas. If a broadband provider offers service to a location within a census block, the entire block is depicted as having access to this level of service.

In addition, the information presented does not differentiate between speeds provided for business/commercial service and residential broadband service. Because of these limitations, these maps may depict overstated levels of broadband service that may not reflect of the types of service available to the majority of residences, businesses and CAIs in the region.

The maps included in this Appendix are listed below:

- Broadband Availability for Uses That Require High Speed (High speed is defined as broadband service with download speeds greater than 10 Mbps and upload speeds greater than 6 Mbps)
- Broadband Availability for Uses That Require Moderate Speeds (Moderate speed is defined as broadband service with download speeds between 3-6 Mbps and upload speeds between 1.5-3 Mbps)
- Level of Service for Broadband Intensive Applications and Uses (Broadband intensive uses are those that require a minimum download speed of 6 mbps and a minimum upload of 1.5 Mbps to be fully functional)
- Broadband Technology with Maximum Advertised Download Speed
- Broadband Availability
- Wireline Versus Terrestrial Wirleless Service Availability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Broadband Availability for Uses that Require High Speed*
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of September 20, 2013.
Broadband Availability at High Transmission Speeds
Service Available
Service Not Available
*High speed broadband defined as:
Advertised Download Speed: Greater Than 10 Mbps
Advertised Upload Speed: Greater Than 6 Mbps
Uses that require high speed broadband:
• Sending/receiving large files and small to medium-sized databases
• HD quality, codec-based, large frame videoconferencing; multiple (bridged) sites/users
• Remote synchronous education, professional development, workshops, etc., facilitated simultaneously at multiple classrooms and/or other locations
• Telehealth/telemedicine applications
• High speed end to end network and business to business applications
• Telemetry-based applications (rely critically on the ability of broadband to continuously monitor and multiplex data, i.e. remote patient monitoring, sensing systems, etc.)
• "Internet 2" connectivity and applications
Map Notes:
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
Note that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
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N
0 0.5 1 2 3 4 Miles
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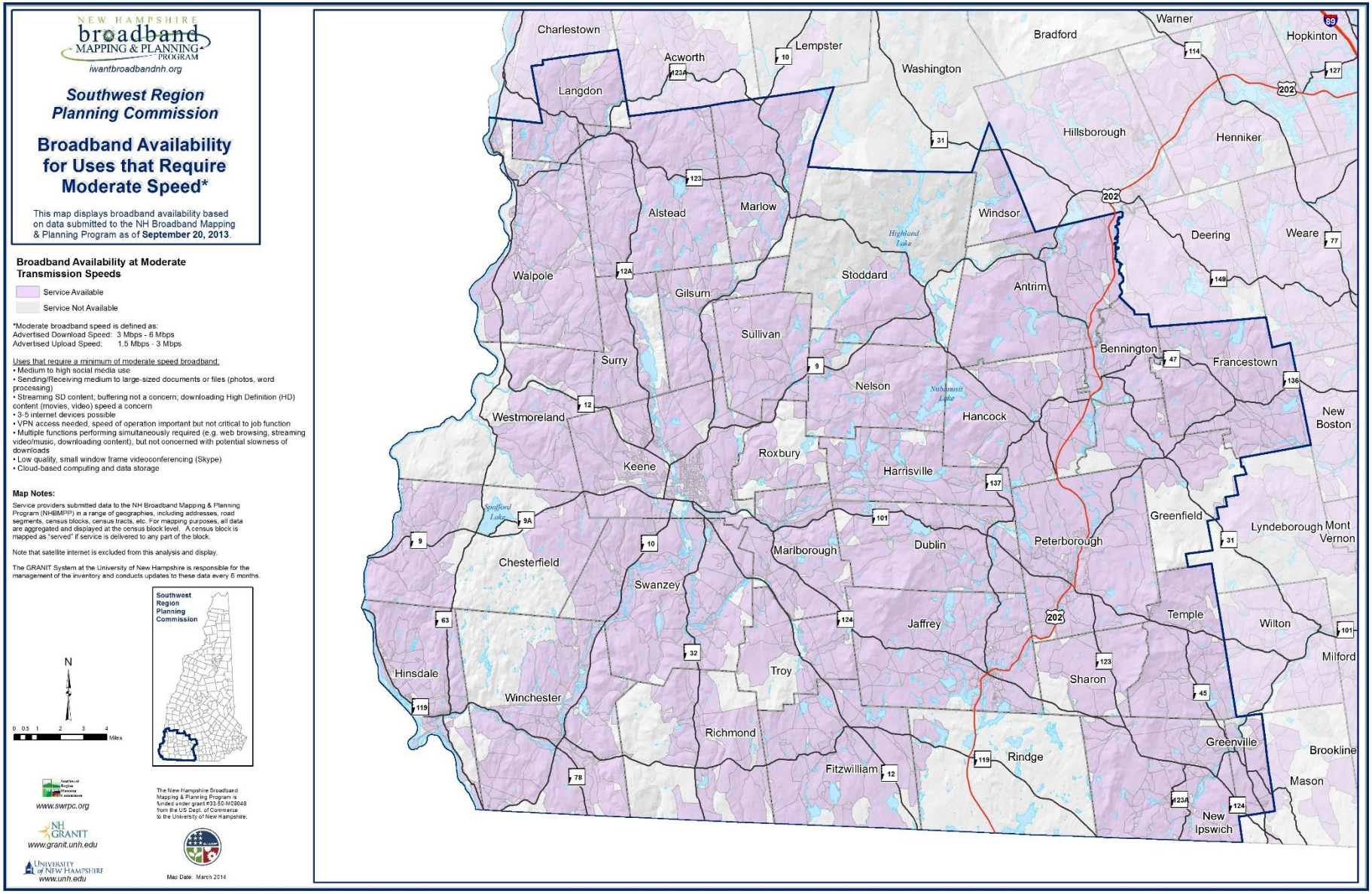
Map Date: March 2014
Charlestown
Langdon
Acworth
Lempster
Washington
Bradford
Warner
Hopkinton
Hillsborough
Henniker
Alstead
Marlow
Windsor
Deering
Weare
Walpole
Stoddard
Antrim
Glisum
Sullivan
Surry
Bennington
Francestown
New Boston
Nelson
Westmoreland
Hancock
Roxbury
Keene
Harrisville
Marlborough
Greenfield
Lyndeborough
Mont Vernon
Dublin
Peterborough
Chesterfield
Swanzey
Temple
Wilton
Jaffrey
Hinsdale
Troy
Sharon
Milford
Winchester
Richmond
New Ipswich
Rindge
Fitzwilliam
Mason
Brookline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Broadband Availability for Uses that Require Moderate Speed*
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of September 20, 2013.
Broadband Availability at Moderate Transmission Speeds
Service Available
Service Not Available
*Moderate broadband speed is defined as:
Advertised Download Speed: 3 Mbps - 6 Mbps
Advertised Upload Speed: 1.5 Mbps - 3 Mbps
Uses that require a minimum of moderate speed broadband:
• Medium to high social media use
• Sending/Receiving medium to large-sized documents or files (photos, word processing)
• Streaming SD content; buffering not a concern; downloading High Definition (HD) content (movies, video) speed a concern
• 3-5 internet devices possible
• VPN access needed, speed of operation important but not critical to job function
• Multiple functions performing simultaneously required (e.g. web browsing, streaming video/music, downloading content), but not concerned with potential slowness of downloads
• Low quality, small window frame videoconferencing (Skype)
• Cloud-based computing and data storage
Map Notes:
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
Note that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
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Map Date: March 2014
Charlestown
Acworth
Lempster
Washington
Bradford
Warner
Hopkinton
Langdon
Hillsborough
Henniker
Alstead
Marlow
Windsor
Deering
Weare
Walpole
Gilsum
Stoddard
Antrim
Sullivan
Surry
Nelson
Bennington
Francestown
New Boston
Westmoreland
Hancock
Roxbury
Keene
Harrisville
Greenfield
Lyndeborough
Mont Vernon
Chesterfield
Marlborough
Dublin
Peterborough
Swanzey
Jaffrey
Temple
Wilton
Milford
Hinsdale
Troy
Sharon
Winchester
Richmond
Greenville
Brookline
Fitzwilliam
Rindge
Mason
New Ipswich

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Level of Service for Broadband Intensive Applications and Uses

This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of **September 20, 2013**.

Level of Service Based on Provider Advertised Speeds

- Served
- Served With Reported Gaps
- Underserved
- Underserved With Reported Gaps
- Unserved
- Unpopulated Areas

Broadband intensive applications and uses are those that require a minimum of 6 Mbps downstream and 1.5 Mbps upstream to be fully functional. These may include: streaming HD content, connecting 5+ internet devices, video conferencing, etc.

SERVED:
Maximum Advertised Download Speed: 6+ Mbps
Maximum Advertised Upload Speed: 1.5+ Mbps

UNDERSERVED:
Maximum Advertised Download Speed: 768 kbps - 6 Mbps
Maximum Advertised Upload Speed: 200 kbps - 1.5+ Mbps

UNSERVED:
Maximum Advertised Download Speed: < 768 kbps
Maximum Advertised Upload Speed: < 200 kbps

REPORTED GAPS are areas where the NHBMPP has received user emails or website surveys indicating that no service is available. Additionally, areas where speed tests have been filed that do not meet the minimum speed criteria are flagged as having a gap in service.

Map Notes:
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.

Note that satellite internet is excluded from this analysis and display.

The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.

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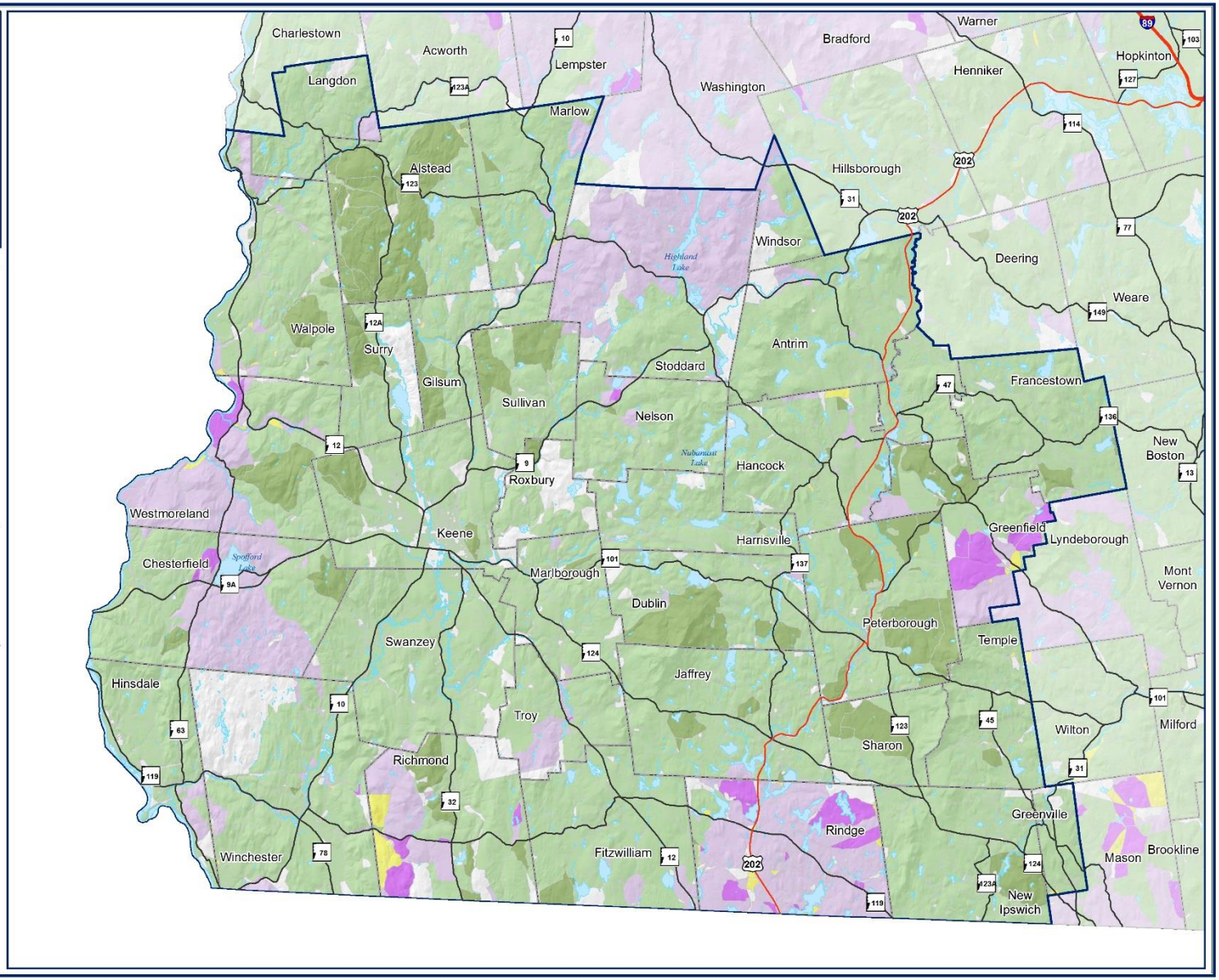
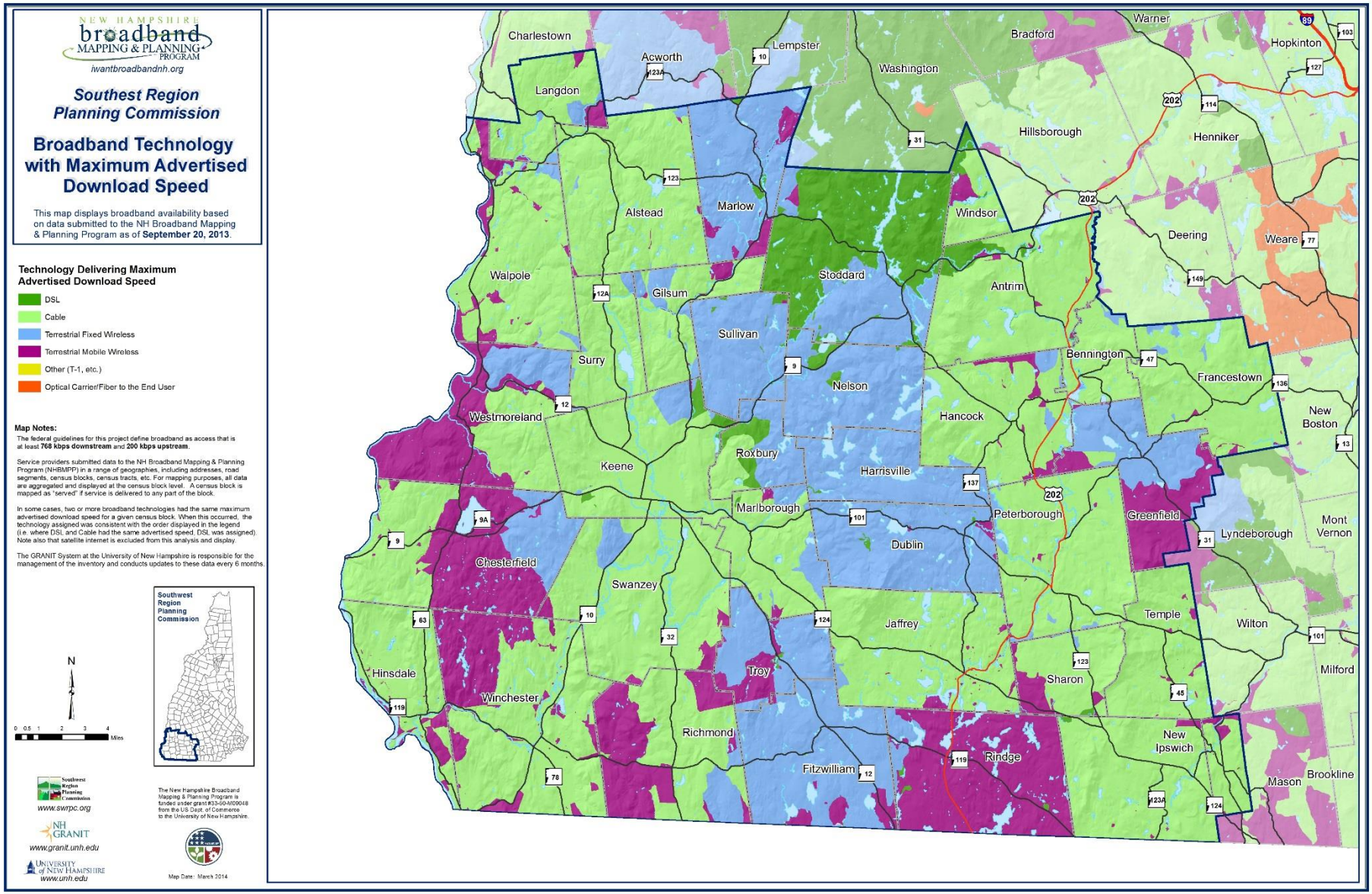
Map Date: February 2014

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Broadband Technology with Maximum Advertised Download Speed
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of September 20, 2013.
Technology Delivering Maximum Advertised Download Speed
DSL
Cable
Terrestrial Fixed Wireless
Terrestrial Mobile Wireless
Other (T-1, etc.)
Optical Carrier/Fiber to the End User
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
In some cases, two or more broadband technologies had the same maximum advertised download speed for a given census block. When this occurred, the technology assigned was consistent with the order displayed in the legend (i.e. where DSL and Cable had the same advertised speed, DSL was assigned). Note also that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
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Map Date: March 2014
Charlestown
Acworth
Lempster
Bradford
Warner
Hopkinton
Langdon
Washington
Hillsborough
Henniker
Alstead
Marlow
Windsor
Deering
Weare
Walpole
Stoddard
Antrim
Gilsum
Sullivan
Surry
Bennington
Francestown
Nelson
New Boston
Westmoreland
Hancock
Roxbury
Keene
Harrisville
Marlborough
Peterborough
Greenfield
Lyndeborough
Mont Vernon
Dublin
Chesterfield
Swanzey
Temple
Wilton
Jaffrey
Hinsdale
Troy
Sharon
Milford
Winchester
Richmond
New Ipswich
Fitzwilliam
Rindge
Mason
Brookline

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Broadband Availability

This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of **September 20, 2013**.

Availability Based On Provider Advertised Speeds

- Served
- Underserved
- Unserved
- Unpopulated Areas

The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream. The NHBMPPhas adopted a higher threshold for minimum broadband transmission speeds as described below.

SERVED:
Maximum Advertised Download Speed: 3+ Mbps
Maximum Advertised Upload Speed: 1.5+ Mbps

UNDERSERVED:
Maximum Advertised Download Speed: 768 Kbps - 3 Mbps
Maximum Advertised Upload Speed: 200 Kbps - 1.5+ Mbps

UNSERVED:
Maximum Advertised Download Speed: < 768 Kbps
Maximum Advertised Upload Speed: < 200 Kbps

Map Notes:
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.

Note that satellite and cellular internet are excluded from this analysis and display.

The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.

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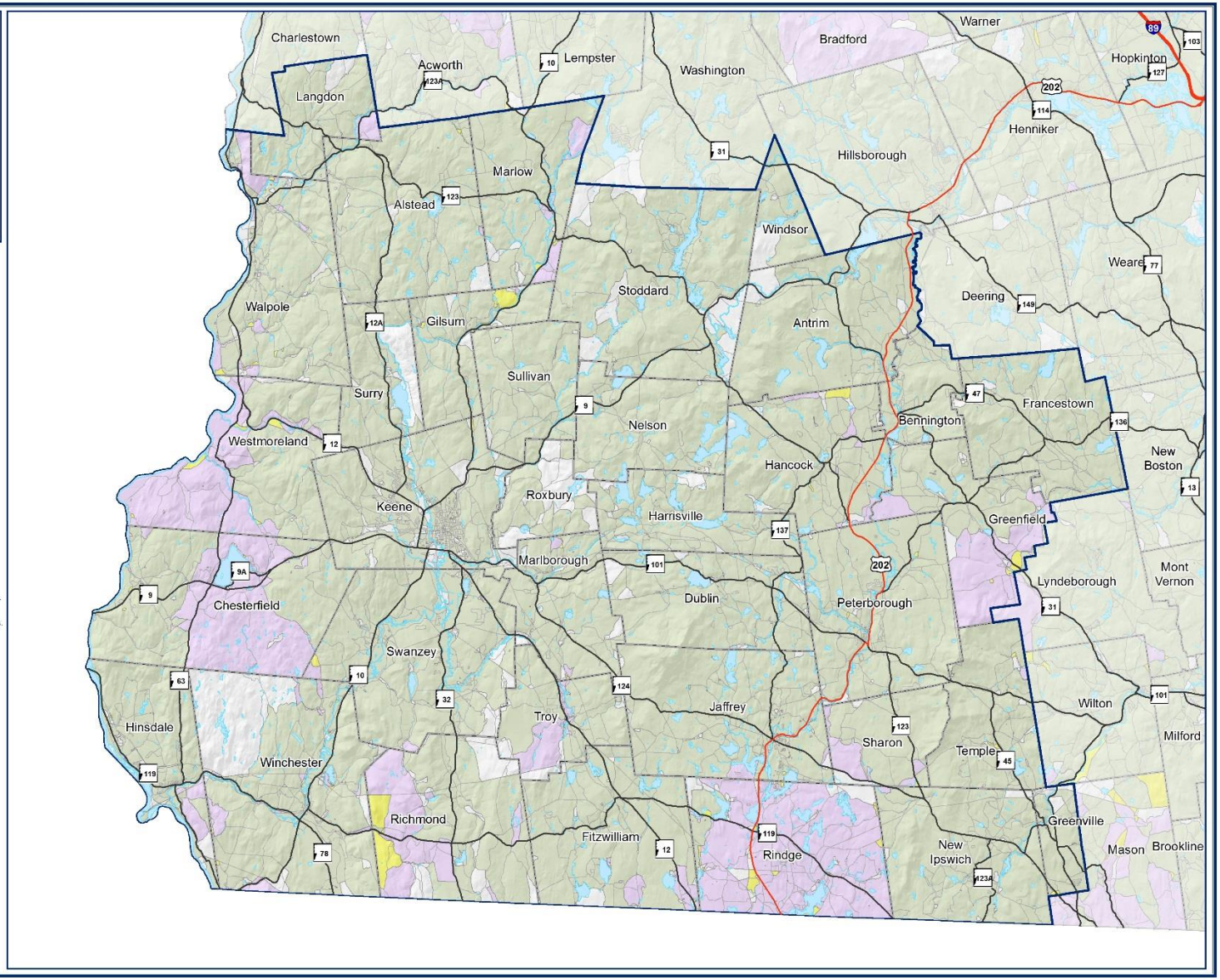
The New Hampshire Broadband Mapping & Planning Program is funded under grant #33-50AC50048 from the US Dept. of Commerce to the University of New Hampshire.

Map Date: February 2014



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Wireline Versus Terrestrial Wireless Service Availability

This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of **September 20, 2013**.

Broadband Availability Based On Provider Advertised Speeds

- Wireline Service Available
- Wireless Service Available

Map Notes:

The federal guidelines for this project define broadband as access that is at least **768 kbps downstream** and **200 kbps upstream**.

Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.

Note that satellite internet is excluded from this analysis and display.

The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.

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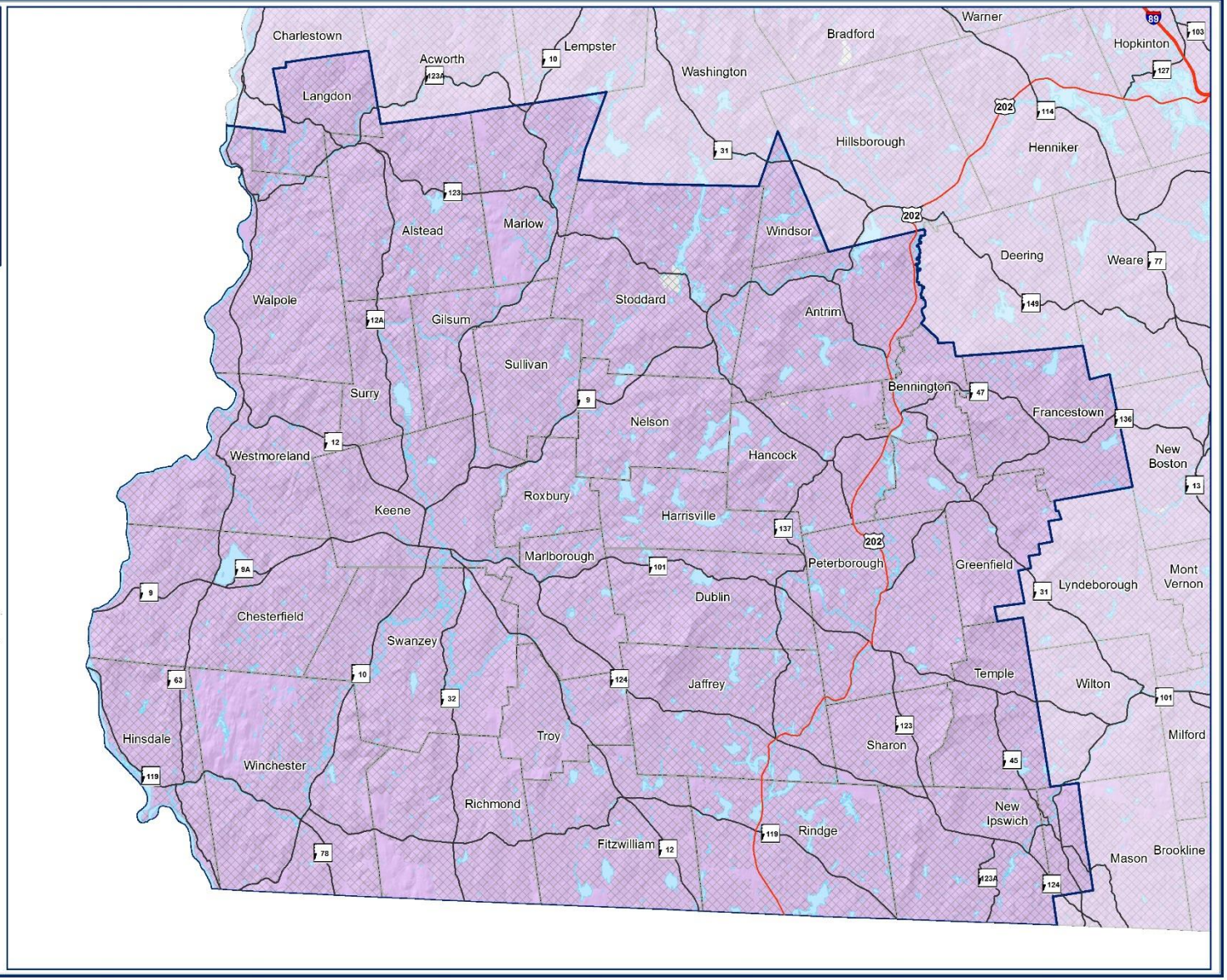
Map Date: March 2014



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