City of Biddeford, Maine
Broadband Plan

Prepared by
Casco Bay Advisors, LLC
October 4, 2019

Made possible through a generous grant from Maine Community Foundation
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1 Executive Summary

Casco Bay Advisors, LLC (Casco Bay) is pleased to present this Broadband Plan (Plan) to the City of Biddeford, Maine (City), examining existing high-speed broadband assets within the City limits, where gaps in coverage may exist, recommendations to prepare for Smart City services and recommendations for ensuring all citizens are included in the use of the Internet.

The intent of this report is not to analyze Internet usage trends, determine how much bandwidth will be required in the future, or explain why the Internet is important to the Study Area. As a society, we already understand that the Internet is pervasive and integrated into all facets of everyday life, and that we all must have unrestricted access to the Internet in order to participate in the increasingly global economy, especially in the areas of healthcare, education, entertainment, financial services, consumer goods and services, and global commerce. Rather, this report presents a foundational understanding of the different Internet access technologies, the existing broadband infrastructure supporting the community, and the gaps that exist in coverage and/or service capacity. With this baseline in hand, we review and present high-level costs to ensure a solid foundation for Smart City applications and a means by which to introduce a much more robust competitive environment.

We applaud the City for taking this initiative to better understand their current resources and to set the stage for ensuring the community is well positioned to take advantage of the introduction of new Internet enabled services.
2  Internet Access and Broadband Definition

The terms “Internet access” and “broadband” are often used interchangeably. There is frequently confusion between the two, especially as the definitions evolve with technology changes.

Internet access connects individual computer terminals, computers, mobile devices, and computer networks to the Internet, enabling users to access Internet services such as email, applications and information delivered via the World Wide Web. Internet service providers (ISPs) offer Internet access through various technologies that offer a wide range of data signaling rates (speeds).

Consumer use of the Internet first became popular through dial-up Internet access in the 1990s. By the first decade of the 21st century, many consumers in developed nations used faster, broadband Internet access technologies.

Broadband is a generic term representing any wide-bandwidth data transmission method with the ability to transport multiple signals and traffic types simultaneously. This data can be transmitted using coaxial cable, optical fiber, radio or twisted pair copper. In the context of Internet access, broadband is used much more loosely to mean any high-speed Internet access that is always on and faster than traditional dial-up access. Different governing authorities have developed inconsistent definitions of what constitutes broadband service based on access speed.

In January 2015, the Federal Communications Commission (FCC) voted to define broadband as Internet service with at least 25 Mbps (megabits per second) download and 3 Mbps upload. Their definition affects policy decisions and the FCC’s annual assessment of whether broadband is being deployed to all Americans quickly enough. In Maine, the ConnectME Authority Board\(^1\) currently defines effective broadband network capacity as speeds equal to or greater than 25Mbps/3Mbps, and anything less as “unserved.”

For those rural and high-cost areas served by Consolidated Communications, Inc. (CCI) where CCI has accepted subsidies through the Connect America Fund – Phase II (CAF-II), the FCC has adopted a minimum speed standard of 10Mbps/1Mbps.

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\(^1\) In recognition of the critical importance of modern technology for education, health care, and business success in Maine, the Legislature created the ConnectME Authority (Authority) in 2006 as an independent state agency to develop and implement broadband strategy for Maine. The Authority is governed by a board which is comprised of members appointed by the Governor or specifically identified and designated by statute.
3 Internet Access Technology Overview

In this section, we present an overview of different Internet access technology, including digital subscriber line, cable modem, fixed wireless, 4G/LTE Advanced, 5G, satellite, and Fiber-to-the-Premise.

3.1 DSL

Digital subscriber line (DSL) is a technology most frequently used by traditional telephone system operators such as Consolidated Communications, Inc. (CCI) to deliver advanced services (high-speed data and potentially video) over twisted pair copper telephone wires. This technology has lower data carrying capacity than the hybrid fiber coaxial network deployed by cable system operators like Charter Communications (Spectrum). Data speeds are range-limited by the length of the copper cable serving the premise, the wire gauge of the copper conductors and the condition of the copper.

DSL service can be delivered simultaneously with wired telephone service on the same telephone line. This is possible because DSL uses higher frequency bands for data transmission than are required for the voice service transmission. On the customer premises, a DSL filter on each non-DSL outlet blocks any high-frequency interference to enable simultaneous use of the voice and DSL services.

The bit rate of consumer DSL services can range from 256 Kbps (kilobits per second) to over 100 Mbps in the direction of the service provider to the customer (downstream), depending on the DSL technology, line conditions, and the length of the copper loop. Until recently, the most commonly installed DSL technology for Internet access has been asymmetric digital subscriber line (ADSL). With ADSL, the data throughput in the upstream direction (the direction from the consumer to the service provider) is lower, hence the designation of asymmetric service.

At the central office, a digital subscriber line access multiplexer (DSLAM) terminates the DSL circuits and aggregates them, where they are handed off to other networking transport equipment. The DSLAM terminates all connections and recovers the original digital information. For locations beyond the maximum distance from the central office for the particular type of DSL technology deployed (7,000 – 12,000 feet), DSLAMs can be deployed in the field in outside plant cabinets (remote terminals) and connected to the central office by fiber optic cables. A shorter distance from the subscriber premise to the DSLAM results in greater bandwidth (speed and/or capacity) for the connected users.

The customer end of the connection consists of a terminal adaptor or "DSL modem.” This converts data between the digital signals used by computers and the voltage signal of a suitable frequency range which is then applied to the phone line.

There are additional formats of DSL technologies that can enhance the capacity of the network. ADSL2+ extends the capability of basic ADSL by doubling the number of downstream channels,
increasing the frequency from 1.1 Mhz to 2.2 Mhz. The data rates can be as high as 24 Mbps downstream and up to 1.4 Mbps upstream, depending on the distance from the DSLAM to the subscriber’s premises. Like the previous standards, ADSL2+ will degrade from its peak bit rate after a certain distance.

ADSL2+ allows port bonding, where multiple ports are physically provisioned to the end user and the total bandwidth is equal to the sum of all provisioned ports. When two lines capable of 24 Mbps are bonded, the end result is a connection capable of 48 Mbps download and twice the original upload speed.

Very-high-bit-rate digital subscriber line 2 (VDSL2+) permits the transmission of asymmetric and symmetric aggregate data rates up to 200 Mbps downstream and upstream on twisted pairs using a bandwidth up to 30 Mhz. It deteriorates quickly from a theoretical maximum of 250 Mbps at the source to 100 Mbps at 1,600 feet and 50 Mbps at 3,300 feet but degrades at a much slower rate from there. Starting from one mile, its performance is similar to ADSL2+. Bonding may be used to combine multiple wire pairs to increase available capacity or extend the copper network's reach.

All new DSL deployments for CCI utilize VDSL2+ equipment.

3.2 Cable Modem
Cable modem Internet access is provided over a hybrid fiber coaxial (HFC) broadband network. It has been employed globally by cable television operators since the early 1990s and is the network architecture utilized by Spectrum. In an HFC cable system, the television channels are sent from the cable system’s distribution facility, the headend, to local communities through optical fiber trunk lines. The fiber-optic trunk lines provide adequate bandwidth to allow future expansion for bandwidth-intensive services. At the local community, an optical node translates the signal from a light beam to an electrical signal and sends it over coaxial cable lines for distribution to potential subscribers.

The coaxial portion of the network connects 25–2,000 homes in a tree-and-branch configuration off the node. RF amplifiers are used at intervals to overcome cable attenuation and passive losses of the electrical signals caused by splitting or "tapping" the coaxial cable.

The HFC broadband network is typically operated bi-directionally, meaning that signals are carried in both directions on the same network from the headend/hub office to the home, and from the home to the headend/hub office. The forward-path or downstream signals carry information such as video content, voice and data. The return-path or upstream signals carry information such as video control signals to order a movie or Internet data to send an email. The forward-path and the return-path are carried over the same coaxial cable in both directions between the optical node and the home.

Data Over Cable Service Interface Specification (DOCSIS) is an international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV (CATV) system. DOCSIS 3.1 has been deployed by Spectrum to provide Internet access over their existing HFC infrastructure. The DOCSIS 3.1 standard is capable of supporting Internet speeds of up to 10 Gbps.
(gigabits per second), but most providers are currently offering speeds of 1 Gbps or less service for residential users.

3.3 Fixed Wireless

Fixed wireless broadband is the operation of wireless devices or systems used to connect two fixed locations (e.g., building to building or tower to building) with a radio or other wireless link. Fixed wireless data (FWD) links are often a cost-effective alternative to leasing fiber or installing cables between the buildings. The point-to-point signal transmissions occur through the air over a terrestrial microwave platform. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying new cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacities. Fixed wireless services typically use a directional radio antenna on each end of the signal. These antennas are generally larger than those seen in Wi-Fi setups and are designed for outdoor use. They are typically designed to be used in the unlicensed Industrial, Scientific, and Medical (ISM) radio frequency bands (900 MHz, 1.8 GHz, 2.4 GHz and 5 GHz). However, in many commercial installations licensed frequencies may be used to ensure quality of service (QoS) or to provide higher connection speeds.

To receive this type of Internet connection, consumers mount a small dish to the roof of their home or office and point it to the transmitter. Line-of-sight is usually necessary for Wireless Internet Service Providers (WISPs) operating in the 2.4 and 5 GHz bands. The 900 MHz band offers better non-line-of-sight (NLOS) performance. Providers of unlicensed fixed wireless broadband services typically provide equipment to customers and install a small antenna or dish somewhere on the roof. This equipment is usually deployed and maintained by the company providing that service.

3.4 4G/LTE Advanced Broadband

4G/LTE Advanced is wireless technology being deployed by cellular telephone providers such as AT&T, Verizon Wireless, US Cellular, Sprint and T-Mobile for traditional mobile phone and data services. The latest standard incorporates two new technologies - Carrier Aggregation, and Multiple Input Multiple Output (MIMO), in order to provide speeds in excess of 100 Mbps, and eventually up to 1 Gbps and beyond. While standard data connections use one antenna and one signal at any given time, 4G LTE Advanced has the capability of utilizing multiple signals and multiple antennas.

Mobile LTE wireless service uses MIMO technology to combine multiple antennas on both the transmitter and the receiver. A 2×2 MIMO configuration has two antennas on the transmitter and two on the receiver, but the technology is not limited to 2x2. More antennas could theoretically operate at faster speeds as the data streams can travel more efficiently. The signal is then combined with “carrier aggregation,” which allows a device to receive multiple 4G signals at once. The received signals don’t have to be on the same frequency; one could receive an 1800 MHz and an 800 MHz signal at the same
time, which is not possible with standard 4G. Up to five different 20 MHz signals can be combined to create a data pipe of up to 100 MHz of bandwidth.

### 3.5 5G Wireless

Fifth-generation wireless (5G) is the latest iteration of cellular technology, engineered to greatly increase the speed and responsiveness of wireless networks. With 5G, data transmitted over wireless broadband connections could travel at rates as high as 20 Gbps by some estimates -- exceeding wireline network speeds -- as well as offer latency of 1 millisecond or lower for uses that require real-time feedback. 5G will also enable a sharp increase in the amount of data transmitted over wireless systems due to more available bandwidth and advanced antenna technology.

In addition to improvements in speed, capacity and latency, 5G offers network management features, among them network slicing, which allows mobile operators to create multiple virtual networks within a single physical 5G network. This capability will enable wireless network connections to support specific uses or business cases and could be sold on an as-a-service basis. A self-driving car, for example, would require a network slice that offers extremely fast, low-latency connections so a vehicle could navigate in real time. A home appliance, however, could be connected via a lower-power, slower connection because high performance isn't crucial.

5G networks and services will be deployed in stages over the next several years to accommodate the increasing reliance on mobile and internet-enabled devices. Overall, 5G is expected to generate a variety of new applications, uses and business cases as the technology is rolled out.

How 5G works - Wireless networks are composed of cell sites divided into sectors that send data through radio waves. Fourth generation (4G) Long-Term Evolution (LTE) wireless technology provides the foundation for 5G. Unlike 4G, which requires large, high-power cell towers to radiate signals over longer distances, 5G wireless signals will be transmitted via large numbers of small cell stations located in places like light poles or building roofs. The use of multiple small cells is necessary because the millimeter wave spectrum -- the band of spectrum between 30 GHz and 300 GHz that most 5G implementations rely on to generate high speeds -- can only travel over short distances and is subject to interference from weather and physical obstacles, like buildings.

Previous generations of wireless technology have used lower-frequency bands of spectrum. To offset millimeter wave challenges relating to distance and interference, the wireless industry is also considering the use of lower-frequency spectrum for 5G networks so network operators could use spectrum they already own to build out their new networks. Lower-frequency spectrum reaches greater distances but has lower speed and capacity than millimeter wave.

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2 [https://searchnetworking.techtarget.com/definition/5G](https://searchnetworking.techtarget.com/definition/5G)
3.6 Satellite

Satellite Internet is available to virtually the entire lower 48 states, with some coverage in Alaska, Hawaii and Puerto Rico. The satellites are positioned more than 22,000 miles above the equator. These satellites are geostationary, which means they are always above a specific point on the earth as it rotates. The first Internet satellites successfully brought the Internet to a larger audience, but the rates were incredibly slow. Modern satellites use more advanced technology to transmit information which provides faster Internet access, but this is still much slower than landline-based Internet and terrestrial wireless Internet services.

When a consumer subscribes to satellite Internet, the company installs household equipment, which consists of an antenna dish and a modem. The antenna is located outside of the house and is generally two or three feet in diameter. The antenna must have an unobstructed view of the sky, called the line-of-sight, in order to communicate with the satellite. The antenna is connected to a modem, which connects to a computer with an Ethernet cable.

To manage bandwidth quality for all users, each plan comes with a cap on the data you can transmit or consume per month. The amount of data allotted depends on the subscriber’s plan. Plans typically range from 5 GB to 50 GB of data transmission per month with use limits prescribed. If you exceed the allotted data amount, Internet speeds will be throttled back until the next month. However, some companies allow subscribers to pay for more data capacity once the threshold is met, resetting normal operation levels.

Looking forward, at least a dozen companies, including Boeing, Amazon, SpaceX, OneWeb and Telesat are deploying, or planning to deploy thousands of Low Earth Orbit (LEO) satellites in massive constellations to provide Internet service to unserved and underserved regions of the world. The benefit of LEO satellites includes greater bandwidth and less latency, with the reported potential of displacing traditional land-line based Internet service. SpaceX and others have begun deploying LEO satellites and are in the process of testing the service to demonstrate their viability.

Satellite industry proponents say that now, unlike decades ago when Teledesic and the earlier iteration of Iridium failed to develop successful businesses, technology advancements are enabling satellite service to be offered more affordably and efficiently.

3.7 Fiber-to-the-Home (FTTH)

Fiber-to-the-Home (FTTH) or Fiber-to-the-Premise (FTTP) is a network utilizing fiber optic cables directly to the home or business and is capable of offering virtually unlimited symmetrical bandwidth. Most FTTP networks can offer 1 Gbps of bandwidth in both download and upload directions, with
some providers offering 2 Gbps and even 10 Gbps service capacity. The majority of new networks being deployed utilize this type of technology.

FTTH networks can be configured and operated in a number of different ways. These include:

- As a single service provider in a closed network environment;
- As an open access dark fiber configuration where, competing providers can lease the fiber and place their own optical/electronics to complete the service;
- As an open access dark fiber configuration where the network owner provides the optical/electronics and leases the service to competing providers; and,
- As a Software Defined Network, where competing providers interconnect with the network and users select their provider in a virtual manner.
4 Mapping of Existing Infrastructure and Capabilities

4.1 Data Collection Efforts

To kick off our mapping initiative, we solicited industry standard GIS-based maps from all known service providers with assets deployed in Biddeford. Two (2) providers declined to provide the requested mapping - Consolidated Communications (CCI) and Charter (Spectrum), one (1) provider was unresponsive (Mainecom) and three (3) provided the information as requested (Maine Fiber Company, Great Works Internet and FirstLight).

In order to incorporate the assets of those who declined or were unresponsive to our request, we performed a field audit to a) identify fiber optic cabling owned by CCI, determine the extent of the Spectrum network and to identify any other fiber optic cabling not previously identified by those who were responsive to our request. As a result, we are highly confident we have identified all of the high-speed broadband assets deployed within the City limits.

Following are maps for each providers assets and a discussion regarding the capability of those assets.
The Maine Fiber Company (MFC) has deployed high count fiber optic cables connecting large businesses and institutional users as extensions off of their 3-Ring-Binder network (3RB) that passes through the City along or in close proximity to Route 1. The MFC services are limited to “dark fiber”, which is fiber optic strands that have not been activated with optical electronics to transmit a signal. Those who lease this dark fiber are responsible for placing their own optical electronics on each end of the fiber optic strand to activate its use.

The MFC 3RB is operated on a non-discriminatory open access basis, meaning that anyone can lease its dark fiber on identical pricing and contractual terms as any other customer.
4.3 Great Works Internet (GWI)

Great Works Internet (GWI), headquartered in Biddeford, leases dark fiber from the primary MFC routes and has deployed its own fiber optic cables (-----) to extend off of the MFC network to reach their targeted clients. GWI is capable of providing any type of service along their network up to 10Gbps or greater.
4.4 FirstLight

FirstLight, which acquired the Maine Fiber Company 3RB network earlier this year, has an extensive network deployed along most all major roadways within the City limits. The mapping above represents both the MFC 3RB and the legacy FirstLight network. Like GWI, FirstLight is capable of providing any type of service along their network up to 10Gbps or greater, including dark fiber.
4.5 Consolidated Communications (CCI)

As the incumbent local telephone company, Consolidated Communications (CCI) has a twisted-pair copper network connecting virtually every potential residential and business subscriber within the City. We did not attempt to map these copper assets, which are utilized for voice and lower speed DSL-based broadband services. The map above illustrates the location of CCI’s fiber optic network based upon our field survey. Like GWI and FirstLight, CCI is capable of providing any type of service along their network up to 10Gbps or greater.
Charter (Spectrum) has deployed their hybrid fiber coaxial network to virtually every location within the City limits. Spectrum’s entry-level broadband service is a minimum 100Mbps/10Mbps, with the capability of increasing the speed to 1Gbps. To our knowledge, with the exceptions noted in Section 5.1 below and with the exception of locations further than 250 feet from the roadway where the subscriber may be required to pay additional charges to extend the connection beyond 250 feet on private property; there are no locations within the City unserved by Spectrum.
4.7 All Providers

The map above is a representation of all of the network assets capable of providing a minimum 100Mbps/10Mbps service.
5 Areas Requiring Service Expansion

5.1 Consumer/Residential

All areas of the City have access to DSL service from Consolidated Communications (CCI). According to information published by the ConnectME Authority\(^3\), all areas of the City have access to a minimum 25Mbps/3Mbps service, with the exception of the following addresses.

<table>
<thead>
<tr>
<th>Street Name</th>
<th>From Address</th>
<th>To Address</th>
<th>Number of unserved addresses</th>
<th>Review Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn Ln</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Clover Leaf Farm Rd</td>
<td>9</td>
<td>9</td>
<td>1</td>
<td>Clover Leaf Farm Rd originates in Kennebunkport</td>
</tr>
<tr>
<td>Colony Dr</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>Unable to locate address</td>
</tr>
<tr>
<td>Dennett Rd</td>
<td>125</td>
<td>140</td>
<td>5</td>
<td>Dennett Rd originates in Dayton</td>
</tr>
<tr>
<td>Fortunes Rocks Rd</td>
<td>100</td>
<td>102</td>
<td>2</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Fortunes Rocks Rd</td>
<td>116</td>
<td>118</td>
<td>2</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Fortunes Rocks Rd</td>
<td>122</td>
<td>124</td>
<td>2</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Fortunes Rocks Rd</td>
<td>136</td>
<td>136</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Fortunes Rocks Rd</td>
<td>138</td>
<td>138</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Gooch St</td>
<td>12</td>
<td>30</td>
<td>3</td>
<td>Commercial area easily served by Spectrum upon request</td>
</tr>
<tr>
<td>Guinea Rd</td>
<td>302</td>
<td>302</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Hedley Reynolds Way</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>UNE Campus Parking</td>
</tr>
<tr>
<td>High St</td>
<td>3</td>
<td>35</td>
<td>9</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>High St</td>
<td>39</td>
<td>57</td>
<td>4</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Hills Beach Rd</td>
<td>153</td>
<td>168</td>
<td>5</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Main St</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>Commercial property served by multiple providers</td>
</tr>
<tr>
<td>Mariner Way</td>
<td>201</td>
<td>220</td>
<td>3</td>
<td>Commercial property easily served by Spectrum and others</td>
</tr>
<tr>
<td>Mariner Way</td>
<td>500</td>
<td>510</td>
<td>2</td>
<td>Commercial property easily served by Spectrum and others</td>
</tr>
<tr>
<td>Moore Ln</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Mountain Rd</td>
<td>49</td>
<td>49</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Noreaster Way</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Unable to locate address</td>
</tr>
<tr>
<td>Ocean View Dr</td>
<td>20</td>
<td>25</td>
<td>6</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Ocean View Dr</td>
<td>26</td>
<td>38</td>
<td>10</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Pool St</td>
<td>332</td>
<td>352</td>
<td>10</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Pool St</td>
<td>605</td>
<td>605</td>
<td>1</td>
<td>UNE Campus</td>
</tr>
<tr>
<td>Riverview Dr</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>Should be served by Spectrum (newer construction)</td>
</tr>
<tr>
<td>Riverview Dr</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>Should be served by Spectrum (newer construction)</td>
</tr>
<tr>
<td>Sokokis Rd</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Timber Point Rd</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Town Line Dr</td>
<td>1</td>
<td>17</td>
<td>4</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Water St</td>
<td>28</td>
<td>28</td>
<td>1</td>
<td>Served by Spectrum</td>
</tr>
<tr>
<td>Water St</td>
<td>36</td>
<td>46</td>
<td>3</td>
<td>Served by Spectrum</td>
</tr>
</tbody>
</table>

\(^3\) In recognition of the critical importance of modern technology for education, health care, and business success in Maine, the Legislature created the ConnectME Authority (Authority) in 2006 as an independent state agency to develop and implement broadband strategy for Maine. The Authority is governed by a board which is comprised of members appointed by the Governor or specifically identified and designated by statute.
As part of this study, we reviewed each of these addresses or address ranges and providing our findings in the “Review Comments” column of the table. Our comments are summarized as follows:

- **Served by Spectrum** - Each of these addresses is either served by Spectrum or should be served by Spectrum, with their minimum 100Mbps/10Mbps service. Any consumers who may not currently have access to Spectrum are likely located on private property beyond 250 feet from Spectrum’s existing cabling and have chosen to not pay the required additional construction charges to extend the Spectrum cable to their home or may not have requested service be extended.

- **Clover Leaf Farm Rd** - This road originates in Kennebunkport and service ends at the town line. We suggest the Town contact Spectrum to negotiate an extension from the Kennebunkport based service.

- **Dennett Rd** - This road originates in Dayton and service ends at the town line. We suggest the Town contact Spectrum to negotiate an extension from the Dayton based service.

- **Riverview Dr** - This appears to be newer construction and should easily be served by Spectrum.

### 5.2 Businesses

Like consumers, businesses have access to services from Spectrum and CCI at speeds equal to consumers, and depending upon their willingness to pay additional charges, may have access to unlimited speeds. FirstLight and GWI also provide service along many of the major roadways and are willing to extend their network on an individual case basis.

### 5.3 Summary

In short, businesses and consumers are considered to be well served throughout the City with the exceptions as noted in the table above. With just two service providers competing for residential customers, the level of competition may not be sufficient to provide the competitive pricing and high-level customer service consumers seek. Introduction of a third city-wide service provider would provide additional competition, and if that network was operated as an open-access dark fiber network, an unlimited number of competitors could be realized (see Section 6.2 - Smart City Recommendations, for further discussion).
6 Smart City Infrastructure Recommendations

6.1 What is Smart City Infrastructure?

_Smart city_ means many things to many people, but its defining characteristic is what it is _not_. It is not a collection of siloed technologies, such as a single commuter app or water-level sensor. A smart city is the way these technologies interconnect – how living spaces, hospitals, schools, bridges, traffic lights and transportation work together to create the city as a platform. Smart cities establish a connection between people, technology, data and infrastructure to create efficiencies and improve quality of life.

What does this connection look like in practice? First, a modern communications network powered by 5G must be deployed widely. 5G is the foundational technology for the Internet of Things (IoT). It is high speed (10 to 100 times faster than 4G), high bandwidth (to handle a massive load of devices) and very low latency (which is the delay between data being passed between devices). Second, the power of the smart city is unleashed by IoT – devices that can communicate with each other to allow communities to interact and be informed by the very infrastructure that surrounds them. Smart cities use IoT for applications as diverse as public safety (such as sensors that detect potholes in the road), mobility (e-scooters that address the last-mile issue and ease traffic congestion), and city services (smart garbage cans that know when a bin is full and needs to be emptied) – to name a few. And, according to a smart-cities study by McKinsey Global Institute, smartphones are the new keys to the city, connecting with IoT devices to give citizens instant access to information about transit, traffic, health services, safety alerts and local news.⁴

6.2 Smart City Recommendations

With the combined service provider networks as illustrated by the map in Section 4.7, providing a minimum 100Mbps/10Mbps service, and the Dark Fiber availability along the major roadways as illustrated by the maps in Sections 4.2, 4.3 and 4.4; the core infrastructure within the City is well positioned to support Smart City initiatives. All of the existing wireless towers and support structures within the City are connected with fiber and all of the service providers are capable and eager to make their assets available, or expand their networks, to support 5G wireless technology⁵.

The downside of this approach requires coordination and collaboration between multiple providers, each of which competes with the others, to provide seamless coverage and ease of use, which may be an unrealistic expectation and a burden upon those wishing to enable Smart City services. An alternative approach may be for the City to partner with a single provider, or to develop an initiative on its own, to create a non-discriminatory open access fiber network serving all residences and businesses.

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⁵ Both AT&T and Sprint have reportedly taken out permits to upgrade their equipment to 5G on the MERC tower.
City-wide to create both a solid foundation for Smart City services and an environment to enable unlimited competition for consumer and business services.

6.2.1 Open-Access Fiber Network Definitions

A non-discriminatory open-access fiber network is an all-fiber network constructed and operated in a manner that allows any service provider to utilize the network under the same pricing, terms and conditions as any other service provider. In other words, it provides a level playing field and encourages and facilitates competition. There are two types of open-access networks:

An Open-Access Dark Fiber network - is a network where the Internet Service Provider (ISP) leases a fiber from the centrally located Point of Presence (POP) to the subscriber and places their own equipment in the POP and their own optical/electronics interface at the subscriber premise to deliver the service.

An Open-Access Lit Fiber network - is a network where the ISP would interconnect their network to the common equipment in the POP and lease the fiber and the optical/electronics at the subscriber premise to deliver the service. With an Open-Access Lit Fiber network, dark fibers could also be provided for applications where a customer, such as a 5G wireless provider, would provide its own optical/electronics for its unique needs.

6.2.2 High-level Estimated Capital Cost

There are a number of variables that impact the construction cost and operation of an open-access fiber network that can only be determined with confidence by producing a detailed engineering plan and financial proforma, which is outside the scope of this Study. However, using various industry metrics and leveraging our experience building and operating fiber networks, we can provide a high-level estimate of such costs. For an Open-Access Lit Fiber network, with 40% of the potential subscribers in the City utilizing the network, we estimate a capital cost of approximately $10,440,000.

6.2.3 Recommended Next Steps

If the City would like to better understand the financial viability and sustainability of an open-access network to introduce greater competition and build a non-discriminatory foundation for Smart City services, we recommend developing a more detailed capital cost estimate (without expending the funds for a detailed engineered plan) and a detailed 5-year financial proforma with the appropriate construction and operating variable sensitivities. Such analysis should reveal the ability to cost effectively finance the engineering and construction and the ability to operate the network in a profitable or break-even manner.
7 Digital Inclusion Recommendations

Universal availability of high-speed broadband is critical to retaining existing residents, supporting our economy and educating future generations. In order to achieve these goals and support a robust broadband infrastructure in a sustainable manner, all members of the community must be included, must be digitally literate, and must have the opportunity to participate on an equitable basis.

**Definition: Digital Literacy** - The ability to find, evaluate, utilize, share, and create content using information technologies and the Internet.

**Definition: Digital Equity** - Where all individuals and communities have the information technology capacity needed for full participation in our society, democracy and economy. Digital Equity is necessary for civic and cultural participation, employment, learning, and access to essential services.

**Definition: Digital Inclusion** - Refers to the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and Communications Technologies (ICTs). This includes five elements:

1. Affordable, reliable and robust broadband Internet service
2. Internet-enabled devices that meet the needs of the user
3. Access to digital literacy training
4. Quality technical support
5. Applications and online content designed to enable and encourage self-sufficiency, participation and collaboration

Digital Inclusion must evolve as technology advances and requires intentional strategies and investments to reduce and eliminate historical, institutional and structural barriers to access.

**Local Resources Necessary to Foster Digital Literacy, Equity and Inclusion**

1. Full-time digital inclusion staff
2. Established digital inclusion planning process
3. Active collaboration with regional and national digital inclusion peers
4. Periodic assessment of resident’s Internet access and use
5. Community based digital inclusion programs
6. Availability of public access computer labs
7. Programs for discount Internet service for low- and moderate-income users
8. Affordable equipment programs

Below we evaluate these eight resources as the related to the City of Biddeford area.
7.1 Full-Time Digital Inclusion Staff

While not specifically identified as “digital inclusion staff,” the Biddeford Schools Adult Education Program\(^6\) integrates digital literacy skills into all of its classes at the Center of Technology and is part of the industry standards they teach. Through their Adult Education program, they offer a variety of classes throughout the year and vary the courses and timing depending on the needs of the students. They offer very basic classes addressing the basic tasks of using the computer to specific software applications like MS Word, Excel etc. Digital literacy is also integrated into the classes for English Language learners.

The nearby Old Orchard Beach/Saco Adult & Community Education Program\(^7\) offers a variety of digital literacy classes similar to the Biddeford Schools Adult Education Program.

Establishing a digital inclusion/literacy program, led by an assigned staff member under the auspices of the Biddeford Schools Adult Education Program and in collaboration with the Old Orchard Beach/Saco Adult & Community Education Program, may address this requirement and foster an expansion of the course selection and delivery locations.

7.2 Established Digital Inclusion Planning Process

Our research finds no established digital inclusion planning process for the City, but Maine is fortunate to have one of the nation’s premier organizations headquartered in Machias, Maine. The Axiom Education & Training Center’s “National Digital Equity Center” (NDEC)\(^8\), led by nationally recognized Susan Corbett, can provide a complete planning process to facilitate a robust digital literacy, equity and inclusion program.

7.3 Active Collaboration with Regional and National Digital Inclusion Peers

Collaboration with regional peers and national digital inclusion experts will be important to leverage the work of other successful programs and share resources within the surrounding area. The digital inclusion planning process should incorporate active collaborations with the State of Maine and the communities adjacent to the City.

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6 [https://biddeford.maineadulted.org/](https://biddeford.maineadulted.org/)
7 [https://oobsaco.maineadulted.org/](https://oobsaco.maineadulted.org/)
8 [http://digitalequitycenter.org/](http://digitalequitycenter.org/)
7.4 Periodic Assessment of Resident’s Internet Access and use

This study identifies where Internet access is available and the download and upload speeds available but makes no effort to determine how the residents use the Internet. A periodic survey to support the planning process in Section 7.2 above will be important to define the needs and better understand the use of the Internet within the Study Area.

7.5 Community Based Digital Inclusion Programs

The table below highlights the digital literacy courses available beginning in the Fall of 2019. Users are encouraged to contact the Biddeford Schools Adult Education Program office or the Old Orchard Beach/Saco Adult & Community Education Program office to request additional classes.

<table>
<thead>
<tr>
<th>Biddeford Adult Education</th>
<th>Old Orchard Beach/Saco Adult &amp; Community Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>YouTube for Business</td>
<td>Facebook</td>
</tr>
<tr>
<td>Photoshop for Presentations</td>
<td>Intro to Photoshop</td>
</tr>
<tr>
<td>Productivity eTools: Be Organized and Get Stuff Done</td>
<td>Instagram</td>
</tr>
<tr>
<td>LinkedIn for Business</td>
<td>Cutting the Cable Cord</td>
</tr>
<tr>
<td>Marketing Using Social Media</td>
<td>Twitter</td>
</tr>
<tr>
<td>Online Advertising</td>
<td>Pinterest</td>
</tr>
<tr>
<td>Integrating Social Media in Your Organization</td>
<td>Etsy 101</td>
</tr>
<tr>
<td>Intermediate Excel</td>
<td>Computer Basics: Email &amp; MS Word</td>
</tr>
<tr>
<td>Intermediate Web Design</td>
<td>Excel Spreadsheet Basics</td>
</tr>
<tr>
<td>Google Apps for Business</td>
<td>Beyond Computer Basics</td>
</tr>
<tr>
<td>Facebook for Business</td>
<td>Quickbooks for Home &amp; Office</td>
</tr>
<tr>
<td>Boosting Your Web Site Traffic</td>
<td>Intro to Wordpress</td>
</tr>
<tr>
<td>Content Marketing</td>
<td>Quick &amp; Easy Web Design</td>
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<tr>
<td>Cyber Security for Managers</td>
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<tr>
<td>Adobe InDesign Essentials</td>
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<td>Adobe Photoshop Essentials</td>
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<tr>
<td>Advanced Excel</td>
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<tr>
<td>Advanced Web Design</td>
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</table>
7.6 Availability of Public Access Computer Labs

For those currently without access to the Internet at home or who cannot afford to subscribe to the Internet or have their own computer, availability of public computers is critical. The McArthur Public Library at 270 Main Street in Biddeford has an extensive array of computers that are available for the public to use, including:

**Available anytime the library is open:**
- 13 desktop computers with Internet access in adult services
- 8 desktop computers with Internet access in children’s services, plus 1 desktop computer loaded with educational games for young children that does not connect to the Internet
- 4 desktops and 2 laptops in teen services, all of which provide Internet access
- 2 desktops paired with microfilm readers in the adult’s services area
- 4 library catalog computers that can search library resources

**Available during library programs or by appointment (for example, when proctoring online exams)**
- 6 laptops with Internet access

7.7 Programs for Discount Internet Service for Low- and Moderate-Income Users

For those who cannot afford Internet service, Consolidated Communications and Spectrum offer discounted services to those who qualify.

7.7.1 FCC Lifeline Program

Lifeline is the FCC’s program to help make communications services more affordable for low-income consumers. Lifeline provides subscribers a discount on monthly telephone service purchased from participating providers in the marketplace. Subscribers can also purchase discounted broadband from participating providers. The discounts, which can be applied to stand-alone broadband, bundled voice-broadband packages (either fixed or mobile, along with stand-alone voice service) will help ensure that low-income consumers can afford 21st-century broadband and the access it provides to jobs, education and opportunities.

Consolidated Communications, Inc. (CCI) offers a Lifeline Program for eligible low-income residential subscribers at their primary residence. The Lifeline Program is a government benefit program. Eligible subscribers can apply the monthly $9.25 federal Lifeline Program discount to a voice service or to a qualifying Internet service. In some states, an additional monthly voice discount is also available.

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9 [https://www.consolidated.com/support/residential-support/lifeline-assistance-programs](https://www.consolidated.com/support/residential-support/lifeline-assistance-programs)
Eligible subscribers who apply the Lifeline Program discount to their CCI voice service may also qualify for free toll blocking to help control long distance usage. These eligible subscribers can still use prepaid calling cards or dial-around services to place long distance calls from their homes. Only one Lifeline Program discount is available per household on either a wireless or wireline qualifying service. Under the Lifeline Program, a household is defined as any individual or group of individuals who live together at the same address and share income and expenses. The Lifeline Program benefit is non-transferable. Consumers who willfully make false statements in order to obtain the discount can be punished by fine or imprisonment or can be barred from the Lifeline Program. Visit Universal Service Administrative Co. at www.usac.org for more information on the Lifeline Program.

**How do I apply?**

To receive the Lifeline Program discount, residential customers must establish the eligibility of their household. Eligibility requirements are explained in detail on the Lifeline Program application and at www.lifelinesupport.org. If you meet the eligibility requirements, complete and sign the application form, attach proof of eligibility and mail directly to USAC. Alternatively, you can verify your eligibility with USAC at www.checklifeline.org. After your eligibility is verified, call CCI at (1.844.968.7224) to add the Lifeline Program discount to your CCI account.

**7.7.2 Spectrum Internet Assist**

Through the Spectrum Internet Assist program, qualified households can receive:

- High-speed 30 Mbps Internet with no data caps
- Internet modem included
- No contracts required
- Add in-home WiFi for $5 more per month

To qualify for Spectrum Internet Assist, a member of the household must be a recipient of one of the following programs:

- The National School Lunch Program (NSLP) free or reduced lunch
- The Community Eligibility Provision (CEP) of the NSLP
- Supplemental Security Income (>/>= age 65 only)

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Further information can be found at: [www.spectruminternetassist.com](http://www.spectruminternetassist.com)
7.8 Affordable Equipment Programs

Low or moderate income should not be a barrier to participating in our digital society. The following organizations focus on making computers available for all:

- **PC’s for Maine**[^11] – A nonprofit effort to increase technology access for people and nonprofits that need technology to achieve important goals. So far, this program has provided more than 9,000 computers that have been used by more than 120,000 Mainers. The average actual cost for each computer with all of its support services is $277. The market value of this service is more than $910 - if such a service was available.

- **Goodwill Technology Access Program**[^12] - Goodwill’s GoodTech Technology Access Program (TAP) offers refurbished computers to qualified individuals at discounted prices. Computers are guaranteed to work and come with new, legal installations of Windows and Microsoft Office obtained directly from Microsoft.

7.9 Public Wi-Fi

The City provides free public Wi-Fi in the downtown area as illustrated by the map below. Additional hotspots are being considered to expand the availability of this free service.

[^11]: [www.pcsformaine.org](http://www.pcsformaine.org)
[^12]: [www.goodwillnne.org/stores/goodtech/](http://www.goodwillnne.org/stores/goodtech/)