EXECUTIVE SUMMARY

CITY OF GREELEY AND TOWN OF WINDSOR, BROADBAND ROADMAP

May 2018

Abstract

Municipalities are taking a more active role in ensuring their communities have reliable, abundant and affordable broadband services for their citizens. Additionally, smart city applications are requiring local governments to plan for robust infrastructure to support these emerging technologies. This white paper discusses models and approaches for the City of Greeley and the Town of Windsor to consider and provides a platform to evaluate financial implications, levels of investment, models and strategies, and options for implementation.

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Introduction and Initial Recommendations

Background Information

The City of Greeley and the Town of Windsor have hired NEO Connect to provide strategic planning for facilitation of better broadband services for the communities. In parallel with NEO's engagement, the City of Greeley and the Town of Windsor staff have conducted high-level surveys from citizens regarding their thoughts on current broadband services, what is important and their opinion regarding the role of government in solving broadband gaps.

Additionally, NEO and City staff have conducted community engagement meetings with the public for feedback. NEO's team provided a current assessment of the broadband landscape in Greeley and Windsor. NEO researched the existing services, pricing and availability of broadband service within both communities and identified gaps in service availability provided by the incumbent providers.

There are many levels of investment that may be considered by a local government to improve broadband services. The first level of investment may be to implement policies and ordinances that reduce the cost of broadband deployment. Another level of investment may be to connect various government and anchor institutions within each community. These strategies lay the foundation for connecting important facilities and help create a broadband distribution system that can further be expanded. Another level of investment may be to extend the broadband distribution system into neighborhoods to connect homes and businesses with fiber.

To identify the costs of various levels of investment, NEO's team gathered information regarding the City of Greeley's and the Town of Windsor's smart city, traffic management, capital improvement projects, and other government communication needs. NEO identified and mapped existing assets that could potentially be leveraged to improve broadband services and identified key community anchor institutions that could benefit from having fiber built directly to their locations. We then provided a high-level design and capital cost projection for several levels of broadband infrastructure development and investment.

In addition to the above set of tasks, NEO's scope of work included providing models for public-private partnerships and best practices regarding what other municipalities are doing or have done to improve broadband services.

Why this is Important and Why Municipalities are Investing in Broadband

Having access to very high-speed broadband and Internet services has become one of the most critical components for education, government services, economic development, healthcare, utility operations, first responders and business operations. The demand for more bandwidth

continues to grow. By 2021, there will be over 30 billion devices connected by the Internet of Things (IoT). Each person will have over 13 connected devices on average, including their cell phones, tablets, clothing, and their cars. The global Internet traffic continues to explode. In 1992, global Internet traffic per *day* was 100 Gigabits. In 2016, the global Internet traffic per *second* was 26,600 Gigabits. It is projected that global Internet use will continue to expand dramatically.

Global Internet Traffic	
1992	100 GB per DAY
1997	100 GB per HOUR
2002	100 GB per SECOND
2007	2,000 GB per SECOND
2016	26,600 GB per SECOND
2021	105,800 GB per SECOND

Internet, data and cellular growth will continue to double in bandwidth every one to two years. Although some of the existing Internet Service Providers (ISP) have invested in their networks to keep up with demand, the majority of networks built by cable and phone companies are maxed out. As the Internet drives all things regarding economic development and vitality, simply put, connectivity is essential.

Coupled with the ever-growing importance of the Internet, the convergence of new smart city applications, traffic management needs, the growth of and application for small cellular site installation and the soon-coming implementation of self-driving vehicles, municipalities are seeking strategies to facilitate and coordinate investment.

Recently, the FCC overturned Net Neutrality rules that govern the availability and access to content and bandwidth. These rules prevented ISP's from blocking certain types of content or placing specific websites or applications in preferential "fast lanes." The FCC's overturning these rules could help the large or incumbent providers stifle the ability of smaller internet companies to compete. Some critics of FCC's decision worry that the large ISPs will begin prioritizing certain websites, applications, content and services over others, either by charging customers to access that content or charging Internet companies to access customers. Internet websites could be "packaged" or "channelized" similar to the way cable companies provide a roster of channels and programming.

The Cities of Longmont, Boulder, Loveland and Ft. Collins are implementing locally-run Internet services as a way of ensuring their citizens and businesses are not impacted by the overturning of Net Neutrality rules. These cities are stating that the Internet would remain open and equitable, serving as a countermeasure to corporations potentially taking over the Internet.

Another reason why local governments invest in broadband infrastructure is to address the availability of advanced broadband services throughout the entire city or town boundary. In

many instances, the incumbent cable and phone companies have invested in some part of the municipality, but much of the community does not have adequate services. Municipalities invest to ensure that all citizens and businesses have access to advanced broadband services at affordable prices and that no one is left out of participating in the digital economy.

Municipal facilitation can take the form of implementing broadband friendly policies and ordinances to reduce the cost of implementation by the private sector, to investing and implementing fiber for government applications and to key anchor institutions, to entering into a public-private partnership to promote a ubiquitous Gigabit strategy, to a full-blown implementation and operations of a municipally-owned Internet Service Provider.

Considerations that impact a local government's broadband strategy and involvement include the level or amount of municipal investment, examination of models and approaches implemented by other communities, exploration of how networks are typically implemented, constructed and operated, as well as exploration of public-private partnership models that are emerging in the industry and possible financing strategies for implementation.

Summary of the Survey Results

Below is a summary of the residential survey results that were facilitated by the Town of Windsor and the City of Greeley staff.

643 residential surveys responses were received. The surveys were posted on the City of Greeley's and the Town of Windsor's websites and social media sites. Although the survey was filled out most likely from residences that care about Internet services, or potentially have an issue with their current Internet services, the survey results strongly suggest the following:

- Reliability is the most important factor for the community, followed by speed and price.
- The community wants to see more reliable, faster, and more abundant broadband services. 81-82% of the respondents stated that the download and upload speeds are too slow either sometimes, most of the time or always. Speeds vary throughout the day as more users are on the Internet and there are times when respondents cannot get on the Internet.
- 54% of the residential respondents telecommute, having either one or more people working from home, providing insight into the broadband needs of homes within the communities.
- 62% of the respondents were Comcast customers using cable modem service; followed by 21% of the respondents using CenturyLink's DSL services.
- When asked to rank the local government's role with respect to broadband access, 57% of the respondents ranked "to build network for the public: homes, businesses and government locations" as the primary role of government, with 16% stating the government's role should be to "partner with current providers" as the primary role.

- 66% of the respondents stated they would support a small monthly utility fee to pay for broadband infrastructure build out.
- The survey stated that the City of Longmont recently became Colorado's first "Gig City," building a fiber network that provides residents with reasonably priced Gigabit service to the home. The survey asked "Would you support the City of Greeley and the Town of Windsor offering Gigabit service to the home." 73% answered "Yes" and 19% answered that more information would be needed. Only 8% replied "No."
- 21% of the respondents said they would potentially move if adequate broadband was not available and 5% said they would definitely move.

Although Comcast has stated that Gigabit speeds (1000 Megabit per second (Mbps)) are available throughout Greeley and Windsor, of the respondents that indicated that they are Comcast customers, none of the speed tests conducted were at Gigabit speeds. The highest speed test result was 350 Mbps in download speeds. The average speed test results for Comcast customers were 71.45 Mbps in download speeds and 8.99 Mbps in upload speeds.

The reasons for the discrepancy between Comcast's speed test results and their stated available speeds are varied. Either customers are signing up for a lower service speed through Comcast, Comcast is not delivering Gigabit speeds, the devices do not support these high bandwidths, Comcast's network was constrained as more users were on the Internet, or Gigabit services are not offered by Comcast in their neighborhoods. There is not an easy way to determine why higher speeds were not achieved by the speed tests.

The FCC definition for broadband is 25 Mbps in download speeds and 3 Mbps in upload speeds. The average speed test for CenturyLink customers was 11.88 Mbps in download speeds and 2.04 Mbps in upload speeds. None of the CenturyLink customers that participated in the survey and speed test met the FCC's definition of broadband service.

Most of the survey respondents also provided comments – All of the comments that were received are included within the Appendix A of this report. Results of the survey are provided within a separate document.

To summarize, most of the comments received were in support of the City of Greeley and the Town of Windsor to invest in a ubiquitous Gigabit fiber initiative. There were a handful of comments that discouraged the government from getting into the broadband business. Many of the responses discussed concern over the existing services not being available, fast enough, or providing the level of services that were subscribed. Many comments discussed the lack of customer care or service available from the incumbent providers. Some responses discussed how no broadband service is available within their neighborhoods and that Comcast does not serve their home with cable TV or broadband service. A good portion of the comments encouraged the City/Town to follow what the City of Longmont has done and what the Cities of Boulder, Loveland and Fort Collins are considering.

Current Assessment, Existing Services and Gaps

Based upon information gathered by the FCC, the Broadband USA Mapping Tool, Broadband Now and the State of Colorado, the following provides information regarding current services and gaps of service within Windsor and Greeley.

Windsor Market

The incumbent cable company in Windsor is Comcast, serving approximately 77% of Windsor; 12.1% of Windsor receive TDS cable services. The incumbent phone company is CenturyLink, with 98.2% of the community having access to DSL services. Rise Broadband is a fixed wireless provider in Windsor and satellite services are available through HughesNet and Viasat. Business Internet providers include CenturyLink, Comcast, Rise Broadband, as well as MHO, another fixed wireless provider in Windsor and Electric Lightwave, Birch Communications and GTT Communications.

According to BroadbandNow, the average download speed in Windsor is 26.82 Mbps. Speed test data is based upon 6,072 speed tests from IP verified users who took speeds test in Windsor between April 2017 and March 2018. Windsor's average download speed is 24.7% slower than the average in Colorado and 17.5% slower than the national average.

12.6% of the Windsor homes have one or fewer wired Internet providers available to them. In other words, these homes have only 1 choice or no options for Internet services.
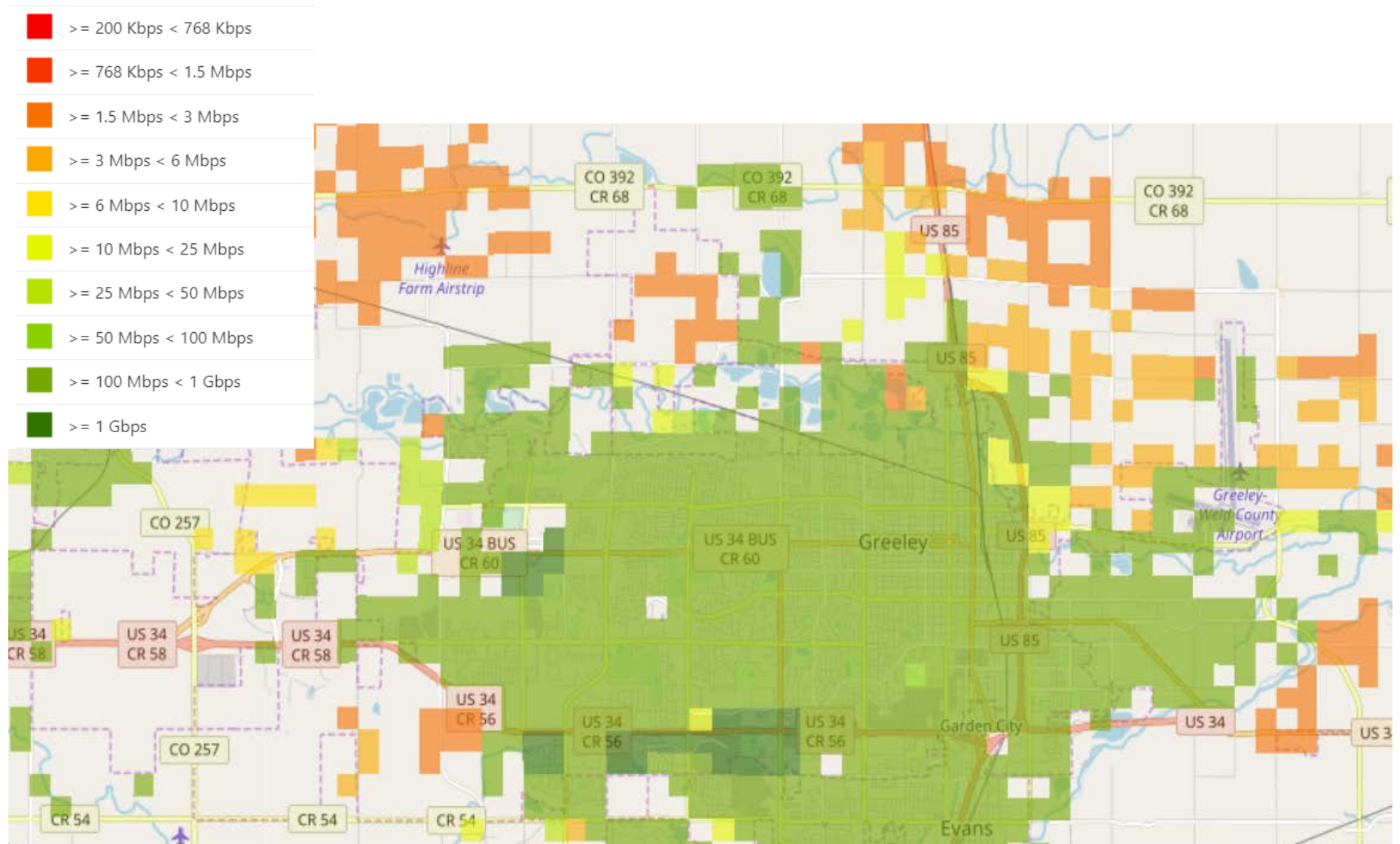
Greeley Market

Residential providers in Greeley include Comcast, CenturyLink, Rise Broadband and Windstream. Satellite providers are HughesNet and Exede Internet. Blue Lightning provides fiber services to 1.1% of the residential community. Business Internet providers include all of the providers listed in Windsor, as well as Level 3 Communications, NewCloud and MegaPath.
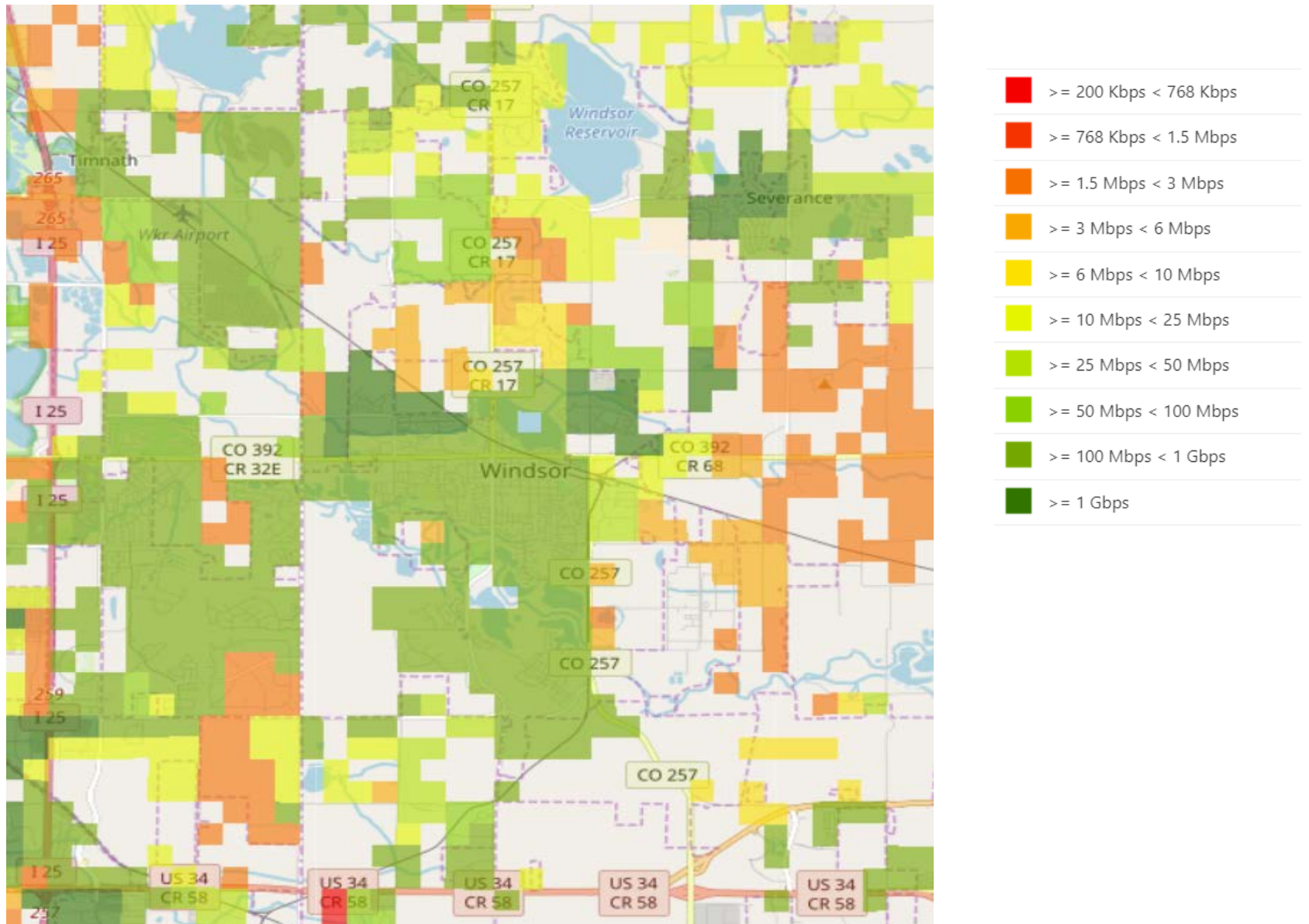
As in Windsor, 12.1% of the consumers in Greeley have access to one or fewer providers. Based upon 26,262 speed tests from April 2017 to March 2018, the average download speed in Greeley is 35.73 Mbps. This is 6.4% faster than the average in Colorado and 11.8% faster than the national average.

Current Speeds and Availability

Comcast states that it offers Gigabit broadband services within Greeley and Windsor, but Gigabit services are not currently available ubiquitously throughout both communities. For this study, Comcast has committed to providing coverage maps of their Gigabit service offerings.

According to the State of Colorado's OIT broadband map, the following maps shows what services are available throughout both communities. Areas shown in dark green have access to up to 1 Gigabit of service.

🟥	>= 200 Kbps < 768 Kbps
🟧	>= 768 Kbps < 1.5 Mbps
🟧	>= 1.5 Mbps < 3 Mbps
🟧	>= 3 Mbps < 6 Mbps
🟨	>= 6 Mbps < 10 Mbps
🟨	>= 10 Mbps < 25 Mbps
🟩	>= 25 Mbps < 50 Mbps
🟩	>= 50 Mbps < 100 Mbps
🟩	>= 100 Mbps < 1 Gbps
🟩	>= 1 Gbps

Initial Recommendations

As discussed, there are several levels of investment that may facilitate better broadband services within a City/Town. Here are the various levels of investment that were evaluated as part of this study.

Levels of Investment

✔ 1) Implement Broadband Friendly Policies and Ordinances and Smart Conduit Construction to Gain Assets and Attract Partners

✔ 2) Connect City Government and Smart City Applications

✔ 3) Connect other Key Community Anchor Institutions

4) Connect Homes and Businesses with Fiber through a Public-Private Partnership or through offering Broadband as a Service

5) Further Evaluate Working with Existing Providers to Improve their Services (Comcast, CenturyLink)

Based upon the initial findings of the broadband plan, NEO and staff recommend the first three levels of investment be considered. The first three recommendations will facilitate and lower the costs for broadband implementation and lay the foundation for improving broadband infrastructure within both communities, regardless of whether the City/Town decides to move forward with a Gigabit broadband strategy to connecting homes and businesses, or not.

Connecting city government locations (water monitoring systems, public safety and other government buildings), smart city applications (traffic lights and parking meters) and key community anchor institutions (i.e. hospitals, schools, and universities) with fiber will greatly enhance communications and broadband speeds for these locations, while dramatically reducing communications costs. While these key facilities are being connected with fiber, both communities will gain more fiber assets that can be leveraged for building out to neighborhoods to connect homes and businesses with fiber. Implementing a shadow conduit/dig once policy will allow the City/Town to facilitate further broadband development

by reducing the costs of broadband expansion, by levering existing public works or construction by other entities.

All of these first three levels of investment will improve communications for applications that will be needed regardless of whether or how the City/Town moves forward with a more ubiquitous Gigabit broadband strategy. Additionally, these strategies will lower the overall cost of further expansion and will provide assets (conduit and fiber) for the City/Town to use as leverage to potentially negotiate a public-private partnership for further expansion.

NEO and staff recommend that investigation into how to implement a ubiquitous Gigabit broadband strategy for homes and businesses be further evaluated (item #4 and #5 above under Levels of Investment.) This would include weighing the pros and cons of various public-private partnership models or providing broadband services directly to citizens and businesses or working with the incumbent providers Comcast and CenturyLink to improve their availability of Gigabit broadband services.

Summary of Capital Costs for the Various Levels of Investment

Below is a summary of the capital costs for implementation of the various levels of investment.

The projected capital costs for the City of Greeley's build for items #2 and #3 is shown below.

With the Use of Existing Fiber				
Description	Eng. & Construction Management	Labor	Materials	Project Total
Traffic Lights, Public Safety, Water Meters, Parking Meters - "Smart City"	$ 270,043	$ 1,161,935	$ 260,223	$ 1,692,201
Water Meter Locations outside City Limits	$ 41,358	$ 183,964	$ 50,488	$ 275,810
Adding on All Other Anchor Institutions	$ 230,184	$ 1,166,545	$ 351,754	$ 1,748,483
Total	$ 541,585	$ 2,512,444	$ 662,465	$ 3,716,493

As a New Build				
Description	**Eng. & Construction Management**	**Labor**	**Materials**	**Project Total**
Traffic Lights, Public Safety, Water Meters, Parking Meters - "Smart City"	$ 624,146	$ 3,260,450	$ 758,316	$ 4,642,912
Water Meter Locations outside City Limits	$ 41,358	$ 183,964	$ 50,488	$ 275,810
Adding on All Other Anchor Institutions	$ 473,049	$ 2,095,045	$ 516,856	$ 3,084,950
Total	**$ 1,138,553**	**$ 5,539,459**	**$ 1,325,660**	**$ 8,003,673**

A summary of the projected capital costs for the Town of Windsor's build for #2 and #3 is shown below.

With the Use of Existing Fiber				
	Eng. & Construction Management	**Labor**	**Materials**	**Total**
Public Safety, SCADA, Smart City	$ 11,532	$ 72,844	$ 27,709	$ 112,085
Adding on All Other Anchor Institutions	$ 11,160	$ 93,390	$ 43,481	$ 148,031
Total	**$ 22,692**	**$ 166,234**	**$ 71,190**	**$ 260,116**

As a New Build							
	Eng. & Construction Management		Labor		Materials		Total
Public Safety, SCADA, Smart City	$	150,660	$	604,032	$	131,811	$ 886,503
Adding on All Other Anchor Institutions	$	139,965	$	588,167	$	132,224	$ 860,356
Total	**$**	**290,625**	**$**	**1,192,199**	**$**	**264,035**	**$ 1,746,859**

Most Fiber-to-the-Premise network use a Gigabit Passive Optical Network (GPON) architecture with active connections to large businesses, mission critical or government locations. Active or passive simply refers to powered electronics in the field. In other words, with a passive architecture, there are no electronics located between the network operations center and the home.

Capital costs will increase when the market share or take rate percentage increases. Below are the projected capital costs with various take rate percentages.

Summary, Windsor Fiber to the Premise Capital Costs			
Take Rate Percentages	**Total Construction Costs**	**Total Equipment Costs**	**Total Capital Costs**
10%	$ 39,685,019	$ 2,336,684	$ 42,021,704
20%	$ 40,797,243	$ 2,579,875	$ 43,377,118
30%	$ 41,906,853	$ 2,846,086	$ 44,752,939
40%	$ 43,016,463	$ 3,093,389	$ 46,109,851
50%	$ 44,129,690	$ 3,357,522	$ 47,487,212
60%	$ 45,238,296	$ 3,711,603	$ 48,949,899

Summary, Greeley Fiber to the Premise Capital Costs			
Take Rate Percentages	**Total Construction Costs**	**Total Equipment Costs**	**Total Capital Costs**
10%	$ 91,877,838	$ 7,438,297	$ 99,316,135
20%	$ 95,308,477	$ 9,475,631	$ 104,784,107
30%	$ 98,737,505	$ 11,803,153	$ 110,540,658
40%	$ 102,168,144	$ 14,006,794	$ 116,174,938
50%	$ 105,603,404	$ 16,097,703	$ 121,701,107
60%	$ 109,034,043	$ 18,535,591	$ 127,569,634

As the capital costs and financial risk is high for building fiber to homes and businesses, NEO and City/Town staff recommending further investigation into various strategies and models for implementing this approach.

Following this report, a companion report will be provided that will discuss the financial considerations and implications of various Gigabit strategies. Financial projections, staffing considerations and financing strategies will be discussed for each model. Additionally, the companion report will address funding and financing options for consideration.