CITY OF HAYWARD

Hayward City Hall
777 B Street
Hayward, CA 94541
www.Hayward-CA.gov

Agenda

Thursday, September 13, 2018

4:30 PM

Conference Room 4A

Council Technology Application Committee

CALL TO ORDER

ROLL CALL

PUBLIC COMMENTS:

(The Public Comment section provides an opportunity to address the City Council Committee on items not listed on the agenda as well as items on the agenda. The Committee welcomes your comments and requests that speakers present their remarks in a respectful manner, within established time limits, and focus on issues which directly affect the City or are within the jurisdiction of the City. As the Committee is prohibited by State law from discussing items not listed on the agenda, any comments on items not on the agenda will be taken under consideration without Committee discussion and may be referred to staff.)

1 APPROVAL OF MINUTES

MIN 18-108 Approval of the Minutes of the CTAC Meeting on June 7, 2018

REPORTS/ACTION ITEMS

2 UrbanLeap Tool - Oral Presentation

3 Fiber Grant - Oral Report

4 Fiber Master Plan - Oral Report

5 Dig Once Policy Draft - Staff report

RPT 18-152 Review of Proposed Dig-Once Ordinance and Policy

6 Wireless Ordinance Draft - Staff Report

RPT 18-151 Review of Proposed Wireless Ordinance and Master License Agreement Terms and Conditions

FUTURE AGENDA ITEMS

7 Drone - Show and Tell (December 2018)

8 Water Systems - Tech Update (December 2018)

9 Citi WiFi (December 2018)

COMMITTEE MEMBER/STAFF ANNOUNCEMENTS AND REFERRALS

ADJOURNMENT

File #: MIN 18-108

Attached is a copy of the Draft Minutes of the CTAC Meeting on June 7, 2018.

CITY OF HAYWARD
HEART OF THE BAY

Council Technology Application Committee (CTAC)

Meeting Minutes of June 7, 2018

Members Present: Al Mendall, Mark Salinas, Elisa Marquez (Absent)

Staff: Nathaniel Roush, Chuck Finney, John Stefanski, Carolyn Saputo, Bolthar Garcia, Linda Mitchell,

Guests: Deonne Kuncle, Chabot College, Ron Gallegos, Knightscope

Public Comments: None

1. Approval of Minutes:

Minutes of March 1, 2018 Approved

2. Security Robot – Informational Presentation

IT Manager Nathaniel Roush gave the Committee an update on technology for the new Library. Hayward is looking into an agreement that would place a security robot that could patrol the parking garage that's across from City Hall as well as potentially patrol the outside area public space of the Library. Ron Gallegos, Director/Client Development of Knightscope gave the Committee a presentation.

Committee Feedback: There was general positive feedback expressed in the product by CTAC committee members regarding the vendor's presentation of the solution. The presentation outlined how the solution has the potential to address concerns expressed from residents to CTAC committee members regarding safety and security in the Watkins parking garage. A general Q&A session followed the vendor presentation.

Committee Q&A

- Are the wheels all terrain? No, but it can traverse anything paved, sidewalks, and multi-level ramps.
- What happens if it's tipped over? An alarm sounds and any damage to a robot could be a felony. If there is any damage done to the robot, Knightscope will cover all maintenance and repairs.
- What if it goes near a cliff/drop? It has cliff detection.

- What happens to the data if you discontinue service? The data will be destroyed with a witness present at the time. The City may cancel service anytime without penalty but must provide a few months' notice.
- How long does it take to get the robot after the order is placed? After the purchase order is received, there is a two-month implementation process; the robot is custom built.

Key Features of Security Robot

- Works for you 24/7 – No time off
- Captures a lot of data
- Automatic License Plate recognition with black list database
- Fire detection
- High quality videos
- Detects people well
- Built in intercom for broadcasting
- Can pre-record messages for broadcasting
- Thermal recognition and anomaly detection
- K5 potentially deploying ADM (Autonomous Data Machine)

The K5 is 5' 2" tall and weighs 400lbs and full 360-degree camera views. The K3 robot has been used in shopping malls, parking structures and inside large warehouses. They're custom built with your preferences, such as route, which functions are enabled and even the badging. The robot can also detect how long someone has been parked in a specific parking spot which can assist in enforcement of time limits placed on the stalls. The software is alert driven and as a result it does not require an individual monitoring the actions the entire day.

The service is a subscription to the machine itself and is an annual reoccurring fee. This fee covers the robot for ongoing maintenance service, theft, damage, and software updates. The robot can traverse anything paved, sidewalks and multi-level ramps. You can override the scheduled route and send the robot anywhere you need it to go.

IT Manager, Nathaniel Roush informed the Committee that this information is being presented to the Committee for awareness. We've had conversations about the contract as well as pricing, so the goal was to bring it to the CTAC Committee Meeting and bring up any concerns. If there are no major concerns, we will sign the contract for subscription.

3. FY2018-19 CTAC Meeting Schedule Feedback – Oral Update

IT Manager Nathaniel Roush gave the Committee an update on future CTAC meeting dates. The scheduled dates are:

September 13, 2018

December 6, 2018

March 7, 2019

June 6, 2019

4. PEG Utilization/Tour of Chabot Facilities

Standing Meeting Items

Fiber Master Plan -

Management Analyst John Stefanski gave the Committee a brief update on the Fiber Master Plan. The City has brought on Magellan Advisors, a consulting firm that specializes in municipal fiber. Our representative with Magellan is the former CIO of Santa Monica who is first person to implement municipally owned fiber and serve as an ISP. We're working with Magellan on the development of the Dig Once Policy/Ordinance, as well as a Wireless Ordinance. Both of those will be brought to the Council in the Fall. Time is of the essence for both items as we move forward with the Fiber Grant, we will be trenching 11 miles and want to make sure we have a policy in allow outside parties to joint trench with the City. With the Wireless Ordinance we are moving fast in hopes of getting ahead of future legislation that would remove some of our rights to our light poles. The goal is with Magellan Advisors to come back to CTAC in September, have a presentation for the Council and then bring draft ordinances.

Fiber Grant - No Update

Future Agenda Items

Water Systems – Tech Update	September 2018
City Wi-Fi – Policy	September 2018
UrbanLeap Tool – Tech Update	September 2018
Drone – Show and Tell	September 2018
Dig Once Policy	September 2018

Committee Member/Staff Announcements and Referrals

Next Meeting: September 13, 2018

Meeting adjourned at 5:02pm

File #: RPT 18-152

DATE: September 13, 2018

TO: Council Technology Application Committee

FROM: Director of Information Technology
Interim Director of Public Works

SUBJECT
Review of Proposed Dig-Once Ordinance and Policy

RECOMMENDATION
That the Council Technology Application Committee (CTAC) reviews and comments on the proposed Dig-Once Ordinance and associated policy. Specifically, staff seeks direction from CTAC regarding the standards and requirements outlined in this staff report and draft ordinance and policy.

SUMMARY

The City Council adopted a Fiber Master Plan in July 2017. This plan directs the City to adopt a dig once policy. Dig once policies generally require the coordination of excavation projects between a municipality and a telecommunication or utility provider and mandate the installation of City owned telecommunication infrastructure such as conduit and fiber for broadband internet. This item provides a proposed Dig Once Ordinance (Attachment II) and Dig Once Policy (Attachment III) for consideration by the CTAC in accordance with the City's Fiber Master Plan.

ATTACHMENTS

Attachment I	Staff Report
Attachment II	Proposed Dig Once Ordinance
Attachment III	Proposed Dig Once Policy
Attachment IV	Fiber Master Plan

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SUMMARY

The City Council adopted a Fiber Master Plan in July 2017. This plan directs the City to adopt a dig once policy. Dig once policies generally require the coordination of excavation projects between a municipality and a telecommunication or utility provider and mandate the installation of City owned telecommunication infrastructure such as conduit and fiber for broadband internet. This item provides a proposed Dig Once Ordinance (Attachment II) and Dig Once Policy (Attachment III) for consideration by the CTAC in accordance with the City's Fiber Master Plan.

BACKGROUND

In July 2017, the City Council adopted a Fiber Master Plan (Attachment IV) to set the overarching goals and objectives for deploying a fiber-optic network throughout the Industrial Corridor. Specifically, this plan recommends that the City take the following actions:

- Consider a dark fiber business model
- *Adopt a dig-once policy*
- Audit its infrastructure and records
- Implement a records management system
- Construct a fiber segment to connect an internet pop
- Expand FTTP to select Industrial Corridor areas
- Signal to the private sector through a procurement process
- Lease dark fiber strands to select industrial corridor customers.

The City Council adopted a dark fiber model with the adoption of the Fiber Master Plan. A current audit of infrastructure and records is currently on-going as a part of the FY2019 Capital Improvement Plan. Design work for the fiber loop within the Industrial Corridor is on-going as a part of the Highspeed Hayward project funded by the Economic Development Administration's $2.7M grant.

In June 2018, the City entered into an agreement with Magellan Advisors following a competitive request for proposals process, to develop and update the City's wireless telecommunications regulations, right of way ordinance, and master license agreements with telecommunication companies.

Representatives from Magellan Advisors will be present at this meeting to answer any questions the CTAC may have.

DISCUSSION

Dig-Once Policies are a current best practice for municipalities entering the fiber infrastructure space. These policies encourage cooperation and coordination between cities and a variety of utility providers and telecommunication companies. Their implicit goals are to:

- Protect newly and recently paved roads and sidewalks;
- Ensure efficient, non-duplicative placement of infrastructure in the Public Right of Way (PROW);
- Minimize the impact of construction on residential and commercial communities;
- Reduce overall costs of all underground work in the PROW by capitalizing on significant economies of scale;
- Enhance the uniformity of construction; and
- Leverage construction for the deployment of a public communications network.

These policies leverage public and private projects to expand the City's conduit and fiber network in an efficient manner.

The technology surrounding the internet and its physical plant is changing rapidly. It is for this consideration that the proposed dig-once ordinance is broken into two components. The individual ordinance mandates higher-level dig-once requirements and references a "Dig-Once Policy" that provides more technical, minimum standards at an administrative level. This structure will afford the Public Works department the ability to adjust regulations as this technology changes.

Ordinance Overview

This ordinance applies to any applicant who applies for an excavation permit within the PROW.

Noticing Requirements

The City will be responsible for or may require an applicant to notify all telecommunications service providers of an impending excavation and afford those entities the opportunity to utilize the excavation to install, upgrade, co-locate, repair, or improve their telecommunications facilities during the excavation project. This notice must be provided at least thirty (30) days prior to the start of the excavation. Those entities participating in the joint trench are responsible for their proportionate share of costs including but not limited to the costs of permitting.

Moratorium

Excavations under this ordinance shall not take place more than once on a particular City street within a 5-year period.

Project Applicability

All construction, reconstruction, and repaving of a City right-of-way shall include a provision for the installation of a public utility infrastructure, such as conduit, tube, duct, or other device designed for enclosing telecommunications wires, fibers, or cables, wherever practical and feasible. Such infrastructure shall be installed in accordance with City regulations, requirements and specifications, including but not limited to the Hayward Municipal Code, as directed by the Director of Public Works or his/her designee. Such excavation shall not take place more than once on a particular City street within a 5-year period.

Policy Maintenance and Exemptions

The Department of Public Works will be responsible for the enforcement and maintenance of this policy. Furthermore, the Director of Public Works or their designee may exempt a project from the requirements of this ordinance in cases where it is not practical or feasible. Cost cannot be a determining factor for project feasibility or practicality. These determinations may be appealed to the City Manager.

Incremental Costs

The Department of Public Works shall be responsible for determining the incremental costs of installing City communications infrastructure. These incremental costs are the costs associated with adding City communications infrastructure to any excavation project, including the cost of the materials needed by the City and any additional labor costs.

Policy Overview

De-Minimis Excavation Standard

Under the current draft, the Dig Once Policy requirements are applicable to all excavation projects that have a minimum continuous open trench length of 300 feet. For reference, C Street between Watkins Street and Foothill Blvd. is approximately 355 linear feet.

All excavations that meet this standard will be required to include the installation of two 3-inch diameter conduits that meet the material and design specifics as determined by the Dig Once Policy.

Design Standards

The Dig Once Policy provides design standards for the installation of conduit and fiber. Conduits referenced above must be:

- Made of PVC Schedule 40 material
- Laid to a dept of not less than 18 inches below grade in concrete sidewalk areas, and not less than 24 inches below finished grade in all other areas when feasible, or the maximum feasible depth otherwise
- Install a minimum of 3-foot radius sweeps and bends,
- Contain tracer wire and external warning ribbon tape a minimum of 3-inches above the conduit.

Ownership and Documentation of Infrastructure

All conduits installed under this policy will be owned by the City. All conduits installed will be documented in the City's geographic information system (GIS) whenever feasible.

Interagency Cooperation

The PROW permittee should make a documented effort to work with other utility agencies to co-locate infrastructure in the same trench whenever feasible. Additionally, each agency/utility shall participate in periodic coordination meetings as requested by the City for the purpose of coordinating activity between public works projects and utility projects in the PROW.

The full draft dig-once ordinance and policy can be found in Attachments II and III respectively.

ECONOMIC IMPACT

Improved broadband connectivity within the City will help to support business attraction efforts. While the existence of fiber is only one of many site selection factors (such as lease

rents, building configuration, traffic patterns, etc.), being able to market Hayward's broadband connectivity to the business community at-large not only helps satisfy a site selection criterion, it will strengthen the City's reputation as a center for innovation and growth.

FISCAL IMPACT

There is no immediate fiscal impact associated with implementing this policy. However, given its requirements, it may increase the cost of certain roadway improvement projects marginally due to the added required installation of conduit and fiber. These increases may be reduced through the sharing of associated costs with other telecommunication providers who utilize the same trench. Additionally, this increase in costs may be offset through revenue associated with the wireless telecommunication facility ordinance update.

STRATEGIC INITIATIVES

This agenda item supports the Complete Communities Strategic Initiative. The purpose of the Complete Communities Strategic Initiative is to create and support structures, services, and amenities to provide inclusive and equitable access with the goal of becoming a thriving and promising place to live, work and play for all.

Goal 1:	Improve quality of life for residents, business owners, and community members in all Hayward neighborhoods.
Objective 4:	Create resilient and sustainable neighborhoods.
Goal 3:	Develop a regulatory toolkit for policy makers
Objective 1:	Update, streamline, and modernize zoning & codes.

NEXT STEPS

Staff will incorporate the feedback on the draft policy and ordinance and present the updated documents to Council for adoption at a later date.

Prepared by:	John Stefanski, Management Analyst II Allen Baquilar, Senior Civil Engineer Kathy Garcia, Deputy Director of Public Works
Recommended by:	Adam Kostrzak, Director of Information Technology Alex Ameri, Interim Public Works Director

Approved by:

Kelly McAdoo, City Manager

ATTACHMENT A

ORDINANCE NO. _____

AN ORDINANCE OF THE CITY OF HAYWARD, CALIFORNIA, AMENDING TITLE 7 OF THE HAYWARD MUNICIPAL CODE BY AMENDING SECTIONS 7-2.00 AND 7-2.04 AND ADDING SECTIONS 7-4 TO ESTABLISH A "DIG ONCE" POLICY FOR INSTALLING UNDERGROUND CONDUITS

WHEREAS, to further the strategic and operational goals outlined in the City of Hayward Fiber Optic Master Plan, the City is designing and constructing City-owned communications infrastructure consisting of an underground fiber-optic network to provide broadband internet service within the Industrial Corridor.

WHEREAS, the City of Hayward desires to develop a public communications network consisting of a lateral distribution network to directly connect City facilities and provide fiber-to-the-premises throughout the City.

WHEREAS, the City of Hayward desires to comply with all mandates regarding public utilities as imposed upon it by state and federal law; and it is determined that there is a need for wireless telecommunication facilities in the City of Hayward; and the City of Hayward chooses to use its police power and land use planning authority to regulate such facilities.

WHEREAS, the proposed requirements for permits and entitlements relative to projects involving the installation of underground conduit respond to recent changes in laws concerning regulation of wireless telecommunication facilities and provide mechanisms for the City to maintain an aesthetically pleasing community environment, protect the safety and welfare of Hayward's residents, minimize degradation of the residential character of neighborhoods, streets, and roadways, and require the best available design to eliminate visual impacts while ensuring that adequate public services and facilities are constructed to accommodate the needs of Hayward's residents.

WHEREAS, pursuant to the California Environmental Quality Act ("CEQA"), the proposed requirements for wireless telecommunication facilities in the public right-of-way are exempt per section 15061 (b)(3), as there is no potential to cause a significant effect on the environment.

WHEREAS, excavations in paved, public rights-of-way degrade and shorten the life of street surfaces which increases the frequency and cost of necessary resurfacing, maintenance, and repair.

WHEREAS, the federal Broadband Opportunity Council has recommended, and the California State Legislature is now considering, the adoption of "Dig Once" policies to encourage broadband deployment, minimize excavations, and save costs by coordinating

infrastructure projects in the public rights-of-way.

WHEREAS, the City desires to strike a balance between the public need for efficient and safe transportation routes and the use of rights-of-way for the underground location of facilities by the City and private entities.

WHEREAS, the City desires to protect and preserve the physical integrity of streets and sidewalks; minimize excavations, traffic and other disruptions related to excavations of public rights-of-way caused by the construction of City-owned communications infrastructure; protect public safety and welfare; and lower its own costs and the costs to applicants seeking to deploy conduit in the City's public rights-of-way by coordinating construction of City-owned communications infrastructure with the deployments of underground conduit by such applicants.

NOW THEREFORE, THE CITY COUNCIL FOR THE CITY OF HAYWARD DOES ORDAIN AS FOLLOWS:

SECTION 1. The City Council hereby amends Section 7.2.00 of Chapter 7 of the Hayward Municipal Code by adding the following definitions, with all other defined terms to be re-lettered accordingly:

(a) "City communications infrastructure" shall mean conduits, pull boxes, and other related facilities that are deployed by the City in furtherance of the strategic and operational goals outlined in the City of Hayward Fiber Optic Master Plan;

(b) "Conduit" shall mean a pipe or tube through which water, waste water or gas is conveyed, or which is used to protect electrical or communications cables;

(c) "Incremental cost" shall mean the cost associated with adding City communications infrastructure to an excavation project, including the cost of the materials needed by the City and any additional labor costs;

(d) "Public Works Department" shall mean the Public Works Department or any successor City agency that is responsible for deploying and managing City communications infrastructure and providing network communications and applications support for the City;

(e) "Public Works Requirements" shall mean the Information Technology Department's published standards for implementing the Information Technology Department's participation in excavation projects involving the installation of City communications infrastructure; (Public Works Department can also be involved, need to flush this out)

(f) "Standard City communications infrastructure specifications" shall mean the type, size, and quantity of conduits, cross section, the size and frequency of pull boxes, and any other facilities that the Information Technology Department determines are

necessary to serve the City's communications needs.

SECTION 2. The City Council hereby amends Section 7-2.15 of CH 7 of the Hayward Municipal Code by replacing subsection (d) in its entirety, as follows:

(a) Denial of permits.

(1) The Engineer may deny or refuse to issue a permit under the following conditions:

(A) When he or she finds that it is not in the best interests of the general public to do so; and

(B) When he or she finds that it will be detrimental to the public health, safety, or welfare.

(2) The Engineer shall deny a permit when he or she finds that the applicant has failed to comply with Section 7-2.46 CH7 of Hayward Municipal Code.

SECTION 3. The City Council hereby amends Section 7-2.10 of Title 7 of the Hayward Municipal Code by adding subsection (l), as follows:

(l) Dig Once. An applicant for an excavation permit under this section for the placement of underground conduit in, along, across, or through any highway shall comply with the requirements in Section 7-2.46 of this chapter.

SECTION 4. The City Council hereby adds a new Section 7-2.46to Title 7 of the Hayward Municipal Code, as follows:

Section 7-3.21. Installation of City Communications Infrastructure.

(a) Need for City Communications Infrastructure. To further the strategic and operational goals outlined in the City of Hayward Fiber Optic Master Plan and deployment of a public communications network, the City Manager or his/her Designee shall consider adding City communications infrastructure to any excavation permit issued under this chapter for the placement of underground conduit in, along, across, or through any highway.

(b) Notice Required.

(1) To the extent feasible, the Director of Public Works, or his/her designee shall notify (or require an applicant for such work to notify) all known telecommunications service providers of an impending excavation and afford all such service providers the opportunity to utilize the excavation to install, upgrade, co-locate, repair, or improve their telecommunication facilities during such an excavation project. Any such notice shall be provided at least thirty (30) days prior to the commencement of excavation. All service providers utilizing the same excavation shall be responsible for their proportionate share of the excavation costs, including but not limited to the costs of permitting. Such excavation shall not take place more than once on a particular City street within a 5-year period.

(2) Notice is only required when the proposed underground conduit installation will be at least 300 linear feet, or such longer distance as the IT Department may establish in the IT Requirements.

(3) In recognition of the need to provide broadband connectivity to the historically underserved areas of the City, and in further recognition of the need to minimize public inconvenience and traffic, and to preserve the integrity and service-life of City streets, all construction, reconstruction, and repaving within a City right-of-way shall include a provision for the installation of a public utility infrastructure, such as conduit, tube, duct, or other device designed for enclosing telecommunications wires, fibers, or cables, wherever practical and feasible. Such infrastructure shall be installed in accordance with City regulations, requirements and specifications, including but not limited to the Hayward Municipal Code, as directed by the Director of Public Works or his/her designee. Such excavation shall not take place more than once on a particular City street within a 5-year period.

(4) A permit for excavation shall be required and will be charged based on staff time spent at the rate in effect as established by the duly adopted fee schedule for engineering plan review.

(5). The Director of Public Works or his/her designee may exempt projects from these requirements where it is determined that it is not practical or feasible. Requests for an exemption must be made in writing with an explanation as to why the project is not feasible. Cost shall not be the determining factor whether a project is feasible or practical. A determination from the Director of Public Works is the final administrative determination of the matter and is not appealable.

(6). The Director of Public Works or his/her designee shall have primary responsibility for enforcement of this policy. Pursuant to the Hayward Municipal Code, excavations not in accordance with this policy shall be

considered noncompliant encroachments which have been declared a public nuisance and which are subject to abatement, removal, and enjoinment by the City of Hayward, as well as by any other remedies provided by law.

(c) Response to Notice. Upon receipt of a notice issued pursuant to subsection (b) of this section, the Public Works Department shall review the notice to determine whether adding City communications infrastructure to the proposed excavation project would be both financially feasible and consistent with the City's goals.

(d) Approval of Application. The City may approve an application and issue a permit if the City finds that an applicant has complied with this chapter and all applicable provisions in the Public Works Requirements.

(e) Applicant's Incremental Costs. The Public Works Department shall be responsible for the applicant's incremental costs when the Public Works Department participates in an excavation project by installing City communications infrastructure.

SECTION 5. The City Council hereby adds a new Section 7-2.47 to Title 7 of the Hayward Municipal Code, as follows:

Section 7-3.22. Public Works Department Requirements.

(a) Adoption of Requirements. The Public Works Department, in consultation with the Engineering Department, shall develop and implement the Public Works Requirements.

(b) Purpose of Public Works Requirements. The Public Works Requirements shall specify the manner in which the Public Works Department will participate in excavation projects by installing City communications infrastructure that meets the City's needs at a reasonable cost.

(c) Minimum Requirements. At a minimum, the Public Works Requirements shall contain the following procedural and substantive requirements for the installation of City communications infrastructure in excavation projects:

(1) The process for the Public Works Department to review planned excavation projects in a timely manner to determine if City participation is feasible and to verify its participation;

(2) The criteria to be used by the Public Works Department to decide whether to decline to participate in excavation projects;

(3) The standard technical specifications for City communications infrastructure;

(4) The standard methodology for determining the incremental costs associated with installing City communications infrastructure in excavation projects;

(5) The requirements and process for excavators to seek exemptions from using the City's standard methodology for determining incremental costs when installing standard City communications infrastructure in excavation projects; and

(6) Alternative methodologies for determining the City's incremental costs when exemptions are granted.

SECTION 6. Severance. Should any part of this ordinance be declared by a final decision of a court or tribunal of competent jurisdiction to be unconstitutional, invalid, or beyond the authority of the City, such decision shall not affect the validity of the remainder of this ordinance, which shall continue in full force and effect, provided that the remainder of the ordinance, absent the unexcised portion, can be reasonably interpreted to give effect to the intentions of the City Council.

SECTION 7. Custodian of Records. The documents and materials that constitute the record of proceedings on which these findings and this Ordinance are based are located at the City Clerk's office located at 777 B Street, Hayward, CA 94541. The custodian of these records is the City Clerk.

SECTION 8. Effective Date. This Ordinance shall become effective thirty (30) days following its adoption.

SECTION 9. Publication. The City Clerk shall certify to the adoption of this Ordinance. Not later than fifteen (15) days following the passage of this Ordinance, the Ordinance, or a summary of thereof, along with the names of the City Council members voting for and against the Ordinance, shall be published in a newspaper of general circulation in the City of Hayward.

IN COUNCIL, HAYWARD, CALIFORNIA _____, 2018

ADOPTED BY THE FOLLOWING VOTE:

AYES: COUNCIL MEMBERS:
MAYOR

NOES: COUNCIL MEMBERS:
ABSTAIN: COUNCIL MEMBERS:
ABSENT: COUNCIL MEMBERS:

CITY OF HAYWARD

Department of Public Works
Engineering Division

DIG ONCE POLICY
(For open trench construction only)

PURPOSE:

The purposes of implementing a Dig Once policy include:

- Protecting newly and recently paved roads and sidewalks;
- Ensuring efficient, non-duplicative placement of infrastructure in the Public Rights-of-Way (PROW);
- Minimizing the impact of construction on residential and commercial communities;
- Reducing the overall costs of all underground work in the PROW by capitalizing on significant economies of scale;
- Enhancing the uniformity of construction; and
- Leveraging construction for the deployment fiber within the City's Industrial Corridor and deployment of a public communications network.

BACKGROUND:

Coordinating the underground installation and co-location of infrastructure within the PROW benefits communities, businesses, and the City. The excavation of roads and cutting of sidewalks substantially reduces the service life, quality, and performance of those surfaces. Furthermore, each underground installation reduces the space available for future infrastructure. While aerial installation methods requiring attachments to utility poles are usually less expensive than underground installation, aerial installations have significant drawbacks. Those drawbacks include negatively impacting the aesthetics within the PROW, limited space on existing utility poles in more crowded areas, dealing with a lack of ownership of overhead infrastructure, and reliability issues as a result of exposure to outside conditions. Underground installation using protective conduit generally provides scalable, flexible, and durable long-term infrastructure.

POLICY DIRECTIVE:

1. Unless waived by the Public Works Director because of undue burden, or an unfavorable cost-benefit analysis, or the consideration of other relevant factors, the PROW Excavator/Permittee shall install two 3-inch diameter conduits for the following types of projects that have a minimum continuous open trench or directional bore length of 300 feet:
   a) Excavations for the purpose of installing utilities, including but not limited to

communications, electrical, gas, water, wastewater, or storm drainage; and

b) Other excavations, or work on public property or in the public right-of-way that provide a similar opportunity to install conduit for future use.

Engineering Division Policy #2018-01
DIG ONCE
POLICY Page 2

2. Unless the Public Works Director determines otherwise, the typical standard installation requirements are listed below:
   a) 3-inch nominal diameter conduit.
   b) Made of high density polyethylene (HDPE) with a standard dimension ratio (SDR) of 11.
   c) Conduit will be laid to a depth of not less than 18 inches below grade in concrete sidewalk areas, and not less than 24 inches below finished grade in all other areas when feasible, or the maximum feasible depth otherwise.
   d) When feasible and needed, install minimum 3-foot radius sweeps and bends.
   E) Composite anti-theft vaults having dimensions of 30" x 48" x 36" (W x L x D), placed in the sidewalk or available green space within the city or municipality ROW, as close to the curb or gutter as possible and spaced at 600-foot intervals or less typically at street intersections.
   F) Pull-rope shall be installed within each conduit or inner duct if required by the Public Works Director.
   G) When practicable, furnish with 10 AWG insulated tracer wire inside at least one pipe and an external "warning" ribbon tape a minimum of 3-inches above the conduit.
   H) All conduit couplers and fittings shall be installed to be watertight. Conduits shall be sealed with endcaps upon installation.
3. Conduits installed will be owned by the City.
4. A record of all City-owned conduits will be documented and transferred to the City for geographic information system (GIS) entry.
5. The PROW Excavator/Permittee should make a documented effort to work with other utility agencies to co-locate infrastructure in the same trench whenever feasible to minimize construction costs, minimize future public disruptions, and encourage efficient use of the PROW.
6. Each utility shall participate in periodic coordination meetings as requested by the City with other utilities and affected public agencies. The purpose of these meetings shall be to coordinate activity between public works projects and utility projects in the PROW. Refer to the City of Hayward Dig Once Policy Manual for more details on this requirement.

Effective Date: XXX, 2018

ATTACHMENT IV

ctc technology & energy

engineering & business consulting

Fiber Optic Master Plan

Prepared for the City of Hayward, California
February 2017

Contents

Figures

Tables

1 Executive Summary

There is a growing desire for robust, fiber-based broadband throughout the U.S., particularly among businesses of all sizes as their needs evolve, and connectivity becomes increasingly integral to business operations. Given this, localities are eager to find ways to fill gaps in available service to help their communities attract and retain businesses. Cities that want to advance economic development and attract a talented workforce are seeking ways to deploy fiber-to-the-premises (FTTP) in their communities, or to partner with private providers that are willing and able to help meet connectivity needs.

The City of Hayward is committed to enabling greater fiber-based connectivity for its numerous businesses, and to eventually expanding services to its residential neighborhoods. The City is focused on a phased municipal broadband deployment, and exploring a potential public–private partnership to achieve these goals.

1.1 Project Background and Objectives

The City intends to leverage any available conduit and fiber infrastructure to support a municipal FTTP deployment to advance the availability, affordability, and reliability of connectivity services for its business sector, which hosts thousands of businesses in a broad range of industries. To this end, the City has received funding from the U.S. Department of Commerce to install a preliminary fiber optic and conduit network. CTC's engineers developed a proposed fiber design (see Section 5) based on the assumption that this infrastructure would be foundational to any future City efforts to deploy an FTTP network.

To supplement the City's direct efforts to deploy FTTP and to potentially support its long-term vision, the City also seeks to understand emerging public–private partnerships in the broadband industry, how to balance risk and reward, and whether a partnership makes sense in Hayward. In short, the City aims to take any steps it can to enable greater connectivity in the community, while not taking on undue risk.

The Fiber Optic Master Plan's primary objective is to analyze and outline the best potential path and business model to deploy a fiber optic network that can meet the community's needs, with an initial emphasis on serving businesses located in Hayward's Industrial Corridor.

1.1.1 Fiber Optic Master Plan Objectives

To achieve the City's vision as outlined in its General Plan 2020,[1] the Industrial Technology and Innovation Corridor (Industrial Corridor)—an approximately nine-square-mile section of industrial-zoned land with more than 5,100 businesses—needs infrastructure to attract investment and support business growth. Today, fiber infrastructure that supports access to broadband Internet service is as vital as streets, water, and sewer infrastructure. Broadband connectivity enhances a community's economic development potential by attracting new advanced businesses and providing existing businesses the tools they need to expand. Accordingly, the City engaged CTC Technology & Energy (CTC) to prepare a Fiber Optic Master Plan to assist in the planning, budgeting, and implementation of a landmark fiber optic network infrastructure project.

The Fiber Optic Master Plan's primary objective is to analyze and outline the best potential path and business model to deploy a fiber optic network that can meet the community's needs, with an initial emphasis on serving businesses located in Hayward's Industrial Corridor. Additional information on this targeted area and the types of business activities within it can be found in the Industrial Technology and Innovation Corridor Baseline Profile,[2] published by the City's Economic Development Division in March 2015.

Specifically, this plan outlines strategies for improved consumer choice for data connection services (including Internet), and economic development and job creation within the community. This plan:

- Provides the City with information and data to set its goals and objectives to facilitate the design and deployment of a fiber optic network in Hayward;
- Presents and evaluates the current supply of broadband communications assets, products, and services in the City;
- Provides an inventory and assessment of existing City-owned assets and infrastructure required to support deployment of a fiber optic network;
- Defines and evaluates potential fiber optic network routes and requirements;
- Identifies potential impacts of a fiber optic network, including impacts on City right-of-way (ROW), City-owned conduit, streetlight poles, traffic lights, existing fiber systems, and other real property;
- Defines services and technologies to be offered on the fiber optic network;
- Presents an engineering study, network design, and deployment cost model;

[1] The General Plan 2040 is available on the City's website at http://cityofhayward-ca.gov/GENERALPLAN/
[2] The Industrial Technology and Innovation Corridor Baseline Profile is available on the City's website at http://cityofhayward-ca.gov/CITY-GOVERNMENT/BOARDS-COMMISSIONS-COMMITTEES/PLANNING-COMMISSION/pc/2015/pca040915-P01.pdf

- Outlines a potential phased approach to deliver the network; and
- Evaluates potential business models to build, operate, and make "last-mile" connections to a fiber optic network.

1.2 Methodology

This report was researched and prepared in the summer and autumn of 2016 by CTC, with ongoing input from City staff. In addition to drawing on our extensive industry experience, our analysis is guided by our conversations and interviews with City staff about the City's objectives and desired outcomes.

Over the course of the engagement, CTC performed the following general tasks:

1. Reviewed the City's key physical infrastructure;
2. Developed and administered an online survey of Hayward businesses;
3. Conducted follow-up interviews with a select group of Hayward businesses to further gauge interest in City FTTP efforts;
4. Researched the region's available broadband services and costs;
5. Conducted onsite and desk surveys of City infrastructure;
6. Evaluated potential public–private partnership business models based on current developments in the broadband industry; and
7. Developed pro forma financial statements for the City, including a governance model for a fiber enterprise.

In addition to those tasks, CTC prepared a proposed fiber design (Section 5), which provides data relevant to assessing the financial viability of network deployment, and offers guidance to develop business models for a potential City construction effort (including the full range of models for public–private partnerships). This estimate also provides key inputs to financial modeling (see Section 7) to determine the approximate revenue levels necessary for the City to service any debt incurred in building the network.

1.3 The City of Hayward's Industrial Corridor Is Unique

Hayward is an economically and ethnically diverse city of approximately 150,000 residents within 45.32 square miles on the eastern edge of the San Francisco Bay. As a regional center of retail, industrial, and public activities, Hayward combines a hometown atmosphere, ideal climate, cultural attractions, parks, and recreational facilities with easy access to suppliers and customers throughout the Bay Area and beyond.

The City is known as the "Heart of the Bay" because of its central location in Alameda County—25 miles southeast of San Francisco, 14 miles south of Oakland, 26 miles north of San Jose, and 10 miles west of Pleasanton and surrounding valley communities. Hayward has two Bay Area Rapid Transit (BART) stations, an Amtrak station, its own executive airport, and an extensive network of freeways and bus lines that provide easy access to the San Francisco, Oakland, and San Jose international airports. The City also boasts easy access to the Port of Oakland, the fourth-busiest container port in the U.S.

The City leveraged its strategic location and natural assets to become a regional hub for commerce and trade. Today, Hayward is home to more than 7,000 businesses, ranging from family-owned retail shops and restaurants, to globally recognized manufacturers, distributors, and retailers. The City's key industries include:

- Advanced and specialized manufacturing;
- Clean and green technology;
- Food and beverage manufacturing;
- Life science and biotechnology; and
- Transportation and logistics.

The City's Industrial Corridor is a large crescent-shaped area of industrial-zoned land located along the City's western and southwestern boundaries. This roughly nine square miles of land is home to more than 5,100 businesses that employ nearly 47,500 workers. Per the City's General Plan, this corridor is expected to grow as an economic and employment center and evolve to achieve a healthy balance of traditional manufacturing and information- and technology-based uses.

Given the importance of the Industrial Corridor, we recommend focusing on providing service to businesses there as part of a phased implementation approach to deploying FTTP in Hayward. Rather than a pilot project, we believe that finding a way to serve the Industrial Corridor—or a subset of businesses there—and maintain service long term will serve the City's interests. This may be possible through a public–private partnership under one of the business plans outlined in Section 1.5. Specifically, the City can target infrastructure deployment to lower barriers for one or more private providers that aim to serve these locations, and it can enable a mid-range FTTP-based retail product.

1.4 The City's U.S. Economic Development Administration Grant Decreases FTTP Construction Costs

The U.S. Department of Commerce's Economic Development Administration (EDA) announced in 2016 that it had awarded just over $2.74 million in grant funds to the City to support fiber

optic infrastructure development.[3] This grant funding will enable the City to install conduit and fiber optic cables, which will support an FTTP deployment in the Industrial Corridor.

The cost estimates in Section 6 anticipate an additional approximately $5.4 million to deploy the proposed fiber design in Section 5.[4] The design and associated costs take the EDA grant into consideration and anticipate that any infrastructure the City develops with the $2.74 million grant will become part of a broader FTTP deployment. The fiber optic infrastructure that the City deploys with grant funds will serve as a backbone for a middle-mile and FTTP deployment.

Our analysis assumes that the grant funds will be used to install both conduit and fiber, and that the conduit will be fully deployed with City fiber infrastructure. Given this, it is unlikely that the City will have excess conduit to make available for other entities to use. In our experience, unless an entity already has excessive unused conduit or has a need to install innerduct,[5] leasing conduit can hamper expansion of fiber as the entity's needs evolve. Further, there is not significant revenue to be realized from leasing empty conduit. Instead, if the City seeks to monetize its infrastructure, it can offer excess fiber strands for dark fiber licensing.

The City's approximately $2.74 million in Economic Development Administration (EDA) grant funds serve as the basis for CTC's engineering design and cost estimates, and enable cost savings for the City's FTTP deployment. The projected cost to deploy the proposed fiber design in Section 5 is approximately $5.4 million, ***in addition to*** *the $2.74 million grant.*

One key network infrastructure component is known as a "hub site," which is a location in the community, typically in the City's ROW, where network backbone fiber terminates in a shelter or enclosure. From this point, middle-mile network fiber is distributed deeper into the community to support eventual FTTP connections to customers. [6] Another important part of network deployment is to connect the network to an Internet point of presence (POP) where the City can access services offered at the POP. Services could include hosting servers and network electronics in a datacenter environment and "peering," which involves direct access to application

[3] "U.S. Department of Commerce Invests Nearly $4 Million in Northern California to Help Build Infrastructure and Support Job Creation," *U.S. Economic Development Administration*, last modified September 9, 2016, https://www.eda.gov/news/press-releases/2016/09/14/northern-ca.htm.

[4] Note that this cost is associated with a "dark FTTP model," in which the City would directly deploy an FTTP network and provide a private partner with a license to use the City-owned fiber. This estimate is for outside plant (OSP) infrastructure only and does not include the cost for network electronics, fiber drop cables, or customer premises equipment. See Section 1.5.1.

[5] Innerduct is smaller conduit (or tube) used to subdivide a larger conduit or duct for the placement of optical fiber cables.

[6] This is also commonly referred to as "distribution fiber," given its purpose.

providers[7] that reside at the POP. In addition to serving as a backbone, the City's grant-funded infrastructure will help connect the network hub to the POP, which can help the City gain access to Internet service providers (ISPs) that may be interested in procuring dark fiber from the City to serve businesses in the Industrial Corridor or along the fiber routes.

Perhaps the simplest benefit the EDA grant offers is approximately $2.74 million in avoided costs to the City. While this does not cover the entire cost to serve the City's target area, it gives the City a notable head start toward achieving its connectivity goals.

1.5 The City Can Consider Three Potential Business Models with Varying Degrees of Risk

*We recommend considering a **dark fiber-to-the-premises (FTTP) model** in which the City deploys, owns, and operates an FTTP network and seeks a private partner to invest in electronics to "light" the network, and offers services to end users.*

We evaluated three core business models for the City to consider, two of which assume the City will seek a private partner. Each model assumes the City will invest in FTTP and take some financial and operating risk, even if the City pursues a public–private partnership based on one of these models. While a private company could come into the City and invest directly without requiring the City to take financial risk of its own, this private investment approach is not a true partnership, and the private sector has not signaled to the City a willingness to take this approach.

In a **dark FTTP model**, the City directly deploys an FTTP network, and provides a private partner with a license to use the City-owned fiber; the partner "lights" the fiber, and offers services to end users. In this model, the partner would pay a per-passing cost to the City to help offset the public-sector costs for fiber deployment. In this model, the City is responsible for all construction and maintenance of the fiber, but does not manage network electronics, customer premises equipment (CPEs), or any customer contracts.

In a **wholesale service model**, the City deploys an FTTP network and "lights" the fiber, and then offers lit services to one or more private providers to offer service to end users. The City is responsible for fiber construction and maintenance as well as all network electronics, including replenishments and vendor contracts.

In a **retail service model**, the City deploys an FTTP network, "lights" the network, and directly offers services to end users. In this model, the City will construct and maintain an FTTP

[7] Examples include Netflix, Vonage, Yahoo, Dropbox, etc.

network, "light" the fiber and maintain all network electronics, and market and sell services to retail customers. The City is responsible for customer service at every level in this model, and enters the local market as a direct competitor to existing providers.

Table 12 describes the City's and a partner's responsibilities in each of the models. It is important to note that certain aspects of a partnership may be negotiable, but that we recommend a division of responsibilities as outlined below. A partnership should help manage the City's risk, and substantially modifying this division of responsibilities could place undue risk on the City. For example, we would view with skepticism a dark FTTP partnership that required the City to invest in both the fiber network and network electronics because it shifts much of the risk onto the City.

The three models we evaluated can be categorized from lowest to highest risk to the City: a dark FTTP model entails the least risk, a wholesale service model is riskier than the dark FTTP model, and a retail service model involves a great deal of risk to the City.

Table 1 shows a visual representation of the responsibilities that would fall to the City under each of the potential business models, and thus the potential degree of risk.

Table 1: Three Potential Business Models

City Responsibility	Model		
	Dark FTTP	Wholesale Service	Retail Service
Invest in and own outside plant (OSP)	X	X	X
Fund and perform fiber maintenance	X	X	X
Invest in own network electronics		X	X
Replenish network electronics		X	X
Manage electronics vendor contracts		X	X
Purchase and maintain CPEs			X
Marketing and customer acquisition			X
Conduct customer service			X

1.5.1 A Dark FTTP Model Will Enable the City to Partner with the Private Sector and Balance Risk

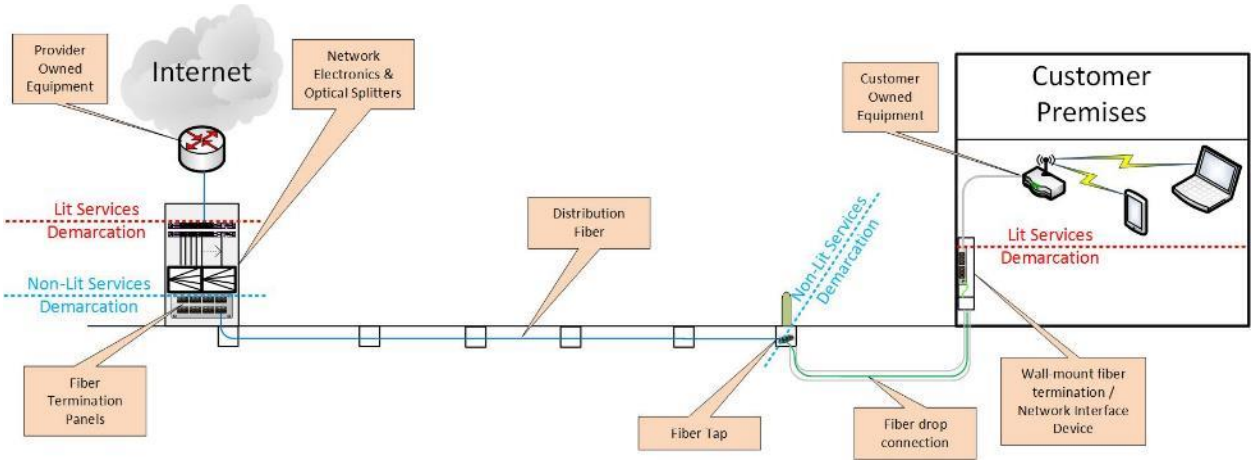
We believe the dark FTTP model represents the best balance of shared risk and reward between the City and a potential partner. In this model, the City is responsible for a substantial capital investment to deploy fiber to the Industrial Corridor (and, perhaps, eventually the entire community), but its risk is offset in part by retaining ownership of an asset. Further, this model assumes the private partner will make a substantial investment of its own in network electronics, and the marketing, advertising, and support responsibilities associated with providing service to end users.

The City is already versed in making infrastructure investments on various public works projects, and will not have to employ a broad range of new staff to learn unfamiliar skill sets such as providing technical support over the phone to customers who call for help with issues related to the equipment in their businesses or homes. Some of the responsibilities for maintaining the dark FTTP network will require additional staff, but we anticipate less than four full-time positions will be necessary to support the City's dark FTTP deployment (see Section 7).

Further, as we noted, the City's approximately $2.74 in grant funding to support conduit and fiber installation is a meaningful step toward infrastructure investment, which will help lower the City's risk even further. Unlike other communities that may not have access to grant funding, the City already has a head start on making an investment in fiber and conduit. If the City can supplement this investment to strategically deploy a dark FTTP network to its preferred target area in the Industrial Corridor, it may become an attractive partner for the private sector.

An example of the demarcation points between the City dark FTTP and the partners' electronics is shown in Figure 1. The Figure also shows the potential demarcation points for lit services (wholesale model).

Figure 1: Demarcation Between City and Partner Network Elements[8]



1.5.2 A Wholesale Service Model Can Enable Multiple ISPs to Serve Customers

A wholesale service model is a lower-risk option than the City choosing to directly provide retail service, but it still represents a significant financial and operational risk for the City. Because the financial and operational risk for the fiber *and* the network electronics falls to the City, any private partner(s) with which the City contracts will automatically shoulder less of the

[8] The analysis in this report assumes that the private partner will install fiber drop cables, and will cover the cost of these installations. A potential variation on this arrangement is for the City to pay for the drop cables. The demarcation is one variable that will be negotiated during a procurement process.

partnership's risk. That is, there will be an imbalance in the shared risk and reward between the parties, which puts the City at a disadvantage from the outset.

This model may still be attractive, however, if the City wishes to retain control of the fiber and the network electronics while shifting responsibilities such as operations, customer support, and marketing to the private sector. If the City is willing and able to take on additional financial and operational risk associated with network electronics—for example, maintaining vendor licenses, upgrading firmware, and periodically replacing network electronics—a wholesale service approach may be a viable option. This model can enable multiple ISPs to use the City's network to offer services by lowering costly barriers to entry.

1.5.3 A Retail Service Model Is High Risk

The only model that does not anticipate some level of partnership is the retail service model, where the City would construct, own, and operate a fiber network over which it would directly provide services to end users. While this model gives the City complete control, it also represents the greatest possible risk to the City. In this model, the City would be responsible for all aspects of network construction and administration, as well as marketing and advertising services to potential customers, providing services, and offering customer support. This is a high-risk model, because all financial and operational responsibility for every aspect of the network and service falls to the City; the City must compete with existing providers that have an established presence in the market and can make use of economies of scale; and the City would be entering the market as a new provider.

*Our analysis indicates that it would cost approximately **$5.4 million** for the City to deploy a dark fiber network to the Industrial Corridor. This cost is in addition to the $2.74 million the U.S. Economic Development Administration awarded the City in 2016.*

There are numerous steps the City must take to implement a retail service model that provides service to end users. Even then, there is no guarantee that the City can successfully manage an inherently unpredictable for-choice business that requires an ability to compete in the marketplace against established providers. If the City opts to pursue this model, it will likely need to create new positions for additional staff; determine whether the fiber optic enterprise will be housed in an existing City department or will be a separate entity; develop a range of policies related to use, including compliance with digital millennium copyright act (DMCA) requirements and other state and federal regulations; and launch a marketing campaign. These are merely the steps necessary to get started. While these considerations are substantial, the complexities associated with ongoing operations are especially significant.

1.6 Estimated Fiber Costs and Phased Deployment

To ensure our design cost estimates reflected City goals and the reality of the infrastructure and market in Hayward, our engineers conducted extensive desk surveys and an onsite field survey, and engaged City staff in discussions throughout the course of this project. Our analysis examined potential costs associated with bringing FTTP to the Industrial Corridor, and a possible phased deployment.

1.6.1 Industrial Technology and Innovation Corridor

Based on a conceptual, high-level design prepared by our engineers, we developed cost examples for the City to consider. While we believe that a dark FTTP model will best meet the City's needs, we conducted analysis for a retail service model as well (see Section 6). This helps illustrate the difference in costs that the City might incur if it opts to pursue a retail service model—if, for example, the City is unable to find a partner to lease dark fiber and still wishes to ensure service to select portions of the community.

Here, we look at the cost to deploy *only* the FTTP outside plant (OSP)[9] infrastructure. This is the total capital cost for the City to build a dark FTTP network for lease to a private partner, which will then provide retail service over the FTTP infrastructure. In other words, this portion of our analysis is consistent with the dark FTTP business model we outlined in Section 1.5.1.

We estimate that a dark FTTP model, in which the City deploys a dark FTTP network to the Industrial Corridor, will cost approximately $5.4 million. As we noted, such a model does not include costs for network electronics, subscriber equipment, or fiber drop cables.

In this model, the partner would take on the costs for the network electronics, which represents approximately a $3 million upfront investment, based on our analysis. Further, the partner would also be responsible for network electronic replenishments and annual fees associated with network electronics, such as vendor licenses.

Table 2, below, outlines the projected costs for this model, and Section 6 provides additional details about this approach.

[9] OSP, known as "layer 1" or the "physical layer" of the network, is both the most expensive part of the network and the longest lasting.

Table 2: Breakdown of Estimated Dark FTTP Cost

Cost Component	Total Estimated Cost
OSP Engineering	$0.5 million
Quality Control/Quality Assurance	0.2 million
General OSP Construction Cost	3.2 million
Special Crossings	0.7 million
Backbone and Distribution Plant Splicing	0.1 million
Backbone Hub, Termination, and Testing	0.5 million
FTTP Lateral Installations	0.2 million
Total Estimated Cost:	$5.4 million

1.7 Recommendations and Next Steps

Section 2.1 indicates that the City is served similarly to comparable markets. While there are some gaps in available service, many of the City's businesses currently have access to fiber-based connectivity or alternative technologies that offer sufficient speeds for their business needs. We note that, based on our experience and analysis, Hayward is ahead of similar cities—even by simply commissioning this Master Plan, the City has set itself apart from many of its peers. Although there is not great urgency for the City to fill gaps, this section describes potential steps the City can take increase broadband availability—especially to businesses—and thereby potentially advance its standing in a global economy.

We recommend that the City:

- *Consider a dark FTTP model*
- *Adopt a dig-once policy*
- *Audit its infrastructure and records*
- *Implement a records management system*
- *Construct a fiber segment to connect an Internet POP*
- *Expand FTTP to select Industrial Corridor areas*
- *Signal to the private sector through a procurement process*
- *Lease dark fiber strands to select Industrial Corridor customers*

One of the most important decisions the City must make, which will inform next steps, is which business model to pursue. **We believe the City will achieve the most favorable outcome by pursuing a dark FTTP model, in which it expands its existing dark fiber and conduit, and grants access to its network to private entities that will offer services.** We believe this approach represents shared investment and risk for the public and private sector, and may help offset the City's financial obligations.

In this approach, the City constructs and owns the fiber network and the private partner "lights" the fiber with electronics and directly serves end users. This model is currently

underway on a large scale in the City of Westminster, Maryland, with its private partner Ting Internet,[10] and in the City of Huntsville, Alabama, with its private partner, Google Fiber.[11]

Retaining ownership of the fiber OSP assets is important to mitigate risk; owning assets is a way for the City to retain some control of the network, and to have some say in when, where, and how it is built. This approach includes a scenario in which a community pursues a partnership with a private provider; a good way to balance risk and reward is for the City to maintain ownership and control of the assets while it assigns operational responsibilities, including the capital investment for network and consumer electronics, to a private partner. This enables both parties to perform functions that highlight their strengths while not having to expend resources and energy attempting to carry out tasks for which they are ill-equipped.

There is risk to the City in this model because it requires a substantial capital investment to build (or expand) and maintain the fiber network, but it also gives the City a degree of control because the City owns the network. In the event the partnership fails for any reason the City owns its assets and can take over control of the network directly or engage a different partner. This partnership model where the City retains ownership of the fiber assets will likely enable the City to make use of its existing fiber assets, and retain more control than simply relying on the private sector, while tempering risk in a way that a retail model cannot.

We note that recent developments with Google Fiber—particularly its apparent scaling back of infrastructure deployment—do not change any of CTC's recommendations in this report.[12] The City is focused on finding ways to serve business customers, while Google Fiber has historically focused on providing residential service.

1.7.1 Initiate a Procurement Process to Deploy Dark FTTP Network

To initiate the proposed lease of the dark FTTP network, we recommend considering two steps. First, issue a request for information (RFI) or request for proposal (RFP). Second, initiate the process to conduct the detailed design and the installation of the dark FTTP network.

1.7.1.1 Initiate a Procurement Process to Communicate the City's Plans to the Private Sector

If the City pursues a dark FTTP or a wholesale service model, it may be prudent to issue a request for information (RFI) or request for proposal (RFP) to signal to the private sector that

[10] Wiley Hayes, "Westminster, Md. Partners with Private Sector to Broaden Fiber-Optic Network," *GovTech*, last modified October 26, 2015, http://www.govtech.com/dc/articles/Westminster-Md-Partners-with-Private-Sector-to-Broaden-Fiber-Optic-Network.html.

[11] Frederic Lardinois, "Google Fiber Is Coming To Huntsville, Alabama," *Tech Crunch*, last modified February 22, 2016, http://techcrunch.com/2016/02/22/google-fiber-is-coming-to-huntsville-alabama/.

[12] Jon Brodkin, "Google fiber division cuts staff by 9%, "pauses" fiber plans in 11 cities," *ArsTechnica*, last modified October 25, 2016, http://arstechnica.com/information-technology/2016/10/google-fiber-laying-off-9-of-staff-will-pause-plans-for-10-cities/.

the City is willing to invest in infrastructure and is seeking a partner. The process can also provide feedback on price point a potential partner might consider (see Section 7.4).

An RFI process allows the City to cast a wide net and ask the private sector for input on potential business models and partnership configurations. An RFP is not as broad as an RFI, but allows the City to set the parameters of the business model it hopes to pursue in a partnership, and define specific requirements it will have of its partner(s). If the City can identify its preferred business model and can develop a framework of what it hopes to accomplish through a partnership, the terms defined in an RFP and a potential partner's response can serve as the foundation for an eventual partnership contract.

If the City opts to pursue a dark FTTP model, the procurement process can describe the type of investment the City is seeking from a private provider, the exact service area the City's dark FTTP deployment will target, and thoroughly describe the City's vision. This can lay out very clearly the City's expectations of a partner, and enable potential partners to evaluate the feasibility of partnering with the City.

For a wholesale service model approach, the City may want to start with a brief questionnaire aimed at known ISPs in the region before it moves forward with a full procurement process. This may identify providers that would be willing to purchase wholesale service from the City, and give the City a sense of what type of potential revenue it may be able to expect from a partnership.

1.7.1.2 Initiate a Procurement Process for the Detailed Design and Construction of the Dark FTTP

Below is the high-level outline of the tasks the City needs to undertake to move from the approval stage to completion of the fiber network.

- Draft, release, and administer an RFP for detailed engineering design based on the design presented in the feasibility study
- Perform oversight of the detailed engineering vendor to obtain engineering deliverables required for construction
- Draft, release, and administer an RFP for fiber construction
- Perform oversight of the fiber construction vendor as it builds the network
- Collect acceptance testing and as-built documentation from fiber construction vendor
- Perform quality assurance (QA)/quality control (QC) of the fiber construction vendor's work

Just to provide some additional context of what the detailed engineering vendor and fiber construction vendor typically provide, we have provided a high-level outline of their tasks below.

The detailed engineering vendor's responsibilities include:

- Field verification of the proposed fiber routes;
- Develop computer-aided design (CAD) drawings for detailed fiber routes;
- Identification and preparation of all permits required for the construction (ROW, environmental, bridge crossing, railroad crossing, etc.); and
- Final engineering deliverables including CAD drawings, Bills of Material, permit packages, splicing details.

The fiber construction vendor's responsibilities include:

- Construction of the fiber infrastructure;
- Delivery and storage of construction materials;
- Provide the City with as-built documentation and acceptance testing of their work; and
- Correct any deficiencies in the fiber infrastructure identified in the QA/QC process.

1.7.2 The City Can Take Small Steps with Potentially Big Rewards Toward Achieving Its Goals

There are opportunities for the City to improve telecommunications services in the community with minimal capital investment. A phased fiber construction approach would allow the City to invest in infrastructure over time that facilitates the goal of eventually providing FTTP to all residents and businesses in the City.

At a high level, we believe the City can take on the following projects to help advance toward its goals without requiring a multi-million-dollar investment in the near term:

- We recommend that, in the coming months, the City consider modifying its ROW ordinance to provide the City with the option of obtaining conduit on routes where utilities are performing excavation. This type of "Dig Once" policy would require any excavation plans fitting specified criteria to include municipal use conduit or fiber, unless the City opts out of the excavation project.
- Conduct an in-depth audit of existing fiber infrastructure and corresponding records, and implement a thorough records management program. This will support the City's current efforts, and will enable a stronger enterprise going forward.
- Spend approximately $60,000 to construct a roughly 0.3-mile segment of fiber to the Internet POP[13] at 25070 O'Neil Avenue. If the City expands fiber and conduit through the Industrial Corridor as planned, and begins offering dark fiber services to high-end customers, this will add value to that offering.

[13] An alternative is to extend fiber to connect to the POP at the BART station. The estimated fiber cost to complete this extension is also approximately $60,000. The City could choose to connect to either location, or to both POPs. To facilitate initial dark fiber leases, just one POP is required.

- Begin expanding FTTP to select portions of the Industrial Corridor, and signal to the private sector through a procurement process that the City seeks one or more partners to offer services over a City-owned fiber network.
- Offer dark fiber services to some locations to support key customers in the Industrial Corridor.

1.7.2.1 Consider Modifying the City's ROW Ordinance to Include a Dig-Once Policy

Future public works projects should also be leveraged to expand the City's conduit and fiber network. Projects such as utility replacements, road widenings, and other major capital improvement efforts may provide the opportunity to install conduit and fiber optics without the need for surface restoration. A coordinated Dig Once ordinance, which typically requires the installation of City-owned communications infrastructure in excavation projects where the City has determined that it is both financially feasible and consistent with the City's long-term goals, is recommended to leverage these types of public and private excavation projects. Section 4.3 further discusses our Dig Once recommendations.

Like Dig Once is a concept called "One-Touch Make-Ready," which applies to infrastructure that will be placed on electric or communication poles. Enacting a One-Touch Make-Ready ordinance is similar to implementing a Dig Once policy in that both aim to simplify the process of deploying infrastructure through coordinated efforts among entities and agencies. The goal is to streamline the process of deploying future-generation communications infrastructure throughout as much of a locality as possible, while minimizing cost and disruption to the ROW.

This analysis does not include a recommendation that the City enact a One-Touch Make-Ready ordinance at this time because our design anticipates a fully underground network. If the City expects to deploy additional infrastructure on poles in the future, or partner with a private entity that may deploy an aerial network, it may be prudent to explore a One-Touch Make-Ready policy.

It is important to note that Dig Once policies typically govern ROW spaces that a locality owns and over which it has control, whereas a One-Touch Make-Ready ordinance generally applies to poles that the locality may not own, or to which it may not have rights. While these poles are often located in the locality's public ROW, it is unclear to what degree a locality can direct pole owners to provide access to their poles. While CTC cannot provide legal guidance, we note that

Louisville Metro Government in Kentucky[14] and Metro Government of Nashville and Davidson County in Tennessee[15] are currently involved in litigation over One-Touch Make-Ready policies.

In conjunction with the dig-once policy, the City can review its permitting process to determine whether there are areas where these processes can become more streamlined. However, we offer caution to ensure that any streamlining does not compromise coordination and long-term ROW management.

1.7.2.2 Conduct Asset Audit and Carefully Manage any Existing and Expanded Fiber and Conduit Assets

One of the most important steps the City can take is to ensure that it is carefully managing its assets, including conduit and fiber. Whether the City opts to expand its assets or maintain the status quo, fiber strand management on the front end can have enormous benefits over the life of the fiber network, and can save potential confusion and cost in the long run.

One initial step toward this end is to conduct a thorough evaluation of all fiber management documentation the City currently has in place. There may exist documentation in the form of spreadsheets, correspondence, or simple text documents. A full fiber management system may be a necessary long-term investment, but the City cannot evaluate its needs until it understands what it already has available. An audit of existing documentation will enable to City to identify gaps in its fiber strand management—and if any documentation already exists, this can be used to develop an initial fiber map, which can then be built onto as the City expands its network.

We encourage the City to maintain detailed records of all its fiber strands and their locations. The importance of keeping meticulous records does not cease once the network is fully constructed. On the contrary, it is critically important for all ongoing and additional connections made on the network to be documented. Updates should be made to "as-built" and strand management documentation in real time to avoid making mistakes later, misremembering strand allocations, or simply forgetting important items altogether.

Documenting the network's fibers and strand usage is crucial, and making sure that City staff has unrestricted access to its strand management tools is equally important. Even if the City works with an outside firm to manage this process, we believe that it is a worthwhile investment to appoint a staff person who will become knowledgeable about and maintain

[14] Brodkin, Jon, "Charter, like AT&T, sues Louisville to stall Google Fiber," *ArsTechnica*, last modified October 5, 2016, accessed January 5, 2017, http://arstechnica.com/tech-policy/2016/10/charter-like-att-sues-louisville-to-stall-google-fiber/.

[15] Fingas, Jon, "Comcast sues Nashville over law that helps Google Fiber," *Engadget*, last modified October 26, 2016, accessed January 5, 2017, https://www.engadget.com/2016/10/26/comcast-sues-nashville-over-google-fiber-law/.

documentation regarding the location of strands on the City's network. Further, using an intuitive and straightforward system and/or software is also key; this will help guard against such critical knowledge being inaccessible to future iterations of City staff and leadership.

Another key aspect of taking care of its infrastructure is to ensure that the City has access to an on-call fiber maintenance contractor that can perform network repairs on an emergency basis. This contractor should be empowered and required to access the City's fiber management system—even if it is simply a shared spreadsheet—to record any network changes as close to real time as possible. The City will benefit tremendously from taking an inventory of its records and ensuring that anyone involved with the network going forward is accountable for this as well.

As we note in Section 7.4.3, the City can choose to hire new staff, engage existing staff, or contract out for various responsibilities related to managing the network. Generally, the degree to which a locality elects to maintain certain responsibilities internally or contract them out is specific to the unique needs of the locality. That is, each locality has its own structure, hierarchy, and collection of staff with various skill sets, and only the locality can determine which functions it can manage internally versus which responsibilities are best delegated to highly skilled contracted vendors. However, although the City may end up contracting out most responsibilities, we encourage keeping documentation creation and management as an internal function for either existing or new City staff. While there are many competent firms that can perform GIS and other network documentation functions for the City, we believe that because the City has a vested interest in the documentation's integrity, fiber documentation and records management is best performed internally.

1.7.2.3 Construct 0.3 Miles of Fiber to Connect to Internet Point of Presence

We recommend the City construct fiber to the Internet POP at 25070 O'Neil Avenue. This requires approximately 0.3 miles of fiber construction at a cost of approximately $60,000. Establishing a presence at the Internet POP allows dark fiber customers to access the services offered at the POP. Services could include hosting servers and network electronics in a datacenter environment, accessing multiple ISPs at rates lower than can be achieved at the customer's premises, and direct access to applications providers that may reside at the POP (such as voice over Internet protocol, or VoIP, services providers).

With the connection to the Internet POP, ISPs may be interested in procuring dark fiber from the City to serve businesses in the Industrial Corridor or along the fiber routes. The dark fiber services may also be used by wireless ISPs to provide connectivity to telecommunications towers and distributed antenna systems to provide backhaul for wireless service. Expanded wireless service may be a way to meet some of the network services needs for businesses in the Industrial Corridor.

1.7.2.4 Deploy FTTP In a Concentrated Area in the Industrial Corridor

The City may want to deploy dark FTTP to select areas of the Industrial Corridor. The City should select a targeted area for deployment where it can reach the maximum number of customers with the least amount of fiber construction. The City should take into consideration the following factors when choosing such an area:

- Density of businesses along specific routes;
- Types of businesses within the area (i.e. technology firms typically require more network services than manufacturers);
- Feedback from businesses in the area on their existing needs;
- Presence of multi-tenant office buildings; and
- Feasibility of fiber construction (i.e. minimal railway and interstate crossings, minimal environmental impact, and presence of existing conduit and fiber).

Once the City has selected a target area, the FTTP network should be constructed to support a full FTTP deployment in the future, which may require additional conduit and larger handholes than currently necessary. To complete an FTTP network that will serve approximately 15 percent of businesses, we estimate a cost of approximately $2.3 million.

*Our analysis indicates that it would cost approximately **$2.3 million** to serve approximately 15 percent of businesses in the Industrial Corridor.*

Note that because our projection in Section 1.6.1 shows that it would cost approximately $5.4 million to deploy FTTP to the entire Industrial Corridor, the projected cost to serve only 15 percent of businesses may seem high. However, whether the City deploys FTTP to 15 percent or 100 percent of businesses in the Industrial Corridor, the backbone must be built out and fiber routed to an aggregation point to support network core development.

It is also important to note that this targeted FTTP network will require the City to establish many of the policies and procedures required to support a larger scale FTTP deployment. This approach can help the City capture the cost to build and operate the network, and helps project the potential cost to expand the network to the full Industrial Corridor and other areas.

1.7.2.5 Offer Dark Fiber Strands for Lease to Select High-End Customers

One of our key recommendations is that the City continue to expand its fiber and conduit network as planned, specifically through the Industrial Corridor. The expanded fiber and conduit system will allow the City to begin offering dark fiber services to high-end customers. As customers purchase dark fiber services, the City will construct additional fiber and conduit to the customers—thus expanding the footprint of the existing network.

Dark fiber services include the City offering fiber optic strands between locations without active electronics. The customer would be responsible for the electronics to activate, or "light," the fiber. In this scenario, the City would only be responsible for maintaining and repairing the fiber. This approach minimizes the City staffing required, as the City would be responsible *only* for the network electronics for the City network. Fiber maintenance and repair can be contracted to a third party, and most of the costs associated with maintaining and repairing the fiber would already be required to run the City's network.

1.8 Expanding FTTP to Residential Customers Adds Considerable Cost

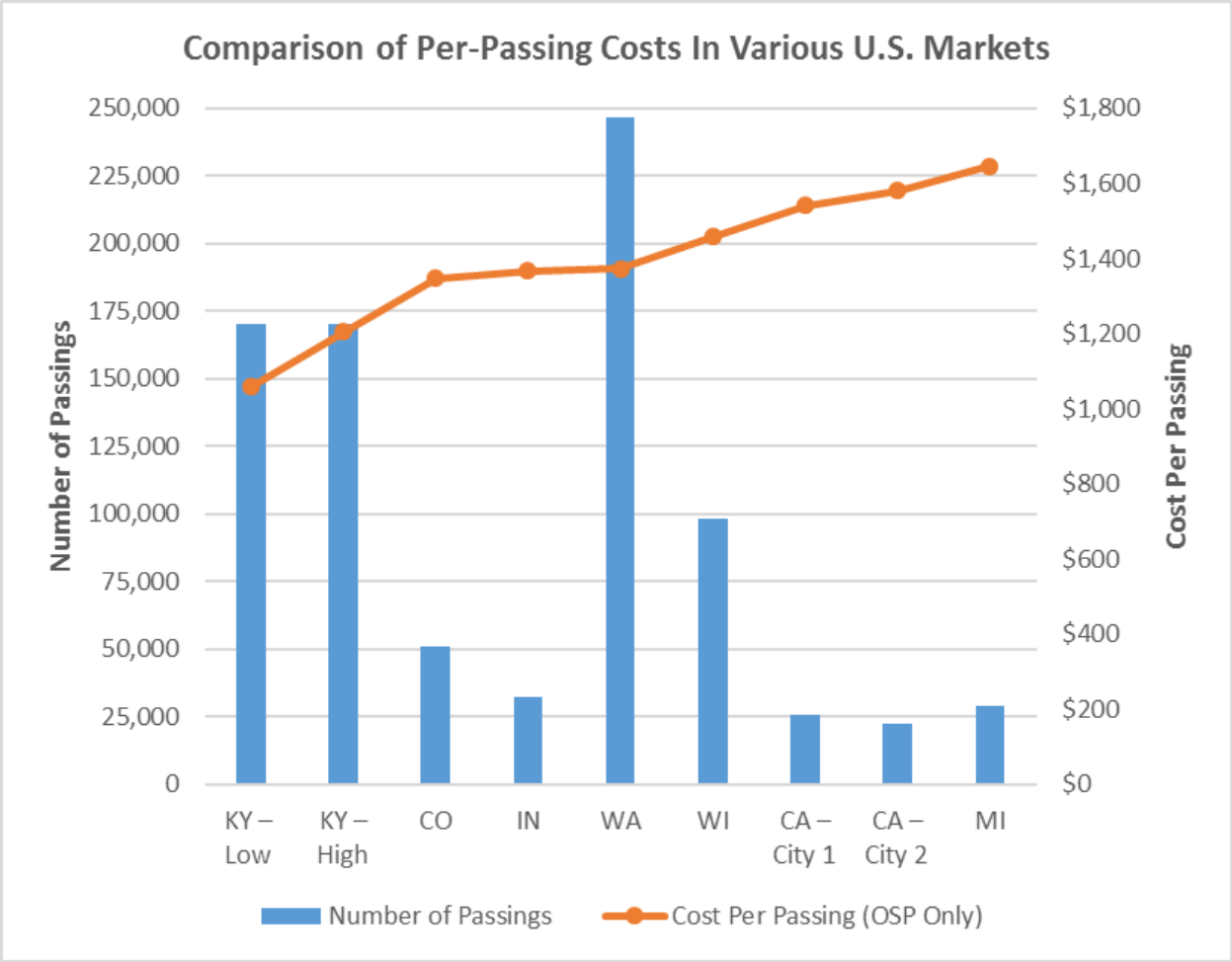
The City aims to eventually consider deploying residential FTTP in addition to serving the Industrial Corridor, and potentially other business customer locations in Hayward. Considering this desire to serve residential users, it is important to understand the potential costs associated with FTTP deployment, and particularly with providing retail service to residential users.

We conducted a high-level analysis of the cost per passing in various states in the U.S., including California, Colorado, Indiana, Kentucky, Michigan, Washington, and Wisconsin. The "per passing cost" is the approximate cost to pass a premises with fiber optics. This cost does not include the cost of the drop cable or the CPEs; it is simply the cost to run fiber in front of a location. Our analysis showed an average per-passing cost of just under $1,400, based on the per-passing costs in the several communities we evaluated.

It is important to note the per-passing costs ranged from $1,100 to over $1,600; as such, we encourage localities to use caution when examining costs estimates from other communities. It is important to note the per-passing costs ranged from $1,100 to over $1,600; as such, we encourage localities to use caution when examining cost estimates from other communities. Using this cost range and assuming there are 46,000 residential passings in Hayward results in a fiber per-passing cost estimate of $50.6 million to $73.6 million. Actual costs will depend on housing densities, construction types, traffic control requirements, make-ready, and other factors.

Still, even with this caveat, the City can begin to understand through other communities' experience the kinds of costs it may incur in an FTTP deployment that includes residential customers. Figure 2, below, shows the range of costs that we considered from various markets throughout the U.S. Note that these examples point to a scenario that considers *only* the FTTP outside plant (OSP), or the fiber and conduit associated with the network. These costs do not consider the cost of network electronics necessary to "light" the network. Additionally, these do not include the cost for installing the customer drop cable, which is the fiber extension that connects a customer's premises to the fiber network.

Figure 2: Comparison of Per-Passing Costs in Various U.S. Markets



2 Broadband Needs and Trends

The need for high-speed broadband is increasingly evident as consumers become more educated on the merits of ultra-fast connectivity. Businesses of all sizes in every industry are finding that their ability to compete successfully depends more than ever on their access to a broadband connection. From manufacturing organizations that rely on high-speed connectivity for automation,[16] to small business owners that need broadband to complete customer transactions and provide WiFi to patrons, businesses' demand is steadily growing.

Further, the workforce is becoming increasingly mobile, and businesses that wish to effectively compete must be aware and accommodating of this reality. Cloud computing and reliable wireless broadband services are two potential areas of significant need for business customers, and examples of accommodating a mobile workforce. Having employees who are mobile and can work from anywhere potentially reduces overhead costs and enables companies to be nimble. As reliable wireless service becomes an integral component of effectively doing business, companies find this is an area where they need significant improvement in dependable connectivity.

Cloud computing—which refers to information technology services, such as software, virtualized computing environments, and storage, available "in the cloud" over a user's Internet connection—is also changing the way businesses operate. The business drivers behind cloud computing are ease of use and, in theory, lower operating costs. For example, business owners understand that adding a new employee to their growing business requires ample resources. This includes purchasing a computer, installing necessary software, and ongoing software license management. Also, local server and application administration requires either dedicated staff or contracted support.

As an alternative, cloud services eliminate the need to maintain local server infrastructure and software, and instead allow the user to log into a subscription-based cloud service through a web-browser or software client. The cloud is essentially a shift of workload from local computers in the network to servers managed by a provider that make up the cloud. This, in turn, decreases the end user's administrative burden for information technology (IT) services.

Even where businesses' needs may be mostly met, many communities have areas that lack reasonably priced, high-speed options for residential customers. Because of this, a pervasive challenge that impacts local businesses is the area's ability to attract and recruit top professional talent. The availability of broadband service varies widely throughout the U.S., and

[16] Chopra, Aneesh, "Insourcing American Jobs: The Importance of "Smart" Manufacturing, Broadband, and IT," *The White House*, last modified January 14, 2012, accessed September 15, 2016, https://www.whitehouse.gov/blog/2012/01/14/insourcing-american-jobs-importance-smart-manufacturing-broadband-and-it.

the small- to medium-size business market tends to lack a range of options to meet these users' needs. Cable and digital subscriber line (DSL) service is typically available to businesses, and options for higher-end services like Metro Ethernet are often available in urban areas. But many communities lack a mid-level service that offers more capacity and reliability than residential-grade cable or DSL, but is less costly than Metro Ethernet and similar dedicated services targeted at large organizations.

This gap represents a market niche that we believe the City may be able to fill by deploying FTTP that can support fiber-based business connectivity. Even if the City does not directly offer services, it can fill broadband availability gaps by enabling one or more private providers to offer services over a robust fiber optic network.

2.1 The City Is Served Similarly to Other Markets, but There Are Still Gaps in Service

Many of the City's services—especially the lowest-priced offerings—provide download speeds far below the Federal Communications Commission (FCC)'s updated definition of broadband of at least 25 Mbps download speed.[17] Further, these tiers may even be "up to," services, which means that the actual speed a customer experiences is less than the advertised amount. For example, if a customer subscribes to an "up to" 5 Mbps service, they may experience speeds as low as 1 Mbps or even less. Given the FCC's updated definition, these services cannot technically be classified as broadband.

In some cases, the available service tiers that would meet the minimum definition of broadband are priced much higher than many of the City's consumers may be able to afford. Unfortunately, this is not unique to the City. On the contrary, our analysis shows that the available speed tiers and price points in the City are comparable to other markets throughout the U.S. In fact, some of the City's existing available service offerings are priced lower for higher service tiers than in other markets. Further, some businesses in the Industrial Corridor are limited to only DSL service.

As the City considers how to pursue a fiber deployment, it may want to focus on gaps in affordable mid-range service offerings. Some subscribers may opt to purchase low-tier service because it meets their needs, but the current market does not adequately meet the needs of subscribers that desire affordable mid-range service. This often applies to small- and medium-sized businesses that have limited funds to allocate to telecommunications spending, but that require fast, reliable service to conduct their day-to-day business.

[17] "2015 Broadband Progress Report," *Federal Communications Commission*, last modified February 4, 2015, accessed September 1, 2016, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report.

These users, and potentially others, likely desire more robust and affordable service, as well as better upload speeds. The upload speeds available in the City today are either minimal (as low as 1.5 Mbps in some cases), or are priced very high ($249.95 per month for 20 Mbps upload for Comcast's small business service). Though upload speeds may not be as important in some markets, the need for improved upload speeds in a city like Hayward is especially prominent, given its location and large business sector.

If the City can directly or in a partnership focus on filling the gap for mid-range services, it may find that this eases the process of introducing a new broadband offering into the market. Competing directly with existing providers to offer roughly the same service that is available today will not set the City or its partner(s) apart in any way. Our analysis shows that the City and the other markets we evaluated seem "well-served," in that there are several providers offering service in the existing market. However, a new offering that is sensitive to availability and supply challenges can address service gaps.

3 Needs Assessment

The City has a range of broadband user groups and stakeholders, and is especially interested in understanding local businesses' connectivity needs. An important part of understanding the potential success of a municipal FTTP deployment is to determine the perceived need for better connectivity options within the community, and willingness to switch to a different service.

To assist in understanding the demand for fiber connectivity and related services, CTC conducted an online survey of Hayward businesses on behalf of the City. Additionally, we compared available services in Hayward to those in select communities, particularly those that identify as "Gigabit Cities." The analysis in this section helps illustrate with broad strokes the potential desire for fiber-based connectivity in the City.

3.1 Business Survey Results

The business survey was designed to collect a range of data to understand current use of Internet and data services, satisfaction with current service providers, and interest in higher-speed Internet and data service offerings. While the survey should not be considered a truly representative sample of all Hayward businesses, it offers some insight into a potential customer base and market in the City, and provides the City with a starting point to understand the service attributes where it may need to focus its efforts.

In general, the survey shows that:

- Most of the respondents represent small- to medium-size businesses;
- Most respondents are not significantly unhappy with most attributes of their current service;
- More than 40 percent of respondents believe the City should have some role in enhancing broadband connectivity options for businesses in Hayward; and
- Approximately 75 percent of respondents would be very or somewhat willing to switch to a 1 Gbps service for $75 per month, and the willingness steadily drops as the service prices increases.

The full survey results are described in Appendix G: Online Business Survey Results, attached to this Report.

3.2 Comparison of Services in Hayward to Gigabit Communities

As is typical of most cities of similar size in the U.S., the City of Hayward has more than a dozen carriers offering residential, small business, enterprise-grade, and carrier services.

We identified 13 service providers in the Hayward area that offer fiber-based enterprise services, from dark fiber connectivity to data transport services, with speeds that range from 1

Megabits per second (Mbps) to 100 Gigabits per second (Gbps). The carriers that provide enterprise-grade lit services in the Hayward area are:

- Access One
- AT&T
- Comcast
- EarthLink
- Integra
- Level 3
- Line Systems
- MegaPath
- Sonic
- TelePacific
- Windstream
- XO Communications
- Zayo

Four service providers in the City have dark fiber availability:

- Integra
- Level 3
- Line Systems
- Zayo

With respect to the availability and pricing of enterprise-grade services, we have seen that the offerings in Hayward are on par with services in regions of similar size and urbanity. The City has a good mix of facilities-based and non-facilities-based providers, with all the major carriers having an established presence in the City. Prices for services are dependent on bandwidth, location, and network configuration; whether the service is protected or unprotected; whether the service is managed; and whether the customer has a service-level agreement (SLA).[18] The pricing for enterprise grade services have continued to drop over the last several years across the country and we expect that trend to continue in Hayward.

Residential and small business customers in the Hayward area have access to a range of services, though individual service options are dependent on location. The main ISPs in Hayward are AT&T, Comcast, and Sonic. Of these providers, Comcast offers fiber-based internet services up to 2 Gbps. There are also wireless ISPs (WISPs), such as Etheric Networks and Cruzio, and satellite-based services available in the City.

[18] An agreement between a provider and a customer that outlines certain parameters about the service an end user can expect; for example, an SLA may indicate that, in the event of an outage, the provider has a limited amount of time to restore service.

The key difference that we see between the residential and small business services in the City in comparison to other communities that have municipal broadband or fiber-to-the-home (FTTH) by a provider like Google Fiber is the ubiquity of service. Though Comcast offers gigabit services in Hayward, the availability of the service would vary based on location and most likely only if there was a strong business case to warrant an expansion of service to a particular location.

With regard to pricing, we have seen communities with a municipality backed service offering price gigabit services from $50 (in Longmont, Colorado), to $100 (in Westminster, Maryland) per month, with low installation costs.[19] Google Fiber offers its residential 1 Gbps services at $70 per month with waived installation costs with a 1-year contract (typically $100).[20] In comparison, the service provided by Comcast in Hayward is for the 2 Gbps speed at $299.95 per month and requires a two-year contract, plus $1,000 in upfront installation and activation fees.

We have provided an assessment of the broadband service available in the City in Appendix B.

[19] In such cases, the municipality has made a substantial capital and/or operating investment in the network, which potentially enables lower service prices than scenarios of purely private investment.
[20] https://fiber.google.com/cities/kansascity/plans/, accessed June 2016

4 Operational and Business Model Options

There are several business models that the City can consider for its fiber deployment. Overall, we believe that the City's key focus should be to deploy fiber in at least select areas of the community, such as the Industrial Corridor. We believe that the City is most likely to be successful if it focuses on infrastructure, and works to lower barriers to market entry for the private sector. By doing this, the City can encourage competition and increase the range of service options available to consumers, but it does not have to take the enormous risk of becoming a service provider and competing with established providers.

The dark FTTP model will have the least risk for the City because it does not entail operational unknowns like a retail service model. Managing agreements with and providing service to end users is generally expensive and unpredictable, and—unlike the dark FTTP model—is not an approach for which the City is already at least partially equipped. Even a wholesale service model carries more risk than a dark FTTP model because there are additional costs and uncertainties associated with maintaining network electronics.

A dark FTTP model is essentially a public works model, in that fiber is simply infrastructure, which the City is already accustomed to managing. This approach allows the City to play to its strengths, and carefully navigate around its potential vulnerabilities (e.g., not having the expertise to successfully market retail service).

If the City determines that a dark FTTP model does not appropriately achieve its goals in the short term, it can opt to pursue a retail service model, where the City becomes the provider and offers services directly to end users. This model carries greater risk for the City because of the marketing, advertising, competition, and customer service components. While it is challenging for a municipality to become a retail service provider, it is not impossible, and the City can choose this path. We recommend this model only if the City finds that it is for some reason unable to pursue a dark FTTP model, or if it is unable to attract a partner to offer services over a City-owned network.

A wholesale service offering is a "middle ground" between a dark FTTP approach and the City becoming a retail service provider. In a wholesale service offering, the City would deploy the FTTP network, and would add network electronics to "light" the fiber. It would then offer "lit services" over the network to one or more ISPs. This model is attractive in that it potentially enables numerous ISPs to offer services. In a dark FTTP model, on the other hand, one provider may control the strands to a location and may or may not offer lit services to a competing provider. The wholesale service offering could potentially help the City achieve open access goals it may have.

4.1.1 Staffing Considerations for Various Business Models

Each of the potential business models we outlined in Section 1.5 requires some additional staffing. Consistent with our assertion that the dark FTTP model entails the least risk for the City, this model requires the lowest investment in additional staff. Similarly, the retail service model requires the greatest investment in additional staff, while the wholesale service model is between these.

For a dark FTTP model, we anticipate that the City will likely need to add 1.5 full time employees (FTEs) in year one, and 2.75 FTEs in year two and beyond. This model requires primarily fiber infrastructure and management staff, with some minimal sales requirements. The "marketing" necessary for this model is restricted to working directly with providers to encourage them to lease access to the City's dark FTTP network.

Table 3: Staffing for Dark FTTP Business Model

New Employees	Year 1	Year 2	Year 3	Year 4	Year 5+
Business Manager	0.50	0.50	0.50	0.50	0.50
GIS	0.50	1.00	1.00	1.00	1.00
Communications - Sales	0.25	0.25	0.25	0.25	0.25
Customer Service Representative	-	-	-	-	-
Service Technicians/Installers & IT Support	-	-	-	-	-
Fiber Plant O&M Technicians	0.25	1.00	1.00	1.00	1.00
Total New Staff	1.5	2.75	2.75	2.75	2.75

Projections for necessary staff increase slightly for a wholesale service model. We anticipate that the City will need to increase staffing by approximately 2.5 FTEs for this model in year one; 4.25 FTEs in years two and three; and 5.25 FTEs in year four and beyond. Because this model requires the City to "light" the fiber by adding network electronics, IT support staff and additional GIS support is added in this model. The sales requirements for this model will be similar to a dark FTTP model: convince private providers to purchase services on the City's network, though in this case providers will purchase "lit" services from the City.

Table 4: Staffing for Wholesale Service Model

New Employees	Year 1	Year 2	Year 3	Year 4	Year 5+
Business Manager	0.50	1.00	1.00	1.00	1.00
GIS	0.50	1.00	1.00	1.00	1.00
Communications - Sales	0.25	0.25	0.25	0.25	0.25
Customer Service Representative	-	-	-	-	-
Service Technicians/Installers & IT Support	1.00	1.00	1.00	2.00	2.00
Fiber Plant O&M Technicians	0.25	1.00	1.00	1.00	1.00
Total New Staff	2.5	4.25	4.25	5.25	5.25

For the retail service model, these numbers increase again because of the addition of a customer service representative. This function is necessary in a retail model, whereas in other models the City will not directly manage or interact with end users. The retail model anticipates a total of 4.75 FTEs in year one, 8 FTEs in years two and three, and 9 FTEs in year four and beyond.

Table 5: Staffing for Retail Service Model

New Employees	Year 1	Year 2	Year 3	Year 4	Year 5+
Business Manager	0.50	1.00	1.00	1.00	1.00
GIS	0.50	1.00	1.00	1.00	1.00
Communications - Sales	0.50	2.00	2.00	2.00	2.00
Customer Service Representative	2.00	2.00	2.00	2.00	2.00
Service Technicians/Installers & IT Support	1.00	1.00	1.00	2.00	2.00
Fiber Plant O&M Technicians	0.25	1.00	1.00	1.00	1.00
Total New Staff	4.75	8	8	9	9

4.2 Fiber Management Requirements

One of the most important steps the City can take is to ensure that it is carefully managing its assets, including conduit and fiber. Whether the City opts to become a retail service provider or simply provide access to its dark FTTP network, fiber strand management on the front end can have enormous benefits over the life of the fiber network, and can save potential confusion and cost in the long run.

Even—or, perhaps, *especially*—if the City contracts out the construction of fiber network, we encourage the City to maintain detailed records of all its fiber strands and their locations. This process is extremely important during the construction phase of the network, and is easiest to carry out during this phase. As construction is underway to build or expand fiber, the City can allocate a staff member or work with a firm to keep track of its fiber usage, which will lay the foundation for ensuring the network's long-term usability and growth.

However, the importance of keeping meticulous records does not cease once the network is fully constructed. On the contrary, it is critically important for all ongoing and additional connections made on the network to be documented. Updates should be made to "as-built" and strand management documentation in real time to avoid making mistakes later, misremembering strand allocations, or simply forgetting important items altogether.

Documenting the network's fibers and strand usage is crucial, and making sure that City staff has unrestricted access to its strand management tools is equally important. Even if the City works with an outside firm to manage this process, we believe that it is a worthwhile investment to appoint at least one staff person who will become knowledgeable about the location of strands on the City's network. Further, using an intuitive and straightforward system and/or software is also key; this will help guard against such critical knowledge being inaccessible to future iterations of City staff and leadership.

4.3 Dig Once Considerations

We recommend that in the coming months, the City consider modifying its ROW ordinance to provide the City with the option of obtaining conduit on routes where utilities are performing excavation. This type of "Dig Once" policy would require any excavation plans fitting specified criteria to include municipal use conduit or fiber, unless the City opts out of the excavation project. This would require the installation of City communications infrastructure in excavation projects where the City determines that it is both financially feasible and consistent with the municipality's long-term goals to develop the communications infrastructure.

Such a policy can reduce the cost of the conduit to the City by 25 percent to 75 percent relative to the cost of a standalone construction project if it installs or has conduit installed in coordination with other excavation. A Dig Once approach can also reduce the impact on ROW and inconvenience to the public.

4.3.1 The Case for Dig Once Policies

The construction of fiber optic communications cables is a costly, complex, and time-consuming process. The high cost of construction is a barrier to entry for potential broadband communications providers. In addition, available space is diminishing in the public ROW. Moreover, cutting roads and sidewalks substantially reduces the lifetime and performance of those surfaces.

Accordingly, encouraging or requiring simultaneous construction and co-location of facilities in the public ROW will reduce the long-term cost of building communications facilities. This is because there are significant economies of scale through:

1. Coordination of construction with road construction and other disruptive activities in the public ROW.
2. Construction of spare conduit capacity where multiple service providers or entities may require infrastructure.

The reason that these economies are available is primarily because fiber optic cables and installation materials alone are relatively inexpensive, often contributing to less than one-quarter of the total cost of new construction. While material costs typically fall well below $40,000 per mile (even for large cables containing hundreds of fiber strands), labor, permitting, and engineering costs commonly drive the total price toward $200,000 per mile if conducted as a stand-alone project.

Moreover, as the ROW becomes more crowded with communications infrastructure and other utilities, the cost of new construction can grow rapidly. In general, however, it is in the best interests of both public and private entities for the public sector to identify construction collaboration opportunities that share the burden of expensive and duplicative labor-related costs and efficiently use physical space in the ROW.

If fiber construction is coordinated with a major road or utility project that is already disrupting the ROW in a rural area, the cost of constructing the fiber, communications conduit, and other materials can range from $10,000 per mile up. However, if fiber construction is completed as part of a separate stand-alone project, the cost of constructing fiber and communications conduit can range from $95,000 to $200,000 per mile and even higher in complex urban environments.

There are numerous methods for constructing fiber optic infrastructure. Underground construction using protective conduits generally provides the most scalable, flexible, and durable method for developing long-term communications infrastructure, but is also typically more expensive than aerial construction methods requiring attachments to utility poles. Underground construction can be preferable despite the cost because of the limit in the quantity of cables and attachments that can be placed on existing utility poles in more crowded areas, and because aerial construction is more exposed and vulnerable to outside conditions.

Banks of conduits constructed simultaneously or large conduits segmented with innerduct, provide multiple pathways for the installation of multiple fiber optic cables located in close

proximity, with the ability to remove, add, or replace fiber optic cables without disturbing neighboring cables.

Conversely, multiple conduits installed at different times must be physically spaced, often by several feet, to prevent damage to one while installing the next. Once the ROW becomes crowded, often the choices of construction methods are reduced, leaving only less desirable methods and more costly locations for construction of additional infrastructure.

Some of the key savings achieved through coordinated construction efforts include:

- Incremental labor and material costs, through reduced crew mobilization expenses and larger bulk material purchases
- Trenching or boring costs, particularly when coordination enables lower-cost methods (e.g., trenching as opposed to boring) or allows multiple entities to share a common trench or bore for their independent purposes
- Traffic control and safety personnel costs, particularly when constructing along roadways requiring lane closures
- Engineering and survey costs associated with locating existing utilities and specifying the placement of new facilities
- Engineering and survey costs associated with environmental impact studies and approvals
- Lease fees for access to private easements, such as those owned by electric utilities
- Railroad crossing permit fees and engineering
- Restoration to the ROW or roadway, particularly in conjunction with roadway improvements
- Bridge crossing permit fees and engineering

4.3.2 Coordinating Conduit Construction with Other Utility Projects Reduces Costs

Where other types of construction are occurring within or along the ROW, such as road construction or resurfacing, roadway widening, sidewalk repairs, bridge construction, and water or gas main installation, there is an opportunity to place telecommunications infrastructure at an overall reduced cost and with reduced disruption to public ROW.

4.3.3 Standard Specification

The challenge in developing a standard specification for a Dig Once project is to incorporate the requirements of known and unknown users, and to provide sufficient capacity and capability without excessive costs.

We considered the following factors in developing a conduit specification:

1. Capacity—sufficient conduit needs to be installed, and that conduit needs to have sufficient internal diameter, to accommodate future users' cables and to be segmented to enable conduit to be shared or cables added at a future date
2. Segmentation—users need to have the appropriate level of separation from each other for commercial, security, or operational reasons
3. Access—vaults and handholes need to be placed to provide access to conduit and the ability to pull fiber. Vaults need to be spaced to minimize the cost of extending conduit to buildings and other facilities that may be served by fiber
4. Costs—materials beyond those that are likely to be needed will add cost, as will the incremental labor to construct them. Beyond a certain point, trenches need to be widened or deepened to accommodate conduit
5. Robustness—the materials, construction standards, and placement need to reasonably protect the users' fiber, and not unduly complicate maintenance and repairs
6. Architecture—sweeps, bend radius, and vault sizes need to be appropriate for all potential sizes of fiber

We recommend further discussions with private carriers to better develop a specification. It may be appropriate to have a different specification for different projects. Based on our knowledge of similar efforts in other cities, and our analysis, we believe the following standardized approach is suitable for major corridors and can be modified as discussions continue with excavators in the rights-of-way:

- Four two-inch conduit, minimum SDR 11 High-density polyethylene (HDPE), each of a separate color or unique striping to simplify identification of conduits within vaults and between vaults, in the event conduit must be accessed or repaired at intermediate points. Conduit count can be reduced if the Industrial Corridor is assessed not to justify the capacity.
- Composite anti-theft vaults having dimensions of 30" x 48" x 36" (W x L x D), placed in the sidewalk or available green space within the city or municipality ROW, as close to the curb or gutter as possible.
- Vaults spaced at intervals of 600 feet or less, typically at the intersection of a city or municipality block.
- Sweeping conduit bends with a minimum radius of 36 inches to allow cable to be pulled without exceeding pull-tension thresholds when placing high-count fiber cables (e.g., 864-count).
- Conduit placed in the same trench directly above the excavator's infrastructure or, where this is not possible, placed with minimum horizontal offset, to minimize cost.

It is important to note that the proposed approach is designed to create consistency and predictability in costs and deployment and is a necessary compromise among the potential users. If an excavation project has a long-time horizon and sufficient budget, it is possible to customize the Dig Once build, potentially adding conduit or adding vaults at particular locations. This plan provides a baseline approach.

The approach is a compromise among different types of users of conduit constructed under *dig once*. Some users might prefer larger conduit for consistency with earlier builds. Others sought a larger count of smaller conduit, to provide more flexibility and the capability for more providers to participate with smaller cable counts.

Two-inch conduit has become a standard size for a wide range of construction projects, and can support the widest range of use cases. A single two-inch conduit can accommodate a range of multi-cable configurations, while retaining recommended fill ratios, allowing a single user to serve its backbone and "lateral"/access cable requirements with a single, dedicated conduit. A few example cable configurations supported by a single two-inch conduit, which are not supported by smaller conduit, include:

- Two medium backbone cables (e.g., 144-strand to 288-strand cables) and one smaller "feeder" cable (e.g., 24-strand cable);
- Large backbone cable (e.g., 864-strand) and two or more smaller feeder cables; or
- Three medium backbone cables.

Compared to placing fewer, larger conduits segmented with innerduct, this approach provides greater opportunity for individual conduit to be intercepted and routed for future vault installation by a particular user. Additionally, two-inch conduit is substantially cheaper to install and physically more flexible than larger varieties, offering more options to route around existing utilities and other obstructions. Placing four conduit will provide a standard allotment of one or two conduit for State or municipality use and provide capacity for other use and for spares.

We recommend SDR 11 HDPE in all cases except where conduit is exposed to the elements (for example, as a riser to building entry), or under extreme levels of pressure (such as under a train or trolley track). SDR 11 HDPE designs will generally support standard highway and railway loads with less than 1 percent deflection when buried with two feet of cover.

5 Proposed Fiber Design

5.1 Construction Methodology

Our analysis assumes underground construction will consist primarily of horizontal, directional drilling to minimize ROW impact and to provide greater flexibility to navigate around other utilities. There are a variety of methods for underground construction, including plowing, trenching, directional boring, and microtrenching.

Plowing is generally the cheapest construction method, and is performed in unpaved areas where little subsurface rock is present, and the fiber route maintains a straight path (e.g., along a highway). The plowing machine pushes away dirt, inserts conduit and covers the conduit with the backfill.

Trenching is similar to plowing in that a narrow hole is dug and conduit is laid and the bottom of the trench, and is then covered with backfill. Unlike plowing, trenching can be performed in most situations but may not be cost-effective when expensive restoration is required to return the streets or rights-of-way to their original (i.e., pre-installation) condition.

Directional Boring is a process in which conduit is placed by drilling horizontally underground without disturbing the surface. The boring machine pushes a long drill that displaces the dirt underground so that a conduit can be installed. The direction and depth of the directional bore can be altered to navigate around other existing utilities. Directional boring is ideal in situations where trenching is not feasible, such as stream and railroad crossings.

Microtrenching uses a specialized saw blade to cut a small trench about a foot deep into the road or sidewalk subsurface. Very tiny conduit is inserted and covered with backfill, and the cut or “microtrench” is then sealed. Specialized fiber is then blown through the conduit system. Microtrenching is best suited for areas where the cost to perform surface restoration is high and roadway construction is not anticipated.

Underground construction costs are subject to uncertainty related to utilities congestion in the public rights-of-way, and the prevalence of subsurface hard rock—neither of which can be fully mitigated without physical excavation and/or testing. Surface restoration requirements can also greatly impact the cost of underground construction. For, example unpaved land is far less expensive to restore than cobblestone streets.

This analysis estimated costs for underground infrastructure placement using available unit-cost data for materials and estimates on the labor costs for placing, pulling, and boring fiber based on construction in comparable markets.

5.2 Overview of Existing Assets

We compiled an inventory of Hayward's current and planned broadband assets, data, and related information. During the process, the City provided documentation of its fiber and conduit. At the City's request, we focused on how the City's assets could be leveraged for future plans, relying on existing documentation rather than performing new surveys and condition assessments. To complete our assessment, we requested several pieces of GIS data from the City, including:

1. Political boundaries
2. Hydro layers (rivers, wetlands, etc.)
3. Rights-of-way/property Lines
4. Street centerlines
5. Street polygons
6. Sidewalk/parking lot polygons
7. Address points
8. Building polygons
9. City facilities
10. Parks and green spaces
11. Existing conduit and fiber
12. Existing assets
13. Huts
14. Water towers
15. Special development areas
16. Any other utility information

We discussed with the City any known plans for constructing fiber and conduit in the future, including:

1. Planned public works projects
2. Current and planned construction by private contractors, utilities, and others

We note that this type of investigation aligns with our longstanding guidance to municipal clients to take advantage of public or private sector construction that creates an opportunity to install City-owned conduit or fiber.

5.2.1 City Conduit and Fiber

Based on the City's GIS data, the City constructed and operates 14.1 miles of fiber and 13.6 miles of conduit. Approximately nine miles of the infrastructure is a U-shaped core fiber path made up of 60-strand cables, which run along Hesperian Boulevard, Mission Boulevard, and Winton Avenue. In addition, a 48-count cable extends north of Winton Avenue on Hesperian

Boulevard, and 24-strand cables extend along Harder Road from Mission Boulevard to Tarman. 24-strand cables extend the Winton Avenue fiber west of Hesperian Boulevard and down Clawiter Road. There is fiber on Enterprise Avenue from Clawiter Road to a water treatment plant. The City also expects to install fiber as part of a project related to California State Route 238, south of Industrial and north of A Street, along Mission Boulevard.

The City's conduit follows much of the same path, including lateral extensions into City Hall, Fire Stations 1 and 4, Hayward Executive Airport, and the Water Pollution Control Facility. Based on conversations with City engineers, most of the existing conduit is 2 inches in diameter with notable exceptions of the conduit along Hesperian Boulevard between Panama Street and Industrial Boulevard, which is 1.5 inches in diameter, and the newer conduit along Mission Boulevard, which is 2.5 inches in diameter.

Vaults, or pull boxes, are generally located every 500 to 600 feet along the fiber path. City engineers indicated that, with some exceptions, pull boxes along Hesperian Boulevard, Harder Road, Clawiter Road, and Mission Boulevard are generally in good condition. Pull boxes along Winton Avenue require some repair work, and fiber along Hesperian Boulevard from Fire Station 4 to Winton Avenue should be further evaluated. Most of the conduit only contains one cable, which means there is room for future additions. City staff reports that the fiber is primarily used for traffic and fire station communications.

Based on our discussions with the City, there is not innerduct or pull cables in this conduit. Standards for fiber and conduit construction have largely been determined by individual contractors hired by the City. It is our understanding that the City is developing a construction standard for future projects.

An additional 27 miles of planned fiber and conduit construction will expand the City's fiber backbone and allow for future expansion in new areas, including multiple paths through the City's Industrial Corridor. In addition to expanding the reach of the City's core loop, the additional fiber will create several loop structures that will allow for redundant connections over diverse physical paths. The proposed fiber also includes connections to Fire Station 3, Weekes Branch Library, and the Hayward Area Recreation & Park District office as well as a loop through the California State University (CSU) East Bay campus. The new fiber would also pass several other community institutions, including schools, parks, and hospitals. The existing conduit and fiber routes are shown alongside proposed future routes in Figure 3 and Figure 4.

Figure 3: Existing and Proposed City-Constructed Infrastructure

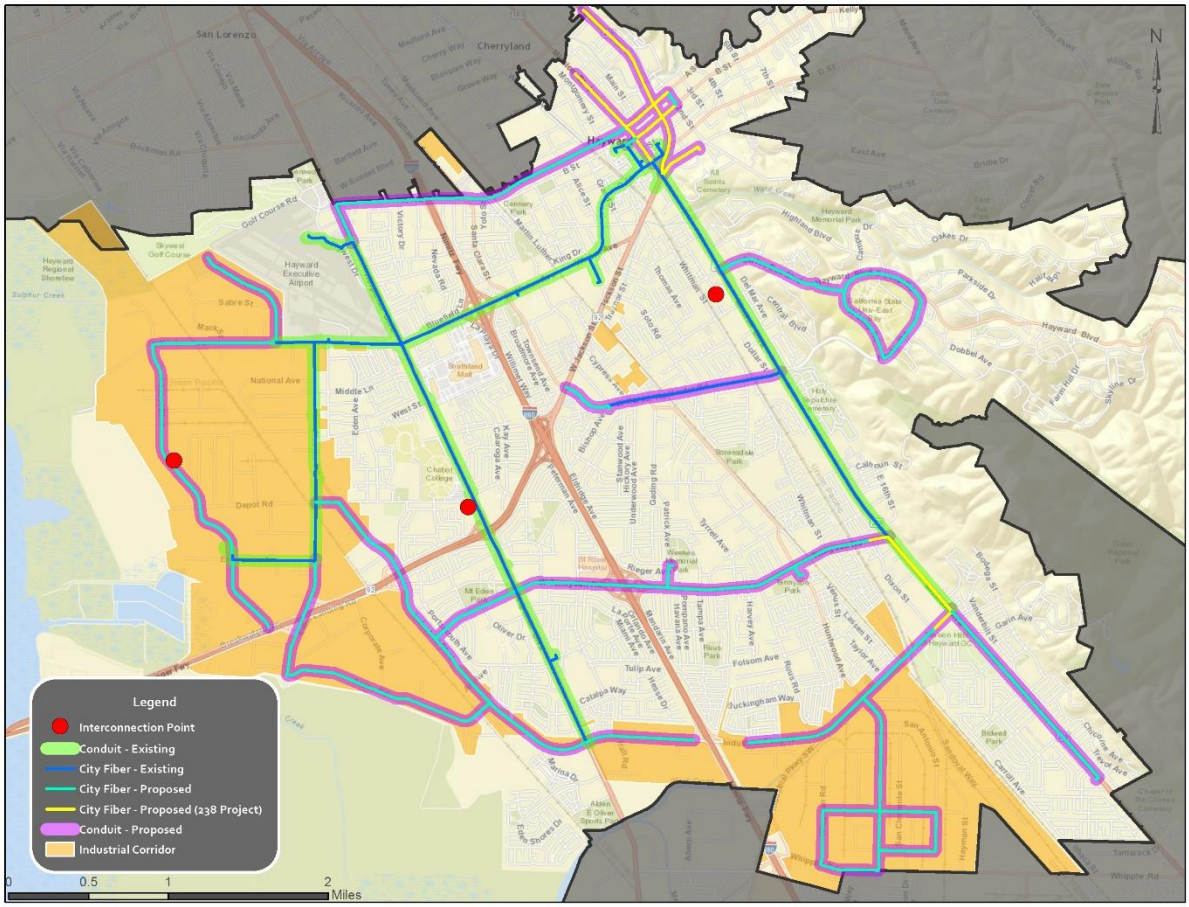
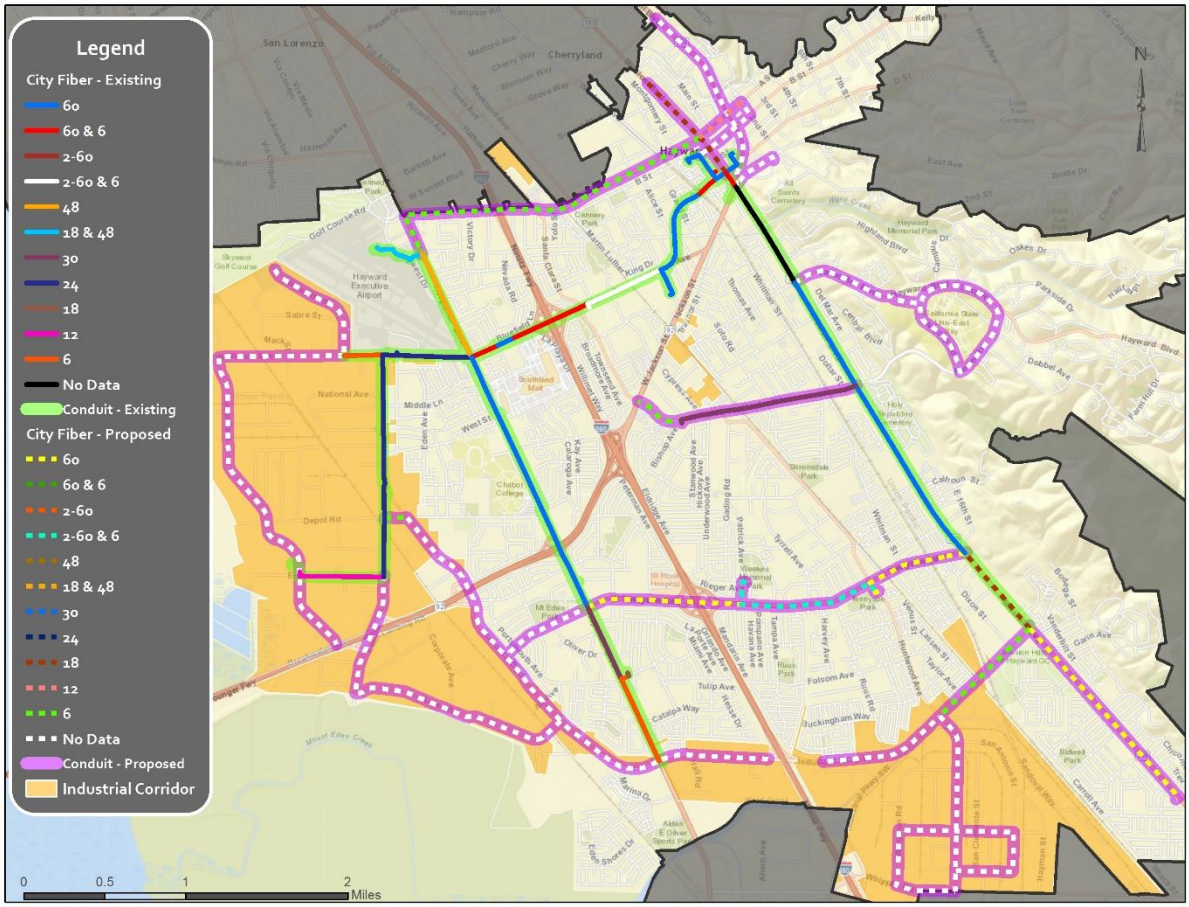


Figure 4: Existing and Proposed City-Constructed Fiber by Strand Count



During our review of the City's records, City staff reported that the City does not currently maintain records of fiber assignment, fiber use, and splice matrices, and that available GIS data does not necessarily include all the City's assets. We recommend that, going forward, the City include fiber assignment and splice matrices in its documentation efforts as this will aid in troubleshooting, future construction, and allocation of fiber strands.

5.3 Leverage Existing Assets

The existing conduit and fiber assets provide a starting point from which the City can expand. The proposed fiber builds will increase the resiliency of the network and allow the City to reach new key areas and institutions such as the Industrial Corridor. The existing strand counts, however, may not be sufficient for future needs.

If the City desires to significantly expand its fiber service, it should examine its current and future fiber needs and use strand counts that accommodate those needs plus those of potential external fiber users in new construction. Where higher strand counts are not available, new

cables can be pulled into the existing conduit if sufficient space is available. Where space is not available, new cables can replace the smaller cable to provide enhanced fiber counts along routes.

Future public works projects should also be leveraged to expand the City's conduit and fiber network. Projects such as utility replacements, road widenings, and other major capital improvements may provide the opportunity to install conduit and fiber optics without the need for surface restoration. A coordinated Dig Once ordinance, which typically requires the installation of City-owned communications infrastructure in excavation projects where the City has determined that it is both financially feasible and consistent with the City's long-term goals, is recommended to leverage these types of public and private excavation projects.

There may also be opportunities for the City to engage further with private partners to serve the Industrial Corridor. The City could, for example, provide transport for service providers that need to reach existing and potential customers as well as strategic peering points such as Internet POPs or data centers in another part of the City. The City may offer conduit to reduce construction costs to the Industrial Corridor—however, as we noted above, we do not recommend this approach.

We have identified three potential connection points within the City:

1. 25070 O'Neil Avenue
2. 21350 Cabot Boulevard[21]
3. 1880 Depot Road

The O'Neil Avenue location is an Internet POP where the City may be able to interconnect with other national and regional networks including Zayo. This POP is close to Route 238 where the City is planning to construct new fiber. The City may be able to arrange for connectivity at this site and include it in the Route 238 project construction so that it may offer transport or use the connectivity for its own purposes.

The Cabot Boulevard location is a Verizon data center approximately 1 mile west of the City's conduit along Clawiter Road.

The Depot Road location is an incumbent local exchange carrier (ILEC) central office, located next to the City's fiber and conduit along Hesperian Boulevard. If it is determined that interconnection services are available at this location, the City may want to take advantage of its proximity to existing fiber.

[21] https://fiberlocator.com, accessed June 2016.

5.4 Conceptual Design and Specifications – Industrial Technology & Innovation Corridor

OSP (layer 1, also referred to as the physical layer) is both the most expensive part of the network and the longest lasting. The architecture of the physical plant determines the network's scalability for future uses and how the plant will need to be operated and maintained; the architecture is also the main determinant of the total cost of the deployment.

Figure 5 (below) shows a logical representation of the high-level FTTP network architecture we recommend for deployment to the Industrial Corridor. This design is open to a variety of architecture options. The figure illustrates the primary functional components in the FTTP network, their relative position to one another, and the flexibility of the architecture to support multiple subscriber models and classes of service.

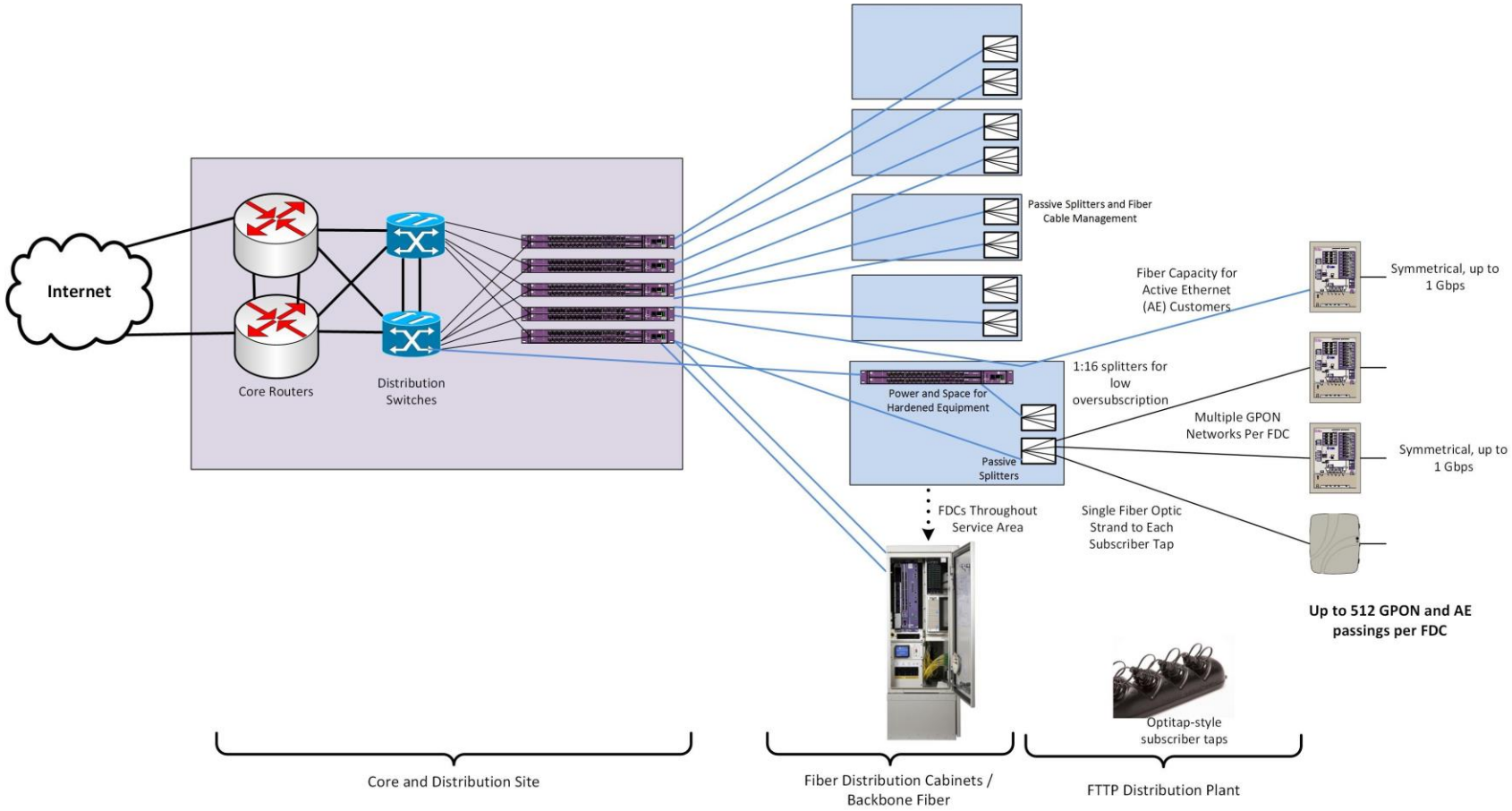
The recommended architecture is a hierarchical data network that provides critical scalability and flexibility, both in terms of initial network deployment and its ability to accommodate the increased demands of future applications and technologies. The characteristics of this hierarchical FTTP data network are:

- Capacity – ability to provide efficient transport for subscriber data, even at peak levels
- Availability – high levels of redundancy, reliability, and resiliency; ability to quickly detect faults and re-route traffic
- Diversity – physical path diversity to minimize operational impact resulting from fiber or equipment failure
- Efficiency – no traffic bottlenecks; efficient use of resources
- Scalability – ability to grow in terms of physical service area and increased data capacity, and to integrate newer technologies
- Manageability – simplified provisioning and management of subscribers and services
- Flexibility – ability to provide different levels and classes of service to different customer environments; can support an open access network or a single-provider network; can provide separation between service providers on the physical layer (separate fibers) or logical layer (separate virtual local area network (VLAN or VPN)
- Security – controlled physical access to all equipment and facilities, plus network access control to devices

This architecture offers scalability to meet long-term needs. It is consistent with best practices for an open access network model that might potentially be required to support multiple network operators, or at least multiple retail service providers requiring dedicated connections to certain customers. This design would support a combination of Gigabit passive optical network (GPON) and direct Active Ethernet (AE) services (with the addition of electronics at the Fiber Distribution Cabinets (FDCs)), which would enable the network to scale by migrating to direct connections to each customer, or reducing splitter ratios, on an as-needed basis.

The design assumes placement of manufacturer-terminated fiber tap enclosures within the ROW or easements, providing water-tight fiber connectors for customer service drop cables and eliminating the need for service installers to perform splices in the field. This is an industry-standard approach to reducing both customer activation times and the potential for damage to distribution cables and splices. The model also assumes the termination of standard lateral fiber connections within larger multi-tenant business locations.

Figure 5: High-Level FTTP Architecture



5.4.1 Network Design

The network design and cost estimates assume the City will:

- Use existing fiber and conduit to connect to an Internet POP in the City;
- Procure space at the POP to host network electronics and provide backhaul to the Internet;
- Use existing City land or ROW space in the Industrial Corridor to locate the core and distribution hub facility with adequate environmental and backup power systems to house network electronics;
- Construct fiber to connect the hub to the FDCs;
- Construct fiber optics from the FDCs to each business (i.e., from termination panels in the FDC to tap locations in the ROW or on City easements); and
- Construct fiber laterals into large, multi-tenant business facilities.

Leveraging the City's existing conduit and fiber resources could decrease the costs associated with both constructing a backbone and identifying locations to house electronics that are near the City's existing resources.

The FTTP network and service areas were defined based on the following criteria:

- Targeting 512 passings per FDC;
- FDCs suitable to support hardened network electronics, providing backup power and an active heat exchange;[22] and
- Avoiding the need for distribution plant to cross major roadways and railways.

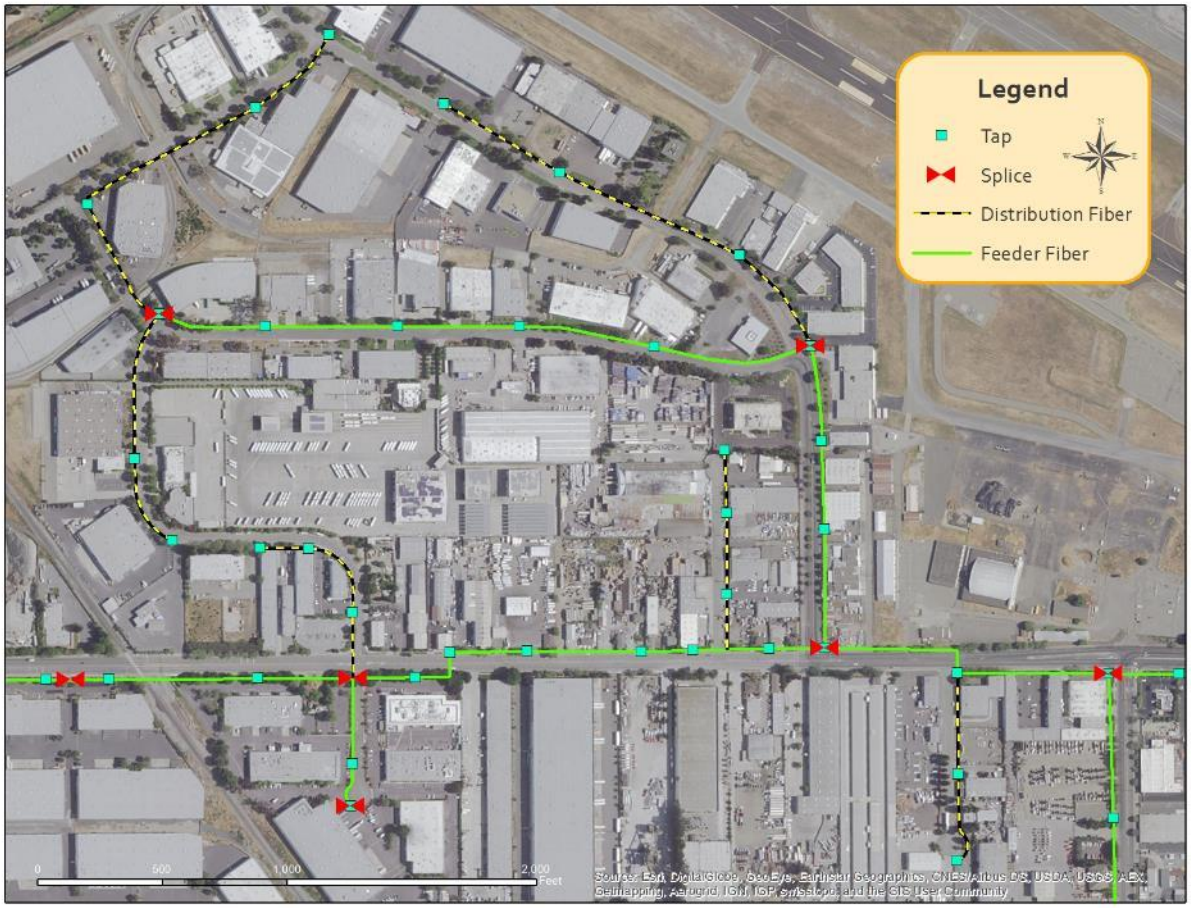
Coupled with an appropriate network electronics configuration, this fiber design serves to greatly increase the reliability of services provided to customers as compared to that of more traditional cable and telephone networks.

The access layer of the network, which encompasses the fiber plant from the FDCs to the customers, dedicates a single fiber strand from the FDC to each passing (i.e., potential customer

[22] These hardened FDCs reflect an assumption that the City's operational and business model will require the installation of provider electronics in the FDCs that can support open access among multiple providers. We note that the overall FTTP cost estimate would decrease if the hardened FDCs were replaced with passive FDCs (which would house only optical splitters) and the providers' electronics were housed only at hub locations.

address). This traditional FTTP design allows either network electronics or optical splitters in the FDCs. See Figure 6 below for a sample design.

Figure 6: Detail Showing FTTP Access Layer Design



This architecture offers scalability to meet long-term needs. It is consistent with best practices for an open access network model that might potentially be required to support multiple network operators, or at least multiple retail service providers requiring dedicated connections to certain customers.

5.4.2 Network Core and Hub Site

The core site is the bridge that links the FTTP network to the public Internet and deliver all services to end users. The proposed network design includes a single core location given the size of the network. However, if consumer demand dictates it, a second Internet POP could be added to increase redundancy to the network.

For the cost estimate, we assumed that the core site electronics would be collocated with the distribution electronics in the Industrial Corridor hub with connectivity to the Internet POP at 25070 O'Neil Avenue.

The core will also house the providers' Operational Support Systems (OSS) such as provisioning platforms, fault and performance management systems, remote access, and other operational support systems for FTTP operations. The core location is also where any business partner or content / service providers will gain access to the subscriber network with their own POP. This may be via remote connection, but collocation is recommended.

The core network electronics run in a High Availability (HA) configuration, with fully meshed and redundant uplinks to the public Internet and/or all other content and service providers. It is imperative that core network locations are physically secure and allow unencumbered access 24x7x365 to authorized engineering and operational staff.

The operational environment of the network core and hub locations is similar to that of a data center. This includes clean power sources, UPS batteries, and diesel power generation for survival through sustained commercial outages. The facility must provide strong physical security, limited/controlled access, and environmental controls for humidity and temperature. Fire suppression is highly recommended.

Equipment is to be mounted securely in racks and cabinets, in compliance with national, state, and local codes. Equipment power requirements and specification may include -48-volt DC and/or 120/240 volts AC. All equipment is to be connected to conditioned / protected clean power with uninterrupted cutover to battery and generation.

For the cost estimate, we assumed that the core and distribution hub will be located on existing City land within the Industrial Corridor.

5.4.3 Distribution and Access Network Design

The distribution network is the layer between the hub and the FDCs, which provide the access links to the taps. The distribution network aggregates traffic from the FDCs to the core. Fiber cuts and equipment failures have progressively greater operational impact as they happen closer to the network core, so it is critical to build in redundancies and physical path diversities in the distribution network, and to seamlessly re-route traffic when necessary.

The distribution and access network design proposed in this report is flexible and scalable enough to support two different architectures:

1. Housing both the distribution and access network electronics at the hub, and using only passive devices (optical splitters and patches) at the FDCs; or

2. Housing the distribution network electronics at the hub and pushing the access network electronics further into the network by housing them at the FDCs.

By housing all electronics at the hub, the network will not require power at the FDCs. Choosing a network design that only supports this architecture may reduce costs by allowing smaller, passive FDCs in the field. However, this architecture will limit the redundancy capability from the FDCs to the hub.

By pushing the network electronics further into the field, the network gains added redundancy by allowing the access electronics to connect to two distribution switches. In the event one distribution switch has an outage the subscribers connected to the FDC would still have network access via the other distribution switch. Choosing a network design that only supports this architecture may reduce costs by reducing the size of the hub.

Selecting a design that supports both models would allow the City to accommodate many different service operators and their network designs. This design would also allow service providers to start with a small deployment (i.e., placing electronics only at the hub site) and grow by pushing electronics closer to their subscribers.

5.4.3.1 Access Network Technologies

FDCs can sit on a curb, be mounted on a pole, or reside in a building. Our model recommends installing sufficient FDCs to support higher than anticipated levels of subscriber penetration. This approach will accommodate future subscriber growth with minimal re-engineering. Passive optical splitters are modular and can be added to an existing FDC as required to support subscriber growth, or to accommodate unanticipated changes to the fiber distribution network with potential future technologies.

Our FTTP design also includes the placement of indoor FDCs and splitters to support large-tenant businesses. This would require obtaining the right to access the equipment for repairs and installation in whatever timeframe is required by the service agreements with the customers. Lack of access would potentially limit the ability to perform repairs after normal business hours, which could be problematic for commercial services.

In this model, we assume the use of GPON electronics for most subscribers and Active Ethernet for a small percentage of subscribers (typically large business customers) that request a

premium service or require greater bandwidth. GPON is the most commonly provisioned FTTP service—used, for example, by Verizon (in its FiOS systems), Google Fiber, and Chattanooga EPB.

Furthermore, providers of gigabit services typically provide these services on GPON platforms. Even though the GPON platform is limited to 1.2 Gbps upstream and 2.4 Gbps downstream for the subscribers connected to a single PON, operators have found that the variations in actual subscriber usage generally means that all subscribers can obtain 1 Gbps on demand (without provisioned rate-limiting), even if the capacity is aggregated at the PON. Furthermore, many GPON manufacturers have a development roadmap to 10 Gbps and faster speeds as user demand increases.

GPON supports high-speed broadband data, and is easily leveraged by triple-play carriers for voice, video, and data services. The GPON OLT uses single-fiber (bi-directional) SFP modules to support multiple (most commonly less than 32) subscribers.

GPON uses passive optical splitting, which is performed inside FDC, to connect fiber from the OLTs to the customer premises. The FDCs house multiple optical splitters, each of which splits the fiber link to the OLT between 16 to 32 customers (in the case of GPON service).

AE provides a symmetrical (up/down) service that is commonly referred to as Symmetrical Gigabit Ethernet. AE can be provisioned to run at sub-gigabit speeds, and like GPON easily supports legacy voice, voice over IP, and video. AE is typically deployed for customers who require specific service level agreements that are easier to manage and maintain on a dedicated service.

For subscribers receiving Active Ethernet service, a single dedicated fiber goes directly to the subscriber premises with no splitting. Because AE requires dedicated fiber (home run) from the OLT to the CPE, and because each subscriber uses a dedicated SFP on the OLT, there is significant cost differential in provisioning an AE subscriber versus a GPON subscriber.

Our fiber plant is designed to provide Active Ethernet service or PON service to all passings. The network operator selects electronics based on the mix of services it plans to offer and can modify or upgrade electronics to change the mix of services.

5.4.3.2 Expanding the Access Network Bandwidth

GPON is currently the most commonly provisioned FTTP technology, due to inherent economies when compared with technologies delivered over home-run fiber[23] such as Active Ethernet. The cost differential between constructing an entire network using GPON and Active Ethernet is 40

[23] Home run fiber is a fiber optic architecture where individual fiber strands are extended from the distribution sites to the premises. Home run fiber does not use any intermediary aggregation points in the field.

percent to 50 percent.[24] GPON is used to provide services up to 1 Gbps per subscriber and is part of an evolution path to higher-speed technologies that use higher-speed optics and wave-division multiplexing.

This model provides many options for scaling capacity, which can be done separately or in parallel:

1. Reducing the number of premises in a PON segment by modifying the splitter assignment and adding optics. For example, by reducing the split from 16:1 to 4:1, the per-user capacity in the access portion of the network is quadrupled.

2. Adding higher speed PON protocols can be accomplished by adding electronics at the FDC or hub locations. Since these use different frequencies than the GPON electronics, none of the other CPE would need to be replaced.

3. Adding WDM-PON electronics as they become widely available. This will enable each user to have the same capacity as an entire PON. Again, these use different frequencies than GPON and are not expected to require replacement of legacy CPE equipment.

4. Option 1 could be taken to the maximum, and PON replaced by a 1:1 connection to electronics—an Active Ethernet configuration.

These upgrades would all require complementary upgrades in the backbone and distribution Ethernet electronics, as well as in the upstream Internet connections and peering—but they would not require increased fiber construction.

5.4.3.3 Customer Premises Equipment (CPE) and Subscriber Services

In the final segment of the FTTP network, fiber runs from the FDC to customers' buildings, where it terminates at the subscriber tap—a fiber optic housing located in the ROW closest to the premises. The service installer uses a pre-connectorized drop cable to connect the tap to the subscriber premises without the need for fiber optic splicing.

The drop cable extends from the subscriber tap (in a handhole underground) to the building, enters the building, and connects to CPEs.

[24] "Enhanced Communications in San Francisco: Phase II Feasibility Study," CTC report, October 2009, at p. 205.

6 Cost Estimate – Industrial Technology & Innovation Corridor

The City recognizes the importance of deploying a robust, scalable FTTP network infrastructure that can support a wide range of applications and services. At the City's request, CTC prepared a high-level network design and cost estimate for deploying a gigabit FTTP network in the City's Industrial Corridor. The FTTP network will promote economic development in the Industrial Corridor where businesses traditionally have limited options for telecommunication services.

The CTC cost estimate provides data relevant to assessing the financial viability of network deployment, and to developing a business model for a potential City construction effort (including the full range of models for public–private partnerships). This estimate will also enable financial modeling to determine the approximate revenue levels necessary for the City to service any debt incurred in building the network.

The CTC design and cost estimate are underpinned by data and insight gathered by CTC engineers through several related steps, including discussions with City stakeholders and an extensive field and desk survey of candidate fiber routes.

The descriptions in this document are highly technical and make use of acronyms. We have included a glossary as Appendix A.

6.1 FTTP Cost Estimate Summary

Based on these inputs and other guidance from the City, we developed a conceptual, high-level FTTP design that reflects the City's goals and is open to a variety of architecture options. From this design, we present two cost examples.

The first is the cost to deploy FTTP infrastructure, all electronics, service drops to the consumer, and CPEs. This estimate shows the total capital costs—which would be incurred by the City, or the City and its partner(s)—to build an FTTP network to support a ubiquitous 1 Gbps data-only service. This is the capital cost the City would occur if it pursued a wholesale or retail model.

The second cost estimate example is the cost to deploy *only* the FTTP OSP infrastructure—consistent with the dark FTTP model, as described in Section 1.5.1. This is the total capital cost for the City to build a dark FTTP network for lease to a private partner.

6.1.1 FTTP Cost Estimate (Fiber and Electronics) – Wholesale and Retail Models

This Industrial Corridor FTTP network deployment will cost approximately $8.5 million, inclusive of OSP construction labor, materials, engineering, permitting, network electronics, drop installation, CPEs, and testing.[25]

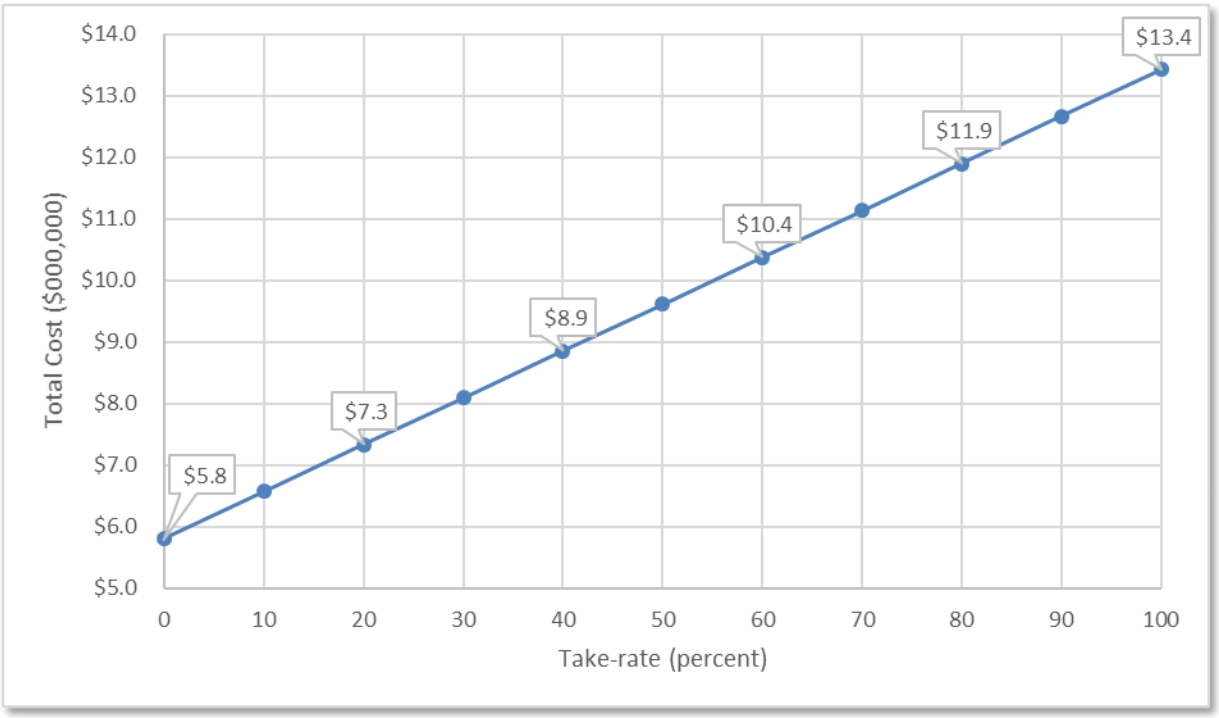
[25] The estimated total cost breakdown assumes a percentage of businesses that subscribe to the service, otherwise known as the penetration rate or the "take rate," of 35 percent.

Table 6: Breakdown of Estimated Total Cost

Cost Component	Total Estimated Cost
OSP	$5.2 million
Central Network Electronics	0.6 million
FTTP Service Drop and Lateral Installations	2.1 million
CPE	0.6 million
Total Estimated Cost:	$8.5 million

Figure 7 shows the change in total estimated cost by varying the expected take rate.

Figure 7: Total Estimated Cost versus Take Rate



The cost is roughly linear by take rate as the per-subscriber cost of adding additional subscribers is constant.

Actual costs may vary due to unknown factors, including: 1) costs of private easements, 2) congestion in the public ROW, 3) variations in labor and material costs, 4) subsurface hard rock, and 5) the City's operational and business model (including the percentage of businesses who subscribe to the service, otherwise known as the penetration rate or the "take rate"). We have incorporated suitable assumptions to address these items based on our experiences in similar markets.

The total estimated technical operating costs for this model are outlined in Section 6.5 (not including non-technical operating costs such as marketing, legal services, and financing costs). The total cost of operations will vary with the business model chosen and the level of existing resources that can be leveraged by the City and any potential business partners.

6.1.2 FTTP Only Cost Estimate (No Electronics, Drops, or CPEs) – Dark FTTP Model

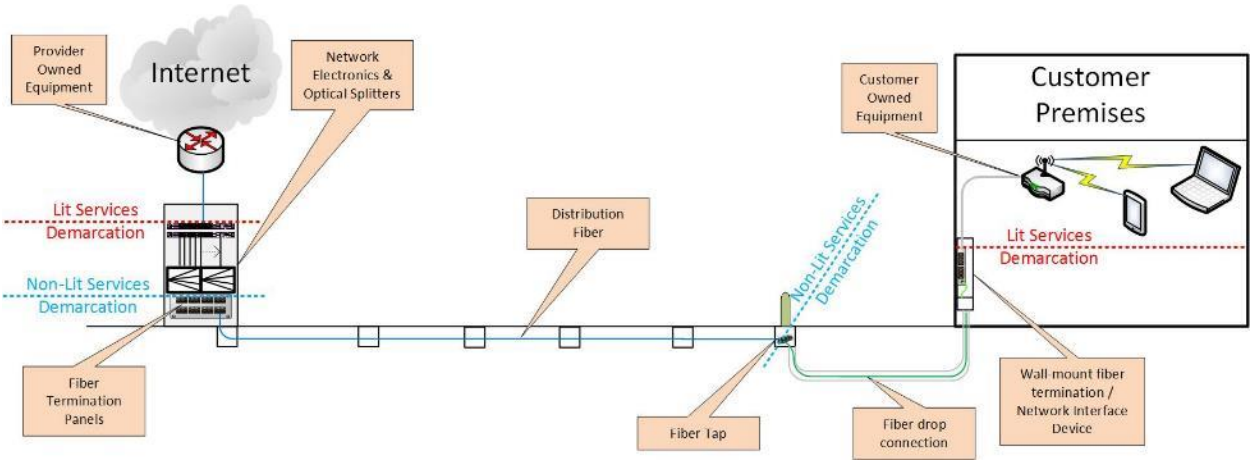
This Industrial Corridor dark FTTP network deployment will cost more than $5.4 million, inclusive of OSP construction labor, materials, engineering, and permitting. This estimate does not include any electronics, subscriber equipment, or drops.

Table 7: Breakdown of Estimated Dark FTTP Model Cost

Cost Component	Total Estimated Cost
OSP Engineering	$0.5 million
Quality Control/Quality Assurance	0.2 million
General OSP Construction Cost	3.2 million
Special Crossings	0.7 million
Backbone and Distribution Plant Splicing	0.1 million
Backbone Hub, Termination, and Testing	0.5 million
FTTP Lateral Installations	0.2 million
Total Estimated Cost:	$5.4 million

This estimate assumes that the City constructs and owns the FTTP infrastructure up to a demarcation point at the optical tap near each business, and leases the dark fiber backbone and distribution fiber to a private partner. The private partner would be responsible for all network electronics, fiber drops to subscribers, and CPEs—as well as network sales, marketing, and operations.

Figure 8: Demarcation Between City and Partner Network Elements



6.2 Cost Estimate Breakdown

The cost components for OSP construction include the following tasks:

- ***Engineering*** – includes system level architecture planning, preliminary designs and field walk-outs to determine candidate fiber routing; development of detailed engineering prints and preparation of permit applications; and post-construction "as-built" revisions to engineering design materials.

- ***Quality Control / Quality Assurance*** – includes expert quality assurance field review of final construction for acceptance.

- ***General Outside Plant Construction*** – consists of all labor and materials related to "typical" underground outside plant construction, including conduit placement, fiber installation, and surface restoration; includes all work area protection and traffic control measures inherent to all roadway construction activities.

- ***Special Crossings*** – consists of specialized engineering, permitting, and incremental construction (material and labor) costs associated with crossings of railroads, bridges, and interstate / controlled access highways.

- ***Backbone and Distribution Plant Splicing*** – includes all labor related to fiber splicing of outdoor fiber optic cables.

- ***Backbone Hub, Termination, and Testing*** – consists of the material and labor costs of placing hub shelters and enclosures, terminating backbone fiber cables within the hubs, and testing backbone cables.

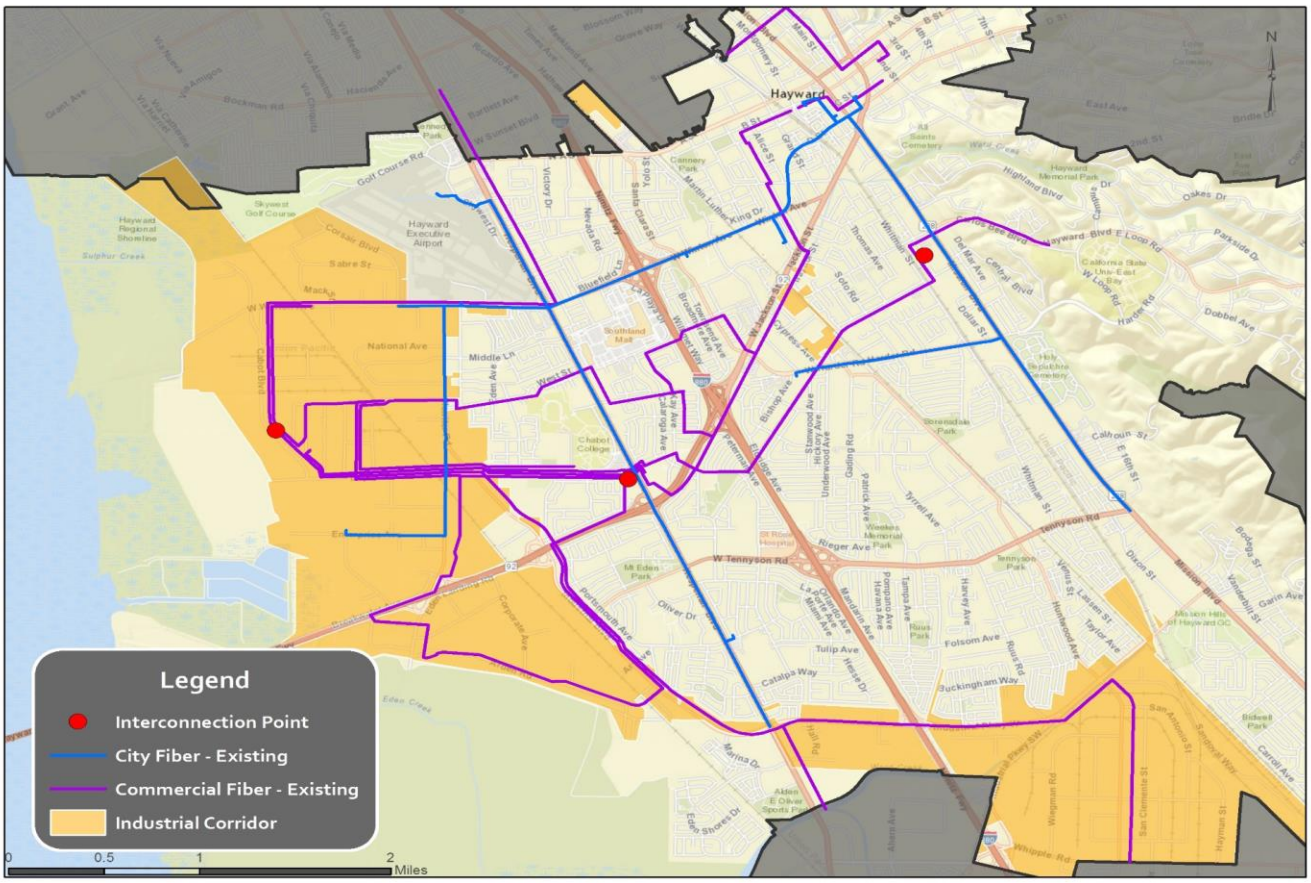
- ***FTTP Service Drop and Lateral Installations –*** consists of all costs related to fiber service drop installation, including outside plant construction on private property, building penetration, and inside plant construction to a typical backbone network service "demarcation" point; this also includes all materials and labor related to the termination of fiber cables at the demarcation point. A take-rate of 35 percent was assumed for standard fiber service drops.

6.2.1 Existing City Network Infrastructure Decreases FTTP Construction Costs

The cost estimate assumes the use of the City's conduit and fiber optic network to provide fiber optic connectivity along most the route between the Industrial Corridor and Internet POPs for network connectivity.

The use of the City's conduit and fiber optic resources as a backbone could reduce the cost and complexity of deploying an FTTP network because the network can reduce the amount of construction needed to provide backbone connectivity in the City (Figure 9).

Figure 9: Map Showing Existing Conduit and Fiber Resources



A detailed engineering design will determine the exact level of savings that the conduit and fiber resources can provide to the Industrial Corridor FTTP network, but we estimate the savings to be between $500,000 and $1 million.

6.3 Field Survey Methodology for Network Design and Cost Estimate

A CTC OSP engineer performed a preliminary survey of the Industrial Corridor via Google Earth Street View to develop estimates of per-mile cost for underground construction in the existing ROW. A CTC engineer then conducted a brief onsite field study of the City's existing conduit and the Industrial Corridor to determine the costs with underground construction in the area. The engineer reviewed available green space, ROW widths, building setbacks, and existing underground utility placements—all of which have been factored in to our design and cost estimate.

The ROW in the Industrial Corridor tends to be wide and many of the areas have additional ROW under sidewalks where existing utilities are not located. Some areas are served by aerial utilities while most the service drops and other areas of the Industrial Corridor have all

underground utilities. Given the width of the ROW we do not anticipate any issues with constructing City fiber optics in the ROW.

One obstacle for construction is the rail lines that crisscross the Industrial Corridor. Railroad crossings require permitting and special construction, which can increase the costs and time required to construct fiber optics. The owner of the rail bed must provide a permit or easement to cross the tracks, which is typically a straightforward process with the larger railroads such as Union Pacific. Crossings may be more difficult if someone else owns the rail bed, and/or it is abandoned.

The review of the existing conduit showed that the conduit and fiber optic system appeared to be in good shape. The older of the existing conduit system was designed to support traffic systems using either twisted copper pair or small count fiber optic cables. Traffic conduit tends to have closer handholes (every 250 feet) than fiber optic telecommunications conduit (every 500+ feet). We also noted that the handholes in the older conduit are smaller than what would be recommended today for a fiber optic network. Higher-count fiber optic cables require larger handholes to properly store slack cable and house the fiber optic splice enclosures. If higher fiber optic cable counts were needed in the future, approximately every other handhole would need to be replaced to accommodate the cable. It is important to note that even with potentially having to replace handholes, the fiber optic and conduit system provide tremendous value to the City.

6.4 FTTP Cost Estimate

This section provides a summary of cost estimates for construction of the FTTP network to all businesses in the Industrial Corridor. With the wholesale and retail models, assuming a 35 percent take rate, this deployment will cost approximately $8.5 million—inclusive of OSP construction labor, materials, engineering, permitting, network electronics, drop installation, CPEs, and testing. Table 8 shows the breakdown of estimated total costs for each network component.

Table 8: Breakdown of Estimated Total Capital Cost – Retail and Wholesale Model

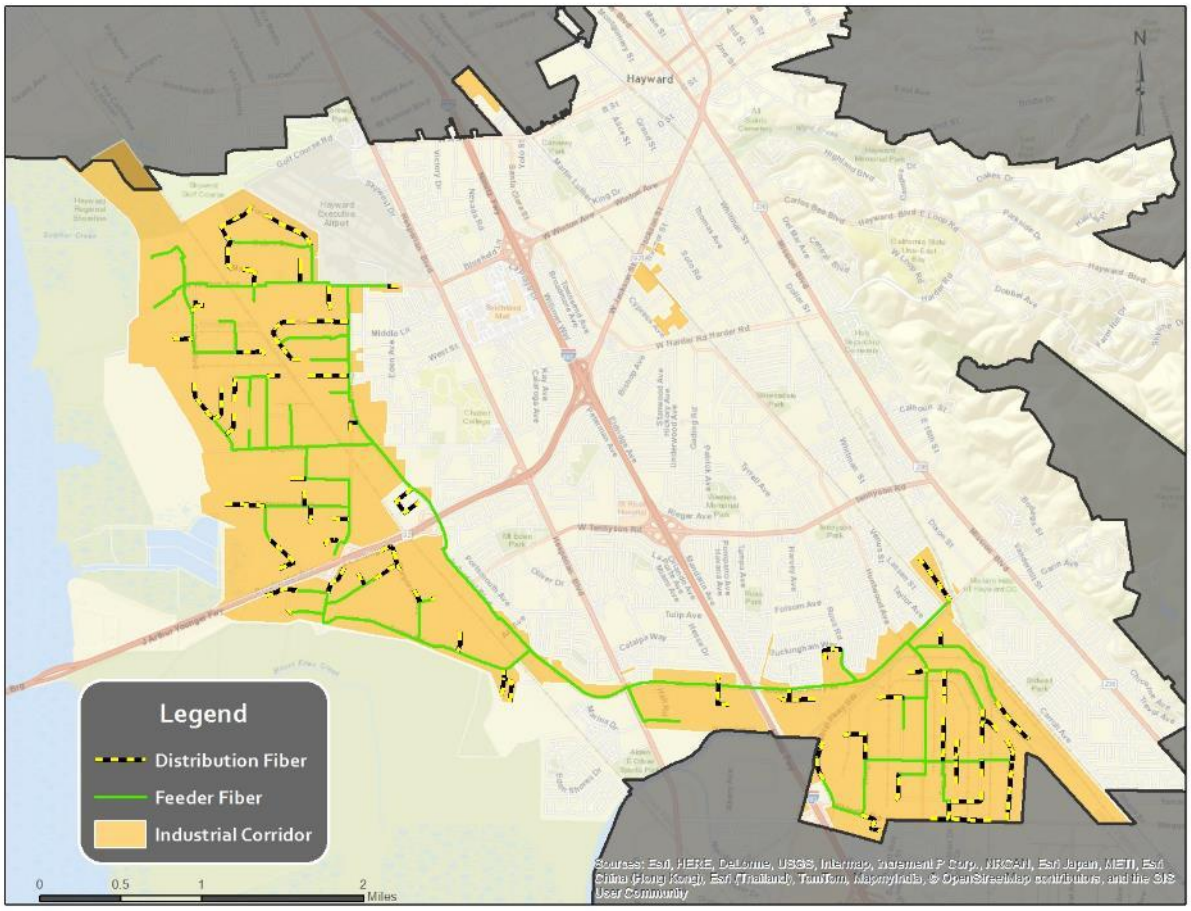
Cost Component	Total Estimated Cost
OSP	$5.2 million
Central Network Electronics	0.6 million
FTTP Service Drop and Lateral Installations	2.1 million
CPE	0.6 million
Total Estimated Cost:	$8.5 million

6.4.1 OSP Cost Estimation Methodology

As with any utility, the design and associated costs for construction vary with the unique physical layout of the service area—no two streets are likely to have the exact same configuration of fiber optic cables, communications conduit, and underground vaults. Costs are further varied by soil conditions, such as the prevalence of subsurface hard rock; location and number of existing utilities; and crossings of bridges, railways, and highways.

To estimate costs for the Industrial Corridor network, we developed a high level FTTP sample design based on street mileage and passings. Since much of the Industrial Corridor has underground utilities, we assumed that the entire FTTP network would be constructed underground.

Figure 10: High-Level FTTP Sample Design Overview



The assumptions, sample design, and cost estimates were used to estimate a cost per passing for the OSP. This number was then multiplied by the number of businesses based on the City's GIS data. The actual cost to construct FTTP to every premises in the Industrial Corridor could

differ from the estimate due to changes in the assumptions underlying the model. Further and more extensive analysis would be required to develop a more accurate cost estimate.

6.4.2 OSP

6.4.2.1 Cost to Construct the Network

In terms of OSP, the estimated cost to construct the proposed FTTP network is approximately $5.2 million, or $2,030 per passing.[26] As we discussed above, our model assumes all underground fiber construction. Table 9 provides a breakdown of the estimated OSP costs. (Note, the costs have been rounded.)

Table 9: Estimated OSP Costs for FTTP

Area	Distribution Plant Mileage	Total Cost	Passings	Cost per Passing	Cost Per Plant Mile
Corridor	33.9	$5,200,000	2,560	$2,030	$150,000

We estimated costs for underground placement using available unit cost data for materials and estimates on the labor costs for placing, pulling, and boring fiber based on construction in comparable markets.

Material costs were generally known, aside from unknown economies of scale and inflation rates, and barring any sort of phenomenon restricting material availability and costs. The labor costs associated with the placement of fiber were estimated based on similar construction projects.

While generally allowing for greater control over timelines and more predictable costs, underground construction is subject to uncertainty related to congestion of utilities in the public rights-of-way and the prevalence of subsurface hard rock—neither of which can be fully mitigated without physical excavation and/or testing. While anomalies and unique challenges will arise regardless of the design or construction methodology, the relatively large scale of this project is likely to provide ample opportunity for variations in construction difficulty to yield relatively predictable results on average.

We assume underground construction will consist primarily of horizontal, directional drilling to minimize ROW impact and to provide greater flexibility to navigate around other utilities. The design model assumes a single two-inch, High-Density Polyethylene (HDPE) flexible conduit

[26] The passing count includes individual single-unit buildings and units in small multi-business buildings as single passings. It treats larger multi-tenant businesses as single passings.

over underground distribution paths, and dual two-inch conduits over underground backbone paths to provide scalability for future network growth.

6.4.3 Central Network Electronics

Central network electronics will cost an estimated $580,000, or $225 per passing, based on an assumed take rate of 35 percent.[27] (These costs may increase or decrease depending on take rate, and the costs may be phased in as subscribers are added to the network.) The central network electronics consists of the electronics to connect subscribers to the FTTP network at the core, hub, and cabinets. Table 10 below lists the estimated costs for each segment.

Table 10: Estimated Central Network Electronics Costs

Network Segment	Subtotal	Passings	Cost per Passing
Core and Distribution Electronics	$360,000	2,560	$140
FTTP Access Electronics	220,000	2,560	85
Central Network Electronics Total	**$580,000**	**2,560**	**$225**

6.4.3.1 Core Electronics

The core electronics connect the FTTP network to the Internet. The core electronics consist of high performance routers, which handle all the routing on both the FTTP network and to the Internet. The core routers should have modular chassis to provide high availability in terms of redundant components and "hot swappable"[28] modular line cards in the event of an outage. Modular routers also provide the ability to expand the routers as demand for additional bandwidth increases.

The cost estimate design envisions redundant rings between the core sites running networking protocols such as hot standby routing protocol (HSRP) to ensure redundancy in the event of a core failure. Additional rings can be added as bandwidth on the network increases. The core sites would also tie to the distribution electronics 10 Gbps links. The links to the hubs can also be increased with additional 10 Gbps and 40 Gbps line cards and optics as demand grows on the network. The core routers will also have 10 Gbps links to ISPs that connect the FTTP network to the Internet.

The cost of the core routing equipment is $260,000. These costs do not include the service provider's OSS—such as provisioning platforms, fault and performance management systems,

[27] The take rate affects the electronics and drop costs, but also may affect other parts of the network, as the city may make different design choices based on the expected take rate. A 35 percent take rate is typical of environments where a new provider joins the telephone and cable provider in a city.

[28] Hot swappable means that the line cards or modular can be removed and reinserted without the entire device being powered down or rebooted. The control cards in the router should maintain all configurations and push them to a replaced line card without the need for reconfirmation.

remote access, and other OSS for FTTP operations. The service providers and/or their content providers may already have these systems in place.

6.4.3.2 Distribution Electronics

The distribution network electronics aggregate the traffic from the FDCs and send it to the core to access the Internet. The distribution electronics consist of high performance aggregation switches, which consolidate the traffic from the many access electronics and send it to the core for route processing. The distribution switches typically are modular switch chassis that can accommodate many line cards for aggregation. The switches should also be modular to provide redundancy in the same manner as the core switches.

The cost estimate assumes that the aggregation switches connect to the access network electronics with 10 Gbps links to each distribution switch. The aggregation switches would then connect to the core switches over single or multiple 10 Gbps links as needed to meet the demand of the FTTP users in each service area.

The cost of the distribution switching equipment is $100,000. These costs do not include any of the service provider's OSS or other management equipment.

6.4.3.3 Access Electronics

The access network electronics at the FDCs connect the subscribers' CPEs to the FTTP network. We recommend deploying access network electronics that can support both GPON and Active Ethernet subscribers to provide flexibility within the FDC service area. We also recommend deploying modular access network electronics for reliability and the ability at add line cards as more subscribers join in the service area. Modularity also helps reduce initial capital costs while the network is under construction or during the roll out of the network.

The cost of the access network electronics for the network is $220,000. These costs are based on a take rate of 35 percent and include optical splitters at the FDCs for that take rate.

6.4.4 Customer Premises Equipment (CPE) and Service Drop Installation (Per-subscriber Costs)

CPEs are the subscriber's interface to the FTTP network. For this cost estimate, we selected CPEs that provide only Ethernet data services (however, there are a wide variety of CPEs offering other data, voice, and video services). Using the estimated take rate of 35 percent, we estimated the CPE for business customers will be $630,000.

Each activated subscriber would also require a fiber drop installation, and related electronics, which would cost roughly $2,860 per subscriber, or $2.7 million total (assuming a 35 percent take rate).

The drop installation cost is the biggest variable in the total cost of adding a subscriber. A short aerial drop can cost as little as $250 to install, whereas a long underground drop installation can cost upward of $3,000. (We estimate an average of $2,160 per drop installation within the Industrial Corridor.)

The other per-subscriber expenses include the cost of the optical network terminal (ONT) at the premises, a portion of the optical line termination (OLT) costs at the hub, the labor to install and configure the electronics, and the incidental materials needed to perform the installation. The numbers provided in the table below are averages and will vary depending on the type of premises and the internal wiring available at each premises.

Table 11: Per-subscriber Cost Estimates

Construction and Electronics Required to Activate a Subscriber	Estimated Average Cost
Drop Installation and Materials	$2,160
Subscriber Electronics (ONT and OLT)	400
Electronics Installation	200
Installation Materials	100
Total	**$2,860**

6.5 Operating Cost Considerations

This section outlines some of the key technical operating expenditures the Industrial Corridor FTTP network would incur. Costs for FTTP network technical operations include staffing (technicians, program manager), OSP maintenance, electronics maintenance, and customer support.

The costs discussed in this section are not meant to be inclusive of all operating costs such as marketing, legal, and financial costs. Further, the magnitude of total cost of operations will vary with the business model chosen, balance of added new staff versus using contractors, the level of existing resources that can be leveraged by the City, and any potential business partners. Staffing requirements and operation costs will vary based on the selected business model. We provide additional staffing and operational cost details in Section 7.

6.5.1 Technical Operational Expenditures

If the City chooses to offer a retail data service, we estimate that the City would likely initially purchase 2 Gbps of Internet capacity. This is an estimated number for the beginning of the

network deployment and can be expected to grow as video streaming and other cloud applications grow in importance. Depending upon the contract terms Internet bandwidth we would estimate costs in the $0.75 per Mbps per month to $1.50 per Mbps per month range in Hayward. We recommend that the Internet access be purchased from multiple Internet providers and be load balanced to ensure continuity during an outage.

The operating costs also include maintenance contracts on the core network electronics. These contracts ensure that the City has access to software support and replacement of critical network electronics that would be cost-prohibitive to store as spares. Where cost effective such as the distribution aggregation switches and the FTTP electronics, we recommend storing spares to reduce the total costs of maintenance contracts. We estimate hardware maintenance contracts and sparing at 15 percent of the total electronics cost.

In addition, we recommend planning for an annual payment into a depreciation operating reserve account based on the equipment replacement cost to help limit risk. This reserve fund should never go negative; the balance that accrues in this account will fund the capital needs for ongoing capital replenishments.

6.5.1.1 Fiber Maintenance Costs

The City would need to augment its current fiber staff or contractors with the necessary expertise and equipment available to maintain the fiber optic cable in an Industrial Corridor FTTP network. Typical maintenance costs can exceed 1 percent of the total fiber OSP construction cost per year and includes a mix of contracted services.

Fiber optic cable is resilient compared to copper telephone lines and cable TV coaxial cable. The fiber itself does not corrode, and fiber cable installed over 20 years ago is still in good condition. However, fiber can be vulnerable to accidental cuts by other construction, traffic accidents, and severe weather. In other networks of this size, we have seen approximately 80 outages per 1,000 miles of plant per year.

The fiber optic redundancy from the hubs to the FDCs in the backbone network will facilitate restoring network outages while repair of the fiber optic plant is taking place.

Depending on the operational and business models established between the City and service providers, the City may be responsible for adds, moves, and changes associated with the network as well as standard plant maintenance. These items may include:

- Adding and/or changing patching and optical splitter configurations at FDCs and hubs;
- Extending optical taps and laterals to new buildings or developments;
- Extending access to the FTTP network to other service providers; and

- Relocating fiber paths due to changes such as the widening of roadways.

The City would need to obtain contracts with fiber optic contractors that have the necessary expertise and equipment available to maintain an Industrial Corridor FTTP network. These contracts should specify the service level agreements the City needs from the fiber optic contractors to ensure that the City can meet the service level agreements it has with the network service providers. The City should also ensure that it has access to multiple fiber optic contractors if one contractor is unable to meet the City's needs. The fiber optic contractors should be available 24x7 and have a process in place for activating emergency service requests.

6.5.1.2 Fiber Locating

The City will be responsible for locating and marking all underground conduit for excavation projects per California's DigAlert System statutes. Locating involves receiving and reviewing excavation tickets to determine whether the area of excavation may impact the City's underground FTTP infrastructure. If the system is impacted, the City must mark its utilities in the manner and within the allotted timeframe provided by the statute.

Locating is either done in-house or by contractors who specialize in utility locating. The City may be able to leverage its existing utility locating personnel, processes, or contractors to reduce the cost of utility locating for the FTTP network.

6.5.2 Technical Staffing Requirements

Additional staffing will be required to perform the maintenance and operation responsibilities of an Industrial Corridor FTTP network. The staffing levels and the responsibility for that staffing will vary greatly with the various potential business models. The following sections outline the technical groups that will be required to maintain and operate the network.

6.5.2.1 Outside Plant

The OSP group will be responsible for the maintenance, operations, and expansion of the City's telecommunications infrastructure including conduit, fiber, and splice enclosures. During construction, the OSP group will be responsible for tracking and overseeing the construction of new infrastructure. Once the network is constructed, the OSP group will oversee any future adds, moves, or changes to the network.

The OSP group may use contractors to perform activities such as construction, repair, and locating. Management of contractors will be a responsibility of an OSP manager with OSP technicians assisting with project oversight and quality assurance and quality control. The OSP manager will also assist with engineering and design of any adds, moves, and changes that occur on the network.

The OSP group will have responsibility for general field operations. This group will include OSP technicians to perform locates, and contracted support to provide repair services. Tasks will include management of the One Call process, fiber locates, response and troubleshooting of Layer 1 troubleshooting, and fleet management. Additionally, it is critical that while many of OSP jobs may be outsourced, that the OSP group be equipped with the proper locate and testing equipment.

6.5.2.2 Network Engineering

The network engineering group develops and maintains the network architecture, responds to high-level troubleshooting requests, manages network electronics and makes sure the network delivers to the end user a reliable service.

The network engineering group is responsible for making architecture decisions that will determine how the network can deliver services to users. The network engineering group will also be responsible for change management and architectural review to ensure that network continuity is ensured after changes.

The network engineering group will also be responsible for vendor selections when new hardware, technologies, or contractor support is needed to support the network. The network engineering team will perform regular maintenance of the network as well as provision, deploy, test, and accept any electronics to support new sites or services.

Network technicians will be responsible for troubleshooting issues with network electronics and responding to customer complaints.

To operate network electronics (if required by the business model) we estimate a staffing requirement of one network manager, up to one network engineer, and up to two network technicians that could be a combination of personnel as well as contracted support. Network staffing levels may vary depending on the take rate of the FTTP network.

6.5.2.3 Network Operations Center and Customer Service

The network will require individuals to perform monitoring and oversight of the network electronics. The group will be responsible for handling technical calls from users, actively monitoring the health of the network, and escalating issues to the proper operations groups. The group is also required to develop and monitor network performance parameters to ensure that the network is meeting its obligations to its users as defined in the network service level agreements (SLAs).

Often network operations require a 24x7 customer service helpdesk and tools for network monitoring, alerting, and provisioning.

7 Business and Financial Model

This section presents a financial analysis based on the candidate business models we outline in Section 1.5, above. Our modeling is based on an FTTP deployment to the Industrial Corridor, and assumes that the City will take some financial risk by investing at least in dark FTTP infrastructure. The models are briefly summarized again in Table 12, with an emphasis on the division of responsibilities between the City and a partner.

Table 12: Responsibility Matrix for Potential Business Models

Activity	Model		
	Dark FTTP	**Wholesale Service**	**Retail Service**
Who invests in and owns the outside plant (OSP), like fiber?	City	City	City
Who invests in and owns the network electronics?	Partner(s)	City	City
Who is responsible for customer service to end users?	Partner(s)	Partner(s)	City

7.1 Overview

Potential business models for an FTTP deployment range from:

- A **retail service model** in which the City directly provides fiber service;
- To a **wholesale service model** in which the City builds an open access network and invites private partners to deliver services over the network;
- To a **dark FTTP model** in which the City builds the fiber and enters a partnership with an anchor service provider, similar to the business model the City of Westminster, Maryland adopted when it partnered with Ting Fiber.[29]

As we noted in Section 1.5, we believe a dark F model will best fit the City's needs, because it leverages the City's abilities and offsets some of the risk associated with implementing a new broadband enterprise, as the City would be required to do in a retail service model.

We conducted financial modeling based on the three potential business models to illustrate the kind of costs and revenues the City might see under each model. This section presents an overview of the FTTP financial model, based on the cost estimates in Section 6. We have provided the City with a complete financial model in Excel format; because the Excel

[29] "Westminster Fiber Network," *City of Westminster,* accessed November 8, 2016, http://www.westminstermd.gov/419/Westminster-Fiber-Network.

spreadsheet can be modified to show the impact of changing assumptions, it will be an important tool for the City to use if it negotiates with a private partner.

These financial projections do not include any economic development or other indirect benefits, which are often not easily quantifiable. The projections also do not include potential revenues from small cell or distributed antenna system (DAS) providers, which may represent a modest revenue source the City can tap into if it can find interested providers.

7.2 Retail Model Financial Projections

The financial analysis in this section assumes the City of Hayward owns and operates the FTTP infrastructure and provides retail service to businesses in the identified service area. As we described above, the City will be the service provider in a retail service model and will be responsible for all aspects of network deployment and maintenance, network and customer electronics, service delivery, and customer service and support. This financial analysis is based on several assumptions, outlined below.

In the analysis, we assume the City offers four base services, at prices that compare favorably to similar services in other cities:

- A 250 Mbps commercial service at $100 per month,
- A 1 Gbps small commercial service at $200 per month,
- A 1 Gbps medium commercial service at $400 per month (including service-level agreement), and
- A 1 Gbps Metro Ethernet transport service at $1,000 per month (including service-level agreement).

We assumed that 68 percent of subscribers will purchase the 250 Mbps service; 15 percent will purchase the 1 Gbps small commercial service; 15 percent will purchase the 1 Gbps medium commercial service; and 2 percent will purchase the 1 Gbps Metro Ethernet service.

Given the assumptions outlined in this section, a 60 percent take rate (the percentage of customers that subscribe to the service) is required to maintain a positive cash flow. Note that this analysis does not indicate or review whether obtaining this required take rate is realistic; rather, it reflects the take rate necessary to maintain a positive cash flow, considering all other assumptions in the model. The complete model is provided in Appendix C.

Please note that, based on other competitive overbuilds, obtaining a 60 percent take rate is considered aggressive, and will likely be difficult to obtain and maintain. Realistically, we would expect a 35 percent to 45 percent take rate.

The financial analysis for this base case scenario is as follows:

Table 13: Base Case Retail Model Financial Analysis with 60 Percent Take Rate

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$341,000	$3,280,000	$3,280,000	$3,280,000	$3,280,000
Total Cash Expenses	(911,000)	(1,419,000)	(1,419,000)	(1,419,000)	(1,419,000)
Depreciation	(234,000)	(1,254,000)	(625,000)	(617,000)	(617,000)
Interest Expense	(185,000)	(617,000)	(485,000)	(321,000)	(111,000)
Taxes	-	-	-	-	-
Net Income	$(989,000)	$(10,000)	$751,000	$923,000	$1,133,000

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$(50,000)	$491,000	$2,770,000	$5,548,000	$8,319,000
Depreciation Reserve	-	1,132,000	1,150,000	354,000	(138,000)
Interest Reserve	185,000	-	-	-	-
Debt Service Reserve	185,000	660,000	660,000	660,000	660,000
Total Cash Balance	$320,000	$2,283,000	$4,580,000	$6,562,000	$8,841,000

The income statement demonstrates an overall health of the enterprise on a year-by-year basis. The above cash flow statement shows the cumulative cash balance of the enterprise. It shows unrestricted and restricted (depreciation, interest, and debt service reserves) cumulative cash balances. The cash flow statement is the most important measure for a public entity. It is important for the enterprise to maintain a positive unrestricted cash balance at the end of each year.

Please note that we used a "flat model" in the analysis. With a "flat model," inflation and salary cost increases are not used in the analysis because it is assumed that operating cost increases will be offset and passed on to subscribers in the form of increased prices. Models that add an inflation factor to both revenues and expenses can greatly overstate net revenues in the out-years since net revenues would then also increase by the same inflation factor.

7.2.1 Financing Costs and Operating Expenses

This financial analysis assumes a combination of bonds and loans will be necessary to deploy the FTTP network. We expect that the City will seek 20-year bonds with principal repayments starting the year after the bond issuance.

We project that the bond issuance costs will be equal to 1.0 percent of the principal borrowed. For the bond, a debt service reserve account is maintained at 5.0 percent of the total issuance amount. An interest reserve account equal to years one and two interest expense is maintained for the first two years.

Our analysis estimates total bonding requirements to be $13.2 million, and we assume that bonds are issued at a 5 percent interest rate.

The model assumes a straight-line depreciation of assets, and that the OSP and materials will have a 20-year life span while network equipment will need to be replaced after 10 years. Last mile fiber and CPEs, as well as other miscellaneous implementation costs, will need to be accounted for after five years. Network equipment will be replaced or upgraded at 80 percent of its original cost, miscellaneous implementation costs will be at 100 percent, and last mile and CPEs will be at 100 percent. The model plans for a depreciation reserve account starting in year three—these monies are set aside to fund future electronics replacements and upgrades.

Table 14 shows operating expenses for years one, five, 10, 15, and 20. As the table indicates, some expenses will remain constant while others will increase as the network matures and the customer base increases.

Table 14: Operating Expenses in Years 1, 5, 10, 15, and 20 – Retail Model

Operating Expenses	Year 1	Year 5	Year 10	Year 15	Year 20
Support Services	$52,000	$28,000	$28,000	$28,000	$28,000
Insurance	25,000	50,000	50,000	50,000	50,000
Utilities	-	-	-	-	-
Office Expenses	6,000	6,000	6,000	6,000	6,000
Facility Lease	-	-	-	-	-
Locates & Ticket Processing	8,000	31,000	31,000	31,000	31,000
Peering	-	-	-	-	-
Contingency	10,000	25,000	25,000	25,000	25,000
Billing Maintenance Contract	10,000	20,000	20,000	20,000	20,000
Fiber & Network Maintenance	16,000	55,000	55,000	55,000	55,000
Vendor Maintenance Contracts	-	83,000	83,000	83,000	83,000
Legal and Lobby Fees	50,000	10,000	10,000	10,000	10,000
Planning	-	-	-	-	-
Consulting	50,000	10,000	10,000	10,000	10,000
Marketing	100,000	50,000	50,000	50,000	50,000
Education and Training	11,000	19,000	19,000	19,000	19,000
Customer Handholding	-	-	-	-	-
Customer Billing (Unit)	-	5,000	5,000	5,000	5,000
Allowance for Bad Debts	3,000	33,000	33,000	33,000	33,000
Churn (acquisition costs)	1,000	15,000	15,000	15,000	15,000
Pole Attachment Expense	-	-	-	-	-
Internet	30,000	41,000	41,000	41,000	41,000
Sub-Total	$372,000	$481,000	$481,000	$481,000	$481,000
Labor Expenses	$539,000	$938,000	$938,000	$938,000	$938,000
Sub-Total	$539,000	$938,000	$938,000	$938,000	$938,000
Total Expenses	$911,000	$1,419,000	$1,419,000	$1,419,000	$1,419,000

Table 15 shows the income statement for years one, five, 10, 15, and 20.

Table 15: Income Statement – Retail Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Revenues					
Internet - Business	$277,000	$3,280,000	$3,280,000	$3,280,000	$3,280,000
Connection Fee (net)	64,000	-	-	-	-
Per Passing	-	-	-	-	-
Per Customer	-	-	-	-	-
Provider Fee	-	-	-	-	-
Assessments	-	-	-	-	-
Ancillary Revenues	-	-	-	-	-
Total	$341,000	$3,280,000	$3,280,000	$3,280,000	$3,280,000
b. Content Fees					
Internet	$30,000	$41,000	$41,000	$41,000	$41,000
Total	$30,000	$41,000	$41,000	$41,000	$41,000
c. Operating Costs					
Operation Costs	$342,000	$440,000	$440,000	$440,000	$440,000
Labor Costs	539,000	938,000	938,000	938,000	938,000
Total	$881,000	$1,378,000	$1,378,000	$1,378,000	$1,378,000
d. EBITDA	$(570,000)	$1,861,000	$1,861,000	$1,861,000	$1,861,000
e. Depreciation	234,000	1,254,000	625,000	617,000	617,000
f. Operating Income (EBITDA less Depreciation)	$(804,000)	$607,000	$1,236,000	$1,244,000	$1,244,000
g. Non-Operating Income					
Interest Income	$ -	$4,000	$5,000	$3,000	$1,000
Interest Expense (10 Year Bond)	-	-	-	-	-
Interest Expense (20 Year Bond)	(185,000)	(621,000)	(490,000)	(324,000)	(112,000)
Interest Expense (Loan)	-	-	-	-	-
Total	$(185,000)	$(485,000)	$(485,000)	$(321,000)	$(111,000)
h. Net Income (before taxes)	$(989,000)	$(10,000)	$751,000	$923,000	$1,133,000
i. Facility Taxes	$ -	$ -	$ -	$ -	$ -
j. Net Income	$(989,000)	$(10,000)	$751,000	$923,000	$1,133,000

Table 16: Cash Flow Statement – Retail Model

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Net Income	$(989,000)	$(10,000)	$751,000	$923,000	$ 1,133,000
b. Cash Outflows					
Debt Service Reserve	$(185,000)	$ -	$ -	$ -	$ -
Interest Reserve	(370,000)	-	-	-	-
Depreciation Reserve	-	(439,000)	(219,000)	(216,000)	(216,000)
Financing	(37,000)	-	-	-	-
Capital Expenditures	(2,588,000)	-	-	-	-
Total	$ (3,180,000)	$ (439,000)	$ (219,000)	$ (216,000)	$ (216,000)
c. Cash Inflows					
Interest Reserve	$ 185,000	$ 95,000	$ -	$ -	$ -
Depreciation Reserve	-	-	-	-	-
Investment Capital	-	-	-	-	-
Start Up Funds	-	-	-	-	-
Grants (infrastructure)	-	-	-	-	-
Grants (customer premises)	-	-	-	-	-
10-Year Bond/Loan Proceeds	-	-	-	-	-
20-Year Bond Proceeds	3,700,000	-	-	-	-
Loan Proceeds	-	-	-	-	-
Total	$ 3,885,000	$ 95,000	$ -	$ -	$ -
d. Total Cash Outflows and Inflows	$ 705,000	$ (344,000)	$ (219,000)	$ (216,000)	$ (216,000)
e. Non-Cash Expenses - Depreciation	$ 234,000	$ 1,254,000	$ 625,000	$ 617,000	$ 617,000
f. Adjustments					
Proceeds from Additional Cash Flows (10 Year Bond)	$ -	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (20 Year Bond)	$ (3,700,000)	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (Loan)	$ -	$ -	$ -	$ -	$ -
g. Adjusted Available Net Revenue	$ (3,750,000)	$ 900,000	$ 1,157,000	$ 1,324,000	$ 1,534,000
h. Principal Payments on Debt					
10 Year Bond Principal	$ -	$ -	$ -	$ -	$ -
20 Year Bond Principal	-	472,000	602,000	768,000	981,000
Loan Principal	-	-	-	-	-
Total	$ -	$ 472,000	$ 602,000	$ 768,000	$ 981,000

Significant network expenses—known as "capital additions"—are incurred in the first few years during the construction phase of the network. These represent the equipment and labor expenses associated with building, implementing, and lighting a fiber network. Table 17 shows the capital additions costs in years one, two, and three, and the total for years one through three.

This analysis projects that the capital additions in year one will total approximately $2.6 million. These costs will total approximately $3.5 million in year two, $1.8 million in year three, and $2.6 million in year four. This totals just over $10.5 million for total capital additions costs for years one through four.

Table 17: Capital Additions – Retail Model

Capital Additions		Year 1	Year 2	Year 3	Year 4
Network Equipment					
Core Network Equipment		$380,000	$ -	$ -	$ -
TBD		-	-	-	-
Additional Annual Capital		-	-	-	-
	Total	$ 380,000	$ -	$ -	$ -
Outside Plant and Facilities					
Total Backbone and FTTP		$1,635,000	$2,726,000	$1,090,000	$ -
Additional Annual Capital		-	-	-	-
	Total	$1,635,000	$2,726,000	$1,090,000	$ -
Last Mile and Customer Premises Equipment					
CPE (residential and small commercial)		$91,000	$182,000	$182,000	$638,000
CPE (medium commercial)		18,000	36,000	35,000	124,000
CPE (enterprise)		6,000	10,000	10,000	36,000
Average Drop Cost		263,000	525,000	523,000	1,836,000
Additional Annual Replacement Capital		-	-	-	-
	Total	$378,000	$753,000	$750,000	$2,634,000
Miscellaneous Implementation Costs					
Splicing		$ -	$ -	$ -	$ -
Vehicles		50,000	-	-	-
Emergency Restoration Kit		50,000	-	-	-
Work Station, Computers, and Software		10,000	7,000	-	2,000
Fiber OTDR and Other Tools		85,000	-	-	-
Generators & UPS		-	-	-	-
OSS		-	-	-	-
Additional Annual Capital		-	-	-	-
	Total	$195,000	$7,000	$ -	$2,000
Replacement Costs for Depreciation					
Network Equipment		$ -	$ -	$ -	$ -
Customer Premises Equipment		-	-	-	-
Miscellaneous Implementation Costs		-	-	-	-
	Total	$ -	$ -	$ -	$ -
Total Capital Additions		$2,588,000	$3,486,000	$1,840,000	$2,636,000

7.2.2 Operating and Maintenance Expenses

The cost to deploy an FTTP network goes far beyond fiber implementation. Network deployment requires additional staffing for sales and marketing, network operations, and other functions. The addition of new staff and inventory requirements will require office and warehousing space:

- Expand office facilities for management, technical and clerical staff
- Expand retail "storefront" to facilitate customer contact and enhance their experience doing business with the FTTP enterprise
- Provide warehousing for receipt and storage of cable and hardware for the installation and on-going maintenance of the broadband infrastructure
- Establish location to house servers, switches, routers, and other core-network equipment

Training new and existing staff is important to fully realize the economies of starting the FTTP network. The training will be particularly important in the short-term as the new enterprise establishes itself as a unique entity providing services distinct from services provided by the City today.

The expanded business and increased responsibilities will require the addition of new staff. Marketing and sales are critical. It is important to be proactive in setting customer expectations, addressing security concerns, and educating the customers on how to initiate services.

The initial additional positions, staffing levels, and base salaries are shown in Table 18. Please note that the table only lists estimated salaries and in the analysis, we added a 40 percent overhead to these salaries.

Table 18: Labor Expenses – Retail Model

	Year 1	Year 2	Year 3	Year 4	Year 5+	Labor Cost
New Employees						
Business Manager	0.50	1.00	1.00	1.00	1.00	$130,000
GIS	0.50	1.00	1.00	1.00	1.00	$80,000
Communications - Sales	0.50	2.00	2.00	2.00	2.00	$75,000
Customer Service Representative	2.00	2.00	2.00	2.00	2.00	$65,000
Service Technicians/Installers & IT Support	1.00	1.00	1.00	2.00	2.00	$90,000
Fiber Plant O&M Technicians	0.25	1.00	1.00	1.00	1.00	$90,000
Total New Staff	4.75	8	8	9	9	

7.2.3 Summary of Operating and Maintenance Assumptions

Additional key operating and maintenance assumptions include:

- Salaries and benefits are based on estimated market wages. See Table 18 for a list of staffing requirements for the retail service model. Benefits are estimated at 40 percent of base salary.
- Use of a help desk service, which includes a $50,000 startup cost and $1.50 per month per customer service fee.
- Insurance is estimated to be $25,000 in year one and $50,000 from year two on.

- Office expense allocations are estimated to be $6,000 per year.
- Locates and ticket processing are estimated to start in year one at $8,000, increase to $15,000 in year two, and increase to $31,000 from year three on.
- Contingency is estimated to be $10,000 in year one and $25,000 from year two on.
- Billing and maintenance contract fees are estimated at $10,000 in year one, and $20,000 from year two on.
- Legal fees are estimated to be $50,000 in year one, and $10,000 from year two on.
- Consulting fees are estimated at $50,000 in year one, and $10,000 from year three on.
- Marketing and promotional expenses are estimated to be $100,000 in year one, and $50,000 from year two on.

Vendor maintenance contract fees are expected to start at $43,000 in year two, increase to $52,000 in year three, and increase again to $83,000 in year four; these fees are expected to remain steady at $83,000 per year beyond year four. Annual variable and operating expenses not including direct Internet access include:

- Education and training are calculated as 2 percent of direct payroll expense.
- Customer billing is estimated to be $0.25 per bill per month.
- Allowance for bad debts is computed as 1 percent of revenues.
- Churn is anticipated to be 5 percent annually.

Fiber network maintenance costs are calculated at 1 percent of the total construction cost, per year. This is estimated based on a typical rate of occurrence in an urban environment, and the cost of individual repairs. This is in addition to staffing costs to maintain fiber.

Internet and peering is estimated at $1.25 per Mbps per month for the first 2 Gbps, and $1.00 per Mbps per month thereafter.

7.2.4 Take-Rate Sensitivity

This section shows the large impact that fluctuations in take rate can have on financial modeling. In the following tables, we show the financial projections for take rates of 50 percent, 40 percent, and 30 percent.

Please note that, based on other competitive overbuilds, obtaining a 60 percent take rate is considered aggressive, and will likely be difficult to obtain and maintain. Realistically, we would expect a 35 percent to 45 percent take rate.

Note that the total unrestricted cash balance in year one with a 50 percent take rate is projected as a loss of $50,000, as shown in Table 19, below. This number is the same as the projections for a 60 percent take rate (see Table 13, above), but by the time we reach year five, the numbers diverge significantly.

The projected unrestricted cash balance with a 60 percent take rate is projected to be approximately $491,000 in year five. With a 50 percent take rate, the unrestricted cash balance in year five is projected as a loss of approximately $451,000.

This is nearly a $1 million difference in unrestricted cash balances based on the difference between a 60 percent and a 50 percent take rate. As the take rate declines, this gap widens, as the tables below show.

Table 19: Take Rate Reduced to 50 Percent – Retail Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$341,000	$2,738,000	$2,738,000	$2,738,000	$2,738,000
Total Cash Expenses	(911,000)	(1,390,000)	(1,390,000)	(1,390,000)	(1,390,000)
Depreciation	(234,000)	(1,104,000)	(579,000)	(572,000)	(572,000)
Interest Expense	(185,000)	(577,000)	(453,000)	(297,000)	(98,000)
Taxes	-	-	-	-	-
Net Income	$ (989,000)	$ (333,000)	$316,000	$479,000	$678,000

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (50,000)	$ (451,000)	$ (220,000)	$404,000	$1,023,000
Depreciation Reserve	-	1,026,000	1,082,000	434,000	90,000
Interest Reserve	185,000	-	-	-	-
Debt Service Reserve	185,000	620,000	620,000	620,000	620,000
Total Cash Balance	$320,000	$1,195,000	$1,482,000	$1,458,000	$1,733,000

As Table 20 shows, the total projected revenues in year five with a 40 percent take rate are approximately $2,176,000. The base case analysis with a 60 percent take rate projected year five revenues at approximately $3,280,000. This is greater than a $1.1 million difference in projected revenues based on take rate.

Similarly, the unrestricted cash balance in year five for the base case analysis—with a 60 percent take rate—is projected at approximately $491,000 per year in year five. With a 40 percent take rate (see Table 20, below), the unrestricted cash balance is projected as a loss of approximately $1.5 million per year in year five.

Table 20: Take Rate Reduced to 40 Percent – Retail Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$341,000	$2,176,000	$2,176,000	$2,176,000	$2,176,000
Total Cash Expenses	(911,000)	(1,362,000)	(1,362,000)	(1,362,000)	(1,362,000)
Depreciation	(234,000)	(953,000)	(533,000)	(526,000)	(526,000)
Interest Expense	(185,000)	(532,000)	(417,000)	(271,000)	(85,000)
Taxes	-	-	-	-	-
Net Income	$ (989,000)	$ (671,000)	$ (136,000)	$ 17,000	$203,000

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (50,000)	$(1,514,000)	$ (3,394,000)	$ (4,988,000)	$ (6,586,000)
Depreciation Reserve	-	922,000	1,018,000	520,000	326,000
Interest Reserve	185,000	-	-	-	-
Debt Service Reserve	185,000	575,000	575,000	575,000	575,000
Total Cash Balance	$320,000	$ (17,000)	$ (1,801,000)	$ (3,893,000)	$ (5,685,000)

Again, the unrestricted cash balance in the base case analysis (Table 13) for a retail model is projected as approximately $491,000 in year five. As Table 21 shows below, the projected unrestricted cash balance with a 30 percent take rate is a loss of approximately $2.5 million in year five.

Table 21: Take Rate Reduced to 30 Percent – Retail Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$341,000	$1,634,000	$1,634,000	$1,634,000	$ 1,634,000
Total Cash Expenses	(911,000)	(1,340,000)	(1,340,000)	(1,340,000)	(1,340,000)
Depreciation	(234,000)	(803,000)	(488,000)	(480,000)	(480,000)
Interest Expense	(185,000)	(493,000)	(384,000)	(247,000)	(72,000)
Taxes	-	-	-	-	-
Net Income	$ (989,000)	$ (1,002,000)	$ (578,000)	$ (433,000)	$ (258,000)

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (50,000)	$ (2,469,000)	$ (6,431,000)	$ (10,216,000)	$ (14,002,000)
Depreciation Reserve	-	816,000	950,000	600,000	554,000
Interest Reserve	185,000	-	-	-	-
Debt Service Reserve	185,000	535,000	535,000	535,000	535,000
Total Cash Balance	$ 320,000	$ (1,118,000)	$ (4,946,000)	$ (9,081,000)	$ (12,913,000)

7.3 Wholesale Model Financial Projections

The financial analysis in this section assumes the City of Hayward owns and operates the FTTP infrastructure and provides wholesale service to ISPs. The ISPs in turn offer retail service businesses in the identified service area. This financial analysis is based on several assumptions, outlined below.

In the analysis, we assume the City offers four wholesale base services, based on a 25 percent discount from the retail model.

- A 250 Mbps commercial service at $75 per month;
- A 1 Gbps small commercial service at $150 per month;
- A 1 Gbps medium commercial service at $300 per month (including service-level agreement); and
- A 1 Gbps Metro Ethernet transport service at $750 per month (including service-level agreement).

We assumed that 68 percent of subscribers will purchase the 250 Mbps service; 15 percent will purchase the 1 Gbps small commercial service; 15 percent will purchase the 1 Gbps medium commercial service; and 2 percent will purchase the 1 Gbps Metro Ethernet service.

As in the case of the retail model, a 60 percent take rate is required to maintain a positive cash flow.

The financial analysis for this base case scenario is as follows:

Table 22: Wholesale Model Financial Analysis with 60 Percent Take Rate (Base Case)

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$271,000	$2,460,000	$2,460,000	$2,460,000	$2,460,000
Total Cash Expenses	(572,750)	(934,250)	(934,250)	(934,250)	(934,250)
Depreciation	(233,000)	(1,253,000)	(623,000)	(616,000)	(616,000)
Interest Expense	(175,000)	(589,000)	(465,000)	(308,000)	(107,000)
Taxes	-	-	-	-	-
Net Income	$ (709,750)	$ (316,250)	$437,750	$601,750	$802,750

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$55,250	$57,250	$909,000	$2,257,750	$3,601,500
Depreciation Reserve	-	1,132,000	1,154,000	366,000	(118,000)
Interest Reserve	175,000	-	-	-	-
Debt Service Reserve	175,000	630,000	630,000	630,000	630,000
Total Cash Balance	$405,250	$1,819,250	$2,693,000	$3,253,750	$4,113,500

This analysis does not indicate or review whether obtaining this required take rate is realistic; rather, it reflects the take rate necessary to maintain a positive cash flow, considering all other assumptions in the model. The complete model is provided in Appendix D.

Please note that we used a "flat model" in the analysis. With a "flat model," inflation and salary cost increases are not used in the analysis because it is assumed that operating cost increases will be offset and passed on to subscribers in the form of increased prices. Models that add an inflation factor to both revenues and expenses can greatly overstate net revenues in the out-years since net revenues would then also increase by the same inflation factor.

7.3.1 Financing Costs and Operating Expenses

This financial analysis assumes a combination of bonds and loans will be necessary. We expect that the City will seek 20-year bonds with principal repayments starting the year after issuance.

We project that the bond issuance costs will be equal to 1.0 percent of the principal borrowed. For the bond, a debt service reserve account is maintained at 5.0 percent of the total issuance amount. An interest reserve account equal to years one and two interest expense is maintained for the first two years.

Our analysis estimates total bonding requirements to be $12.6 million and are issued at a 5 percent interest rate.

The model assumes a straight-line depreciation of assets, and that the OSP and materials will have a 20-year life span while network equipment will need to be replaced after 10 years. Last mile and CPEs as well as other miscellaneous implementation costs will need to be accounted for after five years. Network equipment will be replaced or upgraded at 80 percent of its original cost, miscellaneous implementation costs will be at 100 percent, and last mile and CPEs will be at 100 percent. The model plans for a depreciation reserve account starting in year three - this funds future electronics replacements and upgrades.

Table 23 shows operating expenses for years one, five, 10, 15, and 20. As seen, some expenses will remain constant while others will increase as the network matures and the customer base increases.

Table 23: Operating Expenses in Years 1, 5, 10, 15, and 20 – Wholesale Model

Operating Expenses	Year 1	Year 5	Year 10	Year 15	Year 20
Support Services	$ -	$ -	$ -	$ -	$ -
Insurance	25,000	50,000	50,000	50,000	50,000
Utilities	-	-	-	-	-
Office Expenses	6,000	6,000	6,000	6,000	6,000
Facility Lease	-	-	-	-	-
Locates & Ticket Processing	8,000	31,000	31,000	31,000	31,000
Peering	-	-	-	-	-
Contingency	10,000	25,000	25,000	25,000	25,000
Billing Maintenance Contract	10,000	20,000	20,000	20,000	20,000
Fiber & Network Maintenance	16,000	55,000	55,000	55,000	55,000
Vendor Maintenance Contracts	-	83,000	83,000	83,000	83,000
Legal and Lobby Fees	50,000	10,000	10,000	10,000	10,000
Planning	-	-	-	-	-
Consulting	50,000	10,000	10,000	10,000	10,000
Marketing	30,000	15,000	15,000	15,000	15,000
Education and Training	7,000	11,000	11,000	11,000	11,000
Customer Handholding	-	-	-	-	-
Customer Billing (Unit)	-	5,000	5,000	5,000	5,000
Allowance for Bad Debts	-	-	-	-	-
Churn (acquisition costs)	-	-	-	-	-
Pole Attachment Expense	-	-	-	-	-
Internet	30,000	41,000	41,000	41,000	41,000
Sub-Total	$242,000	$362,000	$362,000	$362,000	$362,000
Labor Expenses	$330,750	$572,250	$572,250	$572,250	$572,250
Sub-Total	$330,750	$572,250	$572,250	$572,250	$572,250
Total Expenses	$572,750	$934,250	$934,250	$934,250	$934,250

Table 24 shows the income statement for years one, five, 10, 15, and 20.

Table 24: Income Statement – Wholesale Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Revenues					
Internet - Business	$207,000	$2,460,000	$2,460,000	$2,460,000	$2,460,000
Connection Fee (net)	64,000	-	-	-	-
Per Passing	-	-	-	-	-
Per Customer	-	-	-	-	-
Provider Fee	-	-	-	-	-
Assessments	-	-	-	-	-
Ancillary Revenues	-	-	-	-	-
Total	$271,000	$2,460,000	$2,460,000	$2,460,000	$2,460,000
b. Content Fees					
Internet	$30,000	$41,000	$41,000	$41,000	$41,000
Total	$30,000	$41,000	$41,000	$41,000	$41,000
c. Operating Costs					
Operation Costs	$212,000	$321,000	$321,000	$321,000	$321,000
Labor Costs	330,750	572,250	572,250	572,250	572,250
Total	$542,750	$893,250	$893,250	$893,250	$893,250
d. EBITDA	$(301,750)	$1,525,750	$1,525,750	$1,525,750	$1,525,750
e. Depreciation	233,000	1,253,000	623,000	616,000	616,000
f. Operating Income (EBITDA less Depreciation)	$(534,750)	$272,750	$902,750	$909,750	$909,750
g. Non-Operating Income					
Interest Income	$ -	$4,000	$4,000	$2,0000	$1,0000
Interest Expense (10 Year Bond)	-	-	-	-	-
Interest Expense (20 Year Bond)	(175,000)	(593,000)	(469,000)	(310,000)	(108,000)
Interest Expense (Loan)	-	-	-	-	-
Total	$ (175,000)	$ (465,000)	$ (465,000)	$ (308,000)	$ (107,000)
h. Net Income (before taxes)	$ (709,750)	$ (316,250)	$437,750	$601,750	$802,750
i. Facility Taxes	$ -	$ -	$ -	$ -	$ -
j. Net Income	$ (709,750)	$ (316,250)	$437,750	$601,750	$802,750

Table 25 shows the cash flow statement for years one, five, 10, 15, and 20.

Table 25: Cash Flow Statement – Wholesale Model

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Net Income	$ (709,750)	$ (316,250)	$437,750	$601,750	$802,750
b. Cash Outflows					
Debt Service Reserve	$ (175,000)	$ -	$ -	$ -	$ -
Interest Reserve	(350,000)	-	-	-	-
Depreciation Reserve	-	(439,000)	(218,000)	(216,000)	(216,000)
Financing	(35,000)	-	-	-	-
Capital Expenditures	(2,583,000)	-	-	-	-
Total	$ (3,143,000)	$ (439,000)	$ (218,000)	$ (216,000)	$ (216,000)
c. Cash Inflows					
Interest Reserve	$175,000	$105,000	$ -	$ -	$ -
Depreciation Reserve	-	-	-	-	-
Investment Capital	-	-	-	-	-
Start Up Funds	-	-	-	-	-
Grants (infrastructure)	-	-	-	-	-
Grants (customer premises)	-	-	-	-	-
10-Year Bond/Loan Proceeds	-	-	-	-	-
20-Year Bond Proceeds	3,500,000	-	-	-	-
Loan Proceeds	-	-	-	-	-
Total	$3,675,000	$105,000	$ -	$ -	$ -
d. Total Cash Outflows and Inflows	$532,000	$ (334,000)	$ (218,000)	$ (216,000)	$ (216,000)
e. Non-Cash Expenses - Depreciation	$233,000	$1,253,000	$623,000	$616,000	$616,000
f. Adjustments					
Proceeds from Additional Cash Flows (10 Year Bond)	$ -	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (20 Year Bond)	$ (3,500,000)	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (Loan)	$ -	$ -	$ -	$ -	$ -
g. Adjusted Available Net Revenue	$ (3,444,750)	$602,750	$842,750	$1,001,750	$1,202,750
h. Principal Payments on Debt					
10 Year Bond Principal	$ -	$ -	$ -	$ -	$ -
20 Year Bond Principal	-	450,000	574,000	732,000	935,000
Loan Principal	-	-	-	-	-
Total	$ -	$450,000	$574,000	$732,000	$935,000
j. Cash Balance					
Unrestricted Cash Balance	$55,250	$57,250	$909,000	$2,257,750	$3,601,500
Depreciation Reserve	-	1,132,000	1,154,000	366,000	(118,000)
Interest Reserve	175,000	-	-	-	-
Debt Service Reserve	175,000	630,000	630,000	630,000	630,000
Total Cash Balance	$405,250	$1,819,250	$2,693,000	$3,253,750	$4,113,500

Significant network expenses—known as "capital additions"—are incurred in the first few years during the construction phase of the network. These represent the equipment and labor expenses associated with building, implementing, and lighting a fiber network. Table 26 shows the capital additions costs in years one, two, and three, and the total for years one through three.

This analysis projects that the capital additions in year one will total approximately $2.6 million. These costs will total approximately $3.5 million in year two, $1.8 million in year three, and $2.6 million in year four. This totals just over $10.5 million for total capital additions costs for years one through four.

Table 26: Capital Additions – Wholesale Model

Capital Additions		Year 1	Year 2	Year 3	Year 4
Network Equipment					
Core Network Equipment		$380,000	$ -	$ -	$ -
TBD		-	-	-	-
Additional Annual Capital		-	-	-	-
	Total	$380,000	$ -	$ -	$ -
Outside Plant and Facilities					
Total Backbone and FTTP		$1,635,000	$2,726,000	$1,090,000	$ -
Additional Annual Capital		-	-	-	-
	Total	$1,635,000	$2,726,000	$1,090,000	$ -
Last Mile and Customer Premises Equipment					
CPE (residential and small commercial)		$91,000	$182,000	$182,000	$638,000
CPE (medium commercial)		18,000	36,000	35,000	124,000
CPE (enterprise)		6,000	10,000	10,000	36,000
Average Drop Cost		263,000	525,000	523,000	1,836,000
Additional Annual Replacement Capital		-	-	-	-
	Total	$378,000	$753,000	$750,000	$2,634,000
Miscellaneous Implementation Costs					
Splicing		$ -	$ -	$ -	$ -
Vehicles		50,000	-	-	-
Emergency Restoration Kit		50,000	-	-	-
Work Station, Computers, and Software		5,000	4,000	-	2,000
Fiber OTDR and Other Tools		85,000	-	-	-
Generators & UPS		-	-	-	-
OSS		-	-	-	-
Additional Annual Capital		-	-	-	-
	Total	$190,000	$4,000	$ -	$2,000
Replacement Costs for Depreciation					
Network Equipment		$ -	$ -	$ -	$ -
Customer Premises Equipment		-	-	-	-
Miscellaneous Implementation Costs		-	-	-	-
	Total	$ -	$ -	$ -	$ -
Total Capital Additions		$2,583,000	$3,483,000	$1,840,000	$2,636,000

7.3.2 Operating and Maintenance Expenses

The cost to deploy an FTTP network goes far beyond fiber implementation. Network deployment requires additional staffing for sales and marketing, network operations, and other functions. The addition of new staff and inventory requirements will require office and warehousing space:

- Expand office facilities for management, technical and clerical staff
- Provide warehousing for receipt and storage of cable and hardware for the installation and on-going maintenance of the broadband infrastructure
- Establish location to house servers, switches, routers, and other core-network equipment

Training new and existing staff is important to fully realize the economies of starting the FTTP network. The training will be particularly important in the short-term as the new enterprise establishes itself as a unique entity providing services distinct from services provided by the City today.

The expanded business and increased responsibilities will require the addition of new staff. Even in the wholesale service model - marketing and sales are critical. It is important to be proactive in setting expectations, addressing security concerns, and educating the ISPs on how to initiate services.

The initial additional positions, staffing levels, and base salaries are shown in Table 27. Please note that, in the financial model, a 40 percent overhead is added to the salaries listed below.

Table 27: Labor Expenses – Wholesale Model

	Year 1	Year 2	Year 3	Year 4	Year 5+	Labor Cost
New Employees						
Business Manager	0.50	1.00	1.00	1.00	1.00	130,000
GIS	0.50	1.00	1.00	1.00	1.00	80,000
Communications - Sales	0.25	0.25	0.25	0.25	0.25	75,000
Customer Service Representative	-	-	-	-	-	65,000
Service Technicians/Installers & IT Support	1.00	1.00	1.00	2.00	2.00	90,000
Fiber Plant O&M Technicians	0.25	1.00	1.00	1.00	1.00	90,000
Total New Staff	2.5	4.25	4.25	5.25	5.25	

7.3.3 Summary of Operating and Maintenance Expenses

Additional key operating and maintenance assumptions include:

- Salaries and benefits are based on estimated market wages. See Table 27 for a list of staffing requirements. Benefits are estimated at 40 percent of base salary.
- Insurance is estimated to be $25,000 in year one and $50,000 from year two on.
- Office expense allocations are estimated to be $6,000 per year
- Locates and ticket processing are estimated to start in year one at $8,000, increase to $15,000 in year two, and increase to $31,000 from year three on.
- Contingency is estimated to be $10,000 in year one and $25,000 from year two on.

- Billing and maintenance contract fees are estimated at $10,000 in year one, and $20,000 from year two on.
- Legal fees are estimated to be $50,000 in year one, and $10,000 from year two on.
- Consulting fees are estimated at $50,000 in year one, and $10,000 from year three on.
- Marketing and promotional expenses are estimated to be $30,000 in year one, and $15,000 from year two on.

Vendor maintenance contract fees are expected to start at $43,000 in year two, $52,000 in year three, and $83,000 year four on. Annual variable and operating expenses not including direct Internet access include:

- Education and training are calculated as 2 percent of direct payroll expense.
- Customer billing is estimated to be $0.25 per bill per month.

Fiber network maintenance costs are calculated at 1 percent of the total construction cost, per year. This is estimated based on a typical rate of occurrence in an urban environment, and the cost of individual repairs. This is in addition to staffing costs to maintain fiber.

Internet and peering is estimated at $1.25 per Mbps per month for the first 2 Gbps and $1.00 per Mbps per month thereafter.

7.3.4 Take-Rate Sensitivity

This section shows the large impact that fluctuations in take rate can have on financial modeling. In the following tables, we show the financial projections for take rates of 50 percent, 40 percent, and 30 percent.

As discussed in the retail model, obtaining a 60 percent take rate is considered aggressive, and will likely be difficult to obtain and maintain. Realistically, we would expect a 35 percent to 45 percent take rate.

Table 28, below, shows financial projections for a 50 percent take rate. While projections for year one are identical to our base case scenario of 60 percent (seen in Table 22, above), the City's unrestricted cash balance shows a loss of approximately $641,000 by year five, and this continues to increase. By year 20, the unrestricted cash balance shows a loss of approximately $1.6 million. This is a $5.2 million difference between the base case scenario with a 60 percent take rate and a scenario with a 50 percent take rate.

Table 28: Take Rate Reduced to 50 Percent – Wholesale Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$271,000	$2,053,000	$2,053,000	$2,053,000	$2,053,000
Total Cash Expenses	(572,750)	(918,250)	(918,250)	(918,250)	(918,250)
Depreciation	(233,000)	(1,102,000)	(578,000)	(570,000)	(570,000)
Interest Expense	(175,000)	(549,000)	(432,000)	(284,000)	(94,000)
Taxes	-	-	-	-	-
Net Income	$ (709,750)	$ (516,250)	$124,750	$280,750	$470,750

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$55,250	$ (640,750)	$ (1,226,000)	$ (1,422,250)	$ (1,621,500)
Depreciation Reserve	-	1,026,000	1,087,000	447,000	111,000
Interest Reserve	175,000	-	-	-	-
Debt Service Reserve	175,000	590,000	590,000	590,000	590,000
Total Cash Balance	$405,250	$975,250	$451,000	$ (385,250)	$ (920,500)

As take rate continues to decrease, financial projections follow suit. As shown in Table 29, below, unrestricted cash balance for a take rate of 40 percent falls to a deficit of nearly $1.5 million by year five. This negative balance continues to grow to over $7 million by year 20. Further, with a take rate of 40 percent, the City would not generate a positive net income until year 20.

Compared to the base model, a 40 percent take rate will dramatically affect unrestricted cash balance, result in a nearly $1.5 million difference by year five, and an over $10.5 million difference by year 20.

Table 29: Take Rate Reduced to 40 Percent – Wholesale Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$271,000	$1,632,000	$1,632,000	$1,632,000	$1,632,000
Total Cash Expenses	(572,750)	(903,250)	(903,250)	(903,250)	(903,250)
Depreciation	(233,000)	(952,000)	(532,000)	(524,000)	(524,000)
Interest Expense	(175,000)	(504,000)	(395,000)	(257,000)	(81,000)
Taxes	-	-	-	-	-
Net Income	$ (709,750)	$ (727,250)	$ (198,250)	$ (52,250)	$ 123,750

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$55,250	$ (1,447,750)	$ (3,501,000)	$ (5,268,250)	$ (7,039,500)
Depreciation Reserve	-	920,000	1,020,000	525,000	334,000
Interest Reserve	175,000	-	-	-	-
Debt Service Reserve	175,000	545,000	545,000	545,000	545,000
Total Cash Balance	$405,250	$17,250	$ (1,936,000)	$ (4,198,250)	$ (6,160,500)

Table 30 shows our lowest projected take rate of 30 percent. In this model, the unrestricted cash balance is a deficit of over $2 million by year five, and the deficit continues to grow to over $12 million by year twenty. In this model, the City is unable to generate a positive net income over the course of 20 years.

In comparison to our base model of a 60 percent take rate, the difference in unrestricted cash balance by year five is over $2.2 million, and nearly $16 million by year 20.

Table 30: Take Rate Reduced to 30 Percent – Wholesale Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$271,000	$1,226,000	$1,226,000	$1,226,000	$1,226,000
Total Cash Expenses	(572,750)	(893,250)	(893,250)	(893,250)	(893,250)
Depreciation	(233,000)	(801,000)	(486,000)	(479,000)	(479,000)
Interest Expense	(175,000)	(465,000)	(362,000)	(234,000)	(68,000)
Taxes	-	-	-	-	-
Net Income	$ (709,750)	$ (933,250)	$ (515,250)	$ (380,250)	$ (214,250)

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$55,250	$ (2,155,750)	$ (5,671,000)	$ (9,014,250)	$ (12,358,500)
Depreciation Reserve	-	814,000	952,000	610,000	572,000
Interest Reserve	175,000	-	-	-	-
Debt Service Reserve	175,000	505,000	505,000	505,000	505,000
Total Cash Balance	$405,250	$ (836,750)	$ (4,214,000)	$ (7,899,250)	$ (11,281,500)

7.4 Dark FTTP Model Financial Analysis

The financial analysis for all scenarios presented here represents a minimum requirement for the City to break even each year, excluding any potential revenue from other dark fiber lease opportunities that may be available to the City.

The base case scenario assumes that the City's private partner will pay a fee of $40 per passing per month, with no upfront or balloon payments. Based on an assumption that the City will deploy an FTTP network in the identified business area, the financial model applies the fee to all business premises in the identified service area. The current model keeps constant the $40 per passing fee, though the City and its partner could negotiate periodic increases.

Please note there is no market data or examples of the dark FTTP model with a business focus. For example, in its agreement with Huntsville Utilities in Huntsville, Alabama, Google Fiber pays under $10 per month per passing, but this is for residences only—no businesses are included. The per-passing fee is the largest "risk" in the model and could be tested with the recommended RFI.

Further, the $40 fee is based on a full recovery of capital and expenses. The FTTP deployment is likely to have additional economic development and other benefits that are not easily measured. In recognition of these benefits, the City could choose to provide funding to the proposed enterprise that would lower the required per passing fee.

The financial analysis for the base case scenario is as follows:

Table 31: Base Case Financial Analysis – Dark FTTP Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$6,140	$1,226,880	$1,226,880	$1,226,880	$1,226,880
Total Cash Expenses	(373,750)	(549,250)	(549,250)	(549,250)	(549,250)
Depreciation	(119,000)	(311,000)	(311,000)	(311,000)	(311,000)
Interest Expense	(130,000)	(351,000)	(275,000)	(176,000)	(51,000)
Taxes	-	-	-	-	-
Net Income	$ (616,610)	$15,630	$91,630	$190,630	$315,630

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (6,610)	$10,340	$25,490	$40,640	$56,790
Depreciation Reserve	-	141,000	185,000	229,000	273,000
Interest Reserve	130,000	-	-	-	-
Debt Service Reserve	130,000	380,000	380,000	380,000	380,000
Total Cash Balance	$253,390	$531,340	$590,490	$649,640	$709,790

Please note that we used a "flat model" in the analysis, which means that inflation and operating cost increases (including salaries) are not used because it is assumed that operating cost increases will be offset by increases in operator lease payments over time (and likely passed on to subscribers in the form of increased prices). We anticipate that the City will apply an inflation factor, typically based on a Consumer Price Index (CPI), to the portion of the per-subscriber fee that covers projected operating expenses during negotiations with a private partner. Please note that it is not appropriate to apply a CPI to the entire passing fee because most of the fee is to support the principal and interest on the debt service.

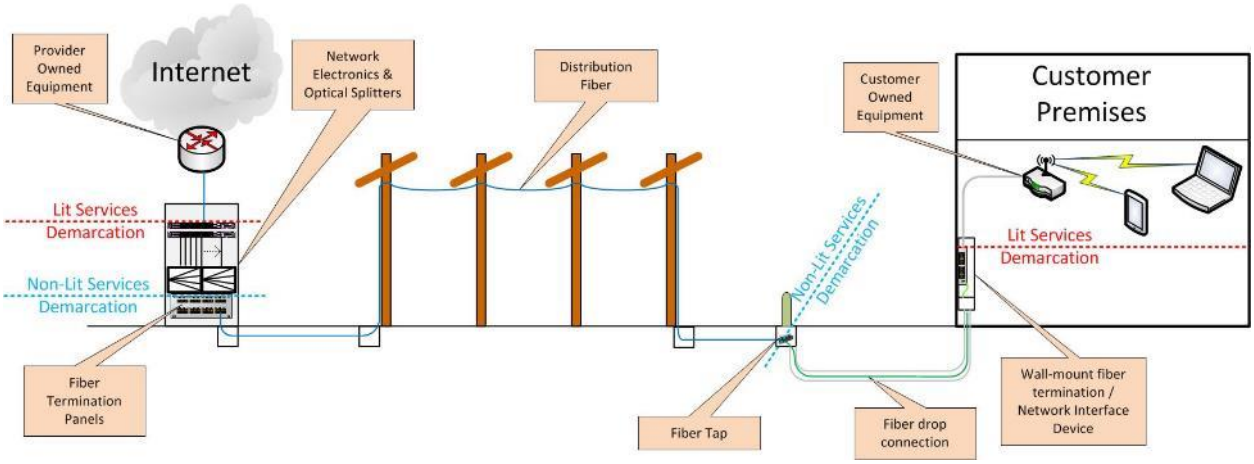
This document presents an overview of the financial model; we have provided the City with a complete financial model in Excel format. Because the Excel spreadsheets can be manipulated to show the impact of changing assumptions it will be an important tool for the City to use as it negotiates with a private partner.

This analysis does not contain any potential revenue from wireless ISPs that are looking for connectivity to wireless access points. A wireless ISP could leverage the FTTP infrastructure and avoid drop costs and investment in the electronics for the FTTP network. The use of the fiber is dependent upon the wireless technologies implemented by the wireless ISP.

7.4.1 Cost Implications of the Dark FTTP Model

The financial analysis in this section assumes that the City constructs and owns the FTTP infrastructure up to a demarcation point at the optical tap near each residence and business, and leases the dark fiber backbone and distribution fiber to a private partner. The private partner would be responsible for all network electronics, fiber drops to subscribers, and CPEs—as well as network sales, marketing, and operations.

Figure 11: Demarcation Between City and Partner Network Elements



Using 100 percent underground construction, the dark FTTP network deployment for the business park will cost approximately $5.5 million, including OSP construction labor, materials, engineering, permitting, and pole attachment licensing. This estimate does not include and electronics, subscriber equipment, or drops.

Table 32: Breakdown of Estimated Dark FTTP Model Cost (aerial and underground construction)

Cost Component	Total Estimated Cost
OSP Engineering	$519,000
Quality Control/Quality Assurance	192,000
General OSP Construction Cost	3,158,000
Special Crossings	703,000
Backbone and Distribution Plant Splicing	139,000
Backbone Hub, Termination, and Testing	475,000
FTTP Lateral Installations	265,000
Total Estimated Cost:	$5,451,000

The above estimates assume that the City constructs and owns the FTTP infrastructure up to a demarcation point at the optical tap near each business, and leases the dark fiber backbone and distribution fiber to a private partner. The private partner would be responsible for all network electronics, fiber drops to subscribers, and CPEs—as well as network sales, marketing, and operations.

The ownership of the drops is an assumption that could be changed through negotiation with a private partner—as, indeed, could many of the assumptions underpinning this analysis. We have chosen this key parameter for the base case scenario because we believe this approach presents a reasonable balance of costs, control, and risk for the City. (City ownership of the drops, for example, would increase the City's control, but also significantly increase the City's costs.)

In a related vein, we note that some network operators suggest that the network's optical splitters should be a part of the Layer 1 or dark fiber assets. We caution against this approach. The network operator (i.e., the City's partner) should maintain the splitters because, as operator of the electronics, it must determine and control the GPON network split ratio to meet the network's performance standards. This may involve moving power users to GPON ports with lower split ratios, or moving users to different splitters to manage the capacity of the GPON ports. The City should not be involved in this level of network management. Also, the City should not have to inventory various sized splitters or swap them as the network operator makes changes. Even if the City were to decide to purchase some of the optical splitters for the network, we believe it should be the network operator's responsibility to manage and maintain the splitters.

7.4.2 Financing Costs and Operating Expenses

For the base financial analysis, we used the OSP costs for a combination aerial and underground construction. In the scenarios, we show the impact of the increased costs for an all-underground deployment.

This financial analysis assumes that the City will cover all its capital requirements with general obligation (GO) bonds. We assumed that the City's bond rate would be 5 percent.

We expect that the City will take three 20-year bonds—one each in years one, two, and three—for a total of $7.6 million in financing. (The difference between the financed amount and the total capital costs represents the amount needed to maintain positive cash flow in the early years of network deployment.) The resulting principal and interest (P&I) payments will be the major factor in determining the City's long-term financial requirements; P&I accounts for about 53 percent of the City's annual costs in our base case model after the construction period.

We project that the bond issuance costs will be equal to 1.0 percent of the principal borrowed. For the bond, a debt service reserve account is maintained at 5.0 percent of the total issuance amount. An interest reserve account will be maintained for the first two years. Principal repayment on the bonds will start in year two.

The model assumes a straight-line depreciation of assets, and that the OSP and materials will have a 20-year life span. Because we assume the City's partner will be responsible for network electronics and CPE, we have not included depreciation or replacement costs for that equipment (although we note that, typically, network equipment would be replaced after 10 years, while CPE and last-mile infrastructure would be depreciated over five years). The model plans for a depreciation reserve account starting in year three to fund future replacements and upgrades.

Table 33 shows the income statement for years one, five, 10, 15, and 20.

Table 33: Income Statement – Dark FTTP Model

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Revenues					
Internet - Business	$ -	$ -	$ -	$ -	$ -
Connection Fee (net)	-	-	-	-	-
Per Passing	6,140	1,226,880	1,226,880	1,226,880	1,226,880
Per Customer	-	-	-	-	-
Provider Fee	-	-	-	-	-
Assessments	-	-	-	-	-
Ancillary Revenues	-	-	-	-	-
Total	$ 6,140	$ 1,226,880	$ 1,226,880	$ 1,226,880	$ 1,226,880
b. Content Fees					
Internet	$ -	$ -	$ -	$ -	$ -
Total	$ -	$ -	$ -	$ -	$ -
c. Operating Costs					
Operation Costs	$169,000	$194,000	$194,000	$194,000	$194,000
Labor Costs	204,750	355,250	355,250	355,250	355,250
Total	$373,750	$549,250	$549,250	$549,250	$549,250
d. EBITDA	$ (367,610)	$ 677,630	$ 677,630	$ 677,630	$ 677,630
e. Depreciation	119,000	311,000	311,000	311,000	311,000
f. Operating Income (EBITDA less Depreciation)	$ (486,610)	$366,630	$366,630	$366,630	$366,630
g. Non-Operating Income					
Interest Income	$ -	$1,000	$1,000	$2,000	$2,000
Interest Expense (10 Year Bond)	-	-	-	-	-
Interest Expense (20 Year Bond)	(130,000)	(352,000)	(276,000)	(178,000)	(53,000)
Interest Expense (Loan)	-	-	-	-	-
Total	$ (130,000)	$ (275,000)	$ (275,000)	$ (176,000)	$ (51,000)
h. Net Income (before taxes)	$ (616,610)	$15,630	$91,630	$190,630	$315,630
i. Facility Taxes	$ -	$ -	$ -	$ -	$ -
j. Net Income	$ (616,610)	$15,630	$91,630	$190,630	$315,630

Table 34 shows the cash flow statement for years one, five, 10, 15, and 20.

Table 34: Cash Flow Statement – Dark FTTP Model

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
a. Net Income	$ (616,610)	$15,630	$91,630	$190,630	$315,630
b. Cash Outflows					
Debt Service Reserve	$ (130,000)	$ -	$ -	$ -	$ -
Interest Reserve	(260,000)	-	-	-	-
Depreciation Reserve	-	(47,000)	(47,000)	(47,000)	(47,000)
Financing	(26,000)	-	-	-	-
Capital Expenditures	(1,823,000)	-	-	-	-
Total	$ (2,239,000)	$ (47,000)	$ (47,000)	$ (47,000)	$ (47,000)
c. Cash Inflows					
Interest Reserve	$130,000	$ -	$ -	$ -	$ -
Depreciation Reserve	-	-	-	-	-
Investment Capital	-	-	-	-	-
Start Up Funds	-	-	-	-	-
Grants (infrastructure)	-	-	-	-	-
Grants (customer premises)	-	-	-	-	-
10-Year Bond/Loan Proceeds	-	-	-	-	-
20-Year Bond Proceeds	2,600,000	-	-	-	-
Loan Proceeds	-	-	-	-	-
Total	$ 2,730,000	$ -	$ -	$ -	$ -
d. Total Cash Outflows and Inflows	$491,000	$ (47,000)	$ (47,000)	$ (47,000)	$ (47,000)
e. Non-Cash Expenses - Depreciation	$119,000	$311,000	$311,000	$311,000	$311,000
f. Adjustments					
Proceeds from Additional Cash Flows (10 Year Bond)	$ -	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (20 Year Bond)	$ (2,600,000)	$ -	$ -	$ -	$ -
Proceeds from Additional Cash Flows (Loan)	$ -	$ -	$ -	$ -	$ -
g. Adjusted Available Net Revenue	$ (2,606,610)	$279,630	$355,630	$454,630	$579,630
h. Principal Payments on Debt					
10 Year Bond Principal	$ -	$ -	$ -	$ -	$ -
20 Year Bond Principal	-	277,000	353,000	451,000	576,000
Loan Principal	-	-	-	-	-
Total	$ -	$277,000	$353,000	$451,000	$576,000

j. Cash Balance					
Unrestricted Cash Balance	$ (6,610)	$10,340	$25,490	$40,640	$56,790
Depreciation Reserve	-	141,000	185,000	229,000	273,000
Interest Reserve	130,000	-	-	-	-
Debt Service Reserve	130,000	380,000	380,000	380,000	380,000
Total Cash Balance	$253,390	$531,340	$590,490	$649,640	$709,790

Significant network expenses—known as "capital additions"—are incurred in the first few years during the construction phase of the network. These represent the equipment and labor expenses associated with building a fiber network. (Again, because the City's responsibility will be limited to OSP, we have not included any costs for core network equipment, drops, or CPE.) This analysis projects that the capital additions (including vehicles and test equipment) in year one will total approximately $1.8 million. These costs will total approximately $2.7 million in year two, and $1.1 million in year three. This totals just over $5.6 million in capital additions for years one through three.

Table 35 – Capital Additions – Dark FTTP Model

Capital Additions		Year 1	Year 2	Year 3
Network Equipment				
Core Network Equipment		$ -	$ -	$ -
TBD		-	-	-
Additional Annual Capital		-	-	-
	Total	$ -	$ -	$ -
		$ -	$ -	$ -
Outside Plant and Facilities				
Total Backbone and FTTP		$1,635,000	$2,726,000	$1,090,000
Additional Annual Capital		-	-	-
	Total	$1,635,000	$2,726,000	$1,090,000
Last Mile and Customer Premises Equipment				
CPE (residential and small commercial)		$ -	$ -	$ -
CPE (medium commercial)		-	-	-
CPE (enterprise)		-	-	-
Average Drop Cost		-	-	-
Additional Annual Replacement Capital		-	-	-
	Total	$ -	$ -	$ -
Miscellaneous Implementation Costs				
Splicing		$ -	$ -	$ -
Vehicles		50,000	-	-
Emergency Restoration Kit		50,000	-	-
Work Station, Computers, and Software		3,000	3,000	-
Fiber OTDR and Other Tools		85,000	-	-
Generators & UPS		-	-	-
OSS		-	-	-
Additional Annual Capital		-	-	-
	Total	$188,000	$3,000	$ -
Replacement Costs for Depreciation				
Network Equipment		$ -	$ -	$ -
Customer Premises Equipment		-	-	-
Miscellaneous Implementation Costs		-	-	-
	Total	$ -	$ -	$ -
	Total Capital Additions	$1,823,000	$2,729,000	$1,090,000

7.4.3 Operating and Maintenance Expenses

The cost to deploy an FTTP network goes far beyond fiber implementation. Network deployment requires network maintenance and technical operations, and other functions. In this model, we assume that the City's partner will be responsible for lighting the fiber and selling services, so the City's financial requirements are limited to expenses related to OSP infrastructure and network administration.

These expanded responsibilities will require the addition of new staff. We assume the City will add a total of three and three-quarters full-time-equivalent (FTE) positions within the first three years, and will then maintain that level of staffing. Our assumptions include one-half FTE for management, one FTE for GIS, one-quarter FTE for communication support, and one FTE for fiber plant maintenance and operations. Salaries and benefits are based on estimated market wages, and benefits are estimated at 40 percent of base salary.

Some of these responsibilities can be contracted out, while some can be absorbed into existing positions within the City. Each City's circumstances are unique, and the skill sets that exist within an organization will inform to what degree responsibilities must be contracted out. We encourage the City to train internal staff for all record-keeping responsibilities—particularly network details such as fiber strand usage and locations. We cannot overstate the importance of keeping meticulous records on the fiber to maintain the long-term integrity of the network, and keeping this function in-house gives the City the greatest degree of control over these records' accuracy.

Locates and ticket processing will be significant ongoing operational expenses for the City. Based on our experience in other cities, we estimate that a contract for locates will cost $8,000 in year one, increase to $15,000 in year two, and increase to $31,000 from year three on. (If the City decides to perform this work in-house, the contract expense would be eliminated—but staffing expenses would increase.)

Additional key operating and maintenance assumptions include the following:

- Insurance is estimated to be $25,000 in year one and $50,000 from year two on.
- Office expenses are estimated to be $2,400 annually.
- Contingency expenses are estimated at $10,000 in year one and $25,000 in subsequent years.
- Legal fees are estimated to be $50,000 in year one and $10,000 from year two on.
- Consulting fees are estimated at $50,000 in year one and $10,000 from year two on.

Fiber network maintenance costs are calculated at one percent of the total construction cost, per year. This is estimated based on a typical rate of occurrence in an urban environment, and the cost of individual repairs. This is in addition to staffing costs to maintain the fiber.

Table 36 lists the City's projected operating expenses for years one, five, 10, 15, and 20.

Table 36: Operating Expenses Dark FTTP Model

Operating Expenses	Year 1	Year 5	Year 10	Year 15	Year 20
Support Services	$ -	$ -	$ -	$ -	$ -
Insurance	25,000	50,000	50,000	50,000	50,000
Utilities	-	-	-	-	-
Office Expenses	6,000	6,000	6,000	6,000	6,000
Facility Lease	-	-	-	-	-
Locates & Ticket Processing	8,000	31,000	31,000	31,000	31,000
Peering	-	-	-	-	-
Contingency	10,000	25,000	25,000	25,000	25,000
Billing Maintenance Contract	-	-	-	-	-
Fiber & Network Maintenance	16,000	55,000	55,000	55,000	55,000
Vendor Maintenance Contracts	-	-	-	-	-
Legal and Lobby Fees	50,000	10,000	10,000	10,000	10,000
Planning	-	-	-	-	-
Consulting	50,000	10,000	10,000	10,000	10,000
Marketing	-	-	-	-	-
Education and Training	4,000	7,000	7,000	7,000	7,000
Customer Handholding	-	-	-	-	-
Customer Billing (Unit)	-	-	-	-	-
Allowance for Bad Debts	-	-	-	-	-
Churn (acquisition costs)	-	-	-	-	-
Pole Attachment Expense	-	-	-	-	-
Internet	-	-	-	-	-
Sub-Total	$169,000	$194,000	$194,000	$194,000	$194,000
Labor Expenses	$204,750	$355,250	$355,250	$355,250	$355,250
Sub-Total	$204,750	$355,250	$355,250	$355,250	$355,250
Total Expenses	$373,750	$549,250	$549,250	$549,250	$549,250

7.4.4 Revenue

The base case scenario assumes that the City's private partner will pay a fee of $40 per passing per month, with no upfront or balloon payments. Based on an assumption that the City will deploy a ubiquitous FTTP network in the business park. The financial model applies the fee to all business premises in the business park. The current model keeps that $40 per passing fee constant, although the City and its partner could negotiate periodic increases.

Operating and maintenance expenses account for approximately 47 percent of the City's total annual costs. (P&I payment on debt is the remaining amount.) At a minimum, 47-percent of the per-passing fee should be increased by a CPI each year.

In the scenarios below, we show the sensitivity of the monthly fee.

7.4.5 Dark FTTP Fee Sensitivity

This section demonstrates the sensitivity of the financial projections to changes in per passing fee. We show the financial projects for fees at $35, $30, and $25 per passing per month.

Table 37, below, shows financial analysis for a $35 per month passing fee. In this model, the unrestricted cash balance shows a loss of approximately $435,000 by year five, and more than $2.6 million by year 20.

Compared to our base model of a $40 per-month passing fee, the decreased fee results in an unrestricted cash balance difference of $760 at year one, growing to an approximately $445,000 difference by year 5, and ultimately a difference of over $2.7 million by year 20.

Table 37: Dark FTTP Model Financial Analysis - $35 Per Month Passing Fee

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$5,380	$1,073,520	$1,073,520	$1,073,520	$1,073,520
Total Cash Expenses	(373,750)	(549,250)	(549,250)	(549,250)	(549,250)
Depreciation	(119,000)	(311,000)	(311,000)	(311,000)	(311,000)
Interest Expense	(130,000)	(351,000)	(275,000)	(176,000)	(51,000)
Taxes	-	-	-	-	-
Net Income	$ (617,370)	$ (137,730)	$ (61,730)	$37,270	$162,270

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (7,370)	$ (435,160)	$ (1,186,810)	$ (1,938,460)	$ (2,689,110)
Depreciation Reserve	-	141,000	185,000	229,000	273,000
Interest Reserve	130,000	-	-	-	-
Debt Service Reserve	130,000	380,000	380,000	380,000	380,000
Total Cash Balance	$252,630	$85,840	$ (621,810)	$ (1,329,460)	$ (2,036,110)

As the per-passing fee decreases, unrestricted cash balance and net income also decrease. Table 38, below, shows financial projections for a $30 per month passing fee. Were the City to charge this fee, we project an unrestricted cash balance deficit of $8,140 at year one, and that deficit increasing to over $5 million by year 20.

In comparison to our base model of a $40 per month passing fee, a $30 fee results in an unrestricted cash balance difference of $1,530 at year 1, growing to a difference of nearly $5.5 million by year 20.

Table 38: Dark FTTP Model Financial Analysis - $30 Per Month Passing Fee

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$4,610	$920,160	$920,160	$920,160	$920,160
Total Cash Expenses	(373,750)	(549,250)	(549,250)	(549,250)	(549,250)
Depreciation	(119,000)	(311,000)	(311,000)	(311,000)	(311,000)
Interest Expense	(130,000)	(351,000)	(275,000)	(176,000)	(51,000)
Taxes	-	-	-	-	-
Net Income	$ (618,140)	$ (291,090)	$ (215,090)	$ (116,090)	$ 8,910

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (8,140)	$ (880,680)	$ (2,399,130)	$ (3,917,580)	$ (5,435,030)
Depreciation Reserve	-	141,000	185,000	229,000	273,000
Interest Reserve	130,000	-	-	-	-
Debt Service Reserve	130,000	380,000	380,000	380,000	380,000
Total Cash Balance	$251,860	$ (359,680)	$ (1,834,130)	$ (3,308,580)	$ (4,782,030)

Table 39, below, shows our projections for the lowest passing fee of $25 per month. In this projection, the unrestricted cash balance begins as a deficit of $8,910, with that deficit growing to $8.1 million by year twenty. Further, this per-passing fee is unable to generate positive net income over the twenty-year projection.

In comparison to our base model, a $25 per month passing fee results in a difference of $2,300 at year one, $1.3 million difference by year five, and ultimately an $8.2 million difference by year 20.

Table 39: Dark FTTP Model Financial Analysis - $25 Per Month Passing Fee

Income Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Total Revenues	$3,840	$766,800	$766,800	$766,800	$766,800
Total Cash Expenses	(373,750)	(549,250)	(549,250)	(549,250)	(549,250)
Depreciation	(119,000)	(311,000)	(311,000)	(311,000)	(311,000)
Interest Expense	(130,000)	(351,000)	(275,000)	(176,000)	(51,000)
Taxes	-	-	-	-	-
Net Income	$ (618,910)	$ (444,450)	$ (368,450)	$ (269,450)	$ (144,450)

Cash Flow Statement	Year 1	Year 5	Year 10	Year 15	Year 20
Unrestricted Cash Balance	$ (8,910)	$ (1,326,190)	$ (3,611,440)	$ (5,896,690)	$ (8,180,940)
Depreciation Reserve	-	141,000	185,000	229,000	273,000
Interest Reserve	130,000	-	-	-	-
Debt Service Reserve	130,000	380,000	380,000	380,000	380,000
Total Cash Balance	$251,090	$ (805,190)	$ (3,046,440)	$ (5,287,690)	$ (7,527,940)

Appendix A: Glossary of Terms

The descriptions in our FTTP design and cost estimate analysis are highly technical and make use of several acronyms that can be confusing, especially to a non-technical audience. While we try to define each acronym the first time it appears in the text, we also believe that a glossary can be a useful tool to navigate this document. This section outlines most of the acronyms that appear in this analysis.

AE – Active Ethernet; a technology that provides a symmetrical (upload/download) Ethernet service and does not share optical wavelengths with other users. For subscribers that receive Active Ethernet service—typically business customers that request a premium service or require greater bandwidth—a single dedicated fiber goes directly to the subscriber premises with no optical splitting.

CPE – Customer premises equipment; the electronic equipment installed at a subscriber's home or business.

Distribution Fiber – The fiber in an FTTP network that connects the hub sites to the fiber distribution cabinets (see below).

Drop – The fiber connection from an optical tap in the ROW to the customer premises.

FDC – Fiber distribution cabinet; houses the fiber connections between the distribution fiber and the access fiber. FDCs, which can also house network electronics and optical splitters, can sit on a curb, be mounted on a pole, or reside in a building.

Access Fiber – The fiber in an FTTP network that goes from the FDCs to the optical taps that are located outside of homes and businesses in the rights-of-way.

FTTP – Fiber-to-the-premises; a network architecture in which fiber optics are used to provide broadband services all the way to each subscriber's premises.

GPON – Gigabit passive optical network; the most commonly provisioned FTTP service—used, for example, by Verizon (in its FiOS systems), Google Fiber, and Chattanooga Electric Power Board (EPB). GPON uses passive optical splitting, which is performed inside FDCs, to connect fiber from the Optical Line Terminals (OLTs) to multiple customer premises over a single GPON port.

Hub – At the hub, optical splitting is used to distribute network services deeper into the community, enabling eventual FTTP connections.

IP – Internet Protocol; the method by which computers share data on the Internet.

LEC – Local Exchange Carrier; a public telephone company that provides service to a local or regional area.

MDU – Multi-dwelling unit (i.e., an apartment or office building).

OLT – Optical Line Terminal; the upstream connection point (to the provider core network) for subscribers. The choice of an optical interface installed in the OLT determines whether the network provisions shared access (one fiber split among multiple subscribers in a GPON architecture) or dedicated Active Ethernet access (one port for one subscriber).

OSP – Outside plant; the physical portion of a network (also called "layer 1") that is constructed on utility poles (aerial) or in conduit (underground).

OSS – Operational Support Systems (OSS); includes a provider's provisioning platforms, fault and performance management systems, remote access, and other operational support systems for FTTP operations. OSS is housed in a network's core locations.

OTT – Over-the-top; content, such as voice or video service, that is delivered over a data connection.

Passing – A potential customer address, typically an individual home or business. Note that, in this report, the passing count includes individual single-unit buildings and units in small multi-business buildings as single passings. It treats larger multi-tenant businesses as single passings. In the Industrial Corridor, we estimated 2,556 passings that serve 5,100 businesses.

Peering – An interconnection between two service providers, or a service provider and an application provider (Netflix, Dropbox, etc.) to facilitate faster, less-expensive connections.

PON – Passive optical network; uses passive optical splitting, which is performed inside FDCs, to connect fiber from the OLTs to multiple customer premises over a single PON port.

POP – Point of presence; a physical location where network switches, routers, and servers are housed. POPs frequently offer appropriate power, cooling, and security resources for network equipment, peering (see above) and at times enable connections to multiple ISPs.

POTS – "Plain old telephone service;" delivered over the PSTN.

PSTN – Public switched telephone network; the copper-wire telephone networks that connect landline phones.

QoS – Quality of service; a network's performance as measured on a number of attributes.

ROW – Right-of-way; land reserved for the public good such as utility construction. ROW typically abuts public roadways.

VoIP – Voice over Internet Protocol; telephone service that is delivered over a data connection.

Appendix B: Assessment of Local Broadband Market

This Appendix is attached as a separate PDF file.

Appendix C: Retail Financial Model (spreadsheet)

This Appendix is attached as a separate Microsoft Excel file.

Appendix D: Wholesale Financial Model (spreadsheet)

This Appendix is attached as a separate Microsoft Excel file.

Appendix E: Dark FTTP Financial Model (spreadsheet)

This Appendix is attached as a separate Microsoft Excel file.

Appendix F: Online Business Survey Questions

This appendix is attached as a separate PDF file.

Appendix G: Online Business Survey Results

To understand the potential market demand for fiber connectivity and related services among Hayward businesses, CTC conducted an online survey in summer 2016. At a high level, the survey showed that the respondents that completed the questionnaire are not overwhelmingly unhappy with their current speeds, and that there is a modest willingness to switch to a higher-speed service—but only if the price point is $75 per month or less.

Most of the businesses indicated that price, reliability, and speed are important factors for them to consider as their connectivity needs evolve and they become increasingly dependent on cloud-based business solutions to support their operations.

Survey Methodology

The survey was sent out via e-email on behalf of the City to approximately 2,600 businesses in July 2016. An online survey mechanism enabled completion of the survey questionnaires over the Internet. The survey was designed to collect a range of data to understand businesses' current use of data and Internet services; satisfaction with current service providers; and interest in new, higher-speed data and Internet service offerings.

The survey's e-mail distribution list was culled from data purchased from InfoUSA on approximately 900 businesses located in Hayward, in conjunction with email lists provided by the City and Chamber of Commerce. CTC worked with City staff to develop a set of questions for Hayward businesses, which were then entered into a survey instrument on SurveyMonkey, an online tool that allows for customization, and provides granular output of responses in various formats for analysis. The survey questionnaire is attached to this report as Appendix C.

50 recipients opted out of the survey; 18 emails were returned as undeliverable; and 1,545 emails were unopened. Of the 1,006 potential respondents that opened the email, 183 clicked through. There were 156 total responses through the email collector, which included the original email we sent through SurveyMonkey.

In the weeks following the initial SurveyMonkey email notification, the City sent a follow-up email outside the SurveyMonkey system, which contained a web link for potential respondents to access the survey. There were 103 responses collected through the web link, for a total of 259 responses all together. Of the approximately 2,600 email recipients, there were 259 respondents that filled out at least some portion of the survey.

While there were 259 responses to the survey, not every respondent completed the full survey, as respondents were able to skip questions and answer questions only partially. We designed the survey in this way to encourage respondents to answer questions for which they had a response, while not forcing them to attempt to answer questions they do not believe are

applicable to their business. Although this does not produce statistically valid results, it can provide insight into the business community's connectivity needs, their willingness to switch to a new provider, and what role they believe the City should play in an FTTP deployment.

Further, a secondary purpose of the survey was to identify potential businesses that would be willing to further discuss their connectivity needs, and their potential willingness to purchase services from the City. The final questions in the survey prompted willing respondents to provide specific information about their contact information and their willingness to speak in greater detail with City representatives about their connectivity needs. While 77 respondents listed their business' specific address, only 41 respondents indicated a willingness to be contacted further. CTC was able to reach 24 businesses for follow-up discussions.

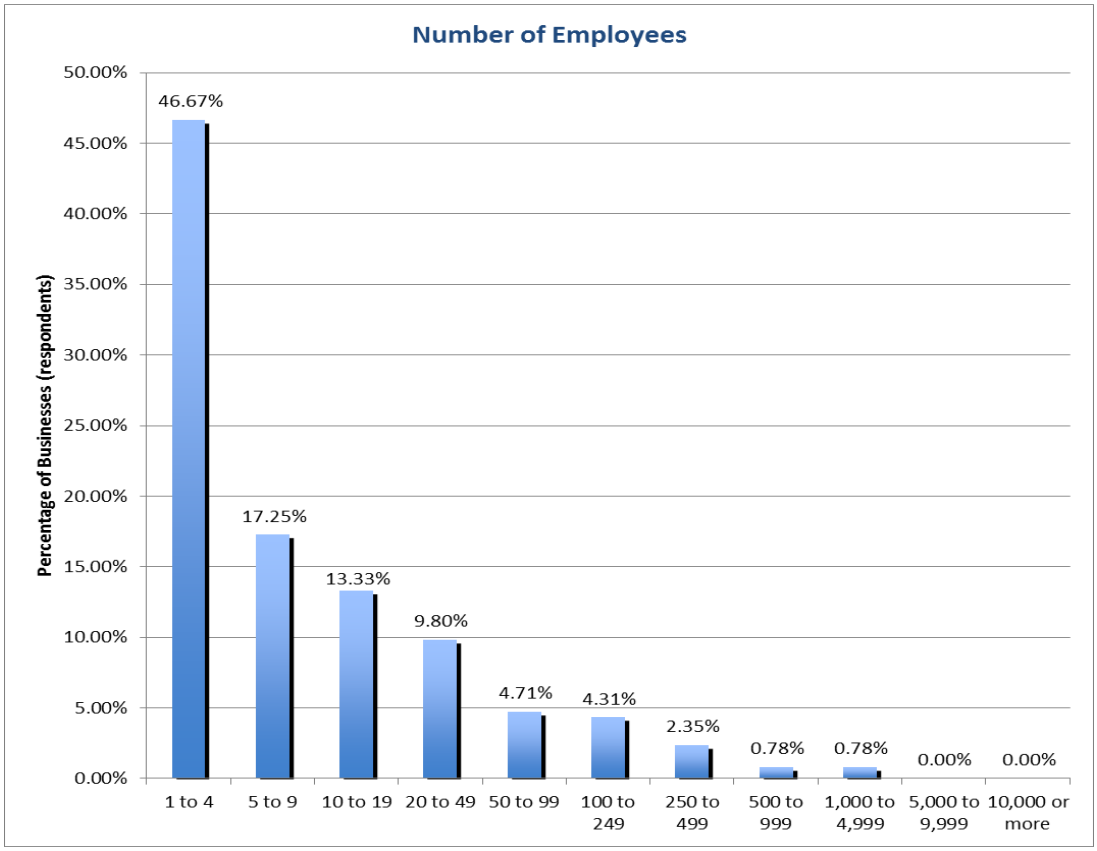
Online Survey Results

As we noted, the survey had some inherent limitations, and the respondents are not truly representative of a random selection of the population. Still, the City can potentially glean some valuable information from the businesses that chose to respond, caveats aside.

The Majority of Responses Were from Small-to-Medium Size Businesses

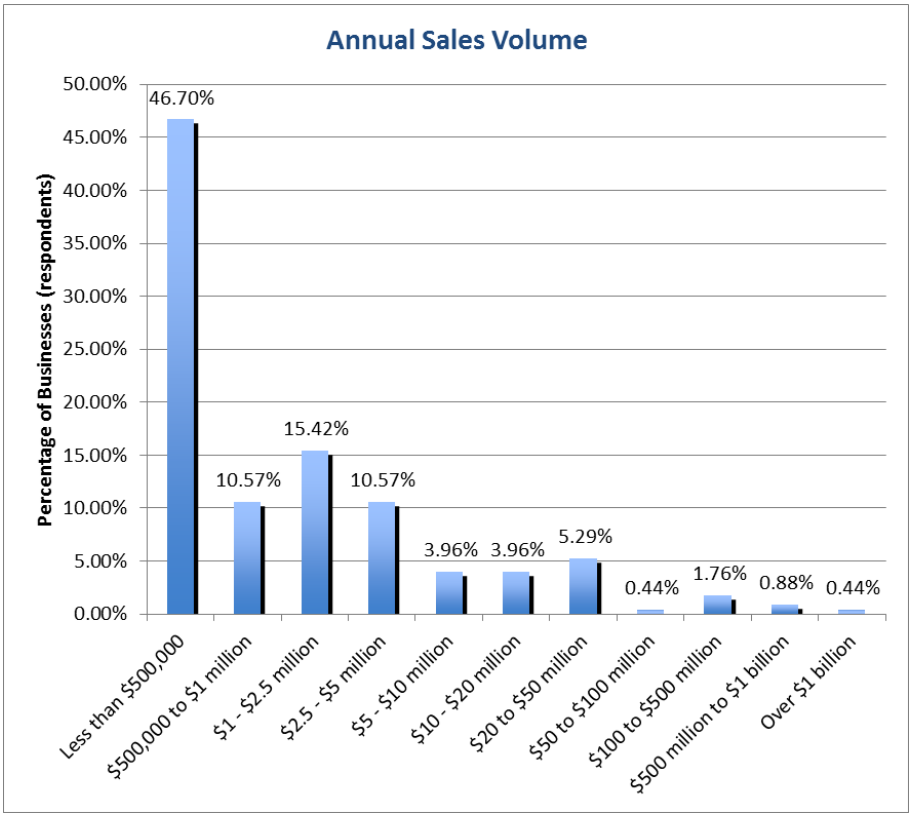
91 percent of the responses were from businesses with only one location. Nearly half the respondents to the business survey represented businesses with 1 to 4 employees, and more than three-quarters (approximately 77.25 percent) came from businesses with less than 20 employees. About 14.5 percent of responses were from businesses with 20 to 99 employees, and about 6.7 percent of responses were from businesses with 100 to 499 employees. Only about 1.5 percent of responses were from business with 500 or more employees. There were no responses from businesses with more than 5,000 employees. See Figure 12, below.

Figure 12: Respondents' Number of Employees (Based on 255 Responses)



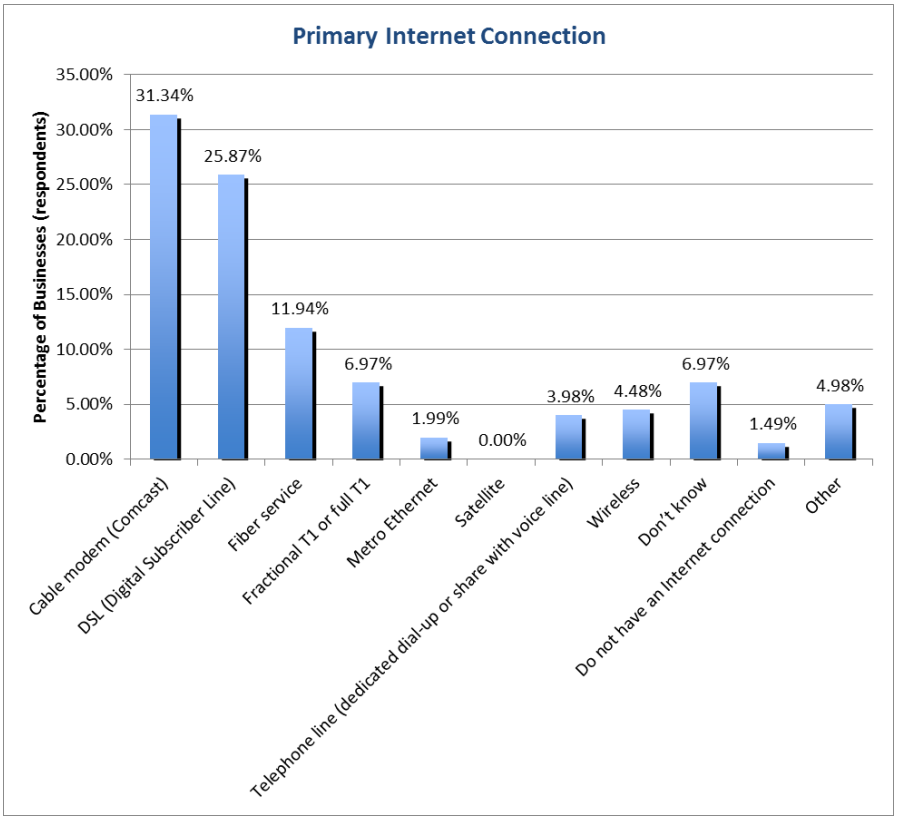
Nearly half of the responses were from businesses with a sales volume of less than $500,000 per year. A majority of businesses (approximately 83.3 percent) represented had an annual sales volume of $5 million or less. Only approximately 3.5 percent of respondents represented businesses with an annual sales volume of $50 million or greater.

Figure 13: Respondents' Annual Sales Volume (Based on 227 Responses)



More than half of the respondents (approximately 57.2 percent) currently subscribe to either cable or DSL; nearly 12 percent of respondents are connected via fiber; and slightly less than 7 percent are connected to a fractional or full T1. See Figure 14, below.

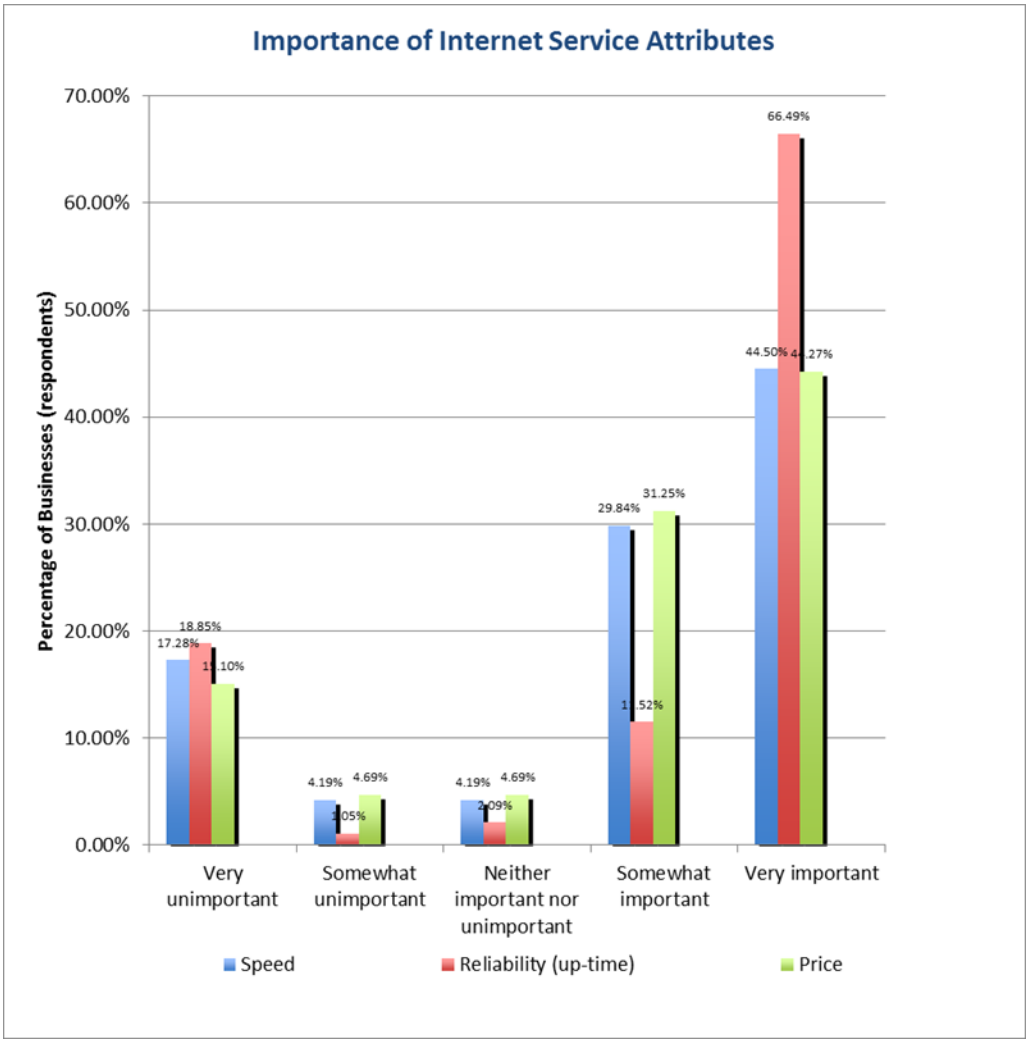
Figure 14: Business Respondents' Primary Internet Connection (Based on 201 Responses)



Nearly Half of Respondents Are Satisfied with Current Internet Speeds

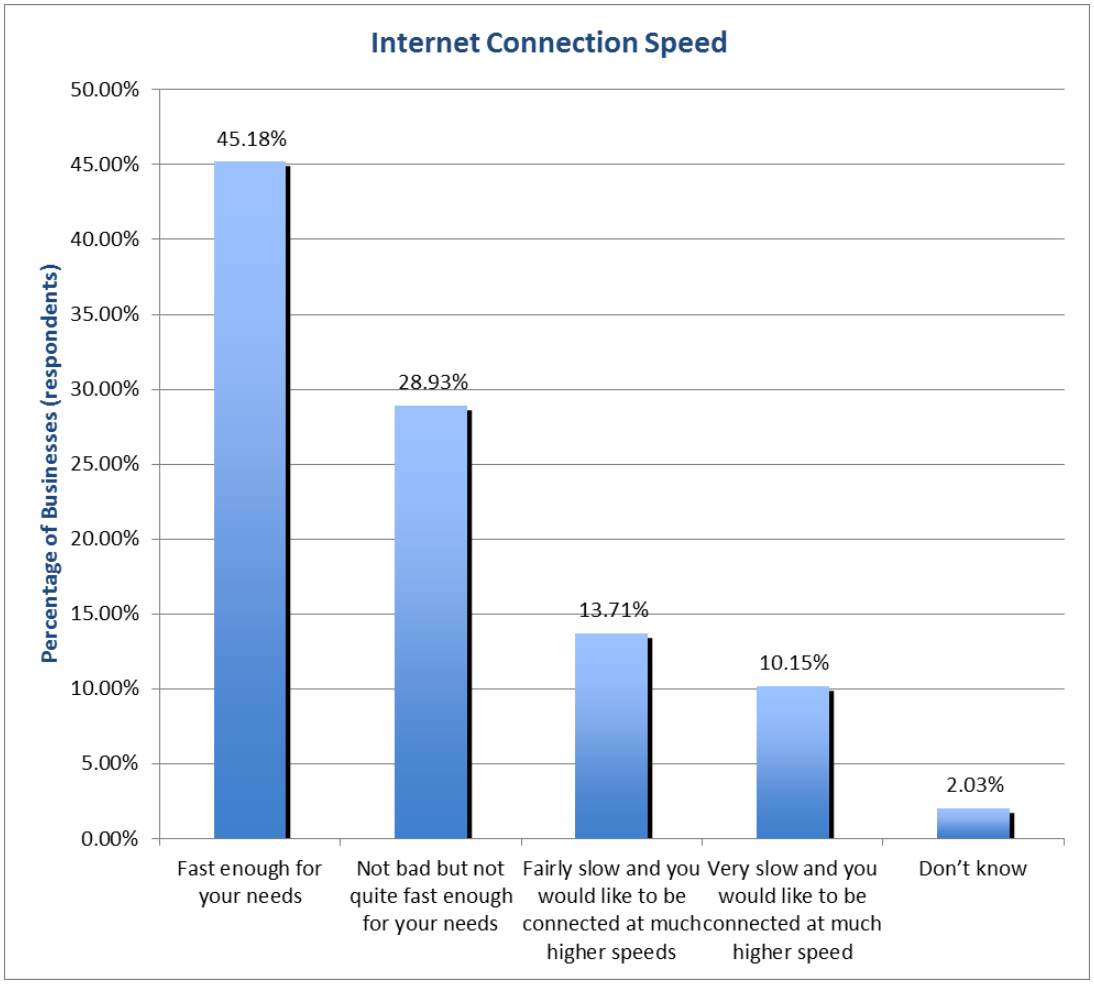
Price, Reliability, and Speed tend to be the most important factors that businesses consider when evaluating their connectivity options, and when considering the possibility of switching providers. Based on the 191 full responses to the question that prompted respondents to indicate the importance of various aspects of their business Internet service, it appears that reliability is most important, followed by price, and speed. Approximately 78 percent of respondents indicated that reliability was somewhat or very important; approximately 76 percent indicated price was somewhat or very important; and approximately 74 percent of respondents indicated that speed was somewhat or very important. See Figure 15, below.

Figure 15: Importance of Price, Reliability, and Speed (Based on 191 Responses)



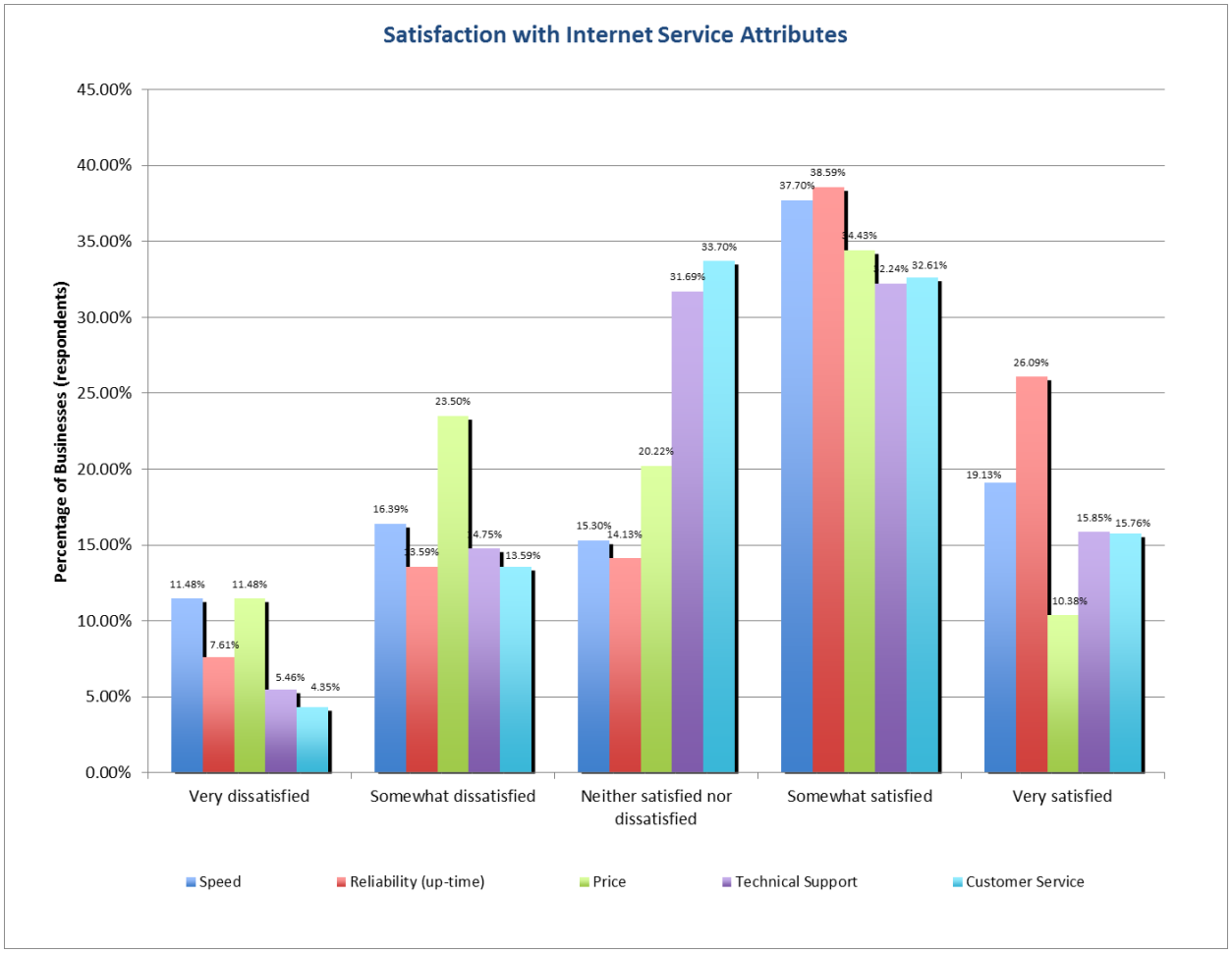
While speed appears to be an important attribute to the respondents, nearly half of the 197 respondents that fully answered the question indicated that their current Internet speed was fast enough for their needs. Approximately 29 percent of respondents indicated that their current speed was not bad, but not quite fast enough for their needs. Only a little over 10 percent of respondents indicated that their current Internet speed was very slow, and approximately 13.7 percent indicated it was fairly slow. That group—approximately 23.9 percent of respondents to the question—indicated that they would like to be connected at higher speeds.

Figure 16: Respondents' Satisfaction With Current Internet Speeds (Based on 197 Responses)



It appears that most respondents are not particularly unhappy with various attributes of their current service (see Figure 17, below). This does not mean that respondents would not consider alternative service from a different provider, but it does indicate that the City would have to find ways to differentiate itself to stand out among its competitors—particularly as a retail service provider.

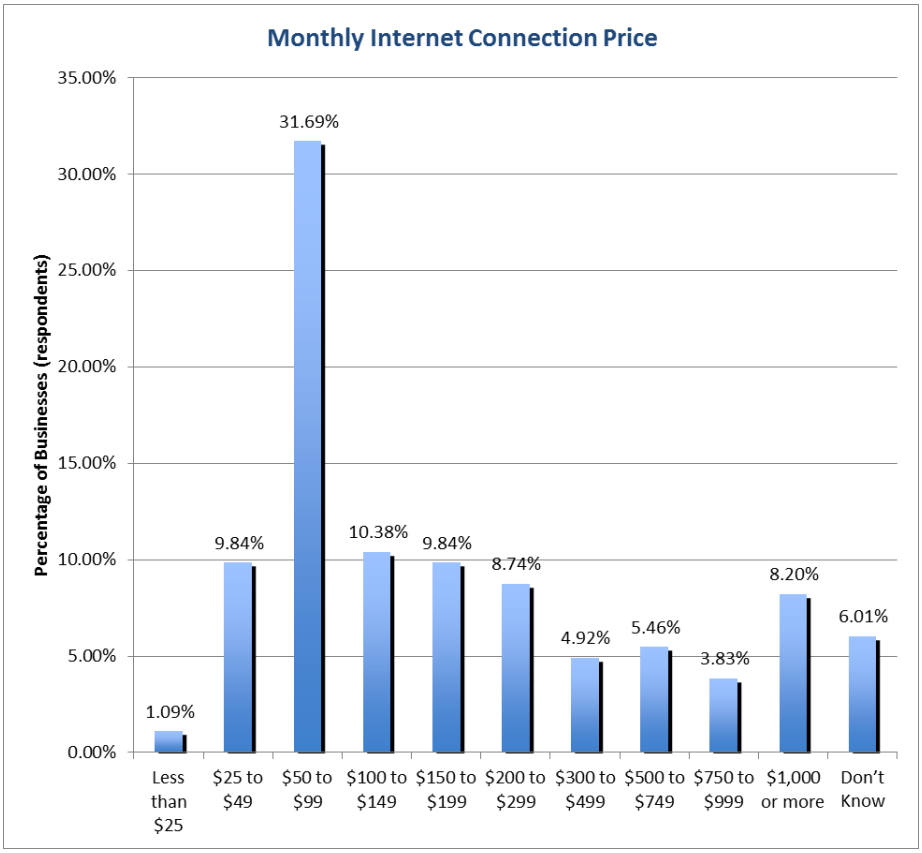
Figure 17: Satisfaction with Current Internet Service Attributes (Based on 192 Responses)



Pricing Sensitivity and Willingness to Switch Service Providers

Almost 60 percent of respondents indicated that they currently pay $100 or more per month for their business Internet connection. Just over 10 percent of respondents indicated that they currently pay $49 or less per month for their business Internet connection. Nearly 32 percent of respondents indicated that they currently pay $50 to $99 per month. See Figure 18, below.

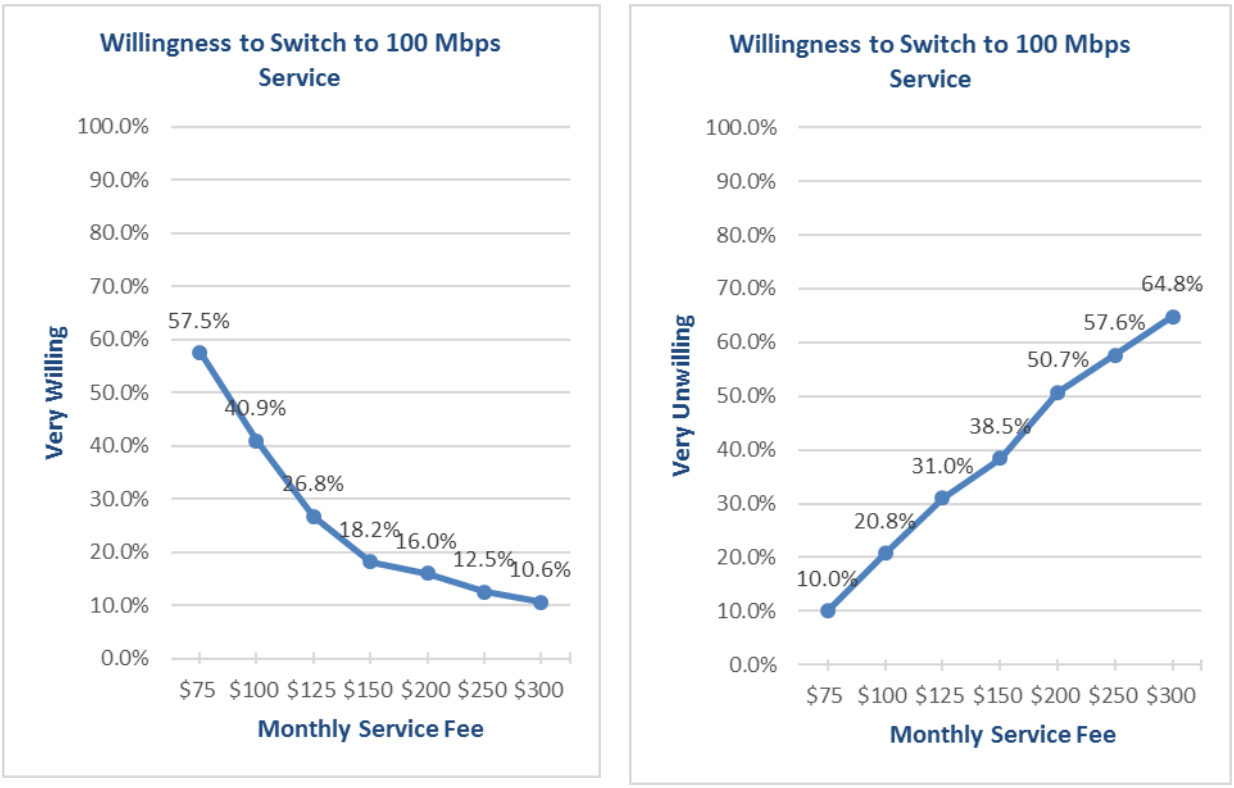
Figure 18: Monthly Cost for Internet Services (Based on 183 Responses)



Although most respondents appear to pay more than $75 per month, or somewhere near that price point, there did not appear to be a significant willingness to switch to much higher speeds. Nearly half of respondents (approximately 45 percent) indicated that they were somewhat or very satisfied with the price of their current services—based on the 192 respondents that fully answered the question. Still, only approximately 35 percent indicated that they were very or somewhat *dis*satisfied with the price of their current services.

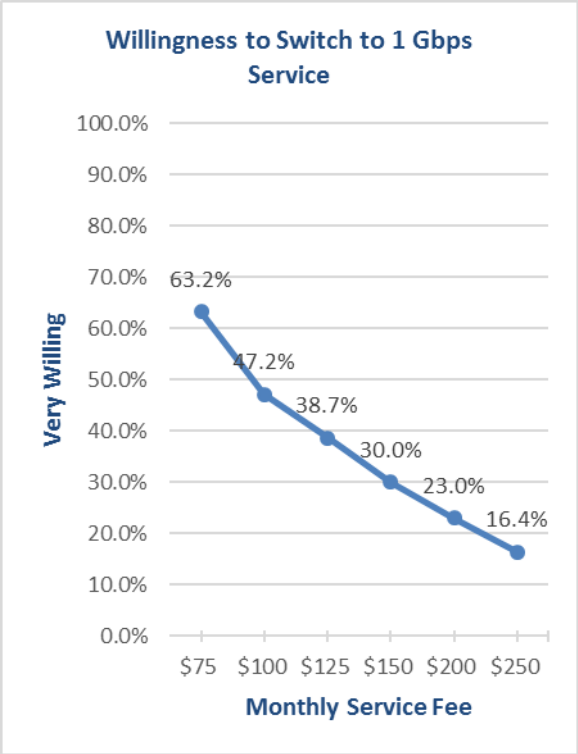
Just under 60 percent of respondents indicated that they would be "very willing" to switch to a 100 Mbps service for $75 per month, and only 10 percent indicated they would be "very unwilling" to switch to 100 Mbps service for $75 per month. The respondents appear to be particularly sensitive to price

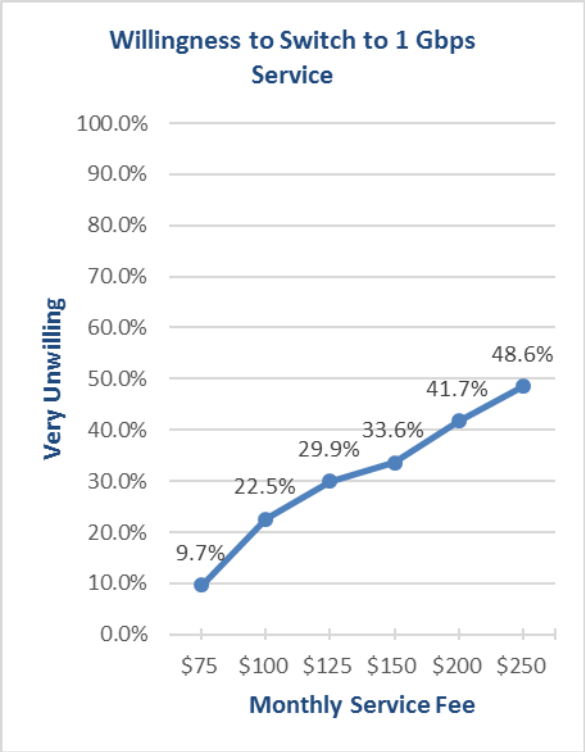
Figure 19: Respondents' Willingness to Switch to 100 Mbps Service at Various Price Points (Based on 142 Responses)



Approximately 63 percent of respondents to the survey indicated they would be "very willing" to switch to 1 Gbps service for $75 per month, which is a slightly higher willingness than those respondents that indicated they would switch to 100 Mbps service at the same price point. Respondents seem slightly more likely to switch service for higher speeds.

Figure 20: Respondents' Willingness to Switch to 1 Gbps Service at Various Price Points (Based on 137 Responses)

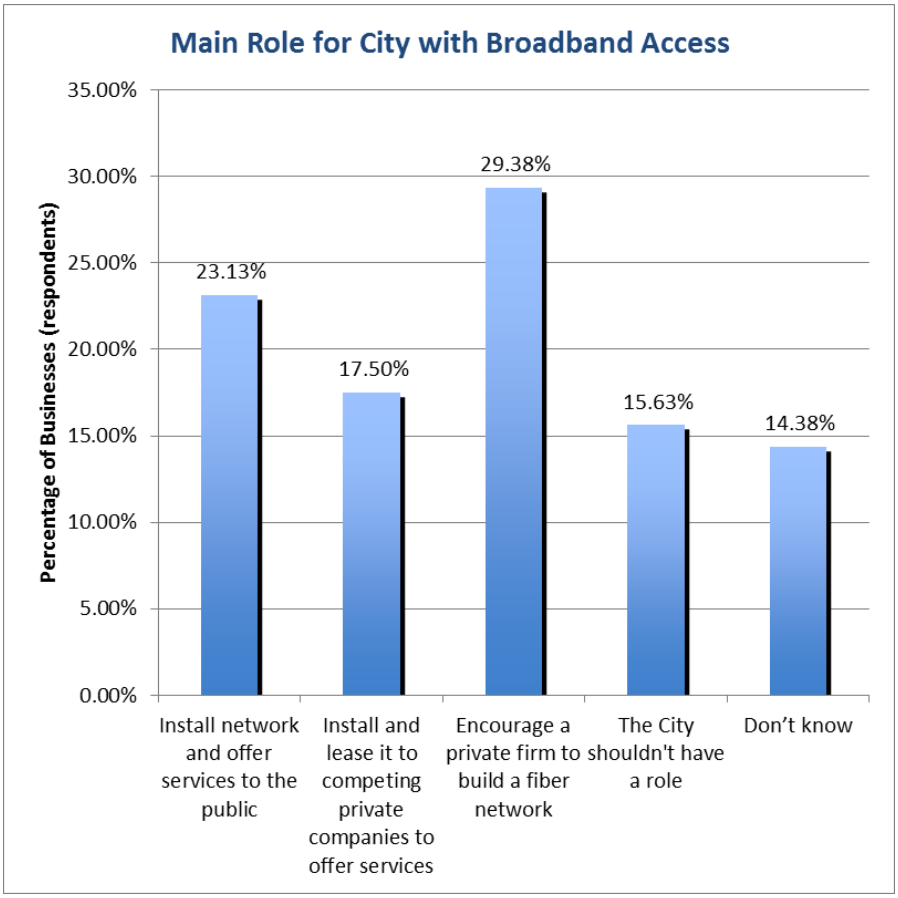




The City's Role

One of the questions the survey asked all respondents was what role they believe the City should play in facilitating broadband access in Hayward. Only approximately 15.6 percent of the 160 responses indicate a belief that the City should have no role. Just over 40 percent of respondents indicate that the City should either install a network and offer services to the public or install a network and lease it to competing private companies to offer services. Approximately 29.4 percent of respondents believe the City should encourage a private firm to build a fiber network in Hayward. Approximately 14.4 percent of respondents do not know what role the City should play. See Figure 21, Below.

Figure 21: Main Role for the City With Respect to Broadband Access (Based on 160 Responses)



Follow-Up Interviews with Select Businesses

As we noted, approximately 40 businesses indicated that they could be contacted further for additional discussions. We managed to reach 24 unique businesses for follow-up conversations to gather these businesses' insights. Most of these respondents believe that the City has some role in at least providing infrastructure to help manage the connectivity challenges in the market today, and especially in the future. Only one respondent indicated the City should become a provider, while only three respondents were on the opposite end of the spectrum and claimed the City's only role should be to expedite permits.

In general, the respondents that we reached indicated that they believe connectivity is critical for their business operations, and their dependency on it is growing. This is especially true as their business operations grow increasingly dependent on cloud computing. Most respondents indicated that the current market does not meet their needs, and that the speed and reliability of currently-available services is especially unlikely to meet their future needs as their businesses grow and evolve.

As is the case with many small- to medium-size businesses in other markets, connectivity options are limited to only DSL or cable for many of the respondents to the business survey. There is a shared perception that competition is lacking in the Hayward business market, and that it must be increased in order to drive better choice for businesses. Further, choices are limited for alternative services, or for back-up options to help offset the speed and reliability challenges these businesses face with their primary providers.

While some of the respondents could purchase cable modem service through Comcast, it tends to be much more expensive than AT&T's DSL service, and the speeds and reliability do not necessarily justify the increased cost. Still, satisfaction related to reliability and speed seems to be marginally higher with Comcast than with AT&T. Most of these respondents claimed that the customer service they receive from their current providers is not good, and they would prefer more positive experiences when seeking support.

File #: RPT 18-151

DATE: September 13, 2018

TO: Council Technology Application Committee

FROM: Director of Information Technology
Interim Director of Public Works

SUBJECT

Review of Proposed Wireless Ordinance and Master License Agreement Terms and Conditions

RECOMMENDATION

That the Council Technology Application Committee (CTAC) reviews and comments on the proposed Public Right of Way Telecommunications Antenna and Facilities Ordinance ("Wireless Ordinance") and associated terms and conditions of the draft Master License Agreement ("MLA"). Specifically, staff seeks direction from CTAC regarding the standards and requirements outlined in this staff report and attached draft ordinance and Master License Agreement terms and conditions.

SUMMARY

The City's existing regulations for telecommunications antenna and facilities were passed in July of 1997. Over the past two years, telecommunication companies have signaled their intention to deploy small cell sites to expand 5G coverage. To complicate matters, the State and Federal legislatures have considered legislation that would constrict the ability of the City to regulate and charge lease revenue for small-cell wireless sites within the Public Right of Way.

This item includes a proposed updated Wireless Ordinance (Attachment II) to accommodate the anticipated requests from telecommunication providers as well as a Master License agreement to ensure the City receives fair compensation for use of the Public Right of Way and that said use is done in a consistent and equitable manner across telecommunication providers.

ATTACHMENTS

Attachment I	Staff Report
Attachment II	Proposed Wireless Ordinance

DATE: September 13, 2018

TO: Council Technology Application Committee

FROM: Director of Information Technology
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BACKGROUND

The City's existing regulations for telecommunications antenna and facilities was passed in July of 1997. Over the past two years, telecommunication companies have signaled their intention to deploy small cell sites to expand 5G coverage. 5G technology is designed to densify coverage within a given community by placing a cell site in intervals of 800 feet, where feasible. Understanding this, the City is anticipating an increase in applications for

small cell facilities in the public right of way (PROW). These telecommunication companies have begun this process with municipalities throughout the state.

Telecommunication companies prefer to install wireless facilities in the PROW since installations on private property will oftentimes be more expensive, or less viable for the buildout of a robust network. The City owns and maintains upwards of 4,700 streetlight poles throughout the community, which present themselves as the prime opportunity for telecommunication companies to complete their 5G networks.

In addition to telecommunication companies beginning to deploy this new technology throughout the State, they have lobbied the State and Federal government to implement laws that severely constrict an individual city's home rule authority in the regulation and assessment of fees for these small cell sites. Last year, SB649 attempted to eliminate local discretionary review of small cell sites, treating their installation as a use by-right in all zones. This year, the United States Senate is considering S.3157 (Thune & Schatz). In its current form, this bill would force local governments to lease out publicly owned infrastructure, eliminate reasonable local environmental and design review, and eliminate the ability for local governments to negotiate fair leases or public benefits for the installation of small cell wireless equipment. At the date of the drafting of this report, this bill has been tabled for the year.

Given that the City's authority to regulate these sites has been under assault by the State and Federal legislatures, time is of the essence for the City to establish updated regulations and to enter into long term lease agreements with telecommunication companies prior to any future iterations of SB649 or S.3157 returning.

In June 2018, the City entered into an agreement with Magellan Advisors following a competitive request for proposals process, to develop and update the City's wireless telecommunications regulations, right of way ordinance, and master license agreements with telecommunication companies.

Representatives from Magellan Advisors will be present at this meeting to answer any questions the CTAC may have.

Small Cell Definitions

Small cells are antenna and related equipment that telecommunication providers deploy to increase their overall network capacity and to extend wireless coverage. They are considerably smaller than their counterpart, Macrocells, which usually take the form of a much larger cell tower site, antenna, or mast. Given their size, small cells lend themselves toward deployment on utility poles, streetlights, and other exterior structures.

They are a vital component to the deployment of new highspeed wireless networks. Demand for quality, reliable wireless networks is increasing rapidly due in part to the "Internet of Things" where everyday items and services from cars, home appliances, real-time arrivals for buses, and basic fundamental items such as cell phones and computers function on a

connection to the internet and Wi-Fi. The deployment of a robust smart cell network is required for the continued growth and use of these items.

DISCUSSION

Current Policy and Procedure

Hayward Municipal Code, Chapter 10, Article 13 establishes the standards for the appropriate siting and change in location of any telecommunication antenna or related facility. The regulations aim to protect the city from adverse effects of telecommunications facilities including any negative environmental impacts, any related visual blight, and ensure a competitive and broad range of telecommunication services and infrastructure.

These regulations cover three classes of antenna ranging from residential satellite dishes to telecommunication towers of varying heights, with many of these sites existing on private property. Depending on class, a permittee would have to receive approval of a Site Plan Review application from the Director of Development Services, an Administrative Use Permit from the Director of Development Services, or a Conditional Use Permit from the Planning Commission. The regulations do not provide a reasonable level of clarity on small cell sites, as this technology is new, and the ordinance was last revised in 1997.

Proposed Policy and Procedure

The proposed ordinance (Attachment II) would govern all telecommunication antennas and related facilities within the PROW. It would be separate from the existing Antenna and Telecommunications Facilities Ordinance of the Planning Code.

The proposed ordinance intends to manage the short and long-term use of the PROW and City infrastructure within the PROW. Under these regulations, all applications for a Wireless Communication Facility (WCF) will be submitted to and ultimately approved by the Public Works Department.

Applications may be for a single facility, modification to an existing facility, co-location facility, aerial mounted wireless/wi-fi equipment, and carrier/cell on wheels (COW). For each of these, the applicant will need to provide a site plan, load calculations, details on the specific equipment to be installed, and photo or computer simulations of the proposed facility before and after installation.

<u>Public Noticing</u>

The City will be required to notice properties within a 500-foot radius for macro and micro cell sites.

Discretionary Review

WCF PROW Permit applications will be subject to discretionary review by the Public Works Department if they are for:

1. New installation of any form of WCF at any location where there is not currently a WCF
2. New installation of any form of WCF where there is a WCF for another carrier
3. Modification to an existing WCF
4. Addition of a new wireless carrier to an existing and eligible WCF that do result in substantial changes
5. Existing wireless projects that do result in a change to the existing site, substantial or not, that add new antennas or increase output of the WCF.

Discretionary review requires public noticing of 500-foot radius and include a 14-day public comment period. The ordinance provides the criteria for approval under Discretionary Review. Following Discretionary Review and approval, the applicant will need to secure the applicable building and encroachment permits.

Administrative Review

WCF PROW permit applications will be subject to Administrative Review by the Public Works Department if they are for:

1. Routine maintenance to an existing WCF
2. Minor modification to an existing WCF
3. Optional pre-submittal applications (which include a tolling of the shot clock)
4. Co-location involving the addition of a new wireless carrier to an existing and eligible WCF on an existing base station that will not result in a substantial change to the existing facility
5. Existing wireless projects that replace existing equipment with like kind, number, and size equipment and do not increase the output of the WCF.

Administrative Review does not require public noticing and will be treated as an "over-the-counter" permit and will be approved by the Public Works Director or their designee.

Pre-Submittal Review

The Ordinance provides applicants the opportunity to request pre-submittal consultations where the applicant can ask questions, and receive guidance and verbal feedback on a proposal. These reviews will include "tolling agreements" where the applicant agrees that the pre-submittal review does not constitute formal review of their application and that any applicable review time limits will not begin until a formal application is submitted.

All applications will have to pay a processing fee as determined by the City's Master Fee Schedule. Applicants may appeal a decision by the Public Works Director to the City Manager.

Permits will be issued for a term of ten (10) years with two five (5) year extensions. Extensions will be contingent on the applicant maintaining compliance with the original permit(s).

Proposed Master License Agreement

In order to address the anticipated rollout of 5G technology and existing demands from 4G within the City, staff has developed an updated Master License Agreement (MLA) to provide a consistent and comprehensive approach to any requests from telecommunication providers. These MLAs will help the City align its own infrastructure within the PROW with the demands for access from telecommunication providers.

The MLA will not grant rights to any individual City streetlight or pole. They will, however, establish the guiding procedures, terms, and conditions which the City will require of a telecommunication provider during their deployment of small cell sites. These providers will need to execute permits for their individual sites as described in the proposed Wireless Ordinance.

Term

MLAs will have a minimum term of ten (10) years with two five (5) year option extensions.

Lease Rate

Under the MLA, the telecommunication lessee will have to pay an initial base annual rent of $2,500 that will increase at a rate of 4% each year thereafter. Furthermore, the agreement includes a "Favored Nations Clause" that states that if the telecommunications entity pays an annual rent greater than the City's rate within the Counties of Alameda (less Oakland), Santa Clara (less San Jose), and Santa Cruz, that the City's lease rate will automatically increase to that higher amount.

Processing Payments

The telecommunication provider will have to pay a base fee plus time and materials for the staff costs associated with processing their MLA and associated pole licenses.

Protection from Future Laws

Each MLA will include a provision stating that "no occurrence or situation arising under any current or future Law, whether foreseen or unforeseen and however extraordinary, will relieve Licensee from its obligations under the Agreement or give Licensee any right to terminate this Agreement in whole or in part." Once entered into a contract, no law from the State or Federal government will be able to supersede the lessee's obligations under the MLA.

Fiber-In-Lieu of Payment

The MLA grants the Public Works Department the discretion to negotiate, as partial consideration paid to the City, a minimum of six strands of fiber and associated conduit that licensee owns to support each licensed pole. The agreement also stipulates that at the end of the term of the MLA, the licensee shall grant to the City by quitclaim or bill of sale title to any fiber strands, conduits, and pull boxes owned by Licensee that the City desires to use at no cost to the City.

Municipal Preference

The MLA requires that in situations where the Licensee has the option to install equipment to either City owned poles or similar third-party poles, that the licensee shall use good faith efforts to attach to City poles.

Commencement of Installation

All installations under a given MLA shall be completed within one year following the mutual execution of an applicable Encroachment Permit.

Security Deposits

Licensee shall pay a security deposit of $25,000 for the life of the agreement to cover any fees and costs to remedy any default by the licensee over the term of the MLA.

ECONOMIC IMPACT

The proposed regulations will improve the City's ability to address the anticipated increase in small cell applications. This will in-turn result in a quicker deployment of cutting-edge wireless technology leading to more robust wireless broadband services and technologies for the community. Making it easier for telecommunications to complete this work will result in better service to businesses and residents. Additionally, the fiber-in-lieu opportunities will increase the City's municipal fiber goals by helping to build out the "last mile" connections identified in the Fiber Master Plan.

FISCAL IMPACT

There is no immediate fiscal impact associated with implementing this ordinance and MLA. However, given the rent and in-lieu considerations within the MLA, the City stands to earn upwards of $2,500 annually on each of the leased City-owned light poles. This resulting new potential revenue access to dark fiber could help to fund the additional buildout of the City's municipal dark-fiber network.

STRATEGIC INITIATIVES

This agenda item supports the Complete Communities Strategic Initiative. The purpose of the Complete Communities Strategic Initiative is to create and support structures, services, and amenities to provide inclusive and equitable access with the goal of becoming a thriving and promising place to live, work and play for all.

Goal 1: Improve quality of life for residents, business owners, and community members in all Hayward neighborhoods.

Objective 4: Create resilient and sustainable neighborhoods.

Goal 3: Develop a regulatory toolkit for policy makers

Objective 1: Update, streamline, and modernize zoning & codes.

NEXT STEPS

Staff will incorporate the feedback on the draft ordinance and MLA and present the updated documents to Council for adoption at a later date.

Prepared by: Fred Kelley, Transportation Manager
Jay Lee, Associate Planner
John Stefanski, Management Analyst II
Kathy Garcia, Deputy Director of Public Works

Recommended by: Adam Kostrzak, Director of Information Technology
Alex Ameri, Interim Director of Public Works

Approved by:

Kelly McAdoo, City Manager

Article 4: Wireless Communications Facilities in the Public Right of Way

The siting and construction of antennas used in providing telecommunications services in the public right of way are subject to the provisions of this Article and the siting and construction of antennas used in providing telecommunications services on all other property are subject to the provisions in Chapter 10 Article 13 of this code (Zoning and Planning).

Section 7-4.00 Title and Purpose

This Article 4 is known as and may be cited as the "Public Right of Way Wireless Communication Facilities Ordinance" of the City of Hayward. The purpose of this Ordinance is to ensure that residents and businesses in the City of Hayward have reliable access to wireless telecommunications networks and state of the art communications services and that installations, modifications, and maintenance of Wireless Communications Facilities (WCF) in the Public Right-of-Way (PROW) are completed in a manner consistent with all applicable laws, are safe, and avoid or mitigate visual, environmental and neighborhood impacts. This Ordinance regulates WCF installations in the PROW to the extent allowed by law.

This ordinance is adopted:

(a) To provide uniform standards for the community desired design, placement, permitting and monitoring of telecommunication facilities consistent with applicable state and federal requirements.
(b) To manage the public right of way as to the time, place, and manner in which it is accessed.
(c) To minimize the environmental and aesthetic impacts of installations in crowded public rights of way.
(d) To strongly encourage telecommunications facilities to be installed only as ancillary uses at new and existing sites.
(e) To require installation on arterial rather than local streets when feasible.
(f) To preserve view corridors, to discourage visual blight and clutter and to encourage aesthetic placement of telecommunication facilities.
(g) To accommodate public and City use of the public right of way, so as to permit maintenance of telecommunication facilities, and to minimize disruption to vehicular traffic and pedestrian flow; and on-street parking.
(h) To minimize unnecessary disruption of the public right of way by coordinating installations so as to effectively manage use of the public right of way.
(i) To ensure the structural integrity, reliability, performance, safety, quality, ease of maintenance, and aesthetic integrity of the public right of way.
(j) To ensure that similarly situated public right of way users are treated in a competitively neutral and non-discriminatory manner while complying with applicable state and federal requirements.
(k) To ensure compliance with all federal, state, county, and local laws.
(l) To prevent hazardous conditions along the public right of way.
(m) To manage the long-term use of the public right of way.

This Ordinance establishes standards for the siting, design, permitting, construction, operation, inspection, maintenance, repair, modification, removal and replacement of communications facilities in the public right of way in recognition of the Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56 (1996); the Middle-Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156, § 6409(a) (2012) (Spectrum Act), *codified at* 47 U.S.C. § 1455(a), and FCC regulations promulgated thereunder by the Federal Communications Commission (FCC), including the FCC's Report and Order of October 21, 2014, FCC 14-153 (rel. Oct. 21, 2014).

Section 7-4.10 Definitions

"Abandon" means when an owner of a WCF intends to permanently and completely cease all business activity associated therewith or fails to comply with ongoing permit or lease terms.

"Accessory Equipment" means any equipment serving or being used in conjunction with a WCF. This equipment includes, but is not limited to, utility or transmission equipment, power supplies, generators, batteries, cables, equipment buildings, cabinets, storage sheds, shelters, vaults, or other structures.

"Administrative Approval" means approval granted by designated staff members authorized to grant approval after Administrative Review.

"Administrative Review" means evaluation of an application by designated staff.

"Antenna" means a device used to transmit and/or receive radio or electromagnetic waves for the provision of services including, but not limited to cellular, paging, personal communications services (PCS) and microwave communications. Such devices include but are not limited to directional antennas; such as panel antenna, microwave dishes, and satellite dishes; omnidirectional antennas; wireless access points (Wi-Fi); and strand mounted wireless access points. This definition does not apply to broadcast antennas, antennas designed for amateur radio use, or satellite dishes designed for residential or household purposes.

"Base Station" means the same as defined by the FCC in 47 C.F.R. § 1.40001(b)(1), as may be amended, which defines that term as a structure or equipment at a fixed location that enables FCC-licensed or authorized wireless communications between user equipment and a communications network. The term does not encompass a tower as defined in 47 C.F.R. § 1.40001(b)(9) or any equipment associated with a tower. The term includes, but is not limited to, equipment associated with wireless communications services such as private, broadcast, and public safety services, as well as unlicensed wireless services and fixed wireless services such as microwave backhaul. The term includes, but is not limited to, radio transceivers, antennas, coaxial or fiber-optic cable, regular and backup power supplies, and comparable equipment, regardless of technological configuration (including distributed antenna systems and small-cell networks). The term includes any structure other than a tower that, at the time the relevant application is filed with the State or local government under this section, supports or houses equipment described in 47 C.F.R. §§ 1.40001(b)(1)(i)-(ii) that has been reviewed and approved under the applicable zoning or siting process, or under another State or local regulatory review process, even if the structure was not

built for the sole or primary purpose of providing such support. The term does not include any structure that, at the time the relevant application is filed with the State or local government under this section, does not support or house equipment described in 47 C.F.R. §§ 1.40001(b)(1)(i)-(ii).

"Camouflage" means the means and methods by which a WCF is designed to conceal the equipment and blend the installation with the surrounding environment. This is accomplished by requiring the use of one or more Concealment Elements. The City of Hayward will not allow installation of monopalms or other artificial trees or plants in the PROW.

"Carrier on Wheels or Cell on Wheels ("COW")" means a portable self-contained WCF that can be moved to a location and set up to provide wireless services on a temporary or emergency basis. A COW is normally vehicle-mounted and contains a telescoping boom as the Antenna support structure.

"Collocation" means the act of siting multiple WCFs on an existing structure.

"Concealment Elements" means:

(1) Radio Frequency transparent screening

(2) Approved, specific colors

(3) Minimizing the size of the Site

(4) Integrating the installation into existing utility infrastructure

(5) Installing new infrastructure that matches existing infrastructure in the area surrounding the proposed Site. The new infrastructure is then dedicated to the City and the installation is integrated into the new infrastructure.

(6) Controlling the installation location

"CPUC" means the California Public Utilities Commission.

"Director" means the City's Director of Public Works – Engineering & Transportation Department or designee.

"Distributed Antenna System (DAS)" means a network of one or more Antenna and fiber optic nodes connecting to a common base station or "hub."

"EMF" means Electro-magnetic Frequency.

"Existing Height" means the height of the structure as originally approved or as of the most recent modification that received regulatory approval prior to the passage of the Spectrum Act. Height shall be measured from natural grade to the top of all appurtenances.

"Interference" means physically or electronically affecting the operation, views, signals or functions of City equipment or third-party equipment.

"Laws" means any and all applicable federal, state and local ordinances, resolutions, regulations, administrative orders, or other legal requirements.

“Macrocell Site” means a Macrocell provides the largest area of coverage within a mobile network. The Antennas for macrocells can be mounted on ground-based masts, rooftops or other existing structures. They are generally positioned at a height that is not obstructed by terrain or buildings. They provide radio coverage over varying distances depending on the frequency used, the number of calls made and the physical terrain. Macrocell Base Stations typically occupy space greater than eight cubic feet for station equipment, greater than three cubic feet per Antenna and three or more Antennas. Macrocell have a typical power output in hundreds or thousands of watts.

“Minor Modification” means changes to an existing WCF or structure that results in less than a Substantial Change.

“Modifications” means changes to an existing WCF or structure that result in a Substantial Change to the structure, increase the number of antennas, increase the size of the antennas or increase the EMF output of the WCF are modifications.

“Noticing” means the process of sending a City approved letter of notification describing the work to be performed. The letter must be sent to all business, owners and residents within a three hundred (300) foot radius of the Site.

"Public right of way" (“PROW”) or "right-of-way" means the area on, below, or above a city owned or controlled street or alley public right of way and the sidewalk and/or parkway adjacent thereto.

“Routine Maintenance” means ensuring that a WCF and structure is kept in good operating condition. Routine Maintenance includes, but is not limited to: inspections, testing and modifications that do not qualify as Modifications. An encroachment permit, excavation permit and traffic control plans may still be required depending on the scope and type of work required. Replacing the existing antennas with new, larger antennas or increasing the number of antennas does not qualify as Routine Maintenance.

“Site” means the WCF area occupied by the structure supporting the Antenna, the Accessory Equipment and the path of the wires and cable connecting the Antenna to the Accessory Equipment.

“Small Cell Site” means an umbrella term for low-powered radio access nodes, including those that operate in licensed spectrum and unlicensed carrier-grade Wi-Fi. The cumulative Base Station equipment for a Small Cell sites occupy no more than seventeen (17) cubic feet, including any pole-mounted Transmission Equipment, preexisting enclosures, Transmission Equipment on the ground associated with Antennas on the structure, but exclusive of Antennas and vertical cable runs for the connection of power and other services. Small cells occupy no more than eight cubic feet for all base station equipment, and no more than three cubic feet per antenna with a maximum of two antennas and typically have a range from ten meters to several hundred meters. Types of small cells include femtocells, picocells and microcells – broadly increasing in size from femtocells (the smallest) to microcells (the largest).

“Substantial Change” means the same as defined by the FCC in 47 C.F.R. § 1.40001(b)(7), as may be amended.

"WCF PROW Permit" is a permit authorized under this Article 4 for a WCF installation in the PROW.

"Wireless Local Area Network (Wi-Fi)" means a wireless networking technology that allows computers and other devices to communicate over a wireless signal mainly using the 2.4 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands. It describes network components that are based on one of the 802.11 standards developed by the Institute of Electrical and Electronics Engineers.

"Wireless Communications Facility (WCF)" means any facility established for the purpose of providing wireless transmission of voice, data, images or other information including, but not limited to, cellular telephone service, personal communications service (PCS), and paging service. A WCF can consist of one or more Antennas and Accessory Equipment.

Section 7-4.20 Application Required for Wireless Communications Facility Public Right Of Way Permit

(a) The applicant for a WCF PROW Permit shall submit an application on a City approved form to the Public Works Department and pay any required fee as established by City Council resolution in its Master Fee Schedule. The application must include all required information. Applications shall be rejected if all attachments are not included at the time of submittal. The Director has the discretion to require applications be submitted by appointment only and to set the frequency and number of appointments that will be granted each day.

(b) In addition to any other application requirements, all utilities granted access to the right-of-way by the California Public Utilities Commission (CPUC) shall file with the City of Hayward a copy of their certificate of public necessity and convenience (CPCN) or submit a copy of said CPCN with each application for a wireless facility. The applicant shall also provide evidence that the applicant holds all current licenses and registrations from the FCC and any other applicable regulatory bodies where such license(s) or registration(s) are necessary to provide wireless services utilizing the proposed wireless communications facility.

(c) For any change to an existing facility, the Director may require documentation to establish whether the change to the site is substantial, whether new Antennas are added or whether the change will result in an increase in EMF output.

(d) For a Minor Modification or a Modification, the applicant shall submit an application on a City approved form to the Public Works Department. The application shall include:

    (1) Electronic plans (in pdf format and electronic GIS-compatible file format) to sufficient detail to include and identify:

        i. Title sheet

        ii. Site plan, showing:

1. the exact location and route requested for applicant's proposed facilities, including other improvements in the area;
2. If excavation is required the plans must include the location and depth of all overhead and underground public utility, cable, water, sewer drainage, fiber optic, and other facilities in the public right of way along the proposed route;
3. The location(s), if any, for interconnection with the facilities of any other parties; and,
4. The specific trees, structures, improvements, facilities and obstructions, if any, that applicant proposes to temporarily or permanently remove or relocate.

iii. If installing additional equipment or changing equipment on the pole include load calculations.

iv. Details of equipment to be installed and the proposed location/s.

v. Include all existing and proposed improvements in the project area.

vi. The site shall be designed per Design Standards included in these guidelines.

(2) Photo or computer simulations representing the above ground facility before and after installation (include any pedestals, vents, conduit and exposed cable).

(3) Copy of permit and approved plans for the existing facility.

(4) Completed wireless site evaluation form with new equipment signed by certifying licensed engineer.

(e) <u>For a Co-location Application</u>, the applicant shall submit an application on a City approved form to the Public Works Department. The application must be submitted per this Policy and include all required attachments.

(1) Electronic plans (in pdf format and electronic GIS-compatible file format) to sufficient detail to include and identify:

i. Title sheet

ii. Site plan. If excavation is required the plans must include the size, depth and location of all subterranean infrastructures in the excavation area.

iii. Load calculations.

iv. Details of equipment to be installed and the proposed location/s.

v. Include all existing and proposed improvements in the project area.

vi. The site shall be designed in accordance with any Design Standards in this Chapter.

(2) Photo or computer simulations representing the above ground facility before and after installation (include any pedestals, vents, conduit and exposed cable).

(3) Completed wireless site evaluation form signed by certifying licensed engineer that includes the combined emissions of all antenna sectors (old and new).

(f) For all new wireless communications facilities and substantial changes to existing wireless communications facilities not covered under Section 6409 of the Spectrum Act (codified at 47 U.S.C. 1455), the applicant shall submit an application on a City approved form to the Public Works Department. The application shall include:

(1) Title Sheet showing:

i. The name, address and telephone number of both the applicant and the owner of the telecommunication facility or WCF;

ii. The name, address and telephone number of the responsible person whom the City may contact at any time concerning the telecommunication facility or WCF;

(2) Legal authority to occupy and use for the purpose mentioned in the application, the streets, alleys, sidewalks or other public places where the excavation, placement, location or installation of telecommunication facilities or WCF is proposed to be made;

(3) Electronic plans (in pdf format and electronic GIS-compatible file format) to sufficient detail to identify and include:

i. The pole number(s), address, and latitude/longitude GPS coordinates of the location of the pole or poles;

ii. Site plan, showing:

1. the exact location and route requested for applicant's proposed facilities, including other improvements in the area;

2. If excavation is required the plans must include the the location and depth of all overhead and underground public utility, cable, water, sewer drainage, fiber optic, and other facilities in the public way along the proposed route;

3. The location(s), if any, for interconnection with the facilities of any other parties; and,

4. The specific trees, structures, improvements, facilities and obstructions, if any, that applicant proposes to temporarily or permanently remove or relocate.

iii. Load calculations.

iv. Details of equipment to be installed and the proposed location/s.

v. Include all existing and proposed improvements in the project area.

vi. The site shall be designed in accordance with the Design Standards included in this Chapter.

(4) Engineering certification demonstrating compliance with all existing RF emission standards. The technical information submitted must include support/analysis to justify the proposed location and height of the telecommunication facility or WCF;

(5) Photo or computer simulations representing the above ground facility before and after installation (include any pedestals, vents, conduit and exposed cable).

(6) A construction plan and schedule, to include start and end dates and phasing, as required by the Agency, including additional telecommunication facility or WCF locations which the applicant plans to install within five years from the date of application submittal. In the event an Applicant states it does not know its construction plans for a five-year period the Applicant must provide a declaration stating that fact and shall provide its construction plans as known in Applicants management and engineering planning processes, which shall be for a reasonable period of time in no event less than two years;

(7) If the applicant's proposed facility involves installing a replacement structure (e.g., a pole) in the public right of way and attaching additional facilities, or installing a facility on a pole owned by a third party, the applicant shall also provide a signed copy of the license, lease, pole attachment agreement, or whatever authorizations are required for the placement of the wireless facility at the location proposed, including proof that the applicant is authorized by the owner of the structure to install and operate the proposed wireless facility on the structure. Such submissions need not disclose financial terms.

(8) If the site is adjacent to a property or area that is included in or eligible for inclusion in the National Register of Historic Places, an Environmental Assessment as defined by the National Environmental Protection Act.

(9) All applicants shall submit a justification study which includes the rationale for selecting the proposed use; if applicable, a detailed explanation of the coverage gap that the proposed use would serve; and how the proposed use is the least intrusive means for the applicant to provide wireless service. Said study shall include all existing structures and/or alternative sites evaluated for potential installation of the proposed facility and why said alternatives are not a viable option.

(10) A coverage map indicating the area which will be served by the proposed telecommunication facility or WCF; and,

(11) A non-refundable application and processing fee, in an amount established by resolution of the City Council to defray the City's costs to process the application and to inspect the telecommunication facility or WCF.

(g) In the event a state or federal law prohibits the collection of any information required by this Section, the Director is authorized to omit, modify or add to that request from the city's application form with the written approval of the city attorney, which approval shall be a public record.

(h) Pre-submittal Requests.

(1) Pre-submittal – The applicant may request a pre-application consultation/submittal to the City. This consultation is for the applicant to ask questions, receive guidance on specific requirements of this Chapter, and receive verbal feedback on specific elements to assist in the design of their site. Multiple proposal options may be provided for the same location under one application.

(2) Pre-submittal Application request is to be made on a City approved form to the Public Works Department and shall include any required fee as established by City Council resolution in its Master Fee Schedule for each submittal. The form shall include a tolling agreement that states the applicant's understanding that the meeting in no way constitutes review of their application and that any applicable "shot-clock," or limits on application review time provided under state or federal law, on their project will not begin until an official application has been submitted.

i. The pre-application request shall include:

ii. Electronic plans (in pdf format) to include:

1. Site plan.

2. Details of equipment to be installed and the proposed location/s.

3. Include all existing and proposed improvements in the project area.

4. The site shall be designed per Hayward Municipal Code Design Standards included in these guidelines.

iii. Photo or computer simulations representing the above ground facility before and after installation (include any pedestals, vents, conduit and exposed cable).

(3) Collaboration – Once conceptual review has been completed, the Public Works Department and the applicant may communicate to address comments and resolve issues identified in advance of an application being submitted. When necessary, at the request of the applicant, City Staff may conduct site visits with the applicant to address and/or resolve specific

issues related to the site. The applicant may request a meeting with city staff to review and discuss conceptual review comments, subject to any applicable fees.

Section 7-4.30 Application Withdrawn

An application for a WCF PROW Permit will be deemed withdrawn if, after it has been processed by the City, the City has sent the applicant a communication requiring a response from the applicant and more than sixty (60) days lapse without a response from the applicant. Once an application has been withdrawn it may not be reopened and a new application must be made. No refunds will be provided for withdrawn applications.

Section 7-4.40 Application Fees

The application for a WCF PROW Permit shall be accompanied by an application processing fee established by resolution of the City Council for its Master Fee Schedule. All fees must be paid in full before any permit shall be issued from the City. Application processing fees must be paid at the time that the application is submitted. These fees are for permit processing and issuance only and are in addition to any other applicable fee or any separate payments that may be required for rent of City infrastructure.

Section 7-4.50 Administrative Review

(a) The following WCF PROW Permit applications are subject to Administrative Review:

(1) Routine Maintenance to an existing WCF.

(2) A Minor Modification to an existing WCF.

(3) Optional pre-submittal applications (which include a tolling of the shot clocks).

(4) Co-location, meaning the addition of a new wireless carrier to an existing and eligible wireless communications facility on an existing base station that will not result in a Substantial Change to the existing facility.

(5) Existing wireless projects that replace existing equipment with the like kind, number and size of the existing equipment and do not increase the EMF output of the WCF and are considered to be Routine Maintenance.

(b) The Director may designate staff to review and approve applications for Administrative Review. These applications are reviewed at the Public Works counter as an over the counter permit.

(c) Administrative Review approval shall be granted if the Director, or designee, finds that:

(1) Application is complete;

(2) The proposed facility meets the definition for the type of facility proposed;

(3) The plans are stamped by a registered civil engineer;

(4) The proposed facility complies with the requirements of the Hayward Municipal Code and all other applicable Laws; and

(5) The proposed facility will not interfere with the use of the PROW.

(d) Following Administrative Review and Approval and a WCF PROW Permit is issued, the applicant can begin to pursue construction and encroachment permits as required. The WCF PROW Permit issued under this Chapter is not valid without all required construction and encroachment permits and any required license under [Code cite for other permits].

Section 7-4.60 Discretionary Review.

(a) The following WCF PROW Permit applications are subject to Discretionary Review:

(1) New installation of any form of WCF at any location where there is not currently a WCF.

(2) New installations where there is a WCF for another carrier.

(3) A Modification to an existing WCF.

(4) Addition of a new wireless carrier to an existing and eligible WCF that do result in Substantial Change (and are not considered a co-location and are considered new installations).

(5) Existing wireless projects that do result in a change to the existing Site, whether a Substantial Change or not, add new Antennas or increase the EMF output of the WCF.

(b) Applications for Discretionary Review shall require Noticing as follows:

(1) The applicant shall mail a notice, in a form approved by the Director, to all owners of real property as shown on the County's current equalized assessment roll, and all occupants within a radius of 300 feet from each antenna location being proposed. The notice shall also be mailed to the Public Works Department. The notice shall describe the proposal and the 14-day comment period. Following the notice, the applicant shall submit a signed affidavit verifying that the notice has been prepared and mailed in accordance with this Section.

(2) The 14-day comment period will run from the postmarked date on the notice received by the Public Works Department. The City will accept comments from the public during this comment period.

(c) The Director, or designee, is the review authority for Discretionary Review applications.

(d) Determination. Following the 14-day comment period, the Director shall review the application, pertinent documentation and public comments. Provided all of the following findings of fact are made, the Director shall issue a formal letter of determination and mail it to the applicant. The Director may impose additional

conditions on the permit relating to time, place and manner. The following findings are prerequisites of an approval.

(1) The proposed facility complies with all of the applicable provisions the Hayward Municipal Code.

(2) The proposed facility will not interfere with the use of the PROW.

(3) The proposed construction plan and schedule will not unduly interfere with the public's use of the PROW.

(4) The proposed facility can be mitigated so that its impacts do not result in a material change to the character of the location and the facility relates harmoniously with the surrounding neighborhood.

(5) The proposed facility's impacts have been mitigated through the use of Camouflage and Concealment Elements

(6) The proposed facility is in compliance with all Federal and State standards and Laws.

(e) Modifications. The City shall require that Modifications to existing facilities bring the Site into compliance with all current Laws. The applicable contractor's licenses and insurance, as established by Laws, shall be required before the permit will be issued and must remain valid during construction.

(f) Following Discretionary Review and Approval a WCF PROW Permit is issued, the applicant can begin to pursue construction and encroachment permits as required. The WCF PROW Permit issued under this Chapter is not valid without all required construction and encroachment permits and any required license under [Code Cite for other permits].

Section 7-4.70 Appeals.

Any party may appeal the Director's decision to the City Council within fourteen (14) calendar days after a determination has been made on the application. The appeal must be submitted in writing on an approved City form to the City Clerk within 14 days after the published determination letter and shall state the specific reason for the appeal. In the event that a decision is appealed, the City Clerk shall schedule the appeal for a public hearing and provide the Council with the record of proceedings. The time and date of the appeal hearing before City Council shall be served to the public by the applicant in the same manner as the initial Noticing. As Section 332(c)(7) of the Telecommunications Act preempts local decisions premised directly or indirectly on the environmental effects of radio frequency (RF) emissions, appeals to the Director's decision premised on the environmental effects of radio frequency emissions will not be considered. An action of the Director of Public Works appealed to the City Council shall not become effective unless and until approved by the City Council. Decisions of the City Council on such appeals shall be final and not subject to further appeal.

Section 7-4.80 Licenses for use of City Property.

In addition to the WCF PROW Permit required under this Chapter and any required encroachment and construction permits, the applicant shall also obtain a license from the City for the use of city property if the WCF is proposed on a city-owned or city-controlled pole, structure or property.

Section 7-4.90 Construction and Encroachment Permits.

Immediately following approval of the WCF PROW Permit and any required license, an applicant may begin the process of applying for construction and/or encroachment permit. The permit shall not be issued until the fourteen (14) day appeal time has passed. The permit issued under this Section is not valid without all required construction and encroachment permits. To begin the process the applicant must submit the following documentation to Public Works Department, in addition to any other information required under this Code for an encroachment or construction permit:

(a) The identity and address of the applicant, including all affiliates of the applicant.

(b) A description of the services that are or will be offered or provided by licensee over or through its facilities.

(c) A description of the transmission medium and capacities that will be used by the licensee to offer or provide such services, both within and outside the City's corporate boundaries.

(d) Engineering plans, specifications and a network map in both paper and electronic GIS-compatible file format of the facilities to be located within the City and any franchise or license area, all in sufficient detail to identify:

  (1) A site plan showing the exact location and route requested for applicant's proposed facilities, including other improvements in the area.

  (2) The location and depth of all overhead and underground public utility, cable, water, sewer drainage, fiber optic, and other facilities in the public way along the proposed route.

  (3) The location(s), if any, for interconnection with the facilities of any other parties.

  (4) The specific trees, structures, improvements, facilities and obstructions, if any, that applicant proposes to temporarily or permanently remove or relocate.

(e) If applicant is proposing to install overhead facilities, evidence that surplus space is available for locating its facilities on existing vertical infrastructure along the proposed route.

(f) If applicant is proposing an underground installation in existing ducts or conduits within the public ways, information in sufficient details to identify:

  (1) The excess capacity currently available in such ducts or conduits before installation of applicant's facilities.

  (2) The excess capacity, if any, that will exist in such ducts or conduits after installation of applicant's facilities.

(g) If applicant is proposing an underground installation within new ducts or conduits to be constructed within the public ways:

(1) The location proposed for the new ducts or conduits.

(2) The excess capacity that will exist in such ducts or conduits after installation of applicant's facilities.

(h) A preliminary construction schedule and completion date.

(i) A preliminary traffic-control plan in accordance with the latest Manual on Uniform Traffic Control Devices.

(j) Information in sufficient detail to establish the applicant's technical qualifications, experience and expertise regarding the facilities and services described in the application.

(k) Information to establish that the applicant has obtained all other governmental approvals, permits, licenses and certifications to construct and operate the facilities and to offer or provide the subject services.

(l) An accurate map showing the location of any existing facilities in the City or license area that applicant intends to use or lease or could reasonably use or lease.

(m) A description of the services or facilities that the applicant will offer or make available to the City and other public, educational and governmental institutions.

(n) A description of applicant's access and line extension policies.

(o) The area or areas of the City the applicant desires to serve and a schedule for build-out to the entire license area.

(p) In the case of installation of new communications facilities, evidence that any CPUC "Certificate of Public Convenience and Necessity" or other regulatory authorization that the applicant is required by law to obtain.

(q) All required fees, deposits or charges required as required under this Code or established by City Council resolution.

(r) Such other and further information as may be required by City Manager, or designee

Section 7-4.100 Periodic Review.

Permits are issued for a period of ten (10) years from the date issued. To extend the permit for additional five (5) year periods the carrier shall provide proof that it continues to have the legal authority to occupy and use the PROW for the purpose set forth in its permit, that its site as it exists at the time of the renewal is in full compliance with the applicable City permits issued for the site, pay the fees for renewal, and amend the a Small Cell Master Lease Agreement (MLA) with the City. Additionally, the carrier must provide an affidavit confirming that the site is still in compliance with the Federal Communications Commission regulations. Failure to submit such an affidavit or proof of legal authority to occupy or use the PROW shall be grounds for non-renewal of the permit. The burden is on the permittee to demonstrate that the site complies with the

requirements herein. Notwithstanding anything to the contrary in this Section, for any WCF on a city-owned or city- controlled pole, structure or property, the term of the WCF Permit shall not extend beyond the term of any required license under Section 7-4.80.

Section 7-4.110 Inspection and Reporting.

The owner of the WCF when directed by the City, must perform an inspection of the WCF and submit a report to the Public Works Department on the condition of the system to include any identified concerns and corrective action taken. Additionally, as the City performs maintenance on City infrastructure additional maintenance concerns may be identified. These will be reported to the owner of the WCF. The City shall give the applicant 30 days to correct the identified maintenance concerns after which the City reserves the right to take any action it deems necessary, which could include revocation of the permit. The burden is on the permittee to demonstrate that it complies with the requirements herein. Prior to issuance of a permit under this Chapter, the owner of the WCF shall sign an affidavit attesting to understanding the City's requirement for performance of annual inspections and reporting.

Section 7-4.120 Revocation.

Any permit or other authorized use of the PROW granted under this Ordinance may be revoked or modified for cause in accordance with the provisions of this Section.

(a) Revocation proceedings may be initiated by the Director.

(b) Public Notice, Hearing, and Action. After conducting a duly-noticed public hearing, the Director or designee shall act on the proposed revocation.

(c) Required Findings. The Director or designee may revoke or modify the permit if it makes any of the following findings:

(1) The permittee obtained the approval by means of fraud or misrepresentation of a material fact;

(2) The permittee substantially expanded or altered the use or structure beyond what is set forth in the permit or substantially changed the installations character;

(3) The use in question has ceased to exist or has been suspended for 6 months or more;

(4) Failure to comply with any condition of a permit issued or any term of a required license under [Code Cites];

(5) Failure to comply with this Article;

(6) A substantive change of law affecting a utility's authority to occupy or use the PROW or the City's ability to impose regulations relating to such occupation or use;

(7) A facility's Interference with a City project;

(8) A facility's Interference with vehicular or pedestrian use of the PROW;

(9) Failure to make a safe and timely restoration of the PROW;

(10) When circumstances make revocation in the best interest of the City.

(d) Notice of Action. A written determination of revocation shall be mailed to the WCF owner within 10 days of such determination.

(e) A permittee whose permit or right has been revoked may have the revocation reviewed, upon written appeal as follows:

(1) Within fourteen days of the revocation, a written appeal shall be filed with the Director. The appeal must contain a statement of any reasons why the permittee believes that the revocation should be reviewed. The Director shall render a decision within twenty-one days of receipt.

(2) If the Director denies the appeal, the permittee may file a written notice of appeal with the City Council within twenty-one days of notification of the appeal denial. In addition to containing a statement of any significant factors and/or hardships as well as alternatives explored, the appeal must contain a response to the findings of the Director that resulted in the denial. The appeal shall be conducted in accordance with the Wireless Application and Siting Policy.

Section 7-4.130 Interference.

(a) The WCF installation shall not damage or interfere in any way with City Property, the City's operations or the operations of prior-existing, third party installations. The City will reasonably cooperate with the applicant and/or carrier to carry out such activities as are necessary to correct the Interference.

(1) Signal Interference – The applicant shall correct any such Interference within 24 hours of written notification of the Interference. Upon the expiration of the 24-hour cure period and until the cause of the Interference is eliminated, the applicant shall cease operation of any WCF causing such Interference until such Interference is cured.

(2) Physical Interference - The City shall give the applicant 30 days to correct the Interference after which the City reserves the right to take any action it deems necessary, which could include revocation of the permit.

(b) The City at all times reserves the right to take any action it deems necessary, in its sole discretion, to repair, maintain, alter, or improve the Sites. Such actions may temporarily interfere with the operation of the WCF. The City will in all cases, other than emergencies, give the applicant 30 days written notification of such planned, non-emergency actions.

Section 7-4.135 Site Selection Guidelines and Criteria.

(a) Wireless facilities installed on City-owned infrastructure in the public rights-of-way shall use a valid master license agreement with the City.

(b) Traffic Obstruction. The placement of the telecommunication facility shall not permanently impede vehicular or pedestrian traffic flow;

(c) No modification to above-ground or at-grade telecommunication facilities, including those related to size, color and shape of the housing, may be made by the applicant without first having obtained approval of the Director.

(d) To the maximum extent feasible, all appurtenant equipment, including radio base station, electrical panel, and control panel assembly, shall be placed below ground. Where feasible, as new technology becomes available, the applicant shall place an existing or proposed above-ground telecommunication facility below ground.

(e) No electrical meters will be allowed. The applicant should negotiate directly with the electric utility to determine a flat rate for installation. The applicant is responsible for the cost of all electrical usage. This provision may be waived on a case-by-case basis by the Director if the Applicant is able to demonstrate use of flat-rated electricity is not feasible.

(f) No net new TF or WCF Poles or Towers shall be allowed in the PROW or on City property, except for approved replacements. This provision may be waived on a case-by-case basis by the Director if the Applicant is able to demonstrate there are no alternatives that are aesthetically preferable.

(g) No net new Transmission Equipment shall be installed above grade on a pedestal, cabinet, or other structure that is detached from the Pole or Tower in the PROW absent demonstration of clear benefit to the City. All Transmission Equipment shall be mounted on the approved Pole using Low Profile equipment, or installed below grade in a vault. Vault vents must be flush to the ground.

Section 7-4.140 Visual Impact Guidelines.

(a) Unobtrusive Design. Telecommunication Facilities shall be designed to be as visually unobtrusive as feasible. Colors and designs must be visually neutral, integrated and compatible with surrounding buildings and/or uses in the area. Facilities shall be sited to avoid or minimize obstruction of views from adjacent properties and otherwise preserve the aesthetic integrity of the public right of way.

(b) An antenna array shall be installed as a shared use on an existing or replacement pole and shall not extend over seven feet beyond the top of the pole. However, no telecommunication facility located within 140 feet of a residential property shall exceed thirty-five (35) feet in height. Additionally, no telecommunication facility shall exceed sixty (60) feet in height from the ground level as measured from the nearest street curb. The Director may modify these requirements if necessary to accommodate General Order 95 of the California Public Utilities Commission.

(c) Camouflaged Design and Screening. When feasible, Applicant shall use state of the art, well camouflaged designs and screening to minimize visual impact of the telecommunication facility. For example, the visual impact of a telecommunication facility may be mitigated by integrating it into existing functional facilities, by the planting of trees to screen the antenna from adjacent private properties.

(d) Landscaping. New landscaping and irrigation designs shall be restored to like or better condition approved by the Director in accordance with the City's landscaping standards.

(1) For telecommunication facilities installed in the public right of way in an area where no sidewalk exists, the permittee shall install landscaping immediately surrounding the installation and restore any landscaping disturbed by the installation. The installed and restored landscaping shall be consistent with the existing surrounding landscaping.

(2) All new landscaping shall be served by an automatic irrigation system installed, or if existing, modified, to sustain landscaping. If an automatic irrigation system is not feasible, applicant shall submit a manual irrigation plan with its application, and guarantee to replace any vegetation that dies from lack of watering.

(e) No Telecommunication Facility shall be illuminated unless specifically required by the FAA or other governmental agency for security or clearance purposes.

(f) Signs and Advertising. No advertising signage or identifying logos shall be displayed on any telecommunication facility except for small identification, address, warnings, and other similar information plates. Such information plates shall be identified in the telecom application and shall be subject to approval by the Director.

(g) If an applicant proposes to replace a pole in order to accommodate their telecommunication facility, the pole shall match the appearance of the original pole to the extent feasible and shall be approved by the Director.

(h) Historic Structures. The telecommunication facility should not be located immediately in front of, beside or behind historic resources recognized by the City pursuant to [Article cite] of this Code.

Section 7-4.145 Design and Other Standards for all sites in PROW.

(a) Engineering calculations sealed by a registered professional engineer licensed in California shall be provided to ensure that the existing pole and footing are adequate to support the new loads. When it is determined that the existing infrastructure is not adequate to support the new loads, the applicant may propose to replace the existing infrastructure with adequate, City approved, new infrastructure at the applicant's expense.

(b) No Antenna owner or operator shall install an Antenna or any related facility on a joint-use pole unless such installation is designed and constructed to comply with the current edition of CPUC General Order 95.

(c) Where the City determines that it requires expert assistance in evaluating an application, the City may hire a consultant and the fee charged by the consultant shall be reimbursed to the City by the applicant regardless of the outcome of the application.

(d) Signage will be maintained in legible condition and the carrier will be required to replace any faded signage within 30 days of receiving written notification from the City that it is in need of replacing.

(e) All wireless communications facilities, including on-site generators, shall be designed to be compliant with the [Noise Code cite] of this Code and all other applicable Laws. Failure to comply with the City's adopted noise standard after written notice and opportunity to cure have been given shall be grounds for the City to revoke the permit.

(f) All cabling and wiring must be contained in conduit, affixed directly to the face of the pole, for as long as it is technically feasible. No exposed slack or extra cable will be allowed.

(g) No historic or decorative street lights are eligible for WCF installations.

(h) The permittee shall assume full liability for damage or injury caused to any property or person by the facility.

(i) The permittee shall repair, at its sole cost and expense, any damage including, but not limited to subsidence, cracking, erosion, collapse, weakening, or loss of lateral support to city streets, sidewalks, walks, curbs, gutters, trees, parkways, street lights, traffic signals, improvements of any kind or nature, or utility lines and systems, underground utility line and systems, or sewer systems and sewer lines that result from any activities performed in connection with the installation and/or maintenance of a wireless telecommunications facility in the public right-of-way. The permittee shall restore such areas, structures and systems to the condition in which they existed prior to the installation or maintenance that necessitated the repairs. In the event the permittee fails to complete such repair within the number of days stated on a written notice by the city engineer. Such time period for correction shall be based on the facts and circumstances, danger to the community and severity of the disrepair. Should the permittee not make said correction within the time period allotted the city engineer shall cause such repair to be completed at permittee's sole cost and expense.

(1) The permittee shall keep the site, which includes without limitation any and all improvements, equipment, structures, access routes, fences and landscape features, in a neat, clean and safe condition in accordance with the Approved Plans and all conditions in this permit. The permittee shall keep the site area free from all litter and debris at all times. The permittee, at no cost to the City, shall remove and remediate any graffiti or other vandalism at the site within 48 hours after the permittee receives notice or otherwise becomes aware that such graffiti or other vandalism occurred. Each year after the permittee installs the wireless facility, the permittee if requested by the Director shall submit a written report to the Director, in a form acceptable to the Director, that documents the then-current site condition.

(2) Property Maintenance. The permittee shall ensure that all equipment and other improvements to be constructed and/or installed in connection with

the Approved Plans are maintained in a manner that is not detrimental or injurious to the public health, safety, and general welfare and that the aesthetic appearance is continuously preserved, and substantially the same as shown in the approved plans at all times relevant to this permit. The permittee further acknowledges that failure to maintain compliance with this condition may result in a revocation of the permit or any other remedy available to the City under the law.

(j) For any facility on city-owned infrastructure, the applicant may be required to enter into a lease agreement with the city for use of the site, in addition to any other permits required by law.

Section 7-4.150 Macrocell Sites in the PROW.

(a) Site Selection:

(1) Preferred locations are on existing infrastructure such as street lights. The infrastructure selected shall be located at alleys and near property line prolongations. If the facility is not able to be placed on existing infrastructure, the applicant shall provide a map of existing infrastructure in the service area and describe why each such Site was not feasible.

(2) When existing infrastructure Sites have been exhausted, the City may require that the applicant provide new infrastructure such as a street light, on which the WCF can be installed. In such cases, the new infrastructure shall be dedicated to the City and will have a primary purpose other than as a WCF and the WCF will be the secondary use. This installation will be defined as a wireless Base Station.

(3) When all other preferred Sites have been exhausted and new infrastructure is not feasible, the applicant may request the installation of a new tower, camouflaged by City approved methods.

(b) Existing Infrastructure requirements

(1) Street light.

i. The installation shall not increase the total height by more than 10% or ten feet, whichever is greater, over other street lights in the area.

ii. The Antenna must be mounted to the top of the pole, or flush to the pole near the top, in a RF transparent screen that is coated or painted an approved color to match the street light pole. The screen is considered to Camouflage the installation.

iii. Equipment, other than Antennas, must be in an underground vault. Vault vents must be flush to the ground.

iv. Wires and cables must run in conduit inside the pole. Underground entry into the pole through the foundation is required.

v. As requested by the City, the applicant or carrier shall host on-site training for City maintenance staff. The training will be offered for each

WCF project on a street light pole. The training shall include occupational safety, personal protection, proximity limits, emergency procedures and contact information.

(2) Utility Pole.

i. Antenna installations will be top of pole mount. If this is not feasible due to California Public Utility Commission rules, then a replacement pole must be installed to comply with this requirement and the Commission rules.

ii. The Antenna must be in a RF transparent screen that is coated or painted an approved color to match the pole. The screen is considered to Camouflage the installation.

iii. Equipment, other than Antennas, must be in an underground vault. Vault vents must be flush to the ground.

iv. If the existing utility pole already has more than two existing risers/drops, the pole must be replaced with a metal pole that allows the new cable and wires to be inside the pole, in conduit. The existing drops will also be relocated inside the new pole and underground entry into the pole through the foundation is required. When the installation will result in two or fewer risers/drops on the pole, the wires and cable may be installed as a riser/drop in conduit painted an approved color or in commercially available black or dark brown conduit, as directed by the City.

(c) Traffic pole. Installations on traffic poles shall not be allowed.

Section 7-4.160 Small Cell Sites in the PROW.

(a) Site Selection:

(1) The preferred location shall be on existing infrastructure such as utility poles or street lights. The infrastructure selected should be located at alleys and near property line prolongations. If the facility is not able to be placed on existing infrastructure, the applicant shall provide a map of existing infrastructure in the service area and describe why each such Site was not feasible.

(2) When existing infrastructure Sites have been exhausted, the City requires that the applicant dedicate new infrastructure such as a street light, on which the WCF can be installed. In such cases, the new infrastructure shall be owned by the City and will have a primary purpose other than as a WCF and the WCF will be a secondary use. This installation will be defined as a wireless Base Station.

(b) Existing Infrastructure requirements

(1) Street light:

i. The Antenna shall be the smallest possible volume but in no case greater than three cubic feet. The Antenna must be enclosed in an RF transparent screen unless a whip style antenna is used. Antenna installations will be

top of pole mount and shall not increase the height by more than 10% or ten feet, whichever is greater, over other street lights in the immediate vicinity. The small size of the Antenna or RF screen, and color treatment is considered to Camouflage the installation.

ii. Equipment, other than Antennas, shall be mounted as prescribed by the Director in one of the manners described.

1. Equipment shall be mounted in a base shroud of approved design to be retrofitted to the existing light standard. The base shroud shall be coated or painted with an approved color to match the existing pole.

2. Equipment shall be mounted directly to the pole a minimum of eight (8) feet above the existing grade and be coated or painted with an approved color to match the existing pole.

3. Equipment shall be mounted to the pole in an equipment box a minimum of eight (8) feet above the existing grade. The equipment box shall be coated or painted an approved color to match the existing pole and will be no wider than two times the diameter of the pole at the point it is mounted nor protrude from the surface of the pole by more than eight inches.

iii. The applicant may propose or the City may require that the existing light standard be replaced with a City approved pole that is manufactured with a base shroud designed to accept wireless equipment and integrated RF screen to accept a wireless Antenna.

(2) Utility Pole:

i. The Antenna shall be the smallest possible volume but in no case greater than three cubic feet and shall be mounted at the top of the pole or on the side of the pole with a bracket. When mounted with a bracket the bracket may extend no more than eighteen (18) inches from the surface of the pole and will be coated or painted an approved color to match the existing pole. The antenna must be enclosed in an RF transparent screen unless a whip style antenna is used. The small size of the Antenna or the RF screen, and color treatment is considered to Camouflage the installation.

ii. Equipment, other than Antennas, shall be mounted as prescribed by the Director in one of the manners described.

1. Equipment shall be mounted directly to the pole a minimum of eight (8) feet above the existing grade and be coated or painted with an approved color to match the existing pole.

2. Equipment shall be mounted in an equipment box that is mounted directly to the pole a minimum of eight (8) feet above the existing grade. The equipment or box shall be coated or painted an approved color to match the existing pole and will be no wider than the

diameter of the pole at the point it is mounted nor protrude from the surface of the pole by more than eight inches.

iii. If the existing utility pole already has more than two existing risers/drops, the pole must be replaced with a metal pole that allows the new cable and wires to be inside the pole, in conduit. The existing drops will also be relocated inside the new pole and underground entry into the pole through the foundation is required. When the installation will result in two or fewer risers/drops on the pole, the wires and cable may be installed as a riser/drop in conduit painted an approved color or in commercially available black or dark brown conduit, as directed by the City.

(3) Traffic pole. Installations on traffic poles shall not be allowed.

Section 7-4.170 Distributed Antenna System (DAS).

Applications for DAS WCF shall be submitted as a single application and will have a single master license agreement and memorandum of understanding for the entire project. Each individual location within the system shall be processed and considered for approval separately. Permitting fees will be applied to each site, in an amount established by City Council resolution for its Master Fee Schedule. Each location will be evaluated and must comply with the installation design guidelines for the type of Site as defined by this ordinance.

Section 7-4.180 Carrier/Cell on Wheels (COW).

(a) A Carrier-on-wheels (COW) will be placed in the PROW or City owned property through a use of an encroachment permit.

(b) The setup location requested for the COW will be reviewed and at the discretion of the Director of Public Works or designee may be modified to ensure public health and safety.

(c) The duration of a permit for a COW will be no longer than is necessary to establish the network and provide the temporary coverage required by the event or emergency.

(d) At the discretion of the Director or his or her designee, the permit may be revoked or modified when in the best interest of the City.

Section 7-4.190 Compliance with Applicable Law and Regulations.

This Article is not intended to be the exclusive means of regulating installation of Facilities in the public right of way and nothing herein is intended to waive any other applicable City requirements, including but not limited to building permit, storm water runoff, business license, excavation and undergrounding regulations. The applicant/permittee shall obtain all permits, licenses, and similar authorizations that are required by other governmental entities for the installation of its Facilities. The applicant/permittee must also be and remain in compliance with all applicable statutes, ordinances, rules, regulations, orders, and decisions issued by any federal, state or local governmental body or agency, including without limitation those issued

by the California Public Utilities Commission and the Federal Communications Commission.

Section 7-4.200 Nonexclusive Use of public right of way.

All permits to construct or place Facilities in the public right of way shall be nonexclusive. The granting of a permit under this article by the City does not provide any permittee with an exclusive use of the public right of way.

All telecommunication facilities permitted by this chapter shall, upon the reasonable demand of the Director, be relocated if required by the City to avoid potential conflicts with a proper governmental use of a street, alley, sidewalk or other public place. All expenses incurred in relocating shall be paid by the telecommunication facility owner.

Section 7-4.210 Director's Guidelines.

To the extent not preempted by applicable laws, the Director may prescribe additional guidelines covering the location, size and depth of excavations in public streets and sidewalks as the Director may deem necessary for the public safety and welfare. Where such guidelines are general in character and are designed to apply to all excavations of a certain type or nature, they shall be promulgated in writing showing the date of their enactment, and a copy thereof, duly certified to by the Director shall be kept on file where they may be made available for public inspection upon the demand of any person. All Work performed under this Article shall be subject to such guidelines.

The Director may also prescribe Standards and Guidelines for Wireless Communications Facilities in the Public Right-of-Way. The primary purpose of these Standards and Guidelines shall be to provide procedural and design guidance and specific design standards and requirements for project applicants proposing wireless telecommunication facilities in the public right-of-way. The Standards and Guidelines Policy document is also intended for use and reference by City staff in reviewing and approving designs and verifying compliance with this Code. The Standards and Guidelines Policy document may also govern the maximum number of applications for WCF placement based on resource limitations, to promote administrative efficiency and deemed necessary or appropriate to organize, document and manage the application intake process. All such guidelines will be in written form and publicly stated to provide applicants with prior notice. Applicants for small cell permits are encouraged to apply for proposed buildout of entire neighborhoods or other contiguous areas to promote administrative efficiency.

Section 7-4.220 Indemnity; insurance.

Prior to issuance of any permit under this article, each applicant shall:

(a) Represent, stipulate, contract and agree that such applicant will indemnify and hold harmless and defend the City of Hayward, its officers and employees from and against any and all suits, actions, judgments, losses, costs, demands, claims, expenses (including attorney's fees), damages, and liabilities of every kind for any and all claims for damage to property, or injury to, or death of persons arising out of or resulting from the issuance of the permit or the placement of the

telecommunication facility, except to the extent any damage or injury is due to the gross negligence or willful misconduct of the City, its officers or employees.

(b) Obtain and file with the Clerk of the Council, and thereafter maintain during the term of any such permit, certificates evidencing comprehensive general liability insurance policy or policies, approved as to form by the City Attorney, issued by an insurance company or companies authorized to do business in the State of California. The City of Hayward, its officers and employees shall be named as additional insureds on said policy or policies. The policy limits of said insurance policy or policies shall be not less than one million dollars ($1,000,000.00) combined single limit for both bodily injury and property damage, or equivalent.

(c) Said policy or policies shall also contain a provision that no termination, cancellation, or change of coverage of insured or additional insured shall be effective until after twenty (20) days' notice thereof has been given in writing to the Clerk of the Council.

(d) Applicants who self-insure shall so state and attest in writing in the Application, which self-insurance in an amount equal to the amount required by this Article or the Guidelines, whichever is higher, shall be subject to approval by the City.

Section 7-4.230 Permit Non-Compliance; No Waivers.

No permittee shall be excused from complying with any of the provisions of this article by any failure of the City on any one or more occasions to seek, or insist upon, compliance with any requirements or provisions of this Code. Regardless of the City's failure to seek compliance on any occasions, such action shall not be considered a waiver of any requirements of this Code.

Section 7-4.240 Future Changes in the Law.

The City's rights under this Article are coextensive with the City's rights under state law with regard to the use of the public right of way by telecommunication corporations (as defined by the Public Utilities Code). If future changes to state or federal law authorize the City to regulate the Utility and its activities within the City and the public rights of way to a greater degree than is now authorized by this article, nothing in this Article will be deemed to limit, restrict in any way, or to modify the City's exercise of that regulatory authority.

Section 7-4.250 Severance.

Should any part of this ordinance be declared by a final decision of a court or tribunal of competent jurisdiction to be unconstitutional, invalid, or beyond the authority of the City, such decision shall not affect the validity of the remainder of this ordinance, which shall continue in full force and effect, provided that the remainder of the ordinance, absent the unexcised portion, can be reasonably interpreted to give effect to the intentions of the City Council.