City of Ontario, California

Engineering Department

Fiber Optic Master Plan

September 2013

Prepared by:

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Owner / Operator of ID Construction Services

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Executive Summary

This milestone document is to be used by the City of Ontario (CITY) for the planning, budgeting, and implementation of a progressive and visionary Fiber Optic Infrastructure (INFRASTRUCTURE) project. While this document represents years of collective development efforts, it is only complete and correct at this point in time, and will require periodic maintenance as a ***"living and breathing"*** document to follow growth and development within the CITY's metropolitan area.

The proposed infrastructure, composing of approximately 19 miles of backbone fiber north of Riverside Drive and approximately 23 miles of backbone fiber south of Riverside Drive, is an investment into a long term capital asset using newly constructed and existing conduit to provide high speed communication links to key locations throughout the CITY. The primary "transport layer" will provide for a 10 Gbps data transport speed, while the "access layer" will have a 1 Gbps data transport speed. Based on the costs of purchasing comparable bandwidth available on the proposed network, the project would have an 8 year return on investment. Using the current leased bandwidth as a comparison, the approximate return on investment would be 20 years. This seems to be reasonable considering that this asset will be used by the CITY for an interminable period.

The benefits to be realized from deployment of this INFRASTRUCTURE are both immediate and long-term. The near term impact will be the transfer of ongoing montly expenses currently committed to communication carrier, to a CITY-owned and managed resource that will provide a level of service and performance not otherwise commercially available for a comparable cost. Secondly, the CITY will be empowered to compete at an advanced level with their Economic Development initiatives to attract and support industries that depend upon advanced telecommunication infrastructure. Finally, the CITY will have a long-term resource that will represent unparalleled performance for the next 30 years and beyond, do deliver outstanding efficiencies for the benefit of the CITY's businesses and residents.

We want to emphasize that this INFRASTRUCTURE is far beyond a *"like-for-like"* replacement project. The proposed project includes an extensive and scalable fiber INFRASTRUCTURE that will be owned and operated by the CITY. The project would ensure local control, security and avoid trending cost increases of leased services. Moreover, it will enable and support future capabilities and initiatives that will not only reduce costs, but represent technology improvements that can impact on CITY building access control, surveillance video, and public safety.

Future CITY initiatives could include use of traffic signal infrastructure to enable wireless network capabilities, which could deliver secure communications for first responders. Video capabilities could be extended to improve traffic management, and end-of-life utility assets can be migrated onto this new INFRASTRUCTURE as legacy wireless systems are retired. The benefits available are far beyond the costs and risks of deployment; it could be reasonably argued that the costs / risks of non-deployment *are even greater*.

Introduction

The City of Ontario provides municipal services to a population of approximately 167,000 residents, as well as commercial, industrial, public and agricultural lands and the Ontario International Airport, within its service area. The CITY recognizes its responsibility to efficiently meet the citizen's needs with long-range planning efforts. This is the basis behind the initiative to develop a Fiber Optic Master Plan for the municipality that would address the CITY's immediate and near-term telecommunications demands, while establishing the infrastructure to meet future needs in a cost-effective and fiscally responsible manner. This report is intended to illustrate a foundation, and to provide a comprehensive planning guide for establishing and upgrading the CITY's telecommunication infrastructure and services offering.

Previous Studies

Previous studies completed and utilized in the development of this Fiber Optic Master Plan include the following:

- Transportation System Communication Master Plan, November 2007
- The Ontario Plan (General Plan), February 2010
- Capital Improvement Program, Fiscal Year 2011 – 12 , 5 Year Plan

Scope of Work

The scope of work for the development of this master plan consists of the following:

I – Project Management

- Work Plan
- Progress Reporting

II – System Inventory

- Technical Memorandum on System Inventory
- Map of Existing System Inventory

III – Needs Assessment

- Technical Memorandum on Needs Assessment
- Conceptual Layout of Needed Infrastructure
- Concept of Operations

IV – Fiber Optic Master Plan

- Description of Area
- Bandwidth Analysis
- System Goals and Recommendations
- Capacity Analysis – Current / Future
- Locations of Fiber Optic Infrastructure, Equipment and Point of Connection

- Implementation Phasing Plan
- Implementation Costs and Schedule
- Design Guideline
- Bid Quality Standard Drawings and Specifications
- Maintenance Requirements and Costs
- Potential Update of development guidelines and policies

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Study Area

The study area, illustrated in Figure 1 below, coincides with the City of Ontario boundary. It is located approximately 25 miles east of downtown Los Angeles, and encompasses approximately 49 square miles of residential, commercial, industrial, public and agricultural lands as well as the Ontario International Airport. It is bordered by the Cities of Chino and Montclair on the west; the Cities of Upland and Rancho Cucamonga on the north; the cities of Fontana and Eastvale on the east; and Riverside County, and the City of Chino on the south.

The major highways crossing through portions of the study area include the San Bernardino Freeway (I-10) on the north, the Pomona Freeway (SR-60) on the south, and the Ontario Freeway (I-15) on the east.

For the purpose of the Fiber Optic Master Plan, the CITY is referred to and broken down in two different areas, Old Model Colony (OMC) and New Model Colony (NMC). The two areas are generally divided by Riverside Drive.

Old Model Colony – General Boundaries

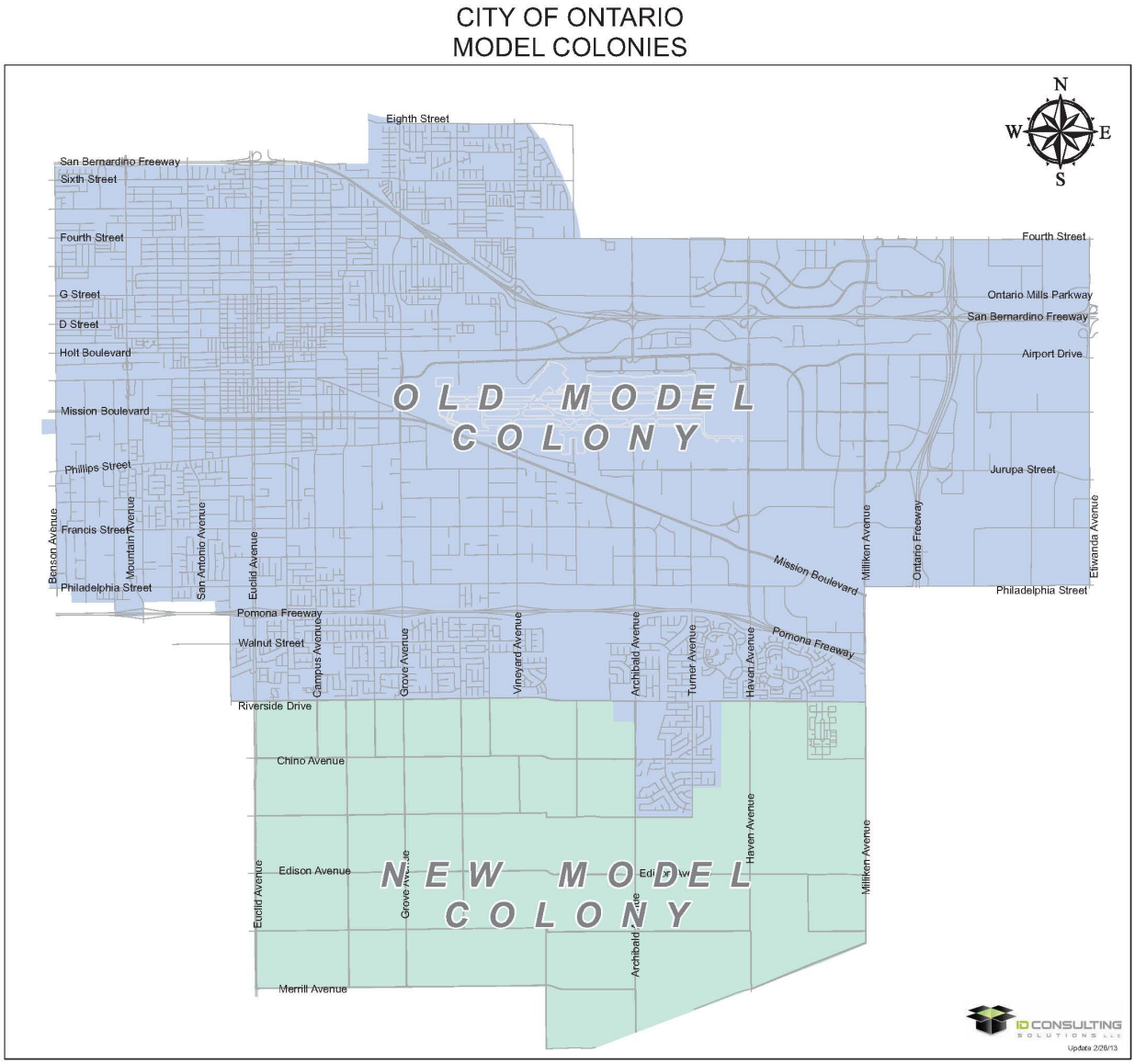
- Northern Boundary – Generally along Fourth St. / Eighth St. / San Bernardino Freeway
- Southern Boundary – Along border with NMC, generally along Riverside Drive
- Eastern Boundary – Generally along Etiwanda Avenue
- Western Boundary – Generally along Benson Avenue

New Model Colony – General Boundaries

- Northern Boundary – Along border with OMC, generally along Riverside Drive
- Southern Boundary – Generally along Merrill Avenue
- Eastern Boundary – Generally along Milliken Avenue
- Western Boundary – Generally along Euclid Avenue

OMC consists of existing residential, commercial, and industrial developments. NMC comprises approximately 13 square miles and currently consists of primarily agricultural land. The CITY's 2010 General Plan details plans to develop the agricultural lands in NMC into a mix of residential, commercial, industrial and public uses. The ultimate residential population of NMC is expected to reach 162,518. Development of NMC has begun with the construction of the Brookfield Homes Development, Edenglen, located southwest of the intersection of Riverside Drive and Mill Creek Avenue.

Figure 1 – City of Ontario Model Colonies



Old Model Colony (OMC)

As described and referred to throughout the Fiber Optic Master Plan and supporting documents, OMC is the established Colony and, as such, has significant existing residential, commercial, industrial developments and municipal locations. Accordingly, Phase I and Phase II of the Fiber Optic Communication Infrastructure will be concentrated in OMC.

New Model Colony (NMC)

Due to the NMC being a planned, annexed portion of the CITY, and the development of the Colony being driven by the developers, it is not possible to project any "Phase" or calendar-based deployment plan. The fiber optic conduit infrastructure and connectivity will be added over time, and will be supported by the infrastructure required of willing developers. Important to note however, the NMC already has a requirement that any developed land must install and provide fiber conduit to all improved lots.

DATA 101 – A Technology Primer

Frequently, units are used in discussion of technology, but not everyone may know what they mean or what they measure. Here are quick definitions for the three most common technology references – file sizes, transport speeds, and bandwidth.

File Sizes

File sizes are expressed in Bytes, which contain 8 bits of data. Think of Bytes like words, and bits like letters. The most common uses of file sizes are Kilobytes (expressed with a capital B, as in KB, and contain 1,024 Bytes), Megabytes (MB, which contain 1,024 KB), and Gigabytes (GB, and these contain 1,024 MB). It's a rough approximation, but it makes it easier to relate these terms: think of KB as thousands, MB as millions, and GB as billions of bytes.

Network Speeds

Network / transfer speeds are expressed differently – as in bits per second (bps). When data is moved, the formatting of "words" (bytes) is no longer relevant, it's just 1's and 0's – moving data files across a network or from place to place, these transfer speeds determine system performance and response time for the users. Almost like the terms above, the most common rates are expressed in units like: Kilobits per second (Kbps) or 1,024 bits per second, Megabits per second (Mbps) or 1,024 Kilobits per second, and Gigabits per second (Gbps) or 1,024 Megabits per second.

In this Master Plan, there are references to several speeds, including T-1 circuits (1.544 Mbps), Fast Ethernet circuits (100 Mbps), Gigabit Ethernet (1 Gbps), and 10 Gigabit Ethernet (10 Gbps). In order to achieve these higher transport speeds over city-wide distances, use of a very high bandwidth media is required – specifically, singlemode fiber optic cabling.

Bandwidth

Bandwidth is the information-carrying capability of any media type, including copper cables and fiber optic cables. Within the industry, singlemode fiber optic cabling is recognized as having infinite bandwidth – that is, there is no effective limit on how fast the data can be transported via this medium. Once emerging technologies are ratified by the industry standards organizations, the very same singlemode fiber optic cabling can be utilized to provide 40Gbps, 100Gbps, and

even higher transport speeds, demonstrating excellent value as a high-bandwidth infrastructure asset.

Infrastructure Locations

Fiber

The CITY's current and proposed network configurations are made possible thru the interconnection of LAN (Local Area Network) and WAN (Wide Area Network) resources. At present, the CITY is dependent upon WAN resources that are rented / leased from service providers, and have a specific maximum capacity for data transmission – the monthly recurring costs are directly relative to the network speeds that are delivered. When the new network of CITY-owned assets is deployed, the monthly recurring costs to WAN service providers will be greatly reduced and the network speeds within the CITY's new fiber infrastructure will be significantly increased, in many instances by nearly two hundred-fold.

The new network assets are comprised of active network components that will be deployed with consideration to redundancy and reliability – the use of fault-tolerant design criteria will insure maximum uptime and performance for CITY operations. This carrier-class network uses a ring topology intended to mitigate the effects of the failure of any individual piece of equipment or fiber outage that could result from a "dig up." This network will also support passive optical network (PON) components at the edge, if the CITY should choose to implement them.

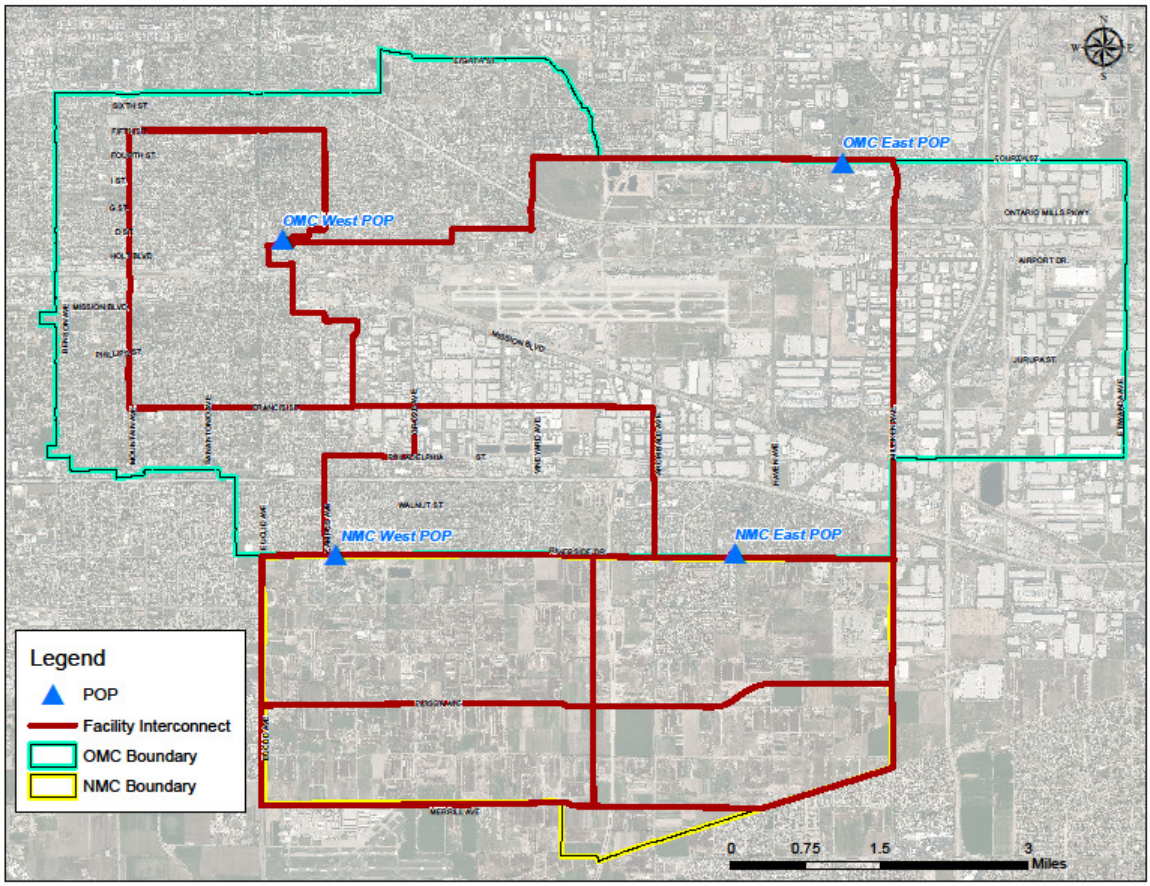
Description of the actual fiber routes will require use of some terminology and networking terms that will be defined here. First, the fiber infrastructure routes have a varying number of fiber strands that are dependent upon their function – Primary Rings and Secondary Rings utilize fiber counts including 2 cables of 432 fibers each, one 432 fiber cable, and one 288 fiber cable. These Primary / Secondary rings provide redundant Transport capability between the CITY's Points Of Presence (POPs), and are initially configured to provide traffic rates at 10 Gigabits per second, or roughly 10 billion bits of data per second.

The CITY Fiber Optic Network has two distinctly separate topologies – Transport and Access Layers. The Transport Layer is the 10 Gigabits per second interconnection between the POPs, and the Access Layer interconnections are 1 Gigabit per second links from the POPs out to the individual CITY facilities / interconnected assets (traffic signals, wells, etc.).

POPs & Electronics

The deployment plan for the CITY POPs provides for four locations where Primary and Secondary rings meet with the active network equipment to provide this 10 Gigabit transport function – two each in Old Model Colony (OMC) and New Model Colony (NMC). The existing City Hall Data Center will be described as the OMC West POP location on all system maps and documents prepared as a part of the Fiber Optic Master Plan.

Figure 2 – City of Ontario Facilities Map (OMC & NMC)

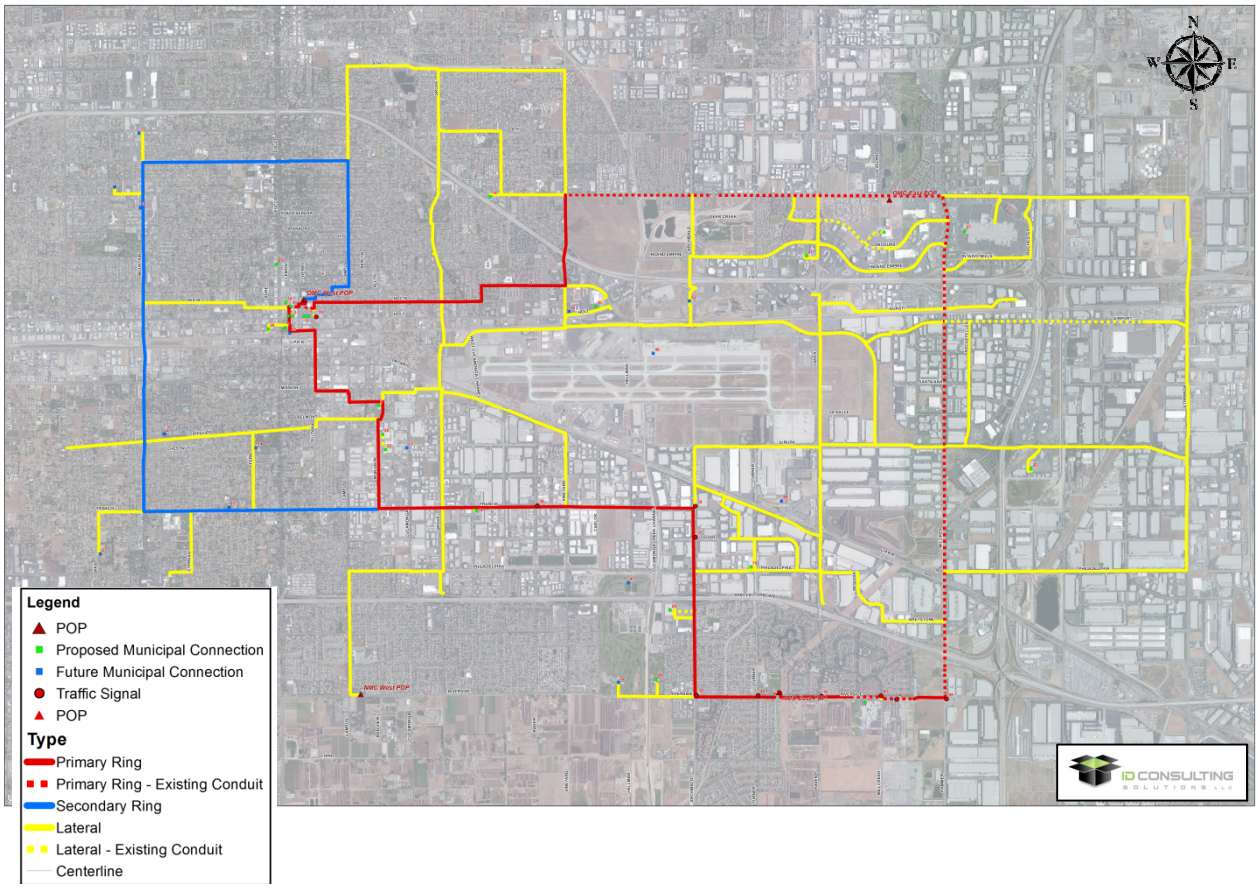


Within each of the four proposed POPs, there will be two layers of active network electronics deployed: the TRANSPORT layer provides POP to POP traffic rates at 10 Gbps, and ACCESS layer connectivity to individual sites / locations / users, initially configured to provide traffic rates at 1 Gbps, or approximately 1 billion bits of data per second.

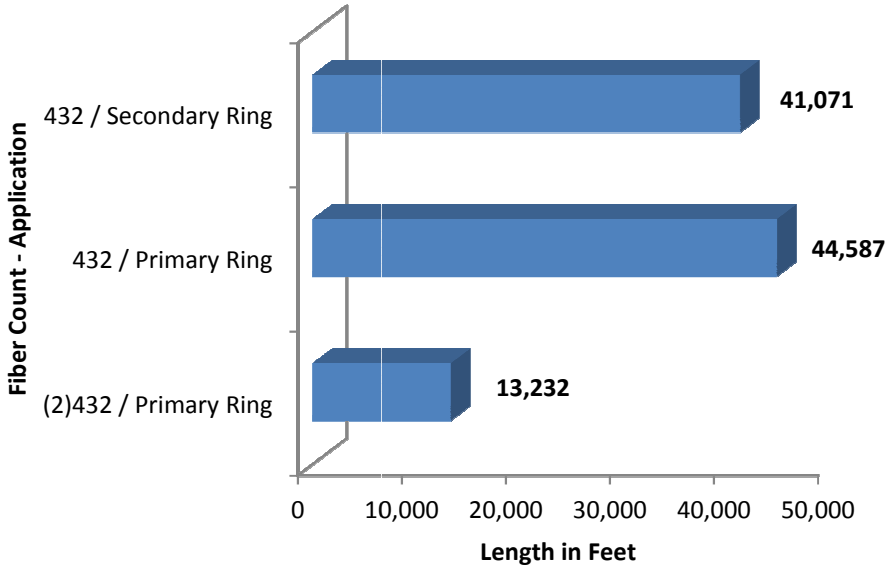
While the active Transport and Access network components are currently configured for 10 Gbps / 1 Gbps traffic rates, it is noteworthy that this capacity exists ONLY within the active components and not the fiber infrastructure itself. The fiber has virtually limitless bandwidth and, with future replacement of the active network components, could readily support higher traffic rates including 40 Gbps and 100 Gbps. Additional discussion about the planned active electronic components will follow the detailed review of the fiber optic infrastructure.

IDCS has prepared / provided a great amount of graphical representation of the Primary and Secondary Rings in the proposed system maps that can be found in detail within the master plan's appendices. The condensed maps and map legends depicted below describe the route footage of the various Primary, Secondary Rings, and Laterals within the OMC and NMC service areas.

Figure 3 – OMC Ring and Lateral Fiber Optic Cabling



OMC Transport Layer Ring Footage



OMC Access Layer Lateral Footage

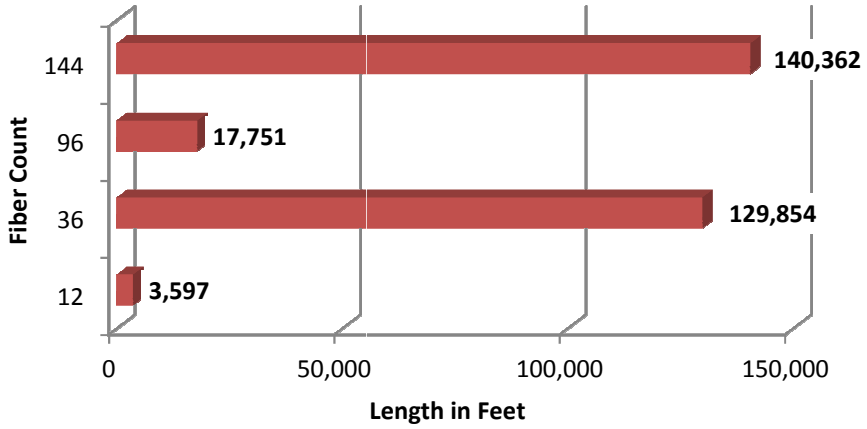
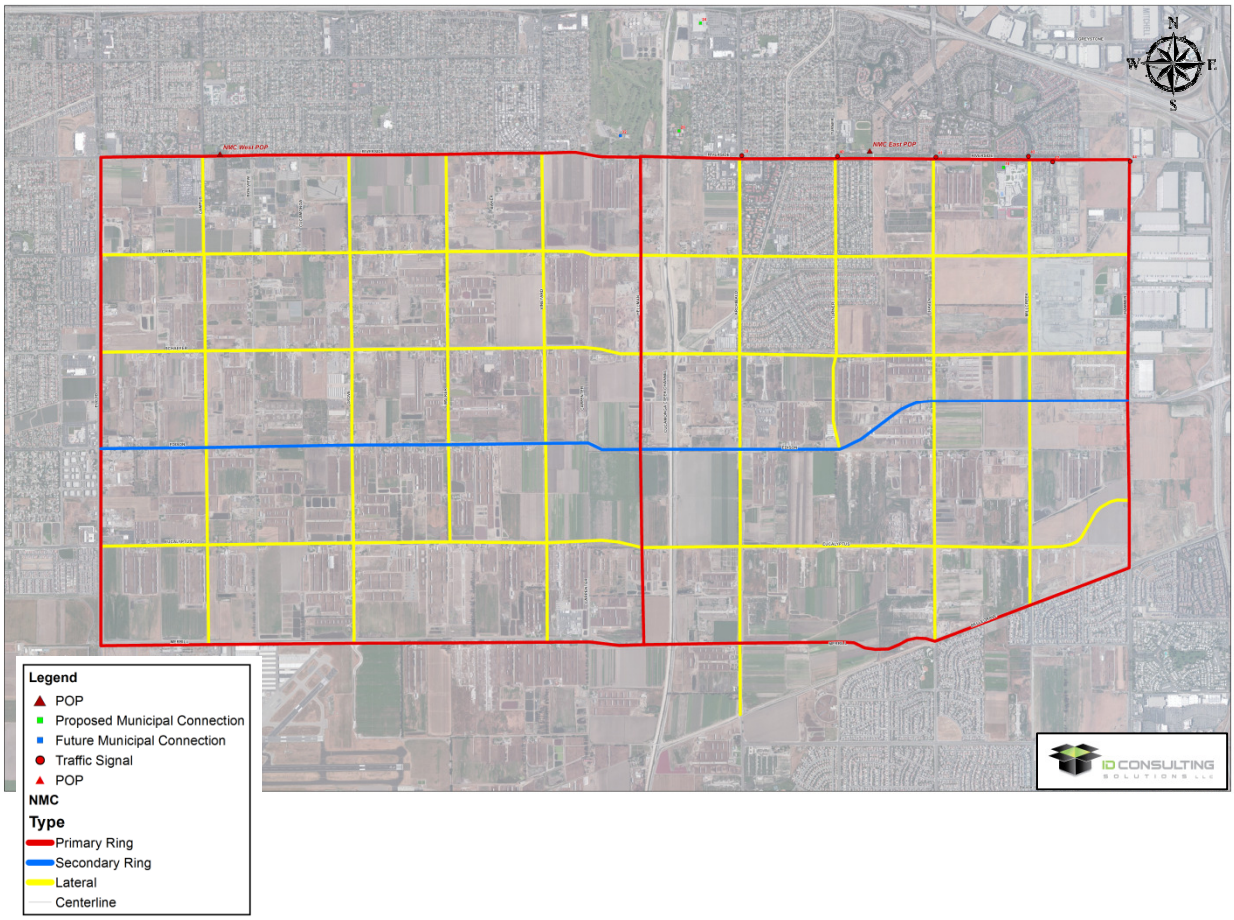
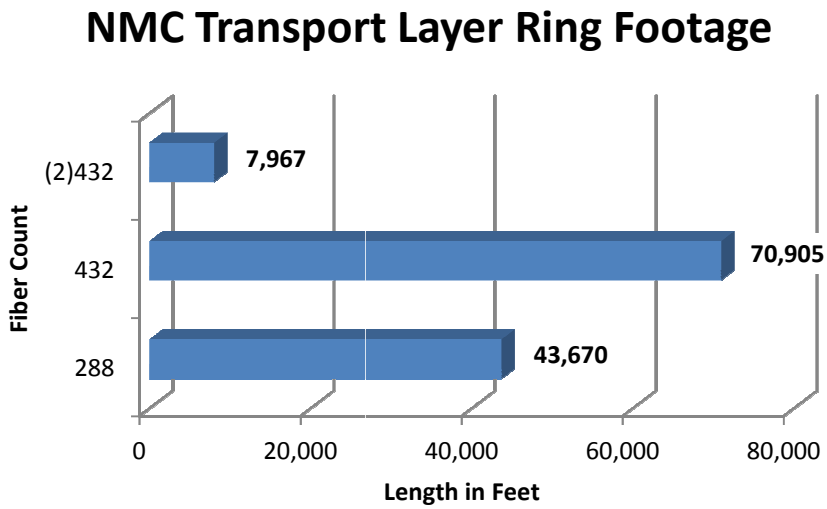
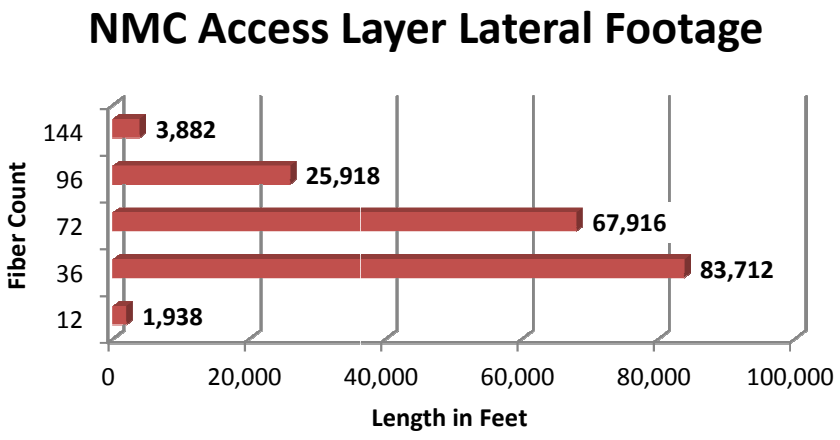


Figure 4 – NMC Ring and Lateral Footages





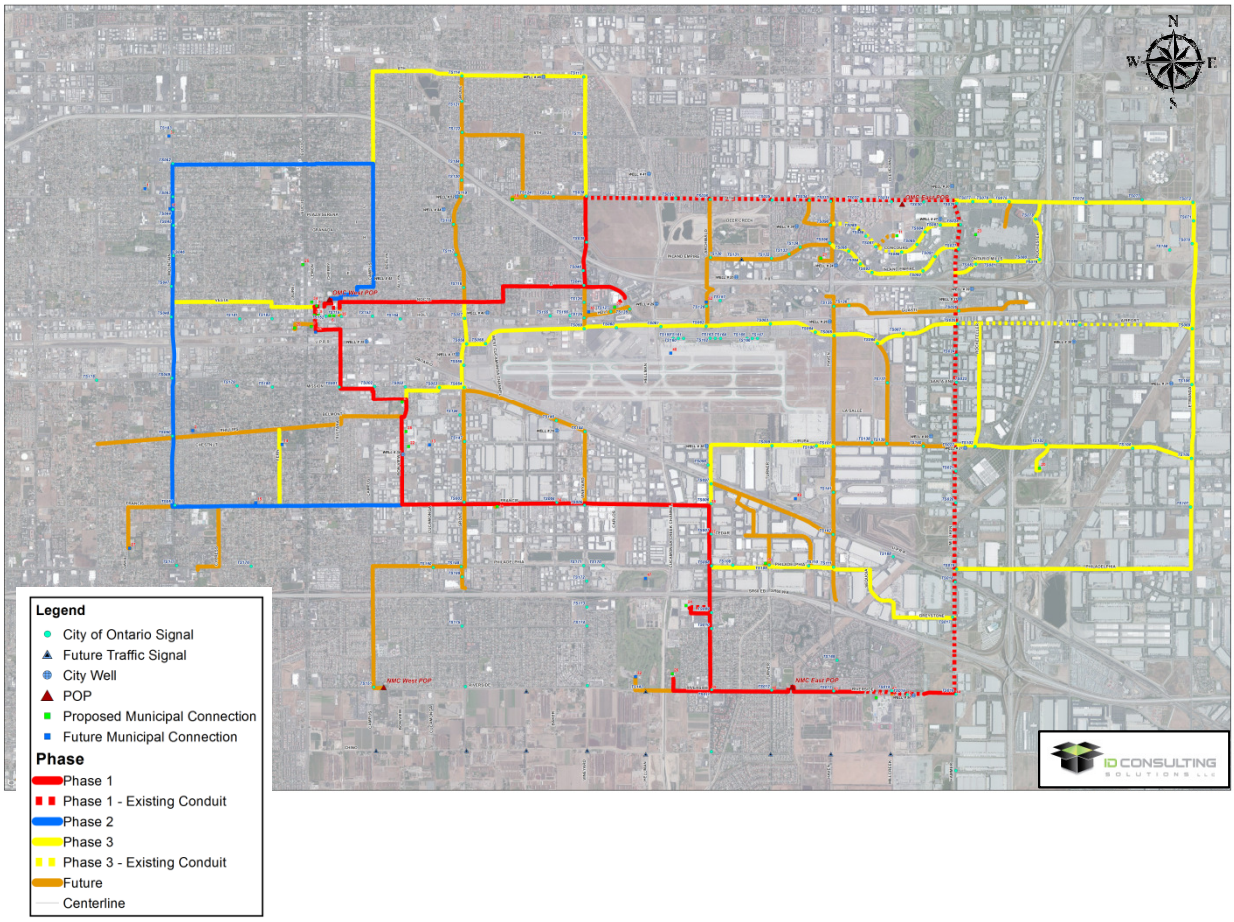


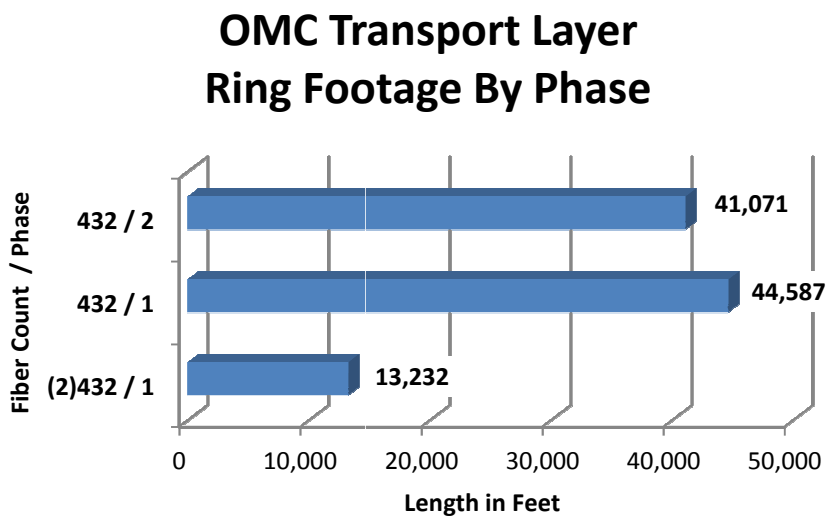
The proposed fiber infrastructure from the POPs out to the various sites / locations / users on the Access network includes fiber cables referred to as Laterals, and they contain a mix of the following fiber strand counts: 144, 96, 72, 36, and 12. This 1 Gbps Access layer traffic is the primary level of service provided to the CITY's network customers (City Facilities), and would be directly relevant in comparison to the rented / leased carrier circuits currently used to support CITY WAN traffic.

As before with the Primary and Secondary Rings, IDCS also provided detailed route maps that depict the Lateral routes and their respective fiber strand counts. As an alternative view of that same data, IDCS will describe those proposed Laterals in separate charts below for the OMC and NMC service areas.

The prior maps within this section only provide data about what the completed system would look like if it was already built. Clearly, there is a time component that would be relevant to the construction and deployment of this new CITY-owned infrastructure, so it would be appropriate to also view the plan to bring these systems on-line. In the maps that follow, the various fiber infrastructures will also be presented with the order in which they are conceptually planned for installation by project phase.

Figure 5 – OMC Implementation Phases and Footages

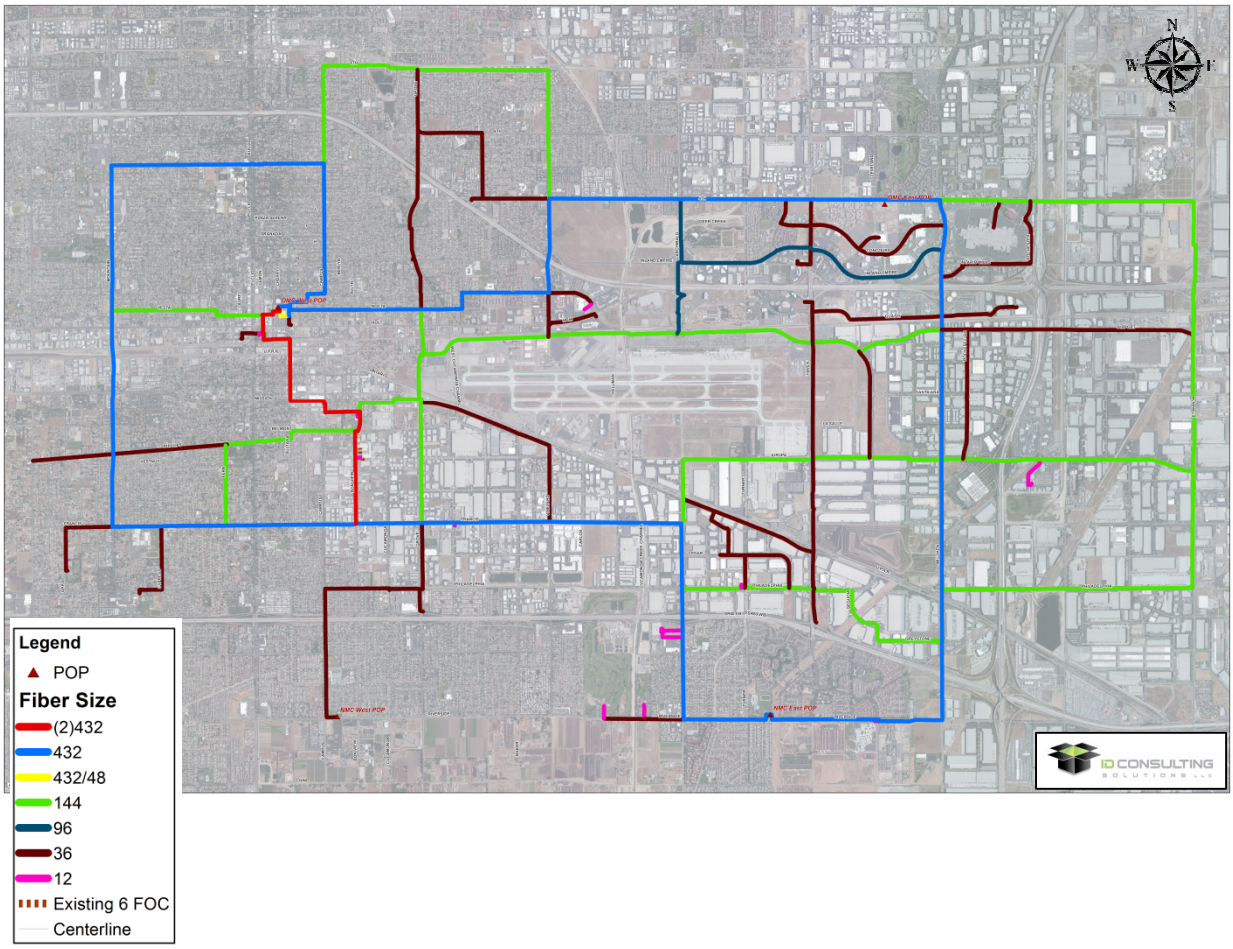




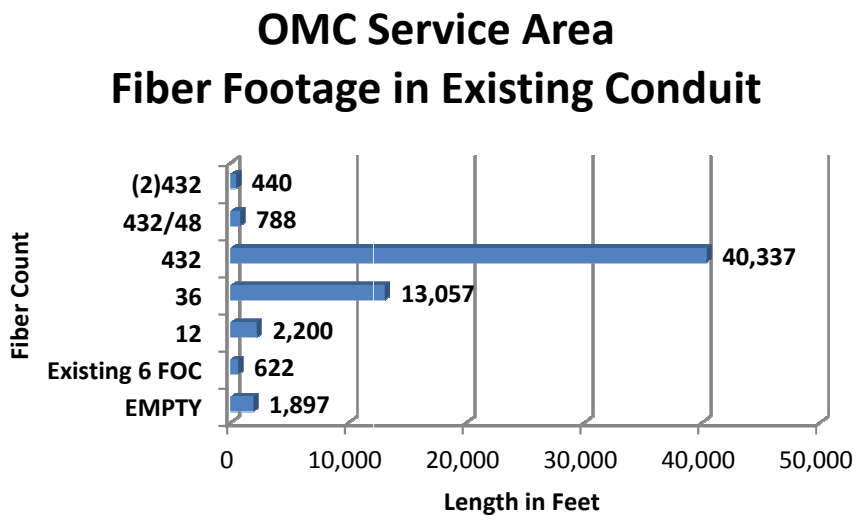
NOTE: Information about phasing of backbone construction in NMC is difficult to forecast, due to the uncertain timing of future developments.

In order to understand the fiber count within the network, the following maps depict the fiber count and footages within the OMC and NMC.

Figure 6 – OMC Fiber Size and Footages



Also, within the OMC areas, a significant amount of existing CITY-owned conduit can be used as a cost-effective resource for installation of fiber optic infrastructure.


OMC Service Area
Fiber Footage in Existing Conduit
Fiber Count
(2)432
432/48
432
36
12
Existing 6 FOC
EMPTY
440
788
40,337
13,057
2,200
622
1,897
0
10,000
20,000
30,000
40,000
50,000
Length in Feet

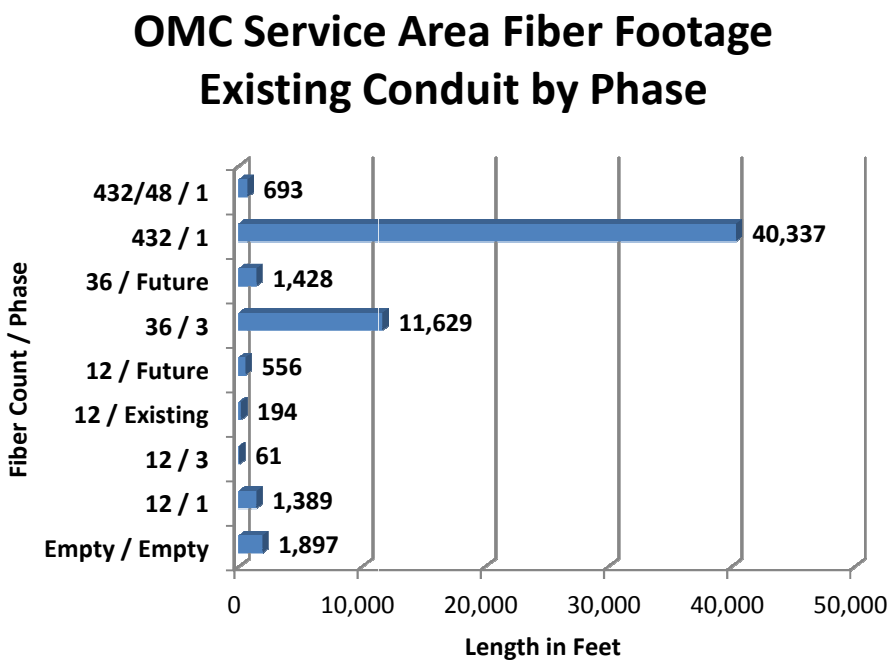
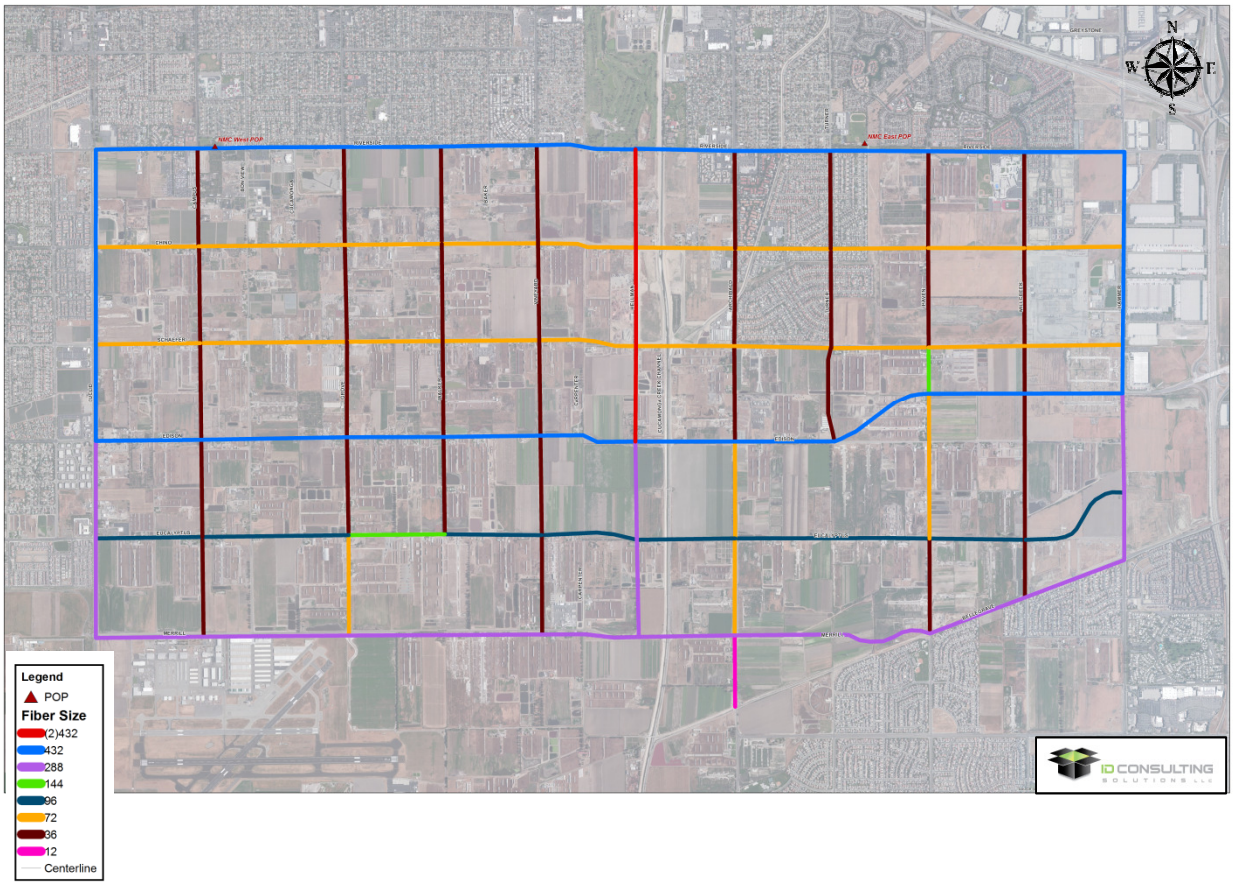
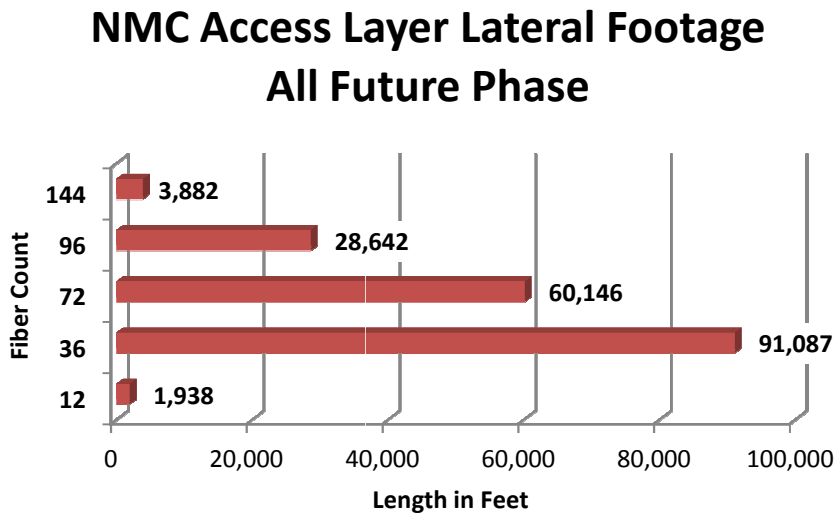

OMC Service Area Fiber Footage
Existing Conduit by Phase
Fiber Count / Phase
432/48 / 1
432 / 1
36 / Future
36 / 3
12 / Future
12 / Existing
12 / 3
12 / 1
Empty / Empty
693
40,337
1,428
11,629
556
194
61
1,389
1,897
0
10,000
20,000
30,000
40,000
50,000
Length in Feet

Figure 7 – NMC Fiber Size and Footages





Implementation Phasing Plan

Overview

As stated in the Conceptual Layout & Needs Assessment Memorandum, it is recommended that the Primary and Secondary Rings in the OMC be built. This will enable the key targets throughout the CITY to be interconnected as the foundation for the CITY to expand the fiber optic communication network. Expansion would be considered with requests from economic development, street improvements (overlays), CIP projects, water upgrades/replacement, sewer upgrades and utility transitions or upgrades.

Naming Conventions *(from Conceptual Layout of Needed Infrastructure document):*

Primary Ring (PR) - The Primary Ring (PR) will act as the transport network for City Services, interconnecting key City targets to the four primary facility locations at City Hall, Riverside Facility, the City Arena vicinity (OMC East), and Centennial Park.
Secondary Ring (SR) - The Secondary Ring (SR) will act as the transport along the West side of the City (OMC) originating and terminating at City Hall through diverse conduit entries.
Laterals - The Lateral routes will act as the feeder routes in and out of the primary and secondary rings from interconnection points to key and future targets.
CIP Projects – These are CITY projects that provide open trenches for other CITY systems, where communication ducts can be placed, with a minor adjustment to the existing excavation (see detailed drawing on page 64).

Within Appendix A, there are detailed descriptions of the system interconnections and project phases for OMC and NMC. However, the descriptions of the Primary Ring, Secondary Ring and the Laterals will be consistent between the two. As NMC is built-out, it will have the same infrastructure characteristics as the CITY Fiber Optic Network in OMC.

Also, the OMC portion of the network has been developed in a phased approached and a description of each is included. Phases are as follows:

- Primary Ring and Key Target Laterals – Phase I
- Secondary Ring and Key Target Laterals – Phase II
- Other Laterals – Future Phase

Due to the unknown timing of NMC development locations, a fully-phased representation of Laterals cannot be developed at this time. However, various key targets have been identified and maps have been developed to illustrate where the Primary Ring and Secondary Ring would be in relation to those targets upon complete build-out.

Old Model Colony (OMC) & New Model Colony (NMC)

Primary Ring – Phase I

The Primary Ring (PR) will act as the transport network for CITY Services, interconnecting three of the four primary POP facility locations at City Hall, Riverside Facility, and the City Arena vicinity. Upon deployment of the PR conduit system, as defined in the OMC fiber exhibit maps, installation of a 432 count fiber optic cable (single jacket with 24 count tight buffer tubes) will provide distribution through planned laterals and along the Primary Ring defined in the OMC and NMC exhibit maps provided herein.

The typical primary Ring cross-section will consist of the following:

- One (1) - 2" HDPE SDR-11 (Smoothwall) roll pipe (Orange)
- Two (2) - 7 Way MicroDuct (Duraline) – 16mm Tubes
- 36"x60" Composite Polyconcrete Handhole (HH-4)

The PR method of installation in the OMC will predominately be accomplished through horizontal directional drilling, pneumatic pushing and the preferred method, trenching. Directional drilling will require pothole locating at road crossings to verify the depth of existing utilities as required and back reaming based on the conduit configuration, typically 6" in diameter. Trenching will be identified in locations where street cuts could exist, along streets without moratoriums and at non-hard surface areas.

Exceptions: The Primary Ring will consist of the typical cross section outlined in OMC & NMC Conduit Exhibit; however, a section from City Hall to E. Francis Street (OMC) and Hellman Avenue from Riverside Drive to Merrill Avenue (NMC) will require an additional 2" conduit defined as PB + (1) 2". The additional 2" will provide a path for the Secondary Ring route from City Hall to the West in the OMC and will provide as the pathway for the two Primary Rings in the NMC.

Secondary Ring – Phase II

The Secondary Ring (SR) will act as the transport along the West side of the CITY (OMC) originating and terminating at City Hall through diverse conduit entries. In both the NMC and OMC, similar to the PR, the SR will support the interconnection of key targets, will be populated with up to 432 count fiber optic cable, and be used to extend along the proposed lateral route in the OMC and NMC Exhibit Map. As it is illustrated in the NMC Exhibit Map, the SR will play a significant role in the fiber design, minimizing stranded fibers and insuring there is a ring topology throughout the PR and SR infrastructure architecture.

The typical Secondary Ring cross-section for both OMC and NMC will consist of the following:

- One (1) - 2" HDPE SDR-11 (Smoothwall) roll pipe (Orange)
- One (1) - 7 Way MicroDuct (Duraline) – 16mm Tubes
- 36"x60" Composite Polyconcrete Handhole (HH-4)

The SR will be installed similar to the Primary Ring, through horizontal directional drilling, pushing and trenching as required.

Laterals (Future Phases)

The Lateral routes will act as the feeder routes in and out of the Primary and Secondary Rings from interconnection points to key targets and future targets. These routes will be installed as New Build, Joint Build or in Existing Duct. Unlike PR and SR, this will be populated with a small distribution fiber optic cable that will be sized appropriately based on area, targets and future needs.

- ***New Build*** - The typical method of placement will be directional boring and limited trenching, primarily at tie-in locations. This cross-section will consist of the following:

  - One (1) - 2" HDPE SDR-11(Smoothwall) roll pipe (Orange)
  - One (1) - 7 Way MicroDuct (Duraline) – 16mm Tubes
  - 30"x48" Composite Polyconcrete Handhole (HH-3)

- ***CIP Joint Build*** - The typical method of placement will likely be trenching with the CITY's communications duct being placed on a stepped shelf within the main trench. This cross-section will consist of the following:

  - One (1) - 2" HDPE SDR-11 (Smoothwall) roll pipe (Orange)
  - One (1) - 7 Way MicroDuct (Duraline) – 16mm Tubes
  - 30"x48" Composite Polyconcrete Handhole (HH-3)

- ***Existing Duct (Traffic Department)*** – The typical method of placement will be installation of a new fiber optic cable and micro ducts through existing CITY owned duct. Depending on the size of this duct will dictate the quantity(s), as defined below:

  - 1" Exist. Duct: One (1) – New fiber optic cable
  - 1-1/2" Exist. Duct: Two (2) Micro Duct – 16mm, One (1) New fiber optic cable
  - 2" Exist. Duct: Four (4) Micro Duct – 16mm, One (1) New fiber optic cable

Building / POP Interconnect

The Primary and Secondary Ring routes will terminate at 4 key building Point of Presence (POP) locations. The following locations will support both the physical fiber termination, cross-connections and transport switch / aggregation switch equipment for the CITY. The four (4) locations are defined as:

- OMC WEST - City Hall
- OMC EAST - City Arena Vicinity
- NMC EAST - Riverside Facility
- NMC WEST - Centennial Park Vicinity (Future)

The NMC WEST POP is to support expansion within NMC and the timing for its construction is dependent on build-out of the NMC network. As such, the budget value to construct NMC WEST is defined within the budget information to follow, but the actual construction of NMC WEST is NOT INCLUDED within either Phase 1 or Phase 2 of this project planning document.

OMC WEST - City Hall (Existing Facility)

Portions of the connectivity project illustrated below include placing conduit from the Northwest corner at the intersection of N. Lemon Ave and B Street to the Northeast corner at the intersection of Plum Avenue and B Street. The conduit will then head North and East (as depicted), ultimately entering City Hall from the East along the West side of Cherry Avenue. This will allow for diverse entrances to the POP location thus resulting in a carrier-class quality network.

Figure 8 - OMC WEST - City Hall (Existing Facility)

NMC EAST - Riverside Facility (Existing Facility)

The Riverside Facility is an existing facility and was originally selected for its location and proximity to NMC and provides a solid location for redundancy and connectivity to existing CITY-owned conduit. The illustration below is a high-level diagram showing what would be constructed. A new generator will be installed, along with a caged environment for the CITY Network and Co-Location (COLO) facilities that are available for entities outside of the CITY Network.

Figure 9 - NMC EAST (Riverside Facility) - Facility Layout Plan

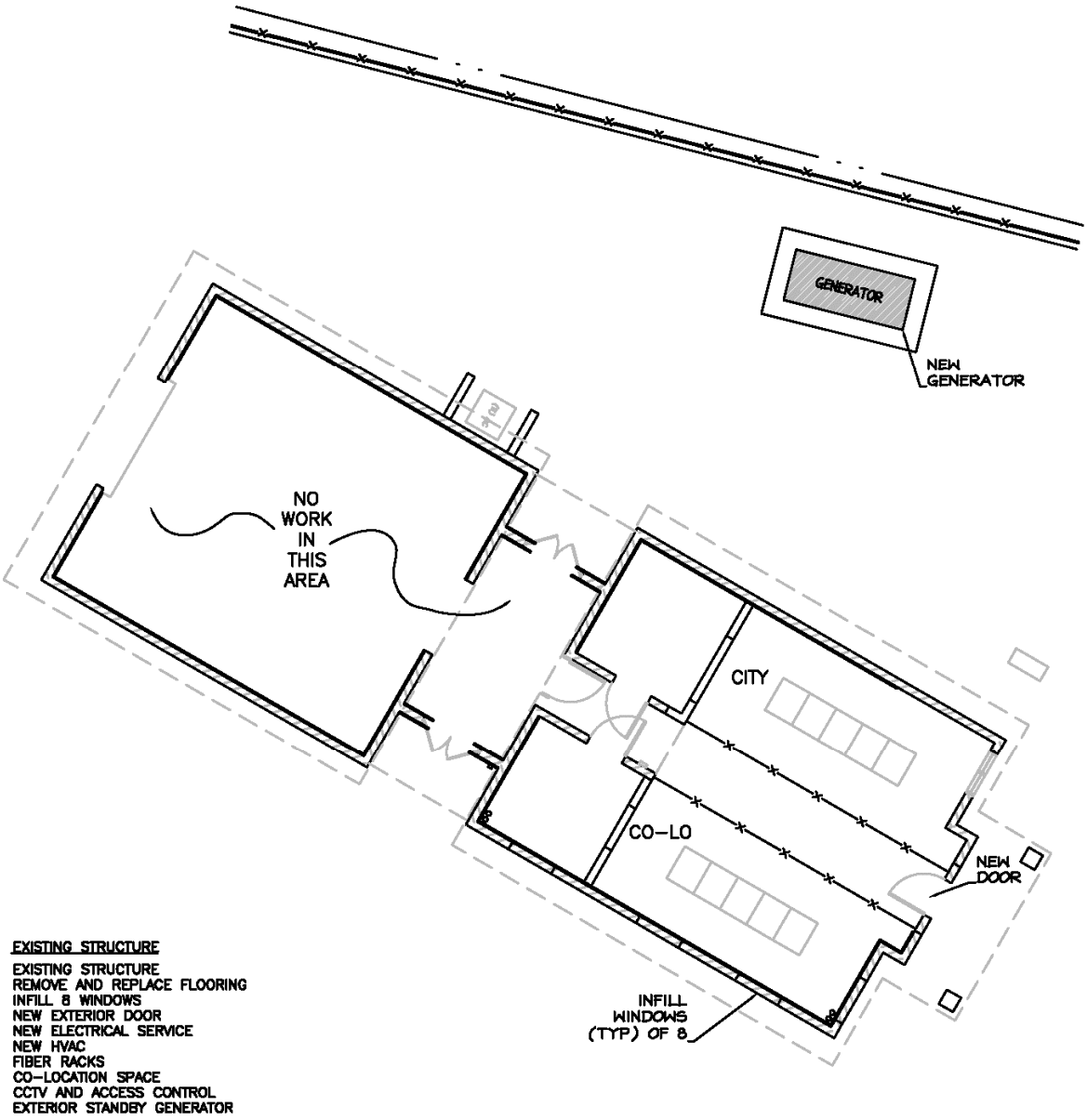
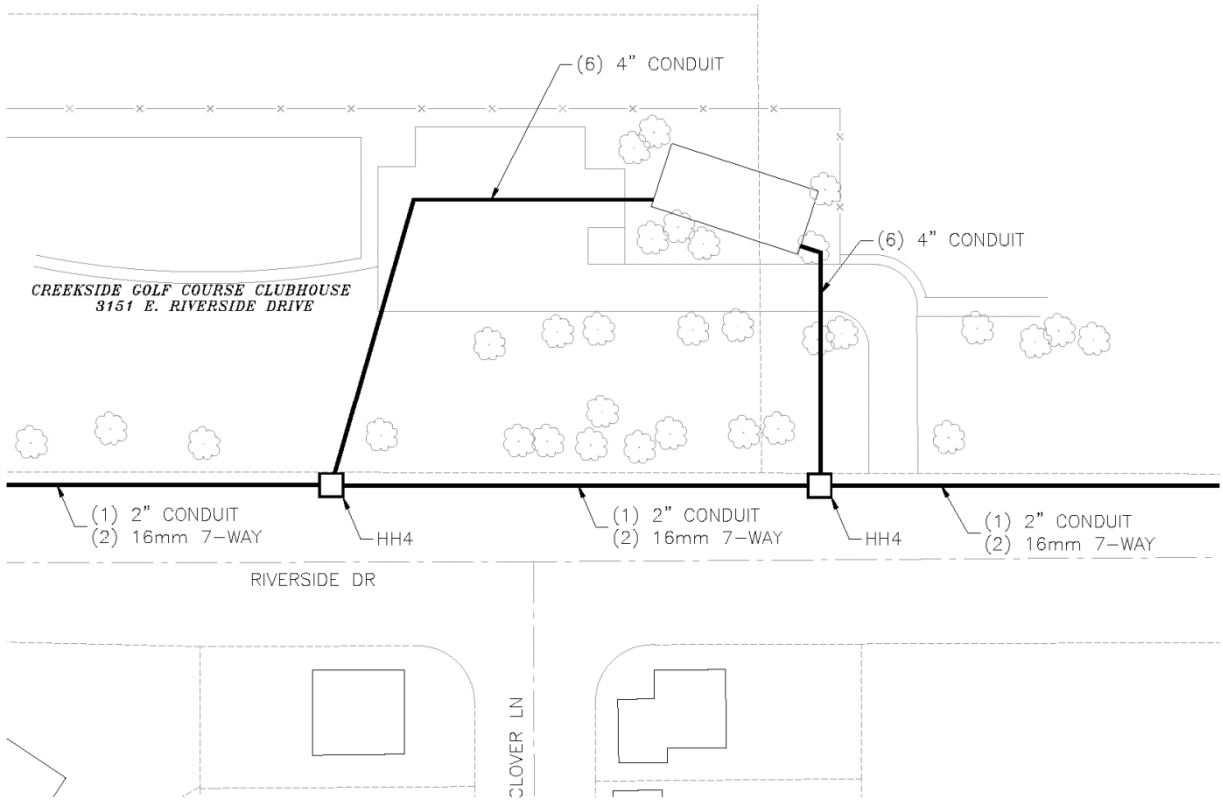


Figure 10 - NMC EAST (Riverside Facility) - Site Layout Plan



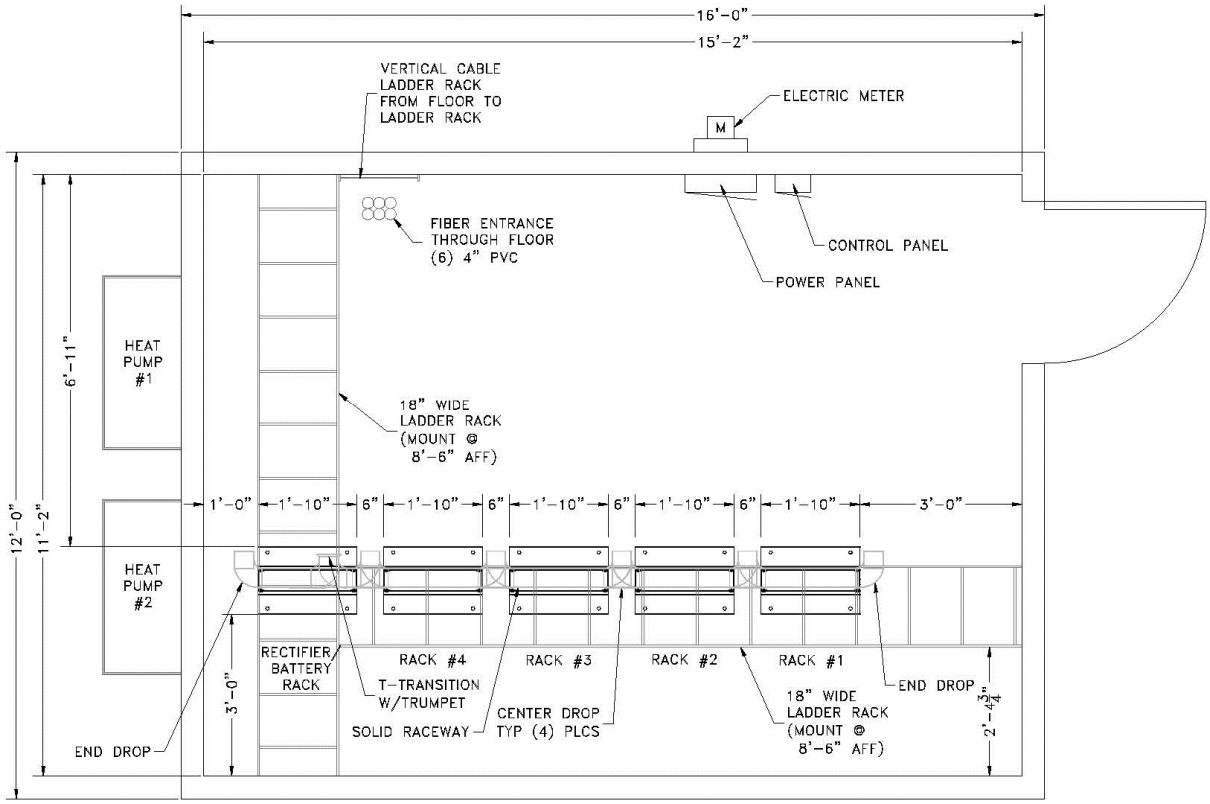
OMC EAST (City Arena Vicinity) / NMC WEST (Centennial Park Vicinity)

Precast Shelters

Final locations for OMC EAST / NMC WEST have not yet been determined. Important to note, OMC EAST would be constructed in close proximity to the backbone network in OMC. The NMC WEST is to support expansion within NMC and the timing for construction is dependent on build-out of the NMC network. As such, the budget value to construct NMC WEST is defined within the budget information to follow, but the actual construction of NMC WEST is NOT INCLUDED within either Phase 1 or Phase 2 of this project planning document.

At each location, a precast concrete shelter would be engineered, erected and configured. Initially, due to construction cost and the initial minimal electrical load of the network electronics used, backup power would consist of a battery bank only. However, during the engineering process, identifying adequate space for a generator / transfer switch / fuel tank would be prudent as additional supporting infrastructure.

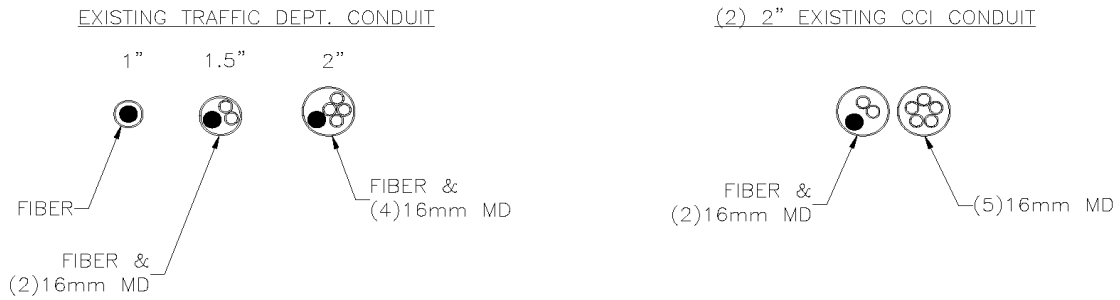
Figure 11 – OMC EAST / NMC WEST Typical Layout



Existing Duct Utilization

The CITY's existing communication and traffic conduit will be utilized when required. In the illustration below, the FIBER represets a maximum fiber count of 288 count and each 16mm MD (Micro-Duct) will support up to 144 fiber count. Specific fiber count is determined by location and communication network needs. A majority of the exisitng ducts currently provide a copper communication connection to surrounding traffic signals that traverses through the traffic cabinets. In order to utilize the duct, the copper cable will have to removed, handholes will have to installed near the cabinet for splicing purposes and some conduit construction will be required to tie in the cabinet conduit to the new handhole. Once the handhole is installed, the conduit sweeps are in place, a pre-terminated fiber optic pigtail will be placed and spliced into the fiber backbone or lateral.

Figure 12 – Existing Conduit Utilization



Capacity Analysis

Current

As reported within the Technical Memorandum based upon data acquired from the CITY, there is a wide spectrum of digital and analog carrier services currently supporting CITY operations. Excerpted from that report, please refer to the following table:

Table 1 – Existing Communication Circuit Counts

EXISTING COMMUNICATION CIRCUIT COUNTS			
Circuit Type	**Size**	**Qty.**	**Total IP**
Ethernet 100Mbps	100 Mbps	5	500
Ethernet 50 / 25 Mbps	50 / 25 Mbps	1	50
Ethernet 5Mbps	5 Mbps	1	5
T-1	1.544Mbps	32	49.408
ISDN	24 x 64Kbps	4	6.16
Digital Subscriber Line	* 1 Mbps	12	12
Frame Relay	* 256Kbps	3	0.75
Voice Grade	64Kbps	38	0.5
Frame Relay	* 56 Kbps	1	-
TOTAL CIRCUITS / Quantity / Mbps		**97**	**623.818**

* Estimated data rates.

All available circuit data was inventoried in an effort to identify monthly recurring costs to the CITY for the circuits listed above. While only 60 of the above 97 circuits were available with detailed pricing information, the estimated costs from the data in hand was utilized to

extrapolate the monthly expense. From a review of actual costs, the following monthly cost estimate was used to establish the total monthly recurring cost for WAN circuits:

Table 2 – Estimated Communication Circuit Expense Per Month

Estimated Communication Circuit Expense		
Ethernet 100Mbps	100 Mbps	$ 1,700
Ethernet 50 / 25 Mbps	50 / 25 Mbps	$ 1,000
Ethernet 5Mbps	5 Mbps	$ 750
T-1	1.544Mbps	$ 300
ISDN	24 x 64Kbps	$ 300
Digital Subscriber Line	* 1 Mbps	$ 40
Frame Relay	* 256Kbps	$ 200
Voice Grade	64Kbps	$ 30
Frame Relay	* 56 Kbps	$ 60

* Estimated data rates.

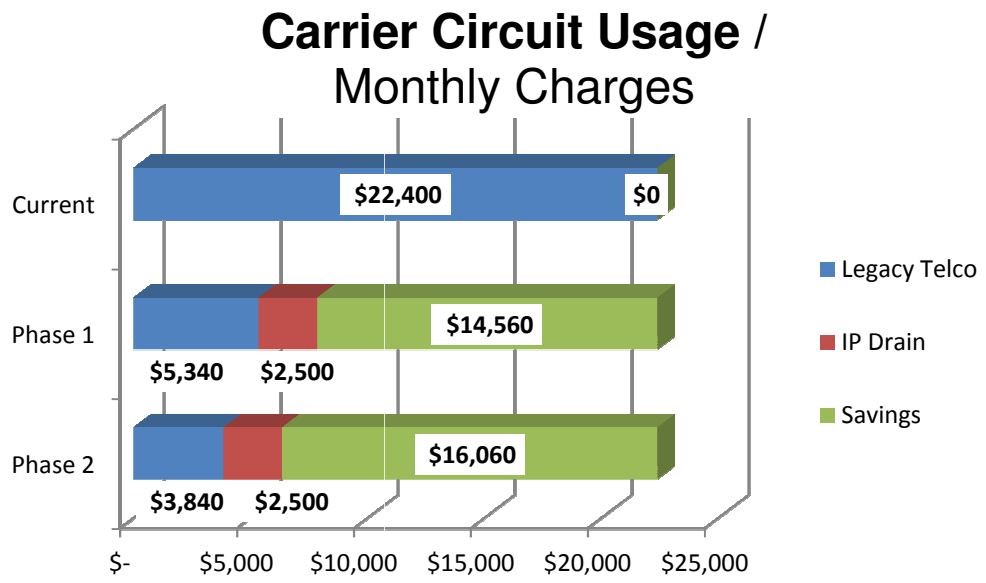
Future

By combining the actual data acquired from the CITY, and with the above estimated monthly expenses, the CITY's monthly recurring costs for carrier circuits is approximately $ 22,400 per month. A very significant portion of these funds would be available each month to support a fiber optic network, representing in excess of $ 268,000 per year.

A replacement system would include the entirety of the fiber optic infrastructure and active network components as described herein, plus the addition of carrier services for communication outside the new system. At present, a significant portion of the traffic between CITY users require both outbound and inbound carrier circuits for interdepartmental communication. If integrated onto a CITY-owned system, the nearly 100 circuits in use today could be replaced with a very small number of high-speed carrier circuits to provide voice, data, and even video communication capabilities.

Preliminary pricing of competitive carrier service offerings, indicates that one 300Mbps IP Internet Drain service, would represent a monthly recurring cost of approximately $ 2,500. As prepared within a May 2012 Cost Savings Breakdown spreadsheet provided by the CITY, there was an expectation that there would be an initial / ongoing requirement for legacy telco circuits that would represent an ongoing monthly cost of approximately $ 3,840. Over time, a majority of traffic requiring legacy telco circuits can be migrated over to the new fiber optic infrastructure, which would provide additional potential savings.

Figure 13 – Carrier Circuit Usage / Monthly Charges



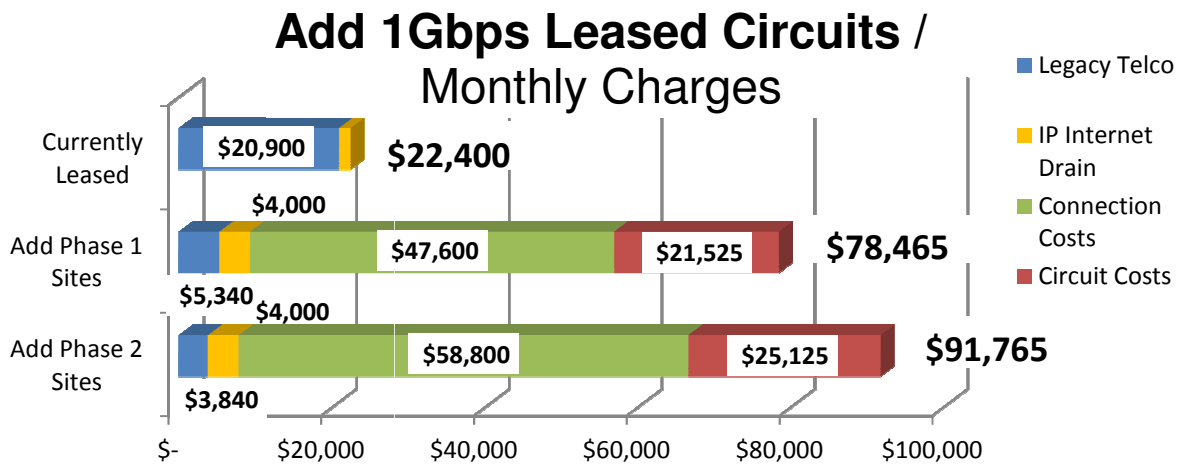
In contrast to the current monthly recurring charges, the CITY should be in a position to realize a reduction in monthly circuit charges in a range between $ 14,560 (after Phase 1) and $ 16,060 (after Phase 2), or between $ 174,720 and $ 192,720 respectively, on an annualized basis. As additional legacy telco circuits can be migrated onto the new network, the monthly savings could grow by an additional $ 3,840, which represents an additional $ 46,080 annual savings.

Apart from the financial effects of this new system, the CITY's operations will be significantly enhanced by moving from the current / legacy circuits to a 1 Gbps / 10 Gbps fiber optic network.

Direct comparison of these two would be similar to comparing the performance of the Wright brothers Flyer against the modern F-22 Raptor. In the effort to better demonstrate the value of the proposed 1Gbps connections to CITY operations in "like-for-like" performance terms, use of equal circuits provided by competitive carriers has also been included for cost / benefit consideration.

In the Figure 14 graph that follows, a comparison is provided that shows: [1] the current leased circuit monthly costs, [2] the monthly cost to apply 1 Gbps connectivity for the sites included in the CITY Fiber Optic Network – Phase 1, and [3] the monthly costs to provide 1 Gbps connectivity to all Phase 1 + 2 sites in the CITY Fiber Optic Network. This illustrates not only the huge leap in system performance, but also sets a baseline cost if these leased circuits were installed today (excluding one-time installation charges).

Figure 14 – Adding 1 Gbps Leased Circuits / Monthly Charges



The monthly charges represented in Figure 14 are comprised of several components, two of which are present in the current network: Legacy Telco and IP Internet Drain. The new carrier charges required to bring the current system up to 1 Gbps capabilities consist of "Connection Costs" (flat rate "empty" connection "pipes", imagine this as a garden hose) and "Circuit Costs" (bandwidth that ranges from 100 Mbps down to 15 Mbps per circuit, which is a close approximation to the current configuration in Table 2, think of this as the water inside the garden hose).

It is dramatically apparent that the current market value of the proposed 1 Gbps network on a "like-for-like" basis with leased carrier circuits will be a useful benchmark against the costs to deploy this CITY Fiber Optic Network.

By migrating a significant portion of CITY traffic onto the proposed Fiber Optic Network infrastructure, there would not only be an incredible gain in speed and efficiency, but also a dramatic reduction in monthly costs – but the prior analysis in Figure 14 was not comparing "apples for apples." If the CITY wishes to compare the relative value of this proposed network architecture, it would be appropriate to calculate the current cost to purchase that same level of service from available service providers. Obviously, this cost comparison would be limited to existing CITY assets that already represent some ongoing monthly expense, specifically the locations to be included in Phases 1 and 2.

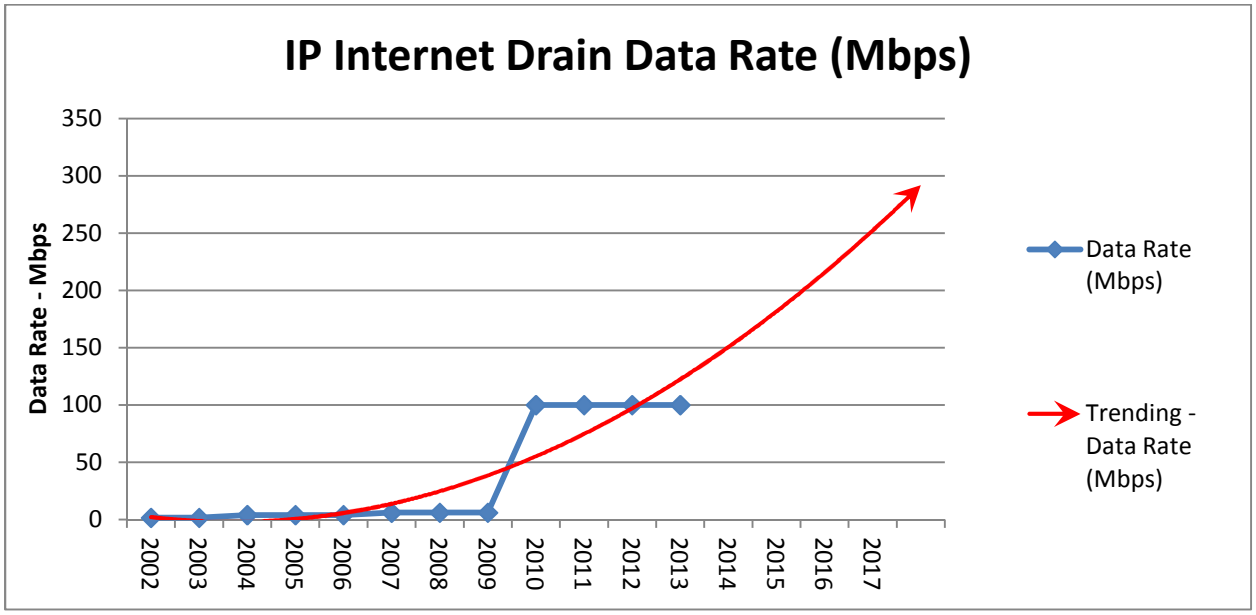
The CITY currently employs 9 different circuit types / multiple data rates that are applied to "brick-and-mortar" buildings that house CITY departments, traffic signals, and other low speed data devices such as wells. To establish a reasonable comparison, we have applied current 1 Gbps connection charges and circuit charges in these three groupings:

- Current 100Mbps Building Locations – 5 locations @ 100Mbps, including City Hall

- Current 50Mbps Building Location – 1 location @ 50Mbps
- All Other Locations – Assumed circuit costs @ 15Mbps each
    - Other Buildings, Traffic Signals – Connections After Phase 1 – 59 Locations
    - Other Buildings, Traffic Signals – Connections After Phase 2 – 75 Locations

It is rather difficult to accurately forecast one of the cost components, the IP Drain – where the current / proposed CITY network meets the world outside of the municipal network. It is sometimes useful to consider past data and trend it forward – and based on ACTUAL CITY IP Drain circuits installed, the following trend can be observed:

Figure 15 – Historical CITY IP Internet Drain Data Rate (Mbps)

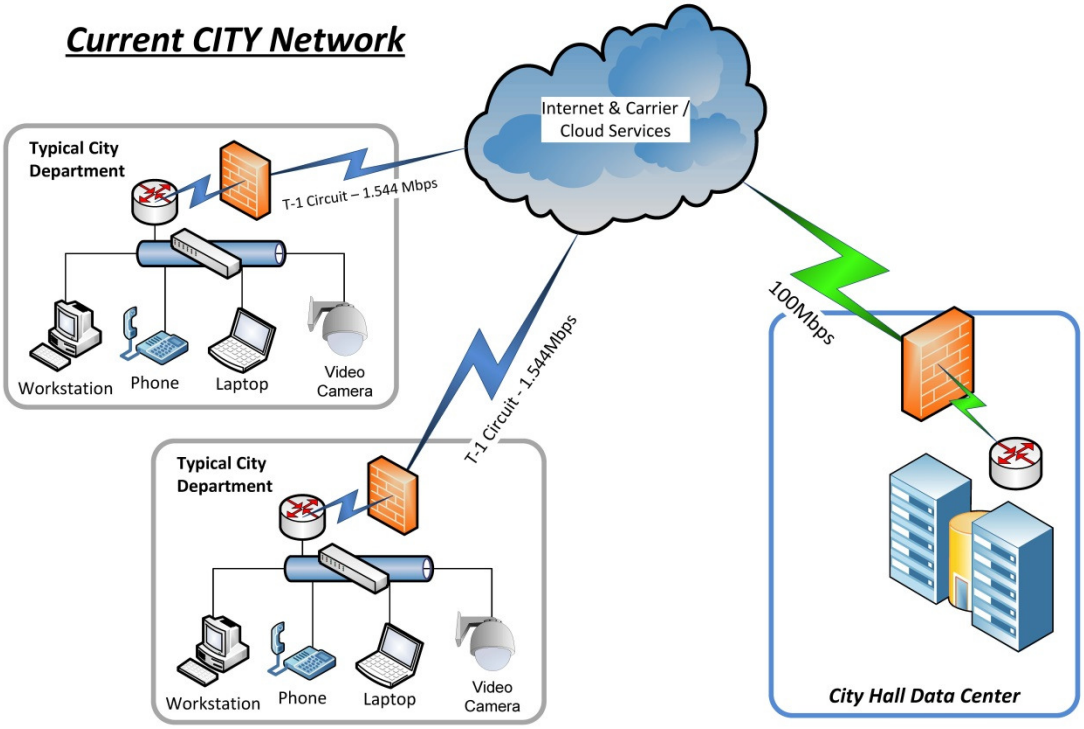


Another view of the CITY's current aggregate Data Rates can be seen in Table 1, which currently total at approximately 624 Mbps. There is a caveat in consideration of that data rate, as it measures both internal and external traffic thru leased carrier circuits – and those circuits would be substantially replaced by the CITY's Fiber Optic Network. At any rate, it is safe to expect significant and continued demand for connection between the CITY's Fiber Optic Network and the outside world.

Bandwidth (Demand) Analysis

Within the prior Capacity Analysis section, the CITY's current Communication Circuit Counts by circuit type / speed have been detailed. To better illustrate the current systems, review this simplified graphical illustration of the current CITY network design:

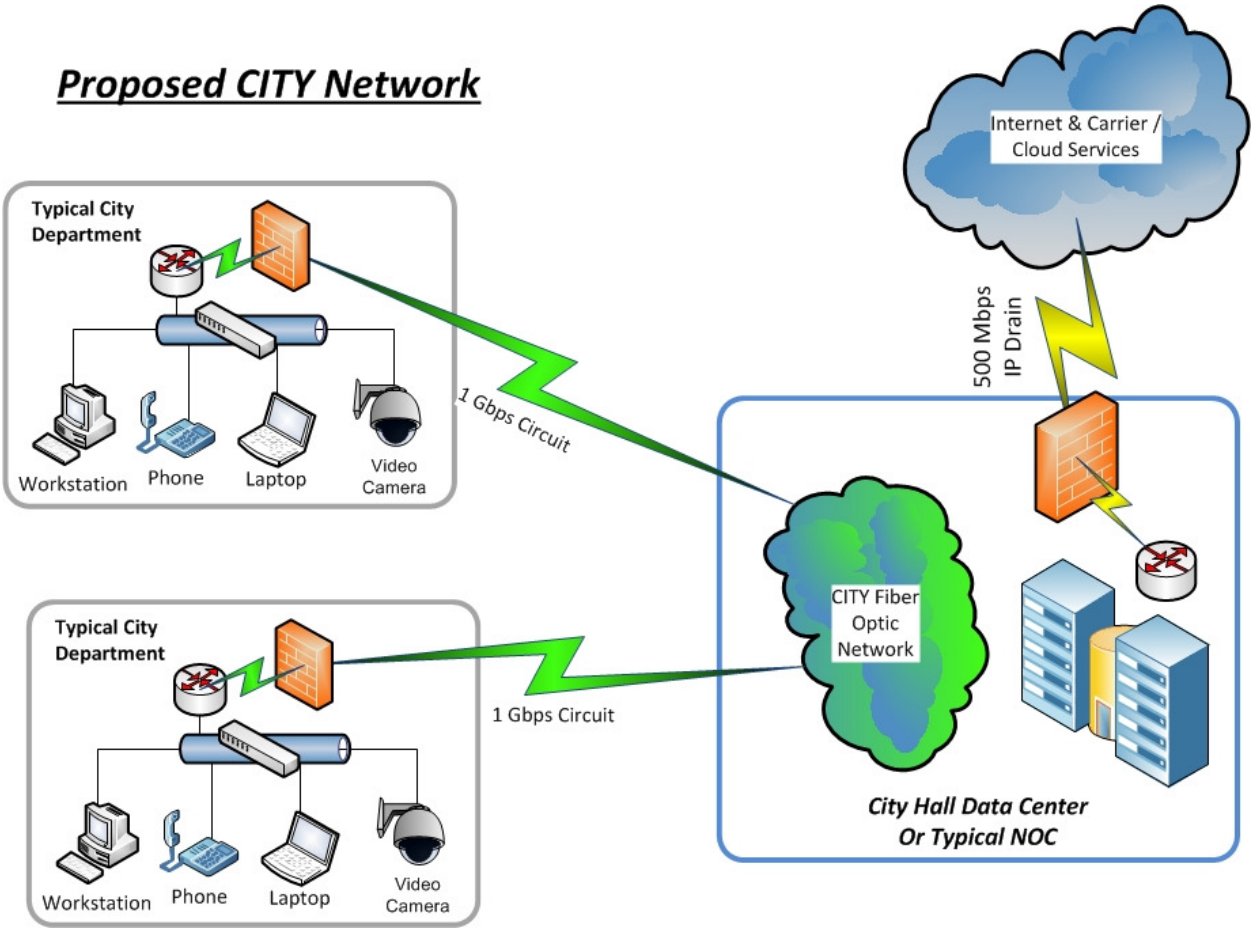
Figure 16 – Current CITY Network Schematic



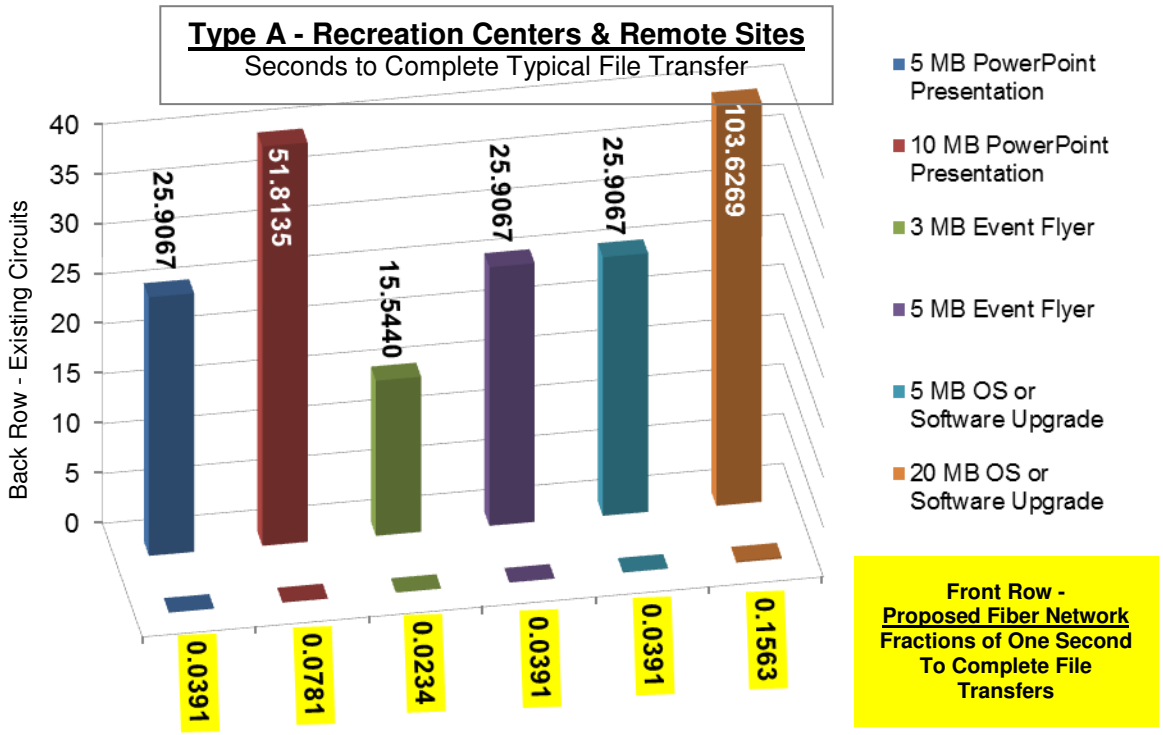
This illustration shows the CITY's use of legacy telco connections that are quite limiting in speed to transport the voice, data, and video communication traffic already in place. Also illustrated in the Capacity Analysis section are the current recurring monthly costs associated with this network infrastructure, comprised of nearly 100 separate circuits. Admittedly, this plan does not propose that ALL legacy telco services can or should be eliminated, but a very substantial portion of them could be migrated over to the proposed fiber optic network infrastructure.

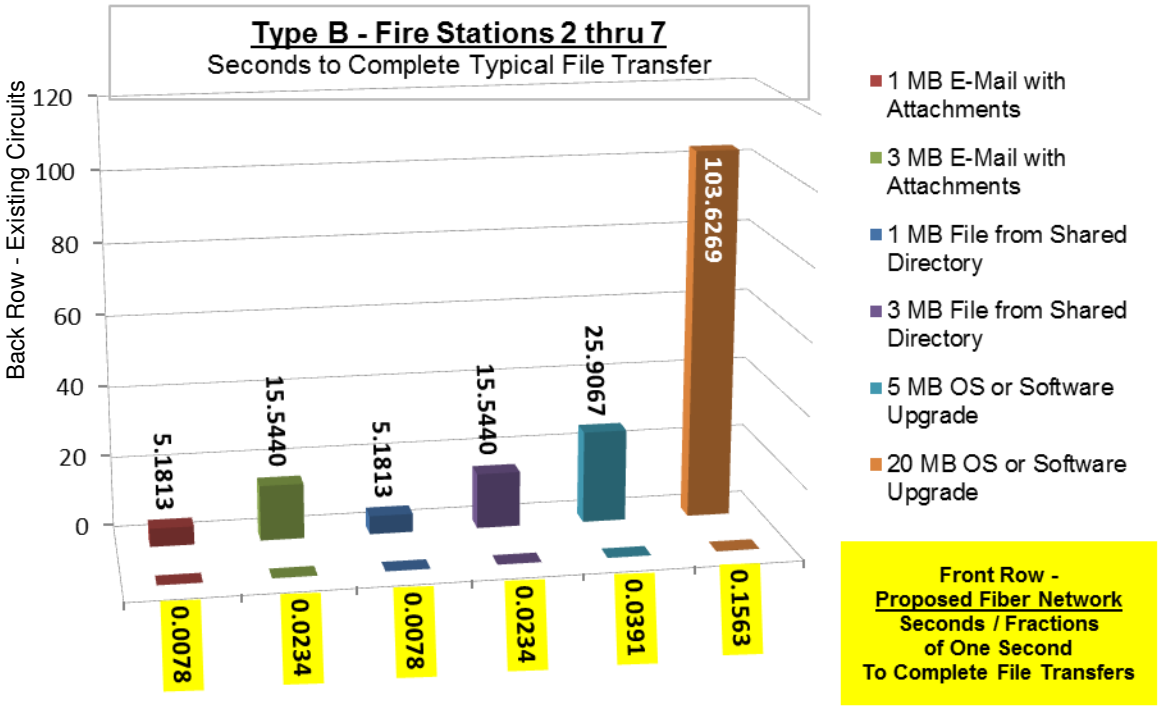
The following graphical illustration shows the Proposed CITY Network in a simplified view:

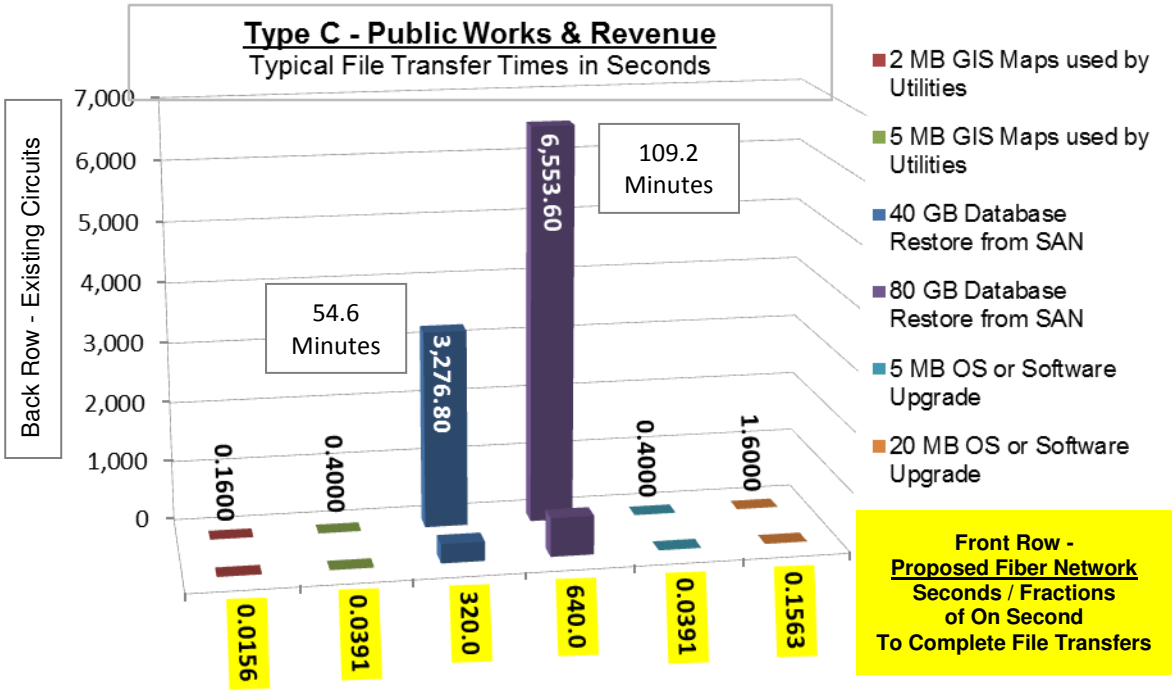
Figure 17 – Proposed CITY Network Schematic

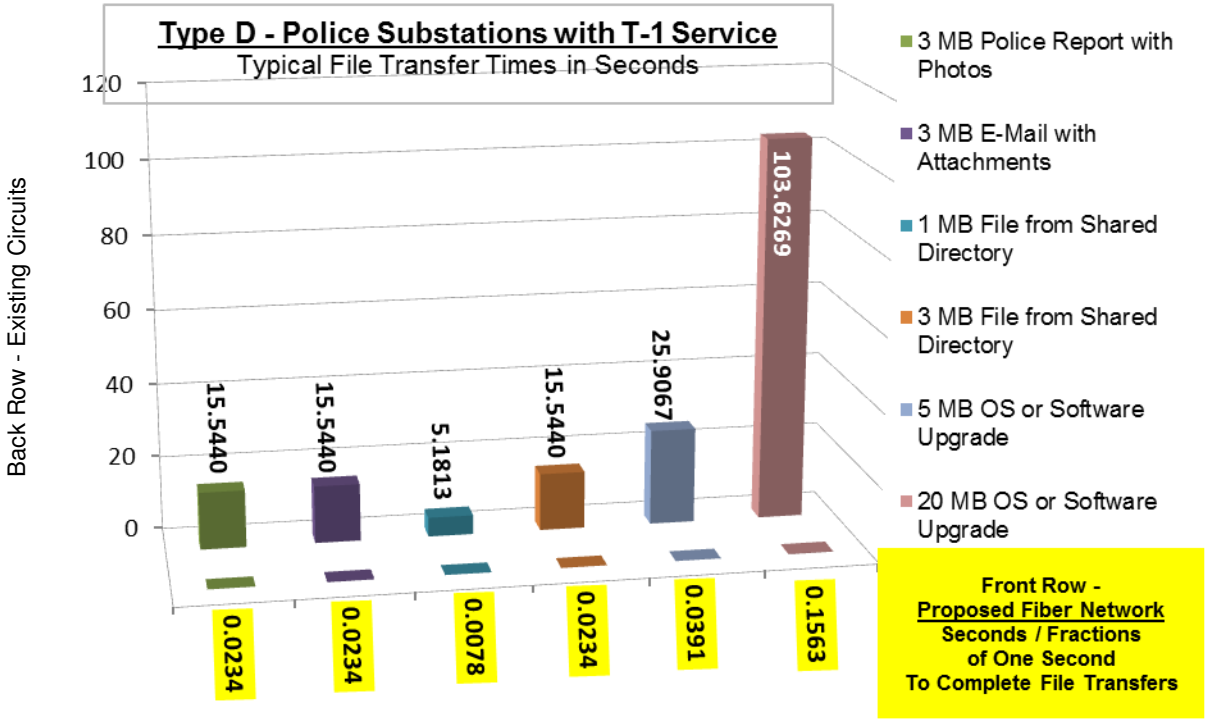


In the effort to better demonstrate the impact the CITY Fiber Optic Network would have on tasks frequently performed by CITY departments, the CITY IT Department was able to define several different tasks and their relative time to complete that task in *network transport time*. Here are four typical users / tasks / data payloads that are common within everyday CITY business:


Type A - Recreation Centers & Remote Sites
Seconds to Complete Typical File Transfer
Back Row - Existing Circuits
40
35
30
25
20
15
10
5
0
25.9067
51.8135
15.5440
25.9067
25.9067
103.6269
0.0391
0.0781
0.0234
0.0391
0.0391
0.1563
5 MB PowerPoint Presentation
10 MB PowerPoint Presentation
3 MB Event Flyer
5 MB Event Flyer
5 MB OS or Software Upgrade
20 MB OS or Software Upgrade
Front Row - Proposed Fiber Network Fractions of One Second To Complete File Transfers


Type B - Fire Stations 2 thru 7
Seconds to Complete Typical File Transfer
Back Row - Existing Circuits
120
100
80
60
40
20
0
5.1813
15.5440
5.1813
15.5440
25.9067
103.6269
0.0078
0.0234
0.0078
0.0234
0.0391
0.1563
1 MB E-Mail with Attachments
3 MB E-Mail with Attachments
1 MB File from Shared Directory
3 MB File from Shared Directory
5 MB OS or Software Upgrade
20 MB OS or Software Upgrade
Front Row - Proposed Fiber Network Seconds / Fractions of One Second To Complete File Transfers


Type C - Public Works & Revenue
Typical File Transfer Times in Seconds
Back Row - Existing Circuits
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0.1600
0.4000
3,276.80
6,553.60
0.4000
1.6000
54.6 Minutes
109.2 Minutes
0.0156
0.0391
320.0
640.0
0.0391
0.1563
2 MB GIS Maps used by Utilities
5 MB GIS Maps used by Utilities
40 GB Database Restore from SAN
80 GB Database Restore from SAN
5 MB OS or Software Upgrade
20 MB OS or Software Upgrade
Front Row - Proposed Fiber Network Seconds / Fractions of On Second To Complete File Transfers


Type D - Police Substations with T-1 Service
Typical File Transfer Times in Seconds
Back Row - Existing Circuits
120
100
80
60
40
20
0
15.5440
15.5440
5.1813
15.5440
25.9067
103.6269
0.0234
0.0234
0.0078
0.0234
0.0391
0.1563
3 MB Police Report with Photos
3 MB E-Mail with Attachments
1 MB File from Shared Directory
3 MB File from Shared Directory
5 MB OS or Software Upgrade
20 MB OS or Software Upgrade
Front Row - Proposed Fiber Network Seconds / Fractions of One Second To Complete File Transfers

Even to a non-technical observer of graphs Type A thru D above, it is clearly apparent that the use of a more advanced network infrastructure would dramatically shorten *"time on task"* for these typical activities across all CITY department staff. These are measurable, repeatable gains in efficiency for each individual employee, but beyond the scope of this document to economically quantify.

Using the "Field Of Dreams" analogy (*"If you build it, they will come."*), there would be new and significant *INTANGIBLE BENEFITS* that would be available to the CITY – provided that the technological connectivity was available. Here are a few of the many potential applications that would be available to the CITY once this Fiber Optic Network is in service:

1. **Police Applications** – High-speed fiber optic connectivity at traffic signal cabinets will provide adequate bandwidth for public safety communication needs. This includes License Plate Recognition (LPR) cameras that can utilize CITY traffic signal poles, high definition Pan-Tilt-Zoom (PTZ) surveillance cameras at high-traffic intersections, Dynamic Message Signs (DMS, similar to the Cal Trans "Amber Alert" signs) which can display graphical images for traffic control and incident management. Current cellular / Digital Subscriber Line (DSL) options do not provide adequate bandwidth to support the amount of traffic that is created with these newer technology systems.

   These available network connections at traffic signal cabinets would allow Incident Command vehicles access to the Police network where officers and dispatchers would have immediate access to CAD, RMS, Cal Photo, Cal Gangs, and other network dependent applications.

2. **Multiple Agencies** – Wi-Fi service would be a huge benefit to have throughout the CITY, but Wi-Fi with sufficient fiber optic backhaul capabilities to a central Internet gateway is even more important. As more and more CITY departments turn to mobile devices for real-time work order entry (Code with Accela, Public Works with MyOntario), the need for a reliable and saturated Wi-Fi network throughout the community is becoming more necessary. For example, Police and Fire report writing entry can be started / finished in the field, while the information is fresh in the mind of the reporting person. Fire's initiative to implement Electronic Patient Care Reporting (ePCR) depends on Internet connectivity; therefore, a high-performing Wi-Fi network would enable quicker dissemination of information between ambulance providers and hospital facilities.

3. **Regional Data Centers** / **Information Sharing Centers** – A fiber optic network would open the doors for information / computing sharing between neighboring cities, counties, and states. As the dependency of private / public cloud-based service increases, it becomes critical to create redundant, resilient, and disaster-ready networks. Government agencies will need to leverage each other's technology footprint to share disaster recovery (DR) resources, draft cooperative agreements for sharing physical and

virtual computing resources across a MAN, and possibly architect backup operational centers to continue operations under emergency conditions.

System Goals

Initial CITY Municipal Network Goals

The initial objective for the CITY Fiber Optic Network is simple; establish a cost-effective, secure, fast and reliable fiber optic based communications infrastructure between CITY facilities. It is intended that the CITY will install this Municipal Fiber Network in the Old Model Colony (the portion of the CITY north of Riverside Drive) as well as in the New Model Colony (the portion of the CITY south of Riverside Drive). The CITY's potential applications and objectives include, but are not limited to:

- Internal CITY Transport (Fire, Police, Traffic, etc.)
- Centralized Network and Communication Management
- Automatic Meter Reading – Water Services (AMR)
- Traffic Control Systems
- Camera Systems (Municipal Security)
- Wireless Connectivity
- Public Safety
- Minimize Growing Communication Costs
- Economic Development

Implementation Costs

The projected Implementation Costs for the proposed CITY Fiber Optic Network is broken down into a phased approach, and related subsystems.

The following is a detail of what is included each of the 6 major categories used to budget the project total cost.

Budget Category Detail

PM, Engineering & Install includes:

- Outside Plant (OSP) Design
- Network Equipment Installation
- Network Operations Center (NOC) Implementation
- System Provisioning

Infrastructure includes:

- Construction Installation
  - Underground Infrastructure Cost
  - Fiber System Cost

Core Electronics include:

- Network Operation Center (NOC) Core Switches
- Access Switches
- Switch Optic Interfaces

Facilities include:

- Electrical / HVAC / Mechanical Systems
- Cable Management
- UPS Power Systems
- Grounding System
- Electronics Racks and Cabinets
- Partitions

Building Entrance Links include:

- Entrance Facilities
  - Trenching, Conduit, Fiber Optic Cabling
- Fiber Splicing, Termination, and Testing
- Access Switch
  - Fiber Optic Interface

Traffic-Water Interconnections include:

- Entrance Facilities
  - Trenching, Conduit, Handhole, Fiber Optic Cabling
- Fiber Splicing, Termination, and Testing
- Access Switch (environmentally hardened)
  - Fiber Optic Interface

Table 3 – Project Budget Detail – Phase 1

City of Ontario Fiber Optic Network Build

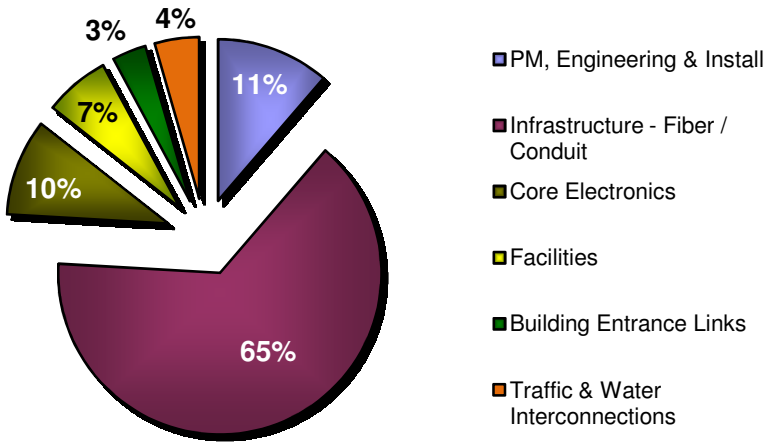
Project Budget Detail

Phase I

PM, Engineering & Install	$580,377	11%
Infrastructure - Fiber / Conduit	$3,314,738	65%
Core Electronics	$497,029	10%
Facilities	$336,255	7%
Building Entrance Links	$174,966	3%
Traffic & Water Interconnections	$228,177	4%
Total Fixed Cost	**$5,131,542**	

5.5.13

City of Ontario
Fiber Optic Network Build - Phase 1
Pie Chart



For a detailed view of the data in Table 3, refer to Appendix B.

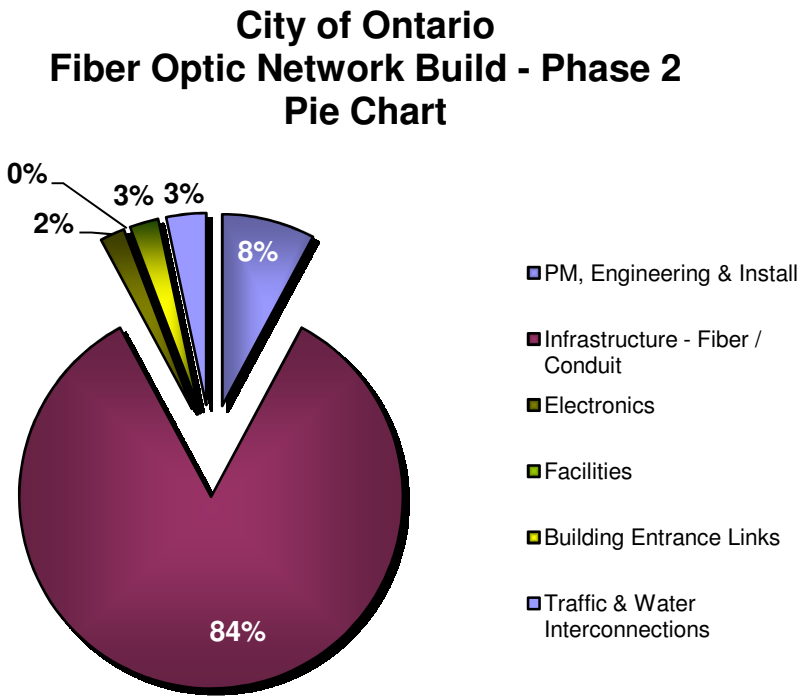
Table 4 - Project Budget Detail – Phase 2

City of Ontario Fiber Optic Network Build

Project Budget Detail

Phase II		
PM, Engineering & Install	$130,682	8%
Infrastructure - Fiber / Conduit	$1,406,221	84%
Electronics	$34,872	2%
Facilities	$0	0%
Building Entrance Links	$40,377	3%
Traffic & Water Interconnections	$55,777	3%
Total Fixed Cost	**$1,667,929**	

5.5.13



For a detailed view of the data in Table 4, refer to Appendix B.

Implementation Cost Summary

Table 5 – Phase 1 & 2 Cost Summary

Cost Component	Phase 1	Phase 2	TOTAL
PM, Engineering & Install	$ 580,377	$ 130,682	$ 711,059
Infrastructure - Fiber / Conduit	$ 3,314,738	$ 1,406,221	$ 4,720,959
Core Electronics	$ 497,029	$ 34,872	$ 531,901
Facilities	$ 336,255	$ -	$ 336,255
Building Entrance Links	$ 174,966	$ 40,377	$ 215,343
Traffic & Water Interconnections	$ 228,177	$ 55,777	$ 283,954
Total Fixed Cost	**$ 5,131,542**	**$ 1,667,929**	**$ 6,799,471**

The costs defined in Table 5 above include construction of three of the four POP locations, as the fourth location (NMC WEST, as referenced on page 27) will be needed at an undetermined future date, as NMC is developed. As requested by the CITY, here are the budget allowances for the physical POP facilities (excluding network electronics):

Table 6 – POP Facility Cost Detail

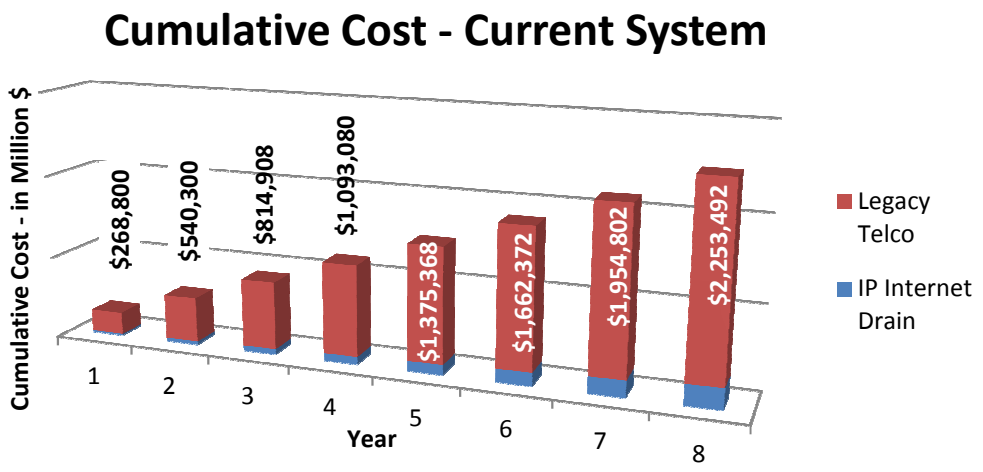
LOCATION	COST	PHASE	DESCRIPTION
OMC WEST – City Hall	$ 8,973	1	2nd Conduit Entrance
OMC EAST – City Arena Area	$ 115,440	1	New Precast Concrete Building
NMC EAST – Riverside Facility	$ 190,842	1	Retrofit of Existing Building
NMC WEST – Centennial Park Area	$ 115,440	Future	New Precast Concrete Building

As a part of prudent fiscal planning, the CITY would need to consider several options for funding the construction of the CITY fiber optic network, including monthly recurring cost reductions that would result, cost recovery period for capital assets, and comparison with equal performing leased circuit options. In tables to follow, the total costs to CITY on an eight-year cumulative basis are presented for the current system, the proposed CITY Fiber Optic Network, and costs for leased carrier circuits that would provide like capabilities to the proposed fiber optic network.

In the following cost forecasts, certain recurring expenses are escalated over time across all examples, and those are detailed below:

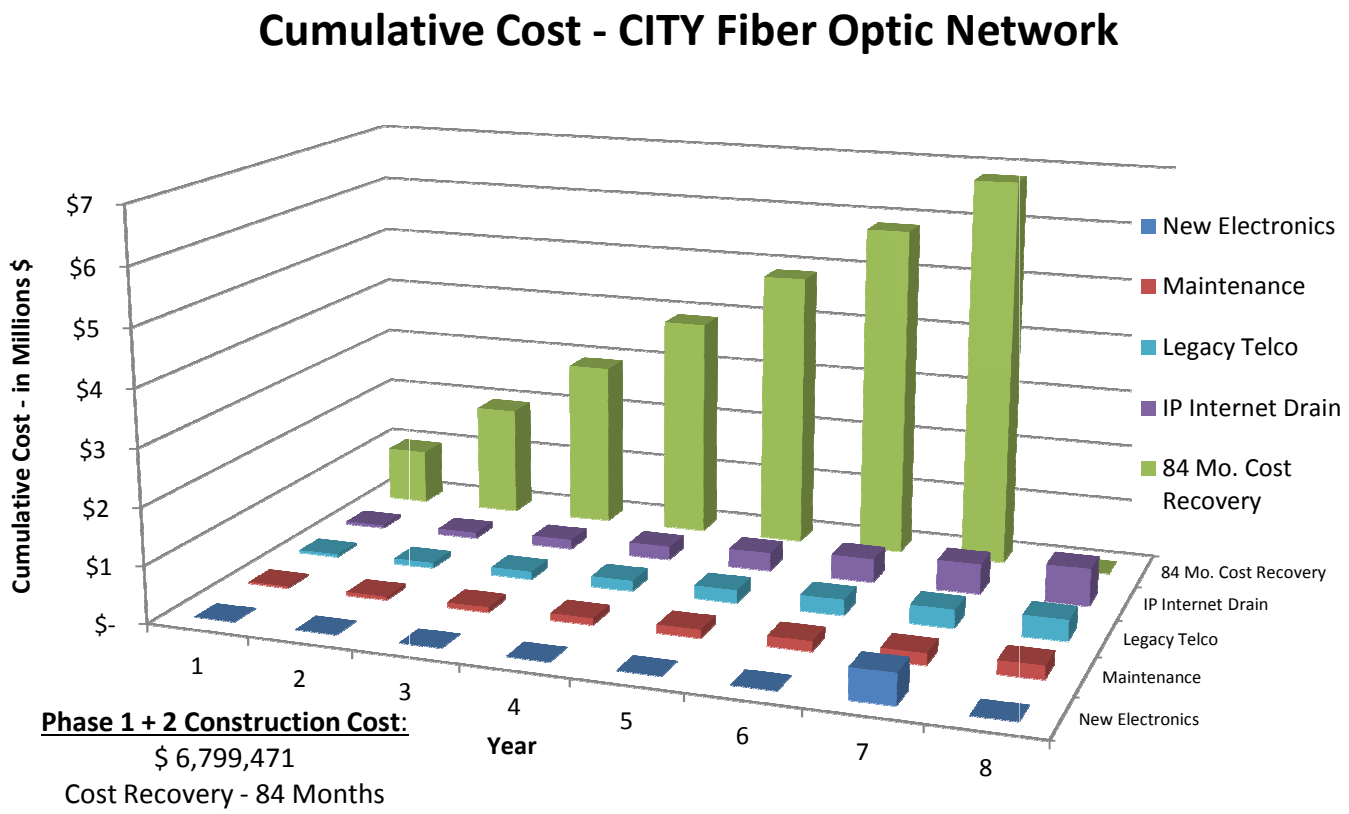
- Forecasted Growth Rate Per Year – IP Internet Drain Requirements – 15% Per Year
- CITY Fiber Optic Network Annual Maintenance Costs – 3% of System Construction Costs

Figure 18 – Eight Year Cumulative Cost – Current Systems



The costs represented above are for a level of service that would not likely serve the CITY's needs over the eight year span of this cost forecast. It is presented as a benchmark to contrast the new CITY fiber optic network, and equal-capability leased alternatives from carriers.

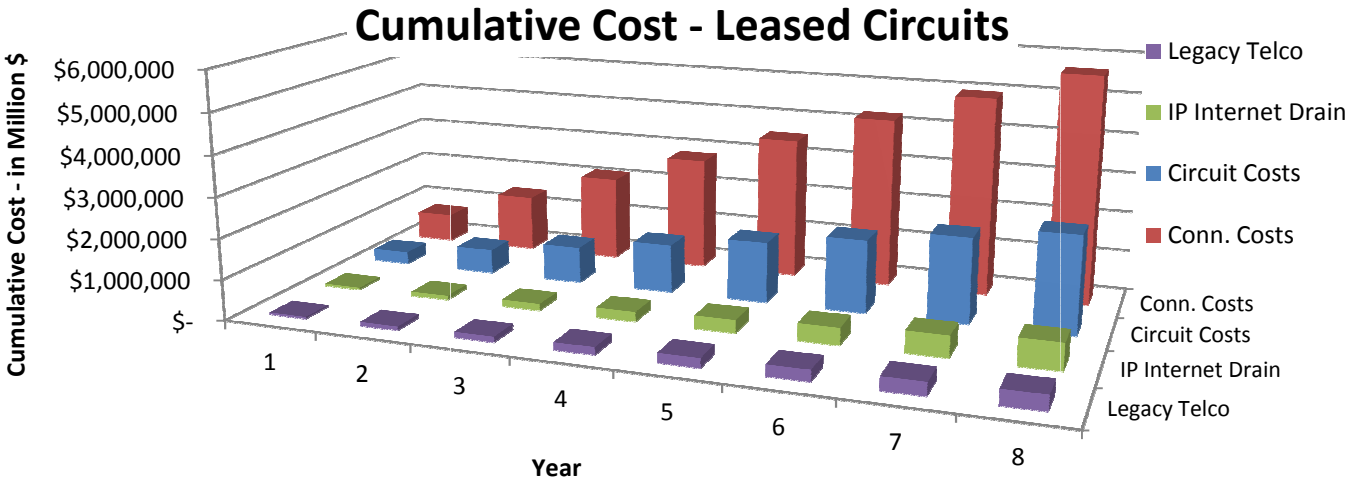
Figure 19 - Eight Year Cumulative Cost Detail – CITY Fiber Optic Network



	1	2	3	4	5	6	7	8
New Electronics	$-	$-	$-	$-	$-	$-	$531,901	$-
Maintenance	$29,399	$58,799	$87,940	$117,080	$146,221	$175,362	$204,502	$233,902
Legacy Telco	$46,080	$92,160	$138,240	$184,320	$230,400	$276,480	$322,560	$368,640
IP Internet Drain	$48,000	$103,200	$166,680	$239,688	$323,640	$420,180	$531,204	$658,884
84 Mo. Cost Recovery	$971,353	$1,942,70	$2,914,05	$3,885,41	$4,856,76	$5,828,11	$6,799,47	$-

Included within the chart / table in Figure 19, there are a couple of noteworthy items. First, the cost recovery period applied to capitalize the initial construction costs was established as 84 months (7 years). Finally, in Year 7, a cost allowance for replacement of the network electronics was included at an amount equal to the current network electronics.

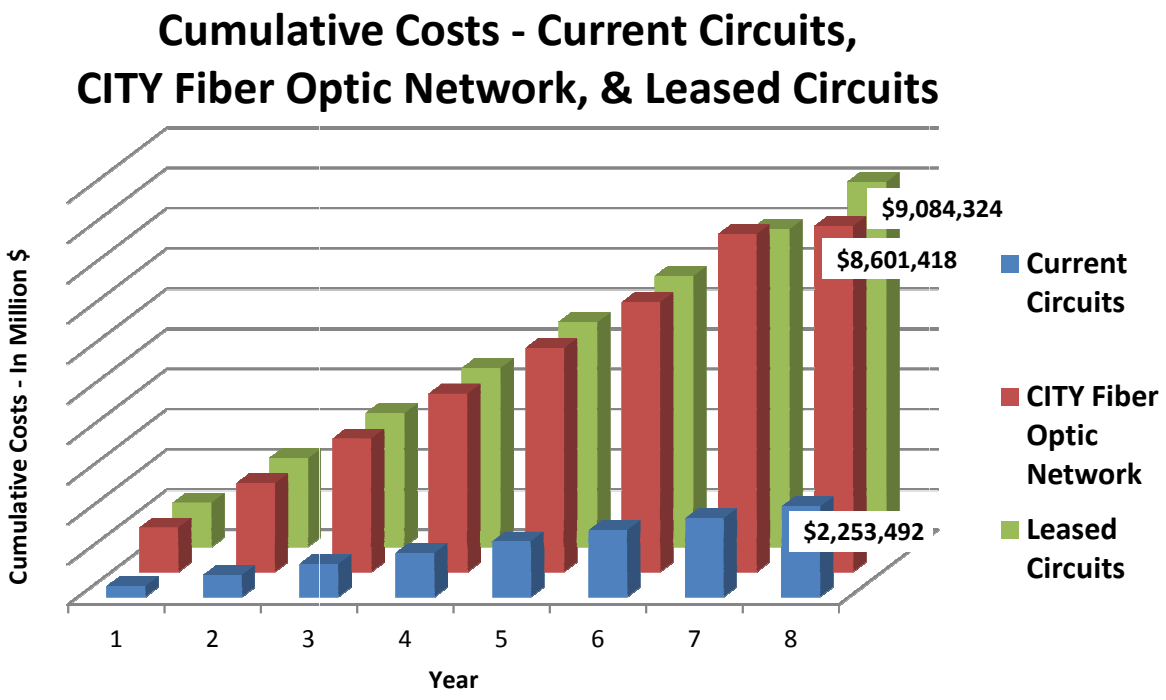
Figure 20 - Eight Year Cumulative Cost – Leased Circuits



	1	2	3	4	5	6	7	8
Legacy Telco	$46,080	$92,160	$138,240	$184,320	$230,400	$276,480	$322,560	$368,640
IP Internet Drain	$48,000	$103,200	$166,680	$239,688	$323,640	$420,180	$531,204	$658,884
Circuit Costs	$301,500	$603,000	$904,500	$1,206,000	$1,507,500	$1,809,000	$2,110,500	$2,412,000
Conn. Costs	$705,600	$1,411,200	$2,116,800	$2,822,400	$3,528,000	$4,233,600	$4,939,200	$5,644,800

Admittedly, the large amount of data represented in Figures 18 (Current System), 19 (CITY Fiber Optic Network), and 20 (Leased Circuits) are difficult to compare as presented – when displayed with the individual cost components; total summary costs on a year-by-year basis are not shown. All summary cost data from Figures 18, 19, and 20 are presented in Figure 21 below.

Figure 21 – Eight Year Cumulative Costs – Current, CITY Fiber Optic Networks, & Leased Circuits



As might be expected, after the completion of the 84 month cost recovery period, the costs for the CITY Fiber Optic Network drop below the costs for leased carrier circuits. Those savings continue as time extends into the future, as demonstrated in Figure 22 below.

Figure 22 – Capital Cost Analysis

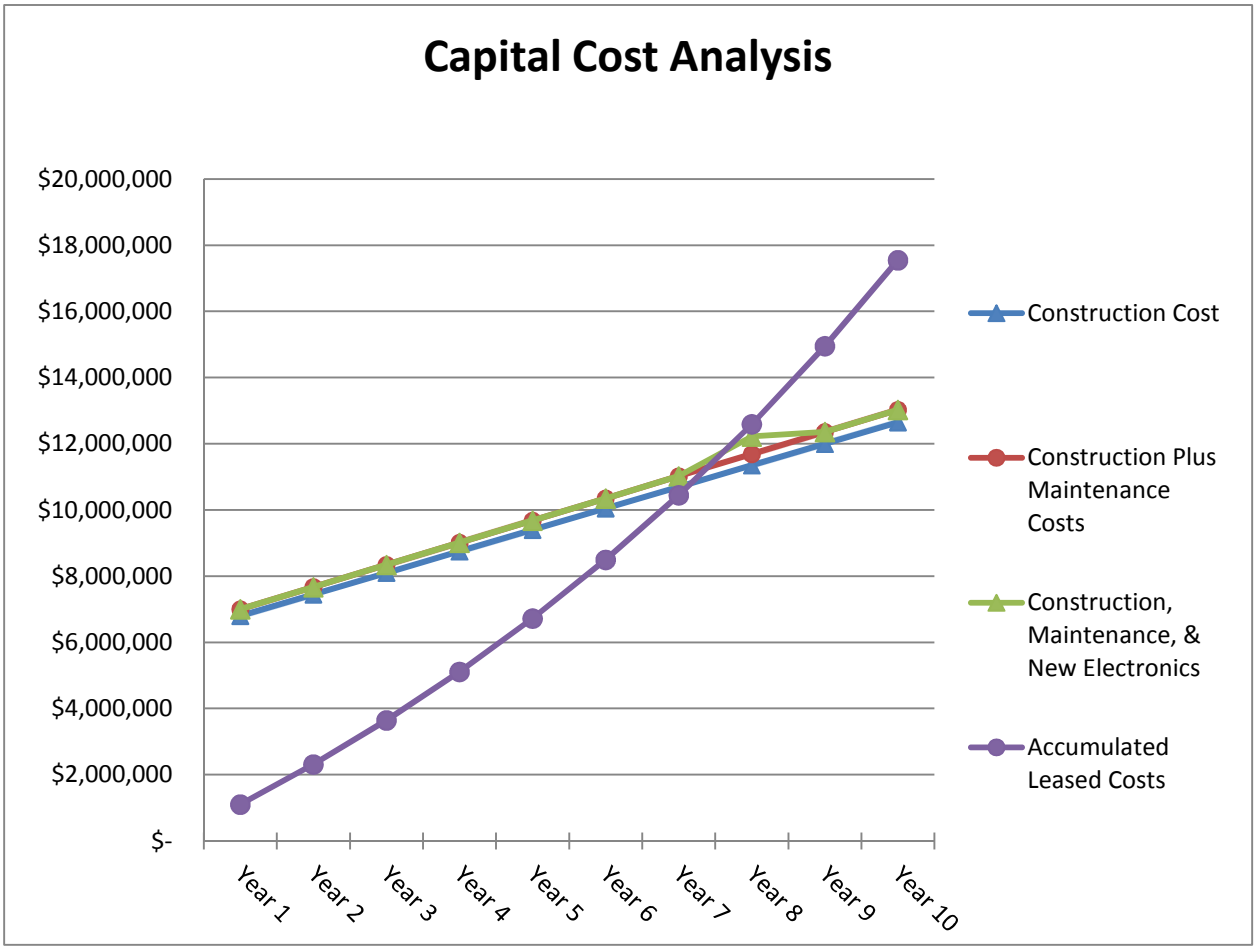
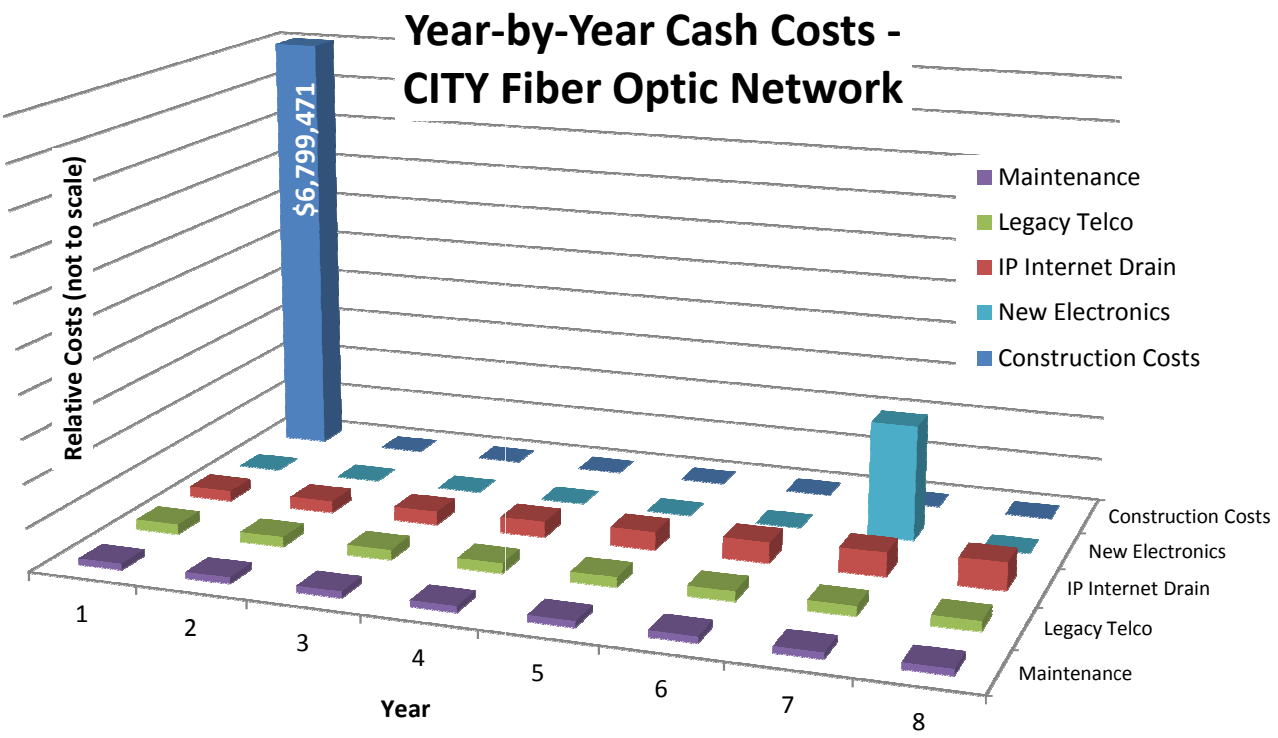


Figure 22 casts the construction costs over the 84 month cost recovery period as in prior figures, but the CITY would not necessarily be bound by this approach to funding capital construction projects. As one additional view of the costs to construct / operate the CITY Fiber Optic Network, the following Figure 23 depicts the year-by-year cash costs, if the project was fully funded at the start.

Figure 23 – Year-by-Year Cash Costs – CITY Fiber Optic Network



	1	2	3	4	5	6	7	8
Maintenance	$29,141	$29,400	$29,399	$29,399	$29,399	$29,399	$29,399	$29,400
Legacy Telco	$46,080	$46,080	$46,080	$46,080	$46,080	$46,080	$46,080	$46,080
IP Internet Drain	$48,000	$55,200	$63,480	$73,008	$83,952	$96,540	$111,024	$127,680
New Electronics	$-	$-	$-	$-	$-	$-	$531,901	$-
Construction Costs	$6,799,4	$-	$-	$-	$-	$-	$-	$-

In consideration of the significant gains in capability and financial viability, the CITY would be well served by moving forward with deployment of these infrastructure resources.

APPENDIX A – SUPPORTING DOCUMENTS

Maintenance Requirements

Ongoing maintenance costs for an enterprise network are generally driven by one key element: "What part of system maintenance can be performed with in-house resources?" In general terms, the greater amount of support services that have to be provided by external resources, the higher the ongoing cost to the CITY.

Other factors that impact on the maintenance costs include coverage days / hours, response time, and onsite spares (self-insurance). For an organization like the CITY with an in-house IT staff, it is reasonable to suggest that the appropriate amount of vendor services and ongoing maintenance costs would likely fall toward the lower end of the range.

Among the available options from most vendors are combinations of technical support options, replacement equipment options including advance replacement / next day / repair & return, and the hours and days where vendor staff is available to provide onsite support. Following is a list of examples that all drive / contribute to annual maintenance costs:

- Technical Support – Via Telephone Support
  - Monday thru Friday – 8AM to 5PM
  - 7 x 24 x 365
- Onsite Technical Support – Vendor Trained Technicians
  - Monday thru Friday – 8AM to 5PM
  - 7 x 24 x 365
- Equipment Replacement Options
  - Same Day – 4 Hours or Less
  - Next Business Day (overnight shipping)
  - Repair & Return
  - Onsite Spares – Critical Components Only

As might be expected, the specific costs are driven by a specific bill of materials, which currently only exists at the conceptual level. Based upon the assumption that the majority of system maintenance can be performed by the CITY IT department, and replacement equipment can be vendor provided within a 4 hour response time, typical annual maintenance costs are approximately 3% of initial installed costs, and can be reliably forecasted up to five years in advance.

Given the conceptual designs for the network core devices, and edge devices for both indoor and outdoor applications, here are the anticipated annual maintenance fees based upon the level of service described above:

- Phase 1

- Projected Network Equipment Cost $ 703,129
- Estimated Annual Maintenance Fee $ 21,094

- Phase 2
  - Projected Network Equipment Cost $ 103,872
  - Estimated Annual Maintenance Fee $ 3,116

Fiber maintenance budgets are typically established to address a number of functions related to the operation and management of a fiber optic network, including dispatch, fiber repairs, and adds / moves / changes to the system. This allows the municipality to have reserve budget capacity to accommodate future outages and changes to the system that may or may not actually occur.

If warranted, the CITY would need to establish a relationship with a 3rd party contractor with the task of receiving outage calls, dispatching repair crews, and restoring service to the affected parties as quickly as possible. It would also be logical / cost effective for the CITY to maintain inventories of a pre-established reserve of spare fiber and splice closures that can be provided to the repair contractor as a part of any emergency restoration process. The CITY should have the capability to find the right level of services for the repair contractor, and establish the level of service / risk that matches their expected tolerance for outage. Specifically, it may be possible to establish a year's worth of cost for providing call center coverage, plus a per incident fee to perform a truck roll to repair / splice fiber.

As a separate budgeting item, the CITY will need to also allocate costs for non-repair / changes that will be required due to unknown but typical changes to a fiber optic infrastructure, such as road realignments, locate services for work near the fiber network, and active network asset changes. These events may or may not actually occur as an operating expense, but allowances in the operating budgets must be considered to address these potential costs.

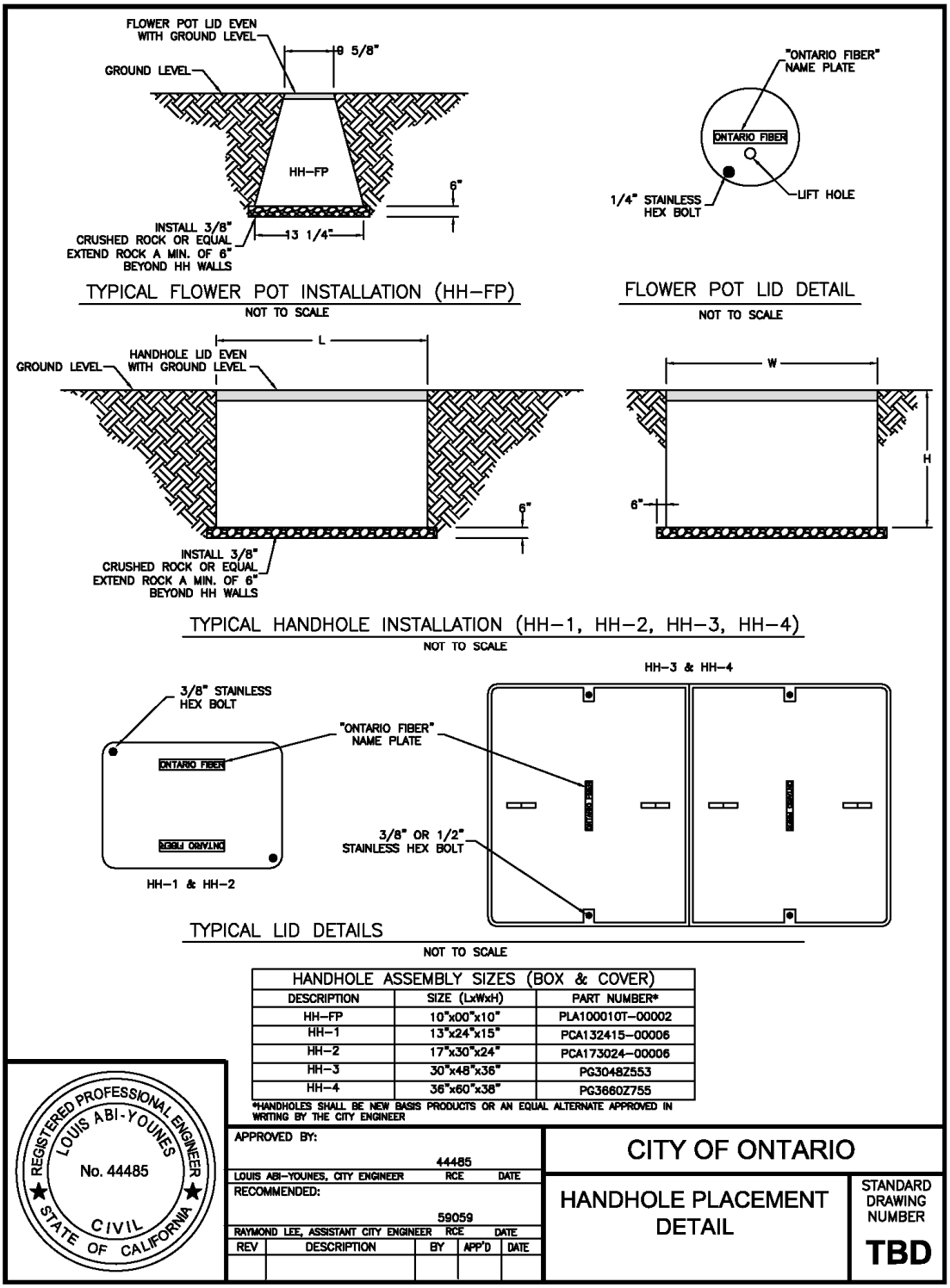
In general terms, an allowance can be derived from the overall fiber construction costs (excluding active network electronics, engineering, and integration costs), and approximately 3% per year is generally accepted as a budgeted value to address both the emergency restoration and operating changes. It is also worthwhile to mention that this 3% allowance DOES NOT cover system changes that would otherwise be captured as capital expense costs, such as a new CIP project or building a new lateral to an existing backbone.

Estimated Annual Fiber Restoration / Adds, Moves, & Changes Budget

- Phase 1 $ 99,500 (approximately)
- Phase 2 $ 42,500 (approximately)

Updated Development Guidelines

Figure 24 – Recommended Standard Drawing



Through the course of developing the Fiber Optic Design Guidelines, the Figure 28 above is recommended to be adopted as a Standard Drawing.

Design Guidelines

General Overview

Engineered drawings, otherwise known as plans, submitted by private design engineers (the "Engineer") to the CITY for plan check shall adhere to these Fiber Optic Design Guidelines, whenever those plans involve the installation of new conduits in accordance with the CITY Fiber Optic Master Plan, or along any local residential street, where fiber optic conduit is required to connect to the homes.

The submitted plans will be checked by the CITY for conformance with the CITY's standards and policies, and for overall acceptability of the proposed design. The following guiding documents are to be used by the Engineer in preparing the plans (in accordance with current CITY requirements, including building codes, electrical codes, etc.). Other pertinent documents may include Specific Plans, Master Plans, and the Conditions of Approval for the project.

Appendix A.5 of this document contains a "Fiber Optic Design Submittal Checklist" that must be fully filled out by the Engineer and included with the submitted plans as part of the submittal package. Other plans pertinent to the installation of Fiber Optic conduits (i.e. Public Infrastructure Plans) shall also be provided with the plans submitted for review.

It is the responsibility of the Engineer to be knowledgeable in dry utility design, and to complete a thorough quality assurance/quality control (QA/QC) review of the plans for errors BEFORE submitting them to the CITY for plan check. Plans submitted with numerous designs and/or drafting errors, drafted with poor quality workmanship, or missing significant information will be rejected and returned.

Plans being re-submitted for a second or subsequent check shall include a new set of plans, the previous set of plans containing the CITY's red lines and comments, the design submittal checklist and any other items that document any comments that have been exchanged between the Engineer and the CITY.

Any and all submittals that do not contain all of the required components as identified in these guidelines are subject to rejection, and may be returned for correction without being reviewed. The Engineer should contact the CITY Engineering Department to determine whether there are any special requirements for a project.

Drafting Standards

All plan sheets submitted shall be 24 inches by 36 inches with the standard CITY title block (in accordance with CITY's Standard Drawing No. 6004). Unless requested, title sheets are not required. No sticky backs or paste-ons will be accepted. At the time of the final submittal, copies of the drawings created shall be provided in CAD format (.dwg, .dxf) to the CITY on a CD, DVD, or other acceptable digital media storage used at that time. All drawings submittal shall utilize an "e-transmit" feature and include any reference drawings, plot files and text files as necessary. Signatures must be "wet-originals" on the final submittal (Mylar).

Projects shall have a complete, master set of General Notes, Construction Notes, and/or Legend of Special Symbols for the whole project on the first sheet of the set. Subsequent project sheets shall require only those Construction Notes, and/or Legend of Special Symbols applicable to that sheet. In no case should a Construction Note or Symbol be defined differently on separate sheets of the same project. Undefined, nonstandard symbols shall not be used.

Reference to other drawings shall be made using the CITY assigned drawing number only. If a drawing number has not yet been assigned, leave a blank space. Drawing numbers will not be assigned until the CITY requests originals.

All surface features such as meter boxes, power poles, sidewalk, drive approaches, existing signs, striping and markings, catch basins, gutters, signal equipment, street lights, existing trees, etc., must be shown.

In those cases, where a project spans multiple jurisdictions, a signature block for each affected agency shall be included on the title page and on each page where there is shared jurisdiction on the project. All jurisdictional boundary lines must be shown on the plans.

All drawings are required to show a north arrow above the plan scale in the lower right hand corner of the drawing, oriented toward either the top or the right side of the drawing. North arrows shall be consistent with the type used as a CITY standard (in accordance with CITY Standard Drawing No. 6003) at said time.

Short dashed lines are to be used when indicating existing equipment and improvements or are planned to be installed by another plan sheet. Solid lines, even if drawn narrower, can be erroneously construed as requiring installation of items that may currently exist.

All submitted plans shall be produced by ink-plotting, or by other permanent print methods. Sepia Mylar prints will not be accepted.

Fiber Optic Plan Standards

The following standards shall be applied to all Fiber Optic Plans:

- The scale of the plans shall be 1”=40’ or 1”=20’ depending on the complexity of the plan and clarity.
- The drawing title shall list the name of the street upon which the lights are located on and a corresponding cross street name.
- Fiber Optic plans are identified by “O-…” drawing numbers.
- All utilities must be shown.
    - If applicable, indicate possible conflicts with irrigation systems, street light systems, and/or other utilities. Identify corrective action to be taken by Contractor should damage occur.
- Where Fiber Optic improvements exist, or are proposed on private property (behind ROW line) indicate existence of, or need for, encroachment and maintenance easements. Appropriate easements must be provided prior to approval of plans for private developments. Pertaining to CITY projects, acquisition will be coordinate with CITY personnel.
- All dimensions for street(s), lane width(s), and utility location(s) are to be provided between centerline and curb.
- It is the design engineer’s responsibility to ascertain and provide for minimum clearance requirements between the fiber optic conduit and all other utilities, railroads, easements, etc. All clearances shall be in accordance with CAL/OSHA, PUC and other jurisdictional agencies that are involved.

Fiber Optic Design – Old Model Colony

It is understood that in the Old Model Colony, very little, if any of the fiber optic conduit construction will be in undeveloped area(s), which is known as “greenfield” development. For this reason, it is proposed that most fiber optic conduit construction will be infill and will attempt to “piggy back” on other CITY Improvement Projects. Placement of fiber optic conduits will be more complicated in OMC than in the New Model Colony (NMC), as NMC is unimproved (or greenfield). It is preferred that all Fiber Optic Conduits be placed underneath the sidewalk when applicable; however, it is understood construction may require trenching in the existing street(s). These situations will be reviewed and approved on a case-by-case situation.

Cross sections for trenching the different levels of network hierarchy are provided in Design Guideline Figures 1 thru 4, which not only include individual trenching details but also include joint trenching details. Where it is preferred or required to directional bore the conduits, Design Guideline Figure 5 provides Directional Boring details. Submitted plans will be required to show the appropriate boring pit locations, and identify all utilities. Prior to boring (and during as necessary) potholing the utilities will be required.

Fiber Optic Design – New Model Colony

NMC provides a unique fiber optic conduit construction opportunity as most Major, Residential and Collector streets have yet to be constructed. Within NMC, similar to the Old Model Colony, where applicable, trenching, joint trenching, and boring shall be used to install the Fiber Conduits and the previous reference Figures to be utilized. Fiber Optic conduit placement will generally be in a joint trench with Street Light conduits, placed behind the curb and under the sidewalk resulting conduit placement will be on the north side of street and the east side of street. It is acknowledged that upon full build out of NMC, conduit will be installed on both sides of the streets; however, for new street improvements, fiber optic conduits shall be placed as recommended above.

Fiber Optic Standards

All Fiber Optic Cable recommended within the Master Plan will be approved by the Engineering Department. The following are the general requirements and description and must be equivalent to the Fiber Optic Characteristics detailed listed in the Fiber Optic Master Plan supporting memorandum, Conceptual Layout of Needed Infrastructure Memorandum.

<u>Singlemode Loose Tube Non-Armored</u>

- Gel-Free/ Dry High Density Buffer Tubes
- Twelve (12) Fibers Per Each Buffer Tube
- Color Coded Buffer Tubes
- Jacketed Central Member
- Dielectric Strength Elements
- Outer Polyethylene (PE) Jacket
- Sequential Markings (Meters)
- Ripcord
- Meets ITU-T G.655 (2009)
- Follows ANSI/TIA/EIA

Conduit Standards

All Conduit recommended within the Master Plan will be approved by the Engineering Department. The minimum acceptable depth for fiber optic cabling / fiber optic conduits shall be 36". The following are the general design standards to comply with:

Primary Ring (PR)

- One (1) - 2" HDPE SDR-11 (Smoothwall) roll pipe (Orange) or equivalent
- Two (2) - 7 Way MicroDuct (Duraline) – 16mm Tubes or equivalent

Secondary Ring (SR)

- One (1) - 2" HDPE SDR-11 (Smoothwall) roll pipe (Orange) or equivalent
- One (1) - 7 Way MicroDuct (Duraline) – 16mm Tubes or equivalent

Laterals

- One (1) - 2" HDPE SDR-11(Smoothwall) roll pipe (Orange) or equivalent
- One (1) - 7 Way MicroDuct (Duraline) – 16mm Tubes or equivalent

Handhole Placement

The fiber optic conduit infrastructure design will place and utilize five (5) different sized Handholes within the communication infrastructure and Handhole details can be found in CITY Standard Drawing No. **TBD**. Each Handhole has a unique use and placement, and the table below illustrates, based on fiber strand count, when each will be used:

Handhole Utilization - Fiber Strand Count

Table 7 – Handhole Utilization – Fiber Strand Count

Description	Fiber Strand Count
HH-FP	Less than or equal to 6 strands
HH-1	Less than or equal to 144 strands
HH-2	Less than or equal to 288 strands
HH-3	Less than or equal to 432 strands
HH-4	Greater than 432 strands

General Handhole Spacing Requirements

It is understood that as each project (Backbone / Lateral / Residential / In-tract) will require a unique design, so an exact standard will not fit the bill. Boxes along the backbone are generally placed every 500' to allow for pulling in the fiber and splicing to adjacent buildings and infrastructure.

Conduits sweeping into the Handholes shall enter in flush with the cut out mouse holes aligned parallel to the bottom of the box and come in perpendicular to the wall of the box. See Design Guideline Figure 6 for Handhole Conduit Entry. Conduits shall not enter at any angle other than near parallel. Sweeps from the mainline to the conduit shall be accomplished using radii recommended by the manufacturer -- see Design Guideline Figure 7 for details.

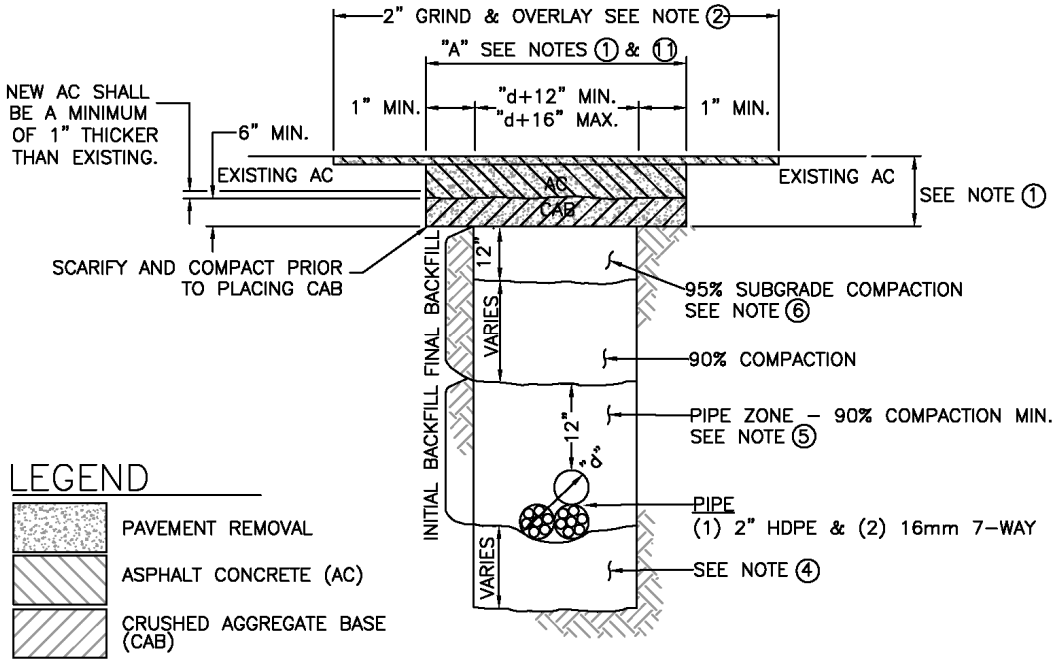
Bid Quality Standard Drawings & Specifications

The Fiber Optic Design Guidelines reference the following cross-sections drawings that are to be used in developing any Fiber Optic Construction Drawings.

Primary Ring (PR)

Install one (1) 2" HDPE and two (2) 7-way (16mm) MicroDuct in accordance with CITY Fiber Optic Design Guidelines. Trenching shall be per CITY Std. 1306.

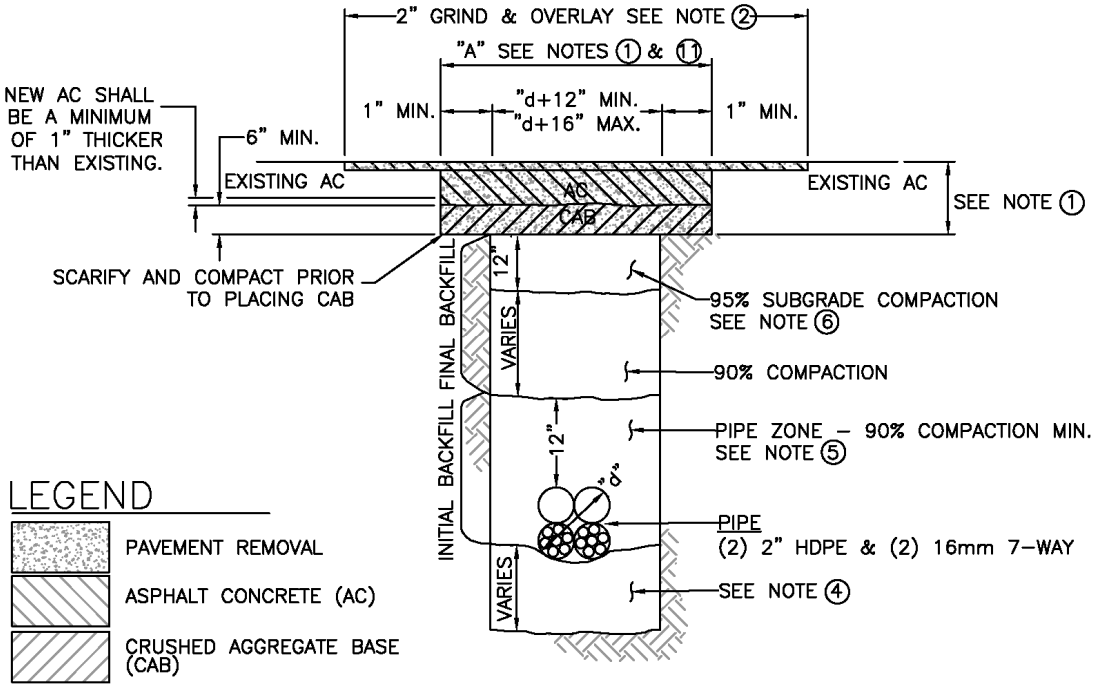
Design Guideline Figure 1 – Primary Ring (PR)



Primary Ring Plus (+) 2" Duct (PR+2")

Install two (2) 2" HDPE and two (2) 7-way (16mm) MicroDuct in accordance with CITY Fiber Optic Design Guidelines. Trenching shall be per CITY Std. 1306.

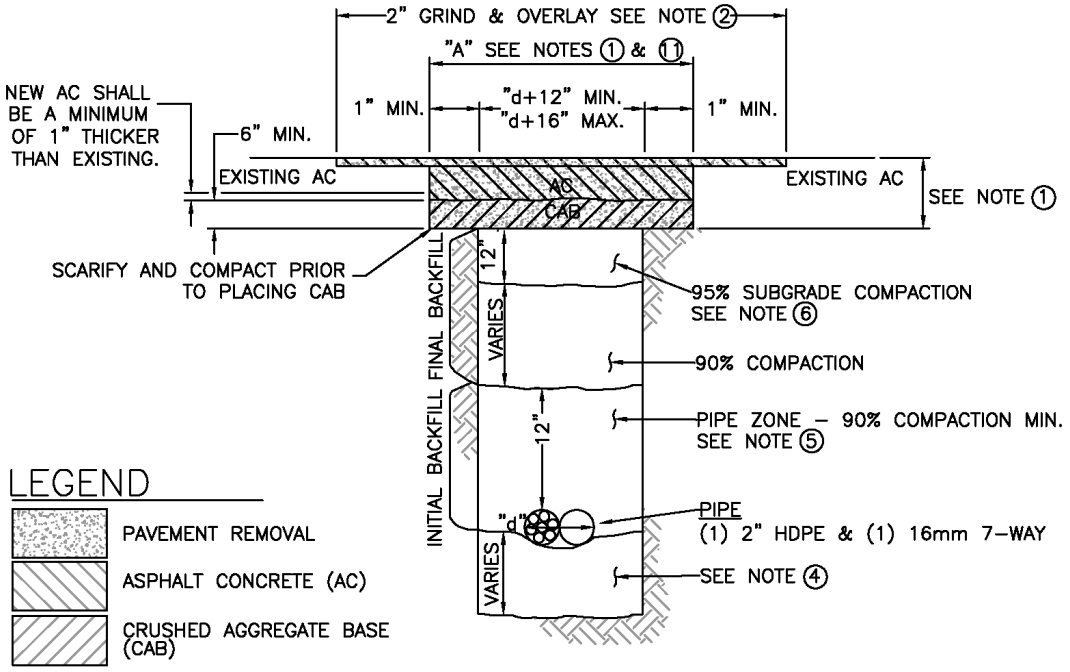
Design Guideline Figure 2 – Primary Ring Plus (+) 2" Duct (PR+2")



Secondary Ring (SR)

Install one (1) 2" HDPE and one (1) 7-way (16mm) MicroDuct in accordance with CITY Fiber Optic Design Guidelines. Trenching shall be per CITY Std. 1306.

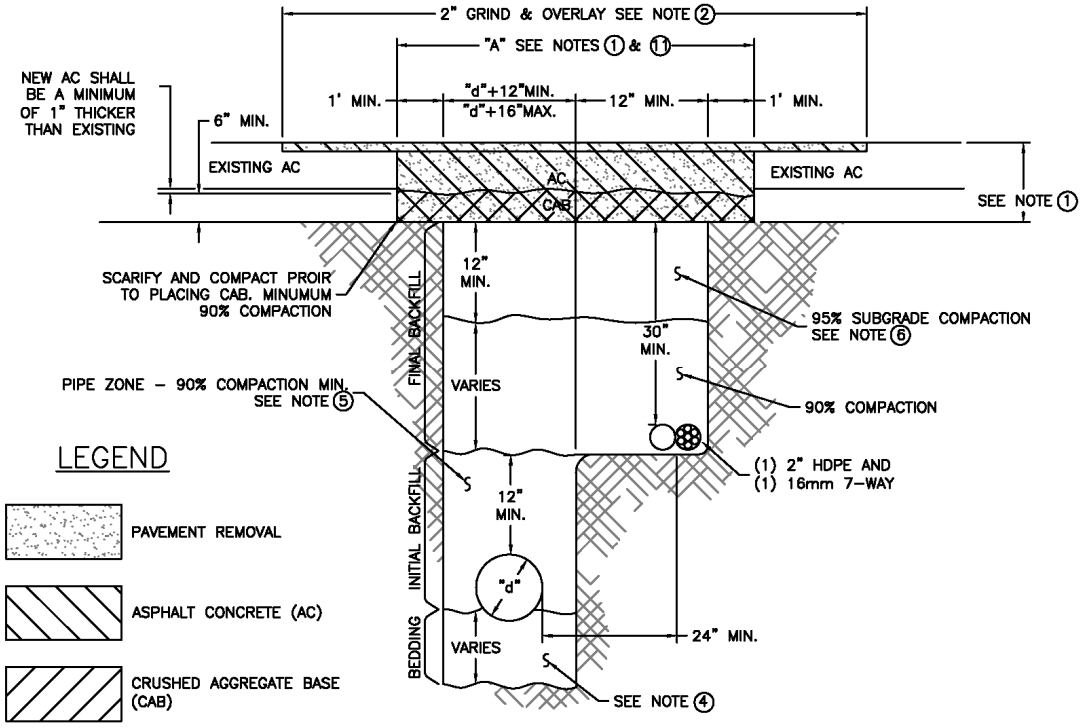
Design Guideline Figure 3 – Secondary Ring (SR)



CIP Joint Build (Stepped Trench Detail)

Install one (1) 2" HDPE and one (1) 7-way (16mm) MicroDuct in accordance with CITY Fiber Optic Design Guidelines. This design guideline will be used in "in-fill" situations (OMC) where joint trench CIP projects can utilized.

Design Guideline Figure 4 – CIP Joint Build (Stepped Trench Detail)



Trench Detail Notes

① EXISTING PAVEMENT SHALL BE WHEEL CUT OR SAW CUT & REMOVED AT THE WIDTH OF DIMENSION "A". THE DEPTH OF THE REMOVAL SHALL BE THE FULL STRUCTURED DEPTH PLUS THE NECESSARY EXCAVATION FOR THE NEW PAVEMENT SECTION AS REQUIRED BY NOTE 9 HEREON.

② FOR LONGITUDINAL TRENCHES OVER 150' IN LENGTH, A MINIMUM 10' WIDE, 2" GRIND AND OVERLAY IS REQUIRED.

③ THE PIPE ZONE WIDTH SHALL BE A MINIMUM OF 12" PLUS THE PIPE DIAMETER AND THE MAXIMUM OF 16" PLUS THE PIPE DIAMETER, IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (GREEN BOOK).

④ BEDDING MATERIAL SHALL BE USED WHEN THE SAND EQUIVALENT OF THE NATIVE MATERIAL IS LESS THAN 30 AS SPECIFIED IN THE PROJECT PLANS AND SPECIFICATIONS OR AS APPROVED BY THE CITY ENGINEER.

⑤ INITIAL BACKFILL MATERIAL SHALL BE OF SELECT MATERIAL AS SPECIFIED IN THE PROJECT PLANS AND SPECIFICATIONS OR AS APPROVED BY THE CITY ENGINEER. INITIAL BACKFILL SHALL BE COMPACTED TO 90% MIN. & TESTED. TEST SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER AND THE CITY ENGINEER PRIOR TO FINAL BACKFILL.

⑥ FINAL BACKFILL SHALL BE SELECT MATERIALS SPECIFIED IN THE PROJECT PLANS AND SPECIFICATIONS OR NATIVE IF DETERMINED BY THE CITY TO BE ACCEPTABLE AND COMPACTED AS NOTED HEREON. COMPACTION TESTS SHALL BE APPROVED BY THE CITY ENGINEER PRIOR TO PLACEMENT OF C.A.B.

⑦ CRUSHED AGGREGATE BASE (CAB) SHALL BE IN ACCORDANCE WITH SECTION 200-2.2 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION ("GREENBOOK") AND SHALL BE COMPACTED & TESTS APPROVED PRIOR TO PLACEMENT OF A.C.

⑧ ASPHALT CONCRETE (AC) SHALL BE REPLACED IN KIND (B-PG 70-10 OR B-AHRM-GG-PG 64-16) AND IN ACCORDANCE WITH SECTION 203-06 AND 201-11 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION ("GREENBOOK") OR AS APPROVED BY THE ENGINEER.

⑨ COMPACTION TESTS SHALL BE TAKEN EVERY 300', MINIMUM OF 1 PER LOCATION.

⑩ TRENCHES WHICH ARE 30" IN DEPTH OR LESS AND 18" IN WIDTH OR LESS SHALL BE BACKFILLED WITH ONE-SACK CEMENT SLURRY.

⑪ IN THE EVENT WALL FAILURE, TRENCH LIMITS MAY BE EXTENDED AS DETERMINED BY THE CITY ENGINEER. ADDITIONAL BACKFILL REQUIREMENTS MAY BE REQUIRED. 1' AC/CAB "WING" SHALL BE LOCATED FROM FARTHEST LIMIT OF TRENCH OR TRENCH WALL FAILURE AS DETERMINED BY THE CITY ENGINEER.

⑫ FULL AC REPLACEMENT OF THE ASPHALT BETWEEN THE TRENCH AND THE CURB OR GUTTER SHALL BE REQUIRED FOR ANY TRENCH WHERE THE PAVEMENT REMOVAL IS WITHIN 3' OF CURB OR GUTTER.

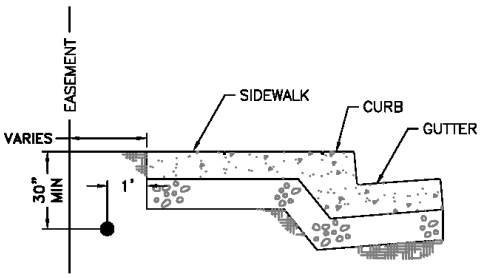
⑬ REMOVAL OF 6 OR MORE SEPARATE AREAS OF PAVEMENT WITHIN A 150' LONGITUDINAL LENGTH OF STREET SHALL REQUIRED A TYPE II SLURRY SEAL EXTENDED 5' BEYOND THE LIMITS OF THE OUTERMOST PAVEMENT REMOVAL.

⑭ THERE IS A 3 YEAR MORATORIUM ON NEWLY PAVED STREETS. ANY TRENCHING WITHIN THIS PERIOD REQUIRES APPROVAL FROM THE CITY ENGINEER.

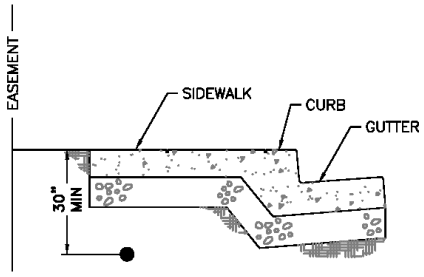
Note: *The above Trench Detail Notes are the CITY's standard and can be found on Standard Drawing 1306*

Directional Bore Detail

Design Guideline Figure 5 - Directional Bore Detail

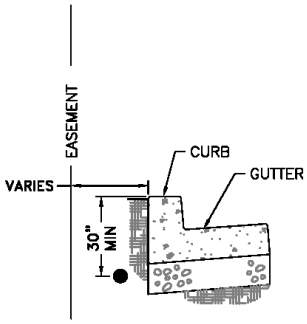


1 BORE BACK OF SIDEWALK
NOT TO SCALE

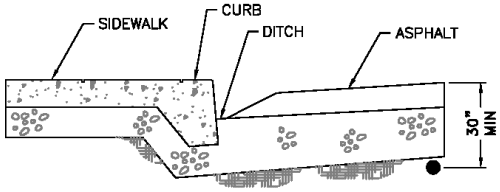


2 BORE UNDER SIDEWALK
NOT TO SCALE

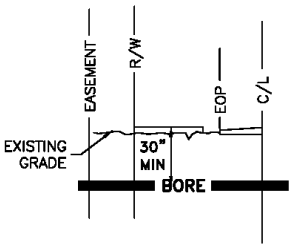
NOTE:
CONSTRUCTION CHOOSES THE APPROPRIATE BORE LOCATION FROM THE OPTIONS ABOVE BASED UPON FIELD CONDITIONS.



3 BORE BACK OF CURB
NOT TO SCALE



4 BORE UNDER ASPHALT
NOT TO SCALE

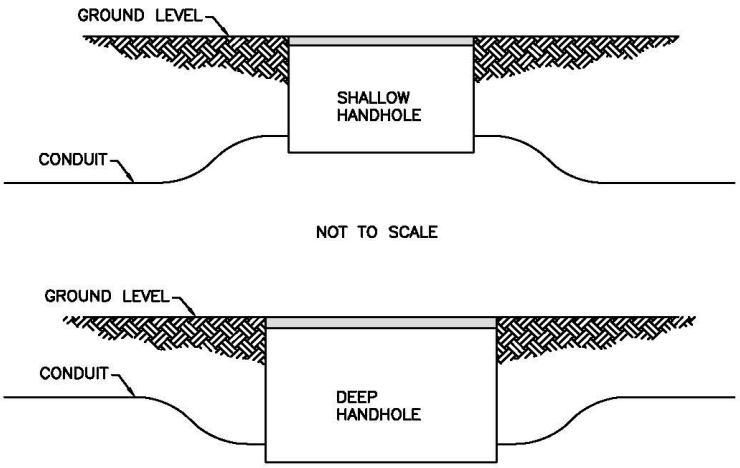


5 BORE ROAD CROSSING
NOT TO SCALE

REQUIRED BORE REAM SIZE	
NUMBER OF PIPES	REAM SIZE
(2) 2" HDPE & (2) 16mm 7-WAY	8"
(1) 2" HDPE & (2) 16mm 7-WAY	6"
(1) 2" HDPE & (1) 16mm 7-WAY	6"

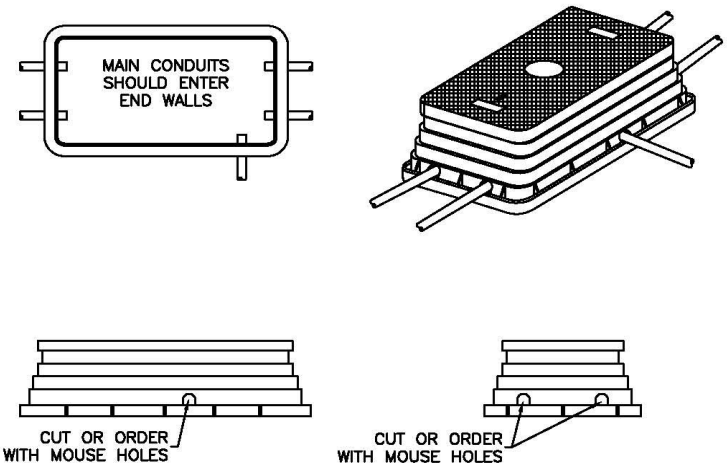
Handhole Conduit Entry Detail

Design Guideline Figure 3 - Handhole Conduit Entry Detail



TYPICAL CONDUIT HANDHOLE ENTRY

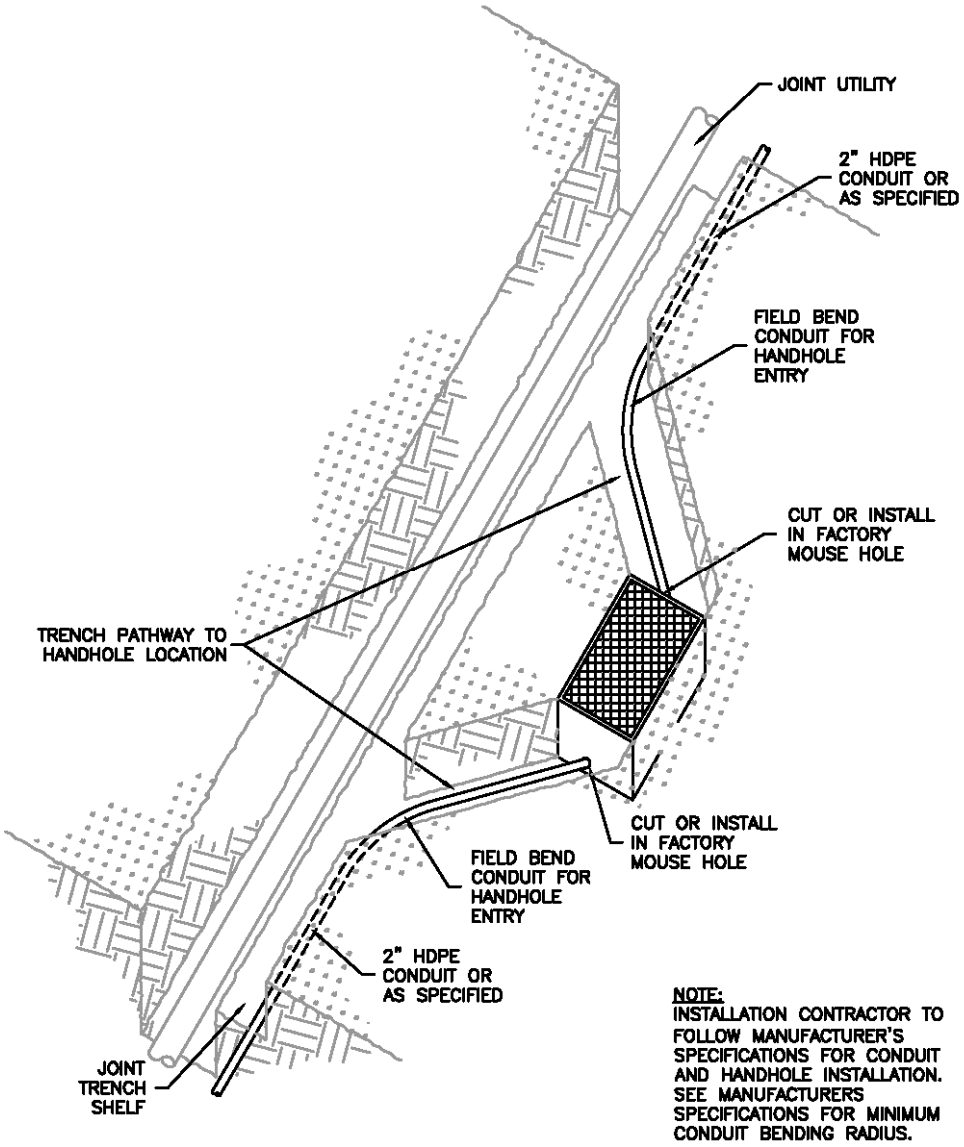
CONDUIT THAT SWEEPS INTO THE HANDHOLE MUST ENTER THE HANDHOLE FLUSH AND LEVEL TO AVOID FIBER MICRO BENDING. WHEN ENTERING A SHALLOW BOX, THE CHANGE IN THE ELEVATION OF THE CONDUIT RUN SHOULD BE KEPT AS SHORT AS POSSIBLE IN ORDER TO MAINTAIN MAXIMUM DEPTH.



RECOMMENDED DUCT/DUCTS ENTRY POINTS

Conduit Sweep Details (Joint Trench Installation)

Design Guideline Figure 7 - Conduit Sweep Details (Joint Trench Installation)



Glossary

TERM	DEFINITION
10 Gigabit Ethernet	Defined by the IEEE 802.3ae-2002 standard for transmitting Ethernet frames at the rate of 10 gigabits per second, approximately 10 billion bits per second.
100 Gigabit Ethernet	Defined by the IEEE 802.3ba-2010 standard for transmitting Ethernet frames at the rate of 100 gigabits per second.
40 Gigabit Ethernet	Defined by the IEEE 802.3ba-2010 standard for transmitting Ethernet frames at the rate of 40 gigabits per second.
7-Way Microduct	A 2" outside diameter polyethylene conduit that contains 7 smaller microducts, each usually 16mm outside diameter. Allows access for future cable installation in an underground raceway already in place.
Access Layer	Layer 2 and 3 functionality in the OSI (Open System Interconnection) model, where initial network users are transported to the nearest POP and interconnected with the Transport Layer. CITY Access Layer data rate is 1 Gbps.
Bandwidth	The information carrying capability of any transmission media, including fiber optic and copper cabling, as well as wireless communications.
Bit	The smallest unit of data, a binary 1 or 0. Commonly expressed as a lower-case "b" in discussion of a data transfer rate, like Kilobits per second (Kbps) or Megabits per second (Mbps).
Byte	A byte consists of 8 bits of data, originally used to encode a single character, and is commonly expressed as an upper-case "B" in reference to data file storage sizes, like Megabytes (MB) or Gigabytes (GB).
Carrier	A common term applied in telecommunications to describe a services vendor, including regulated or unregulated telephone companies.
Circuit Costs	An ongoing monthly expense that is directly related to provisioning on that circuit that establishes the maximum data rate (bandwidth) of the circuit. Imagine this as the "water" inside the garden hose part of the information transport system.
Co-Location	A technology term that describes sharing of space within a common technology infrastructure, such as an equipment room or cabinet.
Connection Costs	One-time charges to install wiring & equipment, plus ongoing monthly expense to maintain the connection, equipment, and system records. Imagine this as the "garden hose" part of the information transport system.
Core Rings	Also referred to as Primary Backbones. Within the CITY fiber infrastructure, Core Rings are fiber routes that include either one or two 432-strand fiber optic cables.
Ethernet	Ratified by the IEEE 802.3 standard in 1985 and originally established with a data rate of 10 Mbps, it has emerged as the base networking protocol upon which most of the current network principles are derived.
Fast Ethernet	An extension of the IEEE 802.3u Ethernet standard (1995) developed to support a data rate of 100Mbps.
Frame Relay	An early analog technology developed to support demand for higher-speed data circuits, typically a shared resource pool across multiple customers. Considered a mid-range service between subrate T-1s and ISDN.
Gigabit Ethernet	Formally adopted by IEEE 802.3-2008, at a data rate of 1 Gbps, or roughly one billion bits per second. The CITY infrastructure will use 1 Gbps connectivity on the Access Layer.
Gigabyte (GB)	Units of measure to describe file sizes, consisting of 1,024 megabytes, or roughly 1 billion bytes of data.

TERM	DEFINITION
Handhole	An underground enclosure for installing, splicing, and testing of both fiber optic and copper cabling. Usually sized in accordance with conduit and cable entrances, but not large enough for a person to enter.
IP Internet Drain	The circuit / interconnection from the private CITY Fiber Optic Network to the public carrier network. The ongoing monthly expense for this interconnection is driven by the maximum data rate (bandwidth) of the circuit. This is where traffic will leave the CITY network and interconnect with the Internet / users not on the CITY Fiber Optic Network.
Kilobyte (KB)	Units of measure to describe file sizes, consisting of 1,024 bytes.
Local Area Network (LAN)	Sometimes referred to as LAN, describes a computer network that is generally within a single building, or a campus of buildings sharing a single physical property.
Lateral	Fiber optic cables ranging from 12 to 144 strands that branch off the Primary Backbones or Secondary Backbones to interconnection points.
Metropolitan Area Network (MAN)	Describes a network that is generally larger than a Local Area Network (LAN), but not as large as a Wide Area Network (WAN). The CITY network would be a good example of a Metropolitan Area Network (MAN), as it is largely confined to the areas of OMC and NMC.
Megabyte	Units of measure to describe file sizes, consisting of 1,024 kilobytes, or roughly 1 million bytes of data.
Passive Optical Network (PON)	A point-to-multipoint, fiber to the premises network architecture in which unpowered optical splitters are used to engage a single singlemode optical fiber that serves multiple premises, and is a form or a fiber-optic access network.
Point Of Presence (POP)	POPs usually describe the point where different networks meet, derived from the Bell Telephone System terminology to define the point of delivery for a particular voice or data service.
Secondary Rings	Also referred to as Secondary Backbones. Within the CITY fiber infrastructure, Secondary Rings are fiber routes that include either one or two 432- or 288-strand fiber optic cables.
Transport Layer	Layer 4 in the OSI (Open System Interconnection) model, where powerful, high speed data forwarding decisions can be made with consideration of the data payload type. CITY Transport Layer data rate is 10 Gbps.
Wide Area Network (WAN)	Describes a network that covers a broad geographic area, and usually consists of a combination of private and public network resources. With the emergence of Cloud-based technologies, even the Internet could be considered as a Wide Area Network (WAN).

Acronyms

ANSI	American National Standards Institute
CIP	Capital Improvement Program
bps	bits per second
Gbps	Gigabits per second (roughly equal to 1 billion bits per second)
HDPE	High-Density Polyethylene
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunications Union - Telecom
Kbps	Kilobits per second (roughly equal to 1 thousand bits per second)
LAN	Local Area Network
MAN	Metropolitan Area Network
Mbps	Megabits per second (roughly equal to 1 million bits per second)
PON	Passive Optical Network
POP	Point of Presence
SDR-11	Standard Dimension Ratio, pipe diameter is 11x pipe wall thickness
T-1	Digital carrier circuit with a data rate of 1.544 Mbps
TIA	Telecommunications Industry Alliance
WAN	Wide Area Network

Reference Documents

Technical Memorandum – System Inventory Memorandum

Conceptual Layout & Needs Assessment Memorandum

Concept of Operations

Fiber Optic Conduit Design Guidelines

Fiber Optic Design Submittal Checklist

1. Map Table Index

NUMBER	MAPS	DESCRIPTIONS
101	NMC Facility Map 050813	Illustrates the future facilities currently identified in NMC
102	NMC Fiber Size Map 050813	Illustration of the proposed fiber location and the fiber count with a complete build-out
103	NMC Infrastructure Map 050813	Illustration of the number of conduits and conduit sizes upon complete build-out
104	NMC Metro Ring Map 050813	Illustration of the fiber ring topology upon complete build-out
105	OMC Facility Map 050813	Illustration of all facilities identified in the process including the Centennial Park POP location
106	OMC Fiber Size Map 050813	Illustration of the fiber count of the network and the locations of the facilities that will be touched
107	OMC Infrastructure Map 050813	Illustration of the conduit size in the network along with the CIP's that would be utilized
108	OMC Metro Ring Map 050813	Illustration of the fiber ring topology upon complete build-out
109	OMC-NMC Facility Map 050813	Illustration of the ring topology covering both OMC and NMC and the location of the identified facilities off the rings
110	OMC-NMC Interconnect 050813	Illustration of the interconnection of OMC and NMC
111	OMC Phase Key Target Map 050813	In the Phased approach, an illustration of all the identified key targets that the network would provide
112	OMC Phase Traffic Map 050813	Illustration of all the types of traffic signals the OMC network will touch in the Phased approach
113	OMC Metro Ring Phase 1 Map 050813	Illustration of Phase 1 construction
114	OMC Metro Ring Phase 2 Map 050813	Illustration of Phase 2 construction

2. Phase 1 Construction

2.1. Building Interconnections

NAME	ADDRESS	LABEL	PHASE
Bon View Community Center	1010 S Bon View Avenue	3	1
Ontario City Hall	303 E B Street	4	1
Senior Center	225 E B Street	5	1
City Hall East (Annex)	200 N Cherry Avenue	6	1
Fire Station #1/Fire Admin	425 E B Street	7	1
Main Library	215 E C Street	8	1
Museum of History and Art	225 S Euclid Avenue	9	1
South Library	3850 Riverside Drive	10	1
Citizens Business Bank Area	4000 E Ontario Center Pkwy	11	1

NAME	ADDRESS	LABEL	PHASE
Fire Station #3	1408 E Francis Street	16	1
Fire Station #5	1530 E Forth Street	18	1
Fire Station #6	2931 E Philadelphia Street	19	1
Fire Station #7	4901 E Vanderbilt Street	20	1
Fire Station #8	3429 E Shelby Street	21	1
Ontario Municipal Utilities Agency	1425 S Bon View Avenue	22	1
Police Department Mills Substation	1 E Mills Circle	23	1
Police Headquarters	2500 S Archibald Avenue	24	1
Westwind Community Center	2425 E Riverside Drive	26	1
Revenue (next to OMUC)	1333 S Bon View Avenue	28	1
Housing / Code Enforcement	208 W Emporia Street	29	1
Ontario Convention Center	2000 E Convention Center Way	30	1
Ontario Town Center Plaza (Downtown Park)	Between B and C Street on Euclid	34	1
NMC West POP	Centennial Park		Future
NMC East POP-Collocation Facility	3151 E Riverside Drive		1
OMC East POP	City Arena		1
OMC West POP	City Hall		1
Ontario Soccer Complex	2200 E Philadelphia St	47	1

2.2. Traffic Signals

NAME	LOCATION (N/S Street / E/W Street)	LABEL	PHASE
Traffic Signal - 001	Sultana Ave @ Mission Blvd	TS001	1
Traffic Signal - 002	Campus Ave @ Mission Blvd	TS002	1
Traffic Signal - 003	Grove Ave @ Francis St	TS003	1
Traffic Signal - 004	Baker Ave @ Francis St	TS004	1
Traffic Signal - 005	Vineyard Ave @ Francis St	TS005	1
Traffic Signal - 006	Archibald Ave @ Francis St	TS006	1
Traffic Signal - 007	Archibald Ave @ Cedar St	TS007	1
Traffic Signal - 008	Archibald Ave @ Philadelphia St	TS008	1
Traffic Signal - 009	Archibald Ave @ Oak Hill Dr	TS009	1
Traffic Signal - 010	Archibald Ave @ Walnut St	TS010	1
Traffic Signal - 011	Archibald Ave @ Riverside Dr	TS011	1
Traffic Signal - 012	Turner Ave @ Riverside Dr	TS012	1
Traffic Signal - 013	Haven Ave @ Riverside Dr	TS013	1

NAME	LOCATION (N/S Street / E/W Street)	LABEL	PHASE
Traffic Signal - 014	Mill Creek Rd@ Riverside Dr	TS014	1
Traffic Signal - 015	Edenglen Ave @ Riverside Dr	TS015	1
Traffic Signal - 016	Milliken Ave @ Riverside Dr	TS016	1
Traffic Signal - 017	Milliken Ave @ Greystone Dr	TS017	1
Traffic Signal - 018	Milliken Ave @ Mission Blvd	TS018	1
Traffic Signal - 019	Milliken Ave @ Philadelphia St	TS019	1
Traffic Signal - 020	Milliken Ave @ Francis St	TS020	1
Traffic Signal - 021	Milliken Ave @ Toyota Way	TS021	1
Traffic Signal - 022	Milliken Ave @ Jurupa St	TS022	1
Traffic Signal - 023	Milliken Ave @ Santa Ana St	TS023	1
Traffic Signal - 024	Milliken Ave @ Brickell St	TS024	1
Traffic Signal - 025	Milliken Ave @ Airport Dr	TS025	1
Traffic Signal - 026	Milliken Ave @ Guasti Rd	TS026	1
Traffic Signal - 027	Milliken Ave @ Ontario Mills Pkwy	TS027	1
Traffic Signal - 204	Milliken Ave @ Inland Empire Blvd / Mall Dr	TS204	1
Traffic Signal - 028	Milliken Ave @ Concours St	TS028	1
Traffic Signal - 029	Milliken Ave @ Fourth St	TS029	1
Traffic Signal - 030	Via Turin @ Fourth St	TS030	1
Traffic Signal - 031	Via Asti @ Fourth St	TS031	1
Traffic Signal - 032	Duesenberg Dr @ Fourth St	TS032	1
Traffic Signal - 033	Haven Ave @ Fourth St	TS033	1
Traffic Signal - 034	Center Ave @ Fourth St	TS034	1
Traffic Signal - 035	Turner Ave @ Fourth St	TS035	1
Traffic Signal - 036	Archibald Ave @ Fourth St	TS036	1
Traffic Signal - 037	Smiderle Loop @ Fourth St	TS037	1
Traffic Signal - 038	Vineyard Ave @ Fourth St	TS038	1
Traffic Signal - 039	Vineyard Ave @ Inland Empire Blvd	TS039	1
Traffic Signal - 040	Vineyard Ave @ G St	TS040	1
Traffic Signal - 041	Vineyard Ave @ D St	TS041	1

2.3. Well Aggregation Sites

PHASE	WELL #
1	WELL # 34
1	WELL # 37
1	WELL # 50

2.4. CIP Projects

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE
Primary Backbone	City Water	MOID P24031	Bon View Ave south of Belmont St.	1
Primary Backbone	City Water	MOID P24039	Bon View Ave south of Woodlawn St.	1
Primary Backbone	City Water	MOID P23420	Maitland St between Caldwell Ave and Taylor Ave	1
Primary Backbone	City Water	MOID P23429	Maitland St between Campus Ave and Caldwell Ave	1
Primary Backbone	City Water	MOID P23430	Campus Ave North of Maitland St	1
Primary Backbone	City Water	MOID P20951	Mission Blvd West of Campus Ave	1
Primary Backbone	City Water	MOID P23395	Mission Blvd West of Campus Ave	1
Primary Backbone	City Water	MOID P25820	Lemon Ave south of Transit St	1
Primary Backbone	City Water	MOID P25816	Transit St East of Euclid Ave	1
Primary Backbone	City Water	MOID P15955	Emporia St West of Plum Ave	1
Primary Backbone	City Water	MOID P21081	Nocta St and Allyn Ave	1
Primary Backbone	City Water	MOID P18203	Nocta St and Allyn Ave	1

3. Phase 2 Construction

3.1. Building Interconnections

NAME	ADDRESS	PHASE
Anthony Munoz Community Center	2140 W Fourth	2
Armstrong Community Center	1265 S Palmetto Avenue	2
De Anza Teen and Community Center	1405 S Fern Avenue	2
Fire Station #2	544 W Francis Street	2
Fire Station #4	1005 N Mountain Avenue	2
Police Department North Substation	Sixth Street and Mountain Avenue	2

3.2. Traffic Signals

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Traffic Signal - 042	Mountain Ave @ Fifth St	TS042	2
Traffic Signal - 043	Mountain Ave @ Fourth St	TS043	2
Traffic Signal - 044	Mountain Ave @ J St	TS044	2
Traffic Signal - 045	Mountain Ave @ I St	TS045	2
Traffic Signal - 046	Mountain Ave @ G St	TS046	2
Traffic Signal - 047	Mountain Ave @ D St	TS047	2
Traffic Signal - 048	Mountain Ave @ Holt Blvd	TS048	2
Traffic Signal - 049	Mountain Ave @ Mission Blvd	TS049	2
Traffic Signal - 050	Mountain Ave @ Phillips St	TS050	2
Traffic Signal - 051	Mountain Ave @ Francis St	TS051	2

3.3. Well Aggregation Site

WELL NO.	PHASE
WELL # 45	2

3.4. CIP Projects

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE
Secondary Ring	City Water	MOID P29045	Francis St East of San Antonio Ave.	2
Secondary Ring	City Water	MOID P-1713	Francis St West of Euclid Ave	2
Secondary Ring	City Water	MOID P24422	Francis St East of Fern Ave	2
Secondary Ring	City Water	MOID P-1712	Francis St West of Euclid Ave	2
Secondary Ring	City Water	MOID P15143	Lynn Haven St East of Sultana Ave	2
Secondary Ring	City Water	MOID P14369	Lynn Haven St between Sultana Ave and Monterey Ave	2
Secondary Ring	City Water	MOID P13487	Fifth St West of College Ave	2
Secondary Ring	City Water	MOID P13485	Fifth St West of College Way.	2
Secondary Ring	City Water	MOID P13169	Fifth St East of Mountain Ave and West of Boulder Ave	2
Secondary Ring	City Water	MOID P13431	Fifth St between Euclid Ave and College	2
Secondary Ring	City Water	MOID P13427	Fifth St East of Euclid Ave	2
Secondary Ring	City Water	MOID P12635	Fifth St West of Euclid Ave	2
Secondary Ring	City Water	MOID P13368	Fifth St between Palm Ave and Euclid Ave	2

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE
Secondary Ring	City Water	MOID P10680	Fifth St West of Palm Ave	2
Secondary Ring	City Water	MOID P13246	Fifth St between Vine Ave and Bonnie Brae Ct	2
Secondary Ring	City Water	MOID P13212	Fifth St East of Chaffey Ct and West of Vine	2
Secondary Ring	City Water	MOID P13220	Fifth St West Chaffey Ct	2
Secondary Ring	City Water	MOID P13221	Fifth St West Chaffey Ct	2
Secondary Ring	City Water	MOID P13223	Fifth St between San Antonio Ave and Alley	2
Secondary Ring	City Water	MOID P10062	Fifth St between San Antonio Ave and Alley	2
Secondary Ring	City Water	MOID P10072	Fifth St East of San Antonio Ave	2
Secondary Ring	City Water	MOID P12916	Fifth St West of San Antonio Ave	2
Secondary Ring	City Water	MOID P10073	Fifth St West of San Antonio Ave	2
Secondary Ring	City Water	MOID P13076	Fifth St East of Granite Ave West of San Antonio Ave	2
Secondary Ring	City Water	MOID P13241	Fifth St East of Boulder Ave and West of Granite Ave	2

4. Phase - Future Construction

4.1. Building Interconnections

NAME	ADDRESS	LABEL	PHASE
Cucamonga Storage Building	1440 S Cucamonga Avenue	13	Future
Homer Biggs Park	2051 S Oaks Avenue	27	Future
Ontario Police Air Support	2009 Porterfield Way, Upland, CA	46	Future
Whispering Lakes Golf Course	2525 E Riverside Drive	32	Future / NMC
Ontario Soccer Complex	2200 E Philadelphia	47	Future

4.2. Traffic Signals – OMC

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Traffic Signal - 052	Bon View Ave @ Mission Blvd	TS052	FUTURE
Traffic Signal - 053	Cucamonga Ave @ Mission Blvd	TS053	FUTURE
Traffic Signal - 054	Grove Ave @ Mission Blvd	TS054	FUTURE
Traffic Signal - 055	South of Airport Dr @ Grove Ave	TS055	FUTURE
Traffic Signal - 056	Grove Ave @ Airport Dr	TS056	FUTURE
Traffic Signal - 057	Grove Ave @ Holt Blvd	TS057	FUTURE
Traffic Signal - 058	West of Cucamonga Channel Wash @ Airport Dr	TS058	FUTURE
Traffic Signal - 059	Vineyard Ave @ Airport Dr	TS059	FUTURE
Traffic Signal - 060	Moore Way @ Airport Dr	TS060	FUTURE
Traffic Signal - 061	Terminal Way @ Airport Dr	TS061	FUTURE
Traffic Signal - 062	Archibald Ave @ Airport Dr	TS062	FUTURE
Traffic Signal - 063	Terminal Way @ Airport Dr	TS063	FUTURE
Traffic Signal - 064	Rental Car Rd @ Airport Dr	TS064	FUTURE
Traffic Signal - 065	Haven Ave @ Airport Dr	TS065	FUTURE
Traffic Signal - 066	Carnegie Ave /Commerce Way @ Airport Dr	TS066	FUTURE
Traffic Signal - 067	Doubleday Ave @ Airport Dr	TS067	FUTURE
Traffic Signal - 068	Wineville Ave @ Airport Dr	TS068	FUTURE
Traffic Signal - 069	Etiwanda Ave @ Airport Dr	TS069	FUTURE
Traffic Signal - 070	Ontario Mills Pkwy @ Etiwanda Ave	TS070	FUTURE
Traffic Signal - 071	Distribution Way @ Etiwanda Ave	TS071	FUTURE
Traffic Signal - 072	Etiwanda Ave @ Fourth St	TS072	FUTURE
Traffic Signal - 073	Barrington Ave @ Fourth St	TS073	FUTURE
Traffic Signal - 074	Wineville Ave @ Fourth St	TS074	FUTURE
Traffic Signal - 075	Franklin Ave @ Fourth St	TS075	FUTURE
Traffic Signal - 076	Richmond Place @ Fourth St	TS076	FUTURE
Traffic Signal - 077	Gurnee Ave @ Fourth St	TS077	FUTURE
Traffic Signal - 078	Rochester Ave @ Ontario Mills Dr	TS078	FUTURE
Traffic Signal - 079	Rochester Ave @ Ontario Mills Pkwy	TS079	FUTURE
Traffic Signal - 080	Ontario Mills Dr @ Ontario Mills Pkwy	TS080	FUTURE
Traffic Signal - 081	Franklin Ave @ Ontario Mills Pkwy	TS081	FUTURE
Traffic Signal - 082	West of Franklin Ave @ Ontario Mills Pkwy	TS082	FUTURE
Traffic Signal - 083	West of Milliken @ Concours St	TS083	FUTURE
Traffic Signal - 084	Ontario Ctr Pkwy @ Concours St	TS084	FUTURE
Traffic Signal - 085	Ferrari Ln @ Concours St	TS085	FUTURE
Traffic Signal - 086	West of Ferrari @ Concours St	TS086	FUTURE
Traffic Signal - 087	Mercedes Ln/Ontario Ctr Pkwy @ Concours St	TS087	FUTURE
Traffic Signal -088	East of Haven @ Concours St	TS088	FUTURE
Traffic Signal - 090	Haven Ave @ Concours St	TS090	FUTURE
Traffic Signal - 091	Ferrari Ln @ Inland Empire Blvd	TS091	FUTURE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Traffic Signal - 092	West of Ferrari @ Inland Empire Blvd	TS092	FUTURE
Traffic Signal - 093	East of Mercedes @ Inland Empire Blvd	TS093	FUTURE
Traffic Signal - 094	Mercedes Ln @ Inland Empire Blvd	TS094	FUTURE
Traffic Signal - 095	Porsche Way @ Inland Empire Blvd	TS095	FUTURE
Traffic Signal - 096	Haven Ave @ Inland Empire Blvd	TS096	FUTURE
Traffic Signal - 097	Archibald Ave @ Mission Blvd	TS097	FUTURE
Traffic Signal - 098	South of Jurupa St @ Archibald Ave	TS098	FUTURE
Traffic Signal - 099	Turner Ave @ Jurupa St	TS099	FUTURE
Traffic Signal - 100	West of Haven @ Jurupa St	TS100	FUTURE
Traffic Signal -101	Haven Ave @ Jurupa St	TS101	FUTURE
Traffic Signal - 102	Toyota Way @ Jurupa St	TS102	FUTURE
Traffic Signal - 103	Auto Center Dr @ Jurupa St	TS103	FUTURE
Traffic Signal - 104	Vintage Ave @ Jurupa St	TS104	FUTURE
Traffic Signal - 105	Etiwanda Ave @ Jurupa St	TS105	FUTURE
Traffic Signal - 106	Etiwanda Ave @ Santa Ana St	TS106	FUTURE
Traffic Signal - 107	Etiwanda Ave @ Francis St	TS107	FUTURE
Traffic Signal - 108	Business Pkwy @ Philadelphia St	TS108	FUTURE
Traffic Signal - 109	Turner Ave @ Philadelphia St	TS109	FUTURE
Traffic Signal - 110	Excise Ave @ Philadelphia St	TS110	FUTURE
Traffic Signal - 111	Haven Ave @ Philadelphia St	TS111	FUTURE
Traffic Signal - 112	Vineyard Ave @ 6th St	TS112	FUTURE
Traffic Signal - 113	Vineyard Ave @ 8th St	TS113	FUTURE
Traffic Signal - 114	Grove Ave @ 8th St	TS114	FUTURE
Traffic Signal - 115	Sultana Ave @ Holt Blvd	TS115	FUTURE
Traffic Signal - 116	Grove Ave @ D St	TS116	FUTURE
Traffic Signal - 117	Grove Ave @ G St	TS117	FUTURE
Traffic Signal - 118	Grove Ave @ I St	TS118	FUTURE
Traffic Signal - 119	Grove Ave @ Fourth St	TS119	FUTURE
Traffic Signal - 120	Grove Ave @ Princeton St	TS120	FUTURE
Traffic Signal - 121	Grove Ave @ 7th St	TS121	FUTURE
Traffic Signal - 122	Grove Ave @ 6th St	TS122	FUTURE
Traffic Signal - 123	Corona Ave @ Fourth St	TS123	FUTURE
Traffic Signal - 124	Baker Ave @ Fourth St	TS124	FUTURE
Traffic Signal - 125	Vineyard Ave @ Holt Blvd	TS125	FUTURE
Traffic Signal - 126	South of D St @ Vineyard Ave	TS126	FUTURE
Traffic Signal - 127	East of Vineyard @ Holt Blvd	TS127	FUTURE
Traffic Signal - 128	Guasti Rd @ Holt Blvd	TS128	FUTURE
Traffic Signal - 129	Archibald Ave @ Guasti Rd	TS129	FUTURE
Traffic Signal - 130	Archibald Ave @ Inland Empire Blvd	TS130	FUTURE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Future Traffic Signal - 131	West of Turner @ Inland Empire Blvd	TS131	FUTURE
Traffic Signal -132	Turner Ave @ Inland Empire Blvd	TS132	FUTURE
Traffic Signal – 133	Shelby Ln @ Inland Empire Blvd	TS133	FUTURE
Traffic Signal – 134	Center Ave @ Inland Empire Blvd	TS134	FUTURE
Traffic Signal – 135	Haven Ave @ Guasti Rd	TS135	FUTURE
Traffic Signal – 136	East of Haven Ave @ Guasti Rd	TS136	FUTURE
Traffic Signal – 137	Commerce Pkwy @ Santa Ana St	TS137	FUTURE
Traffic Signal – 138	Carnegie Ave @ Jurupa St	TS138	FUTURE
Traffic Signal – 139	Commerce Pkwy @ Jurupa St	TS139	FUTURE
Traffic Signal - 140	DuPont Ave @ Jurupa St	TS140	FUTURE
Traffic Signal – 141	Haven Ave @ Francis St	TS141	FUTURE
Traffic Signal - 142	Haven Ave @ Mission Blvd	TS142	FUTURE
Future Traffic Signal - 143	Ontario Rd @ Riverside Dr	TS143	FUTURE
Traffic Signal - 144	Vineyard Ave @ Mission Blvd	TS144	FUTURE
Traffic Signal - 145	Baker Ave @ Mission Blvd	TS145	FUTURE
Traffic Signal - 146	Grove Ave @ Belmont St	TS146	FUTURE
Traffic Signal - 147	Grove Ave @ Acacia St	TS147	FUTURE
Traffic Signal - 148	Grove Ave @ Philadelphia St	TS148	FUTURE
Traffic Signal -149	South of Philadelphia @ Grove Ave	TS149	FUTURE
Traffic Signal - 150	Cucamonga Ave @ Philadelphia St	TS150	FUTURE
Traffic Signal - 151	Campus Ave @ Riverside Dr	TS151	FUTURE
Traffic Signal - 152	Plum Ave @E Holt Blvd	TS152	FUTURE
Traffic Signal - 153	Campus Ave @ Holt Blvd	TS153	FUTURE
Traffic Signal - 154	Allyn Ave @ Holt Blvd	TS154	FUTURE
Traffic Signal - 155	West of Corona @ Holt Blvd	TS155	FUTURE
Traffic Signal - 156	Corona Ave @ Holt Blvd	TS156	FUTURE
Traffic Signal - 157	Guasti Rd @ East of Archibald Ave	TS157	FUTURE
Traffic Signal - 158	East of Barrington @ Ontario Mills Pkwy	TS158	FUTURE
Traffic Signal - 159	At Ontario International Airport @ Terminal Way	TS159	FUTURE
Traffic Signal - 160	At Ontario International Airport @ Terminal Way	TS160	FUTURE
Traffic Signal - 161	At Ontario International Airport @ Terminal Way	TS161	FUTURE
Traffic Signal - 162	At Ontario International Airport @ Terminal Way	TS162	FUTURE
Traffic Signal - 163	At Ontario International Airport @ Terminal Way	TS163	FUTURE
Traffic Signal - 164	At Ontario International Airport @ Terminal Way	TS164	FUTURE
Traffic Signal - 165	At Ontario International Airport @ Terminal Way	TS165	FUTURE
Traffic Signal - 166	At Ontario International Airport @E Terminal Way	TS166	FUTURE
Traffic Signal - 167	At Ontario International Airport @ Terminal Way	TS167	FUTURE
Traffic Signal - 168	Philadelphia St @E Mission Blvd	TS168	FUTURE
Traffic Signal - 169	Haven Ave @ Creekside Dr	TS169	FUTURE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Traffic Signal - 170	Kaiser Dwy @ Philadelphia St	TS170	FUTURE
Traffic Signal - 171	Vineyard Ave @ Philadelphia St	TS171	FUTURE
Traffic Signal - 172	Raymond Kay Way @ Vineyard Ave	TS172	FUTURE
Traffic Signal - 173	North of Banyan St @ Vineyard Ave	TS173	FUTURE
Traffic Signal - 174	Vineyard Ave @ Walnut St	TS174	FUTURE
Traffic Signal - 175	Grove Ave @ Walnut St	TS175	FUTURE
Traffic Signal - 176	San Antonio Ave @ Philadelphia St	TS176	FUTURE
Traffic Signal - 177	Mountain Ave @ Philadelphia St	TS177	FUTURE
Traffic Signal - 178	Benson Ave @ Mission Blvd	TS178	FUTURE
Traffic Signal - 179	San Antonio Ave @ Mission Blvd	TS179	FUTURE
Traffic Signal - 180	Vine Ave @ Mission Blvd	TS180	FUTURE
Traffic Signal - 181	San Antonio Ave @ Holt Blvd	TS181	FUTURE
Traffic Signal - 182	Vine Ave @ Holt Blvd	TS182	FUTURE
Traffic Signal - 183	Mountain Ave @ 6th St	TS183	FUTURE
Traffic Signal - 184	Grove Ave @ Fifth St	TS184	FUTURE

4.3. Traffic Signals – NMC

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Traffic Signal - 185	Grove Ave @ Riverside Dr	TS185	NMC FUTURE
Traffic Signal - 186	Vineyard Ave @ Riverside Dr	TS186	NMC FUTURE
Traffic Signal -187	South of Chino Ave @ Hammer Ave	TS187	NMC FUTURE
Traffic Signal - 188	North of Edison Ave @ Hammer Ave	TS188	NMC FUTURE
Traffic Signal - 189	Hammer Ave @ Edison Ave	TS189	NMC FUTURE
Future Traffic Signal - 190	Walker Ave @ Riverside Dr	TS190	NMC FUTURE
Future Traffic Signal - 191	Ontario Rd @ Chino Ave	TS191	NMC FUTURE
Future Traffic Signal - 192	Ontario Rd @ Schafer Ave	TS192	NMC FUTURE
Future Traffic Signal - 193	Cucamonga Creek Channel Wash @ Edison Ave	TS193	NMC FUTURE
Future Traffic Signal - 194	East of Carpenter @ Eucalyptus Ave	TS194	NMC FUTURE
Future Traffic Signal - 195	East of Carpenter @ Merrill Ave	TS195	NMC FUTURE
Future Traffic Signal - 196	Vineyard Ave @ Merrill Ave	TS196	NMC FUTURE
Future Traffic Signal - 197	Grove Ave @ Merrill Ave	TS197	NMC FUTURE

NAME	LOCATION (N/S STREET / E/W STREET)	LABEL	PHASE
Future Traffic Signal - 198	Campus Ave @ Merrill Ave	TS198	NMC FUTURE
Future Traffic Signal - 199	Archibald Ave @ Merrill Ave	TS199	NMC FUTURE
Future Traffic Signal – 200	Sumner Ln @ Remington Ave	TS200	NMC FUTURE
Future Traffic Signal - 201	Cleveland Ave @ Remington Ave	TS201	NMC FUTURE
Future Traffic Signal - 202	Milliken Ave @ Remington Ave	TS202	NMC FUTURE
Future Traffic Signal – 203	Hammer Ave @ Eucalyptus Ave	TS203	NMC FUTURE

4.4. Well Aggregation Sites

WELL NO	PHASE
WELL # 17	FUTURE
WELL # 27	FUTURE
WELL # 36	FUTURE
WELL # 46	FUTURE
WELL # 47	FUTURE
WELL # 20	FUTURE
WELL # 25	FUTURE
WELL # 29	FUTURE
WELL # 30	FUTURE
WELL # 31	FUTURE
WELL # 35	FUTURE
WELL # 39	FUTURE
WELL # 40	FUTURE
WELL # 41	FUTURE
WELL # 44	FUTURE
WELL # 16	FUTURE - LATERAL RUNS BY
WELL # 24	FUTURE - LATERAL RUNS BY
WELL # 26	FUTURE - LATERAL RUNS BY
WELL # 38	FUTURE - LATERAL RUNS BY
WELL # 49	FUTURE - LATERAL RUNS BY
WELL # 52	FUTURE - LATERAL RUNS BY

4.5. CIP Projects

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE
Lateral	City Water	MOID P22708	Vesta St East of Boulder Ave.	FUTURE
Lateral	City Water	MOID P26906	Vesta St East of Boulder Ave	FUTURE
Lateral	City Water	MOID P22707	Vesta St West of San Antonio Ave	FUTURE
Lateral	City Water	MOID P24956	Vesta St West of Cone Flower	FUTURE
Lateral	City Water	MOID P26753	Vesta St East of Mountain Ave	FUTURE
Lateral	City Water	MOID P24281	Vesta St East of Mountain Ave	FUTURE
Lateral	City Water	MOID P-106	8th St between Campus Ave and Virginia Ave	FUTURE
Lateral	City Water	MOID P7805	Grove Ave North of 8th St	FUTURE
Lateral	City Water	MOID P11799	8th St between Sacramento Ave and San Diego Ave	FUTURE
Lateral	City Water	MOID P798	8th St between San Diego Ave and Vineyard Ave	FUTURE
Lateral	City Water	MOID P6170	8th St between Placer Ave and Sacramento Ave	FUTURE
Lateral	City Water	MOID P11553	8th St between Grove Ave and Amador Ave	FUTURE
Lateral	City Water	MOID P11556	8th St between Amador Ave and Calaveras Ave	FUTURE
Lateral	City Water	MOID P11565	8th St between Calaveras Ave and Del Norte Ave	FUTURE
Lateral	City Water	MOID P1387	8th St between Del Norte Ave and El Dorado Ave	FUTURE
Lateral	City Water	MOID P10284	8th St between El Dorado Ave and Glen Ave	FUTURE
Lateral	City Water	MOID P11669	8th St. between Glen Ave and Humboldt Ave	FUTURE
Lateral	City Water	MOID P11673	8th St between Lake Ave and Baker Ave	FUTURE
Lateral	City Water	MOID P11681	8th St between Lake Ave and Baker Ave	FUTURE
Lateral	City Water	MOID P11674	8th St East of Baker Ave.	FUTURE
Lateral	City Water	MOID P11704	8th St between Baker Ave and Madera Ave.	FUTURE
Lateral	City Water	MOID P11708	8th St between Madera Ave and Marin Ave	FUTURE
Lateral	City Water	MOID P9668	8th St West of Orange Ave	FUTURE
Lateral	City Water	MOID P1389	8th St between Orange Ave and Placer Ave	FUTURE
Lateral	City Water	MOID P11712	8th St between Marin Ave and Orange Ave	FUTURE
Lateral	City Water	MOID P7812	8th St between Virginia Ave and Grove Ave	FUTURE
Lateral	City Water	MOID P-49	8th St between Campus Ave and Virginia Ave	FUTURE
Lateral	City Water	MOID P29490	8th St between Campus Ave and Virginia Ave	FUTURE
Lateral	City Water	MOID P7807	Grove Ave North of 8th St	FUTURE
Lateral	City Water	MOID P7815	Grove Ave North of 8th St	FUTURE
Lateral	City Water	MOID P25853	B St East of Laurel Ave	FUTURE

ROUTE DESCRIPTION	CIP DESCRIPTION	CIP NUMBER	LOCATION	PHASE
Lateral	City Water	MOID P26938	B St East of Palm Ave.	FUTURE
Lateral	City Water	MOID P26941	B St East of Fern Ave.	FUTURE
Lateral	City Water	MOID P26848	B S. East of Vine Ave.	FUTURE
Lateral	City Water	MOID P23499	Mission Blvd East of Greenwood Ave	FUTURE
Lateral	City Water	MOID P25816	Transit St East of Euclid Ave	FUTURE
Lateral	City Water	MOID P25815	Transit St East of Euclid Ave	FUTURE
Lateral	City Water	MOID P25814	Transit St East of Laurel Ave	FUTURE
Lateral	City Water	MOID P22286	Laurel Ave South of Transit St.	FUTURE
Lateral	City Water	MOID P26518	Laurel Ave between Emporia St and Transit St	FUTURE
Lateral	City Water	MOID P27476	Emporia St between Palm Ave and Laurel Ave	FUTURE
Lateral	City Water	MOID P25911	Oaks Ave South of Francis St and North of Philadelphia St.	FUTURE
Lateral	City Water	MOID P27341	Oaks Ave North of Philadelphia St.	FUTURE
Lateral	City Water	MOID P29118	Oaks Ave South of Francis St	FUTURE

5. Fiber Optic Design Submittal Checklist

As referenced in the Fiber Optic Design Guidelines, the following is the itemized checklist required to be completed by an Engineer when submitting plans:

	Item	Yes	No	N/A
I.	**All Sheets**			
1.	Plans are in waterproof ink on Mylar sheets			
2.	Plan sheets are 24 inch X 36 inch with the Standard City Title Block			
3.	Sticky backs or paste-ons are not used			
4.	Signed by the Engineer-of-Work			
5.	Marked with the name, address and telephone number of the firm preparing the plans and date of preparation			
6.	Consecutively numbered and the total number of sheets			
7.	Lettered in a neat and legible style, no hand lettering smaller than 1/8" and no machine letter smaller than 1/10"			
8.	Name and phase of development. Street names and construction station limits			
9.	Clearly designate between existing conditions (dashed) and work proposed (solid)			
10.	Note all reference drawings on plans			
11.	Title block w/ "Fiber Optic Conduit Plan" (top line), street names (2nd line), and limits of construction "From street intersection to XXX' N,S,E,W" (3rd line)			
12.	Standard drawing and title block per City Std 6004			
13.	Show all existing and proposed easements. Clearly indicate public or private			
14.	Review Fiber Optic Master Plan study for locations and details			
15.	Compare to conditions of approval and approved maps			
II.	**Title Sheet**			
16.	Heading "Fiber Optic Plans for _____ in the City of Ontario"			
17.	Consultant recommendation for acceptance block (public facilities only)			
18.	Standard general notes and construction notes provided. Construction notes match plans			
19.	Additional notes are designated as "Special Notes"			
20.	Basis of bearing provided			
21.	Index Map (scale 1"=100' or 1"=500', sheet coverage shown, located on title sheet, street names shown, identify areas in County)			

Item		Yes	No	N/A
22.	Vicinity Map (orient north as on key map, arterial streets shown, project boundary street shown)			
23.	Legend (symbols per City Std 6002-6003, non-standard symbols and abbreviations used are listed and described)			
24.	Underground service alert information at bottom left corner			
25.	Owners/Developers name and address shown			
26.	Separate written justification for deviations provided			
27.	Quantity estimates provided and broken out between public/private & per tract if multi-tract project			
28.	All reference drawings listed			
III.	**Fiber Optic Plans**			
29.	North arrow generally up or to the right			
30.	Plan scale should be either 1”=40’ or 1”=20’ for clarity purposes			
31.	Label property & boundary lines			
32.	Identify area located in County or adjoining City			
33.	Approved name of streets shown			
34.	Stations along the centerline to match existing			
35.	New stationing to increase W to E or S to N except where street ends in W’ly or S’ly dead-end or cul-de-sac			
36.	Dimension and label existing and proposed right-of-way lines			
37.	Dimension and label right-of-way to centerline			
38.	Dimension and label curb to curb			
39.	Dimension and label curb to centerline			
40.	Dimension and label centerline of street to centerline of all utilities (existing and proposed). Also, include dimensions from curb face to centerline of all utilities dimensions.			
41.	Show and label existing power poles, trees, fire hydrants, pipelines, irrigation lines, or structures, etc. in right-of-way or immediately adjacent to right-of-way			
42.	Stations at beginning, end or change in Fiber Optic Line			
43.	Stations at each pull-box, hand hole, or flower pot			
44.	Station CL of driveways, curb inlets, etc.			
45.	Intersecting street centerline stations			
46.	If more than one sheet, match line with station and reference sheet			
47.	Show existing improvements as dashed lines			

Item		Yes	No	N/A
48.	Show existing elevations (as necessary) within parenthesis			
49.	Reference drawing numbers provided			
50.	Notes for connections to existing Fiber Optic Line			
51.	Construction notes and #s with Standard Drawings called out on each sheet. Only construction notes applied to the sheet are shown.			
52.	Details for improvements that are not Standard Drawings			
53.	Typical sections, including utility locations, in conformance with Standard Drawings.			
54.	Number and sizes of conduits are in accordance with Fiber Optic Master Plan			
55.	Improvement plans conform to conditions of approval			
56.	Improvement plans consistent with grading plan, final map and other existing plans			
57.	Compare design to existing plans (if any)			

APPENDIX B – DETAILED BUDGETS

Figure 25 - Infrastructure Budget - Phase 1

City of Ontario Infrastructure Budget
Phase I

Descriptions	Service Drops	POP Facility	New Construction	Existing System	Totals
PM, Engineering & Install					
Totals	**71**	**2**	**57,820 ft**	**35,952 ft**	
Program Management	**$ 4,800.00**	**$ 21,200.00**	**$ 76,000.00**	**$ 7,000.00**	**$ 109,000.00**
Project Management	$ 4,800.00	$ 20,000.00	$ 60,000.00	$ 7,000.00	$ 91,800.00
Meetings / Status Updates	$ -	$ 1,200.00	$ 8,000.00	$ -	$ 9,200.00
Travel / Expense	$ -	$ -	$ 8,000.00	$ -	$ 8,000.00
OSP Design	**$ 170,920.00**	**$ -**	**$ 172,880.89**	**$ 33,575.84**	**$ 377,376.73**
Plan Review	$ 520.00	$ -	$ 2,312.79	$ 719.04	$ 3,551.83
Field Design	$ 142,000.00	$ -	$ 75,165.61	$ 14,380.80	$ 231,546.41
Network Design	$ 14,200.00	$ -	$ 57,819.70	$ -	$ 72,019.70
Final Design	$ 14,200.00	$ -	$ 23,127.88	$ 17,976.00	$ 55,303.88
Permit Development	$ -	$ -	$ 14,454.92	$ 500.00	$ 14,954.92
Network Equipment Installation	**$ 82,300.00**	**$ -**	**$ -**	**$ -**	**$ 82,300.00**
Equipment Design	$ 21,300.00	$ -	$ -	$ -	$ 21,300.00
Distribution Ring Provisioning	$ 45,000.00	$ -	$ -	$ -	$ 45,000.00
Content Provider Network Setup	$ 6,000.00	$ -	$ -	$ -	$ 6,000.00
Provider Inter-Connect & Testing	$ 10,000.00	$ -	$ -	$ -	$ 10,000.00
NOC Implementation	**$ 8,200.00**	**$ -**	**$ -**	**$ -**	**$ 8,200.00**
Network Equipment NOC Setup	$ 4,000.00	$ -	$ -	$ -	$ 4,000.00
Facilities NOC Setup	$ 4,000.00	$ -	$ -	$ -	$ 4,000.00
Emergency Response Testing	$ 200.00	$ -	$ -	$ -	$ 200.00
System Provisioning	**$ 3,500.00**	**$ -**	**$ -**	**$ -**	**$ 3,500.00**
System Provisioning	$ 3,000.00	$ -	$ -	$ -	$ 3,000.00
Distribution Route Testing	$ 500.00	$ -	$ -	$ -	$ 500.00
Engineering / Operations Sub-Totals	**$ 269,720.00**	**$ 21,200.00**	**$ 248,880.89**	**$ 40,575.84**	**$ 580,376.73**
Construction					
Facilities Development	**$ 497,028.64**	**$ 336,255.28**	**$ -**	**$ -**	**$ 833,283.92**
Site Design	$ -	$ 20,000.00	$ -	$ -	$ 20,000.00
City Hall Upgrades	$ -	$ 8,973.28	$ -	$ -	$ 8,973.28
NMC EAST - Riverside Facility	$ -	$ 190,842.00	$ -	$ -	$ 190,842.00
Equipment Procurement	$ 497,028.64		$ -	$ -	$ 497,028.64
OMC EAST - City Arena	$ -	$ 115,440.00	$ -	$ -	$ 115,440.00
Site Acceptance Testing	$ -	$ 1,000.00	$ -	$ -	$ 1,000.00
Construction Installation	**$ 174,966.48**	**$ -**	**$ 3,027,762.15**	**$ 515,152.52**	**$ 3,717,881.16**
Instrastructure Cost	$ -		$ 2,075,444.46	$ 268,801.10	$ 2,344,245.56
Fiber System Cost	$ -		$ 724,140.69	$ 246,351.43	$ 970,492.12
Traffic-Water Interconnections			$ 228,177.00		$ 228,177.00
Building Entrance Links	$ 174,966.48				$ 174,966.48
Construction Sub-Totals	**$ 671,995.12**	**$ 336,255.28**	**$ 3,027,762.15**	**$ 515,152.52**	**$ 4,551,165.07**
Phase I Totals	**$ 941,715.12**	**$ 357,455.28**	**$ 3,276,643.05**	**$ 555,728.36**	**$ 5,131,541.80**

City of Ontario Budget Summary	
Building Entrance Connections	**$ 941,715.12**
Facility Construction	**$ 357,455.28**
New Route Construction	**$ 3,276,643.05**
Existing Conduit System	**$ 555,728.36**
Project Captial Total (Phase I)	**$ 5,131,541.80**

Figure 26 - Core Electronics – Phase 1

City of Ontario
Capital Equipment Budget
Phase I

Product Item	Qnty	Cost	Ext Cost
POP SWITCH CHASSIS	3	$ 32,171.75	$ 96,515.25
POP SWITCH MGMT MODULE	3	$ 5,200.00	$ 15,600.00
POP SWITCH INTERNAL MODULE	3	$ 6,951.75	$ 20,855.25
POP SWITCH TRANSPORT MODULE	3	$ 25,996.75	$ 77,990.25
POP SWITCH DISTRIBUTION MODULE	3	$ 11,696.75	$ 35,090.25
POP SWITCH POWER	6	$ 2,141.75	$ 12,850.50
POP SWITCH POWER CORD	6	$ 21.45	$ 128.70
POP SWITCH WARRANTY	15	$ 7,507.50	$ 112,612.50
TRANSPORT OPTICS	6	$ 1,784.25	$ 10,705.50
DISTRIBUTION OPTICS	6	$ 890.50	$ 5,343.00
ACCESS SWITCH	3	$ 10,721.75	$ 32,165.25
ACCESS SWITCH SOFTWARE	3	$ 1,946.75	$ 5,840.25
ACCESS SWITCH POWER	6	$ 419.25	$ 2,515.50
ACCESS SWITCH OPTICS	3	$ 4,546.75	$ 13,640.25
ACCESS SWITCH WARRANTY	15	$ 867.75	$ 13,016.25
ACCESS SWITCH UPLINK OPTICS	6	$ 890.50	$ 5,343.00
		Tax (8.0%)	**$ 36,816.94**
		Total Capital Equipment Budget	**$ 497,028.64**

Facilities – Phase 1

Figure 27 - POP Details - NMC EAST

PROJECT LOCATION	Facility Retofit NMC EAST - Riverside Facility		
Work Item			
1. Project Management		$	6,500
2. Real Estate Services		$	-
3. Design and Permitting		$	-
Allowance		$	-
4. Site Work		$	2,500
5. On-site Foundations		$	-
6. Delivery, Crane and Assembly		$	-
7. Speciality Systems		$	-
Cable Management		$	2,730
Fencing, Partitions		$	3,060
8. On-site Architectural Enhancements		$	3,000
9. On-site Mechanical and Electrical			
A. Electrical (exterior):		$	8,997
B. Electrical (interior):		$	2,532
C. HVAC:		$	40,440
E. Plumbing:		$	1,560
D. Fire Protection:		$	8,118
F. Controls and automation:		$	-
10. On-Site Accessories		$	-
11. Equipment - 20kW generator		$	-
11. Equipment - Power System		$	52,668
12. Racking, Cabinets		$	47,850
13. Maintenance		$	-
14. Use Tax / Sales Tax		$	10,887
TOTAL		**$**	**190,842**

Facilities – Phase 1

Figure 28 - POP Details - OMC EAST / NMC WEST (Future)

PROJECT LOCATION(s)	Pre-Cast Building 12x16 OMC EAST (City Arena) / NMC WEST (Cent. Park)		
Work Item			
1. Project Management		$	3,000
2. Real Estate Services		$	-
3. Design and Permitting		$	1,500
Allowance		$	2,000
4. Site Work - level grade and 3" of gravel		$	4,000
5. On-site Foundations		$	4,700
6. Delivery, Crane and Assembly		$	9,252
7. Precast Structure		$	48,000
Freight		$	5,350
Insepection Services		$	400
8. On-site Architectural Enhancements		$	3,000
9. On-site Mechanical and Electrical			
A. Electrical (exterior):		$	3,500
B. Electrical (interior):			Included
C. HVAC:			Included
E. Plumbing:			n/a
D. Fire Protection:		$	8,118
F. Controls and automation:		$	-
10. On-Site Accessories		$	-
11. Equipment - 20kW generator		$	-
11. Equipment - Power System		$	13,500
12. Racking, Cabinets		$	4,200
13. Maintenance		$	-
14. Use Tax / Sales Tax		$	4,920
TOTAL PER SITE		**$**	**115,440**

Building Entrance Links – Phase 1

Figure 29 - Building Entrance Links - Phase 1

City of Ontario
Building Entrance Construction Budget
Phase I

Descriptions

Building Entrance Construction

Building Connection	Conduit Installation			
Trenching - Conduit Install	Install conduit	200 '	$ 7.00	$ 1,400.00
Cable Construction	Placed Drop Conduit, Pull Drop	200 '	$ 1.18	$ 236.00
CPE Procurement	12 Port Gig Switch	1	$ 3,600.00	$ 3,600.00
Equipment Installation		1	$ 45.00	$ 45.00
Splice Case		1	$ 350.00	$ 350.00
Splicing, Testing & Patch		4	$ 40.00	$ 160.00
Termination Panel		1	$ 200.00	$ 200.00
Equipment Provisioning		4	$ 60.00	$ 240.00
				$ 6,231.00
			Tax (8.0%)	**$ 498.48**
			Building Entrance Link Total	**$ 6,729.48**
			Building Entrances	**26**
			Total BEL Construction	**$ 174,966.48**

Traffic & Water Interconnections – Phase 1

Figure 30 - Traffic & Water Interconnections – Phase 1

City of Ontario
Traffic & Water Connection Construction Budget
Phase I

Descriptions

Traffic & Water Construction

Customer Installation (Commercial)	Conduit Installation			
Trenching - Conduit Install	Install conduit	80 '	$ 4.00	$ 320.00
Cable Construction	Handhole Placement, Sweeps	1 '	$ 900.00	$ 900.00
CPE Procurement	Westell Switch	1	$ 2,500.00	$ 2,500.00
Equipment Installation		1	$ 45.00	$ 45.00
Splice Case		1	$ 350.00	$ 350.00
Splicing, Testing & Patch		4	$ 40.00	$ 160.00
Gator Patch		1	$ 300.00	$ 300.00
Equipment Provisioning		2	$ 60.00	$ 120.00
				$ 4,695.00

Tax (8.0%)	**$ 375.60**
Device Connection Total	**$ 5,070.60**
Connections	**45**
Total Traffic Construction	**$ 228,177.00**

Figure 31 - Infrastructure Budget - Phase 2

City of Ontario Infrastructure Budget
Phase II

Descriptions	Building Entrance	Facility	New Construction	Existing System	Totals
PM, Engineering & Install					
Totals	**0**	**n/a**	**41,308 ft**	**ft**	
Program Management	**$ -**	**$ -**	**$ 46,000.00**	**$ -**	**$ 46,000.00**
Project Management	$ -	$ -	$ 36,000.00	$ -	$ 36,000.00
Meetings / Status Updates	$ -	$ -	$ 5,000.00	$ -	$ 5,000.00
Travel / Expense	$ -	$ -	$ 5,000.00	$ -	$ 5,000.00
OSP Design	**$ -**	**$ -**	**$ 84,682.25**	**$ -**	**$ 84,682.25**
Plan Review	$ -	$ -	$ 2,065.42	$ -	$ 2,065.42
Field Design	$ -	$ -	$ 57,831.78	$ -	$ 57,831.78
Network Design	$ -	$ -	$ -	$ -	$ -
Final Design	$ -	$ -	$ 16,523.37	$ -	$ 16,523.37
Permit Development	$ -	$ -	$ 8,261.68	$ -	$ 8,261.68
Network Equipment Installation	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Equipment Design	$ -	$ -	$ -	$ -	$ -
Distribution Ring Provisioning	$ -	$ -	$ -	$ -	$ -
Content Provider Network Setup	$ -	$ -	$ -	$ -	$ -
Provider Inter-Connect & Testing	$ -	$ -	$ -	$ -	$ -
NOC Implementation	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Network Equipment NOC Setup	$ -	$ -	$ -	$ -	$ -
Facilities NOC Setup	$ -	$ -	$ -	$ -	$ -
Emergency Response Testing	$ -	$ -	$ -	$ -	$ -
System Provisioning	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
System Provisioning	$ -	$ -	$ -	$ -	$ -
Distribution Route Testing	$ -	$ -	$ -	$ -	$ -
Engineering/Opertations SubTotals	**$ -**	**$ -**	**$ 130,682.25**	**$ -**	**$ 130,682.25**
Construction					
Facilities Development	**$ 34,871.85**	**$ -**	**$ -**	**$ -**	**$ 34,871.85**
Site Design	$ -	$ -	$ -	$ -	$ -
Mechanical Systems	$ -	$ -	$ -	$ -	$ -
Electrical Systems	$ -	$ -	$ -	$ -	$ -
Equipment Procurement	$ 34,871.85	$ -	$ -	$ -	$ 34,871.85
Specialty Systems	$ -	$ -	$ -	$ -	$ -
Site Acceptance Testing	$ -	$ -	$ -	$ -	$ -
Construction Installation	**$ 55,928.88**	**$ -**	**$ 1,467,937.99**	**$ -**	**$ 1,523,866.87**
Instrastructure Cost	$ -	$ -	$ 1,065,837.66	$ -	$ 1,065,837.66
Fiber System Cost	$ -	$ -	$ 340,383.73	$ -	$ 340,383.73
Traffic-Water Interconnections	$ -	$ -	$ 61,716.60	$ -	$ 61,716.60
Building Entrance Links	$ 55,928.88	$ -	$ -	$ -	$ 55,928.88
Construction SubTotals	$ 90,800.73	$ -	$ 1,467,937.99	$ -	$ 1,558,738.72
Phase II Totals	**$ 90,800.73**	**$ -**	**$ 1,598,620.24**	**$ -**	**$ 1,689,420.97**

City of Ontario Budget Summary	
Building Entrance Connections	**$ 90,800.73**
Facility Construction	**$ -**
New Route Construction	**$ 1,598,620.24**
Existing Conduit System	**$ -**
Project Captial Total (Phase II)	**$ 1,689,420.97**

Electronics – Phase 2

Figure 32 - Electronics - Phase 2

City of Ontario
Capital Equipment Budget
Phase II

Product Item	Qnty	Cost	Ext Cost
TRANSPORT OPTICS	2	$ 1,784.25	$ 3,568.50
DISTRIBUTION OPTICS	0	$ 890.50	$ -
ACCESS SWITCH	1	$ 10,721.75	$ 10,721.75
ACCESS SWITCH SOFTWARE	1	$ 1,946.75	$ 1,946.75
ACCESS SWITCH POWER	2	$ 419.25	$ 838.50
ACCESS SWITCH OPTICS	2	$ 4,546.75	$ 9,093.50
ACCESS SWITCH WARRANTY	5	$ 867.75	$ 4,338.75
ACCESS SWITCH UPLINK OPTICS	2	$ 890.50	$ 1,781.00
		Tax (8.0%)	**$ 2,583.10**
		Total Capital Equipment Budget	**$ 34,871.85**

Building Entrance Links – Phase 2

Figure 33 - Building Entrance Links - Phase 2

City of Ontario
Building Entrance Construction Budget
Phase II

Descriptions

Building Entrance Construction

Building Connection	Conduit Installation			
Trenching - Conduit Install	Install conduit	200 '	$ 7.00	$ 1,400.00
Cable Construction	Placed Drop Conduit, Pull Drop	200 '	$ 1.18	$ 236.00
CPE Procurement	12 Port Gig Switch	1	$ 3,600.00	$ 3,600.00
Equipment Installation		1	$ 45.00	$ 45.00
Splice Case		1	$ 350.00	$ 350.00
Splicing, Testing & Patch		4	$ 40.00	$ 160.00
Termination Panel		1	$ 200.00	$ 200.00
Equipment Provisioning		4	$ 60.00	$ 240.00
				$ 6,231.00

Tax (8.0%)	**$ 498.48**
Building Entrance Link Total	**$ 6,729.48**
Building Entraces	**6**
Total BEL Construction	**$ 40,376.88**

Traffic & Water Interconnections – Phase 2

Figure 34 - Traffic & Water Interconnections - Phase 2

City of Ontario Budget
Traffic & Water Connnection Construction Budget
Phase II

Descriptions

Traffic & Water Construction

Customer Installation (Commercial)	Conduit Installation			
Trenching - Conduit Install	Install conduit	80 '	$ 4.00	$ 320.00
Cable Construction	Handhole Placement, Sweeps	1 '	$ 900.00	$ 900.00
CPE Procurement	Westell Switch	1	$ 2,500.00	$ 2,500.00
Equipment Installation		1	$ 45.00	$ 45.00
Splice Case		1	$ 350.00	$ 350.00
Splicing, Testing & Patch		4	$ 40.00	$ 160.00
Gator Patch		1	$ 300.00	$ 300.00
Equipment Provisioning		2	$ 60.00	$ 120.00
				$ 4,695.00

Tax (8.0%)	**$ 375.60**
Device Connection Total	**$ 5,070.60**
Connections	**11**
Total Traffic Construction	**$ 55,776.60**