CITY OF BOULDER, COLORADO

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RFB NO. 74-2019

OPENING DATE:
November 15, 2019 @ 1:00 PM Mountain Time

OPTIONAL PRE-BID MEETING:
October 25, 2019 @ 1:00PM Mountain Time
(Online meeting)

SPECIFICATIONS,
PROPOSAL, CONTRACTS AND BONDS
FOR
FOR THE CITY OF BOULDER, COLORADO
FOR

Fiber Construction Project

FOR INFORMATION:

Tim Scott
City of Boulder Innovation and Technology Department
Project Manager

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Attachments

I. BID OVERVIEW DOCUMENT

CITY OF BOULDER, COLORADO

ADVERTISEMENT FOR BIDS

Fiber Construction Project

Bid No. RFB NO. 74-2019

The City of Boulder is seeking construction services to build a 55-mile, City-wide fiber optic backbone with an additional approximate 10 miles of lateral connections to facilities. The city will only accept electronic submissions in response to this RFB. Electronic submissions are required to be considered for an award. Please plan for a maximum file size of 2GB.

To submit your bid online, please visit www.bidnetdirect.com/colorado. In accordance with the specifications of the RFB, bids will be received until 1:00 P.M. Mountain Time on November 15, 2019. Late bids will not be considered.

If you experience problems submitting your electronic response, please contact the Bidnet Direct technical support team (800-835-4603) ***prior*** to the submission deadline. The 1:00 pm deadline is a hard stop. You must save your submission to the site before the deadline or you will be locked out and your submission will not be accepted.

Electronic bids will be plainly marked "**Bid No. 74-2019, City of Boulder, Fiber Construction Project."**

No Contractor shall submit more than one bid. Bid documents will be issued electronically. A copy of the bid and any related materials may be obtained from the Rocky Mountain E-Purchasing (Bidnet) web site at:

http://www.bidnetdirect.com/colorado

Bids shall be prepared at the bidder's expense and become a City record and therefore a public record. The City is not required to take the lowest bid.

City of Boulder, Colorado
A Municipal Corporation

By: _____
City Clerk

1. PROJECT OVERVIEW AND GOALS

The City of Boulder is seeking construction services to build a 55-mile, City-wide fiber optic backbone with an additional approximate 10 miles of lateral connections to facilities. The City seeks these services to build a world-class telecommunications infrastructure for the 21st century and beyond. In the near-term, this infrastructure is intended to support core City services like traffic signal management and data management systems for public safety. In the long-term this infrastructure could support gigabit speed internet services to homes, a range of City applications, and support for connectivity to smart city projects such as smart streets.

Core City services today, and next generation services in the future, will require significantly greater bandwidth than is available through existing telecommunications infrastructure. While internet access in Boulder is nearly reliable, affordable, and high-speed (broadband) for most community members, internet connections are not universally available to all.

Boulder seeks to construct the first phase of fiber optic fed, high speed, gigabit capable services, so that eventually the fiber is accessible to as many neighborhoods and business locations as possible. These disparities in infrastructure access perpetuate disparities in online opportunities for lower-income residents. For all Boulder residents to share in the benefits of internet access and the prosperity of the digital economy, all must have equal access to the fiber optic infrastructure that underpins them.

This solicitation builds on a significant investment by the City of Boulder in community consultation and broadband infrastructure expansion planning. In a 2018 statistically valid survey of residents, 9 in 10 supported the use of public funds to build out a City-wide broadband. In 2019, the City contracted the services of Magellan Advisors to complete the engineering design for the fiber backbone. The 60% construction prints are included and can be found in ATTACHMENT C: 60% CONSTRUCTION DRAWINGS.

In constructing the fiber backbone to the design specifications outlined in this solicitation, the Contractor should prioritize the following:

- **High-quality work**: installation of fiber-optic cabling to the specifications outlined in Section II: SPECIAL CONDITIONS and Section III: APPLICABLE CITY STANDARDS such that the completed network is connection-ready for both City services and possible partners seeking to lease bandwidth and potentially develop connections to homes and businesses.

- **Timeliness**: completion of work within the agreed-upon construction schedule, without compromising the quality of work.

- **Cost control and proactive communication**: completion of work within the agreed-upon budget and proactive communication regarding operational or geotechnical challenges encountered in decisions that affect the cost of construction.

- **Equity promotion**: the Contractor can advance the City of Boulder's equity goals with who completes the work, i.e., a diverse workforce and/or opportunities for Minority- or Women-owned Business Enterprises (MWBEs) to perform a portion of work.

- **Community engagement**: proactive communication to indicate forthcoming and ongoing construction activities, responsiveness to community concerns about construction site location, and strict observance of City regulations on hours of activity. The Contractor should minimize disruption to pedestrian, bicycle, and vehicle traffic and communities. Contractor is expected to engage closely with the City's community engagement team prior to project phases being constructed.

- **Safety**: strict adherence to Occupational Safety and Health Administration regulations on workplace safety and well-secured work sites with clear signage that safely diverts pedestrian, bicycle and vehicle traffic.

2. BID SUBMISSION TIMELINE AND GUIDENCE

The following are key, tentative dates related to the bid release and submission process for this RFB:

Bid Release Date	**10/17/2019**
Pre-Bid Conference	**10/25/2019 at 1pm Mountain Time**
Q&A Deadline	**10/31/2019 before 5pm Mountain Time**
Bids Due	**11/15/2019 before 1pm Mountain Time**
Planned interviews for shortlisted Contractors	**11/25-26 2019**
Planned Contract Award	**12/13/2019**

The City shall accept the bid that satisfies the minimum bid requirements and qualification criteria prescribed below. If the City determines that a bid does not meet the minimum bid requirements, the bid may be rejected.

Qualification criteria include the following:

- **Ability to execute work in an urban environment** - Demonstrable experience building fiber infrastructure in a large, U.S. metropolitan area (>60,000 in population)

- **Track record of successful business operations** - Contractor can demonstrate that they have either:
    - Been in operation for five years, OR

- Completed a fiber construction contract (or similar telecommunications infrastructure work) valued $5,000,000 or greater

- Additional criteria related to the evaluation of bids is included in SECTION 6: HOW WE CHOOSE.

3. BID CLARIFICATIONS AND PRE-BID CONFERENCE

An **optional** pre-bid conference will be held on **10/25/2019** at 1:00pm Mountain Time. The City of Boulder's Community Broadband webpage (https://bouldercolorado.gov/city-council/community-broadband) contains information to register for the Pre-Bid Conference, which will be held as an online meeting. A dial in number and online meeting capabilities will be made available upon registration.

All technical questions and requests for information relevant to the RFB documents should be emailed to Tim Scott, ScottT@bouldercolorado.gov. All questions or requests for information shall be received by **10/31/2019 at 5:00 pm Mountain Time.** All questions received and relevant answers will be compiled and posted as an addendum on Bidnet. The City anticipates posting this addendum by 11/5/2019 at 5:00 pm Mountain Time.

4. WHAT YOUR BID SHOULD INCLUDE

Submission of the following documents is required for every bid:

a. Cover Letter:

The cover letter must contain the following statements and information:

i. The bid and pricing shall be valid and binding for ONE HUNDRED EIGHTY (180) days following the bid due date and will become part of the contract that is negotiated with the City of Boulder.

ii. The bidder has received and acknowledged all addeda provided in this RFB.

iii. Company name, address, and telephone number of the vendor submitting the bid.

iv. Bids must state the proposer's federal and state taxpayer identification numbers.

v. Name, title, address, e-mail address, and telephone number of the person or persons who are authorized to represent the vendor and to whom correspondence should be directed.

vi. Signature of the bid by a duly constituted official, legally authorized to bind the applicant to both its bid and pricing.

b. Pricing Proposal Form (ATTACHMENT A):

The Contractor shall include unit pricing for every item and acknowledge that it has received each addendum in ATTACHMENT A: PRICING PROPOSAL FORM.

c. Project Timeline and Schedule:

The Contractor shall include a proposed project timeline and schedule for the work outlined within this bid identifying key milestones within the scope of the project. The Contractor should reference ATTACHMENT D: CONSTRUCTION SEQUENCING MAPS and respond with specific information on how it will execute construction sequencing per the defined phases within the term of construction. The City expects the project to be completed, including all punch-list items within a maximum of three (3) years and no later than December 2022.

d. Project Narrative:

The Contractor shall include a detailed narrative outlining the proposed project approach with identification of project risks and the Contractor's plan to mitigate such risks. Within the project narrative, the Contractor shall include previous Contractor projects of similar scope and describe in detail the lessons learned and best practices in its installation of underground fiber-optic networks. The Contractor should provide its production in conduit miles completed over time, disaggregated by conduit in rocky soil or challenging geological conditions versus non-rocky terrain.

The Contractor may also propose detailed strategies for engaging the community around this project based on their experience or alternatives to those included in PART 8.1.C : COMMUNITY ENGAGEMENT. Additionally, the Contractor must complete Form 2 (within ATTACHMENT B GENERAL CONDITIONS FORMS) – Contractor/Subcontractor Qualification Form.

e. Optional Information

Optional: As part of their narrative, the Contractor may propose additional performance metrics, or alternatives to those included in ATTACHMENT E: PERFORMANCE METRICS.

Optional: The Contractor may include as a part of their narrative an alternative bid for performance payments to the approach included in ATTACHMENT F: PERFORMANCE PAYMENTS. Alternative bids must clearly demonstrate how the alternative achieves the City's goals while simplifying payment administration or improving the quality of performance measurement.

Optional: The City of Boulder would like to explore the option for an annual maintenance and repair contract with interested Contractors. Please provide your interest, experience and approach to a potential maintenance and repair contract per the scope defined in SECTION 8f.

Please note that all responses to the optional annual maintenance and repair portion of the project ***will not be scored as a part of this RFB***.

f. General Conditions Forms (ATTACHMENT B):

Forms 1, 2, 20, and 99 are required as a part of the Contractor's bid submission:

- Form 1 – Bid Bond
- Form 2 – Contractor/Subcontractor Qualification
- Form 20 – Proposed Subcontractors
- Form 99 – Non-Collusion Certificate

Submitted bids deficient any of the above required documents will be considered incomplete and will be discarded. The remaining general conditions forms are included in ATTACHMENT G: CONSTRUCTION CONTRACT GENERAL CONDITIONS and should be reviewed and may be included in a final agreement between the Contractor and the City.

g. List of Proposed Subcontractors:

As a supplement to Form 20 – Proposed Subcontractors, the Contractor must provide the company name, relationship, project role and organizational chart showing how subcontractors shall be utilized in relation to the Contractor. The Contractor shall also provide detail on the working relationship between the Contractor and subcontractors, with information on prior engagements where the Contractor has utilized the services of the listed subcontractors. The City will only permit identified subcontractors within the bid response to work on the construction project.

5. INSTRUCTIONS TO CONTRACTORS

a. Contractor's Obligations

The submission of a bid constitutes acknowledgment that the Contractor has complied with all bidding instructions. It is the responsibility of each Contractor, before submitting a bid, to:

- Examine the contract documents thoroughly;
- Become familiar with the local site conditions that may affect cost, progress, performance, and furnishing of the work;
- Consider all Federal, State, and local laws and regulations that may affect cost, progress, performance, and furnishing of the work;
- Study and carefully correlate the Contractor's observations with the contract documents; and
- Contractor shall assume all responsibility for deductions and conclusions as to the difficulties in performing the work.
- Understand the process steps for submitting an electronic bid

b. Bid Specifics

Contractor shall submit its pricing on the PRICE PROPOSAL FORM. The City seeks the Contractor's most competitive pricing offer on the work solicited, acknowledging that the final negotiated price may be subject to small adjustments as the fiber design is finalized and the contract is negotiated.

Bids shall be prepared at the Contractor's expense and are deemed to be public records, subject to the Colorado Open Records Act.

The City reserves the right to reject any and all bids and to waive any informality or irregularities therein. The City reserves the right to evaluate the bids including the base bid and any bid alternatives in any combination deemed to be in the best interest of the City.

Bids not submitted by the required deadline are ineligible for consideration and will not be considered, but the City may change the deadline at any time. Contractors may inspect the bids after the contract(s) with the successful Contractor(s) is/are signed. However, if the City determines that all bids should be rejected and a rebid may be necessary, the City may hold the bid in confidence until the rebid has been completed.

No bids may be withdrawn within a period of one hundred and eighty (180) days after the date set for opening bids, but a bid may be withdrawn up to twenty-four (24) hours prior to expiration of the deadline for submitting bids. Technical irregularities in the bid requirements may be waived if the City determines that such a waiver does not compromise the integrity of the bidding process.

The Contractor shall furnish the City a completed copy of Form 20 – Proposed Subcontractors with the bid.

c. Award of Contract

Award of the contract, if it is awarded, is intended to be made within thirty (30) days after the bid openings. Award will be made through the issuance of a Notice of Award. The Notice of Award will authorize the successful Contractor to proceed with obtaining the bonds, insurance and other certificates required to be submitted with the signed contract. The successful Contractor shall complete and return the signed contract documents within fifteen (15) days after receipt of the Contract Forms.

The City reserves the right to award this project to one or multiple Contractors. The decision to award to a single Contractor or multiple Contractors will be at the discretion of the City. The bonding requirements outlined below apply to all selected Contractors unless otherwise specified. The City expects to award the full scope of work to the selected Contractor but will issue work orders aligned with phases of construction outlined in ATTACHMENT D: CONSTRUCTION SEQUENCING MAPS.

d. Bonds

Each bid shall be accompanied by a money order, certified check, or bid bond payable to the City of Boulder, Colorado, in the amount of not less than five percent (5%) of the total amount of

the bid. No bid will be considered unless accompanied by such deposit. Such check or bid bond shall be forfeited to the City if the bid is accepted and the Contractor fails to sign a contract within fifteen (15) days of acceptance.

- The successful Contractor will be required to furnish a Performance and Maintenance Bond equal to one-hundred (100) percent of the amount of the bid to guarantee:
- The faithful performance and completion of the work in strict accordance with the terms of the contract and each and every covenant, condition and part thereof, according to the true intent and meaning of the contract documents, as herein defined,
- The repair or replacement, where required, or the cost thereof, for a period of two (2) year after the issuance of the Certificate of Acceptance, of all work performed under the terms of the contract and in accordance with the provisions of the Contractor's guarantee, the Special Provisions, or the contract documents.
- A separate Labor and Material Bond, in the amount of one-hundred (100) percent of the amount of the contract price, will be required to ensure the payment of laborers, material suppliers, and subcontractors in connection with the work performed under the contract. This bond must satisfy the requirements of Colorado Revised Statutes, Sections 38§26§105 and 38§26§106, as amended.
- Obtain the foregoing bonds with a surety and guaranty company authorized to do business in the State of Colorado.

6. HOW WE CHOOSE

All bids will be opened on **11/15/19** and reviewed by a selection committee. Each bid shall be reviewed based on the following criteria:

1. Bid Price (50%)
2. Contractor Qualifications (25%)
3. Project Approach and Timeline (25%)

Criteria 1: Bid Price (50%)
Provided that pricing proposed is accurate, per the requested information in ATTACHMENT A: PRICING PROPOSAL FORM, the bid price shall be assessed using the following formula:

$$\frac{The\ price\ of\ the\ lowest\ qualifying\ bid\ received}{The\ price\ of\ Contractor\ Z's\ bid} \times 50$$
$$= Points\ awarded\ to\ Contractor\ Z$$

Criteria 2: Contractor Qualifications (25%)
Contractors that fail to meet the minimum qualification criteria will to not be considered and therefore will not be awarded points.

Per the BID SUBMISSION TIMELINE AND GUIDANCE Section, the minimum qualification criteria include the following:

- Ability to execute work in an urban environment - Demonstrable experience building fiber infrastructure in a large, U.S. metropolitan area (>60,000 in population)

- Track record of successful business operations - Contractor can demonstrate that they have either:

    - Been in operation for five years, OR
    - Completed a fiber construction contract (or similar telecommunications infrastructure work) valued $5,000,000 or greater

Contractors meeting these minimum qualifications shall be assessed on the following:

- Quality of references from past work, assessed based on:
    - Strength of references (9%), judged qualitative based on conversation with references
    - Scoring based on City developed reference review form (9%), judged quantitatively based on reference responses

- Extent and quality of experience implementing similar projects (7%)

    - The City will weigh completed footage of underground conduit in rocky soil or challenging geological conditions more heavily than completed footage of above-ground conduit or underground conduit in non-rocky soil.

Criteria 3: Project Approach, and Project Timeline (25%)

The Project Approach and Timeline shall be assessed on the following:

- **Proposed risk mitigation strategies and project management approach** (10%)
    - A strong bid, outlined in the Project Narrative demonstrates significant experience developing creative solutions to under-ground fiber construction challenges and a track record of proactive communication around challenges to clients and communities, particularly in communities with challenging geological conditions.

- **Timeline and project sequencing approach that supports the City's goals of timely and high-quality work while prioritizing connections to important stakeholder sites** (10%)
    - A strong bid includes a project completion timeline of fewer than 3 years OR provides compelling evidence for the necessity of a longer completion time horizon. A strong bid also demonstrates how the proposed sequencing of the build is accomplished within the specified timeframe.

- **Innovative approaches to measuring performance or engaging the community** (5%)

- A strong bid suggests additional or alternative performance metrics and payments that are easier to measure and verify and/or track key project outputs with greater fidelity. It also includes strategies for engaging the community that better educate the community on the benefits of the project or minimize its costs with fewer administrative resources (from the Contractor or the City) required.

7. SCOPE OF WORK

The City is soliciting bids from qualified, licensed and experienced contractors to construct approximately 55 miles of fiber-optic backbone network ("fiber backbone") and approximate 10 miles of fiber lateral extensions. Engineering design for the fiber backbone is nearing completion. Sixty percent (60%) construction plans with a unit-based bill of materials is provided to support the development of bids by interested contractors.

Construction consists of underground installation of dual two-inch (2") backbone conduits and includes installation of vaults, hand holes and other underground facilities required with the conduit. The project will utilize existing City conduit where available, however, the majority of the project will require installation of new conduit. Construction also includes installation of a 432-strand single-mode, fiber-optic backbone cable in one (1) of the two (2) conduits, termination, testing and documentation of all fiber cables installed.

In addition to backbone construction, conduit and fiber lateral construction will be required to connect City and stakeholder locations to the fiber backbone. These locations include, but are not limited to key City facilities, City managed traffic signals, public safety facilities, affordable housing locations and others. The City plans to purchase and have available for pick up from a local Colorado distribution facility all required backbone (432-strand) single-mode fiber-optic cable. Contractors will be responsible for the procurement and supply of all required fiber lateral materials.

The City has developed a specific construction sequencing plan (see ATTACHMENT D: CONSTRUCTION SEQUENCING MAPS) for the network based on the City's priority locations to be connected. The City strives to minimize community impact throughout the term of construction and expects the selected Contractor to work with the City and community to reduce and manage impact where feasible.

Apart from the backbone fiber cable materials, the selected Contractor will be required to provide all labor, materials, equipment, incidentals, insurance, performance and payment bonds and licenses necessary to install, test and certify the operational parameters of the fiber backbone in accordance with standards set forth in the RFB. City permits are also a requirement of the Contractor. The City expects all City permits to be passed through for reimbursement where applicable with zero mark up, or the City will be the billed directly by each permitting authority. Contractor may charge an hourly rate to the City for permit preparation and management by itemizing such rate on the PRICING PROPOSAL FORM. The City and its network and design engineering firm, Magellan Advisors, will endeavor to secure all other non-City permits required for the project.

The scope of work is divided into two sets of requirements: general and technical.

8. GENERAL REQUIREMENTS

a. Construction Sequencing

The City has proposed a project sequencing approach which is included in ATTACHMENT D, though it remains subject to change. The City will work with the selected Contractor to review this approach. The City will consider the following factors in determining the sequencing of construction of fiber optic segments:

- **Cost-effective completion of entire fiber backbone**
    - The Contractor should propose a construction sequence that allows for the completion of the full fiber backbone at the lowest cost and on the fastest timeline possible, balancing the other factors outlined below
- **Speed to activation of services**
    - The City aims to complete network segments that allow activation of services prior to the completion of the entire fiber backbone, particularly for priority community stakeholders such as Boulder Housing Partners, manufactured home communities, and City facilities.
- **Prioritization of community impact mitigation**
    - Following the City's community engagement goals, the sequencing of work should aim to stagger the impact of construction work so that the number of days of continuous construction in individual communities is roughly comparable.
- **Coordination with joint build opportunities**
    - Where possible and without undue administrative burden, the City would take the lead in coordinating joint build opportunities. The Contractor should be responsive to the City's efforts to coordinate with existing capital projects or joint build opportunities with other partners to install conduit and fiber where street or sidewalk cutting is already planned to take place.

The specific, final sequence of work to be performed will be determined jointly by the City and the Contractor after notification of award and obviously be effected by the permitting process and other potential capital improvement projects occurring within the City at that time.

b. Project Management

The Contractor will be required to coordinate all efforts directly with the City or its representative. It is expected that daily production reports be generated by the Contractor to verify the quantity of infrastructure installed. Productions sheets shall be accompanied by highlighted construction prints showing the location of daily installation. A detailed plan outlining project management, construction management, inspection of work performed, and the City's inspection process to close out permits will be shared with the successful Contractor.

c. Community Engagement

The fiber backbone is intended to be developed for the community's benefit. Community engagement concerning both the benefits and the costs of infrastructure development is therefore an important dimension of success for this project. The City expects to lead direct community engagement work but will rely on regular reporting from the Contractor to support its' community engagement program.

The community impacts of this projects are experienced as the Contractor is performing construction in the public rights of way, and can result in disruption of commutes, traffic congestion, parking and noise pollution. To minimize the impact of this project on residents and communicate its benefits, the City envisions the following distribution of responsibilities related to community engagement between the Contractor and the City:

***Contractor responsibilities**:*

i. *Signage on and around work site*

The signage and traffic markings on and around the work site should be designed to do the following:

- Safely divert vehicle, bicycle and pedestrian traffic around the work area with minimal disruption to traffic flows
- Clearly indicate to community members the timeline and hours within which work will be completed
- Provide a mechanism for community members to give feedback on the Contractor's work (see "Feedback mechanisms" below)
- Display relevant work permits

Notification signage indicating upcoming work on a street segment, sidewalk or bicycle lane should be clearly posted a minimum of 72 hours before work is scheduled to begin. Signage should be posted clearly at applicable intervals along the street segment where work is planned. Notice of upcoming work should include the descriptive information outlined in "Proactive communication," below.

The presence of this signage will be monitored as a part of the performance measurement approach, detailed in the section of the scope of work entitled, "Performance Metrics." For additional guidance on signage and job-site management, refer to 01570 TRAFFIC REGULATION.

ii. *Proactive communication about upcoming and on-going work*

As a part of weekly project reporting, the Contractor will regularly update the City on the status of ongoing work and upcoming work as planned. For all upcoming work in each upcoming two week period, the Contractor will share the following information:

- Affected Street/Sidewalk Area
- Traffic Impacts
- Activity Time (work hours)
- Work Start Date
- Work End Date

For work to be completed in upcoming four week periods, the Contractor will share the affected street/sidewalk area and estimated start and end date.

In addition to signage on and around the work site described above, the Contractor may be required to distribute City approved flyers and at residences and businesses on the block where work is scheduled. Flyers should contain the project information listed above and be distributed to residences and business a minimum of 72 hours before work is scheduled to begin. The City expects to review and approve these flyers in advance before they are utilized on the project.

City Responsibilities:

i. *Lead community meetings*

When the Contractor is selected and the construction sequencing and timeline are determined, the City will likely host various community meetings, possibly attended by the Contractor, to explain the project specifics of the fiber backbone, the neighborhoods and streets that will be affected over the course of the project, and the timeline on which the work will proceed. As work proceeds, the City will be responsible for attending neighborhoods meetings in areas that will be affected by street work. Contractor attendance at these meetings should take place on a quarterly basis and a minimum of 72 hours in advance of planned work in the area and should involve sharing the following project benefits:

- Affected Street/Sidewalk Area
- Traffic Impacts
- Activity Time (work hours)
- Work Start Date
- Work End Date
- Contact (Company name, Manager name)
- Phone Number
- Link to online feedback portal – Inquire Boulder - https://user.govoutreach.com/boulder/faq.php?cmd=shell

ii. *Project updates via digital media*
The City will post descriptive information about construction work and travel impacts to the City of Boulder Capital Projects website, a minimum of 72 hours before work is scheduled to begin. The City will also report on project progress through the website as segments of the fiber backbone are completed. Similar information will be shared via local radio announcements (traffic updates) and social media, which can be re-shared through the City's social media accounts.

iii. *Establish feedback mechanisms for community members*
Community members should have the opportunity to report positive feedback on the Contractor's work or non-compliance with the *work hours* or *timelines* communicated on work site signage and the City website. The Contractor's signage and communication should therefore clearly note the construction manager's contact information and direct community members to the City's online feedback portal Inquire Boulder https://user.govoutreach.com/boulder/faq.php?cmd=shell to submit feedback on the Contractor's work to the City. The City will share comments submitted via the feedback portal with the Contractor as they are received and discuss actions the Contractor has taken in response to feedback during monthly performance management meetings.

d. Ground Conditions

Highly variable ground conditions are expected to be encountered during excavation and directional boring of the proposed facilities, including but not limited to bedrock, boulders, ground water, clay, sand and gravel. It is expected that Contractors are familiar with existing ground conditions and well experienced with underground construction in rocky terrain. Contractors shall have experience and appropriate equipment to successfully install underground infrastructure in such terrain as shown on the construction plans. Ground conditions must be considered in construction scheduling and the Contractor's construction timeline must account for such conditions.

e. Point of Construction Demarcation

Each site connected to the fiber backbone will require a point of demarcation or construction "hand off" to the site. The Contractor shall assume the responsibility of providing fiber connectivity from the fiber backbone to each site designated in the construction prints. The Contractor is responsible to determine final routing of the fiber laterals into each site. This will typically include extension of each fiber lateral from the fiber backbone into the site, installation of a fiber termination panel in either a rack-mounted or wall-mounted configuration and splicing and terminating fiber laterals onto each fiber panel, per the specifications provided in each fiber splice diagrams. The fiber termination panel shall be considered the point of demarcation unless specifically noted on the plans or directed by the City. The Contractor is not responsible for installation of any network electronics that would connect to the fiber termination panel.

f. Maintenance and Repair

Maintenance and repair work is critical to ensuring the operability of the City's fiber backbone. Contractors with the capacity to maintain and repair the constructed fiber backbone and laterals have the **OPTION** to supplement their bid with a narrative describing their interest, experience and approach to providing an annual maintenance and repair contract. The scope for this maintenance and repair contract includes:

- Local labor and equipment resources
- Routine inspections and network protection
- Incremental adds moves and changes
- Inventory maintenance, control and warehousing
- Stocking and maintaining repair materials
- GPS/ GIS data collection and management
- Underground infrastructure repair services
- Emergency Maintenance with specific service level agreement metrics
- Non-Emergency Maintenance
- Cable splicing, testing and trouble shooting
- Proofing existing duct and fiber pulling

Responses to the optional maintenance and repair contract will not be scored as a part of this RFB. Contractors that wish to provide information on their maintenance and repair capabilities should provide a budgetary estimate for such services on an annualized basis.

g. Project Reporting and Performance Metrics

Key to enhancing collaboration with the Contractor is tracking, incentivizing, and regularly discussing performance. The following metrics are not required and instead reflect the City's goals in defining and tracking project success of over the lifetime of the project:

- Project spend against forecasted budget
- Completed footage of conduit to date, compared to the project schedule
- On-time start and completion of construction (boring and conduit installation)
- On-time completion of fiber pulling
- Timely site restoration to City specifications and site clean-up
- Observance of regular work hours (as defined in permit)
- Failure to display appropriate signage and maintain traffic control
- Community complaints and complaint resolution

To support the tracking of these metrics, it is expected that the Contractor document their progress in the completion of work and submit documentation to the City on a weekly basis. The Contractor will report the timing and location of completed conduit, provide documentation of fiber cable testing, and submit drawings as a part of these weekly updates. The location of

completed work, assets and facilities should be geocoded where possible, with supporting documentation describing the tagging procedure.

See ATTACHMENT E: PERFORMANCE METRICS for proposed definitions of each metric, the party responsible collecting them, and frequency of reporting. As a part of their response to this bid, the vendor may propose additional or alternative performance metrics to be tracked over the life of the project.

Alternative bids must clearly demonstrate how the alternative achieves the City's goals of tracking work quality, project progress and community impact while simplifying or improving the quality of performance measurement. The final set of performance metrics and frequency of collection will ultimately be determined by Contractor capacity and will be negotiated by the successful Contractor and the City prior to the finalization of an agreement between parties.

h. Performance Payments

The City is interested in the possibility of structuring performance payments to incentivize the timely completion (to specification) of core components of the fiber construction work described in this bid. The City expects to negotiate the details of the performance payment structure with the successful Contractor, but a draft payment plan is included in ATTACHMENT F: PERFORMANCE PAYMENTS, with proposed payments tied to the following:

- On-time start and completion of construction (boring and conduit installation)
- On-time completion of fiber pulling
- On-time submission of technical documentation
- Timely site restoration and clean-up
- Observance of regular work hours (as defined in permit)

As a part of their project narrative, the Contractor has the option to propose alternative work completion milestones and payment schedules. Alternative bids must clearly demonstrate how the alternative achieves the City's goals of tracking work quality, project progress and community impact while simplifying payment administration or improving the quality of performance measurement. Whether the City and Contractor agree to a performance payment schedule will be determined by budget availability as well as the quality of and ability to verify performance data.

i. System Acceptance

Phasing of construction will require the City to carry out interim testing and accepting of each phase with the Contractor. This will allow the City to begin utilizing the network as each phase of construction is completed. Testing and acceptance procedures will also be required to "tie in" additional phases of construction as they are completed, for which similar testing and acceptance plans will be required by the City. Final system acceptance will occur when all work has been completed in accordance with City and its representatives and the system operates in conformance with the designed specifications.

i. A 180 day performance period will commence for each phase of the network upon completion of each phase's final site location installation. If inconsistencies are discovered during the 180 day performance period, corrective measures shall be taken by the Contractor to remedy the issues. Upon completion of any corrective measures, a new 180 day performance period will begin. Interim testing and acceptance includes completion of restoration activities, labeling, installation of fiber marker posts if required, verification of splicing, trash/debris removal, and other instructions specific to each phase.

ii. Final acceptance of all phases will not be given until all sites have been verified and accepted individually for completion of restoration activities, labeling and fiber marker post installation, verification of splicing, trash/debris removal, and other instructions specific to each phase. A final 180 day performance period will commence for final testing and acceptance of the network upon completion of the project.

j. Contractor Warranty & Guarantee

The Contractor shall warranty and guarantee all work per section 701 of the City's General Conditions found in ATTACHMENT G: CONSTRUCTION CONTRACT GENERAL CONDITIONS.

k. Liquidated Damages

The Contractor shall comply with the provision for liquidated damages per City's General Conditions found in ATTACHMENT G: CONSTRUCTION CONTRACT GENERAL CONDITIONS.

9. CONSTRUCTION CONTRACT GENERAL CONDITIONS

In addition the requirements of this RFB, the Contractor shall abide by the City of Boulder Construction Contract General Conditions, provided in ATTACHMENT G, which are applicable to all construction contracts of the City.

In addition to the standards referenced in this RFB, the Contractor shall also adhere to the City's most recent Design and Construction Standards published in June 2019. More specific standards listed in this RFB shall supersede the City's Design and Construction Standards. Where a more specific standard is not defined in this RFB, within the Construction Contract General Conditions or within the City's Design and Construction Standards, the Contractor shall adhere to the Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Design.

10. TECHNICAL REQUIREMENT ATTACHMENTS

The Contractor must be responsive to the following technical requirement attachments as part of their response to this bid.

ATTACHMENT A: PRICING PROPOSAL FORM
ATTACHMENT B: GENERAL CONDITIONS FORMS

ATTACHMENT C: 60% CONSTRUCTION DRAWINGS
ATTACHMENT D: CONSTRUCTION SEQUENCING MAPS
ATTACHMENT E: PERFORMANCE METRICS
ATTACHMENT F: PERFORMANCE PAYMENTS
ATTACHMENT G: CONSTRUCTION CONTRACT GENERAL CONDITIONS

II. SPECIAL CONDITIONS

1. GENERAL

These Special Conditions define project specific requirements related to this RFB. Information contained in this section are supplemental to the project General Conditions and the standards and specifications contained herein. Project Specific Standards included in this Section will supersede existing City Standards.

2. PERMITTING

The Contractor shall be responsible for obtaining all City permits for the work contained within this RFB. The Contractor is responsible for complying with any requirements set forth by governing permitting authorities. This includes the submission of completed permit application and required submittals and attachments, as well as the creation and submittal of traffic control plans.

The costs of creating traffic control plans by a certified firm shall be included in the unit rates by the Contractor. Permit fees will be either paid by the City directly or the Contractor will pay for permits and submit reimbursement from the City for the costs of each permit with no markup applied. Contractor may charge the City for the costs incurred of permit preparation on an hourly basis as included in the unit pricing sheet. The City shall coordinate and apply for permits with County, State, Railroad and Ditch authorities, given the longer lead times on these permits. All permit conditions for approval shall be followed by the Contractor.

3. EXISTING UTILITIES AND SOFT DIG VERIFICATION

The Contractor is responsible to perform soft digs and visually verify locations of existing utilities within proposed pathways prior to directional boring. All existing utilities found and verified shall be documented with GPS locations and redlines included on final construction as-builts with size, type, owner, depth and offset measurements. This work shall be a project requirement and submitted as part of the project deliverables in an effort comply with Colorado Senate Bill 18-167 requirements for subsurface utility locating. Once all marked utility locations are physically identified, the Contractor shall adjust running lines as needed to keep minimum vertical and horizontal separation from existing utilities per the City's Design and Construction Standards Section 4.06. Contractor shall coordinate and receive approval of any significant running line adjustments with the City.

- Parallel separations between utility mains and services to provide for adequate trench

excavations and maintenance operations shall be as follows. All distances are measured from outside of pipe to outside of pipe:

- Parallel separations between Electric, Telecommunications and/or Gas and Water utility infrastructure is 5' (five feet).

- Parallel separations between Electric, Telecommunications and/or Gas and Sewer utility infrastructure is 10' (ten feet).

- Parallel separations between Electric, Telecommunications and/or Gas and Storm utility infrastructure is 5' (five feet).

	Water	Sewer	Storm	Electric, Telecommunications, and/or Gas
Water		10-ft	5-ft	5-ft
Sewer	10-ft		10-ft	10-ft
Storm	5-ft	10-ft		5-ft
Electric, Telecommunications, and/or Gas	5-ft	10-ft	5-ft	

- Minimum vertical separation between City public utility pipelines or conduits and all gas, electric, and telecommunications utilities shall be 12 inches.

4. RESTORATION AND PAINT REMOVAL

Full restorations of work sites shall be included in Contractor pricing as defined in Section 02200 EXCAVATION AND TRENCHING and 02520 SIDEWALK CURB AND GUTTER AND MISCELLANEOUS CONCRETE. Site restoration includes final street and sidewalk sweeping, vegetation and landscape restoration, including sod, seed and straw, and pavement striping, asphalt, concrete, and brick paver restoration, locate flag removal, and removal of erosion and siltation controls. In some circumstances, locate paint marking removal will be required by methods of soda blasting. In the event the City requests paint removal services, the Contractor will be asked for an estimated time to complete, and if agreed to, will be paid for at an hourly rate.

5. TREE PROTECTION REQUIREMENTS

Public trees are important assets comprising a part of the public infrastructure and are protected by City Ordinance, Title 6-6, "Protection of Trees and Plants." Protection of existing trees is crucial as is preservation of landscaped public rights-of-way for future tree planting efforts.

There are approximately 2800 public trees within 20 feet of the proposed route although this number may change as line locations are finalized.

- 70% trees are <10 inches diameter

- 24% trees are between 11-20 inches diameter
- 6% trees are > 20 inches diameter

Specific tree information shall be provided to the Contractor during pre-construction meetings. City Forestry staff is available for site consultations prior to and after commencement of construction however the on-call services of a Consulting Arborist is required to oversee tree protection and perform tree pruning/removal if needed. The proposed lines also intersect 25 City park sites. Close coordination with City Forestry and Parks staff is required to prevent damage to public trees and park infrastructure. The Contractor is also required to follow tree protection standards as outlined in Section 01560 ENVIRONMENTAL CONTROLS.

6. TRAFFIC CONTROL

The Contractor is responsible for planning, submission and management of all traffic control plans, setup, maintenance and breakdown. These costs must be included in Contractor's project pricing. Traffic control plans shall comply with the most recent edition of the Colorado Department of Transportation Work Zone Safety Guidelines.

7. PROJECT-SPECIFIC STANDARDS

Project specific standards may supersede an established City standard as defined in the City's Design and Construction Standards or the City's Division 1 or Division 2 standards. Variance from these standards are specific and discrete to the fiber backbone construction project, as follows:

a. Final construction as-builts and construction drawings will utilize a GIS-based format compliant with ESRI ArcGIS. The City will advise the Contractor on the exact format of data and shapefiles to be delivered in as-builts.

b. Construction prints will be sized as 11"x17" format instead of 24"x36"

c. The fiber backbone project includes several small segments where four conduits will be installed instead of two, which are included in the construction prints and quantities. In these cases, the City's existing standards call for concrete encasements when 4 or more conduits are installed in parallel. This project will not require concrete encasement for such conduits.

d. Contractor shall avoid placing handholes in hardscape, sidewalks, bike and multi-use paths wherever possible. Handholes shall be considered in hardscape where placement in the softscape is impractical, and only after submittal review and approval from the City on a case by case basis. All restoration shall be completed per sections 02200 EXCAVATION AND TRENCHING and 02520 SIDEWALK CURB AND GUTTER AND MISCELLANEOUS CONCRETE.

e. The Contractor shall be responsible for coordinating all interior site access and lateral fiber termination within facilities. The City will provide site contacts for coordination, access and site surveys. The Contractor shall perform site surveys prior to placement of any lateral

conduits, vaults or fiber at the site.

f. The Contractor will be responsible for coordinating the first phase of construction with an upcoming City resurfacing project along Broadway from Violet to US 36. This will require the proposed conduit running line and handholes to be staked to avoid conflict with other utility relocations and installations. The Contractor shall include the costs of surveyor staking along this section on the project in the Hourly rate section of the ATTACHMENT A: PRICING PROPOSAL FORM.

8. FIBER TESTING

Fiber testing shall comply with the City's 02580 TELECOMMUNICATIONS standard.

9. AS-BUILTS AND PROJECT DOCUMENTATION

The engineering design has been developed in 3-GIS software utilizing 11"x17" sizing for construction prints. Contractors shall provide all construction print redlines, including depths and offsets, GPS locations of all new installations and existing utilities, vault butterfly drawings, directional bore logs including the location, distance and direction of each bore, fiber test results, fiber sequentials, photos of completed splice trays, closed out permits, warranty information and any additional information the City deems necessary. Final as-builts shall be provided in a ESRI ArcGIS format or similar geospatial format consistent with the City's fiber management system.

III: APPLICABLE CITY STANDARDS

SECTION 01070: ACRONYMS AND ABBREVIATIONS

PART 1: GENERAL

Wherever used in these Specifications or on the Drawings, the following abbreviations will have the meanings indicated.

10 GbE 10 Gigabit Ethernet
10 GFC 10 Gigabit Fiber Channel
1000BaseT 1000 Megabits per Second, twisted-pair cable version of an IEEE 802.3 network
100BaseT 100 Megabits per Second, twisted-pair cable version of an IEEE 802.3 network
100g 100 Gigabits
10G-EPON10 Gbits Ethernet Passive Optical Network
3G Third-Generation Wireless
4G Fourth-Generation Wireless
5G Fifth-Generation Wireless
ADM Add/Drop Multiplexing
ANSI American National Standards Institute

APC Angled Polished Connector
ATM Asynchronous Transfer Mode
AWG American Wire Gauge
BER Bit Error Rate
BOC Back of Curb
CATV Cable Television
CD Chromatic Dispersion
CLEC Competitive Local Exchange Carrier
City or COB City of Boulder
CSFP Compact Small Form-Factor Pluggable
CVR Converter Module
CWDM Coarse Wavelength Division Multiplexing
dB Decibel
dBm Decibels Relative to One Milliwatt
DWDM Dense Wavelength Division Multiplexing
EDFA Erbium-Doped Fiber Amplifier
EIA Electronic Industries Alliance
EOP Edge of Pavement
EPON Ethernet Passive Optical Networks
FDDI Fiber Distributed Data Interface
FOTP Fiber Optic Test Procedure
FOTS Fiber Optic Transmission System
FOC Fiber Optic Cable
FSWDM Full Spectrum Wavelength Division Multiplexing
FTP Fiber Termination Panel
FTTB Fiber to the Business or Building
FTTC Fiber to the Curb or Customer
FTTD Fiber to the Desk
FTTH Fiber to the Home
FTTN Fiber to the Neighborhood
FTTO Fiber to the Office
FTTP Fiber to the Premise
FTTx Fiber to the User
GHz Gigahertz
GPON Gigabit Passive Optical Network
GR General Recommendation
HFC Hybrid Fiber Coax
IEEE The Institute of Electrical and Electronics Engineers
IP Internet Protocol
ISO International Standards Organization
LAN Local Area Network
LASER Light Amplification by Stimulated Emissions of Radiation
LEC Local Exchange Carrier
LED Light-Emitting Diode
LGX Light Guide Cross Connect
LWP Low Water Peak

MM Multimode
MSA Master Service Agreement
NM NanoMeter
NZDS Nonzero Dispersion Shifted Fiber
OADM Optical Add/Drop Multiplexer
OAM&P Operations, Administration, Maintenance and Provisioning
OEO Optical Electrical Optical
OLT Optical Line Terminal
OM2/3/4 Optical Multimode
ONT Optical Network Terminal
ONU Optical Network Unit
OTDR Optical Time Domain Reflectometer
OTN Optical Transport Network
PON Passive Optical Network
RoHS Restriction of Hazardous Substances
RW Right of Way
SMF Single-mode Fiber
SONET Synchronous Optical Network
SWDM Selective Wavelength Division Multiplexing
TIA Telecommunications Industry Association
UPC Ultra Polished Connector
WAN Wide Area Network
WDM Wavelength Division Multiplexing
ZWP Zero Water Peak

SECTION 01014: WORK SEQUENCE

PART 1: GENERAL

1-1 Sequence of Construction:

The City has developed a specific construction sequencing plan for the fiber backbone based on the priority of each facility. The City strives to minimize community impact throughout the term of construction and expects the selected Contractor to work with the City and community to reduce and manage impact where feasible. The Contractor shall coordinate with the City to construct the network in a sequence to support the City's priorities per the sequencing plan.

SECTION 01016: CONTRACTOR'S USE OF PREMISES

PART 1: GENERAL

1-1 Contractor Use of Premises:

The Contractor if preapproved, may use the City property designated for equipment and materials if adequate space is available as defined by the City, and the Contractor confines operations to those permitted by local laws, ordinances and permits and meets the following requirements:

- Does not unreasonably encumber site with materials or equipment.
- Assumes full responsibility for protection and safekeeping of products stored on premises.
- Moves any stored products which interfere with operations of the City within 72 hours of request.
- Obtains and pays for use of additional storage or work areas needed for operations.

The Contractor shall include all costs associated with material and equipment storage, office and yard space in their bids. The City shall bear no additional cost associated with City property not being available for the Contractor.

1-2 Limits of Construction:

The Contractor must maintain all construction activities within the City property and/or construction easements and right of ways of the project, or other stated areas, unless permits/and or written permission are obtained by the Contractor, from appropriate authorities or private property owners, outside of these areas. The temporary permits must be secured and paid for by the Contractor at no extra cost to the City.

1-3 Security:

The Contractor shall at all times be responsible for the security of his facilities and equipment. The City will not take any responsibility for the Contractor's missing or damaged equipment, tools, or personal belongings of the Contractor.

SECTION 01060: SAFETY AND HEALTH

PART 1: GENERAL

1-1 Contractor Responsibilities:

The Contractor shall conduct operations in a safe manner at all times. All OSHA regulations, and all other regulations pertaining to the safe operation of construction equipment, workers, methods and the job-site shall be strictly adhered to by the Contractor.

In accordance with the requirements of State and Federal Safety Regulations, the Contractor will be solely and completely responsible for conditions of the job-site, including safety of all persons and property during performance of work. This requirement will apply continuously and not be limited to working hours. The duty of the City to

conduct construction observation of the Contractor's performance is not intended to include review of the adequacy of the Contractor's and Subcontractor's safety measure, in, on, or near the construction site.

The Contractor shall at all times, whether or not so specifically directed by the City, take necessary precautions to insure the protection of the public. The Contractor shall furnish, erect, and maintain all necessary barricades, fences, suitable and sufficient construction signs, provide a sufficient number of watchmen and take all necessary precautions for the protection of the work and safety of the public through or around his construction operations. Crews and representatives will not enter a trench that appears unsafe. It is the Contractor's responsibility to provide a safe trench.

The Contractor shall maintain a safe and clean job-site at all times. Construction debris on traveled road surfaces, temporary detours, access driveways, etc., shall be cleaned away daily. Where applicable (in the opinion of the City), pedestrians and bicyclists shall be furnished with a safe and unobstructed route through the job-site. If the Contractor's operations cause there to be nuisance dust on the road surface, the Contractor must sweep away such dust when so ordered by the City. All costs for maintaining a clean and safe job-site will be considered incidental to the contract and will not be paid for separately. No open excavations will be allowed overnight.

1-2 Potential Job-Site Hazards:

Potential job-site hazards include but are not limited to the following:

- Construction related occupational injury; including the use of tools and heavy equipment; slips, trips and falls; buried gas and power lines, weather and traffic.

Other potential job-sire hazards include the following:

- Organic chemicals
- Inorganic chemicals
- Biologic
- Plant operations
- Radiologic

1-3 Safety and Health Regulations:

The Contractor shall comply with Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act, as set forth in Title 29, C.F.R. Copies of these regulations may be obtained from Labor Building, 14th and Constitution Avenue NW, Washington, D.C., 20013. The Contractor shall also comply with the provisions of the Federal Occupational Safety and Health Act, as amended.

1-4 Safety and Health Submittal:

Before commencing work onsite, the Contractor shall submit, in accordance with Section 01300 - Submittal Procedure, a Health and Safety Plan outlining methods and procedures to be implemented to protect worker safety and contingency plans in the event of an accident. The health and Safety Plan shall address all regulatory and site-specific health and safety requirements, including, but not limited to the following:

- Excavation safety
- Confined space safety
- Traffic safety
- Other safety issues identified in paragraph 1-2 above
- Emergency procedures

SECTION 01071: STANDARD REFERENCES

PART 1: GENERAL

1-1 General:

Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of bid submission, except as may be otherwise specifically stated. However, no provision of any referenced standard, specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of City, Contractor, or Engineer, or any of their Consultants, Agents, or Employees from those set forth in the Contract Documents, nor shall it be effective to assign to Engineer, or any of Engineer's Consultants, Agents, or Employees, any duty or authority to supervise or direct the furnishing or performance of the work.

1-2 Reference Standards:

National Electrical Code, NFPA 70

The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of City. The NEC provides the minimum code requirements for electrical safety. In telecommunications distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to insure the performance of the telecommunications infrastructure.

ANSI/TIA/EIA Standards

The Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) engineering standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products and assist the purchaser in selecting and obtaining the proper product for his or her particular need.

The TIA/EIA Standards are updated every five years. Due to the rapid changes in the telecommunications and electronics industries, TIA/EIA publishes periodic Telecommunications Systems Bulletins (TSB), which provide additional guidance on certain technical issues that must be addressed prior to the next scheduled revision of the standards. The information contained in TSBs is usually incorporated into the applicable standard during the next standards revision. Standards and publications are adopted by TIA/EIA in accordance with American National Standards Institute (ANSI) patent policy. The TIA web site is: http://www.tiaonline.org/

Fiber Optic Standards, TIA/EIA-526 (series)

The TIA/EIA-455 series, together with its addenda, provides uniform test procedures for testing the fiber optic components intended for, or forming a part of, optical communications and data transmission systems. This series contains standard test procedures for optical fibers, cables, transducers, and connecting and terminating devices.

Cabling Standard, ANSI/TIE/EIA-568 (series)

The ANSI/TIA/EIA-568-A (series) is the Commercial Building Telecommunications Cabling Standard. This standard defines a generic telecommunication wiring system for commercial buildings that will support a multiproduct, multivendor environment. It also provides direction for the design of telecommunications products for commercial enterprise.

Grounding and Bonding, ANSI/TIA/EIA-607 (Series)

The ANSI/TIA/EIA-606 (series) is the Commercial Building Grounding and Bonding Requirements for Telecommunications. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern telecommunications systems require an effective grounding infrastructure to ensure optimum performance of the wide variety of electronic information transport systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for telecommunications that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA/EIA-568-A and installed in the pathways and spaces designed in accordance with ANSI/TIA/EIA-569-A.

Customer Owned Outside Plant (OSP), ANSI/TIA/EIA-758

The ANSI/TIA/EIA-758 provides industry standards for the design and construction of customer owned OSP infrastructure. Unless specified otherwise in the COB standard OSP designed and constructed at all COB facilities will be in compliance with ANSI/TIA/EIA-758.

Transmission Performance Specifications, TIA/EIA Bulletin TSB67

TSB67 is the Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair (UTP) Cabling Systems. This bulletin specifies the electrical characteristics and performance requirements of field test instruments, test methods and the minimum transmission requirements for UTP cabling. All testing of horizontal distribution cabling at City facilities will be performed with a TSB67 Level II test instrument.

Additional Horizontal Cabling Practices for Open Offices, TIA/EIA Bulletin TSB75

This document specifies optional practices for open office environments, for any horizontal telecommunications cabling recognized in TIA/EIA-568. It specifies optional cabling schemes and topologies for horizontal cabling routed through modular office furniture or movable partitions, which are frequently reconfigured.

Local Area Network Ethernet Standard, IEEE 802.3 (Series)

The City utilizes the Ethernet LAN protocol at all facilities. All COB infrastructure must be designed to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards, which define protocols and signaling technologies. All newly installed cabling must support 1000BaseX Gigabit Ethernet protocol based on the IEEE 802.3z standard.

The BICSI Telecommunications Distribution Methods Manual

The Building Industry Consulting Service International, Inc. (BICSI) is a Telecommunications Association whose mission is to provide state-of-the-art telecommunications knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Telecommunications Distribution Methods Manual (TDMM). The TDMM is not a code or standard. The TDMM is an extensive volume of information on the various aspects of telecommunications systems and telecommunications distribution. The TDMM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NEC and ANSI/TIA/EIA standards. Designers and installers are encouraged to use the TDMM as an engineering tool, within the constraints of the unique requirements of the COB Infrastructure Standards.

Colorado Department of Transportation Standard Specifications for Road and Bridge Construction

The City has adopted the Colorado department of Transportation (CDOT) Standards and specifications (Latest version) as it relates to restoration. Exceptions to these requirements are listed in section under the restoration chapter in section 02200 EXCAVATION AND TRENCHING.

American Association of State Highway and Transportation Officials (AASHTO),

The American Association of State Highway and Transportation Officials is a standard setting body which publishes specifications, test protocols and guidelines which are used in highway design and construction throughout the United States

ASTM International

ASTM International formerly known as the American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

SECTION 01150: MEASUREMENT AND PAYMENT

PART 1: GENERAL

1-1 Scope:

This section covers methods of measurement and payment for items of work under this contract.

1-2 Requirements:

The total bid price shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work, including furnishing all materials, equipment, supplies, and appurtenances, providing all construction plant, equipment, tools; and performing all necessary labor and supervision to fully complete the work, including completion of as-builts and project deliverables, shall be included in the unit and lump sum prices bid. Pricing for labor units shall include the costs of all labor, tools, equipment, traffic control plans, setup, maintenance, and breakdown, all landscape and soft surface restoration, and all transportation perform the work.

Material unit pricing shall include material specified in new condition, and shall include procurement of approved material, shipping, handling, delivery, and storage. Pricing shall include all work not specifically set forth as a pay item in ATTACHMENT A: PRICING PROPOSAL FORM shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices bid.

1-3 Estimated Quantities for Unit Price Bid Items:

All estimated quantities stipulated in the ATTACHMENT A: PRICING PROPOSAL FORM for unit price bid items are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the bids submitted for the work. The actual amounts of work performed, and materials furnished for unit price bid items may differ from the estimated quantities. The basis of payment for work and materials bid as a unit price will be the actual amount of work done and materials furnished. The Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts for unit price bid items.

1-4 Hourly and Material Pricing:

Provide hourly and material pricing for all company equipment and personnel that includes Contractor markup. Hourly pricing will be used to negotiate and justify change orders for unexpected or emergency work outside of the scope of the contract bid items.

1-5 Description of Bid Items:

Measurement and payment definitions for each contract billable unit are listed Below. All Labor unit costing includes Calling in locates, physical verification, protection and documentation of all existing utilities and infrastructure, traffic control plans, tree protection requirements and documented redlines, as-builts, bore logs and all test results. Also includes setup, maintenance and breakdown, of all traffic control, stormwater and Erosion Control devices per approved plans and permits, site cleanup and restoration. Includes compliance with all standards specifications as outlined in the RFB documents. Materials listed on the pricing sheet will be paid for separately. Any materials needed to successfully install unit per specification shall be considered incidental and included in Contractor's unit rates.

Measurement and payment for labor items:

Directional Bore (x) 2" SDR11
Directional bore should be paid on a lineal foot basis. Number in parenthesis indicates number of conduits to install. Unit shall include successful boring, tracking and pull back of (x) 2" HDPE SDR11 conduit by means of directional bore at 30" minimum depth, locating existing pipelines and utilities, digging, restoring and compaction of bore pits, removal and disposal of excess bore fluid, spoil and/or excess bore pit material, surface restoration to pre-construction conditions, site clean-up and other items needed to complete the work except as called out separately in other bid items. Field measurement shall be made at ground surface. HDPE Conduit shall be paid for separately under materials.

Open cut & Trench (x) 2" at 30" minimum depth of cover
Open cut trenching shall be paid on a lineal foot basis. Number in parenthesis indicates number of conduits to install. Unit shall include opening of trench; installation of (x) 2"

conduit at 30" minimum depth; warning tape; locating existing pipelines and utilities; removal and disposal of spoil and/or surplus trench excavation material, dewatering; sheeting, shoring and or bracing; bedding; backfilling and compaction of job excavated material or placement and compaction of flowable fill or imported granular backfill (if pre-approved by the City), surface restoration to pre-construction conditions, site clean-up, and other items as needed to complete the work except as called out separately in other bid items. Field measurement will determine the final pay quantities for this item. Field measurement shall be made by at ground surface. PVC conduit shall be paid for separately under materials.

Bore Rock Adder
Consists of the labor and equipment required to bore through rock that cannot be accomplished with typical equipment used for a similar bore where rock is not encountered. This unit will only be used when preapproved by the engineer and will be paid on a lineal foot basis only for that portion of the bore that is through rock. This unit is an adder to bore pricing. Conduit to be paid for under materials.

Trench Rock Adder
Consists of the labor and equipment required to cut through and excavate rock that cannot be accomplished with typical equipment used for a similar bore where rock is not encountered. This unit will only be used when preapproved by the engineer and will be paid on a lineal foot basis for only that portion of the trench that is through rock. This unit is an adder to base trench pricing. Conduit to be paid for under materials. Granular or flowable fill backfill unit will be paid when excavated material is unsuitable for backfill and preapproved by the City.

Install #12 AWG Insulated Tracer Wire
Consists of adding a locate conductor inside the conduit with the cable specifically for locating the cable. Tracer wire splices shall only be made in vaults. Payment will be made on a lineal foot basis for tracer wire installed. Line item includes the cost of incidental materials. Tracer wire paid for under materials section.

Install 5/8"x8' copper clad ground rod
Consists of the necessary labor to install (1) 8'x5/8" copper clad ground rod and bonding the auxiliary ground electrodes. This shall include materials necessary to connect electrodes to ground bar. Ground rod shall be paid for separately under materials section.

Rod Existing Conduit and Install Pull Tape
Consists of rodding or blowing of existing conduit and installing mule tape. Payment shall be made on a lineal foot basis for pull tape installed and measured by the sequential numbering on the mule tape, which shall not exceed conduit footage. Tape shall be continuous through conduit with no knots. Muletape material to be paid for separately.

Rod New Conduit and Install Pull Tape
Consists of rodding or blowing of new conduit and installing mule tape. Payment shall be on a lineal foot basis for pull tape installed, and measured by the sequential numbering on

the mule tape, which shall not exceed conduit footage. Tape shall be continuous through conduit with no knots. Muletape material to be paid for separately.

Installation, Underground Fiber Cable - Including Slack
Consists of one (1) foot of underground fiber optic cable placement, which includes labor for pulling or blowing fiber optic cable in conduit. Measurements shall include all slack and be taken from sequentials on the cable as the quantity for payment. Cable material will be paid for separately.

Splicing, Fusion, Single Fiber
Consists of all labor and equipment necessary to open panel or case, perform a single fusion splice of one optical fiber strand in any cable in accordance with splice loss threshold. The labor shall include prep work, applying splice heat shrink and stowing the spliced fiber in a fiber organizer. Any re-splicing due to failed tests shall be at the Contractor's own expense and will not be paid by for the City.

Splicing, Mass Fusion, 12 Fiber Ribbon
Consists of all labor and equipment necessary to open panel or case, mass fusion splice one 12-strand optical fiber ribbon strand in any cable in accordance with splice loss threshold. The labor shall include prep work, applying splice heat shrink and stowing the spliced fiber in a fiber organizer. Any re-splicing due to failed tests shall be at the Contractor's own expense and will not be paid by for the City.

Testing, OTDR, Uni-Directional, Power Meter Testing
Includes the OTDR and Power Meter Testing for each single-mode field splice in one direction. The splice loss of each field splice shall not exceed 0.2 dB at 1310 and/or 1550 nanometers. Power Meter testing consist of using an Optical Power Meter to test the end-to-end attenuation: Attenuation (dB) = Pref-Ptest loss at 1310 and 1550 nanometers and documenting results. Contractor shall not charge the City for retests resulting from failed tests, high splice loss or Contractor error or craftsmanship. Contractor shall provide all testing documentation to the City as part of this pay item.

Testing, OTDR, Bi-Directional, Power Meter Testing
Includes the OTDR and Power Meter Testing for each single-mode field splice in both directions. The splice loss of each field splice shall not exceed 0.2 dB at 1310 and/or 1550 nanometers. Power Meter testing consist of using an Optical Power Meter to test the end-to-end attenuation: Attenuation (dB) = Pref-Ptest loss at 1310 and 1550 nanometers and documenting results. Contractor shall not charge the City for retests resulting from failed tests, high splice loss or Contractor error or craftsmanship. Contractor shall provide all testing documentation to the City as part of this pay item.

Installation, Small Vault 24"x36"x24"
Consists of the installation of (1) 24"x36"x24" Tier 15 handhole placement and lid with suitable backfill. Must be tamped around the handhole, 6" gravel base and conduit tie ins, locate existing pipelines and utilities, removal and disposal of spoil and/or surplus

excavation material, dewatering, sheeting, shoring and or bracing, bedding; backfilling of job excavated material, compaction, surface restoration to pre-construction condition, site clean up, and other items as needed to complete the work except as called out separately in other bid items. Handhole lids shall include the installation of bolts. Includes tying in conduit end into handhole and capping conduit ends with duct plugs. Handhole to be paid for under materials. Includes softscape restoration.

Installation, Large Vault 30"x48"x24"
Consist of the installation of (1) 30"x48"x24" Tier 15 handhole placement and lid with suitable backfill. Must be tamped around the handhole, 6" gravel base and conduit tie ins, locate existing pipelines and utilities, removal and disposal of spoil and/or surplus excavation material, dewatering, sheeting, shoring and or bracing, bedding; backfilling of job excavated material, compaction, surface restoration to pre-construction condition, site clean up, and other items as needed to complete the work except as called out separately in other bid items. Handhole lids shall include the installation of bolts. Includes tying in conduit end into handhole and capping conduit ends with duct plugs. Handhole to be paid for under materials. Includes softscape restoration

Install 4'x4'x4' Split Concrete
Consist of the installation of (1) 4'x4'x4' split concrete manhole flush with grade in hardscape. Unit includes excavation of earth and compaction and placement of 6" gravel base, placement of manhole, installation of manhole racking, frame and cover bonding and grounding. Also includes tie in of all conduits, locating existing pipelines and utilities; removal and disposal of spoil and/or surplus excavation material; dewatering; sheeting, shoring and or bracing, backfilling of job excavated material, compaction, surface restoration to pre-construction conditions, site clean up; and other items as needed to complete the work except as called out separately in other bid items. Material and hardscape restorations will be paid for separately.

Install 2" Electric Metal Tubing (EMT)
Consists of the labor and equipment necessary to install 1 lineal foot of 2" electric metal tubing at site locations. Connectors & couplings shall be compression type. Unit includes all hardware, sweeps, connectors, bushings, couplers and fasteners needed to secure and install conduit per code. EMT Pipe shall be paid for separately. All other materials are considered incidental. Unit includes site coordination and prep, caulking, and site cleanup.

Installation, Splice Closure and Prep Assembly, FOSC 450 (B)(C)(D)
Consists of installing (1) FOSC 450 splice closure. Size is indicated in parenthesis. Includes the closure manufacturer encapsulating material if required, installed in place and the labor for setting up, preparation, prepping tubes into trays, installing trays, ring cuts and opening of the cable sheath or jacket, bonding of the cable shield (if armored), closing the closure, grounding closure to ground rod with #6 AWG solid copper wire, and when applicable, pressure testing, all in accordance with the manufacturer's instructions. Labor units for splicing and testing to be paid separately. Materials for closure and splice trays shall be paid for separately.

2" Core Bore
Consist of a successful clean, non-destructive 2" core hole in concrete for a conduit building entry. Includes all set up of core bore machine, building entry coordination, water for core drill bit and site clean up. This unit is not to be used for spot holes or soft digs.

2" Building Riser with LB – up to 10'
Consists of installing up to a 10' (2") building riser that shall extend sufficiently below the ground line, to maintain a minimum depth of 30" for conduit housing fiber optic cable. The riser shall be installed with required elbows on a firm and uniform supporting base along the shortest route possible on the property, minimizing the number of bends. Pull string is required in the installation. Unit includes material costs for 2" riser, LB and associated hardware. Core bores shall be paid for separately.

Install 12 Port Wall Mount Interconnect
Consists of installing of a fully loaded 12 port wall mounted interconnect box including housing, 12 port connector panel, pigtails, trays or splice cassettes. Unit includes labeling of panel, prepping of all cables and installing panel in rack or wall mount. Panel to be paid for separately under materials.

Install Rack Mount (x)u Fully Loaded Panel with Cassettes and Pigtails
Consists of installing rack-mount fiber termination panel fully loaded with cassettes and pigtails capable of fitting a standard EIA 19" equipment rack or cabinet. Size of panel is indicated in parenthesis. Unit includes labeling of panel and prepping of all cables. Panel to be paid for separately under materials.

Sawcut, Remove and Replace Asphalt 6" thick
Consists of labor and equipment necessary to sawcut 1 square yard of Asphalt up to 6" thick, removal and disposal of asphalt and replacement with new asphalt per CDOT restoration specifications. Includes locating existing utilities, backfill and compaction as required. New asphalt shall be properly tamped and rolled. Includes restoration of any impacted asphalt striping.

Sawcut, Remove and Replace Concrete 6" thick
Consists of labor and equipment necessary to sawcut 1 square yard of concrete up to 6" thick, removal and disposal of concrete and replacement with new concrete per CDOT restoration specifications. Includes locating existing utilities and backfill and compaction as required. Includes all framing, cutting and site clean-up. Includes restoration of any impacted striping.

Remove and replace brick pavers
Consists of labor and equipment necessary to remove and replace 1 square yard of brick pavers, in the pattern in which they were removed. Includes locating existing utilities, backfill and compaction as required. Includes all ground and site prep and site clean up.

Measurement and payment for materials items:

6 CT Fiber Cable
Material consists of (1) lineal foot of 6 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

12 CT Fiber Cable
Material consists of (1) lineal foot of 12 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

24 CT Fiber Cable
Material consists of (1) lineal foot of 24 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

48 CT Fiber Cable
Material consists of (1) lineal foot of 48 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

96 CT Fiber Cable
Material consists of (1) lineal foot of 96 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

144 CT Fiber Cable
Material consists of (1) lineal foot of 144 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

216 CT Fiber Cable
Material consists of (1) lineal foot of 216 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

288 CT Fiber Cable
Material consists of (1) lineal foot of 288 count single-mode loose tube fiber optic cable section 02580 TELECOMMUNICATIONS.

432 CT Fiber Cable
Material consists of (1) Liner foot of 432 count single-mode Ribbon fiber optic cable section 02580 TELECOMMUNICATIONS.

864 CT Fiber Cable
Material consists of (1) Liner foot of 864 count single-mode ribbon fiber optic cable section 02580 TELECOMMUNICATIONS.

2” HDPE Roll Conduit, Orange – SDR 11 w/tape
Material - (1) lineal foot of Smooth wall HDPE SDR 11

2" PVC Schedule 40 Bell End

Material - (1) Lineal Ft of UV Resistant Gray PVC schedule 40 in 20' sticks and Bell ends

#12 AWG Solid THHN Insulated Tracer Wire
Material - (1) Lineal Ft of #12 AWG tracer wire, Jacketed UL and Direct Burial rated

5/8"x8' Copper Clad Ground Rod
Material (1) Pointed end UL rated copper clad ground rod w/ ground rod clamp and #6 Bare Copper

Small Vault, 24” x 36” x 24”
Material- (1) Precast polymer concrete 24"x36"24" ANSI Tier 15 handhole with lid w/ bolts

Large Vault, 30” x 48” x 24”
Material- (1) Precast polymer concrete 30"x48"24" ANSI Tier 15 handhole with lid w/ bolts

4'x4'x4' Precast "split " Manhole with Frame, Cover & Racking.
Material (1) 4'x4'x4' precast splice manhole with frame & Cover. Manhole shall have knockout ports on all 4 walls, and solid bottom with drain.

2" EMT Conduit
Material consists of (1) lineal ft of 2" diameter Electric Metal Tubing . All hardware, couplers, connectors bushings and fitting shall be considered incidental

FOSC 450 B Closure
Commscope # FOSC450-B6 B sized Splice case & associated hardware

Splice Tray for B-Gel Closure (SM12)
Commscope #FOSC-B-TRAY-12/24 splice tray for B sized splice case

Slack Basket for B-Gel Closure
Commscope FOSC-#ACC-B-BASKET -slack basket for B sized splice case

FOSC 450 C Closure
Commscope # FOSC450-C6 splice case and associated hardware

Splice Tray for C-Gel Closure (SM12)
Commscope #FOSC-ACC-C-TRAY-12 splice tray for C sized closure

Slack Basket for C-Gel Closure
Commscope #FOSC-ACC-C-BASKET - Slack basket for C sized splice case

FOSC 450 D Closure
Commscope #FOSC450-D6 D sized Splice case and associated hardware

D Size Ribbon Tray
Commscope #FOSC-D-TRAY-36/S96/L96/A96/RT24 - ribbon splice tray for D sized closure

Slack Basket for D-Gel Closure
Commscope #FOSC-ACC-D-BASKET Slack basket for D sized splice case

Flowable Fill
Trench and excavation units include compacted backfill or flowable fill. This unit shall be paid if excavated material is unsuitable for backfill and preapproved by the City. Flowable fill shall have enough water so that flowable fill flows into place properly without excessive segregation. Additional water shall not be added to the mixture at the project site. The Maximum layer thickness shall be 3 feet . Additional layers shall not be added until flowable fill can be walked on without indenting more than 2 inches.

Imported Granular Backfill
Trench and excavation units include compacted backfill or flowable fill. This Unit shall be paid if excavated material is unsuitable for backfill and preapproved by the City. Granular bedding shall consist of well graded sand or squeegee meeting a fine aggregate standard as approved by the Concrete Aggregate Gradation Table if the CDOT standard Specifications for Road and Bridge Construction. This unit shall be paid by metric ton of material delivered and installed.

SECTION 01200: PROJECT MEETINGS

PART 1: GENERAL

1-1 Pre-Construction Conference:

A preconstruction conference will be held after Notice of Award. The date, time and location will be determined after Notice of Award.

The conference shall be attended by:

- Contractor and Contractor's Superintendent
- Architect/Engineer/Resident Project Representative
- Project Manager
- Others as requested by the Contractor, City or Architect/Engineer

The Contractor shall bring to the conference their schedule for construction as submitted as part of their RFB response, including shop drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

- Review of Contractor's proposed schedule
- Transmittal, review, and distribution of contractor's submittals
- Processing applications for payment
- Maintaining record documents
- Critical work sequencing
- Field decision, change orders, purpose of Force Account
- Use of premises, office and storage areas, security, housekeeping, and City's needs
- Contractor's assignment for safety and first aid

The Project Manager will preside at the meeting and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

1-2 Construction Progress Meetings:

Progress meetings will be conducted weekly or at some other frequency, as directed by the City. These meetings shall be attended by the Contractor's representative and any others invited by the City.

The agenda of these project meetings will include construction progress, the status of submittal reviews, the status of information requests, critical work sequencing, review of strategies for connections into existing facilities, status of field orders and change orders, and any general business. These meetings will be attended by the Contractor at no additional costs to the City.

SECTION 01300: SUBMITTALS

PART 1: GENERAL

1-1 Requirements:

A. Where required by the specifications, the Contractor shall submit descriptive information that will enable the City to determine whether the Contractor's proposed materials, equipment, or methods of work are in general conformance to the design concept and in accordance with the Drawings and Specifications. The information submitted may consist of drawings, specifications, descriptive data, certificates, samples, test results, product data, and such other information, all as specifically required in the Specifications. In some instances, specified submittal information describes some, but not all, features of the material, equipment, or method of work. Features not requiring submittals shall be as specified.

B. Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment, or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the requirements of the Specifications and Drawings. The Contractor shall ensure that there is no

conflict with other submittals and notify the City in each case where its submittal may affect the work of another Contractor or the City. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors.

C. Submittals will be reviewed for overall design intent and returned to Contractor with action to be indicated by the City. It shall be the Contractor's responsibility to assure that previously accepted documents are destroyed when they are superseded by a resubmittal as such.

D. It shall be the Contractor's responsibility to insure that required items are corrected and resubmitted. Any work done before approval shall be at the Contractor's own risk.

1-2 Submittal Procedure:

A. Unless a different number is called for in the individual sections, three copies of each submittal and sample are required, all of which will be retained by the City. Contractor shall submit, in addition, whatever copies he wants returned to him.

B. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate coordinated review. Uncoordinated submittals will be rejected.

C. If the items or system proposed are acceptable but the major part of the individual drawings or documents are incomplete or require revision, the submittal will be returned with requirements for completion.

D. The right is reserved for the City to require submittals in addition to those called for in individual sections.

E. Submittals regarding material and equipment shall be submitted directly to the City and will be accompanied by a transmittal form. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete Sections, for which the submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

F. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX-Y;" where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals (i.e., A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of Submittal 25. Submittals containing operating and maintenance information shall include the characters "O&M" following the submittal number.

G. If the Contractor proposes to provide material, equipment, or method of work that deviates from the Contract Documents, it shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

H. Submittals that do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

1-3 Review Procedure:

A. Submittals are specified for those features and characteristics of materials, equipment, and methods of operation that can be selected based on the Contractor's judgement of their conformance to the requirements of the Drawings and Specifications. Other features and characteristics are specified in a matter that enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform to the Drawings and Specifications. Review shall not extend to means, methods, techniques, sequences, or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the Specifications) of a separate item, and as such, will not indicate approval of the assembly in which the item functions.

B. Unless otherwise specified, within 14 calendar days after receipt of the submittal, the City shall review the submittal and return copies. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment, or work method complies with the Specifications, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicates limited corrections are required, copies will be marked "EXCEPTIONS AS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in Operation and Maintenance data, a corrected copy shall be provided.

3. If the review indicates that the submittal is insufficient or contains incorrect data, copies will be marked "REVISE AND RESUBMIT." Except at its own risk, the Contractor shall note undertake work covered by this submittal until it has been revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED."

4. If the review indicates that the material, equipment, or work method do not comply with the Specifications, copies of the submittal will be marked "REJECTED." Submittals with deviations that have not been identified clearly may be rejected. Except at its own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED."

1-4 Shop Drawings:

A. The term "shop drawings" includes drawings, diagrams, layouts, schematic, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by Contractor to explain in detail specific portions of the work required by the Contract.

B. Contractor shall coordinate all such drawings, and review them for legibility, accuracy, completeness and compliance with contract requirements and shall indicate his approval thereon as evidence of such coordination and review. Shop drawings submitted to the City without evidence of Contractor's approval will be returned for resubmission.

C. Shop drawings shall be clearly identified with the name and project number of this contract, and references to applicable specification paragraphs and contract Drawings. When catalog pages are submitted, applicable items shall be clearly identified.

D. Contractor shall stamp his approval on shop drawings prior to submission to the City as indication of his checking and verification of dimensions and coordination with interrelated items. Stamp shall read:

"(Contractor's Name) represents that we have determined and verified all field dimensions and measurements, field construction criteria, materials, catalog numbers, and similar data, and that we have checked with the requirements of the Specifications and Drawings, the Contract Documents, and General Conditions".

Marks on drawings by Contractor shall not be in red. Any marks by Contractor shall be duplicated on all copies submitted.

E. If shop drawings show variations from contract requirements, Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variations must be approved by the City. If the City approves any such variations, he shall issue an appropriate Contract modification, except that, if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued.

F. Should the Contractor propose any item on his hop drawings, or incorporate an item into the work, and that item should subsequently prove to be defective or otherwise

unsatisfactory, (regardless of the preliminary review), the Contractor shall, at his own expense, replace the item with another item that will perform satisfactorily.

1-5 Operation and Maintenance Manuals:

For those items called for in individual sections, furnish three copies of operation and maintenance manuals. Each manual shall be bound in three-ring notebooks with permanent covers, and separators with index tabs. Operation and Maintenance Manuals shall include installation instructions, operating instructions, and owners manuals for all network infrastructure installed in relation to this project.

1-6 Certificates:

For those items called for in individual sections, furnish three certificates of compliance from manufacturers or suppliers certifying that materials or equipment being furnished under the Contract comply with the requirements of these specifications.

1-7 Samples:

Samples shall be sufficient size to clearly illustrate functional characteristics and full range of color, texture, and pattern.

1-8 Effect of Review of Contractor's Submittals:

Review of Drawings, data, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of its responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the designers or the City, or by any officer or employee thereof, and the Contractor shall have no claim under the Contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED" shall mean that the City has no objection to the Contractor, upon its own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

SECTION 01310: CONSTRUCTION SCHEDULE

PART 1: GENERAL

1-1 Scope:

This section specifies the procedures for preparing and revising the construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to the completion time, specific dates, and for determining the acceptability of the Contractor's progress payment estimates.

1-2 Description:

The Contractor shall prepare a construction schedule to depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor. Assigned values for each part of the work shall be indicated.

Completion time, specific dates and sequencing requirements described in these specifications shall be shown on the schedule. The scheduled duration of each activity shall be based on the work being performed during the normal 40-hour work week with allowances made for legal holidays and normal weather conditions.

1-3 Submittal Procedure:

Within 30 days after the date of the Notice to Proceed, the Contractor shall complete a construction schedule conforming and representing in detail all planned procurement and on-site construction activities. The schedule shall be prepared on reproducible paper and may be in draft form with legible freehand lines and lettering. Upon completion of the schedule, the Contractor shall submit the original and two copies to the City.

Within 14 days after receipt of the submittal, the City shall review the submitted schedule and return one copy of the marked up original to the Contractor. If the City finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy returned to the Contractor for corrections and resubmittal.

1-4 Schedule Revisions:

Revisions to the accepted construction schedule may be made only with written approval of the Contractor and the City. Changes in timing for activities may be modified with written agreement of the Contractor and the City.

SECTION 01410: MATERIALS TESTING

PART 1: GENERAL

1-1 Requirements:

A. Provide such equipment and facilities as are required for conducting field tests and for collecting and forwarding samples. Do not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment found to be acceptable. Any product which becomes unfit for use after approval thereof shall not be incorporated into the work.

B. Tests shall be made by an accredited testing laboratory selected by the City. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the American Society for Testing Materials (ASTM).

C. Where additional or specific information concerning testing methods, sample sizes, etc., is required, such information is included under the applicable sections of the Specifications. Any modification of, or elaboration on, these test procedures which may be included for specific materials under their respective sections in the Specifications shall take precedence over these procedures.

1-3 Contractor's Responsibilities:

A. In addition to those inspections and tests called for in the General Conditions and project documents, Contractor shall also be responsible for and shall pay all costs in connection with testing required for the following:

1. Concrete materials and mix designs.

2. Design of asphalt mixtures.

3. Gradation tests for embedment, fill and backfill materials.

4. All performance and field testing specifically called for by the specifications.

B. All retesting for work or materials found defective or unsatisfactory, including tests covered under 1-2 above.

1-4 Transmittal of Test Reports:

Written reports of tests and engineering data furnished by Contractor for the City's review of materials and equipment proposed to be used in the work shall be submitted as specified for shop drawings. The testing laboratory shall furnish three copies of a written report of each test performed by laboratory personnel in the field or laboratory.

SECTION 01510: TEMPORARY FACILITIES

PART 1: GENERAL

1-1 Office at the Work Site:

During the performance of this Contract, the Contractor shall be required to maintain a field office. At the Contractor's discretion, this office may be the superintendent's vehicle. The superintendent shall always carry an applicable communication device to receive drawings, instructions, and communications. Any communication given to the superintendent or delivered at the Contractor's field office in his absence shall be deemed to have been delivered to Contractor.

Copies of the drawings, specifications, submittals, and other Contract Documents shall be kept at Contractor's office at the site of the work and available for use at all times.

1-2 Water:

Water in reasonable amounts required for and in connection with the work to be performed may be furnished at existing fire hydrants by the City at the request of the Contractor. Contractor shall furnish necessary pipe, hose, nozzles, and tools and shall perform all necessary labor. The Contractor shall obtain from the City Public Works Department Utilities Division a hydrant water meter and backflow prevention device($1500 deposit required) to be installed on the fire hydrant being used for water. Contractor shall make arrangements with the City Public Works Department Utilities Division (who will fix the time, rate, and duration of each withdrawal from the distribution system) as to the amount of water required and the time when the water will be needed. Unnecessary waste of water will not be tolerated. Special hydrant wrenches shall be used for opening and closing fire hydrants. In no case shall pipe wrenches be used for this purpose.

1-3 Power:

Power for heating, lighting, operation of Contractor's plant or equipment, or for any other reasonable use by Contractor will be furnished by the Contractor. Contractor shall furnish necessary cable and connections and shall perform all necessary labor. Temporary heat and lighting shall be maintained until the work is accepted.

1-4 Telephone Service:

Contractor shall make all necessary arrangements and pay all installation charges for telephone lines and shall provide all telephone instruments. The telephone service and instrument in the office of the Resident Project Representative can be a cell phone. The telephone service shall be in the name of the Contractor, and all charges shall be billed to and paid by the Contractor

1-5 Sanitary Facilities:

Contractor shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 workers. Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

1-6 Damage to Existing Property:

Contractor will be held responsible for any damage to existing structures, work, materials, or equipment because of his operations and shall repair or replace any damaged structures, work, materials, or equipment to the satisfaction of, and at no additional cost to, the City.

Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

1-7 Security:

Contractor shall be responsible for protection of the site, and all work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

No claim shall be made against the City by reason of any act of an employee or trespasser, and Contractor shall make good all damage to the City's property resulting from his failure to provide security measures as specified.

Security measures shall be at least equal to those usually provided by the City to protect its existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the site.

1-8 Pollution Control:

Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance will be permitted to enter sanitary sewers, and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

SECTION 01560: ENVIRONMENTAL CONTROLS

PART 1: GENERAL

1-1 Dust Control:

The Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing.

Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

The Contractor shall provide and apply dust control at all times, including holidays and weekends, as required to abate dust nuisance on and about the site that is a direct result of construction activities. The use of chemicals, oil, or similar palliatives will not be allowed. The Contractor shall be required to provide sufficient quantities of equipment and personnel for dust control sufficient to prevent dust nuisance on and about the site.

The City will have authority to order dust control work whenever in its opinion it is required, and there shall be no additional cost to the City. The Contractor shall be expected to maintain dust control effectively whether the City or Engineer specifically order such work.

1-2 Preservation of Natural Features:

The Contractor shall confine operations as much as possible and exercise special care to maintain natural surroundings in an undamaged condition. Within the work limits, barricade trees, rock outcroppings, and natural features to be preserved. Do not remove, injure, or destroy trees or other plantings without prior approval. Do not fasten ropes, cables or guys to existing trees for anchorage. The City shall determine if restoration or replacement of any damaged Natural feature is required.

1-3 Housekeeping:

Keep project neat, orderly, and in a safe condition at all times. Store and use equipment, tools, and materials in a manner that does not present a hazard. Immediately remove all hazardous rubbish. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish and dispose of is at frequent intervals during progress of work. When excavations are made and if suitable, immediately utilize resultant earth with filling and compacting in place, or dispose of unsuitable materials off-site.

Wet down dry materials and rubbish to prevent blowing dust.

Keep volatile wastes in covered containers.

1-4 Disposal:

Disposal of Waste (Unsuitable) Materials: All material determined to be waste will be disposed of in approved landfill in a manner meeting all regulations. Dispose of waste materials, legally, at public or private dumping areas. Do not bury wastes inside of the limits of construction.

Disposal of Garbage and other Construction Materials: Provide sanitary containers/dumpsters and haul away contents such that no overflow exists.

Excess excavation shall become the property of the Contractor and shall be legally disposed of outside the limit of construction. Excess sand, and excess excavated material not used

on-site shall be hauled from the site to an approved disposal site. Excess excavated material suitable for backfill shall not be disposed of until all backfill operations are complete.

Immediately remove any hazardous materials.

All salvaged materials become the property of the City unless the City deems the material to be waste. The Contractor shall haul salvaged material to the location designated by the City.

1-5 Burning:

No burning of debris will be permitted.

1-6 Air and Water Pollution Control:

Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance will be permitted to enter sanitary sewers, and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

Take all necessary reasonable measure to reduce air and water pollution by any material or equipment used during construction. Blowing dust and airborne particulates shall be controlled and utilized agents, if approved by the City, shall be applied in accordance with manufacturer's recommendations.

Do not dispose of volatile wastes or oils in storm or sanitary drains, nor allow such materials to reach drainageways. Do not allow waste materials to be washed into streams or bodies of water. Do not allow fill materials to be washed downstream.

1-7 Erosion Control:

Prevent erosion and sedimentation. Plan and execute construction to control surface drainage from cuts and fills, and from borrow and waste disposal areas.

Minimize amount of bare soil exposed at any one time.

Sod or seed slopes as specified as soon as possible to prevent water pollution, erosion and/or deposition of earth into drainageways or streams.

Construct fill-in waste areas by selectively placing fill material to avoid erosion of surface silts or clays.

Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

Best management practices for erosion control shall be implemented in compliance with the City's Design and Construction Standards, the Colorado Department of Transportation and OSHA regulations.

It is expected that more than 1 acre of land will be disturbed on this project which will require a Stormwater Management and Erosion Control plan. A Stormwater Management and Erosion Control plan will be provided to the Contractor and will be a requirement for the contractor to follow for the duration on the project. Stormwater Management/ Erosion Control Plans will be prepared by or on behalf of the City using the "Colorado Stormwater Discharges Associated with Construction Activity General Permit Application and Stormwater Management Plan Preparation Guidance" as a guide. The Contractors total bid amount shall include all costs associated with the setup, maintenance, and breakdown associated with the Stormwater Management Plan.

1-8 Fire Prevention and Protection:

Hazard Control: Take all necessary precautions to prevent fire during construction. Provide adequate ventilation during use of volatile or noxious substances.

Spark Arresters: Equip all gasoline or diesel-powered equipment used in potential grass fire locations with spark arresters approved by the U.S. Forest Service.

Locate internal combustion equipment so that exhausts discharge well away from combustible materials.

Locate service areas a minimum of 100 feet from buildings. Shut down equipment before fueling.

Smoking: Smoking within buildings or temporary storage sheds is prohibited. Smoking in potential grass fire locations shall be prohibited.

Welding: Cutting by torch or welding shall be performed only when adequate fire protection is provided and maintained for the duration of the work in the area of operations. No welding shall be performed within line of site of the general public. All welding operations shall provide adequate safety to isolate welding operations for the protection of others. Welder shall wear adequate safety gear to include welders mask and flame resistant clothing.

Familiarize all work crews with grass fire potential and methods of reporting fires to the proper authorities. Take immediate action with sufficient personnel from the project crew or with tools and equipment to suppress fires.

1-9 Water Control:

The Contractor shall conduct his operation in such a manner that storm, or other waters may proceed uninterrupted along their existing drainage courses. By submitting a bid, the Contractor acknowledges that he has investigated the risk arising from such waters and has prepared his bid accordingly and assumes all of said risk.

The Contractor is responsible for all groundwater level control.

Construction dewatering water cannot be discharged to surface water or to the City of Boulder storm sewer system without a permit from the State of Colorado.

1-10 Noise Control:

All mechanical equipment shall be equipped with the best available mufflers to reduce noise. The Contractor shall be responsible for obtaining all necessary permits and shall limit noise to the permitted levels. Noise level monitoring shall be performed by the Contractor as necessary to show that the permitted levels are not being exceeded.

1-11 Contaminated Soil and Water:

If contaminated soil and or water are encountered or suspected the contractor shall immediately suspend construction operations and notify the City.

1-12 Tree Protection Requirements from the Forestry Division:

Construction contractors are required to follow tree protection standards established in the City's Design and Construction Standards (DCS), Chapter 3, "Streetscape Design and Tree Protection".

This project will involve construction activities in close proximity to many large, high value trees. These large trees have extensive root systems, many of which have grown up to and under adjacent sidewalks and curbs. Care is to be taken to avoid and/or minimize root damage to trees when removing and replacing hardscapes and utilities.

Construction impacts to tree roots have the potential to adversely affect the health of trees, and to create a significant safety concern should trees become unstable.

Below are highlights from the DCS, Chapter 3 that are especially pertinent to this project:

DCS, Chapter 3, Section 3.05

A. Tree Protection Procedures:

1. Soil Compaction Prevention:

To prevent tree root smothering, no soil stockpiles, supplies, equipment, or any other material shall be placed or stored within a tree dripline or within 15 feet of the tree trunk for column shaped trees, whichever distance is greater.

2. **Root Protection:**
   - **a.** Tree roots shall not be cut unless cutting is unavoidable.
   - **b.** When root cutting is unavoidable, a clean, sharp cut shall be made to avoid shredding or smashing. Root cuts should be made back to a lateral root.
   - **c.** Whenever possible, tree roots should be cut between late fall and bud opening, when root energy supplies are high, and conditions are least favorable for disease causing agents.
   - **d.** The City shall be notified of any cutting of the following roots:
     - **i.** Two roots having a diameter of more than 3 inches, or
     - **ii.** Four roots having diameters between 2 and 3 inches.
   - **e.** Trenches shall be hand-dug- within the dripline in areas where roots 2 inches and larger in diameter are present, and when low branches which may be damaged by equipment are present.
   - **f.** Whenever possible, roots 2 inches or larger in diameter shall be tunneled or bored under and shall be covered to prevent dehydration. Exposed roots shall be covered immediately with soil or burlap and kept moist.
   - **g.** Power tools shall not be used to prune roots, with the exception of arboriculturally approved root -cutting equipment used under the supervision of the City. Only the following approved tools shall be acceptable: overlap hand pruners and/or loppers, (not anvil types) and arborist- -type pruning saws.
   - **h.** When more than one root 2 inches or larger in diameter on any public tree is cut, supplemental watering shall be provided if the tree lacks an operational sprinkler system. The applicant or abutting landowner shall provide the watering.

3. **Tree Fencing:**
   - **a.** Fencing material shall encircle any tree whose outer dripline edge is within 20 feet of any construction activities.

b. Fencing material shall be a bright, contrasting color, durable, and at least 4 feet high. Fence posts shall be comparable to metal T-posts or heavier posts and placed at least 2 feet below ground.

c. Fencing material shall be placed at the dripline or at least 15 feet from any tree trunk, whichever distance is greater, and maintained in an upright position throughout the duration of construction activities.

For a full set of tree protection standards see the City of Boulder, Design and Construction Standards, Chapter 3, "Streetscape Design and Tree Protection".

Public trees are protected by City ordinance: Title 6, Chapter 6: "Protection of Trees and Plants." Damage to such trees is expected to be mitigated by a monetary reimbursement to the City of Boulder.

The Urban Forestry Section fully understands that some damage to tree roots and branches is unavoidable, however, we expect all contractors to follow tree protection standards and to work with the City's Urban Forestry Section to resolve problems when they encounter limitations.

SECTION 01570: TRAFFIC REGULATION

PART 1: GENERAL

1-1 Requirements:

The Contractor shall follow the traffic requirements of the MUTCD Manual including the Colorado supplement, for signage, barricades, cones, flagging and traffic control. This shall include the

1-2 Work Hours:

No work shall be performed, nor shall any traffic lane be closed to traffic during the hours of 7:00 a.m. to 8:00 a.m. or 4:30 p.m. to 6:00 p.m. on streets designated collector or greater without the approval of the City. Construction hours may be further restricted by the City to minimize construction impacts on traffic flow along arterial and collector roadways, or to address environmental and safety concerns. No work can take place on the road system if the road is wet, icy, snow packed, foggy, cloud covered, or if there is not enough light to safely work the area.

Work hours for all other locations shall be as required in the General Conditions.

1-3 Road Closures:

A. Traffic: Access, maintenance and emergency traffic shall not be disrupted by construction operations. If a temporary lane closure is necessary along any thoroughfare, the Contractor shall obtain any permits required for such activity from the appropriate jurisdictional agency in advance of the work.

B. All roads shall be open to at least one lane of traffic at all times. For one lane activities, property equipped radio controller, state certified flaggers will be required. No open trenches shall be allowed overnight.

1-4 Traffic Control:

Traffic control and barricading is the responsibility of the Contractor and shall be done in accordance with the City of Boulder's work Area Traffic Control and Safety Handbook and the most recent additions of the Colorado Department of Transportation MUTCD. All traffic control and barricading shall be maintained on a daily basis by the Contractor. Failure to maintain all traffic control shall cause Contractor operations to be suspended until all traffic control devices are installed and operating correctly in accordance with the approved traffic control plan. Work in the City streets, county roads and State Highways ROW shall require a traffic control plan. This plan shall meet the requirements of the Colorado Department of Transportation. No work shall commence until this plan has been submitted to and approved by the appropriate agency. The traffic control plan shall be prepared by an ATSSA certified traffic control engineer. All traffic control plans are the responsibility of the construction contractor and shall be provided at no additional cost to the City.

SECTION 01600: MATERIAL DELIVERY, STORAGE AND HANDLING

PART 1: GENERAL

1-1 General:

Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the City.

1-2 Pipe:

Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

1-3 Equipment:

A. Packaging and Marking:

All equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site.

Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub assembled units where possible.

B. Identification:

Each item of equipment and valves shall have permanently affixed to it a label or tag with its equipment or valve number. Marker shall be of stainless steel. Location of label will be easily visible.

C. Shipping:

Bearing housings, vents, and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.

Equipment damaged during shipping shall be promptly replaced or corrected to conform to the requirements of the contract before the assembly is incorporated into the work. The Contractor shall bear all costs arising out of such replacement or corrections including any necessary dismantling, inspection, repair, and reassembly.

D. Factory Applied Coatings:

Each item of equipment shall be shipped to the site of the work with either the manufacturer's shop applied prime coating. The prime coating shall be applied over clean dry surfaces in accordance with the coating manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats.

E. Storage:

During the interval between the delivery of equipment to the site and installation, all equipment shall be stored in an enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity, and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.

F. Protection of Equipment after Installation:

After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris, and dirt generated by the placement, chipping, cutting, finishing, and grinding of new or existing concrete; and terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing, and painting of new or existing piping and equipment. As a minimum, vacuum

cleaning, blowers with filters, protective shielding, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint.

SECTION 01640: SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1: GENERAL

1-1 Description:

A. General:

1. This section describes the procedure required by the Contractor for product substitutions.

B. Requests for substitution - General:

1. Base all bids on materials, equipment and procedures specified.

2. Certain types of equipment and kinds of material are described in specifications by means of trade names and catalog numbers, and/or manufacturer's names. Where this occurs, it is not intended to exclude from consideration such types of equipment and kinds of material bearing other trade names, catalog numbers and/or manufacturer's names, capable of accomplishing purpose of types of equipment or kinds of material specifically indicated.

3. Other types of equipment and kinds of material may be acceptable to the City.

4. Types of equipment, kinds of material and methods of construction, if not specifically indicated must be approved in writing by the City.

C. Submission of requests for substitution:

1. After Notice to Proceed, the City will consider written requests for substitutions of products, materials, systems or other items.

2. The City reserves the right to require substitute items to comply color and pattern-wise with base specified items, if necessary, to secure "design intent."

3. Submit three copies of request for substitution. Include in request:

a. Complete data substantiating compliance of proposed substitution with Contract Documents.

b. For products:

i. Product identification, including manufacturer's name.

ii. Manufacturer's literature, marked to indicate specific model, type, size, and options to be considered: Product description. Performance and test data, Reference standards. Difference in power demand. Dimensional differences for specified unit.

iii. Name and address of similar projects on which product was used, date of installation, and field performance data:

c. For construction methods:

i. Detailed description of proposed method.

ii. Drawings illustrating methods.

d. Itemized comparison of proposed substitution with product or method specified.

e. Data relating to changes in construction schedule.

f. Relation to separate contracts.

g. Accurate cost data on proposed substitution in comparison with product or method specified.

4. In making request for substitution, or in using an approved substitute item, Contractor represents:

a. They have investigated proposed product or method and has determined that it is equal or superior in all respects to that specified, and that it will perform function for which it is intended.

b. Contractor will provide same guarantee for substitute item as for product or method specified.

c. Contractor will coordinate installation of accepted substitution into work, to include building modifications if necessary, making such changes as may be required for work to be complete in all respects.

d. Contractor waives all claims for additional costs related to substitution which subsequently become apparent.

D. Substitutions:

1. Request sufficiently in advance to avoid delay in construction.

E. Contractor's Option:

1. For products specified only by reference standards, select any product meeting standards, by any manufacturer, indicate selected type in submission.

2. For products specified by naming several products or manufacturers, select any product and manufacturer named, indicate selected type in submission.

3. For products specified by naming one or more products but indicating option of selecting equivalent products by stating "or equal" after specified product, Contractor must submit request, as required for substitution, for any product not specifically named.

F. Rejection of substitution or optional items:

1. Substitutions and/or options will not be considered if:

   a. They are indicated or implied on shop drawings, or project data submittals, without formal request submitted in accordance with this section.

SECTION 01720: RECORD DRAWINGS

PART 1: GENERAL

1-1 Requirements:

The Contractor shall provide the City one neatly and legibly marked set of redlined drawings showing the final location of all improvements. Marking of the drawings shall be kept current and shall be done at the time the materials and equipment are installed. These drawings shall be available to the City at all times.

One set of full-sized record drawings shall be provided to the City prior to submitting progress payments for amounts in excess of 95 percent of the project's total cost.

The City shall have the right to withhold progress payments if record drawings are not kept current or do not meet the submittal requirements of this section.

All splice points, vaults, hand hole/manhole, and conduit turns of 45-degrees or greater should receive a sub meter accuracy GPS coordinate that is marked and labeled back onto the as-built drawings.

In addition to daily reporting of production, final project deliverables will be required. This includes, but is not limited to, a final set of redlines, including depths and offsets, and GPS Locations of all new installations and existing utilities, vaults, butterfly drawings, and bore

logs with enough information to easily reference location and direction of bore, fiber test results, fiber sequentials, photos of completed splice trays, closed out permits, warranty information and any additional information the City deems necessary.

SECTION 02200: EXCAVATION AND TRENCHING

PART 1: GENERAL

1-1 Description:

This section covers excavation work and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; stripping and stockpiling topsoil; excavation, boring and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

1-2 Submittals:

Specification sheets of all materials specified in this section shall be submitted to the City in accordance with Section 01300. Where gradations or other material properties are specified, information certifying these properties shall also be submitted. All gradation and samples of materials submitted must be approved by the City before incorporated into the work.

1-3 Safety:

With reference to the terms and conditions of the construction standards for excavations set forth in the OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, the Contractor shall employ a competent person and, when necessary, a registered professional engineer, to act upon all pertinent matters of the work of this section.

1-4 Quality Assurance:

All tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of the Contractor. Two initial gradation tests shall be made for each type of pipe bedding, fill, or backfill material, and one additional gradation test shall be made for each additional 500 tons of each material. Initial moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made at the expense of the Contractor Retests of samples failing initial tests shall be at the expense of the Contractor.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the City. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

PART 2: MATERIALS

2-1 General:

All bedding and backfill material shall have the approval of the City and shall be included in the unit price for the pipe unless otherwise specified and indicated in the bid. All bedding and backfill material shall be free of frozen material, organic material and debris.

2-2 Pipe Bedding:

Bedding materials both below and above the bottom of the pipe, classes of bedding to be used, and placement and compaction of bedding materials shall conform to the following requirements.

Bedding materials shall contain no cinders or other material which may cause pipe corrosion.

A. Concrete Encasement: Concrete encasement is not required unless improper trenching or unexpected trench conditions require its use as determined by the City.

2-3 Trench Backfill:

Trench backfill refers to material placed above the pipe bedding and shall be native clean backfill or flowable fill as specified in Section 2-6. For trench excavations in excess of five feet in depth and 16 inches in width and 20 feet in length, granular backfill material as specified in Section 2-7 may be used if approved by the City.

2-4 Stabilization Material:

Stabilization material shall be placed on suitably prepared subgrades and compacted by vibration. Stabilization material shall be compacted in 6” lifts to 90% density.

2-5 Groundwater Barrier Material:

Groundwater barrier material shall meet AASHTO soil classification SC or CL, free from stones, organic material or debris or flowable fill as specified in Section 2-6.

2-6 Flowable Fill:

Flowable fill shall meet the following requirements and shall be used for trench backfill when specified in the contract or by the City, or as a groundwater barrier.

Ingredients	Lbs./C.Y.	Kg/m^3
Cement	50	30
Coarse Aggregate (AASHTO No. 57 or 67)	1700	1009
Fine Aggregate (AASHTO M 6)	1845	1095
Water (39 Gallons) (147 L)	325 (or as needed)	193 (or as needed)

The amount of water shall be such that the flowable fill flows into place properly without excessive segregation. Approximately 39 gallons of water per cubic yard (193 L per m^3) of flowable fill is normally needed. Flowable fill shall have a slump of 6 to 8 inches per ASTM C143. Maximum allow time between batch mixing and placement shall be 90 minutes.

The Contractor may use aggregate which does not meet the above specifications if the cement is increased to 100 pounds per cubic yard (lbs./C.Y.) (60 kg./m^3) and the aggregate conforms to the following gradation:

Sieve Size	% Passing
1 inch (25.0 mm)	100
No. 200	0 - 10

The Contractor may substitute 30 lbs./C.Y. (18 kg/m^3) of cement and 30 lbs./C.Y. (18 kg/m^3) of fly ash for 50 lbs./C.Y. (30 kg/m^3) of cement or may substitute 60 lbs./C.Y. (36 kg/m^3) of cement and 60 lbs./C.Y. (36 kg/m^3) of fly ash for 100 lbs./C.Y. (60 kg/m^3) of cement.

The maximum depth of trench in which flowable fill may be used shall be 3 feet (1 m). With trench depths greater than 3 feet, a combination of backfill materials may be used. An aggregate base course material, compacted by traditional methods and equipment, may be used for depths exceeding the flowable fill limits, and topped off with a flowable fill cap of 3 feet in depth. The flowable fill shall be placed so that it heaps over the top edge of the trench. This is required so that, when the fill is vibrated, the excess water can rise to the surface and flow away from the trench. Any damage resulting from the placing of the flowable fill, or from not providing sufficient consolidation shall be repaired at the construction Contractor's expense.

'Quick' setting flow fill may be used if approved by the City and mix design and materials are submitted for approval per section 1300.

2-7 Granular Backfill Material:

Granular backfill material shall be an imported graded material meeting the CDOT section 703, class 1 or class 3 specifications.

If approved by the City, granular backfill material may be finely divided job excavated material free from debris, rubbish, clods, roots, brush, frozen lumps of earth, organic material and stones larger than 6 inches and with no more than 20 percent by weight passing the No. 200 sieve.

PART 3: EXECUTION

3-1 Working Conditions:

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the City. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-2 Site Preparation:

All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of the Contractor.

In natural areas where excavation will occur, strip all topsoil, or in the absence of topsoil, strip the top 6 inches of surface material and store separately from other excavated materials.

For concrete walks, roadways, parking areas and road crossings, cut existing pavement full depth to a true line before excavation.

3-3 Classification of Excavated Materials:

No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

3-4 Unauthorized Excavation:

Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced,

by and at the expense of the Contractor, with concrete placed at the same time and monolithic with the concrete above.

3-5 Stabilization of Subgrades:

Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than four inches; if the required depth exceeds four inches, the material shall be furnished and installed as specified for stabilization material. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the drawings.

3-6 Blasting:

Blasting or other use of explosives for excavation will not be permitted.

3-7 Shoring:

As needed, all excavations shall be properly sheeted and braced to meet Federal, State and local laws in regard to safe working conditions. The shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Any damage to pipes or structures resulting from settlements, heaving, water or earth pressures, slides, caving, or other causes, due to lack of shoring, sheeting, or bracing, or due to failure of shoring, or due to improper shoring, or due to any other negligence on the part of the Contractor, shall be repaired by the Contractor at his own expense.

Shoring shall be removed as the work progresses, unless left in place by written order of the City. The Contractor will be paid for shoring so ordered left in place on the basis of invoice material cost only. Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting, nor shall sheeting be pulled after backfilling. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

3-8 Water Control and Dewatering:

Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure

to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12 inches or more below the bottom of the excavation. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

3-9 Trench Excavation:

Trenches shall be excavated so that conduit can be laid in accordance with the profiles, grades, elevations and minimum cover as shown on the drawings or specified herein. No trenches or excavation shall be left open after working hours.

A. Excavation in Streets and Other Paved Surfaces. The excavation in streets with asphalt paving must be confined to a minimum width as required to maintain a safe trench condition. The pavement shall be cut vertical and on a straight line.

B. Minimum Cover: Where conduit grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 30 inches within City right of ways. When working in CDOT right of ways, minimum depth is 48 inches or as defined by CDOT permit conditions.

C. Trench Widths: The Minimum width for all trench excavations is 10".

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be done only in areas where the increased trench width will not interfere with surface features.

D. Warning Tape shall be required for all buried cable installation processes except when directional boring operation are used and shall be as follows:

1. Extra stretch terra tape
2. Minimum of 6 inches (6") wide
3. Orange in color with black lettering which reads "Caution Buried Fiber Optic Cable Below"
4. Placed in the Trench a minimum of twelve inches (12") above all conduit/ fiber

E. Trench Walls: The Contractor may slope or bench the trench sidewalls in areas where an increased trench width will not interfere with surfaces features or other utilities. Such sloping or benching shall terminate at a depth not lower than one foot above the top of the pipe barrel, and from that point down, the trench wall shall be vertical. The trenching operation, including the spoil bank and sloping of the trench sidewalls shall be confined to the width of the permanent and temporary rights-of-way, if any.

A clear area shall be maintained a sufficient distance back from the top edge of the excavation to avoid overloading which may cause slides or caving of the trench walls. The excavated material shall be kept trimmed in such a manner as to be of as little inconvenience as possible to the public and adjoining property owners. Unless otherwise authorized by the City, all public thoroughfares and crossroads shall be kept open to traffic. Bridging shall be used when authorized by the City at street crossings, sidewalks and other points where necessary, to prevent serious interruption of travel and to provide access to fire hydrants and public and private premises.

F. Trench Depth: The trenches shall be excavated to such depths that the pipeline can be laid at the elevation of the grade lines shown on the Drawings, or at the depths or covers specified herein. If unauthorized over-excavation occurs, the Contractor shall place and compact stabilization material at no additional cost to the City.

G. Trench Preparation: The trench shall be excavated only so far in advance of pipe laying as permitted by the City. The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches shall be drained so that pipe laying may take place in dry conditions. Trench preparation shall also conform to the details shown on the Drawings.

Trenches above a point 12-inches above the top of the pipe shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing, and the handling of special units as necessary.

Bell holes in the trench bottom shall be provided at each joint to permit the jointing to be made properly and to prevent the pipe from bearing on the pipe bells.

After excavation, the trench bottom shall be uniformly graded and hand-shaped so that the pipe barrel (exclusive of the joint) will have uniform and continuous bearing on thoroughly compacted pipe bedding material throughout the length of the pipe. The trench grade shall permit the pipe spigot to be accurately centered in the preceding laid pipe joint, without lifting the pipe above the grade and without exceeding the permissible joint deflection. If it is necessary to raise the pipe subgrade, approved, compacted bedding material shall be used at the Contractor's expense.

H. Excavation Material: Excess excavated material suitable for backfill shall not be disposed of until all backfill operations are complete. If excavated material

unsuitable for backfill is encountered, the excess material from other locations in the project shall be used for backfill at no additional cost to the City.

I. Rock Excavation: In the event of rock excavation, the bottom of the trench shall be lowered so that the bottom of the trench is 6 inches below the outside surface of the pipe. The space between the rock and the pipe shall be filled with granular bedding material as designated in Section 02200, 2-2D. The bedding material shall be compacted to a density equal to or greater than 90% of the maximum laboratory density. During compaction, the bedding material shall be shaped to provide support along the full length of pipe.

3-10 Directional Boring:

The work specified in this Section documents the approved construction methods, procedures and materials for Directional Boring, also commonly called Horizontal Directional Drilling (HDD).

Directional boring is a trenchless method of installing carrier or casing conduit. It is a multi-step process including site preparation, utility research and identification, equipment set up, and drilling a pilot hole along a predetermined path, and then pulling the product back through the drilled space. When necessary, enlargement of the pilot bore hole may be necessary to accommodate a product larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the product is being pulled back through the pilot bore hole.

Drill head alignment is achieved by the proper orientation of the drill bit head as it is being pushed into the ground by a hydraulic jack to determine orientation and tracking of the drill bit. In order to minimize friction and prevent collapse of the bore hole, a soil stabilizing agent (drilling fluid) may need to be used. All drilling fluid shall be collected and disposed of at an approved disposal facility.

Contractor shall carry out excavation for entry, exit, recovery pits, slurry sump pits, or any other excavation as specified for excavation and backfill. Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation.

Contractor shall confine free flowing (escaping) slurry or drilling fluids at the ground surface during pull back or drilling. Remove all residual slurry from the surface and restore the site to pre-construction conditions.

Within 24 hours of completing installation of the product, Contractor shall clean the work site of all excess slurry or spoils. Contractor shall be responsible for the removal and final disposition of excess slurry or spoils. All work sites are to be restored to pre-construction conditions or as identified in the plans.

The Contractor is responsible for any damage caused by heaving, settlement, equipment, separation of pavement, escaping drilling fluid (frac-out), or the directional drilling operation at no cost to the City.

A. Product Locating and Tracking:

All directional bores shall be constantly tracked during all phases of boring. The approved method of locating and tracking the drill head during the pilot bore include walkover, wire line, and wire line with surface grid verification, or any other system as approved by the City. Use of locating and tracking system capable of ensuring the proposed installation is installed is required. All bore tracking methods shall include:

1. Clock and pitch information
2. Depth
3. Transmitter temperature
4. Battery status
5. Position (x, y)
6. Azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility)
7. Ensure proper calibration of all equipment before commencing directional drilling operation.
8. Take and record alignment reading or plot points such that elevations on top of and offset dimensions from the center of the product to a permanent fixed feature are provided. Such permanent fixed feature must have prior approval of the City. Provide elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a minimum distance between points of 50 feet. Provide sufficient number of elevation and offset distances to accurately plot the vertical and horizontal alignment of the installed product. A minimum of three elevation and plot points are required.

B. Product Bore Hole Diameter:

Minimize potential damage from soil displacement/settlement by limiting the ratio of the bore hole to the product size. The size of the back-reamer bit or pilot bit, if no back reaming is required, will be limited relative to the product diameter to be installed as follows:

Maximum Pilot or Back-Reamer Bit Diameter When Rotated 360 Degrees	
Outside Conduit Diameter Inches*	Maximum Reamer Diameter Inches
Less than 8”	Diameter + 4”
8” to 24”	1.5 x Diameter

Greater than 24”	Diameter + 12”

C. Drilling Fluids:

Contract shall not use any chemicals or polymer surfactants in the drilling fluid without written consent from the City. Certify to the City, in writing, that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Any water source used other than a potable water source may require a pH test.

D. Failed Bore Attempts:

If a Contractor fails to complete an initial drill out, back ream or successful pull back of material, the Contractor shall make 3 attempts to re-drill at no additional costs to the City. If ground conditions, or circumstances exist that are beyond Contractor’s control and prevent the completion of successful undamaged material installation after the third attempt, Contractor shall coordinate with the City to establish alternate methods of installation for that section. If conditions warrant removal of any new conduit installed in a failed bore path, as determined by the City, it will be at no cost to the City. The Contractor shall promptly fill all voids with excavatable flowable fill.

When there is any indication that the installed product has sustained damage or stretched, stop all work, Contractor shall notify the City and investigate the damage. The City may require a pressure test or mandrel to be pulled and reserves the right to be present during the test. The City maintains up to 72 hours to approve or determine if the product installation is in compliance with the specifications. The City may require non-compliant installations to be filled with excavatable flowable fill and replaced at no additional cost to the City.

3-11 Installation of Backfill:

Unless accurate results cannot be obtained, the compaction requirements shall conform to maximum dry density according to ASTM D698, Moisture-Density Relations of Soils (Standard Proctor). When the ASTM D698 test is not applicable, the percentage compaction requirements shall conform to ASTM D2049 Test for Relative Density of Cohesionless Soils.

When required by the City, the Contractor shall excavate backfilled trenches for purposes to perform compaction tests at locations and depths determined by the City. The Contractor shall be responsible for reinstalling and compacting the test excavations at no additional cost to the City.

All backfill above the bedding installation shall be carefully placed and compacted. Compaction shall be achieved with mechanical equipment suitable for the material being

compacted, in 6-inch maximum loose lifts. Tamping equipment such as a hydro-hammer or a drop-hammer that creates excessive vibration outside of the area being compacted shall not be used in areas adjacent to existing structures and utilities. All compaction means must be approved in writing by the City. All backfill shall be compacted to 90% of maximum laboratory dry density or 70 percent relative density. The material shall be within 2.0 percent of optimum moisture content.

The Contractor may request approval of alternate means of compaction. Such request must be submitted to the City in writing. Approval of the compaction method will be made by the City only in writing. Use of specified or approved compaction methods does not relieve the Contractor from providing a complete project meeting the intent of this Specification.

3-12 Structural Excavation and Backfill:

Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

The quality and moisture content of materials for backfill around and outside of structures shall conform to the requirements for materials used for earthfills and embankments.

No backfill shall be deposited or compacted in water.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters, or other surface construction or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less that 12 inches above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

3-13 Earthfills and Embankments:

To the maximum extent available, excess suitable material obtained from structure and trench excavations shall be used for construction of fills and embankments.

Additional material shall be provided as required by the Contractor. After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that surface materials of the subgrade will be compact and well bonded with the first layer of the fill or embankment.

All material deposited in fills and embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials, and shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content.

3-14 Storage of Excavated Material:

Excavated material shall be stockpiled near the immediate construction area in a confined configuration. For storage of excess excavated material suitable for backfill, Contractor shall obtain and pay for a storage site. All transportation to and from (including loading) storage site and temporary land/site acquisition is included in the work.

All excess excavated material at the completion of the work and all debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of the Contractor.

3-15 Restoration:

The latest edition of the "Colorado Department of Transportation Standard Specifications for Road and Bridge Construction" is hereby adopted by reference in these Standards as the City restoration standards, except as specifically amended by the provisions of this chapter.

All work performed under the responsibility of the Contractor shall include full restoration of any disturbed area to like new condition as specified by the Colorado department of Transportation. This includes, but is not limited to; asphalt, concrete, pavers, earthwork, compaction requirements, sod, plants, trees, landscaping, signage, irrigation systems, and all existing utilities.

All streets and paved surfaces shall be restored within two (2) weeks of their excavation. All dirt and debris, including dust shall be removed from streets and paved surfaces within three (3) days of the restoration of streets and paved surfaces. Initial removal of dirt and debris shall be made using a vacuum sweeper, after which the paved surfaces shall be cleaned using water hoses.

A. Concrete Walks, Curb and Gutter, Fencing and Culverts: Restore all existing structures to conditions equal to or exceeding existing structures and according to local requirements.

B. Landscape: After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least one percent shall be provided.

Final grading and surfacing shall be smooth, even, and free from clods and stones larger than one inch in greatest dimension, weeds, brush, and other debris.

The top portion of backfill beneath established lawn areas shall be finished with at least 12 inches of topsoil corresponding to, or better than, that underlying adjoining lawn areas.

C. Other Items: The City will clarify restoration of other minor items as construction proceeds. Such items must be restored to equal or exceed existing conditions.

3-16 Cleanup:

Prior to final inspection and system acceptance, the Contractor shall remove all rubbish and excess materials and leave area in a neat, satisfactory condition.

3-17 Maintenance of Backfill:

All backfill shall be maintained in a satisfactory condition and all places showing signs of settlement shall be filled and maintained during the life of the Contract and for a period of two years following the date of final acceptance of all work performed under the Contract. When the Contractor discovers or is notified by the City that any backfill is not in compliance with the provision of this Contract, the Contractor shall correct such conditions. Any utilities and road surfacing damaged by such settlement shall be repaired by the Contractor to the satisfaction of the City. In addition, the Contractor shall be responsible for the cost to the City of all claims for damages due to settlement of backfilled areas.

SECTION 02520: SIDEWALK, CURB AND GUTTER, AND MISCELLANEOUS CONCRETE

PART 1: GENERAL

1-1 Description:

The work of this section shall detail the restoration requirements and construction of the sidewalk, and curb and gutter, in accordance with these specifications and the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

1-2 Reference Standards:

All references are listed in section 01071, Standard References.

1-3 Submittals:

A concrete mix design shall be submitted to and approved by the Engineer prior to the installation of any sidewalk, or curb and gutter. The mix design used shall be previously approved and currently used by the Colorado Department of Transportation.

PART 2: MATERIALS

2-1 The following concrete classes shall be used.

Curb and Gutter:	Class B
Sidewalk:	Class B

PART 3: EXECUTION

3-1 General Requirements:

A. Excavation: Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm, even surface conforming to the section shown on the drawings or as staked. All soft and unsuitable material shall be removed and replaced with acceptable material.

B. Forms: Forms shall be of wood material only along curved sections, and wood, metal, or other suitable material along straight sections. All forms shall extend for the full depth of concrete. All forms shall have sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. All forms shall be clean and shall be oiled immediately before concreting. Care shall be taken in removing forms to prevent marring or spalling of the concrete.

C. Placing Concrete: The foundation shall be thoroughly moistened immediately prior to the placing of the concrete. The proportioning, mixing, and placing of the concrete shall be in accordance with the requirements for the class of concrete specified.

D. Finishing: For the purpose of matching adjacent concrete finishes, the Project Manager shall approve methods of sidewalk finishing.

E. Joints: The sidewalk shall be divided into sections by dummy joints formed by a jointing tool or other acceptable means as directed. These dummy joints shall extend into the concrete for a least 1/4 of the depth and shall be approximately 1/8 inch wide. Dummy joints shall be installed every 10 feet along sidewalk.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk. Pre-molded expansion joint filler 1/4 inch thick shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete sidewalks and any fixed

structure such as a building or bridge. This expansion joint material shall extend for the full depth of the walk.

All joints shall be sealed with an approved joint sealing compound, as directed by City.

F. Curing: Immediately upon completion of the finishing, the concrete bike path and sidewalks shall be cured for 7 days.

During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as the Engineer may direct.

3-2 Concrete Curb and Gutter:

A. Excavation: Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm, even surface conforming to the section shown on the Drawings or as staked. All soft and unsuitable material shall be removed and replaced with acceptable material.

B. Forms: Forms shall be of wood material only along curved sections, and wood, metal, or other suitable material along straight sections. All forms shall extend for the full depth of concrete. All forms shall have sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. All forms shall be clean and shall be oiled immediately before concreting. Care shall be taken in removing forms to prevent marring or spalling of the concrete.

C. Mixing and Placing: Concrete shall be proportioned, mixed and placed in accordance with the requirements for the class of concrete specified. Compaction of concrete placed in the forms shall be by vibration or other acceptable method. Forms shall be left in place until the concrete has set sufficiently so that they can be removed without injury to the curbing. Upon removal of the forms, the exposed curbing face shall be immediately finished to a uniform surface. For the purpose of matching adjacent concrete finishes, or for other reasons, the Engineer shall approve methods of finishing. No plastering will be permitted.

D. Sections: Curbing shall be constructed in sections having a uniform length of 10 feet, unless otherwise specified. Sections shall be separated by dummy joints 1/8 inch wide, except at expansion joints.

E. Joints: Expansion joints shall be formed at the intervals shown on the Drawings using a preformed expansion joint filler having a thickness of 2 inch. When the curb is constructed adjacent to or on concrete pavement, expansion joints shall be located opposite or at expansion joints in the pavement.

Expansion joints shall be installed between concrete curb and fixed structure, sidewalk, or bridge. Expansion joint material shall extend the full depth of the contact surface.

Contraction joints shall be formed by a jointing tool and shall be at least 1/4 of the concrete thickness in depth and approximately 1/8 inch wide.

All joints shall be sealed with an approved joint sealing compound as directed by the Engineer.

F. Curing: Immediately upon completion of the finishing, all surfaces shall be cured for a period of 7 days.

3-3 Concrete Pavement and Cross Spans:

The Contractor shall perform all cutting and patching of concrete paving and all concrete cross spans in accordance with the Colorado Department of Transportation (CDOT) Standard Specification for Road and Bridge Design, Sections 412 and 601, with the following revisions.

A. Section 601.02 shall be revised as follows:

The desired compressive strength for each class of concrete <u>is</u> a specification.

B. Section 601.05 is revised as follows:

It shall be the responsibility of the Contractor to furnish the mix design for the classes of concrete specified. The mix designs used shall be ones that have been previously approved and are currently used by the Colorado Department of Transportation. The Contractor shall submit the design mix proposed for each class of concrete to be used on the project for approval by the Project Manager. The Contractor shall not place any concrete without an approve design mix.

3-4 Slip-Form Machine:

A slip-form paving machine will be permitted for curb and gutter or sidewalk provided it has been approved prior to use and that the construction conforms to the following requirements:

A. The machine shall form concrete that is uniform in texture, shape and density.

B. Any cost associated with over excavation or compaction necessary to prepare the subgrade for the paving machine tracks shall be borne by the Contractor.

C. Concrete finishers shall follow the machine to form joints and correct any imperfections in finish.

D. The concrete edges shall be straight, smooth, and true. The concrete shall be a stiff (low slump) mix.

SECTION 02580: TELECOMMUNICATIONS

PART 1: GENERAL

1-1 Description:

These standards describe the specifications and methods by which the City's fiber-optic network infrastructure shall be designed and installed. Fiber-optic construction projects shall follow the specifications and principles outlined below, in addition to the City's civil construction standards, regulations, and specifications as they apply. All fiber routes shall be installed within public right-of-way (ROW), existing utility easements, or other property to which the City has legal access.

1-2 Submittals:

A. The Contractor is required to submit all material specifications to the City for review and approval prior to ordering. This includes, but is not limited to, relevant material specifications sheets that include manufacturer, part numbers, size, performance and shop drawings.

B. The Contractor shall allow a minimum of one week (five working days) for the City to review submittals.

C. All products seeking approval either as "approved equivalent" or otherwise, shall be submitted as a product substitution request prior to ordering. Failure to submit product substitution requests may preclude product from being utilized on the project.

D. The burden of proof is on the Contractor to provide documentation that an equivalent product meets the specifications and project requirements. Include in substitution request:

1. Product being replaced

2. Reason for product substitution

3. Full manufacturer specification sheet clearly indicating that all requirements in project documents have been met

E. Failure to meet these requirements will results in the product substitution request being returned without review.

F. All product substitution requests are to be reviewed for approval by the City. Not all requests will be approved, and all decisions are final, without recourse.

1-3 Product Handling:

The Contractor shall exercise care in the handling of all materials to ensure no damage is incurred to conduit, fiber, vaults, handholes and other materials throughout the receiving, storage and placement process. The Contractor shall not store materials directly on the ground. The Contractor shall inspect conduit for cracks, dents, abrasions or other flaws. The City will reject use of any damaged materials. The City maintains the right to inspect all materials prior to installation by the Contractor. Contractor shall replace damaged conduit at no additional expense to the City.

1-4 Craftsmanship:

All work, which is defective in its construction or deficient in any of the requirements of the plans and specifications, shall be remedied or removed and replaced by the Contractor in an acceptable manner at its own expense. No compensation will be provided for any construction beyond the lines and grades shown on the plans or established by the City. Upon failure on the part of the Contractor to comply with any order of the City made under the provisions of this standard, the City may cause the defective work to be remedied or removed and replaced at the expense of the Contractor.

Any unauthorized or defective work, defective material or workmanship or any unfaithful or imperfect work that may be discovered before final acceptance of work by the City shall be corrected immediately with no extra charge even though it may have been overlooked in previous inspections and estimates or may have been caused due to failure to inspect the Work.

All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the City. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the City.

The Contractor shall strictly adhere to all Telecommunications Industry Association (TIA) and BICSI recommended installation practices and manufacturer’s guidelines when installing fiber-optic infrastructure.

The limiting nature of this specification does not relieve the Contractor from responsibility for failure or damage caused by unsound construction practices. The Contractor also must consider and effectively use the guidance and recommendations

provided by product manufacturers and suppliers. The City will not be responsible for the repair or replacement of work if the failure or damage is caused by the fault or negligence of the Contractor.

PART 2: MATERIALS

2-1 Conduit:

Telecommunications conduit may be either polyvinyl chloride (PVC) schedule 40, or high-density polyethylene (HDPE) depending on the installation required.

A. PVC Conduit:

Conduit installed via trenching shall utilize PVC Schedule 40 duct. Conduit shall be installed in lengths of 20 feet with bell ends. Unless otherwise specified, the conduit joint shall be "push-on" type, made from clean, virgin, NSF Approved Class 12454-A or 12454-B PVC conforming to ASTM 1785.

B. High Density Polyethylene (HDPE) Conduit:

Conduit installed via directional drilling shall have the minimum SDR rating of SDR 11. All conduit shall meet the minimum dimension requirements of SDR11, ASTM D-3035 for conduits that are 6 inches or smaller.

2-2 Cable:

All fiber cable unless specifically called out for shall be single-mode cable and rated for the environment in which it is installed. Any outside plant installation of fiber cable shall utilize OSP-rated dielectric, non-armored cable.

Each optical fiber shall be glass and consist of a doped silica core surrounded by concentric silica cladding. All fibers in each buffer tube shall be usable and shall be sufficiently free of surface imperfections and occlusions to meet the optical, mechanical, and environmental requirements. The individual fiber coating within the buffer tubes shall be a dual layered, UV-cured acrylate. The coating shall be mechanically or chemically strippable without damaging the fiber.

The fiber optic cable shall consist of, but not be limited to, the following components:

- Single-mode optical fiber
- 12 fibers per buffer tube (loosetube non backbone cables)
- Central strength member
- Filler rods (as needed per cable type)
- Stranding
- Dry-filled, or gel-filled
- Water blocking tape and water blocking yarn

- Tensile strength member
- Ripcord

A. Pre-Approved Product Sets:

The following product sets are pre-approved for this project. Except as noted, all others will require a substitution request to be completed and approved as per these documents. The City will not consider product sets that have not been pre-approved or accepted as per the substitution request process.

1. Fiber optic cable and connection/termination products shall be manufactured by one of the following:
   a. Prysmian
   b. Corning
   c. CommScope
   d. OFS
   e. Or approved alternate

B. Backbone Cable:

All backbone cable shall be 432-count ribbon fiber. All other cables shall be loose tube

C. Cable Marking:

The optical fiber cable outer jacket shall be marked with manufacturer's name, the month and year of manufacture, the words "Optical Cable," telecommunications handset symbol as required by Section 350G of the National Electrical Safety Code (NESC®), fiber count, fiber type, and sequential meter marks. The markings shall be repeated every two feet. The marking shall be in a contrasting color to the cable jacket. The marking shall be permanent and weatherproof.

D. Buffer Tubes:

The loose buffer tubes shall be single or dual layered in construction. For single layer, polypropylene shall be used. For dual layer, the inner layer shall be made of polycarbonate and the outer layer shall be made of polyester. Buffer tubes shall provide clearance between the fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes and shall not adhere to the inside of the tube. Each buffer tube shall contain 12 fibers based upon the total fiber count in the cable and the fiber assignment table as shown on the plans and these special conditions. No individual buffer tube shall contain more than 12 fibers.

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be

tough and abrasion resistant to provide mechanical and environmental protection of the fibers yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound shall be a homogenous, hydrocarbon-based gel with antioxidant additives. It shall be used to prevent water intrusion and migration. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional, nontoxic, solvents.

Buffer tubes shall be stranded around a central member by a method such as the reverse oscillation stranding process that will prevent stress on the fibers when the cable jacket is placed under strain.

Each buffer tube shall be distinguishable from other buffer tubes in the cable by using the same color coding as specified for fibers elsewhere in this document.

E. Central Member:

The central member, which functions as an anti-buckling element, shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. To provide the proper spacing between buffer tubes during stranding, a symmetrical, linear, overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

F. Filler Rods:

Fillers may be included in the cable cross-section. Filler rods shall be solid medium or high-density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

G. Stranding:

The buffer tubes shall be helically wrapped using the reverse lay stranding process around the central member in order to decouple the buffer tubes and optical fibers from the mechanical forces experienced during installation.

Completed buffer tubes shall be stranded around the central member using stranding methods, lay lengths, and positioning such that the cable shall meet mechanical, environmental, and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage.

H. Core and Cable Water-Block Material:

The cable core shall use either a gel filled, or a dry, water-blocking material to block the ingress and migration of water. The water-blocking performance shall be equivalent to flooded optical cables when tested in accordance with industry standards (ICEA, RUS). Dry, water-blocking material is used in optical cables to enhance the ease of handleability while maintaining reliable water-blocking performance.

I. Tensile Strength Member:

Tensile strength shall be provided by high tensile strength Aramid yarns and/or fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

J. Ripcord:

The cable shall contain at least one ripcord under the jacket for easy sheath removal.

K. Outer Jacket:

The all-dielectric cables (no armoring) shall be sheathed with medium or high-density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and shall not adhere to the Aramid strength material. The polyethylene shall contain carbon black to provide ultra-violet light protection, and it shall not promote the growth of fungus. The jacket shall be free of holes, splits and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable", the number of fibers, fiber type, month and year of manufacture, and sequential measurement markings every meter. The actual length of the cable shall be within ±1 percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The print height of the marking shall be approximately 2.5 mm and must be permanent and weatherproof. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

Table 1 – Field Characteristics

Parameters	**Value**
Mode	Single
Type	Corning SMF-28 or approved equal
Core diameter	8.3 μm (nominal)
Cladding diameter	125 μm ± 1.0 μm
Core to Cladding Offset	≤ 0.8 μm

L. Color Coding:

Optical fibers shall be distinguishable from others in the same buffer tube by means of color-coding according to the following:

1. Blue (BL)
2. Orange (OR)
3. Green (GR)
4. Brown (BR)
5. Slate (SL)
6. White (WT)
7. Red (RD)
8. Black (BK)
9. Yellow (YL)
10. Violet (VL)
11. Rose (RS)
12. Aqua (AQ)

The colors shall be targeted in accordance with the Munsell color shades and shall meet TIA/EIA-598B "Color Coding of Fiber Optic Cables" and RUS 7 CFR 1755.900.

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound and be heat stable. It shall not fade or smear or be susceptible to migration, it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

2-3 Duct Plugs:

All conduit ends shall be properly sealed with mechanical duct plugs. Duct plugs shall be Jack-moon type or equivalent.

2-4 Hand holes:

All hand holes utilized MUST meet the CDOT applicable indexes and be on the CDOT approved equipment list. Hand holes shall be polymer composite Quazite brand or approved equivalent with a minimum tier 15, 20k load rating. The following sizes are to be used unless specifically called out for in the engineering design:

17x30x24 (20K Load)
24x24x24 (20K Load)
24x36x24 (20K Load)
30x48x24 (20K Load)

2-5 Splice Cases:

All splice cases used on this project shall be CommScope FOSC 450 Gel sealed fiber optic splice closure or approved equal. The following sizes shall be used:

FOSC 450A – Holds up to 96 fiber splices
FOSC 450B – Holds up to 144 fiber splices
FOSC 450C – Holds up to 192 fiber splices
FOSC 450D – Holds up to 576 fiber splices

All cases shall be sized to accommodate cable sizes that are housed in the splice case. Contractor shall include splice trays, label all fiber coming in and out of splice case, and protect each fusion splice with heat shrink protectors.

2-6 Fiber Termination Panels:

Cable termination assemblies (connectors, pigtails and couplers) shall be products of the same manufacturer. The cable used for cable assemblies shall be made of fiber meeting the performance requirements of these special conditions for the F/O cable being connected, except that the operating temperature shall be modified to -20°C to +70°C. Manufacturer's attenuation test results shall be provided for all factory-made assemblies. All fiber termination panels shall be fusion spliced pigtails.

Fiber terminations shall be housed in a rack mounted fiber termination panel, sized appropriately for the cable size installed. All materials including fiber panel housing, pigtails, splice cassettes, trays, connector panels and all other materials required for a complete working system shall be provided by the Contractor and shall be included in Contractor's pricing.

2-7 Optical Fiber Connectors:

All optical fiber termination components shall meet or exceed the applicable provisions of TIA/EIA-455-B, Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components.

All rack mounted optical fiber termination connectors shall be of industry standard LC Angled polished APC, type for single-mode optical fiber. The only exception to this are connectors on future outside plant based splitters and splitter cabinets shall be angle polished SC (APC-SC) connectors. All connectors shall meet or exceed the applicable provisions of TIA/EIA-455-2C (FOTP-2), Impact Test Measurements for Fiber Optic Devices, TIA/EIA-455-5B (FOTP-5), Humidity Test Procedure for Fiber Optic Components, and TIA/EIA-455-34A (FOTP-34), Interconnection Device Insertion Loss Test. When tested in accordance with FOTP –2, the connector assembly will be subjected to ten impact cycles by being dropped from a height of 1.5 m. The maximum insertion loss measured before and after the impacts should be $\leq$ 0.50 dB. The mean insertion loss of the before and after impacts should be $\leq$ 0.30 dB. The insertion loss increase measured before and after the impacts should be $\leq$ 0.30 dB. The maximum reflectance measured before and after the impacts should be $\leq$ - 40 dB. When tested in accordance with FOTP – 5, the connector assembly will be subjected to test conditions of 75 °C and 95% relative humidity for 7 days.

Measurements of loss and reflectance will be made at the beginning of the test, at a minimum of six-hour intervals during the test, and at the end of the test. The maximum insertion loss measured before, during or after the test should be $\leq$ 0.50 dB. The mean insertion loss of the before, during or after the test should be $\leq$ 0.30 dB. The insertion loss increase measured before, during or after the test should be $\leq$ 0.30 dB. The maximum reflectance measured before, during or after the test should be $\leq$ - 40 dB.

Optical fiber connectors shall satisfy all interface parameters of equipment components as may be defined by the transmission equipment specifications. All optical fiber connector assemblies shall be machine angle polished for low back-reflection and low insertion losses at both 1310 nm and 1550 nm wavelengths.

Single-mode pigtails shall be provided with factory pre-connectorized single-mode connectors of the "Angle-PC" type. Connectors shall have maximum insertion loss of 0.5 dB or better. Connectors shall have a composite barrel with a “push-pull” connection design, ceramic (zirconia) ferrule. Each connector shall be capable of 200 repeated matings with a total maximum additional increase in insertion loss after 200 matings limited to 0.30 dB.

2-8 Couplers:

Couplers shall be made of nickel-plated zinc or a glass reinforced polymer that is consistent with the material forming the associated APC-LC connector body. The design mechanism for mounting the coupler to the connector panel may be flanged or threaded but shall coincide with the connector panel punch-outs. All coupler sleeves shall be ceramic of the split clamshell or clover leaf design. The temperature operating range for couplers shall be the same as that specified for the APC-LC connectors.

2-9 Pigtails:

Pigtails shall be of simplex (one fiber) construction, in 900 μm tight-buffer form, surrounded by Aramid for strength, with a connector on one end. The outer jacket shall be yellow PVC with a nominal diameter of 3 mm, marked with the manufacturer’s identification information. All pigtails shall be of adequate length for the intended connection purpose, but not less than two meters in length. Pigtails installed in conduit shall follow the installation procedures outlined for fiber optic cables, except that the pulling tension shall not exceed 500 N (110 lbf.).

PART 3: EXECUTION

3-1 Locates:

Contractor shall follow all state laws pertaining to the Colorado 811 Locates rules and regulations. Notification can be completed by utilizing one of the following methods:

1. Call 811
2. Utilize www.colorado811.org
3. Call 1-800-922-1987

Contractor shall utilize sound judgement when completing underground utility excavations and installations. All practical means necessary shall be utilized to locate existing utilities to include locates, soft digs and spot holes, and ground penetrating radar shall be considered to avoid conflicts and to comply with Senate Bill 167. Contractor shall accurately document all located utilities on the construction prints and GPS the locations of these utilities. Marked utilities shall be physically verified, recorded with depth and offsets and shall be part of the required project deliverables as part of the redlines and required as-built documentation. Contractor's pricing shall include these in their bids.

3-2 Permitting:

The construction of fiber in the City public rights-of-way and public easements requires right-of-way permits from the City. Permits from the State of Colorado, railroads and ditch crossings are also required by their respective permitting authorities. The Contractor shall be properly licensed in order to obtain permits to construct public improvements.

The Contractor shall be responsible for obtaining all City permits for the work contained within this RFB. The Contractor is responsible for complying with any requirements set forth by governing permitting authorities. This includes the submission of completed permit application and required submittals and attachments, as well as the creation and submittal of traffic control plans.

The costs of creating traffic control plan by a certified firm shall be included in the unit rates by the Contractor. Permit fees will be either paid by the City directly or the Contractor will pay for permits and submit reimbursement from the City for the costs of each permit with no markup applied. Contractor may charge the City for the costs incurred of permit preparation on an hourly basis as included in the unit pricing sheet. The City shall coordinate and apply for permits with County, State, Railroad and Ditch authorities, given the longer lead times on these permits. All permit conditions for approval shall be followed by the Contractor.

Contractor shall always have a copy of approved permit and associated plans on the jobsite. It is the Contractor's responsibility to coordinate notice of commencement and coordinate with the permitting authority having jurisdiction on any requirements given as a conditional approval of the permitting. This requirement includes coordination of any required railroad flagmen. All fiber construction shall meet or exceed the latest requirements of the respective authorities exercising jurisdiction over the project. The Contractor shall furnish any additional labor or material required to comply with all permitting authorities at no additional cost to the City.

The Contractor shall obtain certificates of inspection and approval from all authorities having jurisdiction and forward copies of same to the City prior to request for project

acceptance inspections, final completion inspections, substantial completion inspections and acceptance testing/demonstrations.

Any portion of the fiber network which is not subject to the requirements of an electric code published by a specific authority having jurisdiction shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association (NFPA).

Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

New or proposed rights-of-way and easements required for construction approval shall be described by a licensed professional land surveyor registered in the State of Colorado and dedicated as follows:

A. In compliance with these Standards; and

B. By subdivision platting or by a separate legal instrument that describes a specific legal description of the dedication.

Agreements required for construction approval shall be executed and may include, without limitation:

1. Development agreement
2. Public improvements agreement
3. Public improvements extensions agreement
4. Subdivision agreement
5. Utility oversizing reimbursement agreement

Permits required for construction approval shall be of approved and issued status and may include, without limitation:

6. City of Boulder floodplain development permit
7. City of Boulder right-of-way construction permit
8. City of Boulder revocable right-of-way permit
9. City of Boulder wetland permit
10. City of Boulder erosion control permit
11. Colorado Department of Transportation access permit
12. Colorado Department of Transportation utility permit
13. Railroad right-of-way encroachment permit
14. District and private ditch crossings permit
15. State of Colorado Public Health and Environment Department 401 permit
16. State of Colorado general permit for stormwater discharges associated with construction activities
17. United States Corps of Engineers 404 permit

3-3 Traffic Control:

The Contractor is responsible to provide adequate temporary traffic control per section 01570 to ensure traffic safety during construction activities and compliance with any federal, state or local regulations pertaining to temporary traffic control. Contractor shall obtain and comply with all required permits and approvals from the agencies responsible for traffic operation on any impacted or occupied facility, including state highways, City streets, sidewalks and multi-use paths.

The Contractor is responsible for preparing and obtaining approved traffic control plans. The plan is to be prepared in compliance with the current edition of the CDOT "Manual on Uniform Traffic Control Devices." Plans shall include adequate provision for the detour of vehicular, bicycle, and pedestrian traffic. When and where installations temporarily disrupt use of a pedestrian way, a safe alternate route shall be provided by the Contractor.

3-4 Installation of Conduit:

Conduit installation shall follow all specifications listed in section 02200, Excavation and Trenching. The conduit shall be placed as shown on the construction documents. If no offset measurement is identified or running line offset needs to be adjusted due to field conditions, conduit shall be placed at an offset from the roadway that meets the governing City standards while still staying within the right-of-way. If this cannot be accomplished, Contractor shall contact the City immediately.

It is the intention of the City of have minimum of (2) 2" conduits placed for all new fiber backbone locations.

Warning tape shall be required for all underground fiber installation except when directional boring is utilized. Warning tape shall include:

1. Utilize an "Extra Stretch Terra Tape" type warning tape or equivalent
2. Minimum of 10 inches (10") wide
3. Orange in color with black lettering which reads "Caution Buried Fiber Optic Cable Below"
4. Placed in the trench a minimum of twelve inches (12") above all conduit/fiber facilities

A. Conduit Joints/Tie ins:

All conduit tie in locations shall be Aluminum barbed and installed with a hydraulic press.

B. Conduit Turns and Transitions:

All conduit turns shall be made with 45-degree bends or sweeps. At no time shall 90-degree bends be utilized.

C. Conduit Draining/Grade Away from Buildings/Structures:

The conduit shall be placed in such a way to as to maintain a gradual grade down away from buildings and other major structures.

D. Pull Rope:

All conduit installed shall be proofed utilizing a mandrel and shall include the installation of a continuous, jet-line pull-string. Duct proofing shall ensure new conduit is continuous, free from dirt and debris and conduit is in good usable condition.

E. Building Entrances:

All building entrances should be surveyed by Contractor and preapproved by the City before construction. final routing of laterals shall be the responsibility of the Contractor. Preference for building entrances is given in the following order (but dictated by the facility itself): use of existing entrance conduit, core drilling and routing conduit vertically up the outside of a facility, attaching a pull-box to the exterior of said building and entering through the wall of the building.

3-5 Installation of Underground Cable:

A. Cable Installation:

All fiber optic cable shall be pulled or blown. All fiber optic cable installations shall include the use of a swivel and 600 lb breakaway.

Contractor shall review the manufacturer's installation instructions prior to commencing with the installation. If any questions arise during installation, Contractor shall refer to the manufacturer's installation instructions or notify the City.

All fibers in the cables shall be usable fibers and shall be free of surface imperfections and occlusions, in order to meet or exceed all the optical, mechanical, and environmental requirements contained in this specification. All cables shall be free of material or manufacturing defects and dimensional non-uniformity that would:

- Interfere with the cable installation employing accepted cable installation practices;
- Degrade the transmission performance and environmental resistance after installation;
- Inhibit proper connection to interfacing elements;
- Otherwise yield an inferior product;

- Each fiber cable shall be all-dielectric, dry water-blocking material, duct type, with loose buffer tubes, and shall conform to these special conditions.

The optical fibers shall be contained within buffer tubes. Backbone fiber ribbons shall be contained within a central tube. Loose tube fibers shall contain 12 fibers per buffer tube. The buffer tubes shall be stranded around an all-dielectric central member. Aramid yarn and/or fiberglass shall be used as a primary strength member and a medium or high-density polyethylene outside jacket shall provide for overall protection.

B. Bend Radius:

The main risk of damage to the fiber optic cable is by overlooking the cable's minimum-bend radius. The Contractor shall allow for at least the minimum-bend radius in all installation of cable. The number of 90-degree turns on a pull shall not exceed three (3) without a pull assist box.

C. Reel Placement:

Reel set shall be adjacent to the hand hole and use a fiber optic manhole pulling block assembly from Sherman & Reilly or equivalent.

D. Cable Slack:

The Contractor shall coil a minimum of 50 feet of cable at each hand hole location unless specifically called out on drawings.

E. Cable Tags:

All cables shall be tagged and labeled at each splice location, fiber termination panel and building entrance. Tags shall clearly indicate the cable size and origin.

F. Strength:

Fibers in the cable will shatter under considerable impact, pressure or if pulling tensions exceed 600 lbs, although not apparent from the outside of the cable. Contractor shall make note of and repair all nicks and cuts to cable jacket or Kevlar layer directly beneath the cable.

G. Tracer Wire:

A #12 AWG insulated solid trace wire shall be placed with all new fiber installations. This trace wire should maintain continuity from end station to end station. The

Contractor may use vaults/hand holes for joining the tracer wire, while keeping these joints visible and out of the way of the fiber cable. Tracer wire shall be placed at the same time as the cable installation inside the duct. In the event the cable will not be immediately installed, a detectable mule tape shall be installed.

H. Bonding & Grounding:

All handholes that include a splice case shall include proper grounding and bonding. If at any time new or existing cable is armored, proper bonding of the cable sheath will also be required.
Splice cases shall be grounding using a #6 AWG solid, bare copper wire. Ground wire and tracer wire shall be properly connected at a 5/8"x8' copper clad ground rod with a ground rod clamp or cad weld according to ANSI/TIA/EIA-606 (series) and the National Electric code (NEC)

The grounding and bonding requirements of this standard are additional technical requirements for telecommunications that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA/EIA-568-A and installed in the pathways and spaces designed in accordance with ANSI/TIA/EIA-569-A.

3-6 Installation of Hand Holes:

A. Installation:

All hand holes and vaults shall be installed flush with the existing grade unless otherwise specifically directed. Box installation shall include a 6" base or crushed stone or gravel for drainage purposes. Any earth disturbed in the immediate area surrounding the box shall be compacted to avoid any future wash outs. All box, hand holes and vault installations shall conform to Section 3-15. Pricing for all boxes shall include placement of all bolts necessary to secure lids. All boxes shall be approved prior to purchasing/installation of said boxes per the material submittal requirements. All box lids shall have "COB Fiber" embedded on them.

B. Box Spacing:

Hand holes and vault spacing on backbone shall be installed per the engineering design and construction prints. If any adjustments in location of hand holes needs to be made by Contractor, location adjustments shall be pre-approved by the City.

Hand hole spacing on the fiber backbone should utilize an average distance of 750' to facilitate access points to the fiber backbone and to assist in the pulling process. Hand holes shall also be placed at any 90 degree turn in conduit running lines, at major intersections, at all splice location and at any location where future fiber connectivity is warranted, per the City's guidance.

C. Conduit Entering Hand Holes:

All conduits shall be stubbed up underneath the bottom of each hand hole leaving at least 8" but no more than 12" of visible conduit exposed. Conduit and inner ducts shall be capped until they are ready for use and to maintain the integrity of the conduit/inner duct from dirt and water.

3-7 Splicing:

A. General Specifications:

Fiber cable shall be installed without splices except where specifically allowed on the engineering design or described in these special conditions. Single-mode fiber cables shall be spliced in pull boxes as shown on the engineering design. When splicing into a distribution cable, only those fibers associated with the count transferring onto the distribution cable shall be severed. All other fibers shall remain intact. The City may allow additional splices between these specified locations where applicable. Splices shall only be performed at locations designated on the engineering design unless otherwise approved by the City.

B. Labeling:

All splice cases, trays and fiber termination panels shall be properly labeled as to identify cable size, fiber count and routing of each fiber strand.

C. Splice Cases:

All closures shall include all necessary fiber organizer trays and shall be supplied as part of the splice case closure. Cable closures shall be installed in accordance with the manufacturer's instructions. All Fiber optic Splicing shall be completed by Fusion Splicing method. No mechanical splicing shall be allowed.

D. Fusion Splicing:

Fiber cables shall be spliced using the fusion splice method and the insertion loss shall not exceed 0.20 dB of loss per splice when tested using a bi-directional average. Field splicing is permitted for the following:

- Connection of cable reel sections.
- Connection of a mainline service distribution cable to a service drop cable or a breakout cable.

- Connection of service drop cable or breakout cable to a fiber pigtail at cabinets or the patch panels.

- Connection of the backbone cable to a fiber pigtail at a hub patch panel.

The Contractor shall not exceed the maximum number of field splices permitted as shown in the engineering design. Completed splices shall be placed in a splice tray. The splice tray shall then be placed in a watertight splice enclosure. Field splices shall be conducted only at locations as shown in the engineering design as an approved splice location.

All splicing equipment shall be in good working order, properly calibrated with calibration certificate showing proof of calibration within the past 12 months. Craftmanship shall meet all industry standards and safety regulations. Cable preparation, closure installation and splicing shall be accomplished in accordance with accepted and approved industry standards.

All splices shall be protected with a thermal shrink sleeve. All fibers shall be labeled in the splice tray with permanent vinyl markers. Pigtail ends shall also be labeled to identify the destination of the fiber. The City shall provide the labeling scheme to the Contractor to follow for the project.

Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job-site and disposed of in an environmentally acceptable manner.

If splice loss exceeds maximum DB loss, splice shall be broken and respliced. If DB loss on splice cannot be obtained after the 3rd splice attempt, fiber splice attempts shall be documented and turned in as a fiber splice exception

E. Photos:

The Contractor shall take geo referenced photos of each splice tray and document as part of the deliverables with the fiber test results. All photos shall be labeled with location, date, installation technician name, company and description of the completed splice.

F. Testing:

The Contractor shall perform fiber testing on 100% of all fiber strands installed. Testing shall be completed using the following standards using equipment, calibrated within the past 12 months.

1. **Reel Testing:**

   All fiber shall be tested on the reel prior to installation with an OTDR. Testing shall be completed to verify continuity of length consistent with the length of the reel documented. OTDR reel tests shall be completed in one direction at 1550nm. Raw OTDR traces as well as pdf copies of reel test shall be provided to the City as part of the test results. Any issues in fiber continuity or defects shall be brought to the attention of the City and shall not be installed until the issue is rectified.

2. **Post Installation Testing:**

All fiber strands shall be tested once they are in their final configuration and fully installed by the Contractor. Test documentation shall be provided to the City as part of the project test results. 100% of all fiber strands installed shall be tested including all bare fibers. Post installation testing shall utilize wavelengths of 1310 and 1550nm. Both OTDR and Power meter testing shall also be utilized. OTDR tests shall be delivered to the City in both raw trace format as well as pdf copies. Power meter tests shall be documented and delivered on a Power meter test form. A minimum 5000' launch reel shall be utilized on all OTDR tests.

All field splicing shall have a bi-directional dB loss no greater than -.20 dB. All connectors shall have a dB loss no greater than -.50dB. In the event any fiber splice or termination test with a dB loss higher than the maximum loss, fiber splices shall be broken and re-spliced until allowable dB loss can be achieved. In the event a fiber stand has been re-spliced 3 different times and cannot meet these standards, an exception document shall be provided identifying the fiber, splice locations, and documentation showing the 3 attempts of re-splicing.

Post Installation and Final Acceptance Testing - Optical Attenuation (Insertion Loss) Procedures:

a. Bi-Directional, Dual Wave-Length (1310/1550 nm) insertion loss testing shall be performed on all Fiber Optic strands using an OTDR (Optical Time Domain Reflectometer).
b. Fibers are to be tested in accordance with: TIA/EIA 526-7
c. Each Span/Section will comply with the following attenuation budget.
   i. Attenuation(maximum): 2(C+L)(F+S) db
   ii. 2= number of connectors per span
   iii. C = maximum allowed loss, per mated connector ≤ 0.35 db
   iv. L = Length in kilometers per span
   v. F = maximum allowed loss, fiber 1310 ≤ 0.35 db/km & 1550 ≤ 0.22 db/km

vi. S = total splice loss (# of splices x max. loss per splice)

d. Any fiber that does not meet the requirements is the responsibility of the Contractor to correct the problem. This is to be at no additional cost to City of Boulder and the City Engineer representative.

Link Integrity Verification (OTDR)

a. Bi-Directional, Dual Wave-Length (1310/1550 nm) Link Integrity Verification shall be performed on all terminated Fiber Optic Connectors using an OTDR (Optical Time Domain Reflectometer).
b. Measurements shall include all connectors, couplings, and cables installed at each system endpoints.
c. All Optical Fibers are to be tested prior to final acceptance, using an OTDR and dead zone launch spool of 5000 ft. minimal distance. All traces are to be saved in Bi-Directional, Dual Window format, 1310/1550 nm and provided to the City of Boulder and the City Engineer representative in electronic format. The saved traces will contain the following information:
    i. Span/location identification – test point, end point, & FTP port
    ii. Cable/Sheath length – Optical Fiber Length
    iii. 2-point db loss, attenuation in db/km (db/mile)
    iv. Fiber Type
    v. Wavelength
    vi. Pulse Width
    vii. Fiber/Cable identification
    viii. Notes Section describing information on span/location
d. All spans are targeted to have ≤ 0.20db/km loss measurements. Unless otherwise specified or approved any spans that fail this measurement shall be repaired by the Contractor at no additional cost to City of Boulder and the City Engineer representative.

1. Documentation

a. Upon project completion the Contractor is to supply the City with a complete set of the final test results in original trace file Electronic Format and PDF copies for City of Boulder and the City Engineer representative. This package is to include printouts of the following:
    i. Pre-installation Cable Testing
    ii. Post Installation – Final Acceptance Testing including
    iii. Optical Attenuation (Insertion Loss)
    iv. Link Integrity Verification (OTDR)
    v. Power Meter light readings
    vi. OTDR & Powermeter Calibration certificates