19.0 Intelligent Transportation Systems (ITS) Infrastructure

The ITS system includes various devices, such as Variable Message Signs (VMS), Closed Circuit Television (CCTV), Travel Time Indicators (TTI),ReadersIn addition, the ITS system includes the various components that make up the communication system, such as conduit, fiber optic cable, and Ethernet Switches.

The Contractor shall be responsible for the design, furnishing, and installation of all ITS devices, the communications network and the supporting infrastructure that is necessary to maintain the existing ITS infrastructure. All ITS elements of the Project shall comply with the requirements of this Section Contractor shall coordinate with CDOT and City ITS prior to taking any ITS Device off line. The Contractor shall maintain the ability to provide VMS messages to I-25 and US 24 traffic during construction. The Contractor shall minimize the down time of traffic cameras and VMS signs.

All design and construction shall comply with the relevant requirements and standards listed in Book 3. Use the most current version of each listed standard as of the final issue date of this RFP, unless modified by Addendum or Change Order. In addition, use the references listed in the Reference Documents as supplementary information.

19.0.1 List of Abbreviations

AC	Alternating Current
ARE	Additional Requested Element
ATR	Automatic Traffic Recorder
AVI	Automatic Vehicle Identification
CDOT	Colorado Department of Transportation
CWDM	Course Wavelength Division Multiplexing
CCTV	Closed Circuit Television
CTMC	Colorado Transportation Management Center
CTMS	Colorado Transportation Management Software
DTD	Division of Transportation Development
IP	Internet Protocol
ITS	Intelligent Transportation System
LED	Light Emitting Diode
MVRD	Microwave Vehicle Radar Detection
NEC	National Electric Code
NTCIP	National Transportation Communications for ITS Protocol
POE	Power over Ethernet
RMS	Ramp Meter Station
ROW	Right-of-Way
RWIS	Road Weather Information System
SMFO	Single-Mode Fiber Optic
TTI	Travel Time Indicator
UPS	Uninterrupted Power Supply
VMS	Variable Message Sign

19.0.2 List of References

Author	Title
CDOT	2011 *Standard Specifications for Road and Bridge Construction*
CDOT	*M & S Standards* – June 27, 2011
CDOT	CDOT *Sign Design Manual* – May 21, 2010
RTD	Design Guidelines and Criteria
AASHTO	*A Policy on Geometric Design of Highways and Streets*
AASHTO	*Roadside Design Guide*
ASTM	American Society for Testing and Materials
EIA	Electronic Industries Alliance
FHWA	*Manual on Uniform Traffic Control Devices* (Current Edition)
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
ITU	International Telecommunications Union
NFPA	*National Electric Code* (Current Edition)
RUS	Rural Utilities Service
Telcordia	Telcordia Technologies
TIA	Telecommunications Industry Association

19.1 Design Requirements

The Contractor shall design the ITS infrastructure components in accordance with the requirements in the following Sections. No part or attachment of any equipment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices. The Contractor shall submit, for approval to CDOT, all ITS devices and materials prior to installation by submitting product sheets. Infrastructure locations need to meet the requirements of CDOT.

19.1.1 Electrical Power

The Contractor shall provide alternating current (AC) power service to every ITS device and cabinet along with a metered service. This includes all existing devices or cabinets that are relocated by the Contractor. More than one device may be powered by each meter. The Contractor shall obtain (from the power service provider) approval of the power service design and coordinate and meet all requirements as specified by the power service provider for the complete and operational power service to all required locations. All power connections to devices shall include a quick-disconnect.

The Contractor shall be responsible for the coordination of power source work to be performed by Colorado Springs Utilities (SU). The Contractor shall contact Colorado Springs Utilities; Ms. Mary Hoaglund at 719-688-4083 to request, and process to completion, the required coordination to establish the metered power sources for ITS devices. The Contractor shall perform all work necessary to maintain existing or establish new metered power sources for ITS devices. All cost charges from the power service provider, and all necessary materials, including meter, labor, and coordination required to maintain existing or establish new metered power

sources shall be included in the Work. Contractor shall be responsible for coordinating all power source billings to the corresponding CDOT regional owner.

19.1.2 Location and Protection of ITS Elements

The Contractor shall locate all ITS infrastructure elements within the public Right-of-Way (ROW) such that routine maintenance will not require a lane closure, affect mainline, ramp, or arterial roadway traffic operations, or require complex traffic control. ITS elements shall not be located in the highway median. All devices shall be placed outside of the clear zone, on approved breakaway devices, or placed behind guardrail for the protection of the travelling public and the infrastructure.

All existing underground utilities shall be identified, and all ITS infrastructure elements shall be designed to avoid outages. The Contractor shall be responsible for all repairs to facilities damaged during construction. The Contractor shall be responsible for maintaining and keeping operational all existing ITS devices during construction. All current live fibers shall be respliced in one work shift. Contractor shall notify CDOT ITS a minimum of two (2) weeks before any ITS device, fiber back-bone, or branch outages.

19.1.3.1 Design Requirements

The Contractor shall coordinate all ITS Device relocations with CDOT ITS and City of Colorado Springs Traffic Engineering. Contractor shall be responsible for all costs associated with any impacts or relocation to the fiber optic lines caused by their design or construction.

19.1.3.2 Material Requirements

The Contractor shall coordinate all ITS materials with CDOT ITS and City of Colorado Springs Traffic Engineering and ensure the materials provided comply with the appropriate specification.

19.1.4 Variable Message Signs (VMS)

The VMS are large dynamic displays that are used for a wide range of purposes, including providing driver information regarding weather advisories, travel times, amber alerts, and construction and incident notifications. No median mounted VMS will be allowed, the existing shoulder mounted VMS shall be relocated to another suitable shoulder mounted location as approved by CDOT if the existing VMS sign locations need to be modified.

19.1.5 Closed Circuit Television (CCTV)

The CCTV cameras are used for monitoring travel conditions in the corridor, such as weather conditions, accidents, traffic congestion, and other events. The video images are also shared with the public via the internet (www.CoTrip.org) .

19.1.5.1 Design Requirements

1. The Contractor shall relocate the existing CCTV camera in the southwest quadrant of the I-25/US 24 interchange to a location agreeable to CDOT ITS and City of Colorado Springs Traffic Engineering.

2. Existing CCTV cameras located outside of the Project limits may be utilized at their existing locations.

19.1.6 Doppler Radar

These is one self-contained, solar-powered unit ,on the west side of I-25 south of Bear Creek that is anticipate to be relocated, that collects point travel data and transmits it wirelessly to the device manufacturer SpeedInfo and to CDOT. These devices are owned by SpeedInfo.

19.1.6.1 Design Requirements

Because the SpeedInfo Doppler radar units are self-contained (including wireless communications), all existing units that need to be relocated shall be re-installed per the manufacturer's recommendations. Locations shall be in a similar area as the original installations.

19.1.7 Pull Boxes and Manholes

19.1.7.1 Design Requirements

The Contractor's design shall utilize fiberglass reinforced, polymer concrete pull boxes and pre-cast concrete manholes with a cast iron frame ring and cover. Pull boxes shall be 24 inches x 36 inches for intermediate locations and manholes shall be used for splice locations. 100 feet of fiber optic cable shall be coiled inside each manhole, and 50 feet of fiber optic cable shall be coiled inside each pull box. Pull box and manhole spacing shall not exceed 1,000 feet.

19.1.7.2 Material Requirements

If determined to be required, all CDOT pull boxes shall be constructed of fiberglass reinforced, polymer concrete and have a detachable cover with a skid-resistant surface and have the words "CDOT COMM", cast into the surface. Painting of words shall not be allowed. All pull boxes shall be verified by a third-party nationally recognized Independent Testing Laboratory as meeting all test provisions of

ANSI/SCTE 77 2007 Specification for Underground Enclosure Integrity, Tier 22 rating. Pull boxes shall be UL listed. Certification documents shall be submitted with material submittals.

All City of Colorado Springs Traffic Engineering communication pull boxes shall have the words —TRAFFIC SIGNAL- physically impressed (not painted) on its top. The interconnect pull boxes or Pull Box (Special) shall have minimum inside dimensions of 30.5" long by 17.5" wide by 24" deep. The covers shall be attached to the pull box body by screw-in bolts and shall have two lift slots to aid in the removal of the lid. Pull boxes that are to be in traveled ways shall be outfitted with traffic bearing lids rated for HS 20-44 loads. The pull boxes shall have a special concrete footing extending 8 inches around the outside and 6 inches around the inside of the pull box bottom, as shown in the plans. Pull boxes installed in dirt or landscape areas shall have a 12 inch wide by 6 inch thick concrete collar placed around the top in lieu of the concrete footing, as shown in the plans. When the plans call for a fiber optic cable location marker to be installed at the pull box location, the concrete foundation support for the location marker shall be placed monolithically with the concrete collar.

Manholes shall consist of a pre-cast concrete, 4'x4'x4'-foot square vault with a base and cast iron frame ring and cover. The manhole shall be designed to provide a pre-cast conduit entrance depth of 3 feet. Each manhole, frame and cover shall conform to AASHTO HS20-44. Each manhole shall be equipped with a removable ladder that is engineered to support 300

pounds. The ladder support shall be permanently fixed to the manhole. The manhole cover shall have a skid-resistant surface and have the words "CDOT COMM", physically impressed (not painted) on its top. The cover shall be attached to the manhole body by screw-in bolts.

Refer to the Modified Standard Specification listed in Section 19.4 for additional requirements.

19.1.8 Cabling and Conductors

The Contractor shall design conductors and cables utilizing a minimum of #12 AWG for all electrical conductors. All video-device control cables and connectors shall be designed in accordance with the manufacturer's recommendation and the CCTV manufacturer's signal attenuation requirements.

19.1.8 Conduit

19.1.8.1 Design Requirements

The Contractor shall design new and separate conduit systems (including all hardware, fasteners, and accessories) for communication and power control systems. Longitudinal conduits for the communications network shall be installed within the ROW and as close to the ROW line as practical. ITS conduit shall be a minimum of 4-foot deep. The mainline communications run shall contain:

1. One 1 ¼" conduits for the CDOT backbone
2. Three 1 ¼" conduit for the City Of Colorado Springs

All Fiber Optic cable splices shall be contained in a manhole not a pull box for CDOT.

All Fiber Optic cable splices shall be contained in a pull box for the City of Colorado Springs.

Lateral conduits shall not exceed the NEC fill ratio requirements. The following conduit colors shall be used so that the contents can be easily identified:

1. 1 1/4-inch City of Colorado Springs fiber conduit – Orange
2. 1 1/4-inch City of Colorado Springs spare/empty conduit – Grey
3. 1 1/4-inch City of Colorado Springs power conduit – Red

19.1.8.2 Material Requirements

All conduits shall meet CDOT specifications. The conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin Schedule 80 high-density polyethylene resin. Conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation, without affecting its properties or performance.

Refer to the Modified Standard Specification listed in Section 19.4 below for additional requirements.

19.2 Construction Requirements

19.2.1 Electrical Power

The Contractor shall make appropriate arrangements with the power service provider for installation or relocation of power service. The Contractor shall also be responsible for all costs of installing or relocating power sources, including involvement with the power service provider at locations for new services throughout the Project.

19.2.2 Location and Protection of ITS Elements

The Contractor shall be responsible for locating all underground existing facilities to avoid or minimize conflicts with these facilities. If any facilities are damaged during construction, the Contractor shall be responsible for all repairs.

The Contractor shall install a grounding system and protection devices that are suitable for each specific relocated ITS element.

19.2.3 Fiber Optic Splicing

Splicing down time would be a two hour window on the weekend for live fibers. The remaining non active fibers can be spliced anytime during the weekend. The Contractor shall coordinate with CDOT and Colorado Springs Traffic two weeks prior to splicing for scheduling of down time. The Contractor will be in charge of splicing .An approved splicing Contractor will be required..

19.2.4 Communications System

Prior to performing any work that may impact existing ITS communications systems, the Contractor shall coordinate with the owner of the affected system.

The Contractor shall be responsible for all splicing work necessary to provide the ITS equipment communications.

Fiber optic backbone conduit shall not be located in the travelled way.

Refer to the Modified Standard Specification listed in Section 19.4 for additional requirements.

19.2.5 Variable Message Signs (VMS)

The Contractor shall be fully responsible for protecting the existing I-25 VMS signs from construction.

Refer to the Modified Standard Specification listed in Section 19.4 for additional requirements.

The Contractor may not reuse existing VMS sign pole for relocation.

19.2.6 ITS Devices

The Contractor shall carry out all reinstallation and field-testing of each relocated unit. The connection of each device to the communication system shall use fiber optic laterals. Existing devices that meet the standards herein may be reused.

The Contractor shall notify CDOT ITS upon reinstallation of each unit and complete a CDOT data sheet.

Refer to the Modified Standard Specification listed in Section 19.4 for additional requirements.

19.2.7 Pull Boxes and Manholes

The Contractor shall install all pull boxes and manholes based on the latest CDOT *Standard Specifications*. Each location shall be easily accessible for maintenance purposes. Pull boxes and manholes shall not be placed in a known flood-prone area or drainage ditch. A fiber optic

cable label shall be attached to each fiber optic cable located within a pull box or manhole. All fiber optic cable splices inside manholes shall be housed in a separate splice closure.

Refer to the Modified Standard Specification listed in Section 19.4, below, for additional requirements.

19.2.8 Salvaging of Materials

The Contractor shall salvage all existing non-standard ITS elements that are affected by the Project. Salvaged equipment shall be returned to CDOT ITS.

19.2.9 Cabling and Conductors

All cables shall be installed per the manufacturer requirements for each device or the requirements found in the Modified Standard Specifications in Section 19.4, below. The maximum conduit fill ratio for both new and existing conduits shall be in accordance with the NEC, latest version.

19.2.10 Conduit

For bores that contain more than one conduit, the conduit shall be bundled together and contained in a single bore.

Refer to the Modified Standard Specifications listed in Section 19.4, below, for detailed construction requirements for all conduit installations.

19.2.11 Integration and Testing

Integration and testing shall be conducted for all components that meet any of the following criteria:

1. A device and/or cabinet supporting the device has been relocated.
2. The communications path between the devices and the local cabinet has been disturbed and/or relocated.
3. A new communication path to a device has been established

The Contractor shall be responsible for the installation and integration of all ITS devices. This includes all VMSs, CCTVs, RMSs, MVRDs, TTIs, ATRs, RWISs and Fiber Optic Cable that currently exist within the project limits. All modifications to the CTMS or Camera software on the CDOT end will be performed by CDOT ITS.

For all devices connected to the fiber optic communication network, integration shall include field site integration and subsystem integration.

19.3 Deliverables

At a minimum, the Contractor shall submit the following to CDOT ITS for review, Approval and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
ITS plan sheets and details	Acceptance	Prior to Released for Construction
Splicing details	Acceptance	4 weeks prior to splicing
Integration and testing plan	Approval	5 weeks prior to testing and integration
CDOT device data sheets	Acceptance	4 weeks prior to device integration

As-builts upon construction showing devices and fiber locations for integration into CDOT's fiber inventory system, for acceptance.

The Contractor shall address all major aspects of this Work, including for individual construction areas/phases and stages, in the Traffic Management Plan (TMP), Traffic Control Plans (TCPs) and Methods of Handling Traffic (MHTs) according to Section 16 – Maintenance of Traffic.

19.4 Project Special Provisions

Appendix A to this Section 19 includes the Modified Standard Specifications that shall be applicable to the Project.

This Section sets forth modifications to the CDOT *Standard Specification for Road and Bridge Construction* for design-build projects. The first section contains revisions to Division 100 of the Standard Specifications. The second section contains revisions to Divisions 200 through 700 of the Standard Specifications, as well as Standard Special Provisions applicable to the Project.

These Contract Provisions are a revised version of CDOT's *Standard Specifications for Road and Bridge Construction*, and contain requirements generally applicable to the Work to be performed by the Contractor. In certain cases, provisions in Section 100 of the *Standard Specifications for Road and Bridge Construction* have been superseded by other provisions of the Contract Documents. For ease of reference, this document uses the same Section numbers as the *Standard Specifications for Road and Bridge Construction*, and identifies provisions of the Contract Documents that have replaced or modified the standard clauses.

All references to "Engineer" that are incorporated into this Section refer to the Contractor's Engineer, unless the context requires otherwise. Non-capitalized terms, such as "work" that are defined in Book 1, Exhibit A, shall have the meanings defined therein unless the context requires otherwise. References to "approve, approval or approved" shall mean "Approve, Approval or Approved" as defined in Book 1, Exhibit A, when the approval is by CDOT or a division of CDOT. If the interpretation(s) pursuant to this paragraph are not clear, CDOT shall decide, in its sole discretion, how these terms shall be interpreted.

When these specifications describe actions, Materials, means or methods that are required and that are qualified by phrases such as: "as directed by the Engineer", "when directed by the Engineer", "as determined by the Engineer", "with or without permission of the Engineer", "in the opinion of the Engineer", "unless authorized by the Engineer", "satisfactory to the Engineer", "as

approved by the Engineer", or "unless another type is specified or is permitted with approval of the engineer", such phrases shall be disregarded. If it is not clear whether a phrase should be disregarded, CDOT will make that decision in its sole discretion.

When these specifications refer to " Department", "Resident Engineer", "Agricultural Engineer", "Bridge, Construction or Maintenance Engineer", "TMC system inspector", "Concrete Engineer", "Project Engineer", "Materials Engineer", "Commissioner", "Structural Metals Engineer", "Department's Lighting Engineer", "Geotechnical Engineer" or any other specific CDOT special engineer, such reference shall mean the CDOT Project Director.

When these specifications use the term engineer relating to the approval of any activities involving the use of explosives, such term shall mean the CDOT Project Director.

When an approval or authorization of the Engineer or CDOT is required in these specifications for the use of alternative or substituted processes or components, the Engineer shall mean CDOT. If it is not clear whether a phrase involves the use of alternative or substituted processes, CDOT will make that determination in its sole discretion.

If these specifications refer to an approval of any correction or repair that deviates from the Contract requirements, the approval must be by CDOT. If it is not clear whether a specification involves a correction or repair that deviates from the Contract requirements, CDOT will make that determination in its sole discretion.

When these specifications provide that reports, records or other documents shall be submitted to CDOT or to the Engineer, such reports shall be made available to CDOT and do not have to be submitted unless either they are otherwise listed in the deliverables in the Contract Documents, or are required shop drawings, warranties, parts lists, instruction sheets or manufacturer's drawings or specifications. Such documents shall be submitted to CDOT as required by the specifications.

When these specifications require actions, Materials, means or methods that are "either as indicated in the Plans or as designated by the Engineer," the Contractor shall disregard the phrase "or as designated by the Engineer."

When these specifications refer to the "Engineer" ordering work beyond the scope of work in the Contract, "Engineer" shall mean CDOT. Whenever in these specifications the Engineer may order work that results in additional costs to CDOT, the "Engineer" shall mean CDOT.

Any acceptances on behalf of CDOT or the State shall be performed by CDOT.

Any references to other standards, codes, or criteria, or to the latest version of other standards, codes, or criteria in Book 2 of the Contract Documents shall mean the latest version at the Proposal Due Date.