

**COLORADO
 DEPARTMENT OF TRANSPORTATION
 SPECIAL PROVISIONS
 I-70 TWIN TUNNELS CONSTRUCTION PACKAGE 1B**

The 2011 Standard Specifications for Road and Bridge Construction, controls construction of this project. The following special provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and plans.

PROJECT SPECIAL PROVISIONS

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Revision of Section 109 – Asphalt Cement Cost Adjustment (Asphalt Cement Included in the Work)	(September 29, 2011)	2
Revision of Section 109 – Compensation for Compensable Delays	(May 5, 2011)	1
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Revision of Section 109 – Measurement of Quantities	(February 3, 2011)	1
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Revision of Section 250 – Environmental, Health and Safety Management	(July 19, 2012)	1
Revision of Section 401 – Compaction of Hot Mix Asphalt	(February 3, 2011)	1
Revision of Section 401 – Compaction Pavement Test Section (CTS)	(February 3, 2011)	1
Revision of Section 401 – Plant Mix Pavements	(February 3, 2011)	1
Revision of Section 401 - Reclaimed Asphalt Pavement	(February 3, 2011)	2
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Revision of 401 and 412 – Safety Edge	(September 23, 2011)	2
Revision of Section 412, 601, and 711 – Liquid Membrane Forming Compounds For Curing Concrete	(May 5, 2011)	1
Revision of Section 601 – Concrete Batching	(February 3, 2011)	1
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Revision of Section 601 – Concrete Slump Acceptance	(July 29, 2011)	1
Revision of Sections 603, 624 and 705 – Drainage Pipe	(April 26, 2012)	2
Revision of Section 620 – Field Laboratories with Forced Air Convection Oven	(February 3, 2011)	1
Revision of Section 627 and 708 – Pavement Marking with Waterborne Paint And Low VOC Solvent Base Paint	(February 3, 2011)	1
Revision of Section 630 – Construction Zone Traffic Control	(February 3, 2011)	1

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STANDARD SPECIAL PROVISIONS

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Revision of Section 630 – Retroreflective Sheeting	(February 3, 2011)	1
Revision of Section 630 - Rolling Roadblock	(May 5, 2011)	2
Revision 703 – Concrete Aggregate	(July 29, 2011)	1
Revision of Section 703 – Aggregate for Hot Mix Asphalt	(November 1, 2012)	2
Revision of Section 712 – Geotextiles	(November 1, 2012)	2
Revision of Section 712 – Water for Mixing or Curing Concrete	(February 3, 2011)	1
Affirmative Action Requirements – Equal Employment Opportunity	(February 3, 2011)	10
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Minimum Wages Colorado, U.S. Department of Labor General Decision Numbers CO100016 thru CO100024, MOD 4, Highway Construction, Statewide	(August 10, 2012)	56
On the Job Training	(July 29, 2011)	3
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Required Contract Provisions – Federal-Aid Construction Contracts	(July 19, 2012)	14
Special Construction Requirements, Fire Protection Plan	(November 1, 2012)	2

NOTICE TO BIDDERS

The proposal guaranty shall be a certified check, cashier's check, or bid bond in the amount of 5 percent of the Contractor's total bid.

Pursuant to subsections 102.04 and 102.05, it is recommended that bidders on this project review the work site and plan details with an authorized Department representative. Prospective bidders shall contact one of the following listed authorized Department representatives at least 48 hours in advance of the time they wish to go over the project.

Program Engineer	Jim Bemelen, P.E. 18500 E Colfax Ave. Aurora, Colorado 80011 Office Phone: 303-365- 7010
Resident Engineer	Russel Cox, P.E. 425 A Corporate Circle Golden, Colorado 80401 Office Phone: 720-497-6905
Project Engineer	Bob Smith, P.E. 425 A Corporate Circle Golden, Colorado 80401 Office Phone: 303-512-5611

The above referenced individuals are the only representatives of the Department with authority to provide any information, clarification, or interpretation regarding the plans, specifications, and any other contract documents or requirements.

COMMENCEMENT AND COMPLETION OF WORK

The Contractor shall commence work under the Contract on or before the 5th day following Contract execution or the **14th** day following the date of award, whichever comes later, unless such time for beginning the work is changed by the Chief Engineer in the "Notice to Proceed." The Contractor shall complete all work in 200 working days in accordance with the "Notice to Proceed."

Section 108 of the Standard Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

The Contractor's progress schedule shall be a Critical Path Method Schedule.

Salient features to be shown on the Contractor's Critical Path Method Schedule are:

1. Mobilization
2. Temporary stormwater erosion control
3. Traffic control for detour paving (traffic shifts, lane closures)
4. Asphalt Paving for Detours
5. Construction of Wall F, FF, and K
6. Doghouse Rail Bridge Rehabilitation (Structure CLR314-W0.7)
7. Bridge Construction of Structure F-15-BR

CONTRACT GOAL

The Department has determined that Underutilized Disadvantaged Business Enterprises (UDBEs) will participate by contracting for a part of the work of this Contract. The contract goal for participation in this Contract by certified DBEs who have been determined to be underutilized has been established as follows:

UDBE*10 Percent

The percentage will be calculated from proposals received for this project according to the following formula:

$$\text{Percentage} = 100 \times \frac{\text{**Dollar amount of work to be contracted to underutilized DBEs (UDBE's)}}{\text{Total dollar amount of the original Contract}}$$

* All DBEs will be considered to be UDBEs.

** Based on DBE contract unit prices rather than prime contract unit prices.

NOTE: Specific Good Faith Efforts required to meet the Contract Goal specified above are defined in the Standard Special Provisions. In addition, the Transportation Commission has determined an overall 10.25 annual goal for the participation of all DBEs.

OJT CONTRACT GOAL

The Department has determined that On the Job Training shall be provided to trainees with the goal of developing full journey workers in the types of trade or classification involved. The contract goal for On the Job Trainees working in an approved training plan in this Contract has been established as follows:

Minimum number of total On-The-Job Training hours required **1280 hours.**

**REVISION OF SECTION 102
PROJECT PLANS AND OTHER DATA**

Section 102 of the Standard Specifications is hereby revised for this project as follows:

Subsection 102.05 shall include the following:

All information for Guaranteed Price Proposal (GMP) preparation will be available for review by the Contractor through plans, specifications, and estimates packages provided by CDOT until the date set for opening of the GMP proposal.

Computer Output Data:

- Phase 1 Environmental Site Assessment - Dated March 2012
- Twin Tunnels Material Management Plan- Dated September 2012
- CDOT Mitigation Commitment Monitoring and Reporting Spreadsheet (partially completed) – Dated October 2012
- CDPS permit, dated October 2012
- Twin Tunnels Environmental Assessment and FONSI – Final Dated October 2012
- Twin Tunnels Wall Structural Selection Report – Final Dated October 2012
- Air Quality Monitoring Plan – Final Dated September 2012
- I-70 Twin Tunnels Incident Management Plan – Final Dated September 2012
- I-70 Twin Tunnels Final Geotechnical Data Report- Draft 8/17/2012
- Twin Tunnels Bridge Structural Selection Report–Final 10/19/2012
- Doghouse Rail Bridge Rehabilitation Tech Memo– Final 1/13/2012

After the GMP proposal has been opened and the GMP has been accepted by CDOT, the Contractor may obtain from CDOT's Printing and Visual Communications Center, 4201 East Arkansas Avenue, Denver, Colorado 80222, at no cost: **15** sets of plans and special provisions; and if available for the project, one set of full-size cross sections, one set of full-size major structure plan sheets, and one set of computer output data. If Contractor has not picked up the plans and other available data by 4:30 p.m. on the second Friday after bid opening, they will be sent to the Resident Engineer in charge of the project. Additional sets of plans and other available data may be purchased on a cash sale basis from CDOT's Visual Communication Center at current reproduction prices. Subcontractors and suppliers may obtain plans and other data from the successful bidder or they may purchase copies on a cash sale basis from the Visual Communication Center at current reproduction prices.

**REVISION OF SECTIONS 104
CONSTRUCTION MANAGER/GENERAL CONTRACTOR
VALUE ENGINEERING CHANGE PROPOSALS**

Section 104 of the Standard Specifications is hereby revised for this project as follows:

Delete subsection 104.07 and replace with the following:

104.07 Value Engineering Change Proposals. Value Engineering Change Proposals (VECP) will not be allowed during the construction of CM/GC Projects.

**REVISION OF SECTIONS 104 AND 105
PAVEMENT SURFACE COURSE MAINTENANCE**

Sections 104 and 105 of the Standard Specifications are hereby revised for this project as follows:

In subsection 104.04, third paragraph, delete the first sentence and replace with the following:

Portions of the roadway, excluding the pavement surface course, that are not included in the contract work will be maintained by the Department.

Subsection 105.19 shall include the following:

The Contractor shall be responsible for timely response to complete all pavement surface course maintenance for portions of the roadway that are not included in the contract work within the project limits, including the approach to project, as required. These services shall be available upon notice, and provided for at all times, including holidays and seasonal no work periods. The Contractor shall provide these services beginning when time count starts for the project through final acceptance. The Contractor shall submit a Pavement Surface Course Maintenance Plan (PSCMP) to the Engineer for acceptance at the Preconstruction Conference. The PSCMP shall include, but will not be limited to, the following:

- (1) Source of materials to be used for pavement surface course repairs (PSCR).
- (2) Type of materials to be used for PSCR.
- (3) Equipment available to use for PSCR.
- (4) Labor, including names and phone numbers, to perform PSCR.
- (5) Response Time. The Contractor and the traffic control supervisor (TCS) shall respond to the project site within 2 hours of notification.
- (6) Traffic Control. The Contractor shall perform traffic control as required until completion of the PSCR.
- (7) Pavement Marking. Full compliance pavement markings shall be in place on all PSCRs prior to opening to traffic.

The Contractor shall complete pavement surface course maintenance in accordance with the PSCMP. To implement the PSCMP, the Contractor shall develop and submit a method for handling repairs (MHR) for each different PSCR that shows the Contractor's proposed construction methods consistent with the PSCMP. Each proposed MHR will be approved in writing by the Engineer before the PSCR will be allowed to begin.

PSCRs shall be completed in a timely manner in accordance with the approved PSCMP. Unless otherwise approved, PSCRs shall be completed within **4 hours** of notification.

Pavement surface course maintenance as described above will be paid for by force account in accordance with subsection 109.04 under the planned force account item, Pavement Surface Course Maintenance.

**REVISION OF SECTION 105
COOPERATION BETWEEN CONTRACTORS**

Section 105 of the Standard Specifications is hereby revised for this project and includes the following:

Subsection 105.07 shall be revised as follows:

The Contractor is hereby advised that other CDOT construction projects will be working concurrently within the project limits. The Contractor must cooperate fully with the Engineer's direction regarding coordination of project schedules, traffic control, public information, and any other coordination deemed necessary by the Engineer.

The Contractor is advised that work on the following CDOT projects will be taking place concurrently in and around this project site:

- | | |
|---|---|
| (1) I-70 Twin Tunnels Construction Package 1A
Bob Smith
425 A Corporate Circle
Golden, Colorado 80401
Office Phone: 720-512-5611 | (4) I-70 Crack Seal: Chief Hosa to Vail Pass
Hiep Pham
425 A Corporate Circle
Golden, Colorado 80401
Office Phone: 720-497-6911 |
| (2) I-70 Frontage Road Improvements Project
Mike Kelemen, P.E.
425 A Corporate Circle
Golden, Colorado 80401
Office Phone: 720-497-6904 | (5) Twin Tunnels Rock Fall and Void Liner Repair
Brad Dugger
425 A Corporate Circle
Golden, Colorado 80401
Office Phone: 720-497-6911 |
| (3) I-70 Bridge Expansion Joint Project
Jim VanDyne
425 A Corporate Circle
Golden, Colorado 80401
Office Phone: 303-324-8408 | (6) Smart Work Zone Project
Clark Roberts
18500 E. Colfax Avenue
Aurora, Colorado 80011
Office Phone: 303-365-7330 |

And potentially, there are additional CDOT and Clear Creek County projects that may also be under construction within the vicinity of the project site. The Contractor shall coordinate the work with the Contractors of these and any other projects to ensure an orderly completion of work.

All cost associated with the foregoing requirements shall be incidental to the contract.

**REVISION OF SECTION 106
CONFORMITY TO THE CONTRACT OF HOT MIX ASPHALT**

Section 106 of the Standard Special Provisions is hereby revised for this project as follows:

Subsection 106.05 shall include the following:

For this project, Contractor process control testing of hot mix asphalt is mandatory.

**REVISION OF SECTION 106
CONTROL OF MATERIAL (SAMPLING)**

Section 106 of the Standard Specifications is hereby revised for this project as follows:

In subsection 106.03 delete the fifth paragraph and replace with the following:

Samples will be taken by the Department except that the Contractor shall sample the following:

- (1) Asphalt cement in accordance with AASHTO T 40.
- (2) Hot mix asphalt (items 403 and 405) in accordance with Colorado Procedure 41.
- (3) A composite of aggregates for Hot Mix Asphalt in accordance with Colorado Procedure 30.
- (4) Plastic Portland cement concrete in accordance with AASHTO T 141. The Contractor shall transport the concrete sample to the place of testing.

The Engineer will designate the sampling time, location, and sample size. The sampling will be conducted in the presence of the Engineer.

**REVISION OF SECTION 107
RESPONSIBILITY FOR DAMAGE CLAIMS, INSURANCE TYPES AND COVERAGE LIMITS,
OWNER CONTROLLED INSURANCE PROGRAM (OCIP) AND PROJECT INSURANCE MANUAL
(PIM)**

Section 107 of the Standard Specifications is hereby revised for this project as follows:

Delete subsection 107.15 and replace with the following:

107.15 Responsibility for Damage Claims, Insurance Types and Coverage Limits, Owner Controlled Insurance Program (OCIP) and Project Insurance Manual (PIM). The Contractor shall indemnify and save harmless the Department, its officers, and employees, from suits, actions, or claims of any type or character brought because of any and all injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or failure to comply with the provisions of the Contract; or on account of or in consequence of neglect of the Contractor in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of the Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright, unless the design, device, material or process involved is specifically required by the Contract; or from any claims or amounts arising or recovered under the Worker's Compensation Act, or other law, ordinance, order, or decree. The Department may retain as much of any moneys due the Contractor under any Contract as may be determined by the Department to be in the public interest.

(a) The Contractor shall obtain, and maintain at all times during the term of this Contract, insurance in the following kinds and amounts:

1. Workers' Compensation Insurance as required by state statute, and Employer's Liability Insurance covering all of Contractor's employees acting within the course and scope of their employment.
 - A. The Contractor shall provide Workers' Compensation coverage that is in compliance with all Legal Requirements (including C.R.S. § 8-44-101, et seq.) and Employer's Liability with minimum limits of \$1,000,000 by disease each person, \$1,000,000 by disease aggregate, and \$1,000,000 each person by accident.
 - B. Subcontractors shall provide Workers' Compensation coverage that is in compliance with all Legal Requirements (including C.R.S. § 8-44-101, et seq.) and Employer's Liability with minimum limits of \$500,000 by disease each person, \$500,000 by disease aggregate, and \$500,000 each person by accident.
2. Commercial General Liability Insurance written on ISO occurrence form CG 00 01 07/04 or equivalent, covering premises operations, fire damage, independent Contractors, products and completed operations, blanket contractual liability, personal injury, and advertising liability with minimum limits as follows:
 - A. \$1,000,000 each occurrence;
 - B. \$2,000,000 general aggregate;
 - C. \$2,000,000 products and completed operations aggregate; and
 - D. \$50,000 any one fire.
 - E. Completed Operations coverage shall be provided for a minimum period of six year following final acceptance of work.

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**REVISION OF SECTION 107
 RESPONSIBILITY FOR DAMAGE CLAIMS, INSURANCE TYPES AND COVERAGE LIMITS,
 OWNER CONTROLLED INSURANCE PROGRAM (OCIP) AND PROJECT INSURANCE MANUAL
 (PIM)**

If any aggregate limit is reduced below \$1,000,000 because of claims made or paid, the Contractor shall immediately obtain additional insurance to restore the full aggregate limit and furnish to CDOT a certificate or other document satisfactory to CDOT showing compliance with this provision.

3. Automobile Liability Insurance covering any auto (including owned, hired and non-owned autos) with a minimum limit as follows: \$1,000,000 each accident combined single limit.

4. Professional liability insurance with minimum limits of liability of not less than \$1,000,000 Each Claim and \$1,000,000 Annual Aggregate for both the Contractor or any subcontractors when:
 - A. Contract items 625 (excluding tunnel surveying), 629, or both are included in the Contract
 - B. Plans, specifications, and submittals are required to be signed and sealed by the Contractor’s Professional Engineer, including but not limited to:
 - (1) Shop drawings and working drawings as described in subsection 105.02
 - (2) Mix Designs
 - (3) Contractor performed design work as required by the plans and specifications
 - (4) Change Orders
 - (5) Approved Value Engineering Change Proposals
 - C. The Contractor and any included subcontractor shall renew and maintain Professional Liability Insurance as outlined above for a minimum of one year following final acceptance of work.

5. The Contractor shall provide Umbrella or Excess Liability Insurance with minimum limits of \$1,000,000 for Package 1B. Minimum limits shall be based upon estimated Construction Values in accordance with the table below. This policy shall become primary (drop down) in the event the primary Liability Policy limits are impaired or exhausted. The Policy shall be written on an Occurrence form and shall be following form of the primary. The Umbrella or Excess which will provide bodily injury, personal injury and property damage liability at least as broad as the primary coverage set forth above, including Employer’s Liability, Commercial General Liability and Commercial Automobile Liability.

<u>Estimated Construction Values</u>	<u>Minimum Umbrella / Excess Liability Limits</u>
Less than \$5,000,000 in CV	\$1,000,000
\$5,000,000 to \$10,000,000	\$2,000,000
\$10,000,000 to \$25,000,000	\$5,000,000
\$25,000,000 to \$75,000,000	\$10,000,000
Over \$75,000,000	Determined by the CDOT Risk Manager

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**REVISION OF SECTION 107
RESPONSIBILITY FOR DAMAGE CLAIMS, INSURANCE TYPES AND COVERAGE LIMITS,
OWNER CONTROLLED INSURANCE PROGRAM (OCIP) AND PROJECT INSURANCE MANUAL
(PIM)**

The Contractor shall ensure that their subcontractors provide Umbrella or Excess Liability Insurance with minimum limits of \$1,000,000. This policy shall become primary (drop down) in the event the primary Liability Policy limits are impaired or exhausted. The Policy shall be written on an Occurrence form and shall be following form of the primary. The Umbrella or Excess which will provide bodily injury, personal injury and property damage liability at least as broad as the primary coverage set forth above, including Employer's Liability, Commercial General Liability and Commercial Automobile Liability.

- (b) CDOT and the City of Idaho Springs shall each be named as an Additional Insured on the Commercial General Liability, Automobile Liability and Umbrella / Excess Liability Insurance policies. Completed operations additional insured coverage shall be on endorsements CG 2010 07/04, CG 2037 07/04, or equivalent. Coverage required of the contract will be primary over any insurance or self-insurance program carried by the State of Colorado.
- (c) Railroad Protective Insurance
In addition to the above, the Contractor shall furnish evidence to CDOT that, with respect to the operation the Contractor or any of its subcontractors perform, the Contractor has provided for and on behalf of the Railroad Company, and each Railroad Company when more than one is involved, Railroad Protective Public Liability and Property Damage Insurance provided for a combined single limit of Five Million Dollars (\$5,000,000) per occurrence with an aggregate limit of Ten Million Dollars (\$10,000,000) applying separately for each annual period for:
1. All damages arising out of bodily injuries to or death of one or more persons.
 2. All damages arising out of injury to or destruction of property.
 3. Said policy or policies of insurance shall be deemed to comply with the Railroad Protective Insurance requirements if each of said policies contains a properly completed and executed "Railroad Protective Liability Form," copies of which are available from CDOT's Agreements Engineer, Colorado Department of Transportation, 4201 E. Arkansas Ave., Denver, CO, 80222. All required policy or policies of insurance shall be submitted to the Project Director for transmittal to the Railroad Company's Insurance Department.

The Railroad Protective Insurance shall be carried until all Work required to be performed under the terms of the Contract is satisfactorily completed as evidenced by the formal acceptance of CDOT. The Railroad Company shall be furnished with the original of each policy carried on its behalf.

- (d) Each insurance policy shall include provisions preventing cancellation or non-renewal without at least 30 days prior notice to Contractor. The Contractor shall forward to the Engineer any such notice received within seven days of the Contractor's receipt of such notice.
- (e) The Contractor shall require all insurance policies in any way related to the contract and secured and maintained by the Contractor to include clauses stating that each carrier shall waive all rights of recovery, under subrogation or otherwise, against CDOT, its agencies, institutions, organizations, officers, agents, employees and volunteers.

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**REVISION OF SECTION 107
RESPONSIBILITY FOR DAMAGE CLAIMS, INSURANCE TYPES AND COVERAGE LIMITS,
OWNER CONTROLLED INSURANCE PROGRAM (OCIP) AND PROJECT INSURANCE MANUAL
(PIM)**

All policies evidencing the insurance lines of coverage required hereunder shall be issued by insurance companies satisfactory to CDOT.

- (f) The Contractor shall provide certificates showing insurance coverage required by this contract to CDOT prior to execution of the contract. No later than 15 days prior to the expiration date of any such coverage, the Contractor shall deliver CDOT certificates of insurance evidencing renewals thereof. At any time during the term of this contract, CDOT may request in writing, and the Contractor shall thereupon within ten (10) days supply to CDOT, evidence satisfactory to CDOT of compliance with the provisions of this section.
- (g) Notwithstanding subsection 107.15(a), if the Contractor is a “public entity” within the meaning of the Colorado Governmental Immunity Act CRS 24-10-101, et seq., as amended (“Act”), the Contractor shall at all times during the term of this contract maintain only such liability insurance, by commercial policy or self-insurance, as is necessary to meet its liabilities under the Act. Upon request by CDOT, the Contractor shall show proof of such insurance satisfactory to CDOT. Public entity Contractors are not required to name CDOT as an Additional Insured.
- (h) When the Contractor requires a subcontractor to obtain insurance coverage, the types and minimum limits of this coverage may be different than those required, as stated above, for the Contractor, except for the Commercial General Liability and Automobile Liability and the subcontractor shall provide an Additional Insured endorsement for such coverage. Those that qualify as needing Professional Liability Insurance in terms of any design work shall provide such coverage as provided for in (4) above.
- (i) CDOT will provide the following lines of Insurance coverage for this project in a CDOT sponsored Owner Controlled Insurance Program (OCIP):

1. Workers’ Compensation.

CDOT will procure, pay for, and maintain Workers Compensation insurance in compliance with statutory limits for the Workers' Compensation Laws of the State of Colorado and Employer's Liability limits of not less than:

- A) \$ 1,000,000 - Each accident for Bodily Injury
- B) \$ 1,000,000 - Policy limit for Bodily Injury by disease
- C) \$ 1,000,000 - Each employee for Bodily Injury by disease.

Covered operations at the Project Site for enrolled Project Contractors. Coverage ceases for any employee of the enrolled Project Contractors when they leave the Project Site for unrelated business. Workers Compensation coverage will extend to employees’ direct travel between two scheduled Project Sites when the travel is conducted for the sole purpose of executing Work. The Project Site will include adjacent or nearby tracts of land where incidental operations, such as the location of Contractor's trailers, offices, CDOT's team's offices, etc. are performed, related to the Work. The Project site will not include permanent locations of any insured party other than CDOT. The OCIP shall not apply to the operations of Project Contractors at their offices, factories, or warehouses.

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Covered operations at the Project Site for enrolled Project Contractors. Coverage ceases for any employee of the enrolled Project Contractors when they leave the Project Site for unrelated business. Workers Compensation coverage will extend to employees' direct travel between two scheduled Project Sites when the travel is conducted for the sole purpose of executing Work. The Project Site will include adjacent or nearby tracts of land where incidental operations, such as the location of Contractor's trailers, offices, CDOT's team's offices, etc. are performed, related to the Work. The Project site will not include permanent locations of any insured party other than CDOT. The OCIP shall not apply to the operations of Project Contractors at their offices, factories, or warehouses.

CDOT will pay any policy related insurance costs for Workers' Compensation not covered because of deductibles, if any. The Contractor shall be responsible for any related Drug and Alcohol accident / incident testing or other contractual obligations as provided for in the Contract which may be related to the incident and/or injured worker.

The Contractor shall estimate and report to CDOT the amount of money that would have been in their bid for Workers' Compensation Insurance and Employer's Liability on form OCIP-B. The Contractor shall also show the amount of money remaining in their bid for Workers' Compensation and Employer's Liability insurance for the coverage items not included in the OCIP on form OCIP-B.

2. Commercial General Liability.

Policy Limits:

- A) \$2,000,000 per Occurrence for Bodily Injury and Property Damage
- B) \$4,000,000 General Aggregate
- C) \$4,000,000 Completed Operations Aggregate

The Policy limits are shared by all Project Contractors enrolled in the OCIP. Policy Exclusions – Examples could include, but are not limited to:

A) COVERAGE A BODILY INJURY AND PROPERTY DAMAGE LIABILITY

Exclusions:

- (1) Expected or Intended Injury
- (2) Contractual Liability
 - Liquor Liability
 - Workers' Compensation and Similar Laws
 - Employer's Liability
 - Pollution
 - Aircraft, Auto or Watercraft
 - Mobile Equipment
 - War
 - Damage to Property – modified or deleted by endorsement
 - Damage to Your Product - modified or deleted by endorsement
 - Damage to Your Work - modified or deleted by endorsement
 - Damage to Impaired Property or Property Not Physically Injured
 - Recall of Products, Work or Impaired Property
 - Personal and Advertising Injury
 - Electronic Data

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B) COVERAGE B PERSONAL AND ADVERTISING INJURY LIABILITY

(1) Exclusions:

- Knowing Violation of Rights of Another
- Material Published with Knowledge of Falsity
- Material Published Prior to Policy Period
- Criminal Acts
- Contractual Liability
- Breach of Contract
- Quality or Performance of Goods – Failure to Conform to Statements
- Wrong Description of Prices
- Infringement of Copyright, Patent, Trademark or Trade Secret
- Insured's in Media and Internet Type Businesses
- Electronic Chatrooms or Bulletin Boards
- Distribution of Material in Violation of Statues
- Unauthorized Use of Another's Name or Product
- Pollution-Related
- War

C) COVERAGE C MEDICAL PAYMENTS

(1) Exclusions:

- Any Insured
- Hired Person
- Injury on Normally Occupied Premises
- Workers Compensation and Similar Laws
- Athletics Activities
- Products-Completed Operations Hazard
- Coverage A Exclusions

D) Additional Policy Endorsements

(1) Endorsements:

- Limits of Insurance
- Named Insured Amended
- Limitation of Coverage to Designated Project
- Amendment Property Damage
- Extended Completed Operations
- Service of Suit
- Signature Endorsement
- Minimum Earned Premium and Premium Audit Premium Endorsement
- Additional Insured – State or Political Subdivision Permits - Blanket
- Additional Insured – Mortgagee, Assignee, or Receiver - Blanket
- Additional Insured – Lessor of Leased Equipment – Automatic Status When Required in Defense Costs and Supplementary Payments Included within the Limits of Insurance
- Deductible Liability/SIR Endorsement

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- Limited Coverage Repair Work
- Trade or Economic Sanctions Endorsement
- Disclosure Pursuant to Terrorism Risk Insurance Act
- Cancellation Provision Endorsement – Manuscript

(2) Claims Directory – Duties in Event of an Occurrence, Offense, Claim or Suit

E) Additional Policy Exclusions

(1) Exclusions:

- Nuclear Energy Liability Exclusion
- Asbestos Exclusion
- War
- Wrap-Up Cross Suits Excl. – Amendment - exception First Named Insured / Contractor
- Designated Ongoing Operations (Scheduled Location(s) excluded)
- Damage to Premises Rented to You
- Lead Exclusion
- Discrimination
- Exclusion – Coverage C – Medical Payments: Any Location or Job Site
- Employment-Related Practices Exclusion
- Fungi or Bacteria Exclusion
- Exclusion – Exterior Insulation and Finish Systems
- Silica or Silica-Related Dust Exclusion
- Total Pollution Exclusion with Hostile Fire Exception
- Exclusion – Contractors Professional Liability (CG 2279)
- Violation of Statutes that Govern Emails, Faxes, Phone Calls or Other
- Methods of Sending Material Information

Standard Insurance Service Office Commercial General Liability Insurance policy or equivalent, including Bodily Injury, Property Damage, Personal Injury and Completed Operations covering operations at the Project Site for Project Contractors shall be provided. An eight-year extension of the Completed Operations Liability coverage for the Colorado Statute of Repose and the Statute of Limitations will begin upon the earlier of expiration of the OCIP policy, Substantial Completion of the Project, or the completion of Work under Contract. This insurance will not extend to products liability coverage for any product manufactured away from the Project Site. The OCIP will be primary and non-contributory as it relates to coverage provided under the OCIP.

Contractor will be responsible for repayment of any deductible for Bodily Injury or Property damage up to \$25,000 per occurrence to the extent loss costs (including allocated loss adjustment expense) payable are attributable to its acts, or the acts of its subcontractors, or any other entity or person for whom it may be responsible, with no increase in the Contract amount.

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To the extent losses covered and payable under the OCIP arise out of, or are the responsibility of the Contractor's subcontractors of any tier, Contractor may seek contribution from those subcontractors in an amount equal to the self-insured retention or deductible amount under the subcontractor's own conventional General Liability Insurance Policy in effect at the time of enrollment into the OCIP, but in no case may the Contractor collectively collect more than the per occurrence deductible of \$25,000 for the occurrence which is the contractual responsibility of the Contractor.

The contractor shall estimate and report to CDOT the amount of money that would have been in their bid for Commercial General Liability Insurance on form OCIP-B. The Contractor shall also show the amount of money remaining in their bid for Commercial General Liability for insuring items not included in the OCIP on form OCIP-B.

3. Umbrella or Excess Liability Insurance.

A) Policy limits:

- (1) \$100,000,000 Each Occurrence
- (2) \$100,000,000 Aggregate

Coverage is in excess of the primary Commercial General Liability and Employer's Liability. Such Excess Liability Insurance will be primary and non-contributory as to any other excess insurance the parties hereto may have in force. An eight-year extension (for the Statute of Repose and Limitations) of the Completed Operations Liability coverage is anticipated and will begin upon the earlier of expiration of the Commercial General Liability Policy or Substantial Completion of the Project, or the completion of Work under Contract. This insurance will not extend products liability coverage for any product manufactured away from the Project Site.

These limits may be satisfied in various combinations with an Umbrella or Excess policy.

The contractor shall estimate and report to CDOT the amount of money that would have been in their bid for Excess Liability Insurance on form OCIP-B. The Contractor shall also show the amount of money remaining in their bid for Excess Liability for insuring items not included in the OCIP on form OCIP-B.

4. Builders Risk Insurance.

CDOT will procure, pay for, and maintain a builder's risk insurance policy, including coverage for in-transit and off-site storage, to protect the interests of the Insured's, including CDOT, Project Contractors and its subcontractors, against the risk of loss or damage to the Work during construction at the Project Site. Such policy will include a waiver of subrogation in favor of CDOT, CDOT's Engineer, Construction Manager, Contractors, and subcontractors.

Coverage will include all materials, supplies and equipment that are intended for specific installation in the Project while such materials, supplies and equipment are located at the Project Site, in transit or while temporarily located away from the Project Site for the purpose of storage at the risk of one of the insured parties, as agreed upon by the CDOT in writing in advance of such transit or storage.

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POLICY COVERAGE FORM AND EXCLUSIONS [EXAMPLES]:

- a) Commercial Inland Marine – Builders Risk Coverage Form
 - 1. Endorsements:
 - A) Extra Expense Endorsement
 - B) Elite Property Enhancement: Builders Risk – sub limits apply
 - C) Builders Risk Warranties

This insurance will not include any coverage for tools or clothing of workers or any tools, equipment, protective fencing, scaffolding, and equipment owned, rented or used by Contractor and used in the performance of the Work, or work performed at off-site fabrication facilities. Contractor shall waive any such rights of recovery from CDOT and/or the OCIP Policies.

Contractor shall be responsible for repayment of any deductible for Property Damage up to \$25,000 per occurrence to the extent loss costs (including allocated loss adjustment expense) payable are attributable to its acts, or the acts of its subcontractors, or any other entity or person for whom it may be responsible, with no increase in the Contract amount. Contractor may not seek contribution of this deductible from its subcontractors.

NOTE: The Builders Risk policy terms vary from policy to policy, and such insurance provided by the CDOT will be subject to such limits of liability, exclusions and deductibles as CDOT may negotiate in its discretion. Contractor is advised to consult the terms of the policy to ascertain its terms.

The Contractor shall estimate and report to CDOT the amount of money that would have been in their bid for Builder’s Risk Insurance on form OCIP-B.

- 5. Contractor’s Pollution Liability.
 - A) CDOT will procure, pay for and maintain Contractor’s Pollution Liability insurance in the following limits:

(1) \$ 25,000,000	Per Claim
(2) \$ 25,000,000	Aggregate Claims Expenses (including Defense Costs) within limits.

Coverage will include Bodily Injury or Property Damage from a pollution event as defined within the policy form resulting from covered operations or completed operations of the Work performed at the Project Site.

Contractor shall be responsible for repayment of any deductible associated with the activities of the Contractor or their subcontractors up to \$25,000 per occurrence to the extent loss costs (including allocated loss adjustment expense) payable are attributable to its acts, or the acts of its Project Contractors and subcontractors, or any other entity or person for whom it may be responsible, with no increase in the Contract amount.

The Contractor shall estimate and report to CDOT the amount of money that would have been in their bid for Contractor’s Pollution Liability Insurance on form OCIP-B.

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6. The OCIP and other insurance Contractor Obligations
- A) CDOT provided Insurance shall not apply to vendors, manufacturers, suppliers, material dealers, haulers and/or independent haulers, and others who merely transport, pick up, deliver or carry materials, personnel, parts or equipment, or any other items or persons to or from the Project Site. Subcontractors providing on site hauling services with dedicated payroll will be considered eligible for enrollment at CDOT's discretion.
 - B) The cost of the OCIP Insurance specified herein to be obtained by CDOT will be paid for by CDOT, and CDOT shall receive and pay, as the case may be, all adjustments in such costs, whether by way of dividends or audits, or otherwise. CDOT shall execute such instruments of assignment as may be necessary to permit CDOT to receive such adjustments and shall cause all Contractors covered by such insurance to do the same.
 - C) The furnishing of insurance by CDOT shall in no way relieve, limit, or be construed to relieve Contractor or subcontractors of any responsibility or obligation whatsoever otherwise imposed by the Contract. CDOT assumes no obligation to provide insurance other than that specified herein. However, CDOT reserves the right to furnish additional insurance coverage of various types and limits.
 - D) The Contractor shall furnish a copy of this Revision of Section 107 to all subcontractors of every tier.
 - E) Prior to commencement of operations at the Project Site, each Contractor shall complete a Contractor / subcontractor Application for enrollment into the OCIP and shall furnish and cause each of its subcontractors to furnish to the CDOT or its Insurance Representative estimates for the total construction values, and estimated WC Payrolls in connection with the Work. The Insurance Representative may request, and the Project Contractor shall comply with such request for copies of rate pages from their Workers Compensation, General and Excess Liability policies, or other insurance related information deemed necessary to effect and maintain coverage, and/or to assure that CDOT has received the appropriate reduction of the total insurance cost excluded from their Contract, including any markup thereon.
 - F) Failure to comply with any of the above items will be considered noncompliance with the Contract and may result in remedial action, including withholding of payment, and/or removal of Contractor and/or subcontractor from the Project Site.
 - G) Liability policies required of the Contractor and their subcontractors in this Revision of Section 107 shall, where prudently feasible, shall name CDOT and the Contractor and their elected and appointed officials, directors, officers, employees, agents, representatives, and any additional entities as CDOT or Contractor may request, as Additional Insured. The Additional Insured Endorsement, equivalent to ISO form CG2010 (07/04) and CG2037 (07/04) edition(s), shall state that the coverage provided to the Additional Insured is primary and non-contributory with respect to any other insurance available to the Additional Insured. Contractor is responsible to ensure to the best of its ability that those entering the Project Site location have evidence of, or hold, the appropriate insurance or that those visitors are escorted while at the Project. Exceptions may be granted where mutually agreed to in advance between CDOT and the Contractor.

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- H) All policies of insurance required in this Revision of Section 107 shall be endorsed to provide that the insurance company shall provide written notice to CDOT at least 30 days prior to the effective date of any cancellation of such policies.
 - I) All policies of insurance, as allowed by statute, that are in any way related to the Work, including those that are secured and maintained by consultants and subcontractors, shall include clauses providing that each underwriter shall waive all its rights of recovery under subrogation or otherwise, against CDOT, their Representative(s), Contractor and subcontractors.
 - J) Parties covered in this Revision of Section 107 shall cause to be furnished to CDOT and Contractor, or their Insurance Representative, certificates of insurance evidencing all insurance as required by this Contract. As and when CDOT or Contractor may direct, copies of the actual insurance policies or renewals or replacements thereof shall be submitted to CDOT or Contractor. All copies of policies, if any, and certificates of insurance submitted to CDOT shall be in form and content acceptable to CDOT or Contractor.
 - K) Nothing contained herein shall relieve Contractor, or its subcontractors of their obligations to exercise due care when performing any Work on the Project or to complete such Work in strict compliance with the Contract.
 - L) By enrolling in the OCIP, the Contractor acknowledges that (A) the limits of OCIP provided insurance are shared by all insured parties under the OCIP for the Project, (B) CDOT and their affiliates of every tier disclaim any responsibility whatsoever for the availability, adequacy or exhaustion of the limits of the OCIP, the present or future solvency of any OCIP insurers, or any claims or disputes by, between, or among CDOT and any Contractor and any subcontractor, or any tier, and any of the OCIP insurance carriers.
 - M) Any type of insurance or increase in limits not described herein which Contractor requires for its own protection or as a result of any applicable law shall be its own responsibility and expense.
- (j) The Contractor and subcontractors are required to carry insurance coverages and limits listed below outside the OCIP which must be the same limits listed in (a) for the Contractor and for the subcontractor.
- 1. Workers' Compensation - Off-site work and exposures
 - 2. Employer Liability - Off-site work and exposures
 - 3. Commercial General Liability - Off-site work and exposures
 - 4. Automobile Liability – at all times
 - 5. Umbrella or Excess Liability - As coverage in excess of the lines of insurance above

All other insurance in Section (a) shall continue to be carried as required.

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- (k) CDOT will provide a Project Insurance Manual (PIM) that gives further detail on insurance and how to enroll in the OCIP. The PIM is hereby included in the Contract by reference.
- (l) General Additional Safety Requirements
- (m) The Contractors and subcontractors shall within their own site specific Safety Requirements or Manuals, ensure compliance has been met with the following Safety Requirements, which are incorporated in the Contract Documents.

The Contractor shall take all necessary precautions to protect the safety and health of the Project Site and is ultimately responsible to establish and maintain a written Contractor Safety Program (CSP) for the Work. The Contractor shall establish administrative and technical means for the mitigation of risk, response to incidents, and recovery/restoration to normal operations at the Project Site. The Program shall include development of a site safety culture which supports, “best practices” for accident prevention, job specific hazard recognition and planning, training, reporting, management oversight, and implementation.

All costs, penalties, and expenses of complying with the requirements of these Safety Requirements shall be included as part of the cost of the Contract. The Contractor shall notify CDOT promptly, in writing, if a charge of non-compliance has been filed against the Contractor, or any subcontractor, in connection with its performance of the Work.

The developed CSP shall apply in all phases of the Work. The objective of the program is to eliminate or control accident risks to personnel, associated management, subcontractors, equipment, facilities, general public, and environment. Required activities include hazard identification & analysis, planning, management, dedicated resources, auditing conformance, training, communicating results and documentation.

Additionally, clear and open partnering and communications relative to the safety program between the Contractor, subcontractors and CDOT's Representatives is a key component in effectively implementing and assuring conformance.

The Contractor is solely responsible for health and safety and shall perform the Work in a safe and environmentally acceptable manner; this includes all of its subcontractors.

1. Safety Criteria

Notice of Correction of other unsafe conditions will be conveyed in writing within 24 hours after receiving written notice from CDOT or CDOT's Safety Representative of unsafe work. Lost time and lost productivity associated with this or any safety violation will be at the sole cost of the Contractor or the subcontractor without additional compensation.

2. Contractor Site Safety Management

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Each subcontractor is required to name an individual on its payroll as a Safety Representative (SR). These SRs are not required to be full-time safety representatives. The subcontractors are required to name an individual(s) who has the experience, ability and authorization to act on the subcontractor's behalf in matters of safety on the Project.

If at any time any subcontractor is performing one or more contracts and has fifty (50) or more employees on site for a period of 2) consecutive workdays, including cumulative workdays under multiple contracts ("high employment"), such subcontractor Shall have a full-time qualified safety representative on the job site to ensure the safety of its operations during the period of such high employment.

The Contractor and subcontractors are required to participate in the project's "Return To Work" program. Contractors and subcontractors shall return injured workers back to work at pre-injury wages as soon as possible through light or modified work tasks, which meet medical department's work restrictions.

The Contractor shall administer any job-site safety recognition incentive program developed for the site in an effort to maintain a safety-conscious workforce at the site.

3. OCIP Required Contractor Site Safety Requirements:

- A) The Contractors Safety Program shall conform to all aspects of this Section and be consistent with the requirements herein and the CDOT Required Contractor's Safety Management Plan.
- B) The Contractor shall conduct a project/site safety orientation for all Contractor & subcontractor employees prior to their working on the Project Site; including orientation for all full time project oversight and management personnel. Upon completion of the orientation, a uniquely project identifiable hard-hat decal shall be provided to each worker.

The safety orientation (at a minimum) shall include the following:

- (1) A description of the extent and nature of the Project.
 - (2) A description of any hazards that can typically be expected during the course of work, and means and methods for avoiding or protecting oneself.
 - (3) Required work practices, job conduct, and injury reporting procedures.
 - (4) Any other general information to acquaint the employee with special work and safety requirements at the Site.
4. The Contractors and subcontractors shall be prohibited from use and possession of alcoholic beverages, drugs (other than prescription), carrying weapons or ammunition onto the site, or using or carrying weapons while performing work on the Project's behalf, or attending Project sponsored activities. Contractor, at its own expense, shall adopt a policy of a drug free work site on the Project, which at a minimum shall include pre-job site and post-accident drug testing. Contractor, at its discretion, may include "for cause" and "random" testing if consistent best practices are applied.

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The Contractor shall require all workers to demonstrate a negative drug test before attending a Project Safety Orientation, and performing any work on a CDOT OCIP Sponsored Project. Previous drug test results from an accredited facility done within forty-five (45) days will be acceptable. Any employee who has not worked on a CDOT OCIP Sponsored Project during the last 12 months must retest and go through a new Project Safety Orientation as provided by the Contractor.

Current crane certification for each crane is required and must be on file at the jobsite.

The Contractors safety enforcement activities shall be documented and/or logged and provided to the CDOT's Safety Representative upon request (without any personnel privacy sensitive information) and this information shall be on file at the jobsite.

Include Personal Protective Equipment (PPE) requirements and policy.

100 percent fall protection at working surfaces above 6ft without review and authorization from OCIP Safety Manager

100 percent eye protection with side shields required.

100 percent wearing of heavy-duty work boots/shoes required.

100 percent wearing of hardhats required.

100 percent wearing of shirt & long pants (no shorts).

100 percent wearing of high visibility vest or clothing.

Hearing protection as required.

(4) OCIP Required Reporting

(i) Accident Reporting. The Contractor shall provide timely verbal notification and a written report to CDOT's Representative, and CDOT's Safety Representative of any and all accidents/incidents whatsoever arising out of or in connection with the performance of the work, whether on or adjacent to the site, which cause death, personal injury or property damage; and or had a serious potential for same. Verbal notification to the CDOT shall be immediate and under no circumstance shall notification exceed one hour from time of occurrence. Verbal notification shall include date and time, location, brief description, extent of property damage, and extent of injuries. A preliminary written accident report shall be furnished to the CDOT's Representative and CDOT's Safety Representative within 24 hours of the occurrence; final is due within 10 working days.

(ii) Monthly Accident/Incident Summary Reports. The Contractor shall provide a written Monthly Accident/Incident Safety Performance Summary Report for losses under their Contract to the CDOT within seven Days of the last day of the month. The report shall include the following minimum information:

(A) A summary, current year for all accidents/incidents – all Project Contractors / subcontractors.

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- (B) Summary of lost time for the Project to date, including total number of lost days and number of lost days accidents.
 - (C) Summary of accident data by Contractor and subcontractor.
 - (D) Summary of Property Damage, including Utility Damage incidents.
 - (E) Status update of any project required corrective actions.
- (5) OCIP REQUIRED CONTRACTOR SAFETY MANAGEMENT PLANS / DOCUMENTS
- (i) Job Task Hazard Analysis Program.
All work activities shall have a written job/task/activity Hazard Analysis (HA) associated with it appropriate for the hazards, scope, and/or complexity of the work. At a minimum this HA will cover the steps, hazards, and mitigation, required to perform the work safely.
 - (ii) Project Hazard Communication Plan
 - (iii) Project Utility Management Plan, locates, accidental damage prevention, and incident reporting/correcting, policies, procedures, and practices.
The Contractor shall have an adequate utility locate, protect, and emergency response program. Any utility strike will be reported to CDOT immediately, investigation and lessons learned follow-up reporting performed, and related program performance measures provided. In addition, no corrections and/or repairs will be re-covered or otherwise made inaccessible until CDOT's Representative or designee has had the opportunity to review.
 - (iv) Project Water Intrusion Prevention and Mitigation Program
 - (v) Project Emergency Response Plan
 - (vi) Project Security Plan

Special consideration and concern shall be given to the storage/protection of highly valuable (i.e., copper), finished product and/or critical materials/equipment to be protected from theft and/or vandalism.

**REVISION OF SECTION 107
PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE**

Section 107 of the Standard Specification is hereby revised as follows:

Subsection 107.12 shall include the following:

The Contractor shall save existing riparian, wetlands, and other vegetation, except for those that must be removed to accommodate construction of the project. The Contractor shall fence specific areas of vegetation to be protected in the field as shown in the plans or as directed by the Engineer.

The Contractor shall perform all the work in such a manner that the least environmental damage will result. Any questionable areas or items shall be brought to the attention of the Engineer for approval prior to vegetation removal or any damaging activity. Damaged or destroyed fenced trees, shrubs, or wetlands, which could have been saved as determined by the Engineer, shall be replaced at the expense of the Contractor.

If the vegetation fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is repaired to the Engineer's satisfaction at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

**REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK**

Section 107 of the Standard Specifications is hereby revised as follows:

Subsection 107.06 shall include the following:

The following work elements are considered safety critical work for this project:

- | | | |
|-----|--|---------------------------|
| (1) | Construction of Cast In Place Walls | [No P.E. stamp required]; |
| (2) | Shoring; | [P.E. stamp required]; |
| (3) | Rock Scaling and Rockfall Mitigation | [No P.E. stamp required]; |
| (4) | Blasting | [No P.E. stamp required]; |
| (5) | Work requiring the use of cranes or other lifting equipment; | [No P.E. stamp required] |
| (6) | Girder Erection | [P.E. stamp required]; |
| (7) | Post Tensioning | [No P.E. stamp required] |

The Contractor shall submit, for record purposes only, an initial detailed construction plan that addresses safe construction of each of the safety critical elements. When the specifications already require an erection plan, a bridge removal plan, or a removal of portion of bridge plan, it shall be included as a part of this plan. The detailed construction plan shall be submitted two weeks prior to the safety critical element conference described below. The construction plan shall be stamped “Approved for Construction” and signed by the Contractor. The construction plan will not be approved by the Engineer.

The Construction Plan shall include the following:

- (1) Safety Critical Element for which the plan is being prepared and submitted.
- (2) Contractor or subcontractor responsible for the plan preparation and the work.
- (3) Schedule, procedures, equipment, and sequence of operations, that comply with the working hour limitations
- (4) Temporary works required: falsework, bracing, shoring, etc.
- (5) Additional actions that will be taken to ensure that the work will be performed safely.
- (6) Names and qualifications of workers who will be in responsible charge of the work:
 - A. Years of experience performing similar work
 - B. Training taken in performing similar work
 - C. Certifications earned in performing similar work
- (7) Names and qualifications of workers operating cranes or other lifting equipment
 - A. Years of experience performing similar work
 - B. Training taken in performing similar work
 - C. Certifications earned in performing similar work
- (8) The construction plan shall address how the Contractor will handle contingencies such as:
 - A. Unplanned events (storms, traffic accidents, etc.)
 - B. Structural elements that don't fit or line up
 - C. Work that cannot be completed in time for the roadway to be reopened to traffic
 - D. Replacement of workers who don't perform the work safely
 - E. Equipment failure
 - F. Other potential difficulties inherent in the type of work being performed
- (9) Name and qualifications of Contractor's person designated to determine and notify the Engineer in writing when it is safe to open a route to traffic after it has been closed for safety critical work.

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**REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK**

- (10) Erection plan or bridge removal plan when submitted as required elsewhere by the specifications. Plan requirements that overlap with above requirements may be submitted only once.

A safety critical element conference shall be held two weeks prior to beginning construction on each safety critical element. The Engineer, the Contractor, the safety critical element subcontractors, and the Contractor's Engineer shall attend the conference. Required pre-erection conferences or bridge removal conferences may be included as a part of this conference.

After the safety critical element conference, and prior to beginning work on the safety critical element, the Contractor shall submit a final construction plan to the Engineer for record purposes only. The Contractor's Engineer shall sign and seal temporary works, such as falsework, shoring etc., related to construction plans for the safety critical elements, (3) Removal of Bridge, (4) Removal of Portion of Bridge and (5) Temporary Works. The final construction plan shall be stamped "Approved for Construction" and signed by the Contractor.

The Contractor shall perform safety critical work only when the Engineer is on the project site. The Contractor's Engineer shall be on site to inspect and provide written approval of safety critical work for which he provided signed and sealed construction details. Unless otherwise directed or approved, the Contractor's Engineer need not be on site during the actual performance of safety critical work, but shall be present to conduct inspection for written approval of the safety critical work.

When ordered by the Engineer, the Contractor shall immediately stop safety critical work that is being performed in an unsafe manner or will result in an unsafe situation for the traveling public. Prior to stopping work, the Contractor shall make the situation safe for work stoppage. The Contractor shall submit an acceptable plan to correct the unsafe process before the Engineer will authorize resumption of the work.

When ordered by the Engineer, the Contractor shall remove workers from the project that are performing the safety critical work in a manner that creates an unsafe situation for the public in accordance with subsection 108.05.

Should an unplanned event occur or the safety critical operation deviate from the submitted plan, the Contractor shall immediately cease operations on the safety critical element, except for performing any work necessary to ensure worksite safety, and provide proper protection of the work and the traveling public. If the Contractor intends to modify the submitted plan, he shall submit a revised plan to the Engineer prior to resuming operations.

All costs associated with the preparation and implementation of each safety critical element construction plan will not be measured and paid for separately, but shall be included in the work.

Nothing in the section shall be construed to relieve the Contractor from ultimate liability for unsafe or negligent acts or to be a waiver of the Colorado Governmental Immunity Act on behalf of the Department.

**REVISION OF SECTION 109
CONSTRUCTION MANAGER/GENERAL CONTRACTOR FORCE ACCOUNTS**

Section 109 of the Standard Specifications is hereby revised for this project as follows:

Delete subsection 109.03 and replace with the following:

109.03 Compensation for Altered Quantities.

- (a) *Guaranteed Maximum Price.* On CMGC Construction projects, when the accepted quantities of work vary from the quantities in the Contract, The Contractor shall accept as payment in full, payment at the original contract unit prices for the installed and accepted quantities of work up to the original quantities shown in the Guaranteed Maximum Price proposal, except as defined in subsections 104.02, 104.03, and 108.11 as approved by the Engineer. All planned Force Account items will be paid for in accordance with subsections 104.03 as listed in the Project Special Provision, Force Account Items. Overruns approved by the Engineer on original quantities as accepted in the Guaranteed Maximum Price proposal under the planned Force Account Item, Minor Contract Revisions.

Overruns approved by the Engineer on original quantities as accepted in the Guaranteed Maximum Price proposal shall be paid for at the original contract unit prices under the planned Force Account Item, Minor Contract Revisions for the following items only: 202-Removal of Tree, 202-Removal of Portions of Present Structure (Class 3) for Structure CLR314-W0.7, 203 Items, 206 Structure Backfill (Flowfill), 208 Erosion Control Items, 212 Landscaping Items, 213 Landscaping Items, 304 Aggregate Base Course, 403 Hot Mix Asphalt, 503 Micropile, 515 Concrete Sealer, 607 Fence (Temporary), 614 Fiber Optic Termination Panel – 6 Fiber, 614 – Fiber Optic Cable (Single Mode)(12 Strand), 625 Construction Surveying (Hourly), 627 Pavement Marking Paint, and 630 Traffic Control Items.

If items and their original quantities shown in the Guaranteed Maximum Price proposal change or are modified by the Department between acceptance of the GMP proposal and issuance of the final construction plans and specifications, the Contractor shall accept as payment at the original contract unit prices for the installed and accepted quantities that have changed.

Allowance will not be made except as provided in subsections 104.02, 104.03, and 108.11, for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation of overhead expense among the contract items or from any other cause.

- (b) *Shared Risk Contingency Pool.* Differing site conditions and extra work performed that the Contractor and CDOT have agreed to share risk under will be paid for as stipulated in the order authorizing the work and compensated out of the planned Force Account Item F/A Shared Risk Contingency Pool. Compensation will be the accepted at Guaranteed Maximum Price unit price.

The shared risk compensations, components, and total amounts for each of the items agreed upon shall be defined in the Project Risk Registry.

If any such alteration directly causes the loss of any work or materials already furnished by the Contractor under the terms of the original Contract, reimbursement for such work or of salvaging such materials will be at actual cost. Any such materials may, at the option of the Department, be purchased at the actual cost to the Contractor, as evidenced by certified invoices.

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**REVISION OF SECTION 109
CONSTRUCTION MANAGER/GENERAL CONTRACTOR FORCE ACCOUNTS**

All cost savings in the Shared Risk Contingency Pool not resulting in the reduction of work or operating performance shall be shared equally between the Contractor and CDOT.

Delete subsection 109.04 and replace with the following:

109.04 Compensation for Changes and Force Account Work.

All bid items and quantities that have the CMGC Risk Pool designation in the Summary of Approximate Quantities in the Plans will be paid for using the Shared Risk Contingency Pool. All bid items and quantities that will be paid for using the Shared Risk Contingency pool will have definitions and identify how to determine when and how to measure payment for the risk item.

Force account work shall not be eligible for the CMGC Management Price Percentage with the following exceptions. The CMGC Management Price Percentage shall only be applied to the following force account work: Minor Contract Revisions, Partnering, Fuel Cost Adjustment, Asphalt Cement Cost Adjustment, On the Job Training, and Erosion Control.

- (a) *Labor*. For all labor and foremen in direct charge of the specific operations, the Contractor will receive the actual rate of wage normally paid for each and every hour that the labor and foremen are actually engaged in the work, as documented by certified payrolls.

The Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits, or other benefits, when the amounts are required by a collective bargaining agreement or other employment contract or generally applicable to the classes of labor employed on the work.

An amount equal to 67 percent of the actual wages and fringe benefits paid directly to the employees will also be paid to the Contractor. This 67 percent will not be applied to subsistence, travel allowance, or to fringe benefits paid to a third party or a trustee. The CMGC Management Price Percentage as specified in the Contract will not be added to labor costs.

- (b) *Materials*. For materials accepted by the Engineer and incorporated in the work, the Contractor shall *receive* the actual cost of such materials, including transportation charges paid (exclusive of equipment rentals as hereinafter set forth) to which the CMGC Management Price Percentage will be added.
- (c) *Owned or Leased Equipment*. For the use of any machinery or equipment, approved by the Engineer, which is owned or leased directly by the Contractor or subcontractors, or by entities that are divisions, affiliates, subsidiaries or in any other way related to the Contractor or subcontractors or their parent companies, the Contractor will be paid in the manner hereinafter specified. Rental rates will be from the current edition of the Rental Rate Blue Book of Rental Rates for Construction Equipment and will be used as follows:

1. Determination of the rental rate to be used will be as follows:
Hourly rate: $RR = (ADJ\ BB/176)(RF) + EOC$
Standby rate: $SR = (ADJ\ BB/176)(RF)(0.5)$
Where: RR = Hourly rental rate
SR = Standby rate

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**REVISION OF SECTION 109
CONSTRUCTION MANAGER/GENERAL CONTRACTOR FORCE ACCOUNTS**

ADJ BB = Blue Book Monthly Rate adjusted for year of manufacture

RF = Regional Factor of 1.06

EOC = Estimated Hourly Operating Costs from Blue Book

2. The number of hours to be paid for will be the number of hours that the equipment is actually used on a specific force account activity.
3. Overtime shall be compensated at the same rate indicated in subsection 109.04(c)1. above.
4. The EOC will be used for each hour that the equipment is in operation on the force account work. Such costs do not apply to idle time regardless of the cause.
5. Idle time for equipment will not be paid for, except where the equipment has been held on the Project site on a standby basis at the direction of the Engineer. Such payment will be made at the standby rate established in subsection 109.04 (b) 1.
6. Incurrence of costs for standby rates for equipment shall not take place until approval has been received from the Engineer. Payment for standby time will not be made on any day the equipment operates for eight or more hours. For equipment accumulating less than eight hours operating time on any normal work day standby payment will be limited to only that number of hours that, when added to the operating time for that day, equals eight hours. Additionally, payment for standby time will not be made in any consecutive 30 day period that the equipment operates for 176 or more hours. For equipment accumulating less than 176 hours operating time in any consecutive 30 day period, standby payment will be limited to only that number of hours that, when added to the operating time for that consecutive 30 day period, equals 176 hours. Standby payment will not be made in any case on days not normally a work day.
7. The rates established above shall include the cost of fuel, oil, lubrication, supplies, incidental tools valued at less than \$500, necessary attachments, repairs, overhaul and maintenance of any kind, depreciation, storage, overhead, profit, insurance, all costs (including labor and equipment) of moving equipment onto and away from the site, and all incidentals, except as allowed in subsection 109.04(c)8.
8. The rental rate for small tools shall be \$2.00 per hour. Small tools are defined as any tool which would be valued between \$500 and \$2,000 if purchased new.
9. Transportation charges for each piece of equipment to and from the site of the work will be paid provided:
 - (1) The equipment is obtained from the nearest source,
 - (2) Charges are restricted to those units of equipment not already available or required on the Project, and
 - (3) The equipment is used solely for the force account work.
10. Fast use expendable parts not included in the Rental Rate Blue Book will be paid at certified invoice cost to which the CMGC Management Price Percentage will be added. Such parts not totally expended on the force account work will be prorated based on actual use.
11. Payable time periods will not include:
 - (1) Time elapsed while equipment is broken down;

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**REVISION OF SECTION 109
CONSTRUCTION MANAGER/GENERAL CONTRACTOR FORCE ACCOUNTS**

- (2) Time spent in repairing equipment; or
- (d) Time elapsed after the equipment is no longer needed. If a piece of equipment that is not in the Blue Book is needed, rates shall be agreed to in writing before the equipment is used.
- (e) *Rental Equipment.* Use of rental equipment not owned or leased by the Contractor or subcontractors will be paid for by certified invoice cost to which the CMGC Management Price Percentage will be added. The EOC will also be paid if not included in the rental rate. The use of and rates for rental equipment
- (f) shall be approved by the Engineer prior to use. Proration of rental rates to an hourly rate for equipment not used solely for the force account shall be based on 176 hours per month, 40 hours per week or 8 hours per day as applicable. The cost of moving the rental equipment onto and away from the job will also be paid when the equipment is used solely for the force account work.
- (g) *Records.* The Contractor's representative and the Engineer shall, on a daily basis, agree in writing on the quantities of labor, equipment and materials used for work completed on a force account basis.
- (h) *Statements.* Payment will not be made for work performed on a force account basis until the Contractor has furnished the Engineer with triplicate itemized statements of the cost of the force account work, detailed as follows:
- (1) Labor classification, hours, rate, and extension for each labor class or pay rate within a class.
 - (2) Equipment type, hours, rate and extension for each unit of equipment.
 - (3) Quantities of materials, prices, extensions and transportation charges.
 - (4) Administrative compensation when applicable. Statements shall be accompanied and supported by certified invoices for all materials and rental equipment including transportation charges. If materials used on the force account work are not specifically purchased for the work, but are taken from the Contractor's stock, the Contractor shall furnish a written statement certifying that the materials were taken from stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.
- (i) *Alternative Method of Documenting Force Account Work.* The following method of documenting the amount of force account work done may be used in lieu of the method described in subsections 109.04 (e) and (f) above, when agreed to by both the Engineer and the Contractor. The Engineer will keep a daily record of the labor, equipment and material used on approved force account work. The Contractor's representative shall review and initial the record each day to ensure that the record is accurate and complete, and that the costs were actually incurred. The Contractor shall furnish certified copies of invoices for the cost of all materials used including transportation charges. If materials used on force account work are not specifically purchased for the work, but are taken from the Contractor's stock, the Contractor shall furnish a written statement certifying that the quantity claimed was actually used, and that the price and transportation charges claimed represent the actual cost to the Contractor. The Engineer will calculate the cost of the force account work each month and include payment on the monthly progress estimate.
- (j) Contract modification orders that change the scope of work outside the accepted GMP documents will include the direct cost of the work and include the CMGC Management Price Percentage as specified in the contract.

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**REVISION OF SECTION 109
CONSTRUCTION MANAGER/GENERAL CONTRACTOR FORCE ACCOUNTS**

- (k) The CMGC Management Price Percentage stated in (a) through (h) above constitute full compensation for all items of expense not specifically designated, including general superintendence, use of incidental tools, field and office overhead, and profit. The total payment made as provided above shall constitute full compensation for such work.

**REVISION OF SECTION 202
REMOVAL OF ASPHALT MAT**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work includes removal and disposal of existing asphalt mat within the project limits as shown on the plans or at locations directed by the Engineer.

In subsection 202.02 delete the seventh paragraph and replace with the following:

The existing asphalt mat which varies in thickness from 2.5 inches to 6 inches shall be removed in a manner that minimizes contamination of the removed mat with underlying material. The removed mat shall become the property of the Contractor and shall be either disposed of outside the project site, or used in one or more of the following ways:

1. Used in embankment construction in accordance with subsection 203.06.
2. Placed in bottom of fills as approved by the Engineer.
3. Recycled into the hot mix asphalt.
4. Placed in the subgrade soft spots as directed by the Engineer.

Subsection 202.11 shall include the following:

The removal of the existing asphalt mat will be measured by the square yard of mat removed to the required depth and accepted.

Subsection 202.12 shall include the following:

Payment will be made under:

Pay Item

Removal of Asphalt Mat

Pay Unit

Square Yard

Unless otherwise specified in the Contract, the disposal of the asphalt mat or its use in other locations on the project will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTION 202
REMOVAL OF PORTIONS OF PRESENT STRUCTURE**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work shall include the removal of all or portions of the following: bridge deck, abutments, piers, wing walls, rail, curb, expansion devices approach slabs, slope paving, and light fixtures. Removal operations shall be conducted so that there will be the least interference with public traffic using the structure.

Subsection 202.02 shall include the following:

At least 10 days before beginning bridge removal the Contractor shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

The existing concrete shall be removed as shown on the plans or as directed by the Engineer. If additional removal of unsound concrete is required, it shall be included in the work.

All methods and equipment used to accomplish this item shall be approved by the Engineer.

Within 24 hours before new concrete is placed, the entire surface upon which new concrete bonds shall be sandblasted to roughen the surface and remove all fractured or loose particles in order to promote good bond with the new concrete.

In subsection 202.02 delete the sixth paragraph and replace with the following:

Before beginning concrete removal operations on the existing bridge decks, a saw cut approximately one inch deep shall be made to a true line along the limits of removal. A one inch deep saw cut shall also be made along the limits of removal on all faces of monolithic concrete elements which may be visible in the completed work.

Subsection 202.12 shall include the following:

The applicable pay item shall be designated by the Summary of Quantities on the plans.

Payment shall be made at the contract unit price for the actual quantity removed.

Payment will be made under:

<u>Pay Item</u>	<u>Unit</u>
Removal of Portions of Present Structure	Lump Sum
Removal of Portions of Present Structure	Each
Removal of Portions of Present Structure	Cubic Yard
Removal of Portions of Present Structure	Square Yard

**REVISION OF SECTION 203
EMBANKMENT MATERIAL**

Section 203 of the Standard Specifications is hereby revised for this project as follows:

In subsection 203.03(a), first paragraph, after the second sentence add the following:

Embankment material shall have an R-value value of at least 78 when tested by the Hveem Stabilometer.

**REVISION OF SECTION 203
COMBINATION LOADER AND DUMP TRUCKS**

Section 203 of the Standard Specifications is hereby revised for this project as follows:

Subsection 203.01 shall include the following:

This work consists of furnishing Combination Loader and Dump Trucks with operators, to be used for their intended purpose as directed by the Engineer.

Subsection 203.04 shall include the following:

Combination Loader shall be standard loader bucket S.A.E. rated 0.765 cu. meter and backhoe up to .2 cu. Meter 4 wheel industrial, utility, or general purpose, with loader front and backhoe, in the 80-100 HP range, either gasoline or diesel engine, or an acceptable equivalent.

Dump Truck shall be of at least 10 cubic yard capacity and shall be in acceptable condition to accomplish the intended work.

The above-described equipment shall be furnished and maintained in good operating condition. Equipment that, in the opinion of the Engineer, is inadequate to produce the required results, shall not be used. All equipment shall be operated by experienced operators, approved apprentices or approved competent trainees. The equipment shall be used as directed by the Engineer.

Subsection 203.12 shall include the following:

Combination Loader and Dump Trucks will be measured by the number of hours that it is actually used as ordered. Time involved in moving onto or off the project will not be measured and paid for under this item. Time will be paid for moving combination loaders, motor grader, and dump trucks from one location on the project to another, if directed, but time will not be allowed for moving equipment considered to be idle or for moves which are made for the convenience of the Contractor. Time will be allowed for combination loaders, motor grader, and dump trucks considered to be on stand-by as part of scaling operations.

Truck (Dump) hours used to haul material off site to dump locations will be paid. The Contractor shall keep a log of hours and mileage to track hours used for hauling off site.

Subsection 203.13 shall include the following:

The accepted quantities will be paid for at the contract price for each of the pay items listed below.

Payment will be made under.

<u>Pay Item</u>	<u>Unit</u>
Combination Loader	Hour
Truck (Dump)	Hour

**REVISION OF SECTION 203
ROCK SCALING**

Section 203 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

The work consists of removing loose rock and debris in areas shown on the plans and as directed by the Engineer.

DEFINITIONS AND QUALIFICATIONS

Scaling Supervisor: The Contractor's designated representative responsible for facilitation and coordination of all rock scaling activities on this project. The Scaling Supervisor shall have a minimum of three years experience in high scaling operations, shall be current in the American Red Cross "Basic First Aid Course" or equivalent, and shall have experience or training in the use of emergency remote rescue techniques.

Rock Scaler: An individual who is engaged in accessing and removing unconsolidated materials using hand tools at locations which require high scaling techniques. Rock scalers shall have either a minimum of six months experience in high scaling operations or shall have attended a training course conducted by an individual who qualifies as a supervisor under this specification.

CONSTRUCTION REQUIREMENTS

The Contractor performing the work on this subsection shall submit proof of at least three (3) projects completed during the past three (3) years that have involved high scaling (in excess of 100 feet vertically) from ropes and/or man baskets. All crew members that will perform rock scaling shall be familiar with rock climbing techniques, radio operation and work site safety.

The Contractor shall be responsible for protecting the roadway and all appurtenances from any damage resulting from Contractor activities. The Contractor shall be responsible for repairing any damage resulting from scaling or other construction activities.

Removal of scaled material from the roadway will be required such that traffic can safely pass through the work zone after each traffic stop.

All work requiring rope access shall be in accordance with the Code of Federal Regulations 1926.501 B15. The Englewood, Colorado Area Office of the Occupational Safety and Health Administration can be contacted at (303) 843-4515 for an interpretation of these regulations as they apply to the work.

METHOD OF MEASUREMENT

Rock scaling will be measured by the total number of hours spent on this bid item that are not incidental to any other bid item. Paid hours shall be the amount of time spent in the removal of material from the slope as shown in the plans or as directed by the Engineer, setting required safety anchors, and time spent on the slope and roadway for the clearing of traffic. The time to ascend and descend the access point for the work area to be scaled will be measured and paid for as Rock Scaler hours.

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REVISION OF SECTION 203
ROCK SCALING

BASIS OF PAYMENT

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Rock Scaler	Hour

Payment for Rock Scaling will be only for the work that is as shown on the plans unless otherwise directed by the Engineer.

All tools and equipment required to complete scaling work shall be included in the Pay Item – Rock Scaler. Payment will not be made for equipment usage, but all equipment usage will be included in the cost of the work.

Payment will not be made for rock scaling conducted in areas outside those shown on the plans or areas not approved by the Engineer.

Payment will be made for rock scaling performed solely for the purpose of worker safety as approved by the Engineer.

Scaling Supervisor hours will not be measured and paid for separately but shall be included in the work.

Permanent disposal of scaled material will be paid for separately under bid items for 203 Truck (Dump) and 203 Loader.

REVISION OF SECTION 203B ROCK EXCAVATION

Section 203B is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

203B.01 General. This work consists of all rock excavation and disposal of all materials, blasting, and the use of explosives in accordance with these specifications and in conformity with the excavation lines, grades and stations shown on the plans or as established by the Engineer.

MATERIALS

203B.02 Definitions.

- (a) *Controlled Blasting.* Controlled Blasting is excavation in rock in which the various elements of the blast (hole size, depth, spacing, burden, charge size, distribution, delay sequence) are carefully designed and controlled to provide a distribution of charge that will fracture the rock to minimize overbreak, flyrock and stressing and fracturing of the rock beyond the designed excavation limits.
- (b) *Perimeter Control Blasting.* The use of specialized techniques to control the blast limit, condition of the rock face after the blast, and condition of the remaining rock. Perimeter control blasting includes the designed use of drill holes, charge type, loading details, blasting sequence, and delays.
- (c) *Pre-splitting.* Pre-splitting refers to a perimeter control blasting technique involving a single row of holes drilled along the neat excavation line which are loaded and fired before any adjoining excavation area is blasted.
- (d) *Cushion Blasting.* Cushion Blasting is a perimeter control blasting technique involving the drilling of a single row of holes along or close to the neat excavation line which are loaded with light, well-distributed charges and are fired either after the main excavation is removed or in the last delay of a single blast.
- (e) *Smooth Wall Blasting.* A technique similar to cushion blasting. Smooth wall blasting techniques involve perimeter holes drilled along the excavation limits which are lightly loaded to remove the final burden, and are fired on the last delay of the detonation sequence. The objective is to obtain smooth walls with minimum overbreak and minimal damage to the rock outside the excavation limits.
- (f) *Perimeter Hole.* A perimeter hole is any hole, loaded or not, at or near the final excavation surface used to break rock to the final excavation surface.
- (g) *Trial Blast.* A Blast or series of blasts designed to assist in determining the combination of blast parameters which are most appropriate to achieve the desired results as described in this special provision.
- (h) *Initial Cut Line Crest Blast.* A small blast at the crest of the cut line used to expose the underlying rock mass for identification of joints and other rock mass features. Initial Cut Line Crest Blasts are used to identify these rock mass features which will then be incorporated into blast plans for subsequent blasts.
- (i) *Half-Cast.* The portion of a drill hole remaining at the blast limit or final excavation surface after a blast.

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**REVISION OF SECTION 203B
ROCK EXCAVATION**

203B.03 Explosives. The explosive storage facility or facilities shall be located on the surface, in the areas in accordance with all Federal, State, and local laws and regulations, and as approved by the Engineer. They shall meet the applicable requirements of Class II magazines.

203B.04 Delays. Delays shall be non-electric for surface blasting unless otherwise approved by the Engineer.

203B.05 Seismograph. The Contractor's seismograph equipment shall meet the following requirements:

- (a) Equipped with a self-triggering device.
- (b) Capable of measuring vibrations in three orthogonal planes (vertical, transverse, and longitudinal).
- (c) Directly measure peak particle velocity.
- (d) Capable of providing a hard copy of the wave form and a summary of the results.
- (e) Seismic range: 0.01 to 10 inches per second with an accuracy of ± 5 percent of the measured peak particle velocity or better at frequencies between 2 Hertz and 200 Hertz, and with a resolution of 0.01 inches per second or less.
- (f) Acoustic range: 80 to 150 dB with an accuracy and resolution of ± 1 dB.
- (g) Frequency response (± 3 dB points): 2 to 200 Hertz.
- (h) Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.
- (i) Capable of internal dynamic calibration.

CONSTRUCTION REQUIREMENTS

203B.06 Waterway and Third-Party Impacts. The Contractor shall prevent rocks and blast debris from entering Waterways and shall prevent adverse impacts to State Waters in accordance with subsection 107.25.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, negligence or misconduct in the execution of the work, or in consequence of the non-execution thereof by the Contractor, the Contractor shall restore, at no cost to the Owner, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner. The Contractor shall regrade the disturbed area as directed and restore the surface material to match the existing in type and quality. Damage to the roadway that affects traffic and damages that may affect public safety shall be repaired immediately.

The Contractor shall submit his proposed methods for blasting, and protection of Waterways and third-parties, to the Engineer for review at least 3 weeks prior to commencement of any blasting work per section 203B.08. The Contractor shall not begin blasting until written approval is granted by the Engineer. If methods used are not

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REVISION OF SECTION 203B
ROCK EXCAVATION

effective in achieving these requirements, the Contractor shall alter the methods and resubmit proposed methods to the Engineer for review.

203B.07 Special Considerations. Excavation shall be to the specified limits, shall minimize overbreak, shall minimize flying rock, and shall avoid damaging the rock mass around the existing tunnels, bridge and other nearby structures. The Contractor shall utilize Controlled Blasting techniques for all excavations to reduce overbreak and control the lines and grades of the excavations. The Contractor shall conduct the work in a manner that ensures the safety of employees, CDOT personnel, and the public.

The traveled roadway outside the limits shown on the plans shall not be compromised. Damage to the roadway outside the specified limits shall be repaired or items shall be replaced to the satisfaction of the Engineer, at the Contractor's expense. All costs resulting from damage to adjacent roadways, existing slopes, waterways, transmission lines, tunnels, nearby structures, or vegetation shall be the responsibility of the Contractor.

203B.08 Preliminary Submittals. The following shall be submitted to the Engineer no later than three weeks prior to beginning any work involving excavation or explosives. Submittals shall be in accordance with subsection 105.02.

Preconstruction Survey. This submittal shall be in accordance with the requirements presented in these sections.

Personnel. Written documentation as supporting evidence of the qualifications of personnel shall be submitted to the Engineer. The submittal shall include:

1. Name and qualifications of person who will be directly responsible for planning, supervising, loading and firing of blasts.
2. Names and Experience of Blasting Supervisors. Blasting supervisors shall have a minimum of five years experience in supervising the loading and firing of charges of rock excavation and shall have all necessary licenses and permits required by the state and other agencies having jurisdiction.
3. Name and experience record of the Contractor's blasting engineer or consultant retained to develop all controlled blasting designs and details.

General Excavation Plan. This submittal shall be a narrative containing at least the following information for all blasts:

1. A list of equipment, which will be available on the site for performing the blasting work.
2. A description of the heavy equipment, which will be available on site to clear the road and bench of debris generated by the Contractor's blasting operations.
3. A listing of the blasting materials which the Contractor will have available on site to perform blasting work. The list shall include the types, sizes and strengths of explosives proposed for the work, a description of the types of detonation systems to be employed.
4. Manufacturers' data sheets for all explosives, primers and initiators to be employed.
5. A description of the pre-blast warning system to be used.

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REVISION OF SECTION 203B
ROCK EXCAVATION

6. Intended direction of rock movement and delay plan.
7. Proposed methods of protecting or stabilizing adjacent roadway structures, waterways, and vegetation.
8. Proposed method of preventing blast rock from entering Waterways, including but not limited to rock fall barriers, delay sequence and blast patterns, and maximum blast size.
9. Proposed methods of controlling flyrock.
10. Schedule for the construction.
11. Expected production rates.
12. Monitoring Plan with locations, equipment, and schedule.
13. Warning Sign locations and sign design with text.

Blast Plans. Blast Plans shall be submitted for all blast types including but not limited to Trial Blasts, production blasts, standard blasts and Initial Cut Line Crest Blasts. Blast plans shall be descriptions and drawings of the planned blasts. Submit a Standard Blast Plan for each blast type to be used throughout the project. Submit Individual Blast Plans for each blast. All Blast Plans shall be signed by the Contractor's Project Manager (highest ranking onsite supervisor) and the Contractor's Blasting Supervisor. If methods used are not effective in achieving the requirements for Rock Excavation, the Contractor shall alter the methods and resubmit revised Blast Plans to the Engineer for review.

Blast Plans shall include the following:

1. Type of blast.
2. Plan and section views to scale of proposed drilling pattern, including diameters, spacing, depth and orientation of drill holes, free faces, burden and sub-drilling.
3. Identification of perimeter control blasting areas and techniques including Presplitting, and Cushion Blasting.
4. Design shape and location of the highwall or rock face to remain after the blast, and identification of joints or other features to follow as limits to the highwall or rock face.
5. Types and quantities of explosives proposed for use in each hole and for each total blast.
6. Blast type designation (for example, exterior presplit, exterior production, etc.)
7. Distribution of the charge in the holes, priming of each hole and stemming of holes.
8. Type sequence and number of delays, delay pattern, diagram for blast and type and capacity of initiation devices.

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9. Signature of blasting supervisor.
10. Type of detonators.
11. Procedures for interfacing with traffic control and for clearing muck and debris in accordance with subsection 104.04.
12. Proposed methods of preventing blast rock from entering Waterways and prevention of other adverse Waterway impacts.

203B.09 Construction Submittals. The following shall be submitted as noted herein:

- (a) *Blast Report.* The Contractor shall furnish an as-built drawing of each blast no later than 24 hours after the shot was fired. Blast Reports shall be signed by the Contractor's Blasting Supervisor. This shall be a complete description of the blast and shall include as a minimum the following information:
 1. Type of blast.
 2. Date, precise time of initiation and location of the blast, including station limits.
 3. A drawing of the blast, which clearly indicates the layout of the holes, and explosives used, and the delays for each. Diagram shall note any changes or deviations from the submitted blast plan.
 4. The name and signature of the person responsible for designing, loading and firing of the shot. The signature of the blasting supervisor.
 5. The actual shape and location of the highwall or rock face remaining after the blast. This shall include a description of the relationship between the actual limits relative to predefined joints and designed limits of the blast.
 6. A description of any overbreak and unusual occurrences including unanticipated rock fall, misfires, remaining unstable ground, and equipment malfunctions.
 7. Powder factor, i.e., the weight of explosives per cubic yard of rock in place.
 8. Quantity of material blasted.
 9. Results of instrumentation including seismograph readings.
 10. Unusual occurrences and notes of damage to facilities, buildings, and structures.
- (b) *Blasting Schedule.* On Friday of each week the Contractor shall provide the Engineer with the coming week's blasting schedule. This schedule shall contain the following information for each scheduled blast:
 1. Date of Blast.

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2. Approximate time of blast.
3. Location of blast by Project Station.
4. Anticipated volume

Review of blast design and techniques shall not relieve the Contractor of responsibility for adequacy, accuracy, safety, proper supervision, and compliance with these Specifications and/or the OSHA Regulations (29 CFR 1926.900-.914) and all federal, state, and local regulations that govern the use of explosives. Transportation and handling of explosive materials shall be in accordance with subsection 107.11.

The Contractor shall notify the Engineer not less than 14 days before beginning rock excavation. The Contractor shall not excavate beyond the dimensions and elevations established except as specified or as directed by the Engineer. The Contractor shall not excavate materials in the rock cut areas prior to the slope staking of the site.

203B.10 General Excavation Requirements.

Blasting work shall be coordinated with the Traffic Control Supervisor, in accordance with the requirements specified in subsection 104.04 and section 630.

The Contractor shall not perform any blasting work until all requirements are fulfilled.

The first blast for each blast type and design shall be a Trial Blast. The purpose of the Trial Blast is to evaluate the actual results of the blast relative to the planned results. If the Trial Blast is successful and approved by the Engineer, following blasts shall increase in size incrementally until the approved production blast size is reached. If the Trial Blast is not approved by the Engineer another Trial Blast shall be made, changing one or more blast parameters. This process shall be repeated at no additional cost to CDOT until the Engineer approves of the Trial Blast.

Non-electric detonation systems shall be used on this project, unless another detonation system is approved by the Engineer. Cap and fuse or safety fuse is prohibited. The Contractor will be allowed to use one electric blasting cap per round to initiate the shot. The electric blasting cap shall not be tied into the blasting circuit until traffic has been stopped and the area has been secured.

Every precaution shall be taken to avoid damage or excessive overbreak of rock below or beyond the lines of excavation. All damage to any other part of the work caused by blasting or any other operations of the Contractor shall be repaired, in a manner approved by the Engineer, at the expense of the Contractor.

Unless otherwise specified, ground vibrations shall not exceed a maximum peak particle velocity (largest single component) of 1 inch per second measured 200 feet from the blast. Blasts shall not damage any existing structures. Furthermore, at the existing structures in the vicinity of the site, the maximum vibration and airblast limits shall not exceed the values indicated in the following tables and Figure B-1, Appendix B, of the United States Bureau of Mines Report of Investigations, RI 8507, 1980.

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Ground Vibration Limits		
Type of Structure¹	Peak Particle Velocity (inches per second)	
	At Low Frequency² (<40 Hertz)	At High Frequency (>40 Hertz)
Modern structures, drywall interiors	0.75	2.0
Older structures, plaster on wood lath construction for interior walls	0.5	2.0

¹ For precarious structures not listed in the table, use the limits for older structures; for all other structures not listed in the table, use the limits listed for modern structures.

² All spectral peaks within 50 percent amplitude of the predominant frequency must be analyzed.

Airblast Limits		
Instrumentation	Residential Structures	All Other Structures
0.1 hertz high-pass system	115	134
2 hertz high-pass system	113	133
5 or 6 hertz high-pass system	110	129
C-slow (for events not exceeding 2 seconds' duration)	85	105

Blasting in the vicinity of concrete and shotcrete shall be limited to prevent damage to CIP concrete and shotcrete. The Contractor shall take special care when blasting in the vicinity of concrete and shotcrete that has not achieved full strength. As a minimum, conform with the following limitations:

Ground Vibration Limits for Green Concrete	
Time After Pour	Peak Particle Velocity (inches per second)
0 – 4 hours	2.0
4 – 24 hours	0.25
1 – 3 days	1.0
3 – 7 days	2.0
>7 days	5.0

The Contractor shall be prepared to remove immediately, all loose and unstable rock in the area surrounding the excavation. All loose material shall be removed from the excavated rock face. Any material outside the authorized cross section, which may be shattered or loosened because of blasting, shall be removed or repaired by the Contractor at his expense. Determination of these damaged areas is to be made by the Engineer.

Blasting mats shall be used to prevent flying rock during blasting operations. The Contractor shall also institute additional containment systems or provide other protective measures to prevent rock and/or debris from being a hazard to the traveling public during drilling, scaling, rockfall mitigation, and other related activities.

All blasts shall be drilled, loaded, tied-off and detonated under the direct charge of the approved blasting supervisor(s).

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The maximum charge diameter in presplit and perimeter holes shall not exceed 1-1/4 inches, unless the Contractor can demonstrate through trial blasts that larger diameter explosives are necessary.

Maximum depth of subdrilling for all blast holes at final subgrade shall be 24 inches.

The production blast holes shall be sequenced using delays such that lines of blast holes are detonated in a sequence starting with the line closest to the free face of the excavation. The perimeter holes shall be fired last in the sequence.

Blasts shall be conducted in conformance with the above limitations as required by the Engineer. These limitations shall remain in effect unless it is demonstrated through trial blasts that the desired results can be achieved when said limitations are exceeded.

203B.11 Special Requirements for Permanent Rock Slopes.

The Contractor shall provide surveyed points on 25-foot stations indicating grade and centerline offset on the back slope after each lift has been excavated and before drilling begins for the next lift. This work shall be performed under the supervision of a Professional Surveyor licensed in the State of Colorado.

Excavation lifts shall be a maximum of 20 ft in height and sized such that the requirements of the traffic control specifications are fulfilled.

Excavation shall be staged to allow rock reinforcement, where required, to be installed as the cut is brought down. Drilling of the next lift will not be permitted until all of the required rock reinforcement for the preceding lift is installed unless approved otherwise by the Engineer.

203B.12 Blast Warning. The Contractor shall establish a system of warning signals prior to blasting. As a minimum warning signals shall be given at one minute and at five minutes and ten minutes prior to each blast. Warning signals shall be audible throughout the work area and for a distance of at least 2,000 feet from the blast.

The Contractor shall implement all necessary restrictions on access to the area including but not limited to pedestrians, vehicles, bicyclists, and equestrians. Coordinate with law enforcement officials and other agencies as necessary for closure of public roads and lands.

The Contractor shall post signs warning the public that there is blasting being conducted in the area. Warning signs shall be posted in accordance with the MUTCD and as necessary to assure public safety and to educate persons who may be in the area and at all roads, trails, paths and clearly visible to anyone that may enter within 2,000 ft of the work area. Highway warning signs shall conform to Blasting Zone (TA-2) of the MUTCD. A special blasting advisory signs shall be placed at the Scott Lancaster Trail to warn pedestrians of the blasting.

203B.13 Blast Monitoring. Blast induced vibrations shall be monitored by the Contractor for every blast. The seismograph shall be located within 200 ft of each blast. Furthermore, if there is a structure within 1000 feet of the blast, a seismograph shall be placed at the structure located in a line between the blast and the structure, unless approved otherwise by the Engineer. Sound levels will be measured using devices having low frequency response capability that accurately measure and record the sound levels. Monitoring Data shall be submitted to the Engineer within 2 working days of each blast.

The Contractor shall comply with all blasting commitments in accordance with the October 2012 Twin Tunnel FONSI.

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The Contractor shall obtain the services of a Seismograph Specialist to install and monitor the seismograph. The Seismograph Specialist shall have at least two years experience in the use of seismographs and monitoring of vibrations specific to construction and blasting. The Contractor shall install seismographs as specified by the manufacturer and to assure good coupling between the seismographs and the ground.

203B.14 Scaling. Rock faces and ledges shall be scaled in excavation areas and on rock slopes to limits established by the Engineer. Scaling shall be performed prior to any blasting. Loose rock fragments shall be removed. Work shall be accomplished by experienced and suitably equipped scalers.

In addition, immediately after each blast, rock surfaces shall be inspected by experienced and suitably equipped scalers who shall dislodge and scale down all loose rock and blast debris.

203B.15 Temporary Support of Excavation. Temporary support of excavation is shown on the plans and shall be performed as required to complete the work as specified. Temporary support of excavation and associated monitoring system(s) shall be designed to be compatible with the anticipated geotechnical conditions identified in the Contract, and shall be adaptable to the actual conditions encountered. Timber elements shall be removed prior to burial within or under other materials.

203B.16 Excess Excavation. Excavation beyond the A-line shall be considered excess excavation and shall be at the expense of the Contractor as defined in subsection 203B.04. Excavation beyond the A-line shall be filled with Concrete (Class D), as approved by the Engineer, and at the expense of the Contractor.

METHODS OF MEASUREMENT

203B.17 Measurement of Rock Excavation. All materials excavated will be measured in cubic yards in its original position by cross-sectioning the areas to be excavated prior to the removal of the material. The measurement shall extend between the limits of the lines and grades as shown in the plans or as established in the field by the Engineer. The volume of the excavation will be computed by the Engineer, using the average end area method, as the difference between the aforementioned cross-section as shown in the plans. Excavation outside the excavation limits shall not be measured for payment.

203B.19 Measurement of Rock Excavation. Measurement will be in accordance with subsection 203.13 (a) of the Standard Specifications.

Scaling that is performed in conjunction with Rock Excavation will not be measured for payment but shall be included in the cost of the work .

BASIS OF PAYMENT

203B.20 The accepted quantities measured as specified above shall be paid for at the unit price bid for the pay items listed below:

<u>Pay Item</u>	<u>Pay Unit</u>
Rock Excavation	Cubic Yard

Payment shall be full compensation for all labor, materials, tools, equipment and incidentals necessary for excavation, removal and disposal of excavated material, temporary support, scaling, blasting and all other work

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ROCK EXCAVATION

required to complete the designated pay items in accordance with subsection 109.02. Blast monitoring will be considered part of blasting and use of explosives, and as such is incidental to the work, and no separate payment will be made. Preconstruction Blast Surveys will be considered part of blasting and use of explosives, and as such are incidental to the work, and no separate payment will be made.

203B.17 The Contractor shall bear the expense of the excavation outside the limits established by the Engineer. The Contractor shall bear the expense of any damage to all facilities, waterways, and structures including the adjacent roadway surface.

**REVISION OF SECTION 210
RESET CCTV CAMERAS**

Section 210 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of resetting a Closed Circuit Television (CCTV) camera and related materials to be mounted on an existing light pole as indicated on the plans. The work also includes installing power from the light pole base as well as pulling back the existing fiber optic lateral cable and re-connecting it to the reset location. All CCTV cameras shall be carefully removed, stored, and reinstalled in a manner that avoids loss or damage. Any down-time for the CCTV camera shall occur Monday – Friday and shall not exceed 48 hours. All infrastructure shall be in place for the reset CCTV location before the existing CCTV is taken out of service.

MATERIALS

The contractor shall use an existing light pole to mount the reset CCTV.

CONSTRUCTION REQUIREMENTS

CCTV cameras designated to be reset shall be removed along with communications and electrical equipment. New CCTV poles shall be installed as noted on the plans along with any new electrical and communications necessary to restore the CCTV service at the new location. Equipment and materials shall be cleaned prior to being reset. Contractor shall verify CCTV functionality prior to reset.

CCTV camera shall be installed in accordance with these specifications, the details shown in the Plans, and in accordance with manufacturer's recommendations. The Contractor shall make all arrangements for a qualified manufacturer's representative to be on-site to ensure proper installation of the CCTV camera.

For the attachment of the adapter bracket to the pole, a 3/4 inch type 201 stainless steel strap used in conjunction with type 201 stainless steel buckles at a mounting height shown on the Plans. The attachment shall be banded to the pole at an orientation to achieve the optimal view of both the main roadway and crossroad or as directed by the Engineer.

A maximum 1 inch hole shall be drilled in the mounting pole to allow passage of the composite cable. The hole shall be free of burrs and sharp edges prior to the installation of the composite cable. The cable shall be attached to the reverse side of the mounting bracket to ensure proper strain relief or damage caused to the camera or housing. The cable shall run down the interior of the pole and exit through non-metallic flexible conduit to the communication cabinet. The non-metallic flexible conduit shall be weather sealed on each end to eliminate exterior liquid entry. The Contractor shall also provide a weather seal for the adapter bracket at the 1 inch hole at the top of the pole per the manufacturer's recommendations.

METHOD OF MEASUREMENT

Reset Closed Circuit Television shall be measured by the actual number of closed circuit television cameras reset and accepted, including all associate hardware, materials, cabling, device connection and configuration, re-pulling of fiber lateral, and power conductors from the power source to the CCTV camera unit.

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**REVISION OF SECTION 210
RESET CCTV CAMERAS**

BASIS OF PAYMENT

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Reset CCTV Camera	Each

Payment will be full compensation for all labor, materials, and equipment required to complete the work.

**REVISION OF SECTION 210
RESET MICROWAVE VEHICLE RADAR DETECTOR**

Section 210 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

This work consists of resetting a microwave vehicle radar detector (MVRD), communications cabinet, and related materials to be co-located on an existing light pole with the reset CCTV camera as indicated on the plans. Any down-time for the MVRD shall occur Monday – Friday and shall not exceed 48 hours. All infrastructure shall be in place for the reset MVRD location before the existing MVRD is taken out of service.

MATERIALS

The contractor shall use an existing light pole to mount the reset MVRD and communications cabinet as shown on the plans.

CONSTRUCTION REQUIREMENTS

The Contractor shall reset and mount all existing MVRD equipment. The Contractor shall supply power to the power supply and both duplex receptacles. The duplex GFCI receptacle shall be wired such that in the event of a ground fault, both the power supply and duplex NEMA 5-15R receptacle remain energized.

The access hole on the bottom of the communications cabinet for power wiring and radar detection unit power/communication cabling shall be reused for entry. 3/4 inch Type 201 stainless steel strap used in conjunction with Type 201 stainless steel buckles shall be used to mount the communications cabinet to the light pole so that the top of the cabinet is approximately 5-7 feet above surrounding grade and the location shall be confirmed by Matthew Becker with CDOT ITS at 303-512-5856. The communications cabinet shall be oriented such that anyone working in the cabinet has direct line of sight with traffic. The Contractor shall be responsible for any necessary modifications or additions needed to mount the communications cabinet to the structure.

0.75 inch Type 201 stainless steel strap used in conjunction with Type 201 stainless steel buckles shall be used to mount the radar detection unit at a height and angle determined by roadway off-set and detection distance in accordance with manufacturer's recommendations.

The manufacturer's recommended power/communication cable shall run on the interior of the mounting structure from the radar detection unit to the communications cabinet. A hole not to exceed 1.5 inches shall be made 12 inches below the radar detection unit to allow passage of the power/communications cable into the structure. The Contractor shall ensure strain relief and drip loops in the power/communication cable before the cable enters the structure in accordance with manufacture's recommendations. A hole not to exceed 1.5 inches shall be made below the communications cabinet to allow the power/communications cable and communications cabinet supply power cable to pass from the interior of the structure to the interior of the communications cabinet. Flexible conduit shall be used to run cables from the structure to the communications cabinet.

The Contractor shall run and connect existing power from the interior of the structure to the 10A circuit breaker in the communications cabinet. The communications cabinet power shall be connected through a 10A in-line waterproof fused disconnect and shall be labeled "Radar Detector Power". The Contractor shall wire supply power, power supply, surge suppressor, and radar detection unit in accordance with the manufacture's recommendations. The 6 outlet power strip shall be plugged into the duplex NEMA 5-15R.

All holes shall be free of burs and sharp edges prior to the installation of all cable, conduit, and conduit nipples. All cable entrances in structures, conduits, and cabinets shall be sealed and waterproofed. All wiring and electrical connections shall be performed in conformance with the latest version of the NEC.

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**REVISION OF SECTION 210
RESET MICROWAVE VEHICLE RADAR DETECTOR**

METHOD OF MEASUREMENT

The Reset Microwave Vehicle Radar Detector will be measured by the actual number of units and all associated materials and work reset and accepted, and will include testing to ensure an accurate data collection and reporting.

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for the Pay Item listed below.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Reset Microwave Vehicle Radar Detector (MVRD)	Each

Payment will be full compensation for all labor, materials, and equipment required to complete the work.

REVISION OF SECTION 210 RESET TRAVEL TIME INDICATOR

Section 210 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

This work consists of resetting a Travel Time Indicator (TTI) and related materials to an existing Microwave Vehicle Radar Detector (MVRD) pole east of Hidden Valley in accordance with the plans, these special provisions, and manufacturer's recommendations. Any down-time for the TTI shall occur Monday – Friday and shall not exceed 48 hours. All infrastructure shall be in place for the reset TTI location before the existing TTI is taken out of service.

MATERIALS

The contractor shall use an existing MVRD pole to mount the reset TTI. Reset TTI shall include resetting the existing IDentity 5100, directional 42 degree antennas, corresponding antenna mounts, antenna signal cables, waterproofing mastic, related mounting hardware, device configuration software, and all other associated cabling and adaptors. It shall also include reconfiguring the optical transceivers in the field cabinet and at the Hidden Valley node building. The Contractor is responsible for installing and aligning the ANTENNA-013-K directional antenna and antenna mounts as shown on the plans and per manufacturer's recommendations.

CONSTRUCTION REQUIREMENTS

The existing Travel Time Indicator reader shall be mounted inside the existing MVRD communications cabinet allowing room for all communication cable connections. A hook and loop fastening system shall be used to mount the reader to the cabinet for ease of removal.

The power supply shall be mounted to DIN rail inside the communications cabinet. All wiring shall conform to the most current version of the NEC.

The Contractor shall supply and install one-inch type 201 stainless steel strap used in conjunction with type 201 stainless steel buckles shall be used to band the antenna mount to the structure at the mounting height shown on the plans or as directed by the Engineer. The Antenna shall be mounted horizontally polarized using the included stainless hardware. The antenna shall be oriented such that it intersects with the oncoming traffic at a 45 degree angle, and is aimed to the center of lane 2.

Holes made in mounting structures shall be the minimum size necessary to secure the conduit connectors and shall not exceed 2 inches in diameter. All holes shall be free of burrs and sharp edges prior to the installation of all cable, conduit, and conduit nipples. All cable entrances in structures, conduits, and enclosures shall be sealed and waterproofed. All wiring and electrical connections shall be performed in conformance with the latest version of the NEC.

The signal cable shall connect RF input/output channels from the telemetry master (toll tag reader) to the telemetry (antenna) units – one cable per antenna. The contractor shall route signal cable through existing structures or through new flexible or rigid PVC conduit mounted to existing structures as shown on the plans. Each signal cable shall be a continuous cable, with no splices, terminated with male N-type crimp on straight plugs on both ends. Installed length of any one signal cable should not exceed 100 linear feet. Installations that require lengths in excess of ~100ft should utilize lower loss cable as to not exceed 3-4dB of loss per run. All signal cables shall be labeled on both ends with UV resistant colored tape before installation. The same color label shall be used on both ends of one cable and label colors shall not repeat at the same installation site. Labels shall be installed such that they are distinguishable from the ground.

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**REVISION OF SECTION 210
RESET TRAVEL TIME INDICATOR**

The Contractor shall ensure strain relief and drip loops in coaxial antenna cable. The Contractor shall provide full support to all coaxial cable not in conduit or wiring trays. All cable entrances in conduits, conduit entrances in structures and cabinets shall be sealed and waterproofed. Cable shall not enter the top of the cabinet housing the telemetry master device. Entering through the bottom of the cabinet is preferred, although side entrances will be permitted. It is suggested that the signal cables be cut longer than needed and installed with the terminated end on the telemetry (antenna) side. Cables can then be re-labeled, cut to length, and terminated once they are run into the telemetry master enclosure. Waterproofing mastic shall be applied at all antennas to signal cable connections following manufacturer's recommendations.

The Contractor shall connect antenna signal cables to the Travel Time Indicator such that:

Northbound vehicle detection corresponds to Port 1,
Southbound vehicle detection corresponds to Port 2,
Eastbound vehicle detection corresponds to Port 3, and
Westbound vehicle detection corresponds to Port 4.

The Contractor shall configure the Travel Time Indicator in accordance with manufacturer's recommendations. The unit shall have CalTrans Title 21 and ISO 18000-6C protocol enabled for tag detection with only active antenna channels enabled and power levels set to the minimum needed for reliable transponder detection.

The unit shall be configured for serial communication with the following:

19,200 bits per second
8 data bits
No parity
1 stop bit
No flow control

The following shall be set to run in the TPS script:

- (1) interval: 60s
- (2) Reader ID: as per plan sheet
- (3) Heartbeat: 10s

METHOD OF MEASUREMENT

Reset Travel Time Indicator will be measured by the actual number of units reset and accepted, and will include testing to ensure an accurate data collection and reporting. Each Reset TTI shall include aiming the antenna, complete in place, in accordance with the plans and these special provisions. Reset TTI shall include reader connections, testing, all necessary cabling, all equipment and labor necessary for installation, and all other items necessary to complete the work. Testing will be measured as 90% vehicle transponder detection. Testing shall include a full data path to the Travel Time Indicator and acceptance by the Department.

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REVISION OF SECTION 210
RESET TRAVEL TIME INDICATOR

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for the Pay Item listed below.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Reset Travel Time Indicator	Each

Payment will be full compensation for all labor, materials, and equipment required to complete the work.

SECTION 211 ROCK REINFORCEMENT

Section 211 is hereby added to the Standard Specifications as follows:

DESCRIPTION

This Work shall consist of furnishing and installing Rock Reinforcement as shown in the Project Plans.

Definitions.

- (a) Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), Rock Bolts and Rock Anchors are considered Rock Reinforcement.
- (b) Rock Reinforcement (Dowel) – The use of grouted, threaded bars installed into a rock mass with the purpose of strengthening the rock mass so that the rock supports itself as shown in the Plans. The anchor is grouted full length in one operation.
- (c) Rock Reinforcement (Number 10) – The use of bar as shown in the Plans. The bar shall have a bond length and a free stressing length. All Rock Reinforcement (Number 10) bars will be tested and locked off to the loads shown in the Plans or as directed by the Engineer.
- (d) Rock Bolts – The materials, testing, bond length and free stressing length will be in conformance with the requirements of Rock Reinforcement (Number 10). The installation of Rock Bolts may require difficult access techniques to supply, drill and install the Rock Reinforcement.
- (e) Rock Anchor– The use of grouted, threaded bars installed through a tunnel lining into the pillar area between tunnels for the purpose of reinforcing and confining the rock mass to improve the strength and stiffness of the pillar in advance of widening of the tunnel(s) as shown in the Plans. The threaded bar includes a hangar nut/assembly at the distal end to support the dowel during grouting until the anchor zone is active. The indicated free length is to be protected by a sealed, polyethylene sheath. The anchor and free length zones are grouted over the full length in one operation using a breather tube to confirm full encapsulation by grout return.

MATERIALS

- a) Rock Reinforcement (Dowel) shall be Grade 75 all thread rebar and shall conform to the requirements of ASTM A-615. The threaded bars shall be of size and dimension as shown on the Plans or as directed by the Engineer. Each bar shall be furnished with appropriate end hardware. Coupling of bars shall be as approved by the Engineer. All Rock Reinforcement bars shall be epoxy-coated in accordance with ASTM A-775.
- b) Rock Reinforcement (Number 10) shall be Grade 75 all thread bars and shall conform to the requirements of ASTM A-615. The threaded bars shall be of size and dimension as shown on the Plans or as directed by the Engineer. The bar shall have multiple corrosion protection requirements as shown in the Plans. The end of the bar that protrudes from the hole shall be epoxy coated for the entire length.
- c) Rock Bolts shall be Grade 75 all thread bars and shall conform to the requirements of Rock Reinforcement (Number 10) as specified herein.
- d) Rock Anchor shall be Grade 150 all thread steel bar conforming to the requirements of ASTM A-722. The bars shall have the nominal diameter and length as shown on the Plans or as directed by the Engineer. Each bar shall be furnished with a hangar nut/assembly, couplers as required, centralizers, grout tubes, polyethylene sheath and end hardware. Bar couplers shall be as supplied by bar manufacturer to develop full bar capacity. All thread bars and couplers shall be epoxy-coated in accordance with ASTM A-775 to a minimum thickness of 10 mil. Hangar nut shall be designed to support full weight of bar in hole during grouting in the size of hole drilled.
- e) Nuts shall be heavy duty conforming to the requirements of ASTM A-108 (Grade 75) or ASTM A-29 (Grade 150) and appropriately sized for the threaded bar specified. Nuts shall develop an ultimate strength of not less than 125 percent of the minimum yield strength of the bar. Nuts for Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), and Rock Bolts shall be epoxy-coated for corrosion protection. The epoxy coating shall be a color approved by the Engineer. Nuts for use with Rock Anchors shall be galvanized.

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ROCK REINFORCEMENT**

- f) Washers shall be made of hardened steel, and conform to the requirements of ASTM A-47 or ASTM F-436 and appropriately sized for the threaded bar specified. Washers may be flat, beveled, or spherical seat as required to adequately seat and load the anchor system without bending the bar. Washers for Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), and Rock Bolts shall be epoxy-coated for corrosion protection. The epoxy coating shall be a color approved by the Engineer. Beveled washers for use with Rock Anchors shall be galvanized.
- g) Bearing Plates for Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), and Rock Bolts shall conform to ASTM A-36 and be epoxy-coated for corrosion protection. The epoxy coating shall be a color approved by the Engineer. Bearing plates for Rock Anchors shall be galvanized.
- h) Cement grout shall be neat-cement or sand-cement and shall consist of a pumpable mixture of type I, II, or III Portland cement conforming to AASHTO M85/ASTM C 150 and water. Cement shall be fresh and shall not contain lumps or other indications of hydration. Chloride-containing grouts or other grouts, which in the opinion of the Engineer may be detrimental to the anchor bar or other components, are not permitted. The grout shall be capable of reaching cube strength AASHTO T 106 of 3000 psi in seven (7) days. The anchor grout shall have a water-cement ratio by weight between 0.30 to 0.50. The grout shall be free of lumps and undispersed cement.

CONSTRUCTION REQUIREMENTS

Safety of the work shall be the responsibility of the Contractor. The work shall be performed in a manner to minimize hazards and exposure of the public, construction personnel, and equipment to hazardous and potentially hazardous conditions. Placement of Rock Reinforcement shall be scheduled so as to ensure safety.

Construction Submittals. The following submittals shall be made to the Engineer at least 10 working days prior to beginning the work.

- (a) One sample each of the various threaded bar types to be used shall be submitted to the Engineer from the normal stock of the manufacturer. Samples of Rock Reinforcement materials, including coupler, centralizer, hangar assembly and end hardware, shall be submitted together with mill reports indicating tensile yield point and elongation results of bar at no additional expense to the Department.
- (b) Certificates stating that samples for testing are from normal stock, which will be used in the work.
- (c) Certificate of Calibration from an independent testing laboratory for each combination of ram, jack, and gauge (if necessary) to be used for testing of the Rock Reinforcement. Stressing ram assembly shall be calibrated specifically for this project within 30 days of the initial testing.

Shop Drawings. The Contractor shall furnish shop drawings as specified in Subsection 105.02, except as noted herein. Shop drawings shall include the following:

- (a) Applicable literature for the threaded bars, end hardware, grout, and field epoxy-coating repair including color sample. The manufacturer's recommended installation, storage procedures and recommended working temperature ranges for threaded bars and grout shall be included.
- (b) A brief narrative describing the Contractor's Rock Reinforcement installation procedures, including a description of all drilling equipment and methods, and grouting equipment and methods. The procedure for spanning open voids and debris filled discontinuities in the rock and sealing drill hole collar to minimize grout loss during installation shall be discussed.
- (c) A brief narrative describing the reinforcement bar testing procedures and equipment. The submittal shall include calibration graphs to correlate gauge pressure to applied load for each combination of ram, jack, and gauge (if necessary) to be used in the Work. The serial number of each component of the testing assembly shall be clearly indicated on each calibration graph.

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- (d) A brief narrative describing methods and equipment to achieve specified tension in Rock Anchors following encapsulation with cement grout and development of grout bond strength in anchor zone
- (e) A narrative describing the materials and procedures for application of epoxy on the end hardware.
- (f) Anchor Drilling Forms. The Contractor shall maintain daily records of Rock Reinforcement work. These reports shall, as a minimum, include the quantities, lengths and location of the reinforcement, depth to bedrock, and testing information and any unusual occurrences on a form that has been pre-approved by the Engineer. Daily records shall be provided to the Engineer within 24 hours of the day they are recorded. If bedrock is not encountered in any drill holes then the Engineer shall be notified immediately and the hole may be relocated at the Engineer's discretion. At Rock Anchor installations through the tunnel lining, thickness of the tunnel lining, depth to rock surface and any drilling difficulties or losses of circulation shall be recorded.

General. All epoxy-coated bar surfaces shall be free of sludge, grease, or any other matter, which might inhibit the bonding ability. The Contractor shall exercise special care to prevent damage to the galvanized or epoxy coating during handling and installation. Wire rope or threaded bars may be rejected or recoated as directed by the Engineer if the epoxy coating and/or outer sections are damaged.

Rock reinforcement for the east and west portal development shall be placed as directed by the Engineer. Locations, orientations, lengths, and quantities for Rock Reinforcement shown in the Plans are approximate. Some of the Rock Reinforcement may require difficult accessing drilling techniques for the installation of the reinforcing bars. The Engineer may increase, reduce, delete, or otherwise alter the Rock Reinforcement as necessary to address actual field conditions.

Rock Anchors for pillar reinforcement shall be placed through the East bound tunnel lining generally perpendicular to the tunnel axis as shown on the Plans or as directed by the Engineer. Additional Rock Reinforcement installed without the approval of the Engineer shall be at the Contractor's expense. Drill holes required for the installation of Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), Rock Bolts and Rock Anchors shall be constructed according to the following requirements:

- (1) Diameter, Length and Alignment. Drill hole diameter for each threaded bar shall be uniform for the entire length of the hole unless otherwise approved by the Engineer. The drilling equipment shall be capable of drilling a straight hole to the depth required, and shall be equipped to inject air into the hole through the bit. The drill hole diameter shall be compatible with the threaded bar, coupler, hangar assembly, tubing and grout to be used. Over-drilling beyond the final installed position of the Rock Reinforcement shall not exceed six inches.
- (2) Orientation. Holes shall be drilled at the orientations and inclinations shown on the plans or as directed by the Engineer. Deviation from those orientations and inclinations shall not exceed five degrees. The Contractor shall use an angle-measuring device to assure the required inclinations. Rock Anchors for pillar reinforcement shall be placed through the tunnel lining generally perpendicular to the tunnel axis and inclined as shown on the Plans or as directed by the Engineer.
- (3) Hole collar location and installation angle for Rock Anchors shall be confirmed with a small-diameter percussion-drilled probe hole and may be adjusted as approved by the Engineer to avoid encountered embedded steel sets, rebar, rock bolts from prior excavation or other obstructions beyond the tunnel lining.
- (4) Cleaning of Drill Holes. Each hole shall be cleaned of all drill cuttings, sludge, and debris by means of compressed air introduced at the back of the hole prior to placement of the grout. Water may be used for flushing holes drilled for Rock Anchors.
- (5) A minimum of two centralizers shall be placed on each Rock Reinforcement bar to position the bar within one inch of the center of the drill hole. The centralizers shall be placed within two feet from the top and bottom of

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the drill hole. The maximum center-to-center spacing of the centralizers shall be ten feet. The centralizers shall be attached securely to the threaded bars so they will not shift during handling or insertion into the drill hole yet will still allow grout tube insertion to the bottom of the drill hole and allow grout to flow freely up the hole. After the drill hole is cleaned and the thread bar is properly placed in the hole, the hole shall be completely filled with cement grout from the lowermost end of the hole until grout emerges from hole collar or grout return tube. The Contractor shall promptly remove any excess grout from the rock face, tunnel lining or tunnel road surface.

- (6) Threaded bars used for the installation of Rock Reinforcement shall be extended through the bearing plate to ensure a sufficient bar length for installation of the end hardware. A flat washer shall be placed between the plate and nut. Where necessary, additional beveled washers shall be used to ensure uniform bearing between the nut and the plate. Maximum protrusion of the Rock Reinforcement (Dowels), Rock Reinforcement (Number 10), and Rock Bolts thread bar shall not exceed 2 inches beyond the nut.
- (7) Maximum protrusion of Rock Anchor bar and end hardware beyond inside surface of tunnel lining shall not exceed 5 inches.

Rock Anchors shall be tensioned over free length to 15 kips by tightening end nut following development of grout strength in anchor zone.

The Contractor shall perform all testing of Rock Reinforcement as specified, or as directed by the Engineer and as required for the safe prosecution of the work.

Anchor Testing and Stressing. Anchor testing requirements specified here apply to Rock Reinforcement (Number 10) and Rock Bolts only.

Testing Equipment. Testing equipment shall include jack, pump, pressure gage, and a reaction frame. The Contractor shall furnish at least one set of laboratory certified stressing equipment for use in conducting these tests. Each set of pull equipment shall consist of a suitably sized hydraulic ram, hydraulic pump (hand or electric) with pressure indicator that has 100 psi interval calibration marks, a dial gauge or travel indicator capable of reading increments of 0.001 inches over a range of 2 inches (dial gauges necessary only if required by non-passing test results), an extension bar, and associated hardware for testing the Rock Reinforcement. The hydraulic pump shall be calibrated by an independent laboratory while connected to the jack prior to field use. Stressing ram assembly shall be calibrated every 90 days throughout the duration of the Work. A calibrated master gauge shall be kept on the site to periodically check the test gauge.

The jack, bearing plates, and reaction frame shall be aligned with the anchor such that unloading and repositioning of the equipment will not be required during the test. The stressing equipment shall be placed over the anchor system in such a manner that the jack, bearing plates, and stressing anchorage are axially aligned with the anchor and the anchor is centered within the equipment.

Required test data shall be recorded by the Contractor. Anchor testing and stressing shall not be conducted until the anchor grout has attained at least the specified 7-day compressive strength.

After an anchor has been accepted by the Engineer, the unneeded portion of the bar may be cut, if not otherwise required for use in re-testing. Cutting shall be done according to bar manufacturer's recommendations and as approved by the Engineer. Care shall be taken not to damage the anchorage. The tendon shall not be cut using a torch or other device, which in the opinion of the Engineer might affect the strength of the tendon at the anchorage. The exposed end, including anchor plate, shall be coated with epoxy paint prior to the grouting.

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Testing - Rock Reinforcement (Number 10) and Rock Bolts. All Rock Bolts and Rock Reinforcement (Number 10) bars will be performance or proof tested as described in this special provision, lift off testing will not be allowed on these anchors.

Performance Test. Submit the details of the performance testing arrangement for approval in accordance with the Construction Submittals section. Construct performance test anchors using the same equipment, installation methods, inclination and bore hole diameter as planned for the production anchors. Changes in the drilling or installation method may require additional performance testing as determined by the Engineer and shall be provided at no additional cost to the Department.

Performance testing to be performed on fully grouted production anchors. The Design Load (DL) during the testing is as shown on the Plans. Performance test anchors shall be incrementally loaded in accordance with the following loading schedule. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The anchor movements shall be recorded to the least 0.001 inch at each load increment.

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PERFORMANCE TEST LOADING SCHEDULE (Typical)

Load	Hold Time
AL	Obtain Reading
0.25DL	Obtain Reading
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
0.75DL	Obtain Reading
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
0.75DL	Obtain Reading
1.00DL	Obtain Reading
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
0.75DL	Obtain Reading
1.00DL	Obtain Reading
1.20DL	Obtain Reading
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
0.75DL	Obtain Reading
1.00DL	Obtain Reading
1.20DL	Obtain Reading
1.33DL	Obtain Reading
	2min
	3min
	4min
	5min
	6min
	10min
AL	Obtain Reading
DL	Lockoff

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed five percent of the Design Load. The load shall be held at each increment just long enough to obtain the movement reading. Except for the reading of the residual movement at AL, no movement readings need to be taken during the unloading of the anchor.

The test load shall be held for 10 minutes. Total movements with respect to a fixed reference point shall be shall

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be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the total movement between 1 and 10 minutes exceeds 0.04 inches, the 1.33DL load shall be maintained for an additional 50 minutes. Total movements shall then be recorded at 15, 20, 25, 30, 45 and 60 minutes. The Load Hold time shall start when the pump begins to load the anchor from the 1.20 * DL to the test load.

During the Load Hold portion of the test the load shall be maintained within two percent of the specified load by use of the load cell.

Proof Test. Proof testing shall be performed on fully grouted production Rock Reinforcement. Rock Anchors installed for pillar reinforcement will not require proof tests but grout strengths must be verified through testing as specified herein.

The anchor movement at each load shall be measured and recorded in the same manner as for performance tests. At load increments other than maximum test load, the load shall be held long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following loading schedule. The anchor movements shall be recorded to the nearest 0.001 inch at each load increment. The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed five percent of the Design Load. The lock-off load is as shown on the plans.

PROOF TEST LOADING SCHEDULE (Typical)

Load	Hold Time
AL	Obtain Reading
0.25DL	Obtain Reading
0.50DL	Obtain Reading
0.75DL	Obtain Reading
1.00DL	Obtain Reading
1.20DL	Obtain Reading
1.33DL	Obtain Reading
	2min
	3min
	4min
	5min
	6min
	10min
AL	1min
DL	Lockoff

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Depending on performance, either 10 minute or 60 minute creep tests shall be performed at the maximum test load. The creep period shall start as soon as the maximum test load is applied and the anchor movement shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. Where the anchor movement between 1 minute and 10 minutes exceeds 0.04 inches based on the average of the two dial gages, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 15 minutes, 20, 25, 30, 45 and 60 minutes.

Acceptance Criteria. Proof and performance test results shall be submitted to the Engineer for review. Acceptance of anchors shall conform to the requirements and recommendations contained in the "Recommendations for Prestressed Rock and Soil Anchors" Post-Tensioning Manual, Fourth Edition, by the Post-Tensioning Institute.

If an anchor fails to meet acceptance criteria the Contractor shall re-grout the anchor and perform a second performance or proof test or any other testing deemed necessary by the Engineer if anchor is installed with a regROUT tube and pressure grouting system. If the anchor still fails to meet the acceptance criteria the Contractor shall remove or de-tension the anchor and provide an additional anchor. The Contractor may submit alternate methods for producing an acceptable anchor to the Engineer for approval.

An anchor shall be considered acceptable when:

- (1) For performance tests, a total creep movement of less than 0.08 inches per log cycle of time between the 6 and 60 minute readings is measured during creep testing and the creep rate is linear or decreasing when plotted on a log scale throughout the creep test. The total measured movement at the maximum test load should exceed 80 percent of the theoretical elastic elongation of the test anchor stressing length.
- (2) For proof tests, a total creep movement of less than 0.04 inches is measured between the 1 and 10 minute readings, or a total creep movement of less than 0.08 inches is measured between the 6 and 60 minute readings, and the creep rate is linear or decreasing when plotted on a log scale throughout the creep test.
- (3) A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test anchor. The pullout failure load shall be recorded as part of the test data.
- (4) Successful tested anchors meeting the above test acceptance criteria may be incorporated as production anchors.

Test Anchor Rejection.

- (1) Performance Test Anchors. If the Engineer determines that the failure was caused by the installation methods or materials, the Contractor shall propose alternative methods and install replacement anchors. Replacement test anchors shall be installed and tested at no additional cost to the Department.
- (2) Proof Test Anchors. If the Engineer determines that the failure was caused by the installation methods or materials, the Engineer may require the Contractor to replace some or all of the installed production anchors between a failed proof test anchor and the adjacent passing proof test anchor. Alternatively, the Engineer may require the installation and testing of additional proof test anchors. Installation and testing of additional proof test anchors or installation of additional or modified anchors as a result of proof test anchor failure will be at no additional cost to the Department.

Testing – Rock Reinforcement (Dowel). Lift off/pullout testing of Rock Reinforcement (Dowel) shall be gradually loaded to the loads in the following section. The Engineer shall monitor the pressure gauge to verify the anchor load is holding the load for 10 minutes at the DL. If pressure is lost on the pressure gauge either due to jacking ram problems or creep of the anchor then the Engineer may require a performance and/or proof test to validate the design assumptions.

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A minimum of 10 percent of the Rock Reinforcement (Dowel) shall have a lift off test performed. The anchor shall be pulled to maximum load of 20 kips. If all the lift off tests are satisfactory to the Engineer (i.e. anchors do not pull out that are in bedrock) then no more testing is required. If an anchor pulls out, then an additional 5 anchors are to be tested then 5 percent of the remaining anchors are to be tested and so forth if applicable. Test locations to be determined by the Engineer.

In the event soil materials or lift off testing indicates that the subsurface materials or construction methods are not providing adequate bond for the anchors or supports the Engineer may require the Rock Reinforcement (Dowel) to be tested as described above for Rock Reinforcement (Number 10).

Testing of Grout. A set of nine cubes of grout shall be taken for every 2 cubic yards of grout or 20 Rock Reinforcement installations, whichever is the lesser quantity, during grouting of the Rock Reinforcement. Sampling, preparation, curing and testing shall be in accordance with AASHTO T 106. Three cubes shall be tested at 1 day, three at 7 days, and three at 28 days.

METHOD OF MEASUREMENT

Rock Reinforcement (Number 10), Rock Reinforcement (Dowel), Rock Bolts and Rock Anchors will be measured by the quantity installed and accepted. Testing of the Rock Reinforcement will not be measured separately but shall be considered incidental to the installation. The final pay quantity will be the Plan design quantity, increased or decreased by any changes authorized by the Engineer. For purpose of measurement, the Rock Reinforcement must be installed, tested and accepted to be considered complete. The specification is for information only as it applies to other specifications and work under the project.

BASIS OF PAYMENT

The accepted quantity of work will be paid for at the contract price per unit of measurement for the pay items listed below. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Rock Reinforcement (Number 10)	Linear Feet
Rock Reinforcement (Dowel)	Linear Feet
Rock Bolts	Linear Feet
Rock Anchor	Linear Feet

Payment for Rock Reinforcement will be full compensation for all work and materials required to complete the items. Accordingly, this work shall include, but is not limited to, drilling, grouting, thread bars, performance tests, proof tests, lift-off tests, grout containment devices, bearing plates, end hardware (nuts, washers), and incidentals necessary to acceptably install the Rock Reinforcement.

Small-diameter percussion-drilled probe holes to confirm location and angle of installation for Rock Anchors placed through tunnel lining are clear of obstructions will not be measured and paid for separately but shall be included in the pay item for Rock Anchor.

**REVISION OF SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT**

Section 250 of the Standard Specifications is hereby revised for this project as follows:

Subsection 250.03 shall include the following:

Contractor shall be aware of the Project specific Environmental Site Assessment (March 2012) and Materials Management Plan. This report's preliminary analysis did not anticipate encountering known hazardous materials in the area of disturbance. However, there is a small potential for the presence of mine waste in soil and/or groundwater in the vicinity of the project area. The Contractor shall be responsible for the required worker health and safety, materials management, analysis and materials disposal according to state regulations. If contaminants are encountered, the Contractor Health and Safety Officer and/or Monitoring Technician shall be on site as necessary during the excavations to ensure the safety of workers and proper management, analysis and disposal of potentially contaminated materials, as detailed in the CDOT Standard Specification 250-Environmental, Health and Safety Management and the Materials Management Plan. The characterization of all materials for proper transport and disposal shall be performed with the approval of the Engineer.

In subsection 250.05, third paragraph, deleted the first sentence and replace with the following:

Specific areas of known or potential contamination have been identified in the Materials Management Plan.

Subsection 250.05 (b) shall include the following:

The Contractor shall be responsible for obtaining the authorization for solid waste disposal, and if necessary, hazardous waste disposal, and shall obtain the necessary transport and disposal manifests with approval of the Engineer. The disposal facility shall be fully compliant with state and federal regulations. The Contractor shall perform all necessary material characterization, reporting requirements, agency coordination and material disposal as required by the Materials Management Plan. For solid waste suitable for non-hazardous landfill disposal, the Contractor shall prepare and submit a "Request to Dispose" with a description and characterization of the material to: Mr. David Singer, CDOT Environmental Manager in Golden, 303-512-5872. It is the Contractor's responsibility to identify and perform the appropriate analyses for waste disposal.

Subsection 250.05 (c) shall include the following:

If potential mine tailings are encountered the Contractor shall follow the steps and procedures detailed in the Materials Management Plan. The MMP Supervisor, in conjunction with CDOT Environmental Manager and the CDPHE RP, will arrange for disposal of the material at the Church Placer Repository, or another approved location. The Church Placer Repository will accept only mining-related materials such as waste rock, mill tailing or metals-contaminated sediment. Repository use may not be available in winter/freezing months. The Church Placer Repository will accept no more than 10,000 cubic yards for compaction.

METHOD OF MEASUREMENT

If contamination is encountered, its management, analysis and disposal will be paid for under a planned force account item.

BASIS OF PAYMENT

Payment will be made under F/A Health and Safety Management

**REVISION OF SECTION 304
AGGREGATE BASE COURSE**

Section 304 of the Standard Specifications is hereby revised for this project as follows:

Subsection 304.02 shall include the following:

Materials for the subbase shall be Aggregate Base Course (Class 6) as shown in subsection 703.03.

Materials for the base course shall be Aggregate Base Course (Class 6) as shown in subsection 703.03

The aggregate base course (Class 6) must meet the gradation requirements and have a resistance value of at least 78 respectively when tested by the Hveem Stabilometer method.

**REVISION OF SECTION 401
HOT MIX ASPHALT COMPACTION
(PNEUMATIC TIRE ROLLERS)**

Section 401 of the Standard Specifications is hereby revised for this project as follows:

In subsection 401.17, first paragraph, delete the second sentence and replace with the following:

Both steel wheel and pneumatic tire rollers will be required on this project. If the Contractor has demonstrated that all of the manufacturer's recommendations were followed and the pneumatic tire roller is detrimental to the finished surface of the HMA, the Engineer, in cooperation with the Contractor and the Region Materials Engineer, may waive the pneumatic tire roller requirement.

**REVISION OF SECTION 403
HOT MIX ASPHALT**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.02 shall include the following:

The design mix for hot mix asphalt shall conform to the following:

Table 403-1

Property	Test Method	Value For Grading			
			SX(100)	SX(75)	Patching
Air Voids, percent at: N (design)	CPL 5115		3.5 – 4.5	3.5 – 4.5	3.5 – 4.5
Lab Compaction (Revolutions): N (design)	CPL 5115		100	75	75
Stability, minimum	CPL 5106		30	28	28
Aggregate Retained on the 4.75 mm (No. 4) Sieve with at least 2 Mechanically Induced fractured faces, % minimum	CP 45		70	70	70
Accelerated Moisture Sus- ceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B		80	80	80
Minimum Dry Split Tensile Strength, kPa (psi)	CPL 5109 Method B		205 (30)	205 (30)	205 (30)
Grade of Asphalt Cement, Top Layer			PG(64-28)		PG(58-28)
Grade of Asphalt Cement, Layers below Top				PG(58-28)	
Voids in the Mineral Aggregate (VMA) % minimum	CP 48		See Table 403-2	See Table 403-2	See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2		65-75	65-80	65-80
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50		0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6
<p>Note: AI MS-2 = Asphalt Institute Manual Series 2</p> <p>Note: The current version of CPL 5115 is available from the Region Materials Engineer.</p> <p>Note: Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.</p> <p>Note: Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen. Gradations for mixes with a nominal maximum aggregate size of ¾ inch or smaller are considered a coarse gradation if they pass below the maximum density line at the #8 screen.</p>					

All mix designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all mix properties at Air Voids up to 1.0 percent below the mix design optimum.

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**REVISION OF SECTION 403
 HOT MIX ASPHALT**

Table 403-2

Minimum Voids in the Mineral Aggregate (VMA)			
Nominal Maximum Size*, mm (inches)	***Design Air Voids **		
	3.5%	4.0%	4.5%
37.5 (1½)	11.6	11.7	11.8
25.0 (1)	12.6	12.7	12.8
19.0 (¾)	13.6	13.7	13.8
12.5 (½)	14.6	14.7	14.8
9.5 (⅜)	15.6	15.7	15.8
* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%. ** Interpolate specified VMA values for design air voids between those listed. *** Extrapolate specified VMA values for production air voids beyond those listed.			

The Contractor shall prepare a quality control plan outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to the Engineer and approved prior to beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

CDOT approved Warm Mix Asphalt (WMA) may be allowed on this project in accordance with CP 59. Unique requirements for WMA design, production and acceptance testing as documented during CDOT WMA approval shall be submitted and approved prior to creation of the Form 43 and before any WMA production on the project. Delays to the project due to WMA submittal and review will be considered within the Contractor’s control and will be non-excusable.

Hot mix asphalt for patching shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX).

A minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all hot mix asphalt.

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REVISION OF SECTION 403
HOT MIX ASPHALT

Delete subsection 403.05 and replace with the following:

403.05 The accepted quantities of hot mix asphalt will be paid for in accordance with subsection 401.22, at the contract unit price per ton for the bituminous mixture.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Hot Mix Asphalt (Grading SX)(75)(PG 58-28)	Ton
Hot Mix Asphalt (Grading SX)(100)(PG 64-28)	Ton
Hot Mix Asphalt (Patching)(Asphalt)	Ton

Aggregate, asphalt recycling agent, additives, hydrated lime, and all other work necessary to complete each hot mix asphalt item will not be paid for separately, but shall be included in the unit price bid. When the pay item includes the PG binder grade, the asphalt cement will not be measured and paid for separately, but shall be included in the work. When the pay item does not include the PG binder grade, asphalt cement will be measured and paid for in accordance with Section 411. Asphalt cement used in Hot Mix Asphalt (Patching) will not be measured and paid for separately, but shall be included in the work.

Excavation, preparation, and tack coat of areas to be patched will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTIONS 403
HOT MIX ASPHALT TICKET COLLECTION**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.05 shall include the following:

The Contractor shall collect the scale ticket on each load when it is delivered to the project site, and ensure that the information required in subsection 109.01 is shown on each ticket:

The scale tickets shall be available on site for CDOT personnel to inspect.

Each day the Contractor shall provide to the Engineer envelopes which contain the previous day's signed tickets and the following:

1. On each envelope: Project number, date of paving, type of material, daily total and cumulative total.
2. One of the following:
 - A. Two adding machine tape tabulations of the weight tickets with corresponding totals run and signed by different persons,
 - B. One signed adding machine tape tabulation of the weight tickets that has been checked and signed by a second person,
 - C. Signed check tape of computer scale tickets that have a cumulative total. These scale tickets must be consecutive and without voids adjustments.
3. A listing of any overweight loads on the envelope, including ticket numbers and amount over legal limit.
4. A comparison of the actual yield for each day's placement to the theoretical yield. Theoretical yield shall be based on the actual area paved, the planned thickness, and the actual density of the mixture being placed. Any variance greater than +2.5% shall be indicated on the envelope and a written explanation included.

The Contractor shall provide a vehicle identification sheet that contains the following information for each vehicle:

- (1) Vehicle number
- (2) Length
- (3) Tare weight
- (4) Number of axles
- (5) Distance between extreme axles
- (6) All other information required to determine legal weight.
- (7) Legal weight limit.

REVISION OF SECTION 503 MICROPILES

Section 503 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of construction of micropile foundations to support bridge abutments. The Contractor shall be responsible for furnishing all materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques that are required for installation, and testing of micropiles for this project.

The Contractor shall select the installation means and methods to ensure that each micropile has an ultimate capacity in excess of the factored load as specified in the plans. The Contractor shall perform the work in accordance with the plans, specifications, and the working drawings. The micropile load capacities shall be verified by verification load testing as required and shall meet the test acceptance criteria specified herein.

Definitions:

- (a) Alignment load (AL): A minimum initial load (5 percent of factored load maximum) applied to micropile during testing to keep the testing equipment correctly positioned.
- (b) Uncased (bond) length (load transfer length): The length of the micropile that is bonded to the surrounding ground and transfers the applied axial loads to the surrounding rock mass.
- (c) Cased length: The designated length of pile that is not bonded to the surrounding ground.
- (d) Factored Load: The maximum factored load (demand) for all micropiles as specified on the plans. Abbreviated hereinafter as FL.
- (e) Verification load test (performance test): Testing of a sacrificial pile to verify the design of the micropile system and the construction methods proposed or being used.

MATERIALS

Materials for the micropile structure shall be new and without defects. When directed by the Engineer, the Contractor shall promptly remove defective materials from the site at no additional cost.

Admixtures for grout shall conform to the requirements of ASTM C 494 / AASHTO M194, and shall be subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Expansive admixtures, accelerators, and admixtures containing chlorides are not permitted.

Cement shall be portland cement conforming to ASTM C 150 / AASHTO M85, Types II, III, or V.

Centralizers and spacers shall be fabricated from Schedule 40 PVC pipe or tube ASTM D-1785, and securely attached to the reinforcement. They shall be sized to position the reinforcement within ½ inch of plan location from center of pile, to allow grout tube insertion to the bottom of the drill hole, and to allow grout to flow freely up the drill hole and casing.

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Grout shall have a minimum 3-day compressive strength of 2500 psi and a 28-day compressive strength of 6000 psi per ASTM C109 / AASHTO T106. The water/cement ratio of the grout mixture shall be between 0.40 and 0.50.

Permanent steel casing/pipe shall have the diameter and at least minimum wall thickness shown on the plans. The permanent steel casing/pipe:

- (1) shall meet the tensile requirements of ASTM A53 Grade B, and the yield strength shall be 35 ksi or 9 greater.
- (2) may be new “Structural Grade” steel pipe meeting above, free from defects, and with two coupon tests per truckload delivered to the fabricator.

For permanent casing/pipe that will be welded, the following material conditions apply:

- (1) The carbon equivalency as defined in AWS D1.1, section X15.1, shall not exceed 0.45, as demonstrated by mill certifications.
- (2) the sulfur content shall not exceed 0.05 percent, as demonstrated by mill certifications.

For permanent casing/pipe that will be welded, the following fabrication or construction conditions apply:

- (1) the steel pipe shall not be joined by welded lap splicing.
- (2) welded seams and splices shall be complete penetration welds.
- (3) partial penetration welds may be restored in conformance with AWS D1.1.
- (4) the proposed welding procedure certified by a welding specialist shall be submitted for approval.

Threaded casing joints shall develop at least the required nominal resistance used in the design of the micropile.

Structural steel plates and shapes for pile top attachments shall conform to ASTM A 36 / AASHTO M183, or ASTM A 572 / AASHTO M223, Grade 36.

Reinforcing steel shall be deformed bars in accordance with ASTM A 615, Grade 75, as shown in the plans. When a bearing plate and nut are required to be threaded onto the top end of bars for the pile top to abutment anchorage, the threading may be provided by the bar deformations or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next larger bar number designation from that shown on the plans shall be provided, at no additional cost. Bar couplers shall develop the ultimate tensile strength of the bars without any evidence of failure, and a maximum of one coupler shall be allowed per micropile, such that any bar portion of a coupled micropile shall have 10.0 foot minimum finished length. .

Water used in the grout mix shall conform to AASHTO T 26 and shall be potable, clean, and free from substances that may be detrimental to cement and steel.

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CONSTRUCTION REQUIREMENTS

Qualifications:

The Contractor shall have previous micropile drilling, grouting, and testing experience in soil/rock similar to project conditions. The Contractor shall have successfully constructed at least three projects in the last five years involving construction totaling at least 100 micropiles of similar capacity to those required in this Contract. The Contractor shall assign an engineer to be in responsible charge of the work with experience on at least three projects of similar scope to this project completed over the past five years. The on-site foremen and drill rig operators shall also have experience on at least three projects over the past five years installing micropiles of equal or greater capacity than required by this project.

At least three calendar weeks before the planned start of micropile construction, the Contractor shall submit five copies of the completed project reference list and a personnel list. The project reference list shall include a brief project description with the owner's name/representative and current phone number. The personnel list shall identify the micropile system designer, supervising engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and shall be complete enough for the Engineer to determine whether each individual satisfies the required qualifications. The Engineer will approve or reject the Contractor's qualifications within ten calendar days after receipt of a complete submission. Additional time required due to incomplete or unacceptable submittals will not be cause for time extension or impact or delay claims. All costs associated with incomplete or unacceptable submittals shall be borne by the Contractor.

Work shall not be started or material ordered until the Engineer gives written approval of the Contractor's experience qualifications. The Engineer may suspend the Work if the Contractor uses non-approved personnel. If work is suspended, the Contractor shall be fully liable for all resulting costs, and no adjustment in contract time will result from the suspension.

Submittals - Working Drawings:

The Contractor shall submit working drawings in accordance with subsection 105.02. The working drawings shall include the following:

- (1) A plan view of the micropile structure that identifies the location of the structure within the project and drainage structures near the micropile structure.
- (2) An elevation view of the micropile structure that shows micropile locations and elevations, vertical and horizontal micropile spacing, existing grade profiles at the wall layout line, and finished top of micropiles.
- (3) General notes for constructing the micropile pile cap and micropile structure, including construction sequencing and special construction requirements.
- (4) Certificates of compliance attesting proof of compliance with specification material requirements for micropile casing, threadbar, and grout, prior to delivery of material to the project site.
- (5) Proposed grouting plan, including grout mix design (with certified test data); methods and equipment for monitoring and recording grout volume, and grout pressure (if pressure grouting is used) during grout placement; estimated curing time for grout to achieve specified strength; and procedure and equipment for Contractor monitoring of grout quality.

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- (6) A thorough narrative describing the Contractor's micropile installation procedures, including a description of all drilling equipment and methods; plans for control and disposal of surface water, drill flush, dust control and excess waste grout.
- (7) A thorough narrative describing the micropile testing procedures, equipment, and setup. The submittal shall include calibration information to correlate gauge pressure to applied load for each combination of ram, jack, and gauge to be used in the Work. The serial number of each component of the loading and testing assembly shall be clearly indicated on the calibration graph. The submittal shall also include any micropile modifications required to ensure required structural capacity is obtained.
- (8) Certificate of calibration from an independent testing laboratory for each combination of ram, jack, and gauge to be used for loading and testing of the micropiles. The equipment shall have been calibrated within three months of the date of this submittal or at the request of the Engineer. Testing shall not begin until the Engineer has reviewed and accepted the calibration data.

The Engineer will review the Contractor's submittal within ten days after receipt of a complete submittal. The Contractor shall not begin micropile structure construction or incorporate materials into the Work until the submittal requirements are satisfied and verification test results have been reviewed and accepted by the Engineer. No adjustments in contract time or delay or impact claims will be allowed due to incomplete submittals.

Preconstruction Meeting:

A preconstruction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Engineer (including structural and geotechnical EOR's), the Contractor, the supervising engineer, and the micropile foremen shall attend the meeting. The preconstruction meeting will be conducted to clarify the construction requirements for the Work, to coordinate the construction schedule and activities, and to establish clearly the responsibilities amongst the parties for issues related to excavation, subsurface conditions, micropile installation and testing, micropile structure survey control, and site drainage control.

Micropile Installation:

The Contractor shall control and properly dispose of drill flush and construction-related waste, including excess grout, in accordance with the specifications and all applicable local codes and regulations. The Contractor shall provide positive control and discharge of all surface water that will affect construction of the micropile installation.

The Contractor shall control the dust during the drilling operations to limit the impacts to the environment, public traffic, and pedestrians.

The Contractor shall coordinate the Work and the excavation so that the micropile structures are safely constructed. No excavations steeper than those specified herein or shown on the plans shall be made above or below the micropile structure locations without prior written approval of the Engineer.

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The micropiles shall be installed within the following tolerances:

- (1) Centerline of piling shall not be more than 3 inches from indicated plan location.
- (2) Pile shall be plumb within 2 percent of total length plan alignment.
- (3) Top elevation of pile shall be plus 1 inch or minus 2 inch maximum from vertical elevation shown in the plans.
- (4) Centerline of reinforcing steel shall be within ½ inch from centerline of micropile.

The Contractor shall select the drilling method, the grouting procedure, and the grouting pressure to be used for the installation of the micropiles. The Contractor shall choose the method which ensures that each completed micropile has an ultimate capacity in excess of the factored load.

Reinforcing shall be placed prior to grouting and shall be free of deleterious substances that might contaminate the grout or coat the reinforcement and impair bond.

The Contractor shall check pile top installations and adjust all installed micropiles to the planned elevations. The interface of the top of casing and the bearing plate shall be prepared by sawing or other suitable means to achieve maximum contact bearing. Lack of contact bearing not exceeding a gap of 1/16 inch is permitted.

Centralizers and spacers (if used) shall be provided at maximum 10-foot spacing. The upper and lower most centralizer shall be located a maximum of 5 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bars and permanent casing. Partially inserted reinforcing bars shall not be driven or forced into the hole. The Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion.

The Contractor shall have means and methods of measuring the grout quantity and pumping pressure (if pressure grouting is used) during the grouting operations. The grout mixture shall be kept in agitation prior to placement and shall be placed within one hour of mixing, in one continuous operation.

The grouting of the micropile will be a two-staged process. The bond length of the micropile shall be grouted the same day the micropile is drilled. The micropile shall be grouted to a level within 2 to 3 feet above the bottom of the cased length. The grout shall be injected from the lowest point of the drill hole. Topping off may be necessary to insure grout level is maintained. A minimum of 8 hours later, or at the direction of the Engineer, the contractor shall grout the annular space inside the cased length of the micropile in a single operation so that the top plate bears uniformly on the steel pipe and the grout. It may be necessary to inject grout through a predrilled hole in the top plate until clean grout exits another predrilled vent hole in the top plate.. The grout shall be pumped through grout tubes that will remain in the hole and be filled with grout. Verification test micropiles shall be tested prior to grouting of the annular space between the bar and cased length of the micropile.

Grout within the micropile verification test piles shall attain the minimum required 28-day compressive strength of 5000 psi prior to load testing. During production, the Engineer shall test the micropile grout for compressive strength in accordance with ASTM C109 / AASHTO T106 at a frequency of no less than one set of three 2-inch cubes from each grout plant each day of operation or per every eight piles, whichever occurs more frequently. The compressive strength shall be the average of the three cubes tested. Grout consistency as measured by grout density shall be determined by the Engineer per ASTM C 188 / AAHTO T133 or API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. Grout samples shall be taken directly from the grout plant. The Engineer shall provide grout cube compressive strength and density test results to the Contractor within 24 hours of testing.

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The Contractor shall prepare and submit to the Engineer full installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The date shall be recorded on the micropile installation log included at the end of this specification. A separate log shall be completed for each micropile.

Verification Load Testing:

The Contractor shall perform verification testing of piles at the locations specified herein or as designated by the Engineer. Verification testing shall consist of a tension load test in accordance with ASTM D 3689, except as modified herein. The annular space between the bar and cased length shall not be grouted until acceptance of the test results by the Engineer. The Contractor shall be responsible for all modifications to the production micropile design to ensure the required structural capacity is obtained

The verification test piles, loading apparatus, reaction pads and the reaction frame shall be capable of safely achieving a maximum tensile test load of 3.0 times the micropile factored load (FL) as shown in the contract documents and approved working drawings. The Contractor shall perform verification load testing of at least one sacrificial test micropile per abutment, at locations to be determined by the Engineer, prior to installation of any production piles. Verification load testing shall be used to verify the adequacy of the Contractors drilling, installation and grouting methods and to verify that the test pile has the planned load carrying capacity as determined by the nominal grout-to-ground bond strength. The sacrificial verification test piles shall be constructed in conformance with the contract plans and approved working drawings. The micropile verification load test results must be reviewed and accepted by the Engineer prior to beginning installation of production micropiles.

The Contractor shall perform a tension verification load test. For verification testing, the annular space between the bar and cased length shall not be grouted until acceptance of the test results by the Engineer. Only the bond length shall be grouted for testing purposes. The Contractor shall monitor movement of the bar and the top of the micropile casing separately. Verification test piles shall be tested within 48 hours of the time that the grout in that pile reaches the specified 28-day strength. The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required. During the testing, the reaction frame shall be sufficiently rigid such that excessive deformation of the testing equipment does not occur.

The maximum load applied during the verification test shall be that which causes failure of the micropile, either by achieving 80% of the ultimate tensile capacity of the steel bar (for ASTM A 722 Grade 150 bar), 90% of the tensile yield capacity of the steel bar (for ASTM A 615 Grade 75 bar) or loss of grout-to-ground bond strength (pullout failure) Verification tests shall be made by incrementally loading the micropile in accordance with the following schedule:

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Load Stage	Load Step	Load	Hold Time (minutes)
Cycle 1	1	0.05 FL	2.5
	2	0.15 FL	2.5
	3	0.30 FL	2.5
	4	0.45 FL	2.5
	5	0.05 FL	1.0
Cycle 2	6	0.15 FL	1.0
	7	0.45 FL	1.0
	8	0.60 FL	2.5
	9	0.75 FL	2.5
	10	0.90 FL	2.5
	11	1.00 FL	2.5
	12	0.05 FL	1.0
Cycle 3	13	0.15 FL	1.0
	14	1.00 FL	1.0
	15	1.15 FL	2.5
	16	1.30 FL	60.0
	17	1.45 FL	2.5
	18	0.05 FL	1.0
Cycle 4	19	0.15 FL	1.0
	20	1.45 FL	1.0
	21	1.60 FL	1.0
	22	1.75 FL	2.5
	23	1.90 FL	2.5
	24	2.00 FL	10.0
	25	1.50 FL	5.0
	26	1.00 FL	5.0
	27	0.50 FL	5.0
	28	0.05 FL	5.0
Cycle 5	29	0.15 FL	1.0
	30	1.75 FL	1.0
	31	2.00 FL	1.0
	32	2.25 FL	2.5
	33	2.50 FL	2.5
	34	2.75 FL	2.5
	35	3.00 FL	2.5
	36	2.00 FL	1.0
	37	1.00 FL	1.0
	38	0.05 FL	1.0

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Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 1.30 FL test load. Where the pile top movement between one and ten minutes exceeds 0.04 inches, the maximum test load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes.

The acceptance criteria for micropile verification test loads shall be:

- (1) The pile shall sustain the FL with no more than 0.5-inch total movement at the top of the pile, relative to the position of the top of the pile at the alignment load.
- (2) At the end of the creep test load increment, test piles shall have a creep rate not exceeding 0.04 inches / log cycle time (1 to 10 minutes) or 0.08 inches / log cycle time (6 to 60 minutes). The creep rate shall be constant or decreasing throughout the creep load hold period.
- (3) Failure does not occur at the 2.00 FL test load. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

The Engineer will provide the Contractor with written confirmation of the micropile capacity and construction within five working days of the completion of the verification load tests. This written confirmation will either confirm the capacities and bond lengths specified in the plans or reject the piles based on the verification test results.

If a verification-tested micropile fails to meet the acceptance criteria, the Contractor shall modify the construction procedure and install an additional verification pile. If subsequent verification piles do not meet the acceptance criteria, the Contractor shall continue to install verification piles as directed by the Engineer until the acceptance criteria is met. At the completion of verification testing, test piles shall be removed down to the elevation specified by the Engineer.

Verification test piles shall not be used as permanent piles in the work.

Method of Measurement

Micropiles will be measured by the linear foot from the elevation shown on the plans to the bottom of the hole as drilled.

Verification Test Pile for micropiles will be measured by the actual number of test piles installed as designated in the plans or at the direction of the Engineer.

Basis of Payment

The accepted quantities will be paid for at the contract unit price per unit of measurement for each of the pay items listed below.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Micropile (8 Inch)	Linear Foot
Verification Test Pile	Each

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Payment for micropiles shall be full compensation for all drilling, hauling and disposal of drill cuttings, performing all necessary pumping; grout and grout overruns, reinforcement including couplers and bearing plate steel; all backfilling; removal of casings; any casings left in place; and for furnishing all tools, labor, equipment, and incidentals necessary to complete the work.

Grout will not be paid for separately but shall be included in the work. Verification testing will be paid for separately.

**REVISION OF SECTION 504
GROUND NAIL WALL**

Section 504 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

504.06 This work consists of constructing a permanent ground nailed wall as specified herein and as shown on the plans. The work includes excavating in staged lifts in accordance with the drawings and approved submittals for drilling ground nail holes to the diameter and length required to develop the specified capacity; grouting the nails; providing and installing the specified drainage features; providing and installing bearing plates, washers, nuts, and other required miscellaneous materials; and constructing the required shotcrete face and constructing the final structural facing.

MATERIALS

504.07 Concrete shall be Class D, conforming to the requirements of Section 601.

Reinforcing Steel shall conform to the requirements of Section 602.

Shotcrete shall conform to the requirements of Section 641 as revised for this project.

Forms and falsework shall conform to the requirements of subsections 601.09 and 601.11.

504.08 Ground Nails.

- (a) *Solid Bar Ground Nails.* Bars shall conform to AASHTO M31, Grade 60 or 75 or ASTM A 722 for Grade 150. Bars shall be deformed, continuous without splices or welds, new, straight, undamaged, epoxy-coated, and encapsulated as shown on the plans. Bars shall be threaded a minimum of 6 inches on the wall anchorage end to allow proper attachment of bearing plate and nut. Threading may be continuous spiral deformed ribbing provided by the bar deformations (continuous thread bars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next-larger bar number designation from that shown on the plans shall be provided at no additional cost.
- (b) *Bar Coupler.* Bar couplers shall develop the full ultimate tensile strength of the bar as certified by the manufacturer.
- (c) *Fusion Bonded Epoxy Coating.* Epoxy coating shall conform to ASTM A 934. The minimum thickness shall be 0.012 inch. (d) *Encapsulation.* Encapsulation shall be minimum 0.04-inch thick, corrugated, HDPE tube conforming to AASHTO M252 or corrugated PVC tube conforming to ASTM D1784, Class 13464-B.
- (e) *Hot Dipped Galvanizing.* Hot dipped galvanizing shall conform to ASTM A 153. The minimum thickness shall be 3 mils applied to cleaned steel bars.

504.09 Ground Nail Appurtenances.

- (a) *Centralizer.* Centralizers shall be manufactured from Schedule 40 PVC pipe or tube, steel, or other material not detrimental to the nail steel; wood shall not be used. Centralizers shall be securely attached to the nail bar; sized to position the nail bar within 1 inch of the center of the drill hole; sized to allow tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole.

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- (b) *Nail Grout.* Grout shall be a neat cement or sand/cement mixture with a minimum 3 day compressive strength of 1,500 pounds per square inch and a minimum 28-day compressive strength of 3,000 pounds per square inch conforming to AASHTO T106.
- (c) *Fine Aggregate.* Fine aggregate shall conform to AASHTO M6.
- (d) *Portland Cement.* Portland Cement shall conform to AASHTO M85, Type I, II, III, or V.
- (e) *Admixtures.* Admixtures shall conform to AASHTO M194. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer. Accelerators are not permitted. Expansive admixtures may be used only in grout used for filling sealed encapsulations. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.
- (f) *Grout Containment Device (GCD).* The GCD shall be a commercially available product manufactured specifically for use with soil nails. It shall be constructed from a geotextile of sufficient strength to survive installation into the drill hole without damage and of sufficient volume to conform to the actual hole size. The GCD shall allow some grout to infiltrate through the geotextile to provide a maximum bond. In addition, the geotextile shall conform to ASTM D-4491 with a minimum permittivity of 0.7 per second.
- (g) *Film Protection.* Polyethylene film shall conform to AASHTO M171.

504.10 Bearing Plates, Nuts, and Welded Stud Shear Connectors.

- (a) *Bearing Plates.* Bearing plates shall conform to AASHTO M183.
- (b) *Nuts.* Nuts shall conform to AASHTO M291, grade B, hexagonal, fitted with beveled washer or spherical seat to provide uniform bearing.
- (c) *Shear Connectors.* Shear connectors shall conform to AASHTO Construction Specifications, Section 11.3.3.1.

504.11 Welded Wire Fabric. Welded Wire Fabric shall conform to AASHTO M55 or ASTM A497.

504.12 Reinforcing Steel. Reinforcing Steel shall conform to AASHTO M31, Grade 60, deformed.

504.13 Geocomposite Strip Drain. Geocomposite Strip Drain shall be manufactured with a drainage core (e.g., geonet) and a drainage geotextile attached to or encapsulating the core. The drainage core shall be manufactured from long chain synthetic polymers composed of at least 85 percent by mass of polypropylenes, polyester, polyamine, polyvinyl chloride, polyolefin, or polystyrene and having a minimum compressive strength of 40 pounds per square inch when tested in accordance with ASTM D 1621 Procedure A. The drainage core with the geotextile fully encapsulating the core shall have a minimum flow rate of 5 gallons per minute per foot of width tested in accordance with ASTM D 4716. The test conditions shall be under an applied load of 10 pounds per square inch at a gradient of 1.0 after a 100-hour seating period.

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GROUND NAIL WALL**

504.14 Underdrain and Perforated Pipe.

- (a) *Pipe.* Pipe shall conform to ASTM 1785 Schedule 40 PVC solid and perforated wall; cell classification 12454-B or 12354-C, wall thickness SDR 35, with solvent weld or elastomeric joints.
- (b) *Fittings.* Fittings shall conform to ASTM D3034, Cell classification 12454-B or C, wall thickness SDR 35, with solvent or elastomeric joints.

504.15 Shotcrete. The Contractor shall submit for approval, all materials, methods, and control procedures for this work.

CONSTRUCTION REQUIREMENTS

504.16 Contractor Qualifications. The ground nailing contractor shall have completed at least 3 permanent ground nail retaining wall projects during the past 3 years totaling at least 10,000 square feet of wall face area and at least 500 permanent ground nails.

The ground nailing contractor shall provide a Registered Professional Engineer with experience in the construction of permanent ground nail retaining walls on at least 3 completed projects over the past 3 years. The ground nailing contractor shall not use consultants or manufacturer's representatives to meet the requirements of this section. The ground nailing contractor shall provide on-site supervisors and drill operators with experience installing permanent ground nails on at least three projects over the past 3 years.

504.17 Submittals. The ground nailing contractor shall submit a brief description of at least 3 completed projects, including the owning agency's name, address, and current phone number; location of project; project contract value; and scheduled completion date and actual completion date for the project.

At least 60 calendar days before starting ground nail work, the ground nailing contractor shall identify the Engineer, on-site supervisors, and drill operators assigned to the project, and submit a summary of each individual's experience. Only those individuals designated as meeting the qualifications requirements shall be used for the project. The ground nailing contractor shall not substitute for any of these individuals without written approval of the Engineer. The Engineer will approve or reject the ground nailing contractor qualifications and staff within 15 working days after receipt of the submission. Work shall not be started on any ground nail wall or materials ordered until the ground nailing contractor's qualifications have been approved by the Engineer. The Engineer may suspend the work if the ground nailing contractor substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of the work will be allowed.

The Contractor shall provide the necessary survey and alignment control during the excavation for each lift, locating drill holes and verifying limits of wall installation. At least 30 days before starting ground nail work, the ground nailing contractor shall submit a Construction Plan to the Engineer that includes the following:

- (1) The start date and proposed detailed wall construction sequence.
- (2) Drilling and grouting methods and equipment, including the drill hole diameter proposed to achieve the specified pullout resistance values shown on the plans and any variation of these along the wall alignment.

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GROUND NAIL WALL**

- (3) Nail grout mix design, including compressive strength test results (per AASHTO T106) supplied by a qualified independent testing lab verifying the specified minimum 3-day and 28-day grout compressive strengths. Previous test results for the same grout mix completed within one year of the start of grouting may be submitted for verification of the required compressive strengths.
- (4) Nail grout placement procedures, equipment and grout containment device's dimensions and material properties (manufacturer's cut sheets).
- (5) Shotcrete materials and methods.
- (6) Ground nail testing methods and equipment setup.
- (7) Identification number and certified calibration records for each test jack and pressure gauge and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, the device identification number, and the calibration test results and shall be certified for an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.
- (8) Manufacturer Certificates of Compliance for the ground nail yield or ultimate tensile strength, nail bar steel type, Portland cement, centralizers, bearing plates, epoxy coating, and encapsulation.

The Engineer will approve or reject the ground nailing contractor's Construction Plan within 30 working days after the submission. Approval of the Construction Plan does not relieve the Contractor of responsibility for the successful completion of the work.

504.18 Storage and Handling. Ground nail bars shall be stored and handled in a manner to avoid damage or corrosion. Bars exhibiting abrasions, cuts, welds, weld splatter, corrosion, or pitting shall be replaced. Bars exhibiting damage to encapsulation or epoxy coating shall be replaced. Repaired epoxy coating areas shall have a minimum 0.012-inch thick coating.

504.19 Excavation. The Contractor shall complete the excavation to neat line and grade in a series of lifts. The height of the exposed unsupported excavation lifts shall not exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. The Contractor shall only excavate that portion of each lift where reinforced shotcrete can be applied in the same work shift, unless otherwise approved by the Engineer. Application of the shotcrete may be delayed up to 24 hours if the ground nailing contractor can demonstrate that the delay will not adversely affect the excavation face stability. The contractor shall take precautions to prevent water from ponding near or infiltrating the face of the exposed excavation. Such precautions shall include temporary surface drainage measures and covering the exposed face of the excavation to prevent water infiltration.

The Contractor shall be prepared to manage overbreaks, soil sloughing from the cut face, and trimming or removing protrusions of cobbles and/or boulders beyond the line of the cut face. Soil sloughing out from behind the excavation neatline, thereby creating voids behind the finished shotcrete and/or undermining the ground nail wall shall not be allowed. The Contractor shall modify their means and methods to minimize or eliminate sloughing soil by placing an incidental lift of reinforced shotcrete prior to drilling ground nails or drilling ground nails through a temporary stabilizing berm or other methods approved by the Engineer. Overbreaks shall be backfilled with incidental shotcrete placed at the same time as the facing shotcrete or backfilled with flowfill contained behind the shotcrete with forms. Voids that may develop behind the shotcrete shall be filled with grout or shotcrete at no additional cost to the department.

Finished excavation and cut face exposures that will not receive shotcrete facing within the specified time limit must be stabilized by placing a temporary soil berm against the exposed face, placing a temporary shotcrete flash-coat, or other methods approved by the Engineer.

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Excavation of the next-lower lift shall not proceed until nail installation, reinforced shotcrete placement, attachment of bearing plates and nuts, expansion joints, contraction joints and nail testing have been completed and accepted in the current lift. Nail grout and shotcrete shall have attained 1,500 pounds per square inch and 2,000 pounds per square inch compressive strength, respectively, before excavation of the next underlying lift.

504.20 Nail Installation. Nail length and drill hole diameter used shall be that necessary to develop the load capacity to satisfy the acceptance criteria for the allowable bond strength required, but not less than the lengths or diameters shown on the plans. Holes shall be drilled for the ground nails at the locations, elevations, orientations, and lengths shown on the plans. Drilling equipment and methods shall be suitable for the ground conditions and conform to the accepted installation methods submitted by the ground nailing contractor. Drilling muds or other similar temporary fluids shall not be used to remove cuttings. If caving ground is encountered, cased drilling methods shall be used to support the sides of the drill holes. Nail bars shall be as shown on the plans. Centralizers sized to position the bar within 1 inch of the center of the drill hole shall be used. Centralizers shall be used as shown on the plans so that their maximum center-to-center spacing does not exceed 8 feet. Centralizers shall also be used within 1.5 feet from the top and bottom of the drill hole.

504.21 Grouting. The drill hole shall be grouted after installation of the nail bar and within 2 hours of completion of drilling. The complete ground nail installation, including drilling, nail placement and grouting shall occur within the same work shift. Drill holes shall not be left open overnight for completion during a subsequent shift. The grout shall be injected at the lowest point of each drill hole through a grout tube or casing. The outlet end of the conduit shall be kept from delivering grout below the surface of the grout as the conduit is withdrawn to prevent the creation of voids. The drill hole shall be completely filled in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test bond length of proof tested production nails. GCD's shall be used to prevent the loss of grout in the hole and to reduce the need for placing additional grout to fill the drill hole (topping off). GCD's may be eliminated in some areas, if the Contractor can demonstrate to the satisfaction of the Engineer that full grout levels are maintained in the drill holes without the need for topping off.

Nail grout shall be tested according to AASHTO T106 at a frequency of one test per mix design and a minimum of one test for every 52 cubic yards of grout placed. Grout cube test results shall be provided to the Engineer within 24 hours of testing.

504.22 Nail Testing. Both verification and proof testing of designated test nails shall be performed by the Contractor. Verification tests shall be performed on sacrificial test nails at locations selected by the Engineer near the approximate locations indicated on the Plans. The overall length of a given verification test nail shall be the same as the longest production nail adjacent to the test location. Proof tests shall be performed on production nails at locations selected by the Engineer or as shown on the plans. Testing of a nail shall not be performed until the nail grout and shotcrete facing have attained 1,500 pounds per square inch and 2,000 pounds per square inch compressive strength, respectively.

Testing equipment shall include 2 dial gauges, independent dial gauge reference beam, hydraulic jack with pressure gauge, electronic load cell, a reaction load frame, steel cribbing and timber cribbing. The pressure gauge shall be graduated in 100 pounds per square inch increments or less. The nail head movement shall be measured with a minimum of 2 dial gauges capable of measuring to 0.001 inch. The dial gauges and loading jack shall be capable of extending a sufficient length to complete the entire test without having to reset the gauges or jack. The reaction load frame and cribbing must be adequate to sustain the applied test loads without excessive deformation and shall be configured to apply no more than 3000 pounds per square foot reaction to the soil as

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uniformly as possible throughout the test (maximum test load). The testing equipment must be free from excessive hydraulic leaks. Frequent adjustments of hydraulic pressure, necessary to maintain the applied testing loads, as a result of reaction frame deformation, cribbing deformation or hydraulic leaks may be cause for suspending the ground nail test and retesting. Adjustments to the reaction frame, cribbing and/or repairs to the hydraulic equipment to prevent oil leaks will be required prior to retesting. All costs (including time) associated with these adjustments and repairs will be at the Contractor's expense.

504.23 Verification Testing Of Sacrificial Nails. Verification testing shall be performed prior to installation of production nails to confirm the appropriateness of the Contractor's drilling and installation methods, and verify the required nail pullout resistance.

Verification test nails shall have both bonded and unbonded lengths. Along the unbonded length, the nail bar shall not be grouted. The unbonded length of the test nails shall be at least 3 feet. The bonded length of the ground nail during verification tests, L_{BVT} , shall be at least 10 feet but not longer than a maximum length, L_{BVTmax} , such that the nail load does not exceed 90 percent of the nail bar tensile allowable load during the verification test. Therefore, the following requirements shall be met:

L_{BVT} shall be within the limits for L_{BVTmax} computed with $2.5 \leq FS_{Tver} \leq 3$, but never less than 10 feet minimum.

The length L_{BVTmax} is defined as:

$$L_{BVTmax} = (C_{RT} \cdot A_t \cdot f_y) / (Q_{ALL} \cdot FS_{Tver})$$

where,

- C_{RT} = Reduction coefficient. Use $C_{RT} = 0.9$ for Grade 60 and 75 bars. If the Engineer allows Grade 150 bars on the project, use $C_{RT} = 0.8$;
- A_t = Nail bar net cross-sectional area after threading;
- f_y = Nail bar yield tensile strength for Grade 60 and 75 bars or ultimate tensile strength if Grade 150 bars;
- Q_{ALL} = Allowable pullout resistance per unit length ($Q_{ALL} = Q_u / FS_p$), as specified on the plans with $FS_p = 2.0$ for static loads and 1.5 for seismic loads; and
- FS_{Tver} = Factor of safety against tensile failure during verification tests (use 2.5 or, preferably, 3).

The maximum bonded length shall be based on production nail maximum bar grade. Larger bar sizes shall be provided at no additional cost if required to meet the 10 foot minimum test bonded length requirement.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = L_{BVT} \cdot Q_{ALL}$$

The DTL shall be calculated based on the test nail's as-built bonded lengths.

Verification tests shall be performed by incrementally loading the verification test nails to failure or a maximum test load of 300 percent of the DTL in accordance with the following loading schedule. The ground nail movements at each load increment shall be recorded.

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Verification Test Loading Schedule

Load	Hold Time
0.05 DTL max.(AL)	1 minute
0.25 DTL	up to 10 minutes
0.50 DTL	up to 10 minutes
0.75 DTL	up to 10 minutes
1.00 DTL	up to 10 minutes
1.25 DTL	up to 10 minutes
1.50 DTL (Creep Test)	60 minutes
1.75 DTL	up to 10 minutes
2.00 DTL	up to 10 minutes
2.50 DTL (or pullout failure)	up to 10 minutes max.
3.0 DTL (or pullout failure)	up to 10 minutes max.
0.05 DTL max. (AL)	1 minute (record permanent set)

The alignment load (AL) shall be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the DTL. Dial gauges shall be set to “zero” after the alignment load has been applied. Following application of the maximum load (3.0 DTL) the load shall be reduced to the alignment load (0.05 DTL maximum) and the permanent set recorded.

Except for alignment and creep test load stage, each load increment shall be held for up to 10 minutes. Except for the alignment and creep test load stages, the ground nail movement indicated on the dial gauges shall be recorded at 1 and 5 minutes after full application of load. If the recorded movement between 1 and 5 minutes is stable (less than 0.01 inches) the test may proceed to the next load stage; otherwise, maintain the load until 10 minutes, record the ground nail movement and then proceed to the next load stage. The verification test nail shall be monitored for creep at the 1.50 DTL load increment. Nail movements shall be measured and recorded during the creep portion of the test in increments of 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. The load shall be maintained during the creep test within 2 percent of the intended load by use of the load cell.

504.24 Proof Testing Of Production Nails. Successful proof testing shall be performed on 5 percent of the production soil nails in each nail row or a minimum of 1 per row. The Engineer will determine the locations and number of proof tests prior to nail installation in each row unless otherwise shown on the plans. Production proof test nails shall have both bonded and temporary unbonded lengths. The temporary unbonded length of the test nail shall be at least 3 feet. The bonded length of the soil nail during proof production tests, L_{BPT} , shall be the least of 10 feet and a maximum length, $L_{BPT\ max}$, such that the nail load does not exceed 90 percent of an allowable value of the nail bar tensile load during the proof production test. Therefore, the following requirements shall be met:

L_{BPT} shall be between 10 feet, minimum, and $L_{BPT\ max}$.

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The length $L_{BPT\ max}$ is defined as:

$$L_{BPT\ max} = (C_{RT} \cdot A_t \cdot f_y) / (Q_{ALL} \cdot FS_{Tproof})$$

Where,

- C_{RT} = Reduction coefficient. Use $C_{RT} = 0.9$ for Grade 60 and 75 bars. If the engineer allows Grade 150 bars on the project, use $C_{RT} = 0.8$;
- A_t = Nail bar net cross-sectional area after threading;
- f_y = Nail bar yield tensile strength;
- Q_{ALL} = Allowable pullout resistance per unit length ($Q_{ALL} = Q_u / FS_p$), as specified on the plans with $FS_p = 2.0$ for static loads and 1.5 for seismic loads; and
- FS_{Tproof} = Factor of safety against tensile failure during proof production tests (use 1.5).

The maximum bonded length shall be based on production nail maximum bar grade. Production proof test nails shorter than 12 feet in length may be constructed with less than the minimum 10 foot bond length.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = L_{BPT} \times Q_{ALL}$$

The DTL shall be calculated based on as-built bonded lengths.

Proof tests shall be performed by incrementally loading the proof test nail to 150 percent of the DTL in accordance with the following loading schedule. The soil nail movements shall be recorded at each load increment.

Proof Test Loading Schedule.

Load	Hold Time
0.05 DTL max. (AL)	1 minute
0.25 DTL	Until Movement Stabilizes
0.50 DTL	Until Movement Stabilizes
0.75 DTL	Until Movement Stabilizes
1.00 DTL	Until Movement Stabilizes
1.25 DTL	Until Movement Stabilizes
1.50 DTL	Creep Test (see below)
0.05 DTL max. (AL)	1 minute (record permanent set)

The alignment load (AL) should be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the DTL. Dial gauges shall be set to “zero” after the alignment load has been applied.

The creep period shall start as soon as the maximum test load (1.50 DTL) is applied and the nail movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. Where the nail movement between 1 minute and 10 minutes exceeds 0.04 inch, the maximum test load shall be maintained for an additional 50 minutes and

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movements recorded at 20 minutes, 30, 50, and 60 minutes. All load increments shall be maintained within 5 percent of the intended load.

504.25 Test Nail Acceptance Criteria. A test nail shall be considered acceptable when all of the following criteria are met:

- (1) For verification tests, the total creep movement is less than 0.08 inch between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
- (2) For proof tests, the total creep movement is less than 0.04 inch during the 10-minute readings or the total creep movement is less than 0.08 inch during the 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
- (3) For verification and proof tests, the total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length.
- (4) A pullout failure does not occur at 2.0 DTL under verification testing and 1.5 DTL test load under proof testing. Pullout failure is defined as the inability to further increase the test load while there is continued pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

The Contractor shall maintain the stability of the hole for the temporary unbonded test length for subsequent grouting. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing, the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at the Contractor's expense.

504.26 Test Nail Rejection. If a test nail does not satisfy the acceptance criterion:

- (1) For verification test nails, the Engineer will evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements will be rejected. The Contractor shall propose alternative methods and install replacement verification test nails. Replacement test nails shall be installed and tested at the Contractor's expense.
- (2) For proof test nails, the Engineer may require the Contractor to replace some or all of the installed production nails between a failed proof test nail and the adjacent passing proof test nail. Alternatively, the Engineer may require the installation and testing of additional proof test nails to verify that adjacent previously installed production nails have sufficient load carrying capacity. Installation and testing of additional proof test nails or installation of additional or modified nails as a result of proof test nail failures shall be at the Contractor's expense.

504.27 Wall Drainage Network. All elements of the wall drainage network shall be installed and secured as shown on the plans. The drainage network shall consist of installing geocomposite drain strips and a 6 inch perforated pipe underdrain as shown on the plans. Exclusive of the 6-inch perforated pipe underdrain all elements of the drainage network shall be installed prior to shotcreting.

- (a) *Geocomposite Drain Strips.* Geocomposite drain strips shall be centered between the columns of nails as shown on the Plans. The drain strips shall be at least 12 inches wide and placed with the geotextile side against the ground. The strips shall be secured to the excavation face and shotcrete prevented from contaminating the geotextile. Drain strips shall be vertically continuous. Splices shall be made with a 12 inch minimum overlap such that the flow of water is not impeded. Drain plate and connector pipe shall be installed at the base of each strip as shown on the plans. Damage to the geocomposite drain strip which may interrupt the flow of water shall be repaired.

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(b) *Footing Drains.* Footing drains shall be installed at the bottom of each wall as shown on the plans. The drainage geotextile shall envelope the footing drain aggregate and pipe and conform to the dimensions of the trench. The drainage geotextile shall overlap on top of the drainage aggregate as shown on the plans. Damaged or defective drainage geotextile shall be repaired or replaced.

504.28 Shotcrete Facing. Construction shotcrete facing and permanent shotcrete facing (if required) shall be installed in accordance with Section 641. Where shotcrete is used to complete the top ungrouted zone of the nail drill hole near the face, the nozzle shall be positioned into the mouth of the drill hole to completely fill the void.

- (a) *Overspray.* All surrounding features, including grading and vegetation shall be protected from shotcrete overspray. Any overspray applied to these features, including grading and vegetation shall be removed at the Contractor's expense.
- (b) *Final Face Finish.* Shotcrete finish shall be either an undisturbed gun finish as applied from the nozzle or a rod, broom, wood float, rubber float, steel trowel or rough screeded finish as shown on the Plans.
- (c) *Attachment of Nail Head Bearing Plate and Nut.* Bearing plate, washers, and nut shall be attached to each nail head as shown on the plans. While the shotcrete construction facing is still plastic and before its initial set, the plate shall be uniformly seated on the shotcrete by hand-wrench tightening the nut. Where uniform contact between the plate and the shotcrete cannot be provided, the plate shall be set in a bed of grout. After grout has set for 24 hours, the nut shall be hand-wrench tightened. Bearing plates shall be located within the tolerances shown on the Plans.
- (d) *Shotcrete Facing Tolerances.* Construction tolerances for the shotcrete facing from plan location and plan dimensions are as follows:

Horizontal location of welded wire mesh; reinforcing bars, and headed studs: ½ inch

Location of headed studs on bearing plate: ¼ inch

Spacing between reinforcing bars: 1 inch

Reinforcing lap, from specified dimension: 1 inch

Complete thickness of shotcrete: If troweled or screed: 0.6 inch; If left as shot: 1.2 inch

Planeness of finish face surface-gap under 10 foot straightedge: If troweled or screed: 0.6 inch; If left as shot: 1.2 inch

Nail head bearing plate deviation from parallel to wall face: 10 degrees

504.29 Forms And Falsework. Forms and falsework shall conform to subsections 601.09 and 601.11 respectively.

504.30 Reinforcing Steel. Reinforcing steel shall be installed in accordance with Section 602.

504.31 Structural Concrete. Structural concrete shall be placed in accordance with Section 601.

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504.32 Architectural Surface Finishes. The Contractor shall design and furnish textured form liners, install form liners, and apply a surface finish (color or stain application) that will duplicate the pattern shown on the plans. Detailed drawings of the form liner shall be submitted for approval by the Engineer in accordance with Subsection 105.02. Before production work begins, a 3 foot high, by 1.5 foot wide, 10 foot long test panel shall be constructed on site using the same forming methods, procedures, form liner, texture configuration, expansion joint, concrete mixture and color or stain application proposed for the production work. Production work shall not begin until the Engineer has approved the test panel.

504.33 Backfilling Behind Wall Facing Upper Cantilever. Backfill shall be relatively free draining granular material compacted within 3 feet behind the wall facing upper cantilever using light mechanical tampers.

504.34 Acceptance. Material for the ground nail retaining wall will be accepted based on the manufacturer production certification or from production records. Construction of the ground nail retaining wall will be accepted based on visual inspection and the relevant production testing records.

METHOD OF MEASUREMENT

504.35 Ground nail retaining walls will be measured by the quantity installed and accepted. Verification testing of ground nails will not be measured separately but shall be considered incidental to construction of the ground nailed wall. The final pay quantity will be the design quantity increased or decreased by any changes authorized by the Engineer

For purpose of measurement, ground nails must be installed, tested and accepted to be considered complete. .

BASIS OF PAYMENT

504.36 The accepted quantity, measured as provided above, will be paid for at the contract unit price per each for the pay items listed below that are shown on the bid schedule. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Ground Nail (10 Foot)	Each
Ground Nail (15 Foot)	Each

Payment for Ground Nail Wall will be full compensation for all work and materials required to complete the item exclusive of any facing items that may be tabulated on the plans. Accordingly, this work shall include, but is not limited to, structure backfill within six feet of the wall layout lines, drilling, grouting, ground nails, verification tests, proof tests, grout containment devices, bearing plates, end hardware (nuts, washers), survey and incidentals necessary to acceptably fabricate and construct the ground nail walls.

All excavation work, including structure excavation and rock excavation required to construct the ground nails and reinforced shotcrete to the lines and grades indicated on the plans will be paid for in accordance with Section 203 Unclassified Excavation.

Geocomposite strip drains, shotcrete, incidental shotcrete to fill overbreak, incidental flowfill to fill overbreak and all shotcrete steel reinforcement delineated in the plans will be paid for in accordance with Section 641 Shotcrete.

The 6 inch perforated pipe underdrain will be paid for in accordance with Section 605.

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Reinforced Concrete (Class D) shown on the plans will be paid for in accordance with Section 601 Concrete (Class D) (Wall) and Section 602 Steel Reinforcement.

REVISION OF SECTION 504 FACING (SPECIAL)

Section 504 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

504.06 This work consists of constructing a MSE (Mechanically Stabilized Earth) Retaining Wall System with welded wire mesh facing above a ground nail wall at the locations and to the lines and grades shown on the plans. Either metallic or geosynthetic reinforcement as specified in this specification may be used as MSE reinforcement in the reinforced structure backfill zone.

MATERIALS

504.07 Shop Drawings. The Contractor shall submit six sets of shop drawings and certified material test reports for review prior to construction of the MSE retaining wall system. See subsection 504.12 for a complete list of submittal requirements. Shop drawings shall be submitted in accordance with subsection 105.02.

The shop drawings shall provide the details necessary to demonstrate compliance with the Contract, including:

- (a) *MSE Retaining Wall Layouts.* Layouts shall conform to the lines and grades on the plans including start, corner, and end stations, elevation changes at foundation steps, total quantity of wire mesh facing units and top and bottom of MSE retaining wall elevations. For MSE retaining walls with rail anchoring slabs, the top of the wire mesh facing units shall be within 2 inches of the bottom of the anchoring slab. The construction batter required to achieve the batter shown on the plans shall be shown on the shop drawings. The contractor's retaining wall vendor shall provide the shop drawings and certified material test reports for the MSE retaining wall system materials that are required for construction of the MSE retaining walls with wire mesh facing.
- (b) *Wire Mesh Facing Reinforcement Locations.* Unless otherwise shown on the plans, each layer of soil reinforcement shall be connected to the wire mesh facing units. The wire mesh facing unit placement sequence shall be shown. The facing unit to facing unit connections, facing unit cut limits and other details, necessary to prevent the loss of backfill while maintaining the MSE wall alignment on straight and curved segments, corners and utility blockouts shall be shown.
- (c) *Wall Elevations.* The actual reinforcement elevations shall be marked on the shop drawings by taking into account the supplied facing unit height and number of reinforced layers.
- (d) *Soil Reinforcement Material for MSE.* The soil reinforcement type, minimum average roll value of the ultimate tensile strength, T_{ULT} (MARV), for geosynthetic soil reinforcement or yield strength for metallic soil reinforcement, spacing, lengths, elevations, and the corresponding wall design height segments shall be shown on the shop drawings. The starting and ending stations for change in grade of reinforcement material shall be shown for walls with different grade of reinforcement material at the same elevation. Material grade shall be clearly identified on each roll of reinforcement to avoid errors in placement. Elevations of the reinforcement layers shall be as specified on the shop drawings.
- (e) *Soil Reinforcement Length (RL).* The soil reinforcement length shall be measured from the front face of the wire mesh facing unit or wrapped backfill to the end of the soil reinforcement. The end of the soil reinforcement is defined as the last cross member for geogrid or metal mesh materials. Except for secondary reinforcement, soil reinforcement lengths shall not be less than the lengths specified on the plans.

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(f) *Soil Reinforcement Spacing for MSE Retaining Walls.*

1. The first (bottom) layer of soil reinforcement shall be placed at the base of the bottom wire mesh facing.
2. The last (top) layer of soil reinforcement shall not exceed 24 inches, below the top of the uppermost wire mesh facing unit for MSE retaining wall.
3. The vertical spacing between layers of adjacent MSE soil reinforcement shall be 24 inches or less. For MSE tributary strength computations, the top row of reinforcement shall be one-half the vertical spacing immediately below the top of the wall.

(g) *Long Term Design Strength (LTDS) of MSE Retaining Wall Reinforcement.*

1. Calculate the applied horizontal earth pressure in the zone of mechanical reinforcement (reinforced zone) at the soil reinforcement elevations using the AASHTO 6th edition LRFD Bridge Specification, Article 11.10.6.2 for service loading (load factor equal to 1.0) and the tributary distance between neighboring soil reinforcements. Use a soil unit weight of 140 pounds per cubic foot, a uniform vertical surcharge pressure of 250 pounds per square foot and an internal friction angle of 34 degrees for the calculations. The LTDS of the soil reinforcement as determined below for each soil reinforcement layer shall be greater than the applied horizontal earth pressure.
2. Metallic (Inextensible) Soil Reinforcement. The steel cross-sectional area at the soil reinforcement connection to the wire mesh facing shall be used in the sacrificial steel thickness calculation. An allowable stress of $0.55 f_y$ shall be applied to the net steel area (at the end of 75 years) to determine the LTDS for metallic soil reinforcements. The following corrosion rates shall be applied to the metallic soil reinforcements to determine the net steel area at the end of 75 years:

Galvanization loss	0.58 mil per year for first 2 years 0.16 mil per year for subsequent years
Carbon steel loss	0.47 mil per year after zinc depletion

3. Geosynthetic (Extensible) Soil Reinforcement. Geosynthetic soil reinforcement shall be a geogrid or woven geotextile. For polyester (PET), polypropylene (PP), and high-density polyethylene (HDPE) reinforcement, the LTDS of material shall be determined using the following K percentages to ensure the required design life. Unless otherwise specified, LTDS shall not exceed the following K percent of its ultimate tensile strength, T_{ULT} (MARV), i.e.

$$LTDS = K * T_{ULT} (MARV)$$

- (1) Geogrid reinforcement (HDPE, PET):

Products	K
Tensor	20%
Fortrac, Miragrid, Strata, Synteen and Raugrid	24%

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(2) All products not listed above:

Products	K
All geogrid or woven geotextile products meeting AASHTO 6th edition LRFD Bridge Specification, Table 11.10.6.4.2b-1.	10%
Products not meeting AASHTO 6th edition LRFD Bridge Specification, Table 11.10.6.4.2b-1 including non-woven geotextile products.	5%

- (h) *Design Heights and Supplied Reinforcing Material.* Unless otherwise defined on the plans, the wall design height shall be measured vertically from the bottom of the lowest wire mesh facing unit to the top final grade above the walls. For both geosynthetic and metallic reinforcement, the required reinforcement LTDS and the supplied LTDS (determined in accordance with the K factors or depletion of material as defined above) with corresponding brand and grade of material shall be marked clearly on the elevation view or in a tabulation summary. The LTDS of the supplied reinforcement grade must meet or exceed the required LTDS corresponding to the reinforcement spacing provided.
- (i) *Obstructions.* Details for the placement of soil reinforcement around obstructions (i.e. steel piles, concrete piers, concrete boxes, pipes, poles, etc.) shall be shown on the shop drawings. Design calculations shall be provided showing that the internal stability of the wall meets the required safety factors in the area of the obstruction.
- (j) *Table of Quantities.* A table comparing the Structural Backfill (Class 1), Mechanical Reinforcement of Soil, and Wire Mesh Facing quantities shown on the plans to the quantities shown in the shop drawings and percent difference (positive percent indicates an increase in shop drawing quantities from the plans) shall be shown on the shop drawings. Structure Backfill (Class 1), Mechanical Reinforcement of Soil, and Wire Mesh Facing quantities shall be calculated in accordance with the Contract. The Contractor shall notify the Engineer of the difference in plan and shop drawing quantities before wall construction begins.
- (k) *Geomembrane Placement Schedule.* Geomembrane placement schedule and clearances to soil reinforcements shall be shown.
- (l) *Shotcrete Reinforcement Attachments.* Attachments to the shotcrete reinforcements shall connect to the welded wire facing and extend into the shotcrete section as shown in the plans. The attachments shall occur at the minimum frequencies both laterally and vertically as shown in the plans. Alternative shotcrete reinforcement attachments shown on the plans may be used by the Contractor. A detailed layout of the alternative attachment shall be provided by the Contractor and approved by the Engineer prior to use on the project.

504.08 Backfill. Wall backfill material in the reinforced structure backfill zone and the *associated* trapezoidal retained structure backfill zone shall conform to the requirements for Structure Backfill (Class 1) of Section 206. For reinforcement tensile stress and associated pullout, a friction angle of 34 degrees shall be assumed for Structure Backfill (Class 1). Structure Backfill (Class 1) shall be considered to be non-aggressive soil for corrosion and durability computations. All reinforcing elements shall be designed to ensure a minimum design life of 75 years for permanent structures.

504.09 Leveling Pad. A concrete leveling pad is not required; however, the ground below the first wire mesh facing unit shall be compacted and level to the lines and grade shown on the plans. Unless specified on the

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plans, the maximum vertical step between adjacent wire mesh facing units shall be no greater than 12 inches.

504.10 Facing (Special). Facing (Special) shall consist of welded wire fabric formed by a 90 degree bend on the wire reinforcement and contain an interlock system to connect with adjacent facing units above and below. The reinforcing mesh shall be shop fabricated of cold drawn steel wire and shall be welded into a finished mesh fabric. The welded steel wire fabric shall be hot dip galvanized at minimum rate of 2.0 ounces per square foot. Any damage done to the mesh galvanization shall be replaced or repaired in an acceptable manner at no additional cost to the Department. Wire mesh facing shall be designed and constructed to create a stiff facing element without bulging of the final wall face. Additional layers of welded wire fabric (backing mat) may be installed at the front of the facing unit per manufacturer's recommendations. Metallic hardware cloth conforming to ASTM A-740 and geotextile separator Class 1 shall be placed between the backfill and wire mesh facing to retain soil per manufacturers recommendations.

504.11 Geomembrane. A Geomembrane shall be installed on all walls at the top of the reinforced structure backfill zone and retained structure backfill zone to intercept surface runoff and prevent salt penetration into the backfill of the wall as shown on the plans. The Geomembrane shall meet the requirements of subsection 712.07 for geomembrane, and shall have a minimum thickness of 30 mils. It shall be spliced with a dual track field seamed joint in accordance with ASTM D4437 or ASTM D7717. For small local coverage areas, less than 30 square feet, the geomembrane may be spliced using a 6 inch minimum overlap and an adhesive or a single seam portable thermal welding tool, as suggested by the geomembrane manufacturer and approved by the Engineer. Unless otherwise shown on the plans, the geomembrane shall extend a minimum distance from the wall face equal to the wall height plus Soil Reinforcement Length (RL) plus 1.5 feet from the beginning to the end of the wall. The geomembrane shall be installed with a slope between 20:1 (minimum) and 10:1 (maximum), as shown on the plans, from the back of the facing elements to a drainage system located at the cut or pre-filled slope as shown on the plans.

The drainage system shall consist of a 12 inch wide geocomposite strip drain inserted into a slot in the geomembrane, at 10 foot maximum spacing, that collects the water from the membrane and conveys it to a water collector system at the toe of the 1:1 slope as shown on the plans. The water collector system shall consist of a 6 inch diameter perforated collector pipe surrounded by Filter Material Class B and wrapped with Class 3 Geotextile. A 6 inch diameter non-perforated drain pipe, shall be used to discharge the water in the water collector system out the end of the wall as shown in the plans.

Alternatives for the drainage system shown on the plans may be used by the Contractor. A detailed layout of this equivalent water collection system shall be provided by the Contractor and approved by the Engineer.

504.12 Certifications, Calculations and Testing Reports. The Contractor shall provide the following reports, certifications, calculations (for static loading only, seismic loading is not required) and checklists as needed to accompany the shop drawing submittal. All engineering calculations, as stated in subsections 504.07(g), 504.07(h), 504.07(i), 504.07(j), 504.12(b) and 504.12(d) shall be certified and stamped by a Professional Engineer licensed in the State of Colorado.

- (a) *Certification of T_{ULT} (MARV) or Ultimate Tensile Strength.* For geo-synthetic reinforced systems only, the Contractor shall submit a certification letter from the manufacturer which provides the T_{ULT} (MARV) and certifies that the T_{ULT} (MARV) of the supplied materials have been determined in accordance with ASTM D4595 or ASTM D6637 as appropriate. For metallic wall reinforcement, a mill test report containing the ultimate tensile strength for the soil reinforcement shall be included in the certification.

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- (b) *Report Of The Wire Mesh Facing to Soil Reinforcement Connection.* A certificate demonstrating that the wire mesh facing and soil reinforcement connection is sufficient for the required long term tensile loading from soil and live loads and the short term construction induced loading with supporting calculations.
- (c) *Report For Soil To Reinforcement Interface Pullout Test.* For MSE retaining walls, the test report shall be prepared and certified by an independent laboratory. The soil to reinforcement interface pullout test method shall conform to the requirements of ASTM D6706. Tests shall include the full range of overburden pressures as defined by the wall design heights.
- (d) *Certification of Reinforcement Pullout.* A certification shall be provided with detailed calculations to demonstrate that reinforcement pullouts meet or exceed the AASHTO 6th edition LRFD Bridge Specification, Article 11.10.6.3 using service loads (load factor equal to 1.0) and a resistance factor of 0.65.
- (e) *Report For Wire Mesh Facing.* A report certifying that the wire mesh facing elements were fabricated in accordance to AASHTO M 55 or ASTM A 1064 from cold drawn steel wire with minimum yield strength of 65 ksi and hot dipped galvanized per AASHTO M 111 or ASTM A 123, at 2 ounces per square foot.

CONSTRUCTION REQUIREMENTS

504.13 Approval and Qualifications of MSE Retaining Wall Installer. The job site wall foreman shall have experience in construction of at least five transportation related MSE retaining walls within the last three years. Transportation related MSE retaining walls are walls that carry or are adjacent to vehicular traffic and are constructed with soil reinforcement in the reinforced structure backfill zone. The foreman must have prior experience or adequate training on the products that the Contractor elects to use on the project. The resume and credentials of the foreman shall be submitted to the Engineer for approval prior to the pre-construction meeting. The foreman shall be on the site for 100 percent of the time during which the wall is being constructed.

504.14 Excavation and Backfill. The prepared subgrade surface at the base of the MSE retaining walls shall receive the same compaction as cut areas required by subsection 203.07. The Contractor shall report to the Engineer in writing density test results for any unsatisfactory bearing material not meeting the minimum 90 percent compaction for walls less than 16 feet high and 95 percent of T-180 for walls higher than 16 feet. If the excavation for the placement of the leveling pad exposes an unsatisfactory bearing material, the Engineer may require removal and replacement of that material. The removed material shall be replaced with Structure Backfill (Class 1) compacted in conformance with subsection 206.03. The Engineer with the assistance of the geotechnical engineer of record will provide the limits including the depth of removal. As directed by the Engineer, and if required, Structure Backfill (Class 1) shall be reinforced with soil reinforcements in conjunction with wick drains and outlet pipes.

The Contractor shall grade the foundation for the bottom of the wall for a width equal to or exceeding the limits of the Reinforcement Length (RL) plus 18 inches as shown on the plans. This graded area shall be compacted with an appropriate vibratory roller for at least five passes or as directed by the Engineer. For cut wall with continuous seepage, phasing of foundation construction or a different drainage and foundation improvement plan may be necessary.

The reinforced structure backfill zone and the retained structure backfill zone portion immediately behind the wall as defined on the plans shall be Structure Backfill (Class 1). Recycled asphalt, recycled concrete and flow-fill material shall not be substituted for Structure Backfill (Class 1). The triangular or trapezoidal portion behind the wire mesh facing, shall be filled with $\frac{3}{8}^+$ inch crushed rock, filter aggregates with filter fabric, or wall system

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specific fill recommended by the MSE retaining wall supplier, as approved by the Engineer. Density tests behind and parallel to the wall in the triangular or trapezoidal portion above the backfill spill zone are not required. Each compacted layer of backfill shall not exceed 8 inches and shall be roughly level. The fill and compaction operation shall start 3 feet from the wall back face and progress toward the end of the reinforcement. All Structure Backfill (Class 1) including fill material under the wall and on-site material as allowed under subsection 504.08 shall be compacted to a density of at least 95 percent of the maximum density as determined according to AASHTO T 180. For on-site foundation material containing more than 30 percent retained on the $\frac{3}{4}$ inch sieve, a method of compaction consisting of a conventional heavy vibratory roller starting with minimum 5 passes shall be used to establish the number of passes required to exceed the 95% T180 density requirement.

At least 6 inches of material shall be in place prior to operation of tracked vehicles over soil with reinforcement. Only power operated roller or plate compaction equipment weighing less than 1,000 pounds is allowed within 3 feet of the front face of the wall. The reinforcement shall not be connected to the wall until the compacted fill is at or slightly higher than the location of the connector.

Backfill containing frost or frozen lumps shall not be used. Backfill that has been placed and becomes frozen shall be removed and replaced at the Contractor's expense. If cold weather conditions prevent the placement of Structure Backfill (Class 1), the Contractor may use Filter Material Class B as backfill without compaction at the Contractor's expense and approved by the Engineer. The Contractor shall provide a test report, prepared and certified by an independent laboratory, that the internal friction angle of soil for the Filter Material Class B meets or exceeds that shown on the plans.

The Contractor shall place additional wire mesh facing including partial facing and properly compacted fill material to return the finished grade to the plan elevations if settlement, as determined by the Engineer, has occurred. A final inspection before the installation of rail anchoring slab will be made after construction settlement, if any, has occurred or 30 days after the completion of the wall. The Contractor shall provide immediate temporary storm water protection and wind erosion control at the end of each day during construction. If settlement occurs as the result of loss of backfill due to wind or water erosion, non-conforming backfill such as frozen fill or over-saturated fill, or if the backfill does not meet compaction requirements, the Contractor shall remove the backfill, wash the soil reinforcement, and bring the elevation to the finished grade at the Contractor's expense. Before final project acceptance, the Contractor shall repair any backfill losses due to wind and water erosion.

To avoid the foundation soil beneath the MSE retaining wall from being washed out by rain, reinforced shotcrete shall be placed in front of the wall as soon as practicable.

504.15 Reinforcement. Steel reinforcement shall be slack free and geosynthetic reinforcement shall be slightly pre-tensioned. The minimum coverage ratio for geogrid reinforcement shall be 67 percent and the spaces between rolls shall be staggered between layers of soil reinforcement. The minimum coverage ratio for woven fabric reinforcement shall be 100 percent and an overlap between rolls is not required. Woven fabric sheet reinforcement shall wrap the structure backfill in maximum 12 inch lifts with a minimum 2 foot return. Soil reinforcement shall not be cut to avoid obstructions unless shown on the shop drawings.

504.16 Wire Mesh Facing. Place wire mesh facing, shotcrete reinforcement attachments, hardware cloth and geotextile separator in successive horizontal lifts as backfill placement proceeds. Connect, tighten, wrap and anchor soil reinforcement elements and shotcrete reinforcement attachments to the wire mesh facing units before placing backfill. Do not exceed an individual lift vertical tolerance and an overall wall (top to bottom) vertical tolerance of 1 inch per 10 feet of wall height. Place reinforcement elements within 1 inch vertically above the corresponding

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connection elevation at the wall face. Do not place reinforcing elements below the corresponding connection elevations. Do not deviate from the designed batter of the wall by more than 1 inch per 10 feet of wall height. Do not deviate more than 2 inches at any point in the wall from a 10-foot straightedge placed horizontally on the theoretical plane of the design face. Place and compact backfill in maximum 8 inch lifts without creating outward bulging of the facing elements. Design and construct the MSE walls as shown on the Plans. Terminate the wire mesh facing used for MSE retaining walls at the beginning and end of each lift with a minimum 4 feet return of the wire mesh facing back into the backfill.

METHOD OF MEASUREMENT

504.17 MSE retaining walls will not be measured for payment in the field, but will be paid for by the calculated quantities shown on the plans for the seven major components of the wall: structure excavation, structure backfill, facing (special), mechanical reinforcement of soil, and geomembrane. Temporary wall system elements or shoring that is necessary for construction of the MSE retaining walls, such as due to construction phasing, shall be paid for under shoring. The Contractor's construction of a system that requires increased or decreased quantities of any of the components to complete the wall to the dimensions shown will not result in a change in pay quantities. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies on the plans in an amount of at least plus or minus five percent of the plan quantity.

- (1) The wire mesh facing quantity was calculated for the square foot of wall front face area from the bottom to the top of the wire mesh facing as shown on the plans. The 4 foot wire mesh facing returns at the beginning and end of the wire mesh facing lifts are not measured.
- (2) The structure excavation quantity was calculated for the total volume of earth to be removed before the installation of the reinforced zone as shown on the plans.
- (3) The structure backfill quantity was calculated for the total volume behind the wall (the retained structure backfill zone) including the material in the reinforced zone as shown on the plans.
- (4) The mechanical reinforcement of soil quantity was calculated for the total volume of the reinforced zone as shown on the plans.
- (5) Geomembrane was calculated based as the product of the MSE wall length and the soil reinforcement length (RL) plus 1.5 feet, disregarding the slope of the membrane.

The square foot and cubic yard quantities computed for payment are the wall plan quantities based on the height measured at 20 foot maximum intervals along the wall layout line.

BASIS OF PAYMENT

504.17 The accepted quantities will be paid for at the contract unit price per unit of measurement for the pay items listed below:

Payment will be made under:

Pay Item
Facing (Special)

Pay Unit
Square Foot

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FACING (SPECIAL)

Structure excavation will be paid for under the Section 206 Pay Item Structure Excavation. Structure backfill will be paid for under the Section 206 Pay Item Structure Backfill (Class 1). Soil reinforcement will be paid for under the Section 206 Pay Item Mechanical Reinforcement of Soil. Geomembrane will be paid for under the Section 420 Pay Item Geomembrane. Perforated pipe underdrain will be paid for under the Section 605 6-inch Perforated Pipe Underdrain. Non-perforated pipe outlet will be paid for under Section 605 Subsurface Drain Outlet.

Rail anchoring systems (slabs) at the tops of walls will be measured and paid for separately under the Section 601 Pay Item Concrete and the Section 602 Pay Item Reinforcing Steel.

Payment will be full compensation for all work and materials required to construct the wire mesh facing MSE retaining wall. Miscellaneous items such as, shotcrete reinforcement attachments, geocomposite strip drains located between the geomembrane and the underdrain, geotextile separator material used at the facing elements, facing fill placed adjacent to the facing elements that may be required by the retaining wall system manufacturer, pins, struts used to stabilize the facing elements, hog rings, etc., will not be measured and paid for separately but shall be included in the work.

**REVISION OF SECTION 513
BRIDGE DRAIN**

Section 513 is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

513.01 This work shall consist of furnishing and placing bridge drains in accordance with the details shown on the plans and the specifications.

MATERIALS

513.02 Pipe for bridge drains shall meet the requirements of ASTM A53 and shall be standard weight.

Down spout pipe shall be hot dipped galvanized after fabrication. Galvanizing shall meet the requirements of AASHTO M111.

Metal used in the manufacture of castings shall meet the requirements of ASTM A48 Class 35B.

CONSTRUCTION REQUIREMENTS

513.03 Bridge drains shall be placed and secured at the locations shown on the plans prior to placement of concrete.

Prior to fabrication of this item, two sets of working drawings which comply with the requirements of Section 105 shall be submitted to the Engineer for information only. The working drawings will not be approved or returned.

METHOD OF MEASUREMENT

513.04 Bridge drains are to be measured will be the number of bridge drains used and accepted.

BASIS OF PAYMENT

513.05 The accepted quantities of bridge drains will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item

Bridge Drain (8 Inch)

Pay Unit

Each

**REVISION OF SECTION 514
PEDESTRIAN RAILING (STEEL)**

DESCRIPTION

Section 514 of the Standard Specifications is hereby deleted for this project and replaced with the following:

514.01 This work shall include all necessary work and material required to install pedestrian railing as shown on the Drawings.

MATERIALS

514.02 Steel shall conform to the requirements of Section 509 and the following:

1. Tubes shall conform to the requirements of ASTM 500.
2. Steel plates and bars shall conform to the requirements of ASTM A36.
3. Bolts shall conform to the requirements of ASTM A307.
4. Zinc coating shall conform to the requirements of ASTM A123, A153, A385 and A386.

Welding shall conform to the American Welding Society Structural Welding Code – Steel, D1.1.

Shop Drawings: Shop drawings shall be submitted in accordance with 105.02 of the Standard Specifications. The Contractor shall submit shop drawings of all pedestrian metal railing fabrications to Engineer for approval, showing sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other trades, shop paint and protective coatings and other pertinent details of fabrication and installation.

1. The shop drawings shall indicate profiles, sizes, connection attachments, reinforcing, anchorage, openings, size and type of fasteners and any accessories.
2. The shop drawings shall include erection drawings, elevations, applicable details and field dimensions.
3. The shop drawings shall indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

Samples: The Contractor shall submit duplicate samples of all materials to be furnished under this section as requested by Engineer.

1. One sample panel will be erected in full prior to mass fabrication of the entire quantity called for.
2. Do not order materials or begin fabrication until Engineer's approval of submittals has been obtained.
3. Furnish to the Engineer a certified statement that the shop-applied finishes conform to these Specifications, including compliance with application thickness and adhesion.
4. Live loads shall be not less than the minimum required by code. Where specific live loads are not set forth in the codes applicable to the work, and are not given on the Drawings, designs shall be such as to support live loads without deflection of more than L/360 of length of any member and without permanent deformation, all with a safety factor of not less than 2.5 to 1.
5. Rail panel sections shall slope with sidewalk.

Immediately before painting, remove rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with SSPC-SP6 commercial sandblast treatment.

Steel elements shall then be painted with a two-coat inorganic zinc polyurethane paint system as specified in Section 708 except that the minimum dry film thickness of the top coat shall be 4.0 mils.

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**REVISION OF SECTION 514
PEDESTRIAN RAILING (STEEL)**

The top coat shall be in conformity with subsection 509.24. Dark brown paint shall be manufactured to meet Fed. Spec. TT-E-529G and the color shall match Fed. Std. 529a, No. 20059.

CONSTRUCTION REQUIREMENTS

514.03 Materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned both prior to and after erection.

Work shall be erected square, plumb and true, accurately fitted, and with tight joints and intersections. All anchors, inserts, and other members to be set into concrete or sandstone base shall be furnished loose by this trade to be built into concrete by those trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.

Materials shall be new stock, free from defects impairing strength, durability or appearance, and of best commercial quality for each intended purpose.

1. All steel members shall be fabricated of structural steel conforming to ASTM A 36.
2. Steel strapping, wire fabric, rails and posts shall be fabricated in a single panel and fastened to posts as detailed.

Connections shall be continuous-welded type for rigid construction, with weld ground smooth. Welding shall conform to applicable requirements of AWS D1.1.

Provide all anchors, bolts, plates and other parts required for securing each item of work of this Section of the construction. Furnish required anchors, bolts and other items required for installation on concrete.

Exposed fasteners shall be of the same material and finish as the metal to which applied, unless otherwise noted.

Metal surfaces shall be clean and free from mill scale, flake, rust, and rust pitting, well-formed and finished to shape and size, true to details with straight, sharp lines and angles and smooth surfaces. Exposed sheared edges shall be eased.

All permanent connections shall be welded. All welds shall be continuous on all exposed surfaces, exposed welds shall be ground flush and smooth with voids filled with metallic filling compound. Tack-welding will be permitted where specifically called for. Screws and bolts will not be permitted, unless otherwise approved by the Engineer in locations where welding is not possible. Where used, heads shall be countersunk, screwed up tight and threads nicked to prevent loosening.

Fastenings shall be concealed where practical. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.

Contractor shall perform all cutting, punching, drilling, and tapping required for attachment of hardware and of work of other Sections where so indicated or where directions for same are given prior to, or with approval of shop drawings.

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**REVISION OF SECTION 514
PEDESTRIAN RAILING (STEEL)**

Pedestrian rail shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration or noticeable deflection during construction.

All steel shall comply with Section 514 of the Standard Specifications. Exceptional care shall be taken in welding and grinding, filing and surface sanding to provide truly smooth, clean, neat and flush construction throughout, free of all surface defects and defacements.

The Contractor shall remove and replace work at no additional cost to the project for work of this section which is improperly located or is not true to line, grade and plumb within tolerances and indicated.

The Contractor shall repair damaged components and finishes as recommended by the manufacturer and as indicated herein.

METHOD OF MEASUREMENT

514.05 Pedestrian Railing shall be measured and paid for by the linear foot from end to end of metal rail sections, as shown on the Drawings.

BASIS OF PAYMENT

212.06 The accepted quantities of the various types of rail measured as provided above will be paid for at the Contract unit price per linear foot, which shall be full compensation for all labor, equipment and materials including embedded anchorages, painting, installation and adjustment, required to complete the item.

Payment will be made under:

Pay Item

Pedestrian Railing (Steel)

Pay Unit

Linear Foot

**REVISION OF SECTION 515
CONCRETE SEALER (CALCIUM NITRITE)**

Section 515 of the Standard Specifications is hereby revised for this project as follows:

Subsection 515.01 shall include the following:

This work consists of applying a penetrating corrosion inhibitor to finished surfaces of existing concrete or to cut surfaces of existing concrete prior to placement of new concrete. The corrosion inhibitor shall be placed under the direction of a manufacturer's representative in accordance with the manufacturer's instructions and as described herein.

Subsection 515.02 shall include the following:

The corrosion inhibitor shall consist of calcium nitrite and liquid carriers or penetrating vehicles, or organic inhibitors such as amino alcohols. The corrosion inhibitor shall conform to AASHTO M194, except for the requirements in tables 1, and 2, and sections 11 through 17. The corrosion inhibitor shall be one on the approved products list of the Department. If there are no approved products on the list the corrosion inhibitor shall be a product approved by the Engineer. If the plans specify the use of a calcium nitrite inhibitor, the inhibitor shall be calcium nitrite, if the plans specify the use of an organic inhibitor, an organic inhibitor shall be used. If the plans do not specify the type of inhibitor, either or both types of inhibitor may be used either individually or in combination, provided that the combination use is in accordance with the manufacturers recommendations.

Subsection 515.05 (a) shall include the following:

Prior to the application of the corrosion inhibitor, surfaces to be treated shall be cleaned by air, sand, or water blasting and flushed with water until all material and contaminants which may interfere with the inhibitor's penetration have been removed.

Subsection 515.05 (b) shall include the following:

The corrosion inhibitor shall be applied when the surface to be treated has been dry for at least 24 hours and above a temperature of 40F, or within a more restrictive temperature range if recommended by the manufacturer.

Subsection 515.05 (c) shall include the following:

After the exposed surfaces have been prepared and allowed to dry, coats of corrosion inhibitor shall be applied in accordance with the manufacturer's recommendations. Each coat shall be evenly applied. Each application shall be allowed to dry prior to making the next application. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the penetrating inhibitor. Traffic shall not be allowed on the treated surface until the corrosion inhibitor has penetrated the concrete and the liquid corrosion inhibitor is no longer visible on the surface. The Contractor shall follow all manufacturer's recommendations, including penetration time, prior to opening treated surfaces to traffic or completing the work.

Enough coats shall be applied so that each square yard of treated surface shall have absorbed 0.12 lb. of calcium nitrite or organic inhibiting agent. When treating areas from which deteriorated concrete has been removed, lap the treated area onto the adjacent surface at least 2' beyond the removal.

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**REVISION OF SECTION 515
CONCRETE SEALER (CALCIUM NITRITE)**

Subsection 515.06 shall include the following:

Concrete sealer will be measured for by the number of square yards of concrete surface covered, except when the corrosion inhibitor is used only under patches. The area measured under patches shall be the area of the patches and shall not include the treatment required for 2' around the patch in 515.05 (c). The pay area for each discrete location (a contiguous treated area not touching other treated areas) shall be rounded up to the next whole square yard.

Subsection 519.07 Basis of Payment, shall include the following:

The accepted quantity of concrete sealer will be paid for at the contract unit price per square yard complete in place. Payment will be made under:

Pay Item

Concrete Sealer (Calcium Nitrite)

Pay Unit

Square Yard

Payment will be full compensation for all work and materials required to complete the item including preparation, furnishing and applying the coats of penetrating corrosion inhibitor.

**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

Section 519 of the Standard Special Provisions is hereby revised to include the following:

DESCRIPTION

519.01 This work consists of preparing, galvanizing, and powder coating steel, aluminum and stainless steel products including bridge rails, electrical transformers and pedestals, light poles, and all exposed steel components and appurtenances in accordance with these specifications. This work does not consist of preparing, galvanizing, and powder coating Pedestrian Railing.

MATERIALS

519.02 All coatings shall be able to withstand prolonged temperatures up to 180 degrees F without sag, blister, or peel damage during the warranty period. Topcoat formulation shall provide weathering, chemical, and ultraviolet (UV) resistance. Coatings shall meet the following ASTM requirements as amended:

- 1) Corrosion Weathering: ASTM D-5894, minimum 6 cycles of exposure; corrosion rating of 8 or higher according to ASTM D-1654; blistering rating of 8 or higher according to ASTM D-714
- 2) Impact Resistance: ASTM D-2794, 30 day test. Epoxies- Minimum 40 in. lbs. All topcoats- Minimum 90 in. lbs.
- 3) Adhesion Testing: ASTM D-4541, 30 day test. Minimum 500 PSI for either: Method B-flat surface; Method E-curved surface
- 4) Abrasion Resistance: ASTM D-4060, 30 day test. Maximum 90 mg loss for 1000 cycles with CS 10 or CS 17 wheel.
- 5) Flexibility. ASTM D-522, 30 day test- Method B. Epoxies shall pass a 180 degree bend over a 3/4" mandrel. All Topcoats shall pass a 180 degree bend over a 3/8" mandrel.
- 6) Top coating color shall be dark brown manufactured to meet Federal Specification TT-E-529G and matching Federal Standard 595, color No. 20059.

CONSTRUCTION REQUIREMENTS

519.03 All galvanizing and coating processes shall conform to the following:

(a) Coating First-Use Galvanized Steel Products – Plant and Shop

Finished coatings shall be warranted for a period of two years from the date of written project acceptance. All associated costs for repair or replacement work necessary during the warranty period shall be at the Contractor's expense.

The Contractor shall furnish a warranty performance bond equal to 100 percent of the contract price for coated galvanized products; this bond shall be maintained until release of responsibility is issued by the Engineer in writing. The Contractor's public and property damage liability insurance shall also remain in effect during the entire warranty period. Conditions for release of warranty responsibility are addressed in Subsection (g).

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**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

Steel products to be galvanized and coated shall be cleaned of weld spatter and bevel finished at exposed corners, edges and points. Areas having welds, cuts, bores, notches or grooves shall also be beveled unless otherwise noted in the Contract or directed by the Engineer. Bevel work shall produce a uniform, smooth finish prior to galvanizing. Bevel size to be used is based on steel thickness and other criteria as follows:

- 1) Less than ½ in. thick - 1/32 in. to 1/16 in.
- 2) Over ½ in. thick – 1/16 in. to 1/8 in.
- 3) Bores, notches & grooves – root face of 1/32 in. to 1/16 in.
- 4) Welds – clean and work finish according to AWS standards.

All fabricators and users of potentially hazardous materials or operations shall determine and comply with Colorado Department of Public Health and Environment regulations.

All coating measurements shall be taken with a Type 2 fixed probe Dry Film Thickness (DFT) gauge. The gauge shall be calibrated according to the Society for Protective Coatings (SSPC) Standard PA-2. In cases of differing readings affected parties shall agree to use the gauge displaying the greater degree of accuracy.

(b) Galvanizing

Galvanizing shall be done according to the Standard ASTM Specification stated in the Contract except that items shall not be quenched with water, oil or liquid. Ambient air quenching is acceptable. Chromate treatment of any type is not acceptable. Zinc-Phosphate Pretreatment or Acrylic Passivation Pretreatments as described in Subsection 519.03 (d) below are acceptable.

The Galvanizer shall measure and record thickness of galvanized coating. Measure frequency shall comply with the applicable ASTM specification. Records shall be provided to the Engineer and to the point of next fabrication.

Spot areas not requiring galvanizing shall be marked and cleanly patched with material that prevents galvanization but does not weaken the adjacent spelter. Repair of patch areas shall comply with Subsection 519.03 (c) below.

Prior to further work, the Galvanizer shall notify the Engineer in writing that the galvanized order is chromate free, air quenched, date(s) of galvanizing, and date(s) of any Zinc-Phosphate or Acrylic Passivation Pretreatments.

Products not certified chromate free by the Galvanizer shall be tested prior to further work. The Contractor shall provide the Engineer with certification from an independent ASTM accredited laboratory listing all individual items that test chromate free. Testing shall comply with ASTM D-2092 Appendix X2. Test results shall be provided to the Engineer before work resumes.

(c) Repair of galvanized products

Uncoated areas or damaged coating exceeding applicable specification limits shall be re-galvanized per original specification. Cuts made after galvanizing shall be ground, beveled, and smoothed before repair. Repair of all cuts, uncoated areas or minor damage shall comply with Practice Method 1) or 2) as described below:

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**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

- 1) Metallizing – conforming to ASTM A-780, Annex A3, except that minor repair areas shall be cleaned according to SSPC method SP-3. SSPC Method SP-2 may be used to clean difficult access areas. Thickness of the repair coat shall reasonably match adjacent galvanizing, as measured by calibrated DFT gauge.
- 2) Paint – conforming to ASTM A-780, Annex A2, except that an organic zinc-rich epoxy paint containing minimum 80% zinc concentration shall be used. The epoxy paint shall conform to all other requirements in Subsection (e), as defined for epoxy. Thinning shall comply with manufacturer’s instruction to prevent adjacent spelter damage. A repair coat of 3 to 5 mils shall be applied by brush or dauber only.

Coat imperfections such as burring, run/drip, high spots, heavy dross, or ash inclusion shall be removed and cleaned. Areas of re-work falling below zinc thickness limits shall be repaired according to method 1) or 2) above.

Printed technical data sheets (PTDS) shall be provided to the Engineer for repair materials used. Spray can paint or cold galvanizing compound repair will be rejected; these substances are not compatible with the coating systems to be employed.

(d) Preparing galvanized surfaces for coating

Products shall be inspected for shipping and handling damage before surface prep work begins. Damage shall be reported to the Galvanizer and to the Engineer prior to repair. The Engineer will order repair or replacement of damaged items. Minor repair of galvanizing shall comply with method 1) or 2) of Subsection (c) above.

The Contractor shall prepare all coatable surfaces to provide a slightly roughened profile without removing over 1.0 mils of the galvanized coating. Minimum ASTM zinc thickness specifications shall still apply after preparation.

Fasteners to be coated shall be lightly brushed or sanded on the surfaces to be coated. Care shall be taken so that a minimal amount of zinc is removed.

Surfaces that become soiled after pretreatment shall be cleaned prior to coating by low pressure, mild detergent wash and rinse. Stained or oiled surfaces may also be mildly scrubbed with a soft bristle nylon brush. Stubborn stains may be mildly scrubbed with a 1-2 percent ammonia solution and thoroughly rinsed. Wash and rinse pressure shall not exceed 100 PSI or 185 F temperature.

Surface preparation work shall be done according to one of the following methods:

Zinc-Phosphate Pretreatment. Treatment can only be used on new galvanizing less than 48 hours of age. Thickness measure after treatment is not required when using this method.

Items shall be immersed in a bath of acidic zinc-phosphate solution for 3 to 6 minutes, rinsed with clean water and dried. The first epoxy coat shall be applied within 48 hours after immersion treatment. If treated items are shipped to a different coating facility they shall be rewashed, rinsed and dried to remove surface soiling. The first epoxy coat must still be applied within 48 hours after immersion treatment.

Acrylic Passivation Pretreatments. Treatment can only be used on fresh hot galvanizing or new galvanizing less than 48 hours of age. Thickness measure after treatment is not required for either application method. Only chrome-free solutions shall be used, applied by a method that ensures

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**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

complete coverage of all coatable surfaces. The Treater shall provide the Engineer with treatment dates for each item and PTDS for solution(s) used. The Galvanizer may apply solution to fresh hot galvanizing that is less than 6 hours of age, still clean, dry, and has cooled to treatment application temperature guidelines. If newly galvanized items are shipped to another treatment facility they shall be washed, rinsed and dried to remove surface soiling. Solution shall then be applied and cured according to supplier's instructions.

Fully cured, treated items shall be rewashed, rinsed and dried again just before coating. Articles not coated within 100 days of treatment shall be abrasive blasted per Subsection (d-3).

Abrasive Blasting. This treatment may be used on galvanized items of any age if beveling requirements as listed in the third and fourth paragraphs of Subsection (a) have been met. The Contractor shall notify the Engineer in writing at least 5 working days before blasting begins. Zinc thickness shall be measured and recorded immediately after blasting and provided to the Engineer within 48 hours of blasting. Thickness limits and measure frequency shall comply with the original applicable ASTM specification. Blast operations shall reasonably conform to ASTM Standard Practice D-6386, Subsection 5.4.1 except for:

- a) Small areas falling below required zinc thickness shall be repaired according to Subsection (c) Practice Method 1) or 2). No single area shall exceed 2 in. at its largest width or 12 in. at its longest dimension.

Total repair area shall not exceed 1% of the coatable surface per item; if limits are exceeded or zinc thickness is below specification the item shall be re-galvanized per original specification.

- b) The Contractor shall measure and record the size, location and repair method used for all repairs. This information shall be included on the report of thickness measurements so the Department can later inspect these areas.
- c) The first epoxy coat shall be applied within 90 minutes of abrasive blasting. Items shall be cleaned free of blast debris before coating. Compressed air used to clean items shall be free of oil residue or other harmful contamination.

(e) Coating and Paint Systems

Prepared items shall be coated with a 2 or 3 coat system described in this Subsection. Alternative coating systems shall be pre-approved in writing by the Engineer. Manufacturers PTDS for each coating type shall state test values for ASTM requirements of this Subsection. Prior to product use the coating supplier shall provide the PTDS and certify to the Engineer in writing that all furnished coating materials meet applicable requirements of this Subsection.

Faying surfaces shall not be painted unless written approval is given by the Engineer. All shop fabrication including welds and attachments shall be completed prior to coating unless otherwise noted in the Contract or directed in writing by the Engineer.

Inorganic zinc coatings shall not be used. Combined DFT of all coats applied over the galvanizing shall range from 6.5 to 10 mils with a topcoat DFT of 3 mils minimum. Dried color of the base coat and topcoat shall closely match. Finished color shall not vary more than 4 delta units from plan specification.

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**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

Volatile Organic Compound (VOC) levels shall not exceed 3.0 lbs. per gallon for each applied coat. Dry films shall contain less than 1% lead and other toxic heavy metals. Zinc concentration of epoxy coats shall not exceed 40 percent. Topcoats shall be of semi-gloss material with a rating of 50-75. Coats shall be applied uniformly to provide an appearance free of laps, streaks, sags, drips, pinholes, and other discontinuities; all such defects shall be repaired prior to product shipment.

The Coater shall measure the DFT of each applied coat according to SSPC, Guide PA-2, except that measurements shall be taken with a calibrated Type 2 fixed probe gauge. Thickness records shall be provided to the Engineer prior to project shipment. The following two coating systems do not require pre-approval:

- a) Powder Coating. The Coater shall oven preheat the articles to abate out-gassing potential. The Coater shall be responsible for utilizing compatible materials and coating processes to obtain proper coat to coat adhesion.

Epoxy Powder base coat(s) shall measure 2 to 6 mils DFT and be applied by electrostatic or Tirbo/Airstatic spray. Powder formulation shall be a non-hybrid epoxy of anti-gassing grade.

The powder topcoat shall be electrostatic or Tirbo/Airstatic spray applied and measure 3 to 6 mils DFT. Powder formulation shall be non-acrylic, high-build, aliphatic-based, Enhanced Polyester or Urethane Polyester of anti-gassing grade.

- b) Liquid Coating. The Coater shall apply coats by conventional or airless spray according to supplier's guidelines. Minimal striping at difficult work areas is permissible. The Coater shall be responsible for utilizing proper work methods and compatible materials to obtain proper coat adhesion. Thinning of paints shall be done according to manufacturer's instruction so that thinned products conform to the solids content and VOC limits of this Subsection.

Epoxy base coat(s) shall measure 2 to 6 mils DFT. Paint shall be a low-blush epoxy polyamide, or a low-blush cycloaliphatic bisphenol-A polyamine. Minimum solids by weight of all epoxies used shall be 68 percent.

The topcoat shall measure 3 to 6 mils DFT. Paint shall be an aliphatic-based Urethane Polyester or aliphatic-based Polyurea Urethane. Specially formulated aliphatic-based Polyaspartic Polyureas may also be used over compatible epoxy bases.

(f) Repair of Coated Products

The Contractor shall be responsible for repairing damage from shipment, installation, field welding, or other repairs necessary during the warranty period. Damage shall be reported to the Engineer prior to repair. Repairs shall be done to the satisfaction of the Engineer.

Significant repair procedures shall require written submittal of proposed repair from the Contractor. The Engineer shall approve the proposal in writing before repairs begin. Significant repairs shall be classified as:

Any damaged area to the base coat material over 1 sq. in. Total repair areas exceeding 5% of the coating per item. Any single topcoat repair area over 64 sq. in.

Minor and touchup repair of topcoats shall be done as follows:

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**REVISION OF SECTION 519
HOT DIP GALVANIZING AND DUPLEX COATING**

A UV rated, aliphatic-based liquid topcoat paint shall be used. The paint shall be compatible with existing topcoat material and closely match existing color. Paint requirements listed in Subsection (e) shall apply to the material. The paint supplier shall provide the Engineer with PTDS for the product(s) used.

Single area repair smaller than 8 sq. in. shall be scuffed with 220 grit sandpaper or equivalent scuff material. Larger areas up to 64 sq. in. may be cleaned according to SSPC, Method SP-2. All border areas at the undamaged topcoat shall be scuffed with 220 grit material. Cleaned, scuffed areas shall be bordered and coated by airless or conventional spray. Work areas shall be adequately shielded to contain errant spray. Fresh repair areas shall be protected as necessary during the initial cure. Repair thickness shall reasonably match the adjacent coating.

The repair coat shall provide an appearance free of sags, runs, streaks, drips, pinholes or other discontinuities. Spray can paint repair will be rejected.

(g) Acceptance Conditions for Release of Warranty Responsibility

Coated products shall be free from the following defects for two full years from the initial date of written project acceptance. Defect areas that received repair during the warranty period shall also be free from the described defects:

No peeling shall exist on any portion of the coatings. No blistering shall exist on any portion of the coatings. Color fading shall not fall below a 35 gloss rating. Mottling defects shall not exceed 3% of the topcoat surface. No cracking of the topcoat material shall be visible. No rusting discoloration shall be visible on the coating. No sag or other coating adhesion loss shall be evident.

METHOD OF MEASUREMENT

519.04 Hot dip galvanizing and duplex coating will not be measured and paid for separately, but shall be considered subsidiary to the pay item for which it is applied to.

**REVISION OF SECTION 601
MASS CONCRETE**

Section 601 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

It is the Contractor's responsibility to minimize cracking which would result from heat of hydration during the curing of large concrete cross-sections. This work consists of temperature control of mass concrete for the purpose of minimizing potential cracking as a result of excessive temperature differentials due to the heat of hydration in the curing phase of large concrete cross-sections and for limiting the maximum temperature of concrete during the curing process. Temperature control of these structures shall be provided in accordance with ACI 207.1R-96, "Mass Concrete," and ACI 207.4R-93 "Cooling and insulating Systems for Mass Concrete" except as modified by the requirements in this Special Provision or by the Contractor's accepted Mass Concrete Placement and Curing Plan.

The provisions herein apply to any concrete element designated as mass concrete in the Plans. In general, this will be any element with a least dimension greater than 4 feet and having a volume to surface ratio (V/S) greater than 1.5 feet unless otherwise designated by the Engineer with the concurrence of CDOT.

- (a) *Temperature Limitations.* The maximum temperature differential between the interior and a point two inches from the surface along the shortest line from the geometric center to the nearest surface of the element, and the maximum peak concrete curing temperature shall be limited as described herein. These temperature conditions shall be maintained from time of concrete placement until all interior concrete temperatures are decreasing. Surface mounted temperature sensors will not be used to measure differential temperatures.

During the Curing Period, the temperature differential between the center of the placement and a point two inches from the surface along the shortest line from the geometric center to the nearest surface of the element shall not exceed the following limits:

- First 48 hours 40 degrees Fahrenheit
- Next 2 to 7 days 50 degrees Fahrenheit
- Next 8 to 14 days 60 degrees Fahrenheit

Protection can be removed when the temperature difference between the ambient and the point two inches from the surface doesn't exceed 35 degrees Fahrenheit.

The maximum peak curing temperature of all mass concrete elements shall not exceed 160 degrees Fahrenheit.

- (b) *Temperature Control.* The Contractor shall control the maximum temperature and interior and exterior temperature differential in the mass concrete in accordance with the following:

- (1) *Submittals.* At least three (3) calendar days prior to scheduled concrete casting for a particular mass concrete element, the Contractor shall submit a Mass Concrete Placement and Curing Plan to the Engineer for acceptance with a copy to CDOT for information. At a minimum, the Plan shall include the following information:

- A heat generation and dissipation analysis
- Discussion of placement and curing methods indicating how temperature controls are to be achieved
- Proposed concrete design mix information

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**REVISION OF SECTION 601
MASS CONCRETE**

The submittal shall include, but not be limited to, the following:

- (i) Heat generation and dissipation analysis in accordance with ACI 207.1R-96 for the geometry of each mass concrete element or other recognized heat transfer methods accepted by CDOT. The analysis shall determine the predicted concrete temperature at the center and two inches inside of the exterior surface exposed to air for a time period until all concrete temperatures are decreasing and the maximum temperature differential has been reached and begins to decrease, or the curing period defined above, whichever is longer. Analyses shall be performed for the anticipated mean weekly ambient or enclosure air temperatures for the period of the proposed placement, and for temperatures plus, and minus, 10 degrees Fahrenheit of the mean weekly ambient air temperature.
 - (ii) Anticipated concrete placement temperatures measured at discharge into the forms for the anticipated ambient air temperatures at the surface of the member.
 - (iii) A copy of any models developed for thermal analyses, such as the Schmidt model, with the site and element specific input data, output, and results.
 - (iv) The method(s) that are intended to be used for ensuring the maximum temperature differential between the interior and two inches inside of the exterior surface of the designated mass concrete elements, and a maximum peak curing temperature, at the anticipated mean weekly ambient or enclosure air temperatures in which the element is intended to be cast are not exceeded.
- (2) *Mix Design.* Ground granulated blast furnace slag or Class F fly-ash may also be used in the mix to reduce the heat of hydration. Slag and/or fly-ash shall be from a source approved by the Engineer or CDOT certified source, shall be compatible with the type of cement and thoroughly blended in the mix. Other precautions for reducing the heat of hydration may be taken, such as the addition of controlled quantities of ice in lieu of equal quantities of mixing water. However, the mix shall contain no frozen pieces of ice after blending and mixing components. All constituent materials shall be compatible with the proposed cements, workability enhancing additives and water reducing agents as necessary to provide concrete satisfying all requirements of the Contract Documents.
- (3) *Temperature Monitoring.* The Contractor shall provide temperature-monitoring devices to record temperature development between the interior and the exterior of the element at points shown in the accepted Mass Concrete Placement and Curing Plan. A minimum of two independent sets of interior and exterior points shall be monitored for each element to provide redundancy in case of failure of a device. The monitoring points shall be located at the geometric center to the nearest surface of the element for the exterior point.

Monitoring devices shall be automatic sensing and recording instruments that record information at a maximum interval of one hour. These devices shall operate for a maximum range of 0 to 180 degrees Fahrenheit with an accuracy of + 2 degrees Fahrenheit. In addition, the Contractor shall take readings and record data at intervals not great than six hours to ensure that the automatic devices are working properly and that the temperatures are within allowable limits. The intervals of one and six hours shall begin immediately after casting is complete and shall continue until 24 hours after all of the following are met:

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**REVISION OF SECTION 601
MASS CONCRETE**

- Maximum temperature differential is reached and begins to drop; and
- Maximum peak curing temperature is reached and begins to drop; and
- Mass concrete elements take their permanent form and environmental exposure (i.e. all formwork, insulation, and other temporary items have been removed)

When the temperature difference between the ambient and the point two inches from the surface does not exceed 35 degrees Fahrenheit, automatic temperature readings can be replaced with manual temperature readings. These manual temperature readings shall be performed at intervals not greater than six hours. The maximum temperature differential between the interior and a point two inches from the surface along the shortest line from the geometric center to the nearest surface of the element shall not exceed 60 degrees Fahrenheit. If the maximum appears that it may subsequently be exceeded, appropriate protection measures to prevent exceeding the 60 degree Fahrenheit limitation must be taken.

These readings shall be transmitted to CDOT and the Engineer daily.

If monitoring indicates the maximum temperature differential or the maximum curing temperature will, in the determination of the Engineer, or has exceeded the maximums, the Contractor shall take immediate action to retard further growth in the differential or maximum temperatures. Additionally, the Contractor shall make the necessary revisions to the approved plan to no exceed the maximum differential and maximum curing temperatures on any remaining placements. Revisions to the accepted Mass Concrete Placement and Curing Plan must be approved by the Engineer prior to implementation.

- (c) *Crack Repair.* The Contractor shall seal all mass concrete cracks between 0.010 inches (0.25 mm) and 0.020 inches (0.51 mm) in width, with a CDOT approved epoxy crack sealant applied in accordance with the manufacturer's recommendations.

Mass concrete cracks between 0.020 inches (0.51 mm) and 0.060 inches (1.50 mm) in width shall be filled using a CDOT approved epoxy injection system and materials. The epoxy injection operation shall be in accordance with the material and equipment manufacturer's published recommendations.

Mass concrete cracks greater than 0.060 inches (1.50 mm) in width shall be evaluated by the Design Manager to consider whether these cracks compromise the integrity of the design or fitness for use. If the Design Manager asserts that these cracks do not compromise the integrity of the design or the fitness for use, the Design Manager shall submit a repair plan for CDOT acceptance.

Cracks shall not be repaired until all concrete cooling operations are completed. All injection ports, excess epoxy and sealing epoxy shall be removed from the concrete surface.

METHOD OF MEASUREMENT

Mitigation of thermal effects in mass concrete will not be measured.

BASIS OF PAYMENT

Payment for analysis and mitigation of thermal effects in mass concrete will be handled via Force Account Mass Concrete.

**REVISION OF SECTION 601
TUNNEL FORMWORK (FURNISH ONLY)**

Section 601 of the Standard Specifications is hereby revised for this project as follows:

Subsection 601.01 shall include the following:

This work also consists of furnishing tunnel formwork to be used for the construction of the cast-in-place final tunnel lining in accordance with the lines, grades and dimensions shown on the plans or as established.

Subsection 601.09(a) shall include the following:

(1) *Tunnel Formwork.*

1. Tunnel Formwork shall:
 - A. Be designed per ACI 347 and ASCE 37 to satisfy dimensional tolerances stated in CDOT Standard Specifications.
 - B. Resist vertical and lateral movement for full height of pour using a concrete mix with a water-cement ratio of not more than 0.40.
 - C. Reinforcement support plan, if it involves the form.
 - D. Produce full vertical construction joints using steel or timber bulkheads.
 - E. Utilize vibrators mounted to the form.
 - F. Include viewing ports, spaced every 600 square feet, to allow visual observation and access for vibrating while concrete is being placed and vibrated.
 - G. Be compatible with the groundwater control system (e.g. geocomposite drain panels, formation drain pipes, geotextile).
 - H. Be designed for use beyond limits of mined tunnels to form cast-in-place concrete portal structures.
 - I. Accommodate required filling rates as determined by Contractor.
2. The Contractor shall submit working drawings for tunnel formwork that shall include the following information:
 - A. Geometry and expected tolerances
 - B. Conceptual layouts of anchors, shores and braces
 - C. Viewing port locations and size
 - D. Concrete placement locations
 - E. Construction joint forming details

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**REVISION OF SECTION 601
TUNNEL FORMWORK (FURNISH ONLY)**

METHOD OF MEASUREMENT

Subsection 601.19 shall include the following:

Tunnel Formwork, including the form, its accessories, structural support, and transportation system will not be measured but will be paid for on a lump sum basis.

BASIS OF PAYMENT

Subsection 601.20 shall include the following:

Payment will be made under:

Pay Item

Tunnel Formwork (Furnish Only)

Pay Unit

Lump Sum

Payment for Tunnel Formwork will be a not-to-exceed amount per the actual invoice. Partial payments for Tunnel Formwork will be made as the formwork is ordered, shipped and accepted according to the following schedule:

- (1) 25% of the actual invoice price will be paid after receipt of documentation that the formwork has been ordered.
- (2) 65% of the actual invoice price will be paid after receipt of documentation that the formwork has been shipped.
- (3) 10% of the actual invoice price will be paid after the formwork has been delivered and accepted.

Tunnel formwork becomes the property of CDOT after completion of Package 2 or in the event CDOT does not accept the Contractor's bid for Construction Package 2 and advertises Construction Package 2.

**REVISION OF SECTION 603
REINFORCED CONCRETE PIPE**

Section 603 of the Standard Specifications is hereby revised for this project as follows:

Subsection 603.02 shall include the following:

Reinforced concrete pipe shall be manufactured from concrete that meets the requirements for severity of sulfate exposure **Class 0** specified in subsection 601.04.

REVISION OF SECTION 612 LOCATION MARKERS

Section 612 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Contractor shall furnish and install location markers for identifying fiber optic cable and other utilities at locations shown on the plans.

MATERIALS

Location Marker (Fiber Optic) (Dome) shall be made of non-conductive high-density polymer, and shall be integrally white in color with an orange cap. All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. In some instances when markers are installed on National Forest Service Lands the fiber optic marker shall be brown in color.

Location Marker (Utility) (Flat Slat) shall be made of fiberglass reinforced composite, and shall orange in color. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. In some instances when markers are installed on National Forest Service Lands the fiber optic marker shall be brown in color.

Concrete footing for dome marker shall be 18 x 18 x 12 inches per project detail. Concrete footing shall be Concrete Class B and shall be in accordance with Section 601.

Location Marker Electronic (Ball) shall be a Full Range Electronic Marker Ball operating at the frequency of 101.4 kHz for communication line locating. The electronic marker ball shall be compatible with a Dynatel cable locator. These electronic markers shall be installed within 12 inches of the lid of said pull box, manhole or open trench. Electronic Markers may be fabricated into the pull box or manhole.

CONSTRUCTION REQUIREMENTS

Location Marker (Fiber Optic) (Dome) shall be installed at appropriate Pull Box and Manhole (TMS) locations as shown on the plans to identify both the backbone fiber cable and lateral fiber cable. To additionally designate the fiber cable, intermediate markers shall be installed at 1000-foot spacing along the running line.

The marker shall include a label with CDOT contact information and the designation of "FIBER OPTIC CABLE". The label shall have black lettering on an orange background. The label shall include the highway milepost of the Pull Box or Manhole (TMS). The mile post shall be to the nearest hundredth. This label shall be placed below the "FIBER OPTIC CABLE" warning label. In some instances when markers are installed on Forest Service Lands the dome marker label shall have black lettering on a brown background. The Contractor shall provide the label submittal to the Project Engineer.

Location Marker (Utility) (Flat Slat) shall be installed at utility pull box/manhole locations and utility point of service to identify both electric and telephone communication lines. Contractor shall designate the utility line with a marker installed mid-point between the utility point of service and the device.

The markers shall include a label with CDOT contact information and the designation of "ELECTRICAL CABLE" or "TELEPHONE CABLE". The label shall have black lettering on an orange background. In some instances when markers are installed on Forest Service Lands the flat marker label shall have black lettering on a brown background. The Contractor shall provide the label submittal to the Project Engineer.

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**REVISION OF SECTION 612
LOCATION MARKERS**

Location Marker Electronic (Ball) shall be installed inside each pull box, manhole or open trench at locations shown on the plan sheets. The Marker Ball shall be securely positioned for optimal output and prevent accidental removal.

The Contractor shall provide the Engineer with three copies of detailed As-Built drawings showing the installed locations of all markers and the associated utilities. These drawings shall include but not be limited to the following:

- (1) Type of location marker installed
- (2) Distances between location markers
- (3) Distances between pull boxes and manholes to ITS devices
- (4) The distance and location to each CDOT utility point of service connection source point which the local utility companies have provided, including electrical power, transformer source, and telephone pedestals.

METHOD OF MEASUREMENT

Location markers, labels and footing will be measured by the actual number of markers, including EMS ball markers that are placed and accepted.

BASIS OF PAYMENT

<u>Pay Item</u>	<u>Pay Unit</u>
Location Marker (Fiber Optic) (Dome)	Each
Location Marker (Utility) (Flat Slat)	Each

Payment will be full compensation for all work, materials and equipment required to place the markers at the locations shown on the plans, including excavation, backfill, and patching.

Concrete for footing will not be measured and paid for separately but shall be included in the Pay Item – Location Marker (Fiber Optic) (Dome).

**REVISION OF SECTION 613
ELECTRICAL CONDUIT**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Subsection 613.01 shall include the following:

This work includes furnishing and installing either HDPE or PVC electrical conduit. All materials furnished, assembled, fabricate and installed under this item shall be new, corrosion resistant and in strict accordance with the plan sheets and these Special Provisions.

MATERIALS

Subsection 613.02 shall include the following:

All conduit shall be Schedule 80 in the diameters, quantities and colors as shown on the project detail sheet and shall be compliant with all ASTM and Bellcore TW-NWT-000356 requirements.

All HDPE conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin 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.

PVC conduit shall be certified by the manufacturer as meeting ANSI/UL 6 and 651. The manufacturer shall be ISO 9000 compliant.

Electrical Conduit (Bored) shall be HDPE and installed using a trenchless technology of directional boring.

Electrical Conduit (Plastic) shall be PVC or HDPE and installed by direct burial methods such as plowing, open trenching, or other excavation methods.

Each individual conduit shall be equipped with a pull tape as described below. Each bore or trench shall have a copper tracer wire of at least 12 gauge in one of the conduits.

Each individual conduit shall be equipped with pull tape. The pull tape shall have a minimum tensile strength of 1800 lbs. and be of a design and manufacture that prevents cutting or burning into the conduit during cable installation.

The installation of conduit shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, utilities, landscaping, and sprinkler systems. Excavations and conduit installation shall be performed in a continuous operation. All trenches shall be backfilled by the end of a shift. The material from trenching operations shall be placed in a location that will not cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

The following conduit colors shall be used so that the contents can be easily identified:

1. 2-inch conduit for CDOT fiber – Orange
2. 2-inch conduit for power – Red
3. 2-inch conduit for other – Black

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**REVISION OF SECTION 613
ELECTRICAL CONDUIT**

CONSTRUCTION REQUIREMENTS

Subsection 613.03 shall include the following:

The Contractor shall take all necessary precautions to avoid heaving any existing asphalt/concrete mat or over-excavating a trench, whether caused by equipment directly or by dislodging rocks and boulders. Any such heaving or over-excavation shall be repaired or replaced at the Contractor's expense. The Contractor shall bear the cost of backfilling all over-excavated areas with the appropriate backfill material as approved by the project engineer.

The Contractor shall restore all surface materials to their preconstruction condition or better, including but not limited to pavement, sidewalks, sprinkler systems, landscaping, shrubs, sod, or native vegetation that is disturbed by the conduit installation operation. All repairs shall be included in the cost of the conduit.

If the Contractor is unable to bore the conduit at the lengths shown on the plans from access point to access point, all splice couplings and associated work to splice conduit shall be included in the cost of this item. The coupling technology shall allow the conduit to be connected without the need for special tools, and shall form a watertight, airtight seal. Breaking force between segments shall exceed 250 pounds of force. No metal fittings shall be allowed. No elevation difference between the conduit run and the splice location will be allowed. Conduit splices shall be kept to a minimum and all locations shall be approved by the project engineer. Additional pull boxes shall not be substituted for splices.

Conduit plugs shall be supplied and installed in all conduit ends as soon as the conduit is installed. Conduit shall be plugged at all termination points such as pull boxes, manholes, controller cabinets, and node buildings. All plugs shall be correctly sized to fit the conduit being plugged. Empty conduits shall be sealed with removable mechanical type duct plugs that provide a watertight barrier and are equipped with a rope tie on the inside end for connection of the pull tape. No foam sealant will be allowed. All plugs and sealant shall be approved prior to construction.

All conduits shall use sweeps to elevate the buried conduits to the final grade within a pull box or manhole, as shown in the plans. The sweeps shall be terminated within the pull boxes and manholes to allow for easy installation and removal of the conduit plugs. The sweeps shall be set above the ground surface within the pull box at a height that does not interfere with the coiling of the fiber optic cable.

All conduit runs are intended for the future installation of fiber optic cable and shall have a limited number of bends. The sum of the individual conduit bends on a single conduit run between two pull boxes shall not exceed 270°. No individual bend shall be greater than 45°. All conduit bends shall have a minimum acceptable radius of 30 inches.

If new conduits are installed in existing pull boxes, manholes or cabinet bases the Contractor shall carefully excavate around the pull box or manhole and install the new conduit as shown in the plans. The Contractor shall not damage the existing pull box, manhole or their contents. If the existing pull box, lid, or the concrete collars are cracked or damaged during conduit installation, the Contractor shall restore the damaged section to preconstruction condition at no additional cost.

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**REVISION OF SECTION 613
ELECTRICAL CONDUIT**

METHOD OF MEASUREMENT

Subsection 613.10 shall include the following:

Electrical Conduit will be measured by the actual number of linear feet that are installed and accepted. Conduit shall also include anchors, bands, skids, sweeps, pull tape, copper tracer wire, adapters, fittings, conduit plugs, installation equipment, splice couplings, mounting brackets and hardware, structure anchors, adhesives, labor, and all other items necessary to complete the work.

Subsection 613.11 shall include the following:

Electrical Conduit contract unit price shall be full compensation for work described above, specified in the plans, and complete and in place.

BASIS OF PAYMENT

Subsection 613.11 shall include the following:

Payment will be made under:

Pay Item

2 Inch Electrical Conduit
2 Inch Electrical Conduit (Bored)
2 Inch Electrical Conduit (Plastic)

Pay Unit

Linear Foot
Linear Foot
Linear Foot

**REVISION OF SECTION 613
ELECTRICAL CONDUIT (LIQUIDTIGHT FLEXIBLE METAL)**

Section 613 of the Colorado Department of Transportation Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Subsection 613.01 shall include the following:

This work consists of furnishing and installing liquidtight flexible metal conduit for above-ground applications when transitioning from underground conduit to a pole-mounted cabinet or device.

MATERIALS

Subsection 613.02 shall include the following:

All materials furnished, assembled, fabricated, or installed under this item shall be new, corrosion resistant and in strict accordance with the Plans and these Special Provisions.

All underground-to-aboveground and aboveground conduit installations shall utilize liquidtight flexible metal conduit (LFMC) as indicated on the Plans.

LFMC shall meet UL safety standard UL 6 *Electrical Rigid Metal Conduit - Steel* and be manufactured to ANSI C80.1 *Electrical Rigid Steel Conduit (ERSC)*.

Conduit directional changes from a vertical orientation to a horizontal orientation shall be accomplished through the use of a Type “LB” conduit bodies as called out in the Plans. The Type “LB” conduit bodies shall be fitted to accommodate the thread on 2” diameter RMC. Each Type “LB” conduit body shall come equipped with a cover, preassembled gasket and hardware to secure the cover to the body. The cover shall be removable to facilitate fiber optic cable pulling and future cable maintenance. Malleable iron conduit bodies and covers shall utilize a zinc electroplate finish.

All conduit transitions shall be constructed in a smooth and gradual manner as directed by the Engineer. Conduit sweeps into pull boxes and splice vaults shall be installed to facilitate pulling fiber optic cable directly through the pull box or splice vault.

Prior to installation, the specifications for all conduit types, couplings, fittings, elbows, L-bends, mounting hardware, conduit plugs, sealing plugs, pull tape, warning tape and curb markers shall be submitted to the Engineer for written approval.

CONSTRUCTION REQUIREMENTS

Subsection 613.07 shall include the following:

All conduit installation shall conform to the requirements of the following NEC sections as applicable:

- NEC Article 356 LFMC

All RMC shall be installed to permit expansion and contraction per the manufacturer’s requirements without causing damage to the structure, junction box, fiber optic cable or other elements. The Contractor shall submit to the Engineer for approval the design of all installation materials and methods that are proposed prior to installing the conduit, hangers, anchors and other elements.

2

**REVISION OF SECTION 613
ELECTRICAL CONDUIT (LIQUIDTIGHT FLEXIBLE METAL)**

Contractor shall drill a hole in the bottom of the cabinet, the LFMC shall connect to this opening and the connection shall be sealed.

METHOD OF MEASUREMENT

Subsection 613.11 shall include the following:

Accepted quantities of electrical conduit will be paid as measured above which price includes all items as listed above including full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing electrical conduit as shown on the Plans, as specified in the Standard Plans and Standard Specifications, as specified in these Special Provisions, and as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made under:

Pay Item

2 Inch Electrical Conduit (Liquidtight Flexible Metal)

Pay Unit

Linear Feet

**REVISION OF SECTION 613
PULL BOXES**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Contractor shall furnish and install fiberglass reinforced, polymer concrete pull boxes.

MATERIALS

Subsection 613.07 shall include the following:

Pull boxes installed in dirt or landscaped areas shall have a concrete apron with 3 sides, 12 inches wide by 6 inches deep and a top side of 18 inches wide by six inches deep for marker installation. Pull boxes shall not be installed above the grade of the apron. Concrete apron shall have a 1% slope away from the top of pull box. All concrete aprons shall be Class B and shall be in accordance with Section 601.

Pull boxes shall have a detachable cover with a skid-resistant surface and have the words “CDOT COMM” or “CDOT POWER” cast into the surface, as appropriate. Painting of words shall not be accepted. The cover shall be attached to the pull box body by means of 3/8 x 3.5 inch lag head stainless steel hex head bolts and shall have two (2) lift slots to aid in the removal of the lid.

Wire mesh shall be installed in a manor to completely surround the box. The wire mesh shall meet the material standard ANSI/ASTM A555-79 and made of T-304 stainless steel, 0.025 inch wire diameter minimum and shall have a spacing of 12 mesh per inch.

Pull boxes shall be verified by a 3rd 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.

The Pull Box (18x30x18) and the Pull Box (24x36x24) shall have a one piece lid.

CONSTRUCTION REQUIREMENTS

A minimum of 12 inches of ¾ inch granite-gravel shall be installed as a base for the pull box to aide in drainage. The ¾ inch granite-gravel shall be free of dirt and debris and spread evenly to facilitate a level base for the pull box. The Contractor shall ensure that sufficient compacting is made prior to the installation of ¾ inch granite-gravel to help alleviate future settling.

Wire mesh shall be installed in a manor to completely surround the box. The wire mesh shall be installed prior to the installation of the pull box above the bed of 3/4” granite-gravel and extending one foot past the outer edges of the concrete apron. The wire mesh shall be gently cut to allow only the entrance of the conduit at the bottom of the box. Any openings cut in the wire mesh larger than the diameter of the conduit shall be remedied by the installation of additional wire mesh to obtain a completely sealed pull box enclosure.

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**REVISION OF SECTION 613
PULL BOXES**

METHOD OF MEASUREMENT

Subsection 613.11 shall include the following:

Pull Boxes will be measured by the actual number that are installed and accepted, and will include base, lid, excavation, backfill, concrete apron, wire mesh and 3/4" granite-gravel. Pull Boxes shall also include the removal and patching of pavement, sidewalks, curb and gutters and their replacement in kind to match existing grade.

BASIS OF PAYMENT

Subsection 613.12 shall include the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Pull Box (24"x36"x24")	Each
Pull Box (18"x30"x18")(Deep)	Each

Concrete will not be measured and paid for separately, but shall be included in the cost of the pull box.

**REVISION OF SECTION 613
SECONDARY SERVICE PEDESTAL**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Contractor shall furnish and install the Secondary Service Pedestal in accordance with the plans and these special provisions.

MATERIALS

Subsection 613.02 shall include the following:

Secondary Service Pedestal shall consist of the following:

- 125A, 120/240V, NEMA 3R meter housing conforming to the utility provider requirements
- 100A, 250V heavy duty, 2-pole, NEMA 3R, service entrance rated disconnect switch with ground and neutral bars
- 100A, MLO, 120/240-10-3W, 8 space NEMA 3R load center with branch circuit breakers
- Heavy duty, galvanized c-channel type rack setting in concrete
- 5/8 8 foot copper-clad driven ground rod with approved clamp

CONSTRUCTION REQUIREMENTS

All hardware shall be installed in accordance with manufacturer's recommendations and per the latest CDOT M&S Standards.

METHOD OF MEASUREMENT

The Secondary Service Pedestal will be measured by the actual number of units installed and accepted.

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for the Pay Item listed below.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Secondary Service Pedestal	Each

Payment will be full compensation for all labor, materials, and equipment required to complete the work.

**REVISION OF SECTION 613
LIGHTING**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.02(h) shall include the following:

Wiring shall be stranded copper, 600 VAC rated, with insulation that is U.L. listed for exterior use in conduit, THW, THHW, THWN, or XHHW and size as designated on the plans.

Subsection 613.09 shall include the following:

- (a) *Lighting Control Center.* A complete lighting control center includes a NEMA 1 load center, grounding system, contactors, control relay, telemetry relay, NEMA-3R meter housing, NEMA-3R service disconnect switch, maintenance receptacle, by-pass switch, photoelectric control, NEMA 4 enclosure (cabinet type), concrete pad, step up and step down transformers (with all NEC required means of disconnect and over current protection) for remote signage devices and all related components, and connections to the power supply.

METHOD OF MEASUREMENT

Subsection 613.11 shall include the following:

Lighting Control Center will be measured by each control center furnished and accepted.

Pull boxes on lighting circuits (from the Lighting Control Center to each pole) will not be measured and paid for separately, but shall be included in the work.

BASIS OF PAYMENT

Subsection 613.12 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Lighting Control Center	Each

The lump sum price bid for wiring will be full compensation for all electrical circuitry necessary to complete the power installation as shown on the plans. All conductors in conduit, regardless of type, are part of the wiring item and will not be measured nor paid for separately.

The following items will not be measured and paid for separately, but shall be included in the work:

- (1) Splices required in continuous runs that exceed roll quantity
- (2) Additional splices in junction boxes, splice boxes, pull boxes, device pole hand holes
- (3) Electrical conductor tagging
- (4) Testing of the devices installation, including temporary power and all required cable connections

**REVISION OF SECTION 614
COMMUNICATIONS CABINET**

Section 614 of the Standard Specification is hereby revised for this project as follows:

DESCRIPTION

Subsection 614.01 shall include the following:

Communications cabinets shall be furnished and installed at the proposed CCTV camera locations as indicated on the plans, to house and protect electrical power components, DIN rails, field equipment, communications telemetry equipment and fiber optic termination panels.

MATERIALS

Subsection 614.08 (c) shall be deleted and replaced with the following:

Communications cabinets shall be UL 508A Industrial Control Panels listed and conform to a NEMA Type 4X rating. Communications cabinets shall be constructed of 0.125 inch Type 5052 H-32 aluminum conforming to the requirements of ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate. The dimensions shall be appropriate to adequately house the equipment.

Table 1 - Communications Cabinet Types

COMMUNICATIONS CABINET	DIMENSIONS	MAXIMUM WEIGHT (W/O BACK PANEL)
Type 2	30" (h) x 24" (w) x 12" (d)	40 lbs.

All fabricated materials and added components must be free from burrs and sharp edges. Exterior seams of the cabinet shall be continuously welded with edges ground smooth to a 0.03 inch radius. All welding shall be done with gas tungsten arc welds that comply with AWS B2.1-22-015 Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Aluminum and C5.6 Recommended Practices for Gas Metal Arc Welding. All welds shall be neatly formed and free of blisters, blowholes, cracks and other irregularities. All bolts, clamps, fasteners, hinges, latches, nuts and screws shall be stainless steel, unless an alternative corrosion proof material is approved in writing by the Department.

The cabinet door opening shall be designed to prevent dust and moisture intrusion in conformance to NEMA 4X requirements. All flange joints shall be welded or continuously formed. The door shall have an adequately sized, oil-resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 4X requirements and shall be permanently bonded to the door. The door shall utilize a continuous stainless steel hinge that allow for door removal from the hinge side. Hinges shall be mounted such that the cabinet door opens out to the left, unless otherwise specified on the Plans, Project Details or as specified by the Department. Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking. The cabinet shall have a lock and be keyed identical to other cabinets on the corridor. A document holder constructed of high-impact thermoplastic shall be provided for each communications cabinet and permanently mounted to the lower portion of the inside door. The Contractor shall insert a copy of the communications cabinet Bill of Materials (BOM), individual communications cabinet component specification sheets and an as-built electrical/low-voltage wiring diagram of the communications cabinet in the document holder.

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**REVISION OF SECTION 614
COMMUNICATIONS CABINET**

Each communications cabinet, designated for mounting on a pole, shall include a pole mounting kit suitable for pole diameters ranging from 7-12 inches. Each pole mounting kit shall include channel bars (for attachment to factory mounting holes on the back of the communications cabinet), pole shims (to prevent cabinet movement against pole), stainless steel straps and all other associated mounting and sealing hardware. The channel bars, pole shims and associated mounting hardware shall be manufactured from either galvanized steel or stainless steel. Mounting holes on the back of the communications cabinet shall be installed at the factory (communications cabinet Manufacturer) to assure NEMA 4X integrity along with all factory-recommended mounting and sealing hardware. Field installation or modification of mounting holes shall be prohibited.

CONSTRUCTION REQUIREMENTS

Each communications cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein.

Two conduit access holes shall be made on the bottom of the communications cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, as applicable for each communications cabinet application. The conduit access holes shall be sized and positioned at locations shown in the Project Details to ensure the proper, safe routing of cabling entering the cabinet. The holes shall be free of burrs and sharp edges prior to the installation of LFMC, fittings and nipples. Conduit access holes and appropriate sealing strategies to maintain a NEMA 4X integrity shall be performed at the factory and no field installation or modification of the conduit access holes shall be permitted.

Back Panels

Back panels shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the Department. One back panel and associated mounting hardware shall be included with each communications cabinet and be rated for use in NEMA 4X cabinets. The back panel shall be not less than 27 inches (h) × 21 inches (h) and protected on one side with a plastic film. The back panel shall be mounted within the communications cabinet with a minimum of four screws.

Outlet Box

Each communications cabinet shall contain a 4 inch square junction box attached to the back panel as shown in the Project Details. Each junction box shall be constructed of drawn or welded steel and have a minimum depth of 1.25 inches. Each junction box shall include knockouts and clamps for conduit and cables, as appropriate. Steel box covers shall be provided with each junction box as appropriate for the specific communications cabinet application, e.g., duplex receptacles and/or duplex GFCI receptacles.

Duplex NEMA 5-15R receptacles shall be provided within the outlet box as specified in the Project Details. NEMA 5-15R receptacles shall be rated for 125 VAC, 0.5 HP and 15 A. It shall be of commercial grade quality and be manufactured from high strength nylon. NEMA 5-15 receptacles shall have two poles, three wires and include a self-grounding strap to insure ground contact.

Duplex NEMA 5-15R GFCI receptacles shall be provided within the outlet box as specified in the Project Details. NEMA 5-15R GFCI receptacles shall be rated for 125 VAC, 0.5 HP and 15 A. It shall be of commercial grade quality and manufactured from high strength nylon. NEMA 5-15R GFCI receptacles shall have two poles, three wires, a manual reset button and a self-test button.

Both duplex NEMA 5-15R and duplex NEMA 5-15R GFCI receptacles shall be UL listed.

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**REVISION OF SECTION 614
COMMUNICATIONS CABINET**

Power Strip

Furnish and install one back panel mounted power strip with six front facing NEMA Type 5-15R outlets. Mounting location shall be as shown in the Project Details. The power strip shall be rated for 15 A at 120 VAC. It shall have an energy rating of 630 Joules, clamping voltage of 500 V and EMI/RFI noise filter of 150 KHz to 100 MHz at up to 43 dB. The power strip shall have a recessed power switch and a power cord of not less than 2.5 feet.

Power Conditioner

The power conditioner shall be designed for outdoor use, support an operating temperature range of -40°F to +165°F, be operational in humidity levels of 0% to 95% (non-condensing) and operate at an altitude ranging from sea level to two miles above sea level. It shall utilize an input voltage of 120 VAC, 40 to 70 Hz and an output voltage of 120 VAC ($\pm 3\%$), user selectable 50 to 60 Hz ($\pm 0.25\%$). The power conditioner shall support an output current of 4.8 A (400 W/570 VA). It shall have a total harmonic distortion not exceeding 3.0%. The power conditioner shall utilize input and output electrical connectors conforming to the IEC 60320-1 Appliance Couplers for Household and Similar General Purposes specification. Its dimensions shall not exceed 1.7 inches (h) \times 11 inches (w) \times 8.5 inches depth and its weight shall not exceed 5 lbs. One power conditioner shall be provided with each communications cabinet.

DIN Rails

Each communications cabinet shall utilize standard 1.38 inch DIN rails. The DIN rails shall be of steel construction with a coating for corrosion resistance. The DIN rails shall utilize 0.25 inch \times 0.71 inch slots for fastening to the back panel located in each communications cabinet. The spacing of the DIN rail slots shall be 0.98 inch center-to-center. DIN rails and associated mounting hardware for attachment to the back panel shall be provided with each communications cabinet in the lengths and quantities specified in the Project Details.

12 VDC Power Supply

The 12 VDC power supply shall support an input voltage range of 85-264 VAC and frequency range of 47-63 Hz. It shall have a typical efficiency of at least 76% and typical AC current of 1.6 A at 115 VAC. The 12 VDC power supply shall provide an output voltage of 12 VDC and have a current rating of 6.3 A. It shall support an output current range of 0 to 6.3 A and have a rated power of 75 W. The 12 VDC power supply shall have overload protection of 105-150% for its rated output power and overvoltage protection for voltages of 15-16.5 VDC. It shall be designed for an operating temperature of +14°F to +140°F and humidity levels of 20% to 90% (non-condensing). The 12 VDC power supply shall conform to the following standards: IEC 60068-2-6 Environmental Testing (Vibration) and UL 508 Industrial Control Equipment. It shall be DIN rail mountable, have dimensions not exceeding 5 inches (h) \times 2.25 inches (w) \times 4 inches (d) and a weight of not more than 1.5 lb. One 12 VDC power supply shall be provided with each communications cabinet.

Warranty

The communications cabinet manufacturer shall affix a permanent label on the inside of the door that identifies the cabinet type, date of manufacture, warranty expiration date and manufacturer's name. The warranty expiration date shall be expressed in the (mm/dd/yyyy) format. The warranty shall cover all communication cabinet materials and workmanship, including pole mounting kits, for two (2) years after delivery of each communication cabinet.

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**REVISION OF SECTION 614
COMMUNICATIONS CABINET**

METHOD OF MEASUREMENT

Communications Cabinet will be measured by the actual number of Communications Cabinets installed and accepted.

BASIS OF PAYMENT

Payment will be under:

Pay Item

Communications Cabinet

Pay Unit

Each

Payment will be full compensation for all labor, materials and equipment required to complete the work.

**REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR
This specification is to be used for all NON 334 cabinet sites.**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work shall consist of furnishing, installing, and configuring a microwave vehicle radar detector (MVRD) in accordance with these Special Provisions at the locations shown on the Plans.

MATERIALS

The Microwave Vehicle Radar Detector shall include: the radar detection unit with mounting hardware, manufacturer configuration software, power/communication cable, detection unit power supply, serial surge suppression, and any additional hardware necessary for a complete and functional installation.

Radar detection unit shall be a Wavetronix SmartSensor HD, model number WX-SS-126 meeting the following requirements:

The radar detection unit shall include a non-intrusive device using frequency modulated continuous wave radar technology for the gathering of vehicle information including traffic volume, lane occupancy, individual and average speed, vehicle classification, and presence. It shall have auto configuration capabilities to simultaneously identify up to twelve highway lanes with the ability to detect over center median barriers and accurately detect partially occluded vehicles. Weather shall not impact the radar detection of the unit. Wind or temperature change shall not cause the device's original field installation configuration to alter over time. The radar detection unit shall include necessary hardware for pole mounting.

Manufacturer configuration software shall be the latest production version and allow for device discovery, configuration, and troubleshooting.

Power/communication cable shall be the manufacturer's recommended cable for functional operation of the radar detection unit.

A WX-CLK-301 module shall be furnished and installed, along with any cabling, to convert communications from Serial to Ethernet.

Detection unit power supply shall be Wavetronix WX-CLK-201 DIN mountable hardened AC to DC supply meeting manufacturer's recommendations for functional operation. Power supplies are not required when installed at ITS cabinets with existing 12VDC power supplies.

Serial surge suppressor shall be Wavetronix Click WX-CLK-200. The surge suppressor shall be DIN rail mountable with hot swappable protected busses. The surge suppressor shall provide protection for RS-232, RS-485, and DC power to the radar detection unit. Wiring for the surge suppressor shall be by means of pluggable screw terminals and include unprotected RS-232 and RS-485 communications connectors. The surge suppressor shall have a minimum operating temperature range of -29 to 165°F up to 95 percent relative humidity.

Additional hardware, including but not limited to: mounting hardware and data interconnection cables.

CONSTRUCTION REQUIREMENTS

0.75 inch Type 201 stainless steel strap used in conjunction with Type 201 stainless steel buckles shall be used to mount the radar detection unit at a height and angle determined by roadway off-set and detection distance in accordance with manufacturer's recommendations.

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**REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR**

The power/communication cable shall run on the interior of the mounting structure from the radar detection unit to the communications cabinet. A hole not to exceed 1.5 inches shall be made to allow passage of the power/communications cable into the structure. The hole shall not be made below the centerline of the sensor mount, or more than 2 ft above the centerline of the sensor mount. The Contractor shall ensure strain relief and drip loops in the power/communication cable before the cable enters the structure in accordance with manufacture's recommendations, and shall seal the hole with duct seal. Flexible conduit shall be used to run cables from the structure to the communications cabinet. A hole not to exceed 1.5 inches shall be made below the communications cabinet to allow the power/communications cable and communications cabinet supply power cable to pass from the interior of the structure to the interior of the communications cabinet.

All holes shall be free of burs and sharp edges prior to the installation of all cable, conduit, and conduit nipples. All cable entrances in structures, conduits, and cabinets shall be sealed and waterproofed. All wiring and electrical connections shall be performed in conformance with the latest version of the NEC.

The Contractor shall make necessary arrangements to install the serial surge suppressor on DIN rail inside the communication cabinet. The power/communications cable shall be terminated on the protected side of the WX-SC-200 surge suppression unit per manufacturer's recommendations. The radar detection unit shall be wired to support RS-232 and RS-485 serial communications. Power shall be wired to the manufacturer's recommended power supply or the existing 12VDC power supply supplied in the communications cabinet. Wiring from the surge suppressor to the communication device shall be stranded Cat5 cable.

The Contractor shall utilize the latest version of manufacturer's software to verify optimal and correct sensor alignment to the roadway and configure the sensor. The Contractor shall configure the radar detection unit to detect all lanes per Plan sheets or Project Engineers' direction and in accordance with the manufacture's recommendations. The Contractor shall configure the sensor for the following

Sensor Settings:

General:

Subnet/ID=000/Sensor ID per Plans

Location= HWY Installed Direction Mile Post and Common Name

Orientation=Direction the unit is pointing

Comm:

RS-232 Baud Rate=9600bps

Advanced:

SS105 Protocol=Off

RTMS protocol=Off

HW Handshaking RS-232=Off

Lane Setup:

Sensor Alignment = Shall show green, unless detected lanes are not parallel.

Lane configuration=setup per 'Proposed Lane Configuration in New Sensor' column on table

Data Setup & Collection

Interval Data – Interval=30s

Date& Time=Current

Data Push=Can be on as long as output is NOT on RS-232 port

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**REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR**

METHOD OF MEASUREMENT

The Microwave Vehicle Radar Detector will be measured by the actual number of units installed and accepted, and will include, testing, radar detection unit, detection unit power supply, manufacturer configuration software, power/communication cable, detection unit power supply, serial surge suppressor, pole-mounting hardware, installation hardware, all necessary wiring, communication cables, labor and all other items necessary to complete the work. Testing will be measured by verification of vehicle detection, speed and volume of all lanes in both directions with 90% accuracy.

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for the pay item listed below.

Payment will be made under:

Pay Item

Microwave Vehicle Radar Detector

Pay Unit

Each

**REVISION OF SECTION 614
FIBER OPTIC TERMINATION PANEL - 6 FIBER**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

This work consists of furnishing and installing 6-port fiber optic termination panels in field communications cabinets for single mode fiber. The 6-port termination panels shall be secured to the side of the communications cabinets.

MATERIALS

Configurations shall be as shown in the project plans and special details. The configurations of patch panels shall be as follows:

The unit shall meet the design requirements of ANSI/TIA/EIA-568 and the plastics flammability requirements of UL 94 V-0.

Field termination panels shall be provided in all communications cabinets install which require communications via fiber optic cable as shown in the plans. The panels shall be 6-port as shown on the plans and provided with ST type bulkheads. The panel shall be sized to accommodate the entry of the lateral fiber optic cable, the fiber fan-out, and bulkheads.

CONSTRUCTION REQUIREMENTS

All hardware shall be installed in accordance with manufacturer's recommendations. The Contractor shall provide the Project Engineer with documentation and all manuals. All connector housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606.

METHOD OF MEASUREMENT

Fiber optic termination panels and splice trays will be measured by the actual number of fiber optic termination panels and splice trays installed and accepted. Fiber optic pre-connectorized patch cables shall be included in the cost of termination panels installed.

BASIS OF PAYMENT

Payment will be under:

Pay Item

Fiber Optic Termination Panel - 6 Fiber

Pay Unit

Each

Payment will be full compensation for all labor, materials and equipment required to complete the work.

**REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing single mode fiber optic cable.

Fiber optic cable shall be used for either main backbone cable or lateral cables that connect to equipment field cabinets. The main backbone cable shall be terminated in a Communications Node or Regeneration Building. Lateral fiber cables shall be terminated using fan-out kits in a termination patch panel in the field equipment cabinet.

All fiber optic cables shall be suitable for outdoor conduit installation.

MATERIALS

All fiber optic cable shall have compatible chromaticities with proposed and existing cables.

All optical cables furnished on this project shall meet the following fiber optic industry standards:

- a) International Telecommunications Union Recommendation G.652 Table D
- b) Electronic Industries Alliance (EIA)
- c) Telecommunications Industry Association (TIA)
- d) International Organization for Standardization (ISO)
- e) Telecommunication industry Association (TIA)
- f) International Telecommunications Union (ITU)
- g) Insulated Cable Engineers Association (ICEA)

All cables shall be new and unused non-armored outdoor cable consisting of dispersion-unshifted, low water peak single-mode fiber strands free of surface imperfections and inclusions. Each single mode fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be of matched clad design.

(a) Fiber Strands

- a) Typical core diameter of 8.3 μ m
- b) Cladding Diameter of 125. 0 \pm 1 μ m
- c) Core-to-Cladding Offset: \leq 0.5 μ m
- d) Cladding Non-Circularity: \leq 1 %
- e) Coating Diameter (Colored): 245 \pm 10 μ m.
- f) Maximum Attenuation (Loose Tube): 0.35 dB//km at 1310 nm wavelength and 0.22 dB/km at 1550 nm wavelength
- g) Mode-Field Diameter: 9.20 \pm 0.30 μ m at 1310 nm wavelength and 10.40 \pm 0.50 μ m at 1550 nm wavelength

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

- h) Attenuation at the Water Peak: 0.32 to 0.34 dB/km at 1383 ± 3 nm wavelength
- i) Cutoff Wavelength: ≤ 1260 nm.
- j) Zero Dispersion Wavelength: 1300nm to 1322 nm
- k) Zero Dispersion Slope: $0.090 \text{ ps} / (\text{nm}^2 \bullet \text{km})$
- l) Polarization Mode Dispersion: $0.06 \text{ ps} / \sqrt{\text{km}}$
- m) Maximum Polarization Mode Dispersion at 0.01% distribution (PMDq): $0.20 \text{ ps} / \sqrt{\text{km}}$
- n) Maximum Fiber Dispersion: $3.5 \text{ ps}/(\text{nm} \bullet \text{km})$ for 1285 nm through 1330 nm and shall be $< 18 \text{ ps}/(\text{nm} \bullet \text{km})$ at 1550 nm.
- o) Fiber Curl: ≥ 4.0 m

All optical fibers shall be proof tested by the manufacturer to a minimum load of $0.7 \text{ GN}/\text{m}^2$ (100 ksi).

The fibers shall not adhere to the inside of the buffer tube.

The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be capable of being mechanically stripped with a force of 0.3 – 2.0 lbf (1.3 – 8.0 N).

Each single mode fiber strand shall be color coded with distinct and recognizable colors in accordance with the most recent version of EIA/TIA-598, Optical Fiber Cable Color, as shown in the plans.

(b) Buffer Tubes

Each buffer tube shall contain 6 or 12 fibers as appropriate for the respective size cable.

Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm

Each buffer tube shall be color coded with distinct and recognizable colors in accordance with the most recent version of EIA/TIA-598, Optical Fiber Cable Color, as shown in the plans.

In buffer tubes containing multiple fibers, the coloring shall be stable during temperature cycling as stated under “Fiber Specification Parameters” and shall not be subjected to fading or smearing onto each other or into the buffer tube gel filling material. Colorings shall not cause fibers to stick together.

Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester.

Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

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**REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)**

Buffer tubes shall be stranded around a central member of the cable using a reverse oscillation stranding process.

The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink requirements of EIA/TIA standards.

(c) Fiber Cable

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.

The central anti-buckling member of the cable shall consist of a glass reinforced plastic rod. The purpose of the central member shall be to prevent buckling.

For single layer cables, a water blocking tape shall be applied longitudinally around the outside of the strand tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus, electrically non-conductive homogenous. It shall also be free from dirt and foreign matter. Gel filled water-blocking compound shall not be allowed in the cable core interstices in either the backbone cable or the lateral cables.

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 (or rendered so by the flooding compound), and dielectric with low shrinkage.

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

Tensile strength shall be provided by high tensile strength dielectric yarns and shall be helically stranded evenly around the cable core.

Outer cable jacket shall have a consistent thickness throughout the entire cable length and shall be sheathed with medium density polyethylene, (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The MDPE shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The cable jacket shall be free of holes, splits and blisters.

Cable jackets shall be marked with sequential foot markings, year of manufacture and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within 0 to 1% of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be easily readable.

(d) Environmental Parameters

- a) Shipping, storage and operating temperature range of the cable as defined by Bellcore GR-12 shall be; -40°C to +75°C (-40°F to +167°F)
- b) Operating temperature range of the cable as defined by Bellcore GR-12 shall be; -40°C to +70°C (-40°F to 158°F)

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**REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)**

- c) Installation temperature range of the cable as defined by Bellcore GR-12 shall be; -30°C to +60°C (-22°F to +140°F)

(e) Quality Assurance

- a) All optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.
- b) The cable manufacturer shall be ISO 9001 registered.

(f) Packaging

- a) The complete cable shall be packaged for shipment on non-returnable wooden reels.
- b) Top and bottom ends of the cable shall be available for testing.
- c) Both ends of the cable shall be sealed to prevent the ingress of moisture.
- d) Each reel shall have a weatherproof reel tag attached identifying the reel and cable.
- e) Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.

CONSTRUCTION REQUIREMENTS

The Contractor shall provide the Engineer with two copies of the cable manufacturer's installation instructions for all fiber optic cable. All installations shall be in accordance with the manufacturer's recommendations except as otherwise directed by the Engineer. All additional costs including fiber optic cable associated to damages caused by the Contractor's neglect of recommended procedures shall be the Contractor's responsibility.

The Contractor shall submit a Method Statement to the Engineer indicating cable routing, splice points and cable end splicing locations. Installation of the cable will not be permitted until the schematic diagram has been approved by the Engineer.

Fiber optic cable including both backbone cables and lateral cables shall be installed in continuous runs. Under no conditions shall fiber optic cable be cut or spliced at intermediate points without express written direction from the Engineer.

Blowing cable is an acceptable alternative to pulling cable. If the Contractor chooses to use this method, submittals for cable installation shall be submitted along with complete information on fiber installation equipment.

The maximum pulling tension shall be 2700 N (600 lbs) during installation (short term) and 890 N (200 lbs) long term installed.

All cables shall have a minimum bending radius based on the diameter of the cable and shall meet the following;

- a) Pulled under tension, (Short Term) – 20 (Twenty times the cable diameter)
- b) Pulled not under tension, (Long Term) – 10 (Ten times the cable diameter)

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**REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)**

The fiber optic cable shall be installed in the conduit with a split-mesh cable grip to provide a firm hold on the exterior covering of the cable.

The manufacturer's recommended limits for cable pull lengths shall not be exceeded. The Contractor shall use a pulley system with a numerical readout indicating the cable tension. The pulley system shall be capable of alerting the installer when the cable pulling tension approaches the manufacturer's maximum allowable tension. The Contractor may supplement this procedure with a breakaway tension limiter set below the lowest recommended tensile limit of the cables being pulled. Intermediate pulleys shall be used at all pull boxes or manholes along the installation run to prevent cable damage.

If cable installation limits are met and the entire length cannot be installed completely from the shipping reel, installation shall be continued from the mid-point of the run. The Contractor shall first pull one-half of the cable from the reel at the mid-point through the conduit to one end of the run. The other half of the cable shall be removed from the reel and carefully placed on the ground in a figure eight pattern with a minimum loop diameter of 10 feet. While installing the remaining cable, care shall be taken to avoid any dragging against the ground resulting in damage or excess bending of the cable. The Contractor shall not kink, twist or bend the cable during installation coiling or uncoiling.

The cable shall be continuously lubricated as it enters the conduit. The Contractor shall only use pulling lubricants recommended by the cable manufacturer. Liquid detergent shall not be used.

If the Contractor must install new cable in conduits which contain existing fiber or electrical wiring, the Contractor shall be responsible for any damage to the existing cables or wires. After this installation the Contractor shall perform a functional test of all the equipment connected by the existing fiber cables or electrical wiring to ensure proper working conditions.

If an existing fiber optic cable is damaged during construction, it shall be removed from both points of termination and replaced, at no cost to the project. In no case shall the fill of any new conduit exceed the requirements of the National Electrical Code. The Contractor shall provide documentation to the Engineer supporting the conduit fill. All costs associated with equipment testing and repairs shall be included in the cost of the Fiber Optic Cable.

Lateral cables shall be installed in continuous runs from the backbone splice location to the field equipment cabinet. Odd length cables and reel ends are acceptable for lateral cables provided they are pre-tested and free of defects and are of sufficient lengths to archive continuous runs.

Lateral cables shall have slack and include a maximum of three locations of appropriate strain relief within all field equipment cabinets.

All fiber optic cables shall include identification labels attached to the cable in each pull box, manhole or field equipment cabinet. The label shall be provided with information as shown on the Project Detail Sheet.

The Contractor shall coil 50 feet of lateral cable in the manholes and pull boxes.

The Contractor shall ensure that all cable coils and splice canisters are attached to the cable management hardware in all pull boxes and manholes.

The Contractor shall terminate the lateral cable at the field equipment cabinet using a buffer tube fan-out kit. Fanned-out fiber strands shall be terminated in a termination block with ST connectors.

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

The Contractor shall submit a final documentation package. The final documentation package shall include the cable manufacturer’s installation procedures, technical support documentation and material documentation. These documents shall match the original submittals provided to the Engineer.

METHOD OF MEASUREMENT

Fiber Optic Cable shall be measured by the Linear Foot for both backbone and lateral cable and shall include all labor and materials required to install, splice and terminate the cable to make a complete and operational system and shall include the following items:

1. All required splice closures and splice closure reseal kits shall be furnished and provided to CDOT ITS for installation by Comcast.
2. All required termination panels in field equipment cabinets.
3. All required fan-out kits, hardware and labor to accomplish fan-out.
4. All required termination connectors, adapters, jumpers, pigtails, hardware and labor required to accomplish lateral cable terminations.
5. Identification labels for both backbone and lateral fiber cables in each pull box, manhole and field equipment cabinet.
6. As Built Documentation

BASIS OF PAYMENT

Payment for Fiber Optic Cable will be made according to the following schedule:

50% upon completion of cable installation

50% upon the review and acceptance of all fiber test results showing the conformance to this specification and the 614 Test Fiber Optic Cable Specification included in this plan package.

Payment will be made under:

Pay Item

Fiber Optic Cable (Single-Mode) (12 Strands)

Pay Unit

Linear Foot

Testing Fiber Optic Cable will not be measured or paid for separately. See 614 Test Fiber Optic Cable specification included in this plan package.

**REVISION OF SECTION 614
BUFFER TUBE FAN-OUT KIT**

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

For this project, the Buffer Tube Fan-out Kit shall be furnished and installed on 12-strand single mode fiber optic lateral cable ends in field communications cabinets.

MATERIALS

The Contractor shall use fiber optic fan-outs on the 12 fiber single mode lateral cable in the communications cabinet. Fanned out cables shall be installed on the ends of lateral fiber cable strands. Buffer tubes for lateral fiber strands shall be 9mm minimum and shall be neatly coiled and secured within the field termination panels with tubes matching the lateral fiber strand color. Bulkhead connectors shall be terminated on the ends of the lateral cable strands and installed on the back side of the termination panels.

METHOD OF MEASUREMENT

Buffer Tube Fan-Out Kit will be measured by the actual number of 12 fiber fan-out kits installed, terminated, and accepted.

BASIS OF PAYMENT

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Buffer Tube Fan-out Kit	Each

Payment will be full compensation for all labor, materials and equipment required to complete the work.

REVISION OF SECTION 614 CLOSED CIRCUIT TELEVISION CAMERA

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing an Internet Protocol (IP) Closed Circuit Television (CCTV) camera at the locations shown on the Plans.

MATERIALS

The CCTV camera shall include: camera with weatherproof dome housing, pole mount adapter, Power over Ethernet (PoE) midspan module, manufacturer supplied management software, Cat-6 Ethernet cables, and all attachment hardware to complete installation.

Camera Specifications –

The pan-tilt-zoom camera shall be of dome type construction and shall be enclosed in a sealed, heated environmental video dome housing to operate in 93% humidity at a minimum operating temperature of -40° to 122°F carrying both IP66 and NEMA 4x ratings. The camera shall utilize Ethernet protocol for native communications and be capable of sending multiple individually configurable video streams in H.264 and MJPEG format up to 30fps and capable of gathering a minimum of 50 preset color video still frame images with a minimum 176x120 resolution and maximum 704x480. The camera shall have an internal web interface for configuration with security functionality allowing multiple user access levels with password protection. The camera shall support Ipv4/v6, HTTP, HTTPS, SSL/TSL, QOS Layer 3 DiffServ, FTP, SMTP, SNMP v1/2/3, UpnP, DNS, DynDNS, NTP, RTSP, TCP, UDP, IGMP, RTCP, ARP, SOCKS.

Technical specifications for the camera shall be as follows:

- The lens shall be f=3.4 to 119mm, F1.4 to 4.2, autofocus; focus range of 35 mm (wide) to 800 mm (telephoto) to infinity. The angle of view shall be 2.8°- 48° horizontal with minimum zoom capability of 35x optical and 12x digital
- Minimum illumination color 0.5 lux at 30 IRE and B/W 0.005 lux at 30 IRE
- The camera shall provide dual mode, day (color) and night (monochrome) video down to 0.008 lux
- Shutter speed shall be variable from 1/30000 to 0.5 seconds at 60Hz.
- The pan function shall provide 360° of continuous rotation at 0.05 – 450°/s and a 220° tilt range allowing for 20° view above the horizon at 0.05 – 450°/s

Pole mount adapter arm and bracket -

The adapter shall have a minimum 33 lb load rating and have provisions that allow mounting directly to the weatherproof dome housing without modification to the housing. The adapter bracket shall have slots for a minimum of 2 straps or banding material for mounting to the poles from 3 inches to 6 inches in diameter. The bracket shall have cable strain relief in at least two locations on the reverse side, (between the bracket and the pole).

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**REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION CAMERA**

PoE midspan module-

Power for the camera shall be by means of a high power over Ethernet midspan module with a pass through port for all Ethernet communications. The module shall meet IEEE 802.3at and 802.3af standards and operate at temperatures from -40°F to +122°F. The PoE module shall allow 100-240 VAC input and 55 VDC output at 60W and operate at temperatures from -40°F to +122°F.

Manufacturer's supplied management software-

Management software shall give the user access to discover and configure the camera using standard network protocols. Software shall allow for network setup and firmware updates.

Cat6 Ethernet cable-

Cable shall be a UTP cable, Category 6 rated and constructed of 24 AWG stranded copper wires. The outer jacket shall be UV resistant PVC insulation. The Ethernet cable shall be terminated with male 8P8C connectors as a 'straight through' cable using the Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA) T- 568B pin/pair assignments.

CONSTRUCTION REQUIREMENTS

The CCTV camera shall be installed in accordance with these specifications, the details shown in the Plans, and in accordance with manufacturer's recommendations. The Contractor shall make all arrangements for a qualified manufacturer's representative to be on-site to ensure proper installation of the CCTV camera.

The weatherproof dome housing shall be attached to the pole mount adapter using the materials supplied from the manufacturer.

For the attachment of the adapter bracket to the pole, a ¾ inch type 201 stainless steel strap used in conjunction with type 201 stainless steel buckles at a mounting height shown on the Plans. The attachment shall be banded to the pole at an orientation to achieve the optimal view of both the main roadway and crossroad or as directed by the Engineer.

A maximum 1 inch hole shall be drilled in the mounting pole to allow passage of the Ethernet cable. The hole shall be free of burrs and sharp edges prior to the installation of the Ethernet cable. The Ethernet cable shall be attached to the reverse side of the mounting bracket to ensure proper strain relief or damage caused to the camera or housing. The Ethernet cable shall run down the interior of the pole and exit through non-metallic flexible conduit to the communication cabinet. The non-metallic flexible conduit shall be weather sealed on each end to eliminate exterior liquid entry. The Contractor shall also provide a weather seal for the adapter bracket at the 1 inch hole at the top of the pole per the manufacturer's recommendations.

The PoE midspan module shall be securely mounted in the communication cabinet and plugged into the communications power outlet. The Ethernet cable attached to the camera shall be connected to the PoE midspan output jack. A separate Cat 6 Ethernet cable shall be provided for connection to the field communication device.

METHOD OF MEASUREMENT

Closed Circuit Television will be measured by the actual number of Closed Circuit Televisions installed and accepted for a complete installation. Also included shall be all configuration, cabling, dome housing, adaptor arm, adaptor bracket, and PoE midspan module. All costs associated with arranging for the manufacturer's representative to be on-site will not be measured and paid for separately, but shall be included with the cost of the CCTV.

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REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION CAMERA

BASIS OF PAYMENT

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Closed Circuit Television	Each

Payment will be full compensation for all labor, materials and equipment required to complete the work.

**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

Section 614 of the Standard specifications is hereby revised for this project as follows:

DESCRIPTION

Testing shall be performed to assure the cable’s performance and durability in the field environment. It shall conform to the following industry standards organizations:

- Electronic Industries Alliance (EIA)
- Insulated Cable Engineers Association (ICEA)
- International Electrotechnical Commission (IEC)
- International Organization of Standardization (ISO)
- International Telecommunication Union – Telecommunication Standardization Sector (ITU-T)
- Telcordia Technologies, Inc. (Telcordia)
- Telecommunications Industry Association (TIA)

The industry standards shown in the table below shall be referenced throughout this section by its Section Standard Number (SSN).

SSN	Standard	Edition	Fiber Optic Test Procedure (FOTP)	Standard Title
8-1	TIA-526-7	02	7	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
8-2	TIA-455-78	B	78	Optical Fibers: Attenuation Measurement Methods and Test Procedures
8-3	ICEA S-84-608	07	N/A	Telecommunications Cable Filled, Polyolefin Insulated, Copper Conductor Technical Requirements
8-4	ICEA S-85-625	07	N/A	Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements
8-5	ITU-T G.652	05	N/A	Characteristics of a Single-Mode Optical Fiber and Cable
8-6	TIA-455-3	B	3	Procedure to Measure Temperature Cycling Effects on Optical Fiber Units, Optical Cable and Other Passive Components
8-7	EIA-359		N/A	Colors for Color Identification and Coding
8-8	TIA-598	C	N/A	Optical Fiber Cable Color Coding
8-9	TIA-455-82	B	82-B	Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
8-10	TIA/EIA-455-81	B	81	Compound Flow (Drip) Test for Filled Fiber Optic Cable
8-11	TIA/EIA-455-41	A	41	Compressive Loading Resistance of Fiber Optic Cables
8-12	TIA-455-104	A	104	Fiber Optic Cable Cyclic Flexing Test
8-13	TIA/EIA-455-25	C	25	Impact Testing of Optical Fiber Cables

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**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

SSN	Standard	Edition	Fiber Optic Test Procedure (FOTP)	Standard Title
8-14	TIA-455-33	B	33	Optical Fiber Cable Tensile Loading and Bending Test
8-15	TIA-455-85	A	85	Fiber Optic Cable Twist Test
8-16 NOT USED	TIA/EIA-455-181	93	181	Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components
8-17	TIA/EIA-455-226	02	226	Calibration of Optical Time-Domain Reflectometers
8-18	TIA-455-231	03	231	Calibration of Fiber Optic Power Meters
8-19	ISO/IEC 17025	05	N/A	General Requirements for the Competence of Testing and Calibration Laboratories
8-20	TIA-455-37	A	37	Low or High Temperature Bend Test for Fiber Optic Cable
8-21	TIA/EIA-455-98	A	98	Fiber Optic Cable External Freezing Test
8-22	Telcordia GR-20 CORE	3	N/A	Generic Requirements for Optical Fiber and Optical Fiber Cable
8-23	ISO 9000	N/A	N/A	International Standards for Quality Management

8.10: FIELD TESTING

8.10a: Prior to completion of the work, the CONTRACTOR shall run the following tests on all traffic signals in the presence of the ENGINEER or the signal maintenance contractor.

8.10b: Each circuit shall be tested for continuity and for grounds.

8.10c: A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for each traffic signal system shall consist of not less than thirty (30) days of continuous, satisfactory operation commencing with full operation of all electrical facilities.

8.10d: When fiber optic cable is installed, the fiber optic cable test shall consist of the testing of single mode fiber optic cable. The testing procedures involve an Optical Time Domain Reflectometer (OTDR) test and an Optical Power Meter Test.

The guidelines for fiber optic cable testing include:

- (1) Launch box and test jumpers must be of the same fiber core size and connector type as the cable system:
 - i) Singlemode fiber 8.3/125 μm

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**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

- (2) The light source and OTDR must operate within ± 20 nm of the 1310/1550 nm singlemode nominal wavelength for testing in accordance with SSN 8-1.
- (3) The power meter and the light source must be set to the same wavelength during testing.
- (4) The OTDR and power meter must be calibrated at each of the nominal test wavelengths and traceable to the National Institute for Standards and Technology (NIST) calibration standards. The calibration of the OTDR and power meter shall conform to the requirements set forth in SSN 8-17 and 8-18, respectively.
- (5) All system connectors, adapters and jumpers must be cleaned as per manufacturer's instructions before measurements are taken.

MATERIALS

- A) Fiber Optic Cable Testing Equipment.** Equipment shall be calibrated biennially by the manufacturer or by a SSN 8-19 accredited calibration laboratory. A copy of the most recent certificate of calibration and any out-of-tolerance conditions shall be provided to the ENGINEER prior to the initiation of any testing activities. The following is equipment and information is required to perform fiber optic cable tests:
- (1) an OTDR (submit certification and put in checklist)
 - (2) a launch box (min length – 300 m)
 - (3) a light source at the appropriate wavelength
 - (4) Optical Power Measurement Equipment capable of measuring optical power in dBm.(submit certification in checklist)
 - (5) CPR Test Jumper-1 and Test Jumper-2 shall be 1-4 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested per SSN 8-1.
 - (6) Jacket Length measurements for lateral and backbone cable at each end including splice enclosures and patch panels.
 - (7) Bare fiber slack not accounted for in jacket length.
- B) Optical Fiber Cable Testing with OTDR.** The CONTRACTOR shall perform an OTDR test of all fibers in all tubes on the reel, prior to installation of the fiber. The test results shall be supplied to the ENGINEER prior to installation of the cable.

Fiber testing shall be performed on all terminated fibers from patch panel to patch panel and unterminated fibers from end to end. Additionally, mid entry splices into mainline cables require testing of all strands in the mainline cable, before and after installation. Testing shall consist of a bi-directional end-to-end OTDR trace performed per SSN 8-2. The system margin loss measurements shall be provided at dual wavelengths 1310 and 1550 for singlemode fibers.

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**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

Tables to be filled out by contractor for OTRD results.

Pulse width
Layout

OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant; generally, more accurate or reliable values will be obtained by using an Optical Power Meter

Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

The CONTRACTOR shall use an OTDR that is capable of storing traces electronically and shall save each final trace.

To ensure the traces identify the end points of the fiber under test and the fiber designation, the CONTRACTOR shall use a test reel if required, to eliminate the “dead zone” at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results.

If the fiber designation is not indicated on the trace itself, the CONTRACTOR shall provide a cross-reference table between the stored trace file name and the fiber designation.

In compliance with SSN 8-2 , the CONTRACTOR shall record the following information during the test procedure:

- (1) Name and contact information for individual responsible for conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date and valid certification of calibration).
- (3) Date test is being performed.
- (4) Jacket readings in and out of each splice vault and each pullbox
- (5) Corrected index of refraction– do we need this – use refraction recommended by Cable manufacturer.
- (6) Optical source wavelength and spectral width.
- (7) Fiber identification.
- (8) Start and end point locations.
- (9) Launch conditions
- (10) Method of calculation for the attenuation or attenuation coefficient.
- (11) Acceptable link attenuation.

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- C) Optic Fiber Cable Testing with Optical Power Meter.** The CONTRACTOR shall conduct an Optical Power Meter Test for each fiber installed. Singlemode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

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**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

In compliance with SSN 8-1, the following information shall be recorded during the test procedure:

As above

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength, spectral width,
- (5) Fiber identification.
- (6) Start and end point locations.
- (7) Test direction.
- (8) Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- (9) Measured attenuation of the link segment.
- (10) Acceptable link attenuation.

D) Acceptable Attenuation Values. Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.

- (1) *Singlemode Fiber.* The general attenuation equation for any singlemode link segment is as follows:

$$\text{Acceptable Link Attn.} = \text{Cable Attn.} + \text{Connector Attn.} + \text{Splice Attn.}$$

8.3 μm Single-mode Attenuation Coefficients:

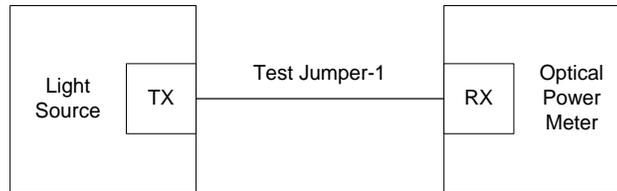
- (i) Cable Attn.=Cable Length (km) x (0.35 dB/km@1310 nm or 0.25 dB/km@1550 nm)
- (ii) (No. of Mated Connections x 0.50 dB)+Connection Attn. (LC connectors)=(No. of Connections x 0.14 dB)+0.24 dB.
- (iii) Splice Attn. (Fusion)=Splices x 0.30 dB.

E) Test Procedures. All fiber testing shall be performed on all fibers in the completed end-to-end system.

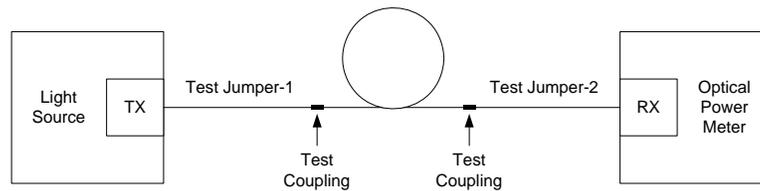
- (1) *Singlemode Fiber.* The singlemode Optical Power Meter fiber test shall be conducted as follows:

- i) Clean the test jumper connectors and the test coupling per manufacturer's instructions.
- ii) Follow the test equipment manufacturer's initial adjustment instructions.
- iii) Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE



- iv) If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement (P_{ref}). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- v) Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.
- vi) Attach Test Jumper-1 to one end of the cable plant to be measured and Test Jumper-2 to the other end.



- vii) Record the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the true value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:
 - a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.):
 $CPR (dB) = P_{sum} - P_{ref}$
 - b) If P_{sum} and P_{ref} are in watts:
 $CPR (dB) = 10 \times \log_{10} [O_{sum}/P_{ref}]$

F) Test Acceptance. The CONTRACTOR shall demonstrate that the tests result in acceptable attenuation values.

The CONTRACTOR, solely at the CONTRACTOR’S cost, shall resplice any fusion splices and/or reterminate any terminations that have test results exceeding acceptable attenuation values. The CONTRACTOR, solely at the CONTRACTOR’S cost, shall retest any fiber links that have been re-spliced.

The CONTRACTOR, solely at the CONTRACTOR’S cost, shall bring any link not meeting the requirements of this specification into compliance.

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**REVISION OF SECTION 614
TEST FIBER OPTIC CABLE**

G) Submittals. The CONTRACTOR shall submit test results documentation as both a hard copy and electronic copy.

After each reel test, the CONTRACTOR shall submit one hard copy of the OTDR trace for every fiber on the reel. After installation, the CONTRACTOR shall submit one hard copy of the OTDR trace for every fiber. Hard copy traces shall be organized and bound in logical order in an 8 ½” x 11” hard cover binder.

The CONTRACTOR shall submit, after approval of the hard copy traces, electronic copies of all traces (pdf and native file format) and appropriate software, if needed, to allow reading the traces.

The CONTRACTOR shall submit one copy of the complete contract Plans, including additional drawings issued as part of any change orders, with any deviations clearly marked in color. Deviations to be noted and shall include but not be limited to the following:

- (1) Fiber Splice location
- (2) Fiber Splice configuration
- (3) Termination layout

H) Thirty Day Burn In Period.

8.10e: During the thirty-day burn-in period, the CONTRACTOR is responsible for the maintenance of the system or systems. The cost of any maintenance necessary, except electricity, damage by public or act of God, shall be borne by the CONTRACTOR and will be considered as included in the price paid for the contract item involved, and no additional compensation will be allowed therefore.

BASIS OF PAYMENT

Payment will be made under:

Pay Item

Test Fiber Optic Cable

Pay Unit

Lump Sum

Payment will be full compensation for all labor, materials and equipment required to complete the work.

**REVISION OF SECTION 614
FIBER OPTIC SPLICE CLOSURE**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Subsection 614.01 shall include the following:

Fiber optic splice closures and fiber reseal kits are to be furnished and provided to CDOT ITS. All fiber optic splicing will be performed by Comcast. The contractor shall contact Bill Kascek with CDOT at 303-564-5549 two weeks prior to splicing to coordinate fiber optic cable splicing by Comcast.

MATERIALS

Subsection 614.08 shall include the following:

(u) *Fiber Optic Splice Closure.* The fiber optic splice canister shall be furnished by the Contractor and provided to CDOT ITS. It shall be sized to provide capacity for splicing the total number of strands in all cables entering the canister.

The splice closure shall be a stand-alone closure that does not require an outer closure and shall meet the following minimum requirements:

- The closure shall seal, anchor and protect fiber optic cable splices.
- The closure shall provide for a minimum of two additional spare entries in addition to the required number of cables being spliced up to a maximum of six total cable entries.
- The closure shall be suitable for underground applications and shall be water and airtight.

The closure shall be sized to provide the capacity equal to the total number of strands in all cables entering the closure.

If an existing closure, or a closure provided by the Contractor requires reentry and resealing, the Contractor shall furnish the fiber reseal kit and provide to CDOT ITS.

It is the Contractor's responsibility to ensure that the fiber optic splice enclosure and associated fiber cable coil fit adequately within the pull box specified on the plans. No additional payment shall be made for modifications to the pull box.

The Contractor shall contact the Bill Kascek with CDOT at 303-564-5549 two weeks prior to work at each splicing location to coordinate fiber optic splicing.

METHOD OF MEASUREMENT / BASIS OF PAYMENT

Subsection 614.13 shall include the following:

Fiber Optic Splice Closure will not be measured or paid for separately but will be considered subsidiary to Fiber Optic Cable (Single Mode) pay item.

**REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION POLE WITH LOWERING DEVICE**

DESCRIPTION

This work consists of furnishing and installing closed circuit television poles for the mounting of various Intelligent Transportation Systems (ITS) devices and communications cabinets. This work shall be done in accordance with these specifications, the latest AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5th Edition, with current interims (Sign Code), and in conformity with the details shown on the plans.

This work includes the installation of a single tapered tubular steel post, a lowering system for a closed circuit television (CCTV) camera, and a concrete caisson foundation at the location shown on the plans. Lowering device shall allow closed circuit television cameras to be lowered to five feet above ground for maintenance purposes without interfering with any other pole-mounted devices or cabinets. Lowering device cables shall be contained inside the pole.

MATERIALS

- (a) *Poles.* Tapered tubular steel posts shall conform to the requirements of ASTM A595 Grade A or ASTM A572 Grade 55. Bars and plates shall conform to AASHTO M-270. Anchor bolts shall conform to ASTM F1554 Grade 55. All steel shall be galvanized in accordance with AASHTO M-111 (ASTM A123), except fasteners shall be galvanized in accordance with AASHTO M-232 (ASTM A153). Shop drawings shall be submitted in accordance with Section 105.02.
- (b) *Lowering device.* The camera lowering system shall be designed to support and lower a standard CDOT closed circuit television camera (as described in the Contract), lens, housing, Pan-Tilt-Zoom mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The Contractor shall ensure that the camera lowering system device and the pole are compatible. The lowering system shall consist of a pole, suspension contact unit, divided support arm, a pole adapter for attachment to a pole one foot from the top, pole top junction box conduit mount adapter, camera connection box and shall lock into place to prevent shaking of the camera. The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and insure the contact unit cannot twist under high wind conditions. Square support arms are not acceptable. The camera-lowering device components and arm shall be designed in accordance with the Sign Code for 110 mph wind velocity (3-Second Gust). The lowering device manufacturer shall be able to identify a minimum of three previous projects where the proposed system has been installed successfully.

The suspension contact unit shall have a load capacity 600 pounds with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of two latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The lowering device manufacturer shall provide a conduit mount adapter for housing the lowering cable. This adapter shall have an interface to allow the connection of a Contractor provided 1.50 inch PVC conduit and be located just below the cable stop block at the back of the lowering device. The Contractor shall supply internal conduit in the pole as directed by the Lowering Device provider. The only cable permitted to move within the pole or lowering device during lowering or rising shall

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**REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION POLE WITH LOWERING DEVICE**

be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operations.

The female and male socket contact halves of the connector block shall be made of materials rated for outdoor use and extreme temperature ranges. The female socket contacts and the male pin contacts shall be copper plated with nickel and gold.

The current carrying male contacts shall be 12 gauge (1/10 inch in diameter). There shall be four alignment contacts that are longer than the rest which will mate first and break last providing optimum grounding performance. The number of contacts shall be 16 and the camera mounted thereto, shall be capable of performing all of its necessary functions on 16 contacts or less.

The current carrying female socket contacts shall be 12 gauge (1/10 inch in diameter). The female socket contacts shall be spring-loaded to provide positive mating.

A composite cable (video, data and power) will be potted and sealed into each half of the connector block.

The composite cable will be a continuous run of cable from the top of the pole to the field cabinet or other junction box. No pole top splices will be allowed. The composite cable from the bottom connector will feed into the camera junction box or directly to the camera. The coaxial cable will be provided with BNC connectors.

All pulleys for the camera lowering device and portable lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearings, or sintered- oil impregnated, bronze bushings. The lowering cable shall be a minimum 1/8-inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with seven strands of 19 wires each.

All electrical and video coaxial connections between the fixed and lower able portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and 1 volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The interface and locking components shall be made of stainless steel and or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

- (c) *Foundation.* Concrete for caisson foundations shall Class BZ and shall conform to the requirements of Section 601. Reinforcing steel shall conform to the requirements of Section 602.

CONSTRUCTION REQUIREMENTS

The lowering device manufacturer shall furnish the Contractor an on-site factory trained representative. The manufacturer shall furnish the CDOT engineer documentation certifying that the electrical contractor has been instructed on the installation, operation and safety features of the lowering device. The manufacturer shall provide CDOT personnel with the same on-site 6 hour training session on the use of the lowering device.

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**REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION POLE WITH LOWERING DEVICE**

The Contractor shall ensure that the camera will provide weights and /or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

The Contractor shall ensure that the camera will provide the power and signal connectors for attachment to the bare leads in the pole top and/or camera junction boxes.

Caisson foundations shall be installed in accordance with Section 503.

METHOD OF MEASUREMENT

CCTV Pole with Lowering Device will be measured as the actual number of poles that are installed and accepted.

BASIS OF PAYMENT

<u>Pay Item</u>	<u>Pay Unit</u>
CCTV Pole with Lowering Device (50 foot)	Each

Payment will be full compensation for all labor, materials and equipment required to complete the work.

All costs associated with arranging for the manufacturer’s representative to be on-site will not be measured and paid for separately, but shall be included in the work.

All costs for the caisson will be measured and paid for separately in accordance with Section 503 under pay item 503- Drilled Caisson.

All costs for the camera, traffic detectors and cabinet will be measured and paid for separately in 614- CCTV and 614-Comm Cabinet.

**REVISION OF SECTION 614
ETHERNET SWITCH**

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

For this project the Ethernet Switch shall be an IE3000 CISCO Ethernet Access Switch to be installed at roadway Intelligent Transportation System (ITS) devices for data communications from the field device to the regeneration node.

MATERIALS

This Ethernet switch is proposed for the transport of Ethernet data for roadway devices on this project. The Cisco 3000 switch shall be configured with 8 10/100 Ethernet ports in addition to two (2) Small Form-Factor Pluggable (SFP) based 1 Gigabit Ethernet ports. An additional SFP shall be provided at the existing Hidden Valley node building switch.

The Contractor shall furnish and install the Cisco 3000 Ethernet Switch as configured in the item table below. The table describes items for a single CISCO Ethernet switch

ITEM DESCRIPTION	ITEM NUMBER	QUANTITY
CISCO IE 3000 Switch, 8 10/100 + 2 T/SFP	IE-3000-8TC	1
IE 3000 Power Transformer	PWR-IE3000-AC=	1
Smartnet 8x5xNBD	CON-SNT-IE38TC	1
1000Base LX/LH SFP, Rugged	GLC-LH-SM-RGD=	3*

* One of the SFP Optics shall be installed at the existing Hidden Valley node building switch.

The Ethernet switch shall be installed with a basic configuration in conformance with CISCO Systems by certified CISCO Systems personnel either prior to installation or at the installation site. Final configuration for data transport will be conducted by CDOT personnel after installation, basic configuration approval and final acceptance has been given.

The contractor shall place attenuators on the receive end of the ZX optics if necessary. After the fiber has been installed, the contractor shall test the actual losses and base the attenuator on the field conditions.

If field changes are made which would affect the original Contractor order of the Ethernet switch, and would require any reconfiguration of the Ethernet switch order, the Contractor shall ensure that the CISCO Systems representative is contacted and made aware of such changes in order to alleviate any possible delays in the delivery.

All associated hardware not listed in the item table is considered subsidiary and is required for a complete installation and shall be included as part of the work.

If for any reason the switch or any associated device modules are defective or are damaged at the time of installation by either the Contractor or by CISCO Systems, the item shall be removed and replaced at no additional cost to the project. Items shall also be replaced if any failures occur due to manufacture defects, at no additional cost to the project prior to the final acceptance.

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**REVISION OF SECTION 614
ETHERNET SWITCH**

The Ethernet switch shall be DIN Rack mountable.

The Contractor shall provide patch cables for the connection of the Ethernet switch to the fiber optic patch panel. The cable shall be a single mode-duplex cable, in lengths sufficient to span from the switch to the patch panel with a maximum of two feet of slack. Connectors shall match both the switch SFP module and the proposed patch panels.

METHOD OF MEASUREMENT

Ethernet Switch will be measured by the actual number of Ethernet Switches installed and accepted.

BASIS OF PAYMENT

Payment will be under:

<u>Pay Item</u>	<u>Pay Unit</u>
Ethernet Switch	Each

Payment will be full compensation for all labor, materials and equipment required to complete the work

**REVISION OF SECTION 614
SIGN PAINTING (DARK BROWN)**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

In subsection 614.09, eleventh paragraph, delete the first sentence and replace with the following:

Structural steel shall be given one shop coat of primer and two (2) coats of dark brown paint in conformity with subsection 509.24. Dark brown paint shall be manufactured to meet Fed. Spec. TT-E-529G and the color shall match Fed. Std. 595B, No. 20059 All exposed portions of galvanized steel shall conform to the following:

- (a) All foreign substances shall be removed.
- (b) One coat of bonding agent shall be applied uniformly on the surface. Bonding agent shall be Vinyl Butyral Wash Primer conforming to MIL-P-15328 (SSPC Paint No. 57). After the bonding agent has dried sufficiently, (not more than 24 hours) one coat of exterior enamel shall be applied by a suitable method that will insure a uniform coating free of blemishes, discontinuities, base edges or other imperfections. Defective surfaces shall be touched up with paint as required.

Structural members, walkway grating, brackets, railing, electrical conduit, metal sign posts, backings sees, and the backside of all new sign panels, for signs indicated in the Tabulation of Signs and Overhead Sign Tabulation, shall be painted dark brown. Paint shall conform to Section 708. All aluminum surfaces to be painted shall be prepared as noted above for galvanized steel.

Subsection 614.14 shall include the following:

Painting signs and sign structures dark brown will not be paid for separately but shall be included in the work.

**REVISION OF SECTION 620
FIELD FACILITIES**

Section 620 of the Supplemental Specifications is hereby revised for this project as follows:

Subsection 620.02 shall include the following:

The Field Office (Class 2) shall be equipped with a facsimile machine and a copy machine. The functions of both machines may be combined into a single machine or may be separate, as approved by the Engineer.

The Contractor shall install and maintain the facsimile and copy machines in the Engineer's field office.

The facsimile machine shall print on plain paper and shall be capable of sending documents of all sizes up to and including 11" X 17". The machine shall be one of the following or an equivalent as approved by the Engineer.

- 1) Panasonic UF-750 Plain Paper Laser Fax
- 2) Xerox 7020 Facsimile Terminal
- 3) Canon Fax 850

The copy machine shall be a dry, desk top model with a stationary platen.

The copy machine shall be capable of producing a minimum of 15 copies per minute. Maximum size of the original shall be 11" x 17" with standard intermediate sizes and shall have an automatic document feeder capable of feeding a stack of up to 25 originals ranging in size from 5-1/2" x 8-1/2" to 11" x 17".

Copy machine shall have two (2) standard paper cassettes accommodating paper sizes 5- 1/2" x 8-1/2" to 11" x 17". Each cassette shall accept 250 sheets for a total of 500 sheets of paper capacity. Machine shall have a single sheet bypass for manual copying onto special stock not in paper cassettes and capable of using copy paper sizes 5-1/2" x 8-1/2" to 11" x 17".

Copy machine shall have an automatic exposure control to automatically control exposure level for each original with a manual light/dark exposure control and shall be capable of copying original documents of both sheets and bound documents.

Copy machine shall be capable of making 1 to 99 continuous copies and shall be capable of copying onto light weight paper of 16# or onto heavier paper of 32#.

Copy machine shall be capable of zoom magnification/reduction from 70% to 150% in 1% increments.

Paper for both machines will be provided by the Department. All other supplies, parts, and repairs shall be provided by the Contractor. One additional toner cartridge for each machine shall be provided and shall be replaced by the Contractor as directed by the Engineer.

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REVISION OF SECTION 620
FIELD FACILITIES

The Field Office (Class 2) shall be provided with a minimum of three telephones, one located at each end office of the facility and one in the center portion. Two private lines shall be provided with roll over capability for incoming phone calls. Each of the telephones provided shall be fully capable of utilizing either line. The Contractor shall supply an ISDN line to the field office for the duration of the project. This shall include an internet service provider and all necessary hardware to allow the Project Engineer and the Project Inspector (2 computer Connections) to have internet access using a VPN connection. This will not be paid for separately but will be included in the Field Office Item. Three jacks shall also be provided for connection to a microcomputer modem or to a facsimile machine modem. One jack shall be located in each of the offices in either end of the field office, and one jack shall be located in the center portion of the field office. The Contractor shall provide a communications cord for the facsimile machine and one for a microcomputer, each long enough to reach one of the jacks from any location in the field office.

Subsection 620.06 shall include the following:

The Field Office (Class 2) and the Field Laboratory (Class 2) shall each be equipped with one of the two following security systems or an approved equal:

- 1) Security guard on premises at all time during non-working hours, or
- 2) Surveillance or silent watchman type electronic security system installed in each of the field facilities and in the yard in which the facilities are set.

The Contractor shall provide insurance against theft or damage for all inventory stored in the field facilities. The Contractor shall replace any equipment damaged or stolen within five working days.

The Contractor shall maintain all furnished equipment in good working condition and shall replace or repair any nonfunctional equipment within five working days.

Field facilities shall be fully functional for the Engineer's use from the beginning day of work, until 45 calendar days after final project acceptance or until the Engineer requests its removal in writing, whichever time is least.

Subsection 620.08 shall include the following:

All costs incidental to the foregoing requirements shall be included in the original contract price for the field facility.

**REVISION OF SECTION 625
CONSTRUCTION SURVEYING (HOURLY)**

Section 625 of the Standard Specifications is hereby revised for this project as follows:

Subsection 625.01 shall include the following:

The Contractor shall also perform Construction Surveying (Hourly) as required by the Engineer. This item will not be used for work as defined in item 625 Construction Surveying. The intent of this is to compensate the Contractor for plan revisions or work to be done due to inconsistencies or errors on the plans that could not have been reasonably detected by the Contractor.

Subsection 625.12 shall include the following:

The method of measurement for the work described as construction surveying (hourly) shall be measured on an hourly basis. The number of hours paid will be the actual crew time, based on a 2-man crew, as determined by the Engineer. Office support hours for calculations, etc., will be paid at one half hour of crew time per one hour of office work as determined by the Engineer.

In subsection 625.13, delete the second paragraph and include the following:

Payment for the work described as construction surveying (hourly) shall be paid at the hourly rate bid and will be full compensation for the work necessary to complete the work. The payment will be made when the work is complete.

Payment will be made under:

<u>Pay item:</u>	<u>Pay Unit</u>
Construction Surveying (Hourly)	Hour

**REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES**

Section 626 of the Standard Specifications is hereby revised for this project as follows:

Subsection 626.01 shall include the following:

The Contractor shall prepare and maintain a Public Information Plan (PIP) in coordination with CDOT to develop and communicate information to and from the public regarding the Project. This PIP shall be used throughout the duration of the Work by the Contractor to manage and implement the public information process. Included in the PIP and in coordination with CDOT, the Contractor shall provide information on project vision, progress and coping during project work.

The Contractor shall be accessible 24 hours a day, seven days a week, for Activities associated with public information and shall have experience in this area. The Contractor shall provide contact information, including home, mobile and e-mail addresses to CDOT for Acceptance (which may include Public Information Manager (PIM), project managers, and the additional public information officers) at NTP. The Contractor shall hold regular coordination meetings with CDOT to provide Project schedule, accomplishments, and planned activities for the upcoming week.

The Contractor's final PIP shall be submitted to CDOT for Approval prior to NTP. The Contractor shall schedule and hold PIP review meetings with CDOT to review, assess input, and/or modify the Contractor's PIP as necessary.

CDOT has identified the below listed Stakeholders as audiences requiring Contractor outreach. The Contractor shall describe in the PIP its approach to communicating with these stakeholders and coordinating with CDOT. The Stakeholders include, but are not limited to:

1. Area residents.
2. Property owners and property management companies.
3. Commuters.
4. The traveling public.
 1. Commercial vehicle operators and Colorado Motor Carriers Association.
 5. Local, regional, and state government officials.
 6. Chamber of Commerce
 7. Business owners, employees, and customers.
 8. Neighborhood associations.
 9. Emergency response agencies, such as the Colorado State Highway Patrol, Police Departments, AMR (ambulance), Fire Departments, hospitals.
 10. Delivery and courier services.
 11. Recreational users and businesses.
 12. CDOT employees and other internal team members, including CDOT headquarters and Public Relations Office.
 13. Mass transit agencies/companies.

As part of the Contractor's PIP, the Contractor shall develop and use a communication matrix listing the stakeholders and the information tools to be used to address each group of stakeholders' informational needs. The Contractor shall develop a communications matrix for stakeholder groups, and individuals and businesses with special needs, which will identify:

1. The customer group(s) that require information.
2. Location or region of customer group(s).
3. What information is needed?
4. When information is needed?

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**REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES**

5. Tools to be used for disseminated information.
6. Results of information dissemination.

The Contractor shall develop a master distribution list (or database) of contacts to be used for General public information, publications, and informational flyers/newsletters. This list or database shall be presented to CDOT for review, prior to NTP.

Depending upon project impacts, contact with stakeholders may be required daily, weekly, monthly or periodically throughout the duration of the project. Communications tools could include hand flyers, door hangers, newsletters, mailers, using e-mail distribution lists, and the I-70 Twin Tunnels website, as approved by CDOT in the Public Information Plan. Each communication tool shall include contact information, PIM's name, office phone, CDOT Web-site address with CDOT logo. Cell phone numbers and e-mail addresses shall be provided where service is available. All public information correspondence and subsequent updates must be approved by CDOT Region Public Relations Manager 48 hours before distribution.

The Contractor shall be responsible for collecting, processing, and providing to CDOT several types of coping information that impact the Project. Outlined below are some, but not all, of the types of information necessary to inform the public regarding the Project. The Contractor shall include the following types of information and minimum performance expectations when developing the various components of the PIP:

1. Construction Activities.

Construction notification shall be made available to CDOT at least two weeks prior to the beginning of any construction in any area of the Project. The Contractor shall coordinate, communicate, and address coping strategies in its PIP. Notification of construction events shall include:

- (1) Description of activity.
- (2) Start and end of the activity.
- (3) Residents and businesses impacted or affected.
- (4) Proposed alternative routes and detours.
- (5) The Contractor's contact for further information.
- (6) Project public web site address for further information.
- (7) Commercial Vehicle Access and Restriction Information.

2. Maintenance of Traffic.

The Contractor shall issue a weekly lane closure report information to CDOT, using a template provided by the Engineer, that it can be used for notices regarding the Maintenance of Traffic for the entire Project for commuters, emergency services agencies, residents, businesses, or any other stakeholders who will be impacted by the Project. The Contractor shall include, at a minimum, the following elements within the notifications:

- (1) Description of the activity.
- (2) The start of the activity.
- (3) The end of the activity.

3. Pedestrian and Bicycle Access

The Contractor shall clearly define and communicate to stakeholders and CDOT information that it can use to inform the public and other associated stakeholder groups its plans for maintaining bicycle access, pedestrian access, and handicapped mobility.

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**REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES**

In an event of a crisis, CDOT will be the lead agency to handle communication with the media, public, CDOT staff, etc. The Contractor shall be available to help coordinate with CDOT and provide information necessary to respond to the crisis. The PIP shall include a crisis communications plan for the Contractor's response to

Department of Public and Environmental Health two weeks prior or within 24 hours of any unexpected construction that results in turbidity or sedimentation in Clear Creek.

The Contractor shall implement a telephone hotline prior to NTP as a means of receiving community input, answering questions, and prompting possible solutions regarding Project related activities. The hotline shall be available to the public 24 hours a day, seven days a week, and shall be publicized in all Project information materials and signage throughout the Project. The PIM shall record a friendly greeting on the project's published phone line each week, updating the message throughout the week, as necessary, depending on changes in work schedule, activities and traffic impacts. The recording shall include each week's forthcoming activities including work days, hours and expected traffic delays, posted detours, project completion date, and office hours. The PIM shall check the answering machine at least twice every calendar day, including weekends. The PIM shall respond to callers and e-mail inquiries as soon as possible, but at least within 24 hours. The PIM shall keep a logbook of all calls including the contact name, date of contact, date responded, the contact's comments, and the action the PIM took. A copy of this log shall be submitted to the Engineer every two weeks or more frequently, as requested by the Engineer.

The Contractor shall maintain a logbook of citizen and business contacts, including names, addresses, phone numbers, nature of the inquiry and subsequent action taken during construction and shall provide the Engineer a copy each week. All inquiries and complaints shall be followed up with either a return phone call, or a meeting, as warranted.

Media relations efforts shall be directed and distributed by CDOT including news releases, traffic advisories, editorial, feature stories, etc. During the Work, the Contractor shall immediately notify CDOT of any situations involving the media, and all communication requests shall be tracked by CDOT. The Contractor shall be familiar with, and comply with, the CDOT News Media Communications Guidelines, which outlines required protocol when contacted by media representatives.

The Contractor shall develop and implement community and business relation strategies that communicate coping messages to the public. Coping strategies shall focus on providing the public with the information they need to make short-term and long-term decisions about how they can deal with the work with as little disruption as possible.

The Contractor shall erect construction traffic signs with the dates the Contractor expects to initiate and complete construction and with the Contractor's public information office's or PIM's phone number at each major approach to the project. The signs shall conform to the requirements of Section 630 and shall be erected at least one week prior to the beginning of construction. These signs shall be updated if the project schedule changes, at no cost to the project.

An individual project Web-site has been developed for this project and is hosted on CDOT's web site using the CDOT template. The PIM shall provide a link to this website to all of the contacts listed below so they may include it on their respective websites.

<http://www.coloradodot.info/projects/i70twintunnels>

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**REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES**

The site will be revised as directed by the Engineer but shall at a minimum be updated weekly to include the information provided on the phone greeting as described above.

The Contractor shall host public or other stakeholder meetings at the request of the Engineer. The meetings will be held in a convenient location for community and business groups. Depending upon the Contractor's proposed

Traffic Control Plan (TCP), and areas impacted within each phase, other meetings may be required. The Contractor's PIP shall outline its approach to these construction information meetings. Public meetings shall provide construction schedules, impacts, traffic management plans, and other coping information. A member of the Contractor's management team or public information team and CDOT will attend all meetings. The Contractor and CDOT shall jointly organize, conduct and arrange all meetings and extend invitations to appropriate participants.

Subsection 626.02 shall include the following:

The Engineer will monitor the PIM and all public information services. When the Contractor provides acceptable public information services in accordance with these specifications, partial payments for the pay item Public Information Services will be made as the work progresses. These partial payments will be made as follows:

When 25 percent of the original Contract amount is earned, 50 percent of the amount bid for this item, less all previous payments, will be paid.

When 50 percent of the original Contract amount is earned, 60 percent of the amount bid for this item will be paid.

When 75 percent of the original Contract amount is earned, 80 percent of the amount bid for this item, less all previous payments, will be paid.

When 100 percent of the original Contract amount is earned, 100 percent of the amount bid for this item, less all previous payments, will be paid.

Failure to provide acceptable public information services will result in withholding of progress payment for this item. Continued failure to provide the services required will result in non-payment of the corresponding percentage of the original bid item and may result in suspension of the work in those areas affected until acceptable public information services are provided by the Contractor.

For the purpose of public information services, the term "original Contract amount" as used above, shall mean the amount bid for the construction items on this Contract, not including the amounts bid for Public Information Services and Mobilization, and "aggregate Contract amount earned" shall mean the net amount on the current monthly pay estimate, not including the amounts earned for Public Information Services and Mobilization.

Payment for Public Information Services will be full compensation for all fliers, public information office, telephone lines, and all other labor and materials required to complete the item, except signs. Signs will be measured and paid for in accordance with Section 630.

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**REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES**

Payment will be made under:

Pay Item

Public Information Services

Pay Unit

Lump Sum

The Public Information Services Contact Sheet shall include the following:

Public Information Services Contact List

Dial 911 for any emergencies

Clear Creek County: Administrator

Phone: 303-679-2309

City of Idaho Springs City Manager

Phone: 303-567-4421 ext. 126

Clear Creek County: Commissioners

Phone: 303-679-2312

City of Idaho Springs Public Works

Phone: 303-567-2400

Clear Creek County: Emergency Response Manager

Kathleen Krebs 303-679-2370

kkrebs@co.clear_creek.co.us

City of Idaho Springs Police

Phone: 303-567-4421 ext. 117

Clear Creek Dispatch (non-emergency situations)

303-679-2393.

Contact for Project UTC Coordination

Officer Wolf

Phone: 303-567-4421 ext. 117

Clear Creek County: Environmental Health

Mitch Brown, 303-679-2335

City of Idaho Springs Fire Chief

Phone: 303-567-4342

Clear Creek County: Emergency Management

303-679-2320

Clear Creek County Sheriff's Department

Phone: 303-679-2376

Colorado State Patrol

Phone: 303-567-4201 (Idaho Springs Post)

Phone: 303-249-4501 (Region Dispatch is in Frisco)

Clear Creek County: Road and Bridge Dept.:

Phone: 303-679-2334

Colorado Department of Transportation, Public Information Office

Stacey Stegman, 4201 E. Arkansas, Room 277, Denver, CO 80222

Phone: 303-757-9362

Fax: 303-757-9153

Stacey.Stegman@state.co.us

Colorado Department of Transportation Region Public Relations Manager

Bob Wilson, 4201 E. Arkansas, Room 277, Denver, CO 80222

Phone: 303-757-9431

Fax: 303-757-9153

Bob.J.Wilson@state.co.us

**REVISION OF SECTION 630
PORTABLE MESSAGE SIGN PANEL**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work includes furnishing, operating, and maintaining a portable message sign panel.

Add subsection 630.031 immediately following subsection 630.03 as follows:

630.031 Portable Message Sign Panel. Portable message sign panel shall be furnished as a device fully self contained on a portable trailer, capable of being licensed for normal highway travel, and shall include leveling and stabilization jacks. The panel shall display a minimum of three - eight character lines. The panel shall be a dot-matrix type with an LED legend on a flat black background. LED signs shall have a pre-default message that activates before a power failure. The sign shall be solar powered with independent back-up battery power. The sign shall be capable of 360 degrees rotation and shall be able to be elevated to a height of at least five feet above the ground measured at the bottom of the sign. The sign shall be visible from one-half mile under both day and night conditions. The message shall be legible from a minimum of 750 feet. The sign shall automatically adjust its light source to meet the legibility requirements during the hours of darkness. The sign enclosure shall be weather tight and provide a clear polycarbonate front cover.

Solar powered message signs shall be capable of operating continuously for 10 days without any sun. All instrumentation and controls shall be contained in a lockable enclosure. The sign shall be capable of changing and displaying sign messages and other sign features such as flash rates, moving arrows, etc.

Each sign shall also conform to the following:

- (1) In addition to the onboard solar power operation with battery back-up, each sign shall be capable of operating on a hard wire, 100-110 VAC, external power source.
- (2) All electrical wiring, including connectors and switch controls necessary to enable all required sign functions shall be provided with each sign.
- (3) Each sign shall be furnished with an operating and parts manual, wiring diagrams, and trouble-shooting guide.
- (4) The portable message sign shall be capable of maintaining all required operations under Colorado mountain-winter weather conditions.
- (5) Each sign shall be furnished with an attached license plate and mounting bracket.
- (6) Each sign shall be wired with a 7-prong male electric plug for the brake light wiring system.

Subsection 630.12 shall include the following:

The portable message sign panel shall be on the project site at least **14 days** prior to the start of active roadway construction. Maintenance, storage, operation, relocation to different sites during the project, and all repairs of portable message sign panels shall be the responsibility of the Contractor.

Subsection 630.14 shall include the following:

Portable message sign panels will be measured one of the two following ways:

- (1) By the actual number of days each portable message sign is used on the project as approved by the Engineer.
- (2) By the maximum number of approved units in use on the project at any one time.

2

**REVISION OF SECTION 630
PORTABLE MESSAGE SIGN PANEL**

Subsection 614.15 shall include the following:

Pay Item

Portable Message Sign Panel

Pay Unit

Each

**REVISION OF SECTION 630
PORTABLE SPEED CONTROL MONITOR**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work includes furnishing, operating, installing, and maintaining portable speed control monitors.

Subsection 630.031 is added following Subsection 630.03 as follows:

630.031 Portable Speed Control Monitor. If the Portable Speed Control Monitor is powered by solar panels, it shall use a battery bank with a charge controller that will operate the monitor for 30 days (running continuously) without any sunlight. The Portable Speed Control Monitor shall have its own separate power source with independent back-up battery powered source. Monitors that are diesel generator powered shall be provided with enough fuel capacity for 30 days.

The actual speed of approaching vehicles shall be displayed on a panel that uses light emitting diodes (LEDs) that conform to MUTCD requirements on a flat black background. The pixels (groups of LEDs) shall be arranged so they form at least a two-digit display of 18 inches high by 12 inches wide numbers. The speed limit shall be visible from a minimum of 650 feet. The display shall contain an ambient light sensor that allows the internal CPU to adjust the screen's brightness automatically to account for daytime or nighttime light conditions.

The trailer shall be equipped with a rack, when raised allows speed limit signs to be mounted. A lockable storage compartment shall be provided to store speed limit signs. Portable Speed Control Monitor shall be self-contained on a portable trailer, licensed for normal highway travel.

Weatherproof casing shall enclose the LED display modules, electronics, and radar, which will be able to withstand harsh outdoor environments, including snow. The Portable Speed Control Monitor shall be capable of maintaining all required operations under Colorado all season weather conditions, and shall also be able to survive vibrations caused by transporting it on uneven road surfaces.

The Portable Speed Control Monitor shall be adjustable to show speeds at 5 mph increments from 10 mph through 65 mph. Speed limits signs to match the possible speed increments shall be included and shall meet CDOT standards. The Portable Speed Control Monitor shall be able to operate in the range of -22° F to 110° F.

Prior to obtaining the item, the Contractor shall submit the trade name, model number, and specifications of the portable message signs the Contractor intends to use to the Engineer for approval. The Department's decision concerning the acceptability of the item will be final.

The unit shall use K Band radar to detect speed.

2

**REVISION OF SECTION 630
PORTABLE SPEED CONTROL MONITOR**

Subsection 630.11 shall include the following:

Maintenance, storage, operation, relocation and all repairs of Portable Speed Control Monitor shall be the responsibility of the Contractor. In case of sign failure or malfunction, the Contractor shall repair or replace the non-operational sign immediately.

Subsection 630.13 shall include the following:

Portable Speed Control Monitor will be measured by the actual number of the units approved and used on the project.

Subsection 630.14 shall include the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Portable Speed Control Monitor	Each

**REVISION OF SECTION 630
PORTABLE VARIABLE SPEED LIMIT SIGN**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work includes furnishing, operating, installing, and maintaining portable variable speed limit signs.

Subsection 630.032 is added following Subsection 630.03 as follows:

630.032 Portable Variable Speed Limit Sign. If the Portable Variable Speed Limit Sign is powered by solar panels, it shall use a battery bank with a charge controller that will operate the monitor for 30 days (running continuously) without any sunlight. The Portable Variable Speed Limit Sign shall have its own separate power source with independent back-up battery powered source. Signs that are diesel generator powered shall be provided with enough fuel capacity for 30 days.

The posted speed limit shall be displayed on a panel that uses light emitting diodes (LEDs) that conform to MUTCD requirements on a flat black background. The pixels (groups of LEDs) shall be arranged so they form at least a two-digit display of 18 inches high by 12 inches wide numbers. The speed limit shall be visible from a minimum of 650 feet. The display shall contain an ambient light sensor that allows the internal CPU to adjust the screen's brightness automatically to account for daytime or nighttime light conditions.

The trailer shall be equipped with a rack, when raised allows speed limit signs to be mounted. A lockable storage compartment shall be provided to store speed limit signs. Portable Variable Speed Limit Sign shall be self-contained on a portable trailer, licensed for normal highway travel.

Weatherproof casing shall enclose the LED display modules, electronics, and radar, which will be able to withstand harsh outdoor environments, including snow. The Portable Variable Speed Limit Sign shall be capable of maintaining all required operations under Colorado all season weather conditions, and shall also be able to survive vibrations caused by transporting it on uneven road surfaces.

The Portable Variable Speed Limit Sign shall be adjustable to show speeds at 5 mph increments from 10 mph through 65 mph. The Portable Variable Speed Limit Sign shall be able to operate in the range of -22° F to 110° F.

The Portable Variable Speed Limit Sign shall be equipped with communications that allow for remote configurations of speed settings and scheduling.

Prior to obtaining the item, the Contractor shall submit the trade name, model number, and specifications of the portable message signs the Contractor intends to use to the Engineer for approval. The Department's decision concerning the acceptability of the item will be final.

2

**REVISION OF SECTION 630
PORTABLE VARIABLE SPEED LIMIT SIGN**

Subsection 630.11 shall include the following:

Maintenance, storage, operation, relocation and all repairs of Portable Variable Speed Limit Signs shall be the responsibility of the Contractor. In case of sign failure or malfunction, the Contractor shall repair or replace the non-operational sign immediately.

Subsection 630.13 shall include the following:

Portable Variable Speed Limit Sign will be measured by the actual number of the units approved and used on the project.

Subsection 630.14 shall include the following:

Pay Item

Portable Variable Speed Limit Sign

Pay Unit

Each

**REVISION OF SECTION 630
IMPACT ATTENUATOR (TEMPORARY)**

Section 630 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing, installing, certifying, moving, repairing, maintaining, and removing temporary impact attenuators in accordance with these specifications and in conformity with the lines and details shown on the plans or established.

MATERIALS

Each impact attenuator shall be selected from the Crash Cushion and End Treatment Application Chart as listed in the *Safety Selection Guide* on the CDOT Design and Construction Project Support web site. Impact attenuators shall conform to the requirements of the manufacturer and be capable of bi-directional shielding of the objects detailed and located on the plans.

If the posted speed limits of the construction zone are 45 miles per hour or less, the impact attenuator shall meet the requirements of NCHRP Report 350 TL-2. For posted speed limits in the construction zone greater than 45 miles per hour, the attenuator shall meet the requirements of TL-3.

CONSTRUCTION REQUIREMENTS

The site shall be prepared to receive the impact attenuator by filling, excavating, smoothing, constructing the paved foundation pad, installing approved transition and anchoring, and all other work necessary for the proper installation of the attenuator.

The impact attenuator shall be fabricated and installed in accordance with the manufacturer's recommendations. The Contractor shall provide a copy of the manufacturer's installation instructions and parts list to the Engineer prior to installation of the device.

Each installation shall be supervised and certified as correct upon completion by a representative of the device manufacturer or by an employee of the Contractor who is a certified installer. The certified installer shall have completed device training and shall be registered with the manufacturer as a certified installer. The Contractor shall submit all appropriate documentation to validate that the certified installer has completed device training and has been registered with the manufacturer as a certified installer.

METHOD OF MEASUREMENT

Impact Attenuator (Temporary) will be measured by the number of attenuators shown on the plans, installed, certified, and accepted.

2

**REVISION OF SECTION 630
IMPACT ATTENUATOR (TEMPORARY)**

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for the pay item listed below:

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Impact Attenuator (Temporary)	Each

Payment will be full compensation for all work and materials required to furnish, install, certify, move, repair, maintain, and remove the impact attenuator. Site preparation, foundation pad, epoxy painting, and all necessary hardware including anchors and transitions will not be paid for separately, but shall be included in the work.

**REVISION OF SECTION 630
MOBILE ATTENUATOR**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work shall consist of furnishing, operating, and maintaining a truck with an attached impact attenuator.

Subsection 630.09 shall include the following:

Mobile Attenuator Options:

Truck Mounted Attenuator. The Contractor shall supply a vehicle with a truck mounted attenuator approved by the FHWA to meet NCHRP 350 criteria for level TL-3 collisions. The attenuator shall be mounted to a suitable truck in a manner meeting the Manufacturer's specifications. The truck shall be furnished with a roof mounted Advance Warning Flashing or Sequencing Arrow Panel (B Type). The truck shall be used when setting up or taking down the work zone and shall be parked in the activity area protecting the construction work while work is being performed, unless otherwise directed.

Trailer Attenuator. The Contractor shall supply a vehicle with an attached trailer attenuator approved by the FHWA to meet NCHRP 350 criteria for level TL-3 collisions. The trailer attenuator shall be attached to a suitable host truck in a manner meeting the Manufacturer's specifications, to include factory-installed 20-ton (minimum) rated pintle hook and ½-inch (minimum) steel frame plate, or as specified by Manufacturer. The trailer shall be furnished with a mounted Advance Warning Flashing or Sequencing Arrow Panel (B Type).

The weight of the host truck shall be between 10,000 and 20,000 lbs, or as specified by the trailer attenuator manufacturer. The Contractor shall provide a certified scale ticket confirming the weight of the truck without trailer attached.

The Trailer Attenuator attached to its host truck shall be used when setting up or taking down the work zone and shall be parked in the activity area protecting the construction work while work is being performed, unless otherwise directed. A buffer zone shall be provided in front of the host truck, for worker safety. This buffer zone shall be in accordance with the manufacturer's recommendations, but shall be no less than 100 feet in length, unless otherwise directed.

Subsection 630.13 shall include the following:

Maintenance, storage, operation, and all repairs of Mobile Attenuator and associated vehicle shall be the responsibility of the Contractor.

Subsection 630.15 shall include the following:

Mobile Attenuators will be measured as the actual number of days that it is used on the project. For this project, a day will be considered to be one 12-hour shift of a Mobile Attenuator is used on site. Mobile Attenuators which are left in place during non-working will not be included, and will not be considered active on the project.

2
REVISION OF SECTION 630
MOBILE ATTENUATOR

Subsection 630.16 shall include the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Mobile Attenuator	Day

Payment will be full compensation for all labor, materials and equipment required to operate and maintain the truck and attenuator for the duration of the project, including the attenuator and flashing panel.

**REVISION OF SECTION 630
COURTESY VEHICLE**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

The Contractor shall provide a passenger van or vehicle with a bike rack sufficient to transport 12-15 bicyclists through the project limits when project construction work requires closure of bicycle and pedestrian bike path for safety. The Contractor will identify staging locations within ¼ mile of the project limits where bicyclists can safely wait for the courtesy vehicle. The Contractor shall allow no more than a 30 minute delay for bicyclists and associated equipment to be loaded into the vehicle, transported through the project limits, and unloaded. If the courtesy vehicle cannot safely pass through the project, the Contractor shall provide an alternate route for approval by the Engineer.

The contractor shall allow no more than a 30 minute delay for bicyclists to be picked up, transported through the project construction zone, and dropped off. If the van cannot safely pass through the project, the Engineer shall direct the driver what route is to be used. The Engineer will identify a location at the west and east ends of the project where bicyclists can safely wait for the van.

Subsection 630.15 shall include the following:

Vehicle rental to accommodate 12-15 people and associated bicycles, licensed driver, bike rack, fuel, insurance, and all other associated costs for transporting bicyclists through the work zone.

Vehicle rental (large passenger van (12-15 people)), licensed driver, bike rack, fuel, vehicle insurance, and all other associated costs for transporting bicyclists through the work zone.

Subsection 630.16 shall include the following:

Payment will be made under:

Pay Item
Courtesy Vehicle

Pay Unit
Day

**REVISION OF SECTION 630
TRAFFIC CONTROL MANAGEMENT**

Section 630 of the Standard Specifications is hereby revised as follows:

Subsection 630.11 shall include the following:

The Contractor shall designate individuals, other than the superintendent, to be the Traffic Control Supervisors. The Traffic Control Supervisors shall be certified as a worksite traffic supervisor by either the American Traffic Safety Services Association (ATSSA) or the Colorado Contractors Association (CCA), and shall have a current Department flaggers certificate. A copy of each of the Traffic Control Supervisors certifications shall be provided to the Engineer at the preconstruction conference. The Contractors Superintendent and all others serving in a similar supervisory capacity shall have completed a CDOT-approved two-day Traffic Control Supervisor training as offered by the CCA. The one-day ATSSA Traffic Control Technician (TCT) training along with the two-day ATSSA Traffic Control Supervisor training will serve as an alternate. If the alternate is chosen, the Contractor shall provide written evidence that at least an 80 percent score was achieved in both of the two training classes. The certifications of completion or certifications of achievement for all appropriate staff shall be submitted to the Engineer at the preconstruction conference.

Traffic Control Supervisors duties shall include:

- (1) Preparing, revising, and implementing each required Method of Handling Traffic in accordance with the Traffic Control Plan;
- (2) Directly supervising project flaggers;
- (3) Coordinating all traffic control operations including those of subcontractors and suppliers;
- (4) Coordinating project activities with appropriate police, emergency service, and fire control agencies;
- (5) Preparing a traffic control diary for each shift traffic control devices are in use. Only one diary per 12 hour shift is necessary per TCS. This diary shall be submitted to the Engineer daily and become a part of the Department's project records. The diary shall include the following information as a minimum:
 - (i) Date;
 - (ii) For Traffic Control Inspection, the time of the inspection;
 - (iii) Project number;
 - (iv) Traffic Control Supervisor name;
 - (v) Description of traffic control operations (lane closures, shoulder closures, pilot car operations, detours, etc.) including location, setup and takedown time, and approved Method of Handling Traffic (MHT) number;
 - (vi) Types and quantities of traffic control devices used in accordance with the approved MHT;
 - (vii) List of flaggers and uniformed traffic control (UTC) used, including start time, stop time, and number of flagging hours and UTC hours used; and
 - (viii) Traffic control problems (traffic accidents; damaged, missing or dirty devices, etc.) and corrective action taken.
- (6) Inspecting traffic control devices on every calendar day that traffic control devices are in use, masked, or turned away from traffic. These inspections shall include at least one night inspection per week. The designated shift TCS or another representative who is certified as a work site traffic supervisor shall perform these inspections.
- (7) Insuring that traffic control devices are functioning as required.
- (8) Overseeing all requirements covered by the Contract which contribute to the convenience, safety and orderly movement of traffic. Have an up-to-date copy of the MUTCD and applicable standards and specifications available at all times on the project.
- (9) Attending all project scheduling meetings
- (10) Supervising the cleaning and maintenance of all traffic control devices. A certified worksite traffic supervisor shall be responsible for Traffic Control Management (TCM) on a 24-hour-per-day basis. A TCS shall be on the work site at all times when Traffic Control Management (TCM) is performed and shall be on call at all Upon request of the Engineer, the TCS may be required to be on the project site at times other than normal times.

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**REVISION OF SECTION 630
TRAFFIC CONTROL MANAGEMENT**

working hours. During non-work periods, a designated TCS shall respond to the job site within 45 minutes. The TCS may appoint a qualified representative to serve as the TCS for periods of time as approved by the Engineer. The qualified representative shall be certified as a TCS and shall assume all duties and responsibilities of the TCS. The Contractor shall maintain a 24 hour telephone number at which one of the designated TCS can be contacted. A TCS shall not act as a flagger except in an emergency or in relief for short periods of no more than 15 minutes over a 60 minute period.

The Contractor's Superintendent, Traffic Control Manager (TCM), Courtesy Vehicle, and each UTC unit shall be equipped with a reliable mobile telephone unit or at all times that has a local number for contact with one another, the Project Engineer, or emergency response dispatchers when emergency services are required. UTC mobile telephone units shall be made available at the project field office and shall be signed in and out by UTC personnel each shift.

The Contractor shall furnish a push to talk radio with telephone service or equivalent as approved by the Engineer. One each will be required for the project staff, one each for the Project or Construction Superintendents, one each for Traffic Control Supervisors, two for the impact truck drivers, two for the stop flaggers and any other essential personnel as required. All radios shall have a group talk feature or equivalent. The radios shall be equipped with battery chargers and rechargeable batteries. The radios shall be supplied one week prior to the commencement of work

The TCM shall make immediate contact with emergency personnel as required to assist accident victims, expedite the removal of broken-down vehicles, and maintain the smooth flow of traffic in accordance with the Tunnels Incident Management Plan.

Subsection 630.15 shall include the following:

METHOD OF MEASUREMENT

Traffic Control Management will be measured as the actual number of days that it is used on the project. For this project, a day will be considered to be one 12-hour shift of a Traffic Control Supervisor (TCS) in which traffic control conforms to the approved MHT. Traffic control devices which are left in place during non-working will not be included, and will not be considered active traffic control.

3
REVISION OF SECTION 630
TRAFFIC CONTROL MANAGEMENT

Subsection 630.16 shall include the following:

BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item

Traffic Control Management

Pay Unit

Day

**REVISION OF SECTION 641
SHOTCRETE**

Section 641 of the Standard Specifications is hereby revised for this project as follows:

Subsection 641.02 shall include the following:

Reinforcing steel, unless otherwise noted, shall conform to the requirements of Section 602.

Geocomposite strip drains, as shown in the plans, shall conform to the requirements of Revised Section 504 Ground Nail Wall.

Expansion joints shall be constructed at the locations and as shown in the plans. Expansion joint filler shall conform to the requirements of Section 705.01(b) Preformed Joint Fillers.

Subsection 641.09 shall include the following:

Pay Item
Shotcrete

Pay Unit
Square Yard

Reinforcing steel, including welded wire fabric, deformed steel bars, geocomposite strip drains and expansion joints, will not be measured and paid for separately but shall be included in the work.

**REVISION OF SECTION 715
LIGHTING MATERIALS**

Section 715 of the Standard Specifications is hereby revised for this project as follows:

Subsection 715.07 shall include the following:

Chain station lighting control shall be by fiber tap (where fiber optic backbone system exists), or by existing telemetry page tap. Either control type (fiber tap or page tap) shall be routed through a Communication Cabinet to convert fiber optic cable or cell pager into a copper hardwired control relay system.

Subsection 715.08 shall include the following:

The following equipment is for a typical chain station lighting control center installation and may or may not be required at every chain station location, provide devices as shown on the plans and details:

- (a) Meter Socket - (100 amp minimum) NEMA-3R, to utility company specifications. Mount on the back of the NEMA 4 enclosure.
- (b) Main Disconnect Switch - heavy duty, fusible, service entrance rated, NEMA-3R. Mount on back of NEMA 4 enclosure.
- (c) Circuit Load Center – all copper bus, NEMA 1, with full size neutral and ground bars, with main/branch breakers and number of poles as indicated on the panel schedule. Mount panel inside of the NEMA 4 enclosure.
- (d) Ground Fault Interrupter Maintenance Receptacle – 20 amp, 120 VAC, with back box and cover plate. Mount inside NEMA 4 enclosure.
- (e) Multiple Pole Light Contactors – mechanically held, open type, minimum 30 amp, 600 VAC rated contacts, 120 VAC coil with clearing contacts. Mount inside the NEMA 4 enclosure. See plans and details for number of contactors required.
- (f) By-Pass Switch – 20 amp, SPST, 277 VAC rated toggle switch with back box and cover plate. Mount inside the NEMA 4 enclosure.
- (g) Telemetry Relay – 120 VAC coil, 3 amp 120 VAC rated contacts, with screw terminal base. Mount inside the NEMA 4 enclosure.
- (h) Control Relay – 120 VAC coil, 15 amp 120 VAC rated contacts, with screw terminal base. Mount inside the NEMA 4 enclosure.
- (i) Photo Electric Control – 120 VAC, photocell with twist-lock receptacle base for control of median lighting. Mount on north side of the NEMA 4 enclosure.
- (j) Step Down/Control Transformer – 1 KVA, 480 VAC, 1-phase (primary), 120/240 VAC 1-phase (secondary) with primary safety switch and secondary safety switch and fusing.
- (k) Ground Rods and Conductors – 5/8” x 10’-0” Lg. copper-clad driven with ground conductor exothermic weld or approved clap to ground rod. Two rods required per LCC. See plans for conductor size.
- (l) Cabinet Type Enclosure – NEMA 4 enclosure with lockable hinged cover, back panel and 12” legs. Mount on a minimum 12” thick concrete pad with a minimum of 6” overlap on all sides. All components listed above shall fit inside or on this enclosure.

FORCE ACCOUNT ITEMS

DESCRIPTION

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made in accordance with subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at \$5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

<u>Force Account Item</u>	<u>Estimated Quantity</u>	<u>Amount</u>
F/A Minor Contract Revisions	F.A.	\$ 350,000
F/A Partnering	F.A.	\$5,000
F/A Asphalt Pavement Incentive	F.A.	\$25,000
F/A Fuel Cost Adjustment	F.A.	\$50,000
F/A Asphalt Cement Cost Adjustment	F.A.	\$ 100,000
F/A On-The-Job-Trainee	F.A.	\$3,840
F/A OCIP Enrollment and Reporting and Accuracy	F.A.	\$625
F/A OCIP Safety Compliance and Loss Reporting	F.A.	\$1,875
F/A Obtain Power from XCEL	F.A.	\$15,000
F/A Environmental Health and Safety Management	F.A.	\$50,000
F/A Shared Risk Contingency Pool	F.A.	\$58,520
F/A Mass Concrete	F.A.	\$25,000
F/A Hotel Vouchers	F.A.	\$5,000

F/A Minor Contract Revisions - This work consists of minor work authorized and approved by the Engineer, which is not included in the contract drawings or specifications, and is necessary to accomplish the scope of work of this contract.

F/A Partnering - This force account is to account for costs associated with the partnering process for CMGC processes during construction activities.

F/A Asphalt Pavement Incentive – Roadway Smoothness Incentive payment will be made in accordance with Standard Special Provisions Revision of

F/A Fuel Cost Adjustment - This force account is to pay for contract price adjustments will be made to reflect increases or decreases in the prices of gasoline, diesel and other fuels from those in effect during the month in which bids were received for the Contract if the Contractor has specified on the Form 85 that the price adjustment will apply to the Contract.

F/A Asphalt Cement Cost Adjustment - Asphalt Cement Cost Adjustment will be made in accordance with Revision of Section 109 – Asphalt Cement Cost Adjustment (Asphalt Cement Included in the Work).

F/A On-the-Job Trainee - This force account is to cover the cost of the OJT Training hours.

F/A OCIP Enrollment, Reporting, and Accuracy – This force account covers the incentive for the OCIP require enrollment and reporting for the Contractor and all subcontractors. It also has incentive for accurate reporting.

F/A OCIP Safety Compliance and Loss Reporting – This force account covers the incentive for the OCIP for Safety Compliance and Accurate and Timely Loss Reporting.

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FORCE ACCOUNT ITEMS

F/A Obtain Power from XCEL – This force account covers the cost of supplying power to the two air quality testing and monitoring sheds installed north and south of the Twin Tunnel bores.

F/A Environmental Health and Safety Management – This force account covers the incentive for developing and implementation of early stage hazardous waste disposal plans. This is a mitigation requirement through the I-70 Twin Tunnels Widening FONSI and I-70 Twin Tunnels Widening Materials Management Plan.

F/A Shared Risk Contingency Pool – This force account covers the shared risk contingency item 503-00060 Drilled Caisson (60 Inch) as defined in special project provision Revision of Section 109 CMGC Force Accounts and the Twin Tunnels 1A and 1B Combined Risk Register.

F/A Mass Concrete – This force account covers the risk of Bridge Structure F-16-BR requiring Mass Concrete engineering analysis and processes to mitigation mass concrete challenges.

F/A Hotel Vouchers – This force account covers hotel vouchers for residents in and near the Twin Tunnels Widening project site to be issued at the direction of the Engineer and CDOT Region 1 ROW.

SPECIAL CONSTRUCTION REQUIREMENTS

1. The Contractor shall submit a plan to contain debris from all wall construction and excavation operations as approved by the Engineer. The plan will specifically identify how the traveling public will be protected and how the protection for fallen debris will be accomplished. Plan shall be submitted to the Engineer at least 5 working days prior to work on the excavation or walls begins.
2. The Contractor shall submit a plan to maintain drainage during construction as approved by the Engineer. Special attention to drainage during milling operation when only driving lanes are milled shall be addressed. Maintaining drainage will not be paid for separately, but shall be included in the cost of the work.
3. Extra equipment, labor, and materials may be required for the Contractor to meet the schedule and will not be paid for separately.
4. The Contractors personnel on the construction site shall wear personal protective equipment (including hard hats and safety vests) at all times.
5. The field office shall remain in place 30 calendar days after final acceptance or as approved by the Engineer in writing.
6. The Contractor shall attend a Pre-Construction and Environmental Pre-Construction meeting prior to starting any work on the project.
7. The Field Office and Field Lab shall be fully operational prior to any work starting on the project.
8. All BMPs for this Construction Package 1B shall be in place prior to any work starting on the project.
9. All costs associated with the foregoing requirements will not be paid for separately, but shall be include in the cost of the work.
10. The Contractor shall perform a walkthrough of the project limits with the CDOT Environmental Project Manager David Singer (303-512-5872) prior to disturbance to identify any local important community resources.
11. The Contactor shall address commitments in the Materials Management Plan for the I-70 Twin Tunnels Widening project.
12. The Contractor shall follow and implement all environmental commitments from the June 2012 Twin Tunnels Environmental Assessment, the October 2012 Twin Tunnels FONSI, and help CDOT provide mitigation tracking throughout the construction phase.

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SPECIAL CONSTRUCTION REQUIREMENTS

13. The Contractor shall perform the following Inspection Scheduling and Quality Control Responsibilities:

Inspection Scheduling

The Contractor shall perform the following:

- 1) A daily proposed work schedule shall be developed by the contractor and his sub-contractors which shall communicate all work being performed on the project.
- 2) The game plan shall be written onto dry erase boards in a field facility easily accessible to all project personnel during construction.
- 3) The dry erase boards shall be divided into the following columns:
 - a. Contractor
 - b. Location and Brief Description of Work
 - c. Tests and Inspections Required and Time of Inspection or Test (Night work is also detailed here)
 - d. Look Ahead Information
- 4) All work for the next day and the following night shall be entered into the board by 1:00PM each day.
- 5) Weekend or Holiday work is required shall be entered into the board by Thursday at 1:00PM.
- 6) The items on the board shall be entered into a spreadsheet and sent to a standing email list every afternoon at 3:30PM. Work assignments for owner construction management staff shall be made by the Engineer based on this spreadsheet.
- 7) Every attempt shall be made to accommodate work which appears on the schedule and occurs close to the scheduled time. Work which does not appear on the spreadsheet or is significantly delayed shall be rescheduled.

Contractor's Quality Control Responsibilities

The Contractor shall perform a Quality Control inspection before the owner's Quality Assurance inspection. The Contractor's quality control inspection results shall be documented on a signed Inspection Request Form which shall be given to the owner's inspector before the quality assurance inspection may begin.

The owner's inspector may place a green tag on the work if it is found to be acceptable and a red tag if there are issues which must be addressed before subsequent work can be performed (eg. concrete placement). The Contractor shall reschedule any Red Tagged work for a follow-up inspection once it has been complete.

TRAFFIC CONTROL PLAN - GENERAL

The key elements of the Contractor's method of handling traffic (MHT) are outlined in subsection 630.10.

The components of the TCP for this project are included in the following:

- (1) Subsection 104.04 and Section 630 of the specifications.
- (2) Standard Plan S-630-1, Traffic Controls for Highway Construction and Standard Plan S-630-2.
- (3) Schedule of Construction Traffic Control Devices.
- (4) Signing Plans.
- (5) Detour Details.
- (6) Manual on Uniform Traffic Control Devices (MUTCD).

Special Traffic Control Plan requirements for this project are as follows:

At least one week prior to starting construction, the Contractor shall notify the CDOT Engineer of the date the Contractor intends to start construction.

Temporary striping shall be in full compliance at the completion of each working day.

Lane Closure and traffic crossovers shall conform to the I-70 Project Specific Lane Closure Strategy.

Traffic shall be returned to normal operation, on a paved surface at the completion of each day's work unless otherwise approved.

Prior to starting construction, the Contractor shall notify the Region 1 Traffic Engineer and Clear Creek County Road and Bridge of the date the Contractor intends to start construction.

The Contractor shall coordinate all operations requiring traffic control with scheduled Holidays and special events. No work requiring traffic control will be allowed for the following events unless directed by the Engineer.

1. Thursday November 22nd, 2012 – Thanksgiving Day
2. Tuesday December 25th, 2012 – Christmas Day
3. Tuesday January 1st, 2013 – New Year's Day
4. Monday January 21, 2013 – Martin Luther King Day
5. Monday February 18, 2013 – President's Day
6. Monday May 27th, 2013 – Memorial Day
7. Thursday July 4th, 2013 – Independence Day
8. Monday September 2nd, 2013- Labor Day
9. Monday October 14th, 2013 – Columbus Day
10. Monday November 11th, 2013 – Veteran's Day

There may be other events as directed by the Engineer. These events are in addition to the ones listed.

A pathway will be kept clear of dirt, gravel, and other construction debris for pedestrian and bicycle traffic. If any closures are required, contractor shall provide a courtesy vehicle to transport bicyclists through the project construction zone.

Unauthorized delays or traffic interruptions resulting from Work not in accordance with the I-70 Twin Tunnels Lane Closure Strategy will be considered a violation of this provision and shall be subject to price reductions as described in Revision of Section 105 – Violation of Working Time Limitation.

The Contractor shall provide all construction vehicles with flashing amber lights.

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TRAFFIC CONTROL PLAN – GENERAL

The Contractor shall submit construction sequencing, traffic sequencing proposal, and methods of construction to the Engineer for approval.

All traffic operations, detours, and associated MHTs shall be submitted to the Engineer for review and approval. The Contractor shall schedule and coordinate all traffic closures and MHTs at least seven days prior to the closure or MHT taking effect.

The Contractor shall not have construction equipment or materials in the lanes open to traffic at any time.

The Contractor shall organize the work such that there will be no hazards within the Clear Zone at the completion of each day's work.

Employee vehicle parking is prohibited where it conflicts with safety, access or flow of traffic. No employee parking will be allowed within the clear zone. The Contractor and the Engineer, prior to starting work, shall locate parking areas to be approved by the Engineer.

The crossover detour shall be restored back to normal I-70 operations at the completion of each working day. Traffic shall be returned to normal operation, on a paved surface at the completion of each day's work unless otherwise approved.

The Contractor and the Engineer, prior to starting work, shall locate staging areas to be approved by the Engineer.

Unless otherwise included in the plans, or as directed by the Engineer, the Contractor shall maintain access to ingress and egress to all local roads and driveways. Special consideration should be given to bicycle traffic. A MHT shall be required for handling bicycle traffic and shall be submitted to the Engineer for approval.

Any signs damaged due to the Contractor's operations shall be replaced in-kind or repaired by the Contractor at no expense to the project.

Sufficient Traffic Control Devices are included in the plans to cover expected construction activities. Should the Contractor elect to utilize additional devices to enhance the operation, the additional devices will not be paid for but shall be provided at the Contractor's expense, unless otherwise approved for payment by the Engineer and shall be paid for at the unit prices approved in the GMP.

The Contractor shall contract directly or through a subcontractor with Idaho Springs Police Department, Colorado State Patrol (CSP), and Clear Creek County Sheriff agencies for Uniformed Traffic Control (UTC). Uniformed Traffic Control (UTC) shall be coordinated as follows:

- (a) Contractor shall coordinate with Officer Wolf with Idaho Springs Police Department (ISPD) to schedule all UTC hours for all agencies.
- (b) Contractor shall first contract UTC with Idaho Springs Police Department within the city limits of Idaho Springs.
- (c) Contractor shall contract with Colorado State Patrol outside of Idaho Springs including when UTC is required on Floyd Hill.
- (d) Contractor shall contract with Clear Creek County Sheriff with UTC is required for closures at the US 6/I-70 Interchange.
- (e) Contractor shall coordinate with Officer Wolf with Idaho Springs Police to fill in any UTC hours that cannot be filled if responsible agencies cannot perform. Additional CSP participation, if needed, shall be coordinated through Officer Wolf with ISPD and Captain Prater with CSP.
- (f) Contractor shall coordinate UTC so that each agency is responsible for incident response in the project areas where they are assigned for UTC.

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TRAFFIC CONTROL PLAN – GENERAL

During I-70 closure operations the Interstate may be closed no longer than 20 minutes. All traffic shall be cleared before any other operation that interferes with traffic will be permitted. Violation of these closure limitations shall be subject to all provision set forth in the Revision of Subsection 105.03 of the Standard Special Provisions.

UTILITIES

The following table includes contacts within CDOT that can assist in locating CDOT owned facilities. Please note CDOT is now affiliated with UNCC. For additional assistance, call 303-365-7312.

CDOT Fiber Optic facilities are located by Comcast Cable.

<u>UTILITY OWNER / ADDRESS</u>	<u>CONTACT / EMAIL</u>	<u>PHONE / FAX</u>
CDOT Electric – Region 1 18500 E. Colfax Ave. Aurora, CO 80011	Jim Chase jim.chase@state.co.us	303-365-7312 – Office 303-303-981-0922 – Cell CDOT Locates:303-365-7312
CDOT Utilities – Region 1 18500 E. Colfax Ave. Aurora, CO 80011	Dave Ruble, Region Utility Engineer dave.ruble@state.co.us Tracy Vance, Asst, Utility Engineer tracy.vance@state.co.us Dave Campbell, Utility Inspector david.campbell@state.co.us	303-365-7310 303-365-7309 303-365-7304
CDOT ITS (FIBER) 425 C Corporate Circle Room 109 Golden, CO 80401	Rick Sembrat Richard.Sembrat@state.co.us	303-512-5804 – Office
CDOT Traffic Signals Mountain Areas Only 219 County Road 1003 Frisco, CO 80443	Steve Smith steve.smith@state.co.us	(970)668-0253 Office (970)485-0136 Cell (970)668-0276 Fax
Xcel Energy (East of Eisenhower) 4019 Evergreen Pkwy., P.O. Box 640, Evergreen, CO 80437	Jonnye Worrell jonnye.worrell@Xcelenergy.com	303-445-4504 – Office 303-957-7152 – Cell 303-445-4572 – Fax
Century Link 1855 S. Flatirons Ct., Boulder, CO 80301	Dan Lewis Dan.Lewis@centurylink.com	303-441-7142 Business 303-441-6021 Cell 720-291-0703 Business Fax
Comcast Cable 6793 W. Canyon Ave., #13-C, Littleton, CO 80128	Scott Moore Scott_moore@cable.comcast.com	303-603-2970 Business 720-413-0171 Cell
City of Idaho Springs (Water & Sanitation) Public Works	John Bordoni pw@idahospringsco.com	303-567-2400 Business

The Contractor shall coordinate with the CDOT Project Engineer and any appropriate utility company to facilitate the installation, placement and relocation of all utilities impacted on this project.

The work described in these plans and specifications requires full cooperation between the Contractor and the utility owners in accordance with Subsection 105.11 in conducting their respective operations, so the utility work can be completed with minimum delay to all parties concerned. Also, in accordance with the plans and specifications, and as directed by the Engineer, the Contractor shall keep each utility owner advised of any work being done to its facility, so that each utility owner can coordinate its inspections for final acceptance of the work

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UTILITIES

with the Engineer.

The Contractor shall coordinate the work with the owners of the utilities impacted by the work. Coordination with utility owners includes, but is not limited to, staking construction features, providing and periodically updating an accurate construction schedule which includes all utility work elements, providing written notification of upcoming required utility work elements as the construction schedule indicates, allowing the expected number of working days for utilities to complete necessary relocation work, conducting necessary utility coordination meetings, and all other necessary accommodations as directed by the Project Engineer. Surveying and/or staking of utility relocations to be performed by the owner shall be the responsibility of the utility owner.

Prior to excavating or performing any earthwork operations, the Contractor shall positively locate all potential conflicts with existing underground utilities and proposed construction, as determined by the Contractor according to proposed methods and schedule of construction. The Contractor shall modify construction plans to avoid existing underground facilities as needed, and as approved by the Engineer.

The CDOT Contractor shall provide traffic control for any utility work expected to be coordinated with construction, as directed by the CDOT Engineer.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.

THE WORK LISTED BELOW SHALL BE PERFORMED BY THE CONTRACTOR:

NOTE: The Contractor shall provide written notice to each utility owner, with a copy to the Engineer, immediately prior to each utility work element expected to be coordinated with construction. The number of days of prior notice is noted for each owner.

Contractor coordination with Xcel Energy

Coordinate the relocation of the overhead power lines and poles and any affected segment of underground or aerial electric cable for this project. Confirm the existing locations for all overhead and buried electrical lines along the limits of this project and coordinate the relocation of any overhead or buried power lines that conflict with the construction of this project. Coordinate the installation of temporary power for this project. All work will be done by Xcel Energy forces. Use caution when working around these lines.

CDOT Contractor shall provide the utility owner written notice 30 days immediately prior to each utility work element expected to be coordinated with construction.

Contractor coordination with Century Link

Field locate any buried or aerial telephone lines or fiber optic lines, pedestals, manholes, splice boxes, markers and risers that are within the project limits. Coordinate any associated telephone risers, telephone lines, splice boxes, markers and pedestal adjustments with Century Link. A Century Link line is attached to Xcel's power poles that are running along the Game Check area. This line will be reset in conjunction with Xcel's relocation. Any power pole relocation will need to be coordinated with Century Link. Relocations will be completed by Century Link. Use caution when working around these lines and utility features

CDOT Contractor shall provide the utility owner written notice 30 days immediately prior to each utility work element expected to be coordinated with construction.

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Contractor coordination with Comcast Cable

Field locate any overhead or buried cable TV line. A Comcast cable line is attached to Xcel's power poles that are running along the game check station. This line will be reset in conjunction with Xcel's relocation. Any power pole relocation will need to be coordinated with Comcast. Comcast will accomplish all utility relocations of their facilities.

The CDOT Contractor shall provide the utility owner written notice 30 days immediately prior to each utility work element expected to be coordinated with construction.

THE WORK LISTED BELOW WILL BE COMPLETED BY THE UTILITY COMPANIES OR THEIR AGENTS:

Although the CDOT Contractor shall provide traffic control for utility work expected to be coordinated with construction, traffic control for utility work outside of typical project work hours will not be permitted unless it is directed by the Engineer.

Xcel Energy

Xcel has a power pole line that runs along the game check area. Xcel will relocate the overhead line to a new alignment. Xcel will accomplish all electrical line relocations. Xcel will provide temporary power for the Contractor's use. This work is expected to take 30 working days to complete and shall be coordinated with the construction of this project.

Century Link

Century Link will relocate all buried cables, aerial cables/poles and fiber optic lines that conflict with the construction of this project. Century Link is sharing the overhead utility pole with Xcel. The relocation work is expected to take 60 working days to complete. Century Link needs to be notified immediately if there is a conflict with the construction of this project. Century link must give its' customers 90 days of advanced notified prior to splicing fiber optics. All of the relocation work shall be coordinated with the construction of this project.

Comcast Cable

Comcast has an aerial utility line attached to the Xcel Energy's poles. Comcast will relocate their facilities along with Xcel Energy's relocation. Comcast will need to notify their customers 30 days prior to interrupting their customers' service.

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavating or grading is planned in the area of underground utility facilities. The Contractor shall notify all affected utilities at least two (2) business days, not including the actual day of notice, prior to commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at 811, to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective owner. Please note that UNCC marks only its member's facilities – Other facilities, such as ditches and drainage pipes may exist, and it is the Contractor's responsibility to investigate, locate and avoid such facilities. Utility service laterals shall also be located prior to beginning excavation or grading.